Section Four

PATHOLOGY

DOCTOR’S COMPANION

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SECTION FOUR

PATHOLOGY

The Interpretation of Pathology Tests

FORMAT

Test Name, Test Substance  [Abbreviation]
(Alternate Name) [Abbreviation]

RI: Reference interval (or value), and units. System Internationale (SI) units are used where possible. (Alternative units are in brackets). 90% of the population have results that lie within this range.

Ind: Indications. The suspected diseases and conditions in which the test is indicated.

Int: Interpretation of the results. The diseases, conditions, syndromes etc. that should be considered with results that vary from the reference interval (eg: HIGH, LOW, V.LOW). With a history, examination and possibly other tests (in some instances, other tests that should be considered are in brackets after the diagnosis followed by a ?), a definite diagnosis may be made from the differential diagnoses suggested.

Phys: The basic physiology of the test, to enable the significance to be better understood.

See also Other Relevant Tests

Abbreviation
See Test Name

Please Note:
Reference intervals for tests vary considerably between laboratories, particularly with enzyme tests. When available, reference intervals supplied by the testing laboratory should be used.
3-Hydroxybutyrate, Plasma
See Hydroxybutyrate, Plasma

4-Hydroxy-3-Methoxy Mandelic Acid, Urine [HMMA] (Vanillylmandelic Acid) [VMA]
RI:  10-35 µmol/day (1.8-7.1 mg/day) (<2.5 µg/mg creatinine)
Ind: Severe hypertension
Int: V.HIGH - Phaeochromocytoma (catecholamines?)
HIGH - Neuroblastoma, some foods (eg. caffeine, bananas), drugs (eg. salicylates)
Phys: Urinary catecholamines and their metabolites (eg. HMMA) are increased 10-100 times in the presence of phaeochromocytoma. Catecholamines increase BP markedly. For 3 days before test avoid meat, fish, poultry and gelatin
See also Metanephrine, Urine; MIBG Scan

5-Aminolaevulinate, Urine
RI:  <40 µmol/L
     <3.8 mmol/mol creatinine
Ind: Porphyria (B.porphyrins?)
Int: HIGH - Acute attack of acute intermittent porphyria, lead poisoning, type 1 tyrosinaemia

5 HIAA
See 5-Hydroxyindole Acetic Acid, Urine

5-Hydroxyindole Acetic Acid, Urine [5 HIAA]
RI:  10-80 µmol/24 hours (2-10 mg/24 hours)
Ind: Malabsorption syndromes
Int: HIGH - Sprue (S.gliaden A/B?), gluten intolerance, carcinoid syn.
Phys: Patients with malabsorption often have abnormalities in tryptophan metabolism. 5 HIAA is a tryptophan metabolite, and its urinary level is increased with excessive tryptophan breakdown. For 3 days before test avoid alcohol, avocado, banana, eggplant, coffee, tea, pineapple, plum, tomatoes, walnuts and drugs (eg. imipramine, paracetamol, MAOIs, phenothiazines)
See also Vitamin D, Serum

14C Breath Test
See Carbon-14 Urea, Breath

17-Hydroxy Steroids, Serum
See Steroids, 17-Hydroxy, Serum

25-Hydroxyvitamin D, Blood
RI: 45-150 nmol/L
Ind: Osteomalacia, rickets
Int: LOW - Poor diet, malabsorption syndromes, lack of sun exposure, chronic liver disease, chronic renal disease, hyperthyroidism, anticonvulsant therapy
HIGH - Vit. D intoxication
Phys: 25-Hydroxyvitamin D is essential for absorption of calcium from gut

AAT
See Alpha1-Antitrypsin, Serum

ACE
See Angiotensin Converting Enzyme, Blood

Acetaminophen
See Paracetamol

Acetone, Serum
RI: 0.05-0.35 mmol/L (0.3-2 mg/100 mL)
Ind: Diabetes, coma
Int: HIGH - Diabetic acidosis (glucose?)
Phys: Intracellular carbohydrate starvation in diabetes inhibits the citric acid cycle and the metabolism of ketone bodies

Acetone, Urine
RI: Negative
Int: POSITIVE - Diabetic acidosis
Acetylator Status, Blood or Urine
RI: > 70% drug excreted in acetylated form
Ind: Risk of drug toxicity
Int: LOW - Slow acetylator, potential to develop drug toxicity
Phys: Caffeine or sulphonamide used as test drug, and urine or serum collected 6 hours later. Slow acetylators may become rapidly toxic when given drugs that are excreted in acetylated form (eg: sulphas, isoniazid, procainamide, hydralazine)

Acetylcholine Receptor Antibody
See Anti-Acetylcholine Receptor Antibody Titre, Serum

Acetylcholinesterase, Amniotic Fluid [AChE]
RI: Second trimester <9 U/L
    Third trimester <7 U/L
Ind: Suspect fetal neural tube defect
Int: HIGH - Significant risk of neural tube defect [eg. spina bifida, anencephaly, microcephaly] (AFP?)
Phys: Experimental, but economic and reliable screening test. Small numbers of false positives may occur

AChE
See Acetylcholinesterase, Amniotic Fluid

Acidified Serum Test, Blood (Ham Test)
RI: Negative
Ind: Haemolytic anaemia
Int: POSITIVE - paroxysmal nocturnal haemoglobinuria, congenital dyserythropoietic anaemia
Phys: Washed red cells incubated with fresh acidified serum. Lysis positive

Acidosis
See Base excess; Bicarbonate, Serum; Lactate, Blood; pH, Serum
Acid Phosphatase, Total, Serum [ACP]
(Prostatic Acid Phosphatase)
RI: 2.3-5.7 U/L (0.5-4 KAU)
Ind: Prostatic disease
Int: V.HIGH - Metastatic prostatic carcinoma.
     HIGH - Prostatic carcinoma (PSA?), acute myelocytic leukaemia (FBC?), prostatitis.
Phys: Phosphatase is present in high concentration in the prostate gland. It is released only when carcinoma spreads beyond the gland capsule. It may be high after rectal examination

ACLA
See Cardiolipin Autoantibodies, Blood

ACPA
See Anti-Cyclic Citrullinated Peptides, Serum

ACTH
See Adrenocorticotrophic Hormone, Plasma

Activated Partial Thromboplastin Time, Plasma [APTT]
RI: Adult : 28 to 38 seconds
     11-16 years : 31 to 44 seconds
     6-10 years : 30 to 46 seconds
     1-5 years : 29 to 45 seconds
     <1 year : 26 to 50 seconds
Ind: Coagulation disorders
Int: HIGH - Heparin therapy, coagulopathy involving intrinsic and common coagulation pathways requiring further investigation (eg. congenital haemophilia, disseminated intravascular coagulation), lupus anticoagulant
Phys: Nonspecific test measuring numerous factors except numbers VII and XIII. Good initial test for coagulopathies.
See also other tests listed under Coagulation Screen

Activated Protein C Resistance, Serum [APC Resistance]
(Factor V Leiden Mutation)
RI: Negative (>2.2)
Ind: Recurrent thromboembolism
Int: POSITIVE (<2.0) - Familial thrombophilia
Phys: Inherited resistance to anticoagulant action of activated protein C resulting in removal of a check on the clotting mechanism. Ratio of clotting time with and without activated protein C is measured

**Acute Phase Reactants**
See C- Reactive Protein; Erythrocyte Sedimentation Rate

**Addis Count**
See White Cell Count, Urine

**Adenosine Deaminase, Red Blood Cell**
RI: Refer to laboratory
Ind: Immunodeficiency
Int: LOW - Severe immunodeficiency due to lack of adenosine deaminase

**Adenosine Deaminase (ADA), Ascitic Fluid**
RI: 0-15 U/L
Ind: M.tuberculosis
Int: HIGH: TB (esp. if lymphocytosis)
Phys: ADA is secreted by activated lymphocytes

**Adenosine Deaminase, Pericardial Fluid**
RI: 0-30 U/L
Ind: Tuberculosis
Int: HIGH: TB (esp. if lymphocytosis)
Phys: ADA is secreted by activated lymphocytes

**Adenosine Deaminase, Pleural Fluid**
RI: 0-30 U/L
Ind: Tuberculosis
Int: HIGH: TB, rheumatoid effusions (esp. if lymphocytosis)
Phys: ADA is secreted by activated lymphocytes

**ADH**
See Antidiuretic Hormone, Serum
Adrenal Cell Antibodies, Serum [AdCA]
RI: Absent
Ind: Addison's disease
Int: PRESENT - Addison's disease

Adrenaline
See Catecholamines, Plasma; Catecholamines, Urine

Adrenocorticotrophic Hormone, Plasma [ACTH]
RI: 10 - 80 ng/L (0 - 0.5 mU/100 mL, 2.2 - 17.8 pmol/L). Morning reading
Ind: Pituitary disease
Int: LOW - Pituitary insufficiency, extrapituitary Cushing's disease
HIGH - Cushing's disease of pituitary origin (P.cortisol?), adrenal insufficiency, pituitary adenoma, oat cell carcinoma of lung
Phys: ACTH stimulates production of all adrenal cortical hormones. Produced in the pituitary gland. Specimen should be taken between 8 and 10 am. Rapid assessment and special transportation required

AFP
See Alpha-Fetoprotein, Amniotic Fluid; Alpha-Fetoprotein, Serum

Alanine Amino Transferase, Serum [ALT]
(Alanine Transaminase, Glutamic Pyruvic Transaminase) [SGPT]
RI: 3 - 40 U/L
Ind: Liver or heart disease
Int: V.HIGH - Acute hepatitis (type serology, Ig?), liver necrosis
HIGH - Obstructive jaundice (AST?), chronic hepatitis, neoplastic liver disease, cirrhosis, fatty liver, haemochromatosis, myocardial infarct (Troponin, CK?), infectious mononucleosis, viraemia, Reye syn., alcohol, drugs (eg. allopurinol, captopril, clavulanic acid, trimethoprim, erythromycin, flucloxacillin, gold, carbamazepine, phenytoin, oestrogen, testosterone).
ALT > AST - Extrahepatic obstruction, acute hepatitis
ALT < AST - Cirrhosis, intrahepatic neoplasm, haemolytic jaundice, alcoholic hepatitis
LOW - Renal failure, vit. B6 deficiency
Phys: Liver tissue is rich in the transferases of the Kreb's cycle, as are the heart, kidney and muscle. ALT more liver specific than AST
Albumin Concentration Gradient, Ascitic Fluid/Serum
RI: No difference
Difference between serum albumin and ascitic fluid albumin measured
Ind: Ascites
Int: < 11 g/L - Exudative ascites [i.e. malignancy, peritoneal inflammation]
     > 11 g/L - Transudative ascites [i.e. liver disease, cirrhosis, portal hypertension]
Phys: Ascitic fluid protein concentration depends on the relative permeability to protein and serum of the vascular bed from which the ascites arises

Albumin, Serum
RI: 33 - 41 g/L
     Pregnancy: 24 - 31 g/L
Ind: Liver disease. Guide to prognosis
Int: LOW - Hepatic necrosis, hepatitis (LFT?), hepatic cirrhosis, malnutrition, malabsorption, nephrotic syndrome, systemic infections, chronic inflammation, autoimmune diseases, CCF, overhydration, glomerulonephritis, protein losing enteropathy, leukaemia, Wilm’s tumour, burns, pregnancy, elderly.
     HIGH - Shock, dehydration, prolonged tourniquet during venepuncture, steroid therapy.
See also Serum-Ascites Albumin Gradient

Albumin, Urine
RI: <15mg/day
Ind: Renal disease
Int: HIGH - Urinary tract infection, diabetic nephropathy, nephrotic syndrome, glomerulonephritis, renal failure, pregnancy-induced hypertension

Albumin-Globulin Ratio
RI: 1 - 2.2
Ind: Liver disease
Int: HIGH - Liver damage (LFT?)
Phys: In liver disease there is a hypoalbuminaemia which lowers plasma osmotic pressure and causes ascites. At the same time gamma-globulins rise, increasing the ratio between the two
**Albumin Gradient, Serum-Ascites**
See Serum-Ascites Albumin Gradient

**Alcohol**
See Ethanol, Serum

**Aldolase, Serum**
RI: 1 - 8 IU/L (1 - 8 U/mL)
Ind: Suspected major organ damage
Int: HIGH - Myocardial infarct (CPK, LDH?), muscular dystrophies, haemolytic anaemia (Hb?), metastatic prostatic carcinoma (ACP, PSA?), leukaemia (FBC?), acute pancreatitis (amylase?), hepatitis
Phys: Destruction of tissue results in the release of aldolase into the serum. It is present in all tissues. Creatine phosphokinase is a better test

**Aldosterone, Plasma**
RI: 100 - 400 pmol/L (0.003 - 0.01 µg/100 mL)
Ind: Hypertension
Int: HIGH - Adrenocortical adenoma (K?), oedema, malignant hypertension, diuretic therapy, congestive cardiac failure, pregnancy
LOW - Adrenocortical insufficiency (S.E, S.urea?), diabetic nephropathy, renal failure (S.creatinine?), drugs (eg. ACE inhibitors, beta-blockers, NSAID, cyclosporin, triamterene)
Phys: Aldosterone secretion by the adrenal cortex is controlled by volume receptors, angiotensin II, potassium concentration, and minimally by ACTH. Take sample in morning after rest. High aldosterone/renin ratio in adrenal disease. High aldosterone and renin in renal disease
See also Renin, Plasma

**Aldosterone, Urine**
RI: 8 - 33 nmol/24 hours (6 - 16 µg/24 hours)
Ind: Adrenal gland investigation, hypertension
Int: HIGH - Adrenocortical adenoma, cirrhosis, nephrosis, ascites, CCF, toxaemia of pregnancy, malignant hypertension (VMA?)
Phys: Excess secretion of aldosterone by the adrenal cortex causes hypertension and hypokalaemia
Alkaline Phosphatase, Neutrophils
Int: V.HIGH (in mother) - Down syn.  
HIGH - Polycythaemia rubra vera (B.erythrocytes?)
Phys: Use in combination with maternal S.HCG, S.AFP and S.oestriol levels

Alkaline Phosphatase, Serum [ALP]
RI: Adult male : 15 - 120 U/L  
Adult female : 25 - 115 U/L  
Pregnancy : 125 - 250 U/L  
Child : 70-300 U/L  
Bone isoenzyme : 10 - 20%  
Liver isoenzyme : 40 - 60%
Ind: Bone and liver disease
Int: V.HIGH - Biliary obstruction (AAT?), metastatic carcinoma of liver (GGT?)  
HIGH - Bone metastases, osteomalacia, rickets (Ca, vit. D?), myositis ossificans, Paget's disease of bone (ACP?), hyperparathyroidism, hyperthyroidism, hepatitis (LFT, type serology?), primary biliary cirrhosis, breast cancer, prostatic carcinoma, pancreatic disease, recent fracture, transient benign hyperphosphatasia of childhood, children with rapid bone growth, viral infection in children, late pregnancy, breastfeeding.  
LOW - Hypothyroidism (T4?), congenital hypophosphatasia, growth retardation, zinc deficiency.
Phys: Alkaline phosphatase is present in high concentrations in growing bone and liver. Also found in intestine, and placenta. Normal levels do not exclude hepatic disease. An isolated raised ALP with normal liver function tests is more likely to indicate bone disease.  
See also Alanine Amino Transferase, Serum; Alkaline Phosphotase Isoenzymes, Serum

Alkaline Phosphatase Isoenzymes, Serum
RI: Only indicated if total ALP raised.
Ind: Bone and liver disease.
Int: BONE ISOENZYMES PREDOMINATE - Healing fracture, Paget disease, bony malignancy (primary or secondary), hyperthyroidism, hyperparathyroidism, renal osteodystrophy, lymphoma, osteomalacia, rickets, vitamin D deficiency.  
PLACENTAL (REGAN) ISOENZYMES PREDOMINATE - Bronchial carcinoma, ovarian carcinoma, pancreatic carcinoma.  
LIVER ISOENZYMES PREDOMINATE - Cholestatic liver disease
See also Alkaline Phosphatase, Serum
Alkalosis
See Base excess; Bicarbonate, Serum; pH, Serum

Allergen Specific Immunoglobulin E
See Radioallergosorbent Test, Serum

Alpha 1-Antitrypsin, Faeces [AAT]
RI: <1.5mg/g dry weight
    Clearance <12.5mL/d
Ind: Protein losing enteropathy
Int: HIGH - Protein losing enteropathy
Phys: Blood loss into intestine may give false high

Alpha 1-Antitrypsin, Serum [AAT]
RI: 1.8 - 3.6 g/L
Ind: To determine cause of neonatal hepatitis, childhood liver cirrhosis,
    cryptogenic liver cirrhosis, chronic obstructive lung disease Int: HIGH
    - Inflammation, tissue necrosis, trauma, malignancy, exogenous estrogen,
    pregnancy, cirrhosis (LFT?), cholestasis, hormone excess, many
    infections
    LOW - Alpha-1-antitrypsin deficiency, idiopathic respiratory distress
    syndrome of infancy, severe disease of the pancreas and liver, nephrotic
    syndrome
Phys: Glycoprotein synthesised in liver that inhibits trypsin and other proteases

Alpha 1-Microglobulin, Urine
RI: <15mg/L
    <1.5g/mol creatinine
Ind: Renal tubular disease
Int: HIGH - Fanconi syndrome (S. & U.phosphate?), nephrotic syndrome
    (U.protein?), other renal tubular disorders
Phys: Immunoassay

Alpha-Fetoprotein, Amniotic Fluid [AFP]
RI: 16 weeks gestation 8 - 24 µg/L
   18 weeks gestation 7 - 23 µg/L
   20 weeks gestation 3 - 16 µg/L
Ind: Monitoring pregnancy
Int: DROP - Normal pregnancy
RISE - Fetal distress (L-S ratio?), neural tube defect, congenital nephrotic syn., twins
V.LOW - Down syn. [see Investigations section 3]
Phys: Level should slowly drop throughout middle trimester of pregnancy
See also Oestriols, Plasma

Alpha-Fetoprotein, Serum [AFP]
RI: Non-pregnant < 12 µg/L
Pregnant - rises throughout pregnancy as follows:

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<th>Weeks gestation</th>
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Unit µg/L
Ind: Liver disease, monitoring pregnancy, gonadal cancer
Int: V.HIGH, PREGNANT - Multiple pregnancy, Down syndrome [trisomy 21], neural tube defect, anencephaly, congenital nephrosis, fetal distress, intrauterine death

HIGH - Hepatic carcinoma, colon carcinoma, stomach carcinoma, hepatitis, cirrhosis, other hepatic diseases, gonadal teratoma, testicular carcinoma, embryonal carcinoma, steady rise in normal pregnancy
LOW - Drop in late pregnancy indicates fetal distress
Phys: Normal plasma protein in fetus which drops to very LOW levels after birth. Excess in non-pregnant adult indicates serious disease

Alpha Subunit, Glycoprotein Hormones, Serum
RI:
Male: <0.6 IU/L
Female:
Premenopausal: <1.0 IU/L
Postmenopausal: <2.0 IU/L
Pregnant: <2.5 IU/L
Ind: Pituitary tumour
Int: HIGH - Hormone secreting pituitary tumour
Phys: Some pituitary tumours secrete only alpha subunit of glycoprotein hormone (eg. LH, TSH, FSH) rather than complete hormone
ALT
See Alanine Amino Transferase, Serum

Aluminium, Serum
RI:  <400 nmol/L
     Toxic >2000 nmol/L
Ind: Renal dialysis
Int: HIGH - Renal failure, dialysis encephalopathy, medications
Phys: Contamination of specimen may occur easily

AMH
See Anti-Müllerian Hormone, Serum

Amikacin, Blood
See Aminoglycosides, Blood

Amino Acids, Urine
RI:  Units mmol/mol creatinine
    Alanine < 100
    3-Amino-butyric acid < 25
    Arginine < 20
    Citrulline < 5
    Glutamine < 150
    Glycine < 350
    Histidine < 400
    Isoleucine < 10
    Leucine < 10
    Lysine < 100
    Methionine < 10
    Ornithine < 10
    Phenylalanine < 20
    Serine < 100
    Taurine < 300
    Tyrosine < 20
    Threonine < 30
    Valine < 10
Ind: Suspected metabolic disease
Int: ALL HIGH - Premature infant, Hartnup disease
     Arginine HIGH - Arginase deficiency syn.
Citrulline HIGH - Hyperornithinaemia-hyperammonaemia-hypercitrullinuria syn.
Glycine HIGH - Nonketotic hyperglycinaemia, familial iminoglycinuria
Histidine HIGH - Histidinaemia
Leucine and isoleucine HIGH - Maple syrup urine disease, other rare conditions of organic acid metabolism
Methionine HIGH - Homocystinuria
Ornithine HIGH - Gyra te atrophy of the choroid and retina, hyperornithinaemia- hyperammonaemia-hypercitrullinuria syn.
Phenylalanine HIGH - Phenylketonuria
Tyrosine HIGH - Richner-Hanhart syn. [see Syndromes section 6], tyrosinosis
MIXED PATTERN - Fasting, infection
Others HIGH - Usually rare inherited errors of metabolism

Phys: Changes in urinary concentration of certain amino acids can be used to detect metabolic diseases
Chromatographic process

See also Cystine, Urine

Aminoglycosides, Blood
RI: Amikacin - peak 25 - 30mg/L, trough <10mg/L
     Gentamicin - peak 5 - 8mg/L, trough <2mg/L
     Tobramycin - peak 5 - 8mg/L, trough <2mg/L
     Vancomycin - trough 5 - 10mg/L
Ind: Monitoring of antibiotic dose
Int: Adjust dosage as appropriate
Phys: Peak measure taken 6 hours after once daily dosage, trough immediately before next dose. Toxicity if levels above exceeded, ineffective dose if peak doses too low. Vancomycin peaks not accurate for dosage management

5-Aminolaevulinate, Urine
See numerical entries at beginning of this section

Amiodarone, Serum
RI: Therapeutic range 1.5 - 3.9 µmol/L (1.0 - 2.5 mg/L)
Ind: Amiodarone treatment
Phys: Elimination half life 40 days. Measure drug levels only 3 months after dosage adjustment
**Amitriptyline, Serum**
RI: Therapeutic range 60 - 240 µg/L (150 - 880 nmol/L)
Phys: Several weeks may be required to reach steady state due to long half-life

**Ammonia, Serum [NH₃]**
RI: < 50 µmol/L (< 90 µg/100 mL)
Ind: Liver disease
Int: HIGH - Hepatic insufficiency (bilirubin?), portacaval shunt, high protein diet, organic acidaemia, gastrointestinal tract bleeding, methicillin or spironolactone therapy, Reye syn., genetic hyperammonaemia, transient in neonate
Phys: Serum ammonia is derived from the putrefaction of food in the bowel by bacteria, and from protein metabolism

**Amoeba Antibodies, Serum**
RI: Absent
Ind: Extraintestinal amoebiasis
Int: POSITIVE - Hepatic amoebiasis in past
RISING TITRE - Recent hepatic infection
Phys: Gut infections do not cause antibody reaction. Test will remain positive for many years

**Amylase, Serum**
RI: 30 - 180 U/L (Racial differences)
Ind: Pancreatic disease
Int: HIGH - Acute pancreatitis (aldolase, lipase?), cancer of the pancreas, mumps, salpingitis, perforated duodenal ulcer, sialectasis, hepatic disease, ruptured ectopic pregnancy, dissecting aortic aneurysm, small bowel obstruction
LOW - Hepatitis, toxaemia of pregnancy, pancreatic insufficiency
Phys: Amylase is produced in the pancreas and salivary glands. Excess is produced in inflammation, or is forced into the serum by pancreatic duct blockage

**Amylase, Urine**
RI: 170 - 2000 U/L (Racial differences)
(0.8-80 U/mmol creatinine)(<17IU/L)
Ind: Pancreatitis
Int: HIGH - Pancreatitis
Phys: Urinary amylase is raised with the same conditions as serum amylase. Useful in late presentation of pancreatitis, as levels remain high for 7 days after serum amylase drops.

**ANA**
See Antinuclear Antibodies, Serum

**Anabolic Steroids, Urine**
RI: Absent
Ind: Detection of steroid use
Int: POSITIVE - Use of anabolic steroids in previous days or weeks
Phys: Rate of metabolism and clearance from urine depends on individual characteristics, type of steroid and dose

**Anaemia**
See Haemoglobin

**ANCA**
See Anti-Neutrophil Cytoplasmic Antibodies, Serum

**Androgens**
See Testosterone, Serum

**Androstenedione, Serum**
RI: Males 1.7 - 5.2 nmol/L (0.05 - 0.29 µg/100mL)
Females 1.7 - 7.0 nmol/L (0.05 - 0.35 µg/100mL)
Prepubertal < 2 nmol/L (<0.05 µg/100mL)
Postmenopause 1.7 - 4.5 nmol/L
Ind: Female hirsutism
Int: HIGH - Hirsutism, virilising tumours, congenital adrenal hyperplasia, polycystic ovarian syndrome, acne, premature baldness, pubertal status
Phys: Collect sample mid-morning. Immunoassay

**ANF**
See Antinuclear Antibodies, Serum
Angiotensin Converting Enzyme, Blood [ACE]
RI: 11 - 40 U/L (higher levels in children)
Ind: Suspect sarcoidosis
Int: HIGH - Sarcoidosis, tuberculosis, leprosy, silicosis, asbestosis, cirrhosis, diabetes mellitus, alcoholism, hyperthyroidism, Gaucher's disease
LOW - Drugs [eg. ACE inhibitors]
Phys: Good measure of sarcoid disease activity

Angiotensin II, Plasma
RI: 5 - 35 pmol/L (5 - 35 ng/L)
Ind: Hyperaldosteronism
Int: HIGH - Hyperaldosteronism
Phys: Collect in heparin at mid-morning. Unstable hormone requiring immediate blood separation. Must rest for 12 hours before test, and be off all drugs for one month. Angiotensin II controls aldosterone production from the adrenal glands

Anion Gap, Serum
RI: 8 - 16 mmol/L
Ind: Electrolyte imbalance
Int: HIGH - Metabolic acidosis, diabetic ketoacidosis (GTT?), renal failure, lactic acidosis, methanol ingestion, salicylate overdose, hepatic failure, alcoholism, magnesium deficiency, starvation
LOW - Hypoalbuminaemia, liver disease, multiple myeloma, hypercalcaemia
Phys: Anion gap = cations (Na+ + K+) – anions (Cl- + HCO3-). Gap is made up of phosphate, sulfate, protein, pyruvate, lactate and other ions. If all elements are considered, gap is zero

ANS
See Anti-Smith Antibodies, Serum

Anti-Acetylcholine Receptor Antibody Titre, Serum [Anti-AChR]
RI: −0.5 to +0.5 nmol/L
Ind: Myasthenia gravis
Int: HIGH - Myasthenia gravis
Phys: Specific antibody for myasthenia gravis that is elevated in 80% of cases
Antibodies, Specific
See Antimicrobial Antibodies, Serum or CSF; Immunoglobulin Antibodies, Specific, Serum

Anticardiolipin Antibodies, Blood
See Cardiolipin Autoantibodies, Blood

Anti-CCP
See Cyclic Citrullinated Peptide Antibodies, Serum

Anti-Centromere Antibodies
See Centromere Autoantibodies, Blood

Anti-Citrullinated Peptide Antibody, Serum [ACP]
See Cyclic Citrullinated Peptide Antibodies, Serum

Anti-Deoxyribonuclease-B Titre, Serum [Anti-DNAse B]
RI: 0 - 340 (varies widely between labs)
Ind: Rheumatic fever
Int: HIGH - Streptococcal pyoderma, rheumatic fever (ASOT?), nephritis
Phys: Antibody to extracellular enzyme of group A Streptococci. Persists for longer than ASOT. 20% of streptococcal infections do not elicit antistreptolysin antibodies.
See also Anti Streptolysin O Titre

Anti-Deoxyribonucleic Acid Titre, Serum [Anti-DNA]
RI: <100 IU/mL
Ind: Connective tissue disease (auto-immune disease)
Int: HIGH – autoimmune disease eg. SLE, rheumatoid arthritis etc.
Phys: Used in association with other tests to diagnose and follow the course of certain autoimmune disease. Major criteria should be used for diagnosis of individual disease. Does not rise in drug induced SLE
See also ANCA, Serum; Anti-Smith Antibodies, Serum; Cardiolipin Autoantibodies, Blood; Complement C3 and C4; DNA Autoantibodies; ENA, Serum; Histone Autoantibodies, Blood; HLA-DR3, Serum; LE Cells, Blood; Lupus Anticoagulant Antibody, Serum
Antidiuretic Hormone, Serum [ADH]  
(Vasopressin, Serum) [AVP]
RI: 0.4 - 2.4 pg/mL
Ind: Disorders of urine production
Int: HIGH - Syndrome of inappropriate ADH secretion, central diabetes insipidus
LOW - Nephrogenic diabetes insipidus
Phys: Diurnal variation in level, maximum in early hours of morning, minimum in early afternoon
See also Osmolality, Serum

Anti-Double Stranded DNA Antibodies, Serum [Anti-dsDNA]
RI: <7 IU/mL
Ind: Inflammatory joint disease, suspect SLE
Int: HIGH - Systemic lupus erythematosus
Phys: Highly selective for SLE, but antibodies are not present in all patients with SLE. Presence indicates renal involvement. Levels vary with disease activity and can be used to assess patient response to treatment.

Anti-dsDNA
See Anti-Double Stranded DNA Antibodies, Serum

Anti-ENA
See Extractable Nuclear Autoantibodies, Serum

Anti-Extractable Nuclear Antibodies
See Extractable Nuclear Autoantibodies, Serum

Anti-Factor Xa, Plasma [AntiXa]
RI: Therapeutic range -
   Once daily dosing 1.3 - 2.0 U/mL
   Twice daily dosing 0.6 - 1.0 U/mL
Prophylactic range -
   Twice daily dosing 0.4 - 0.6 U/mL
Ind: Monitoring of low molecular weight heparin (LMWH) dosage
Int: Adjust dosage depending on results
Phys: Not used routinely for patients on LMWH but useful in low weight, obese, renal failure and pregnant patients. Blood sample for testing should be taken 3 to 5 hours after LMWH dose.
Anti-Gliaden Antibodies, Serum
See Gliaden Antibodies, Serum

Anti-Glomerular Basement Membrane Antibodies
See Glomerular Basement Membrane Autoantibodies, Blood

Anti-Histone Antibodies
See Histone Autoantibodies, Blood

Antimicrobial Antibodies, Serum or CSF
RI: Absent
Ind: Check for cause or type of infection
Int: POSITIVE - Present or recent infection with specific microbe
Phys: Test is specific for a particular infective agent. Only a limited number of microbes (and their diseases) can be checked. Tests available include those for Brucellosis, Chlamydia, Coxiella (Q fever), Coxsackie virus, Cytomegalovirus, Echoviruses, Epstein-Barr virus (infectious mononucleosis), hepatitis A, hepatitis B, hepatitis C, Herpes simplex, Legionnaires disease, Leptospirosis, measles, mumps, Mycoplasma pneumoniae, Ross River fever, rubella, salmonellosis and toxoplasmosis

Anti-Microsomal Antibodies
See Thyroid Microsomal Autoantibody Titre, Serum

Antimitochondrial Antibodies, Serum
See Mitochondrial Autoantibodies, Serum

Anti-Müllerian Hormone, Serum [AMH]
(Müllerian Inhibiting Hormone) [MIH]
RI: 0.9 to 2.5 ng/mL
Ind: Assessing female fertility.
Int: LOW – Reduced number of ova in ovaries, menopause
HIGH – Polycystic ovarian syndrome
Phys: Detected in males throughout life, but higher in childhood. Only present in females after puberty, but decreases with age. Produced in testes and
ovaries respectively. Test should be performed after ceasing oral contraceptives.

**Anti-Neutrophil Cytoplasmic Antibodies, Serum [ANCA]**

- **RI:** Negative
- **Ind:** Vasculitis, SLE
- **Int:** POSITIVE
  - Perinuclear pattern - Vasculitis, Churg-Strauss syndrome, ulcerative colitis.
  - Cytoplasmic pattern - Wegener's granulomatosis.
- **Phys:** Titres fluctuate with severity of disease

*See also LE Cells, Blood; Lupus Anticoagulant Antibody, Serum*

**Antinuclear Antibodies, Serum [ANA]**

*Fluorescent Antinuclear Antibodies [FANA]; Antinuclear Factor [ANF]*)

- **RI:** 0 - 25 IU/mL (titre 0 - 10)
- **Ind:** SLE and other connective tissue (autoimmune) diseases
- **Int:** Higher titres have higher specificity.
  - HIGH - Autoimmune conditions (eg: rheumatoid arthritis, Felty syn., Sjögren's syn., dermatopolymyositis, vasculitis, juvenile chronic polyarthritis, mixed connective tissue disease), thyroid disease (eg: Hashimoto's thyroiditis, Graves disease), malignancy (eg: lymphoma, leukaemia, some solid tumours), liver disease (eg: chronic active hepatitis, cirrhosis, hepatitis B, chronic liver disease), lung diseases (eg: pneumoconioses, asbestosis, idiopathic pulmonary fibrosis, fibrosing alveolitis, primary pulmonary hypertension, TB), haematological disorders (eg: pernicious anaemia, idiopathic thrombocytopenic purpura), parasitic diseases (eg: malaria), subacute bacterial endocarditis, myasthenia gravis, leprosy, relatives of SLE patients, pregnancy, some elderly people, drugs (eg. hydralazine, procainamide)
- **Phys:** ANF represents the nuclear water insoluble protein (fraction) antibodies. Extractable nuclear antigen antibodies represents the nuclear water-soluble protein antibodies. Histone antibodies are a marker for drug induced SLE. Tested by indirect immunofluorescence of nuclei in tissue substrates. Homogenous pattern in SLE and Sjögren syn. Peripheral pattern uncommon but occurs in 10% of SLE patients. Speckled pattern in SLE, scleroderma, other connective tissue diseases and up to 20% of normal elderly women. The preferred way of testing is by indirect immunofluorescence. Different patterns are associated with different autoimmune diseases. Overlap does occur. ENA antibodies often add specificity to the diagnosis. Patient should be evaluated against the major criteria for each disease. Antibodies may often be present years before onset of clinical disease.
Antiphospholipid Antibodies, Serum
RI: Negative
Ind: Recurrent thromboses and miscarriages.
Int: POSITIVE - Antiphospholipid syndrome.
Phys: Syndrome in which there are recurrent thromboses in both arteries and veins. 20% of patients with phospholipid antibodies (of which cardiolipin antibodies is a subsection) develop clinical disease.
See also Cardiolipin Autoantibodies, Blood

Anti-Skeletal Muscle Antibodies, Serum [SKM]
RI: Negative
Ind: Myasthenia gravis (anti-AChR?)
Int: POSITIVE - Myasthenia gravis
Phys: Specific tissue autoantibody

Anti-Smith Antibodies, Serum [ANS]
RI: Negative
Ind: SLE
Int: POSITIVE - SLE (33% of cases)
Phys: More vasculitis and less renal disease in this form of SLE. High specificity for SLE.
See also LE Cells, Blood; Lupus Anticoagulant Antibody, Serum; Extractable Nuclear Antigen Antibodies, Serum

Anti-Smooth Muscle Antibodies, Serum [SMA]
RI: Negative
Ind: Hepatic disease
Int: POSITIVE - Chronic active hepatitis, primary biliary cirrhosis, infectious mononucleosis, disseminated carcinoma, SLE, viral hepatitis, other infections, other autoimmune diseases
Phys: Non-specific tissue auto antibody. Low specificity.

Antistreptolysin O Titre, Serum [ASOT]
RI: 0 - 300 IU/mL (<200 Todd units/mL) [varies widely between labs]
Ind: Severe infections
Int: HIGH - Haemolytic streptococcal infection, rheumatic fever
Phys: Persons infected with beta-haemolytic Streptococci often develop antibodies against the haemolysin O produced by Streptococcus. This antibody inhibits haemolysis of red cells by a standardised Streptococcus haemolysin. 20% patients with active disease may not develop an ASO antibody titre. Anti-Deoxyribonuclease-B titre should be considered. Other major clinical signs must be used to established the diagnosis of a streptococcal infection.

See also Anti-Deoxyribonuclease-B Titre

Antithrombin III, Blood [AT III]
RI: 80 - 120% (0.77-1.20 U/mL)
Ind: Unusual venous thromboses
Int: LOW (< 60%) - Congenital [autosomal dominant] AT III deficit, dysfunctional AT III, familial thrombophilia
Phys: AT III inhibits clotting by preventing conversion of fibrinogen to fibrin, and also acts on factors IX, X, XI and XII

Anti-Thyroglobulin Antibody, Serum (Thyroglobulin Antibody)
RI: <60 U/mL
Ind: Thyroid disease
Int: HIGH - Hyperthyroidism (25% of cases), autoimmune thyroiditis, thyroid carcinoma
See also other Thyroid Function Tests

Anti-Thyroid Peroxidase Antibodies, Serum
RI: <60 U/mL
Ind: Thyroid disease
Int: HIGH - Inflamed thyroid gland, Hashimoto’s thyroiditis, other autoimmune conditions affecting the thyroid
See also Anti-Thyroglobulin Antibody, Serum

Anti-TSH Receptor Antibodies, Serum [TRAB]
RI: Negative
Ind: Thyroid disease
Int: POSITIVE - Graves' disease, thyrotoxicosis
Phys: TRAB are the autoantibodies that bind to the TSH receptor and activate it, causing the excess production of thyroid hormones in Graves' disease
Anti-Tyrosine Autoantibodies, Serum [IA-2]  
(Insulinoma Associated 2 Antibodies, Serum)  
RI:  <0.8 U/mL  
Ind:  Diabetes  
Int:  HIGH - Type one diabetes mellitus, latent autoimmune diabetes in adults, potential to develop type one diabetes  
Phys:  Definitive diagnostic marker for type one diabetes.  
See also Glutamic Acid Decarboxylase, Serum

AntiXa  
See Anti-Factor Xa, Plasma

APC Resistance  
See Activated Protein C Resistance, Serum

Apolipoproteins, Serum [Apo]  
RI:  ApoA1 1.0 - 1.8g/L  
     ApoB 0.8 - 1.6g/L  
Ind:  Atherosclerosis  
Int:  LOW - Increased risk of atherosclerosis  
Phys:  Immunoassay. May be measured as an alternative to HDL and LDL  
See also High Density Lipoprotein Cholesterol, Blood; Cholesterol, Blood; Lipoprotein A, Serum; Low Density Lipoprotein Cholesterol, Blood

APTT  
See Activated Partial Thromboplastin Time, Plasma

Arbovirus Antibodies, Specific  
See Immunoglobulin Antibodies, Specific, Serum

Arsenic, Blood [As₂O₃]  
RI:  2-23 µg/L  
Ind:  Arsenic poisoning  
Int:  Chronic poisoning 100-500 µg/L  
     Acute poisoning 600-9300 µg/L  
Phys:  Sources include house and garden pesticides, occupational exposure through manufacturing of glass, ceramics, dye, wood products and paint.
Occurs naturally in the environment and in food, especially fish. Arsenic is only detected in blood for 2 to 4 hours after exposure due to short half life.

**Arsenic, Hair and Nails**

RI:  
- Nails 20 - 60 µg/100 g  
- Hair < 65 µg/100 g  
- Chronic poisoning 100 - 4700 µg/100 g  
- Acute poisoning > 20,000 µg/100 g

Ind: Valuable to document time of arsenic exposure, confirmation of chronic toxicity

Int: HIGH: Arsenic poisoning

**Arsenic, Urine [As₂O₃]**

RI:  
- 10-300 µg/L  
- Within 4 hours after seafood intake 200-1700 µg/L  
- Acute toxicity > 1000 µg/g creatinine

Ind: Occupational exposure to arsenic, suspected arsenic poisoning

Int: HIGH – Overexposure to arsenic, arsenic poisoning

Phys: Elevated for 20-30 hours after ingestion

**Ascitic Fluid**

See Paracentesis Fluid

**Ascorbic Acid, Serum**

See Vitamin C

**ASOT**

See Antistreptolysin O Titre

**Aspartate Amino Transferase, Serum [AST]**

(Aspartate Transaminase)  
(Glutamic Oxaloacetic Transaminase) [SGOT]

RI:  
- 4 - 40 U/L  
- Pregnancy: 1 - 21 U/L

Ind: Liver disease

Int: V.HIGH - Obstructive jaundice, acute hepatitis (type serology, Ig ?)  
HIGH - Myocardial infarct (Troponin, CK?), myocardial inflammation, intrahepatic neoplasm, cirrhosis, haemolytic jaundice, muscle trauma,
muscular dystrophy, alcoholism, some anaesthetics, vigorous exercise, Reye syn., paracetamol overdose, haemolysis or refrigeration of sample
LOW - Renal failure, vit. B6 deficiency
AST:ALT RATIO >2 - Alcoholism.
Phys: AST is widely distributed with high concentrations in liver, heart, muscle and kidney. Rises to a peak 36 hours after infarct, and returns to normal after 3-4 days
See also Alanine Amino Transferase, Serum; Gamma Glutamyl Transferase, Serum

Aspergillus Precipitins, Serum
RI: Absent
Ind: Asthma triggered by aspergillosis
Int: PRESENT - Allergic bronchopulmonary aspergillosis
Phys: Does not diagnose invasive aspergillosis

AT III
See Antithrombin III, Blood

Autoantibodies
See Antinuclear Antibodies, Serum; Anti-Skeletal Muscle Antibodies, Serum; Anti-Smith Antibodies, Serum; Anti-Smooth Muscle Antibodies, Serum; Anti-Thyroid Peroxidase Antibodies; Basement Membrane Autoantibodies, Blood; Cardiolipin Autoantibodies, Blood; Centromere Autoantibodies, Blood; Extractable Nuclear Antigen Autoantibodies, Serum; Glomerular Basement Membrane Autoantibodies, Blood; Histone Autoantibodies, Blood; Intercellular Cement Substance Autoantibodies, Blood; Intrinsic Factor Autoantibodies, Blood; Islet Cell Autoantibodies, Blood; Mitochondrial Autoantibodies, Serum; Myocardial Autoantibodies, Blood; Ovarian Autoantibodies, Blood; Parietal Cell Autoantibodies, Serum; Reticular Cell Autoantibodies, Serum; Thyroid Microsomal Autoantibody Titre, Serum

Autohaemolysis Test, Blood
RI: Lysis at 48 hours with added glucose < 0.9%. Lysis at 48 hours without added glucose 0.2-2.0%
Ind: Red cell disorders
Int: HIGH WITHOUT GLUCOSE - Hereditary spherocytosis, other red cell membrane congenital defects
HIGH WITH AND WITHOUT GLUCOSE - Pyruvate kinase deficiency, disorders of red cell glycolysis
Phys: Competence of cell membrane and glucose metabolism affects degree of red cell lysis

**Avian Influenza Antibodies, Serum**
See Immunoglobulin Antibodies, Specific, Serum

**AVP**
See Antidiuretic Hormone, Serum

**B Cell Lymphocytes, Blood**
RI: 0.06-0.60 x 10^9/L
Ind: Leukaemia
Int: CD20 HIGH - Acute lymphoblastic leukaemia
Phys: Follicular dendritic cell
*See also T Cell Lymphocytes, Blood*

**B2M**
See Beta-2 Microglobulin, serum

**B12**
See Vitamin B12, Serum

**Barbiturates, Serum**
RI: Zero
Ind: Overdosage, control of therapy
Int: HIGH - Overdosage
Phys: Coma over 90-170 μmol/L (higher with phenobarbitone). Plasma half-life 2-6 days

**Barmah Forest Virus Antibodies, Serum**
See Immunoglobulin Antibodies, Specific, Serum

**Base Excess, Arterial Blood**
RI: +3 to −3 mmol/L
Ind: Metabolic disorders
Int: HIGH - Metabolic alkalosis, respiratory acidosis
LOW - Metabolic acidosis, respiratory alkalosis
Phys: Collected in sealed, heparinised syringe

Basement Membrane Autoantibodies, Blood
(Pemphigoid Autoantibodies)
RI: Negative
Ind: Blistering skin diseases
Int: POSITIVE -Pemphigoid
Phys: Immunofluorescent test. Titre does not correlate with disease severity

Basophils, Blood
RI: <0.1 x 10⁹/L (10 - 100/µL) (0.1 - 1.0%)
Ind: To determine nature of infection or blood disease
Int: V.HIGH - Chronic myeloid leukaemia, myelofibrosis, polycythaemia vera, urticaria pigmentosa
HIGH - Chronic inflammation, myxoedema, ulcerative colitis, allergic reactions, some viraemias, splenectomy
LOW - Steroid therapy, stress, pregnancy, hyperthyroidism, some infections.

See also Full Blood Count; Lymphocytes, Blood; Neutrophils, Blood

Bence-Jones Proteins, Urine
(Paraprotein)
RI: Nil
Ind: Myelomatoses
Int: PRESENT - Multiple myeloma, renal damage, macroglobulinaemia, plasmacytoma, autoimmune diseases, other lymphoid malignancies.
Phys: Light chains of abnormal immunoglobulins are easily filtered through kidney into urine

Beta HCG
See Chorionic Gonadotrophin, Human, Beta, Serum

Beta-2 Microglobulin, Serum [β2M]
RI: Adults 0.8 - 2.5 mg/L; >65 years 0.8 - 3.0 mg/L
Ind: Multiple myeloma, suspected AIDS
Int: HIGH - AIDS (HIV?), multiple myeloma, plasmacytoma, chronic lymphocytic leukaemia, acute monoblastic leukaemia, hepatitis B, Epstein-
Barr virus and cytomegalovirus infections, sarcoid, rheumatoid arthritis, Sjögren syn., Crohn's disease, renal failure
Phys: Raised in early stage of AIDS, and increases with worsening immune dysfunction. Useful prognostic marker in lymphoproliferative disorders

**Beta-2 Microglobulin, Urine**
RI: < 0.5 mg/L (< 40 µg/mmol creatinine)
Ind: Renal dysfunction
Int: As for Beta-2 Microglobulin, Serum, plus:
HIGH - Renal damage [eg. from cytotoxic drugs, heavy metal poisoning, NSAID overdose, aminoglycosides], glomerulonephritis
Phys: Globulin excreted in renal tubulo-interstitial disorders

**Bicarbonate, Serum [HCO₃⁻]**
RI: 24 - 32 mmol/L (24 - 32 mEq/L)
Ind: Acid-base imbalance
Int: HIGH [Respiratory Acidosis] - Underventilation of lungs (pH, VC, FEV₁?), COPD, asthma, pulmonary oedema, trauma, cerebrovascular accident, pneumonia, drug overdose, myopathy, Guillain-Barré syndrome, pneumothorax.
HIGH [Metabolic Alkalosis] - Bicarbonate therapy, potassium depletion (K?), vomiting, chronic diarrhoea, pyloric stenosis, gastric aspiration, late salicylate poisoning, Cushing syn., diuretics, antacids, steroid therapy
LOW [Respiratory Alkalosis] - Hyperventilation, hysteria, altitude sickness, excess artificial respiration
LOW [Metabolic Acidosis] - Starvation, diarrhoea, liver failure, dehydration, early salicylate poisoning, diabetes mellitus (glucose?), anuria, severe renal disease, ureterocolic anastamosis
Phys: The bicarbonate level is dependent upon removal of carbon dioxide from the blood as well as the amount of acid or base formed in or added to the body

**Bilirubin, Serum**
RI: Total : 1 - 20 µmol/L
Direct (conjugated) : 1 - 6 µmol/L
Indirect : 2 - 13 µmol/L
Neonate :17 - 170 µmol/L
Pregnancy : 3 - 14 µmol/L
Ind: Liver disease, anaemia
Int: HIGH DIRECT & INDIRECT - Hepatitis (Ig, ALT, AST?), bile duct blockage, gall stones, toxic reactions, Gilbert syn., malignancy, cirrhosis (LFT?), haemolysis of sample.
HIGH DIRECT - Biliary obstruction (stones, malignancy or fibrosis), intrahepatic cholestasis, Dubin-Johnson syn., chemicals, drugs (eg. allopurinol, captopril, clavulanic acid, trimethoprim, erythromycin, flucloxacillin, gold, carbamazepine, phenytoin, oestrogen, testosterone)
HIGH INDIRECT - Haemolytic disease, haematoma resorptions
HIGH IN NEONATE - Physiological jaundice, haemolytic disease, spherocytosis, sickle cell anaemia, birth trauma, hepatitis, hypothyroidism, prematurity, biliary atresia, choledocal cyst, starvation, meconium ileus, Crigler-Najjar syn., drugs

PHYSIOLOGICAL JAUNDICE (infants) - Clinical icterus is not apparent in infants until S.bilirubin is >100 µmol/L, but in older children is apparent clinically when S.bilirubin is > 40 µmol/L. Kernicterus is possible with levels >300µmol/L

CHANGES IN SERUM BILIRUBIN LEVELS IN THE NEONATE

Phys: Haemoglobin destruction gives bilirubin, which is conjugated in the liver and excreted in the bile. Any overload or blockage of this system raises levels. The direct van den Bergh reaction reads conjugated bilirubin
The graph shows progressive changes in serum bilirubin levels due to haemolytic jaundice, obstructive jaundice (eg. biliary atresia, cystic fibrosis, galactosaemia) and decreased liver enzyme activity (eg. prematurity, Gilbert's disease, physiological disorders, viral infections, Crigler-Najjar syn., breastfeeding)

Bilirubin, Urine
RI: Nil
Ind: Liver disease
Int: PRESENT - Jaundice due to conjugated hyperbilirubinaemia
    ABSENT WITH CLINICAL JAUNDICE - Jaundice due to unconjugated hyperbilirubinaemia, hypervitaminosis A
Phys: Unconjugated bilirubin is lipid soluble, and cannot appear in urine.
    Conjugated bilirubin is water soluble. In hypervitaminosis A, jaundice is not due to bilirubin, but carotene
Bismuth, Serum
RI: < 20 nmol/L
Ind: Bismuth poisoning (eg. bismuth subcitrate medication)
Int: < 48 nmol/L - Nontoxic level
48 - 240 nmol - Intermediate range, possible toxicity
> 240 nmol - Toxic

Blast Cells, Blood
RI: Nil
Ind: Noted on routine blood film
Int: PRESENT - Marrow infiltration, carcinoma, leukaemia, sarcoma
Phys: Most primitive form of white cell. Further investigation essential when found in peripheral blood

Bleeding Time
RI: 1 - 7 minutes
Ind: Coagulation disorders
Int: HIGH - Drugs (eg. aspirin, NSAIDs), thrombocytopenia, thromboasthenia (platelets?), haemophilia, Christmas disease, von Willebrand's disease, Bernard-Soulier syn., Glanzmann syn.
Phys: Normal with anticoagulant therapy (eg. heparin). Measures platelet function
See also International Normalised Ratio - Prothrombin

Blood Gases
See Carbon Dioxide, Blood; Oxygen, Blood

Blood Group
RI: Types - A (A1 & A2), AB, B, O
Rhesus factor:
Rh+ (87%) (genotype cDe,CDe, CDE)
Rh– (13%) (genotype cde, cdE)
Rh± (rare) (genotype Cde)
Other factors - M, N, S, s, U
Familial factors - Kell, Duff, Lewis, Kidd, etc.
Ind: Blood transfusion, presurgery, medicolegal, precautionary
Int: Blood type and factors determine which blood a patient should receive. In emergency: O– is universal donor, AB+ is universal recipient. Parentage can be determined within limits by comparing grouping and other blood factors (particularly M and N) of parents and child

**Blood Volume**
RI: 60 - 80 mL/kg
Mean values: Male 4,500 mL, Female 3,600 mL
Phys: Measured by dye or radioisotope dilution methods. Increased 40% in pregnancy

**Blood, Faecal, Occult**
See Occult Blood, Faeces

**Blood, Urine**
See Haematuria

**BNP**
See B-type Natriuretic Peptide, Serum

**Bone Marrow**
See Marrow Cells, Bone

**Bone Mineral Density [BMD]**
RI: T score above –1
Ind: Osteoporosis
Int: BELOW –2.5 - Osteoporosis requiring treatment
–1 to –2.5 - Borderline, retest in 2 yrs., institute prevention with HRT or calcium
Phys: Dual photon densitometry measures bone density at wrist and interpreted as a T score variation from young normal mean
See also C-Terminal Telopeptide, Serum; N-Telopeptide, Cross Linked, Urine

**Brain Natriuretic Peptides, Serum**
See B-type Natriuretic Peptide
Breast Milk Analysis
RI: Colostrum (1 - 5 days postpartum)
   Energy 239 kJ/100 mL (57 calories/100mL)
   Total protein 1460 - 6800 mg/100 mL
   Lactose 1100 - 7900 mg/100 mL
   Amino acids 700 - 4000 mg/100 mL
   Total fats 2740 - 3180 mg/100 mL
   Total solids 10 - 16 g/100 mL
   Sodium 26 - 135 mEq/L
   Iron 0.02 - 0.05 mg/100 mL
Transition Milk (5 - 10 days postpartum)
   Energy 264 kJ/100 mL (63 calories/100mL)
   Total protein 1270 - 1890 mg/100 mL
   Lactose 6100 - 7900 mg/100 mL
   Amino acids 600 - 1000 mg/100 mL
   Total fats 2730 - 5180 mg/100 mL
   SG 1.034 - 1.036
   Total solids 10.5 - 15.5 g/100 mL
   Sodium 19 - 53 mEq/L
   Iron 0.04 - 0.07 mg/100 mL
Mature Milk (15+ days postpartum)
   Energy 272 kJ/100 mL (65 calories/100mL)
   Total protein 730 - 2000 mg/100 mL
   Lactose 4900 - 9500 mg/100 mL
   Amino acids 900 - 1600 mg/100 mL
   Total fats 1340 - 8290 mg/100 mL
   SG 1.026 - 1.037
   Total solids 10.3 - 17.5 g/100 mL
   Sodium 6 - 43 mEq/L
   Iron 0.02 - 0.09 mg/100 mL
Ind: Infant feeding problems, failure to thrive
Int: Abnormal results indicate inadequate or inappropriate lactation

Breath Test, Carbon-14 Urea
See Carbon-14 Urea, Breath

B-type Natriuretic Peptide, Serum [BNP]
(Brain Natriuretic Peptides)
RI: <40 pmol/L
Ind: Suspected cardiac failure
Int: HIGH - Congestive cardiac failure (echocardiography?)
     >220 pmol/L - Cardiac failure highly likely
Phys: A peptide of 32 amino acids that is released from cardiac ventricles in response to stretching.

**Brucellosis Antibodies, Serum**
RI: Negative.
Ind: Suspected Brucellosis.
Int: HIGH - Brucellosis.
Phys: Agglutination tests not sensitive and not specific. IFA and ELISA IgM and IgG tests more sensitive of specific. Antibodies indicate exposure and not necessarily active disease. Culture of the organism or detection by PCR can be used to confirm the diagnosis. Brucella Coombs test used in clinically suspected cases with a negative agglutination test.

*See also Immunoglobulin Antibodies, Specific, Serum*

**Buccal Smear**
Int: Microscopic examination of cells from the buccal mucous membrane enables the sex of the individual to be determined. The presence of a Barr body on the nucleus indicates female, its absence indicates male.

*See also Oestrogens, Urinary*

**Burr Cells, Blood**
See Erythrocyte Count, Blood

**BUN**
See Urea, Blood

**Bunnell, Paul**
See Paul Bunnell Test

**14\(^C\) Breath Test**
See Carbon-14 Urea, Breath

**C3 and C4**
See Complement, Serum
Ca
See Calcium, Ionised, Blood; Calcium, Corrected, Serum; Calcium, Serum; Calcium, Urine

CA
See Cancer Associated Antigens, Serum

CA 15-3
See Cancer Associated Antigens, Serum

CA 19-9
See Cancer Associated Antigens, Serum

CA 50
See Cancer Associated Antigens, Serum

CA 125
See Cancer Associated Antigens, Serum

CA 195
See Cancer Associated Antigens, Serum

CA 549
See Cancer Associated Antigens, Serum

Cadmium, Serum
RI: $< 0.04 \mu\text{mol/L}$
Ind: Industrial exposure in battery, electroplating, paint, plastic & ceramic factories; copper, lead or zinc smelting
Int: HIGH - Excessive exposure
Phys: May accumulate in food chain, particularly in shellfish

Caeruloplasmin, Serum
RI: 1.5 - 3.5 mmol/L (0.2 - 0.47 g/L)
Ind: Copper deficiency
**DOCTOR’S COMPANION**  
Section Four - Pathology

**Int:**  HIGH - Pregnancy, hyperthyroidism (ETR?), infection, aplastic anaemia, (FBC, Hb?), acute leukaemia, liver cirrhosis  
LOW - Wilson's disease

**Phys:** Serum copper is 95% bound to caeruloplasmin  
*See also Copper, Serum*

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**Calcitonin, Plasma**

**RI:**  < 27 pmol/L (<100 ng/L)  
**Ind:**  Thyroid and parathyroid disease

**Int:**  HIGH - Thyroid carcinoma, primary hyperparathyroidism, phaeochromocytoma, Cushing syn., multiple neuromas, carcinoid tumour, carcinomas of other organs (eg. liver, lung, breast, kidney).

**Phys:** Collect specimen mid-morning. Polypeptide hormone involved in regulation of calcium and bone metabolism

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**Calcium, Corrected, Serum**

**RI:**  2.15 - 2.55 mmol/L  
**Ind:**  As for Calcium, Serum  
**Int:**  HIGH - As for Calcium, Serum  
LOW - Same as Calcium, Serum except hypoalbuminaemia not relevant

**Phys:** Calculated by an algorithm that corrects artefacts due to hypoalbuminaemia and hyperalbuminaemia. Correction algorithms inaccurate in presence of renal failure, chronic acidosis or alkalosis, raised macroglobulins and in the presence of drugs that compete for albumin binding sites

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**Calcium, Ionised, Blood**

**RI:**  1.14 - 1.30 mmol/L  
**Ind:**  Investigation of abnormal S.calcium  
**Int:**  HIGH - Hyperparathyroidism (Nordin test?), early malignancy, sarcoidosis, vit. A toxicity, vit. D toxicity, milk-alkali syn., other causes of hypercalcaemia  
Normal ionised, high total serum calcium - Chronic alkalosis (i.e. from vomiting, steroids or diuretics)  
Normal ionised, low total serum calcium - Protein binding anomaly, chronic acidosis, hypoalbuminaemia  
LOW - Hypoparathyroidism, vit. D deficiency, dietary insufficiency, other causes of hypocalcaemia

**Phys:** The ionised calcium fraction alone interacts with cell membranes and transport systems, and is responsible for clinical signs and symptoms of hypo- or hypercalcaemia. Any variation from normal range highly significant
See also Calcium, Serum

**Calcium, Serum [Ca]**
RI: 2.2 - 2.7 mmol/L (9 - 10.8 mg/100 mL)
Ind: Renal, bone and parathyroid disease
Int: HIGH - Parathyroid overactivity (P, PTH?), osteolytic tumours, hypervitaminosis A, hypervitaminosis D, vit. D sensitivity, excess Ca absorption, lymphomas, sarcoidosis (S.ACE?), other neoplasias, hypophosphatasia, dehydration, hyperalbuminaemia, renal tubular acidosis, renal failure, thyrotoxicosis (TSH?), von Recklinghausen's disease of bone, excess milk ingestion, multiple myeloma, Paget's disease of bone, milk-alkali syn., adrenal insufficiency, acute rhabdomyolysis, prolonged immobilisation, parenteral nutrition, infancy, postmenopause, familial benign hypercalcaemia (U.Ca?), prolonged application of tourniquet during collection, transient effect in 4%, drugs (eg. thiazide diuretics, lithium, tamoxifen)
Phys: The absorption of calcium is dependent on vit. D which is obtained by sun irradiation of a skin cholesterol. The amount of calcium added to or removed from bone depends on calcitonin which is secreted by the parathyroid glands. Fasting sample required. Use of tourniquet during venesection may cause false high result

See also Calcium, Corrected, Serum; Calcium, Ionised, Blood

**Calcium, Urine [Ca]**
RI: 2.5 - 7.5 mmol/day
Ind: Parathyroid or bone disease
Int: HIGH - Hyperparathyroidism, high serum calcium, osteoporosis
LOW - Renal failure, nephrotic syn.
Phys: Strongly affected by diet

See also Calcium, Serum

**Calculi, Renal**
See Renal Calculi

**Calprotectin, Faeces**
RI: <50mg/Kg
Ind: Colonic inflammatory diseases
Int: HIGH – Crohn disease, aspirin or NSAID use.
Phys: Useful as a marker for patients who may need further investigation by colonoscopy, and to follow response to treatment.

Cancer Associated Antigens, Serum
(Carbohydrate Antigens) [CA]
RI: < 30 U/mL; mean 12.9 U/mL; peak 6 U/mL
Ind: Detection or monitoring of certain cancers
Int: CA 15-3 HIGH - Metastatic breast cancer (70%+), localised breast cancer (10%+). False positive with hepatic failure
CA 19-9 HIGH - Pancreatic cancer (80%+), bile duct cancer (66%+), stomach cancer (50%+), hepatoma (50%+), colorectal cancer (25%+). False positive with cirrhosis, cholangitis, pancreatitis
CA 50 HIGH - Pancreatic cancer (75%+), colorectal cancer (45%+). False positive with pancreatitis
CA 125 HIGH - Epithelial ovarian cancer (85%+), endometrial cancer, Meig syndrome, ovarian hyperstimulation, peritonitis, disseminated intra-abdominal carcinoma, mesothelioma. False positive with endometriosis, active hepatitis, pancreatitis, ascites, autoimmune diseases affecting the peritoneal cavity and pelvic inflammatory disease.
CA 195 - Pancreatic cancer (85%+), gastrointestinal cancer
CA 549 - Breast cancer (50%+), lung cancer, colon cancer, prostate cancer. False positive with endometriosis, hepatic disease, ovarian disease
Phys: A reading above 30 U/mL highly suspicious of carcinoma. Any reading above the mean should be regarded suspiciously and repeated to check for rising values. Used for following course of carcinoma and for screening in patients with family history of carcinoma. Radio-immunoassay using monoclonal antibodies
See also Carcinoembryonic Antigen, Serum; Squamous Cell Carcinoma Associated Antigen; Vasoactive Intestinal Peptide
See also Cancer in Investigations, Section Three

Cancer Associated Serum Antigen, Serum [CASA]
RI: Negative
Ind: Ovarian cancer
Int: POSITIVE - Epithelial ovarian cancer (75%+), colon cancer, uterine cancer, cervix cancer, breast cancer. False positive possible in late pregnancy

Cannabis
See Tetrahydrocannabinol, Urine
Carbamazepine, Serum
(Tegretol)
RI: Therapeutic range 20 - 50 µmol/L (6 - 12 µg/mL)
Ind: Carbamazepine therapy
Int: Adjust dosage to keep serum level within therapeutic range
Phys: Carbamazepine is used for epilepsy and trigeminal neuralgia. Sample prior to next dose

Carbohydrate Antigens
See Cancer Associated Antigens, Serum

Carbohydrate-Deficient Transferrin, Blood
RI: <1.7% but varies between laboratories
Ind: Alcoholism
Int: HIGH - Chronic alcoholism, non-alcoholic liver disease, carbohydrate-deficient glycoprotein syndrome (very rare), genetic variant of transferrin known as D1 (rare).
Phys: Immunoassay. Detects alcohol intake of > 60 gram per day during the past 9 days. Sensitivity 82%, specificity 97%.

Carbon Dioxide, Blood [pCO₂]
RI: 25 - 30 mmol/L (25 - 30 mEq/L) (combining power 45 - 65% vol.)
pCO₂ 4.6 - 6.0 kPa (42 ± 4 mmHg)
Ind: Pulmonary or vascular insufficiency
Int: HIGH - Hypoxia due to poor air entry, poor lung function, or poor circulation. Higher values far more significant than slightly raised values, as relationship between alveolar ventilation and pCO₂ is not linear (see graph)
See also Bicarbonate, Serum

**Carbon-14 Urea, Breath**

(¹⁴C Breath Test)

RI: Negative  
Ind: Peptic ulcer  
Int: POSITIVE - Confirms presence of *Helicobacter pylori* as causative agent of peptic ulcer  
Phys: A small amount of radiolabelled urea is swallowed on an empty stomach. After 15 minutes, samples of breath carbon dioxide are collected into hyamine solution. ¹⁴C activity is measured by liquid scintillation counting and results expressed using the following formula:-  

\[
\frac{% \text{ administered dose}}{\text{ mmol CO}_2 \text{ trapped}} \times \text{ weight in Kg.}
\]

High levels are positive  
See also CLO Test; Helicobacter pylori Antibodies

**Carboxyhaemoglobin, Blood**

RI: 0.5 - 1.5% of Hb  
Ind: Determine smoking status, carbon monoxide poisoning  
Int: HIGH - Smoker, inhalation of exhaust fumes or other exposure to carbon monoxide  
Phys: Levels up to 8% may be found in heavy smokers. 10-20% causes headache and exertional dyspnoea; >20% causes confusion and
irritability; >50% causes loss of consciousness and death with prolonged exposure; >70% causes rapid death.

See also Nicotine, Serum; Cotinine, Serum

**Carcinoembryonic Antigen, Serum [CEA]**

RI: 0 - 2.5 µg/L  
Ind: Colorectal carcinoma, monitoring cancer therapy  
Int: HIGH - Colorectal cancer, gastric cancer, thyroid cancer, breast cancer, lung cancer, cervix cancer, seminoma, pancreatic cancer, hepatomas, cirrhosis, heavy smokers  
Phys: Produced by tumours of endodermal tissue. False positives common. Useful to follow progress of cancer therapy.  
See also Cancer Associated Antigens, Serum; Human Epidermal Receptor 2 neu, Breast Tissue

**Cardiac Enzymes**

See Aldolase, Serum; Aspartate Amino Transferase, Serum; Creatine (Phospho) Kinase, Serum; Lactate Dehydrogenase, Serum; Myoglobin, Serum; Troponin T, Serum

**Cardiolipin Autoantibodies, Blood [ACLA] (Anticardiolipin Antibodies)**

RI: Absent  
Ind: Autoimmune disease  
Int: PRESENT - SLE, antiphospholipid syndrome, other autoimmune diseases, thromboembolic disorder, serious infection  
Phys: ELISA test. Antibodies may be IgG or IgM class.  
See also ANA, Serum; ANCA, Serum; Anti-DNA, Serum; Anti-Smith Antibodies, Serum; Complement C3 and C4; DNA Autoantibodies; ENA, Serum; Histone Autoantibodies, Blood; HLA-DR3, Serum; LE Cells, Blood; Lupus Anticoagulant Antibody, Serum

**Carnitine, Plasma**

RI: Free: 30 – 70 µmol/L  
Total: 40 – 80 µmol/L  
Ind: Myopathies  
Int: LOW - Carnitine deficiency states may cause myopathy (including heart) and hypoglycaemia  
Phys: Carnitine deficiency may be due to reduced intake, impaired synthesis, renal disease or acidaemia
Carotene, Serum
RI: 0.93 - 3.7 µmol/L
Ind: Icterus, malabsorption
Int: HIGH - Carotenaemia due to excessive intake of pawpaw, carrots, pumpkin, etc.; hypothyroidism, hyperlipidaemia
LOW - Tropical sprue, fat malabsorption

CASA
See Cancer Associated Serum Antigen, Serum

Casoni's Test
RI: Negative
Ind: Hydatid disease (Echinococcosis)
Int: POSITIVE - Hydatid disease, false positive possible
Phys: Superseded skin test. Blood hydatid antibody test more reliable
See also Hydatid Antibodies, Blood

casts, Urine
See White Cell Count, Urine

Catecholamines, Plasma
RI: Adrenaline <0.3nmol/L
Noradrenaline <2.5nmol/L
Dopamine <0.5nmol/L
Ind: Severe hypertension
Int: ADRENALINE & NORADRENALINE HIGH - Phaeochromocytoma
DOPAMINE HIGH - Neuroblastoma
Phys: Relax patient for 30 min. after insertion of IV canula to allow catecholamines to return to base state
See also Catecholamines, Urine; Clonidine Suppression Test; U.HMMA, U.metanephrine; MIBG scan

Catecholamines, Urine
RI: Adrenaline < 80 nmol/day (0.11 - 0.52 nmol/L)
Noradrenaline < 780 nmol/day (1.27 - 2.81 nmol/L)
Dopamine < 3500 nmol/day
Ind: Hypertension
Int: ALL HIGH - Phaeochromocytoma (HMMA?), drugs [eg. methyldopa]
DOPAMINE HIGH - Ganglioneuroma, neuroblastoma
LOW - Failure (or damaged) adrenal medulla
Phys: Adrenaline and noradrenaline are the catecholamines produced in the adrenal medulla. Excesses are produced by the organ of Zuckerkandl and other areas of the medulla in phaeochromocytoma
See also Catecholamines, Plasma; Clonidine Suppression Test; U.HHMA, U.metanephrine ; MIBG scan

CBE
See Full Blood Count

CCP
See Cyclic Citrullinated Peptide Antibodies, Serum

CD Types, Lymphocytes
See T Cell Lymphocytes, Blood

CEA
See Carcinoembryonic Antigen, Serum

Centromere Autoantibodies, Blood
RI: Absent
Ind: CREST syn.
Int: PRESENT - CREST syn. [see Syndromes section 6]
Phys: Highly accurate test for this syndrome

Cerebrospinal Fluid Cells
RI: Neutrophils 0/µL
Lymphocytes 0-5/µL
Erythrocytes 0-5/mL (higher with traumatic tap)
Ind: CNS disease
V.HIGH [> 2000 - predominantly polymorphonuclear leucocytes] - acute bacterial meningitis
Cerebrospinal Fluid Colour
RI: Clear
Ind: CNS trauma or infection
Int: YELLOW - Old haemorrhage, very high protein
     RED - Recent haemorrhage, traumatic tap
     CLOUDY - High cell count

Cerebrospinal Fluid, Glucose
See Glucose, CSF

Cerebrospinal Fluid, Immunoglobulins
See Immunoglobulin G, CSF

Cerebrospinal Fluid, Lactate
See Lactate, CSF

Cerebrospinal Fluid Pressure
RI: Horizontal adult 70 - 200 mm H₂O
    Horizontal child < 100 mm H₂O
    Horizontal infant < 80 mm H₂O
Ind: Brain disease
Int: LOW - Schaltenbrand syn.
     HIGH - Viral meningitis or encephalitis, subdural haemorrhage,
     subarachnoid haemorrhage, alcoholism
     V.HIGH - Bacterial meningitis, syphilis, TB, cerebral haemorrhage,
     toxoplasmosis

Cerebrospinal Fluid, Protein
See Protein, CSF

Cerebrospinal Fluid, Specific Gravity
See Specific Gravity, CSF

Cerebrospinal Fluid, Volume
RI: 100 - 140 mL
Ceruloplasmin
See Caeruloplasmin, Serum

Cervical Smear
See Papanicolaou Smear, Cervix

CGA
See Chromogranin A, Serum

Chlamydia Detection
See Immunoglobulin Antibodies, Specific, Serum; Ligase Chain Reaction, Urine; Polymerase Chain Reaction, Blood

Chloride, CSF $[\text{Cl}^-]$ 
RI: 120 - 130 mmol/L (700-750 mg/100 mL)
Ind: Meningitis
Int: LOW - Acute meningeal infections, TB

Chloride, Serum $[\text{Cl}^-]$ 
RI: 97 - 108 mmol/L
Ind: Water, electrolyte imbalance, renal disease
Int: LOW - Vomiting, water overload, salt losing nephropathy, chronic or severe diarrhoea, alcoholism (GGT?), cystic fibrosis, drugs (eg. diuretics).
HIGH - Salt water drowning, excess ingestion, dehydration, renal tubular acidosis, diarrhoea, excess purging, ureterosigmoidoscopy, biliary drainage, idiopathic
Phys: The level of Cl- is directly dependent on the level of Na

Chloride, Sweat $[\text{Cl}^-]$ 
RI: 4 - 50 mmol/L (4 - 50mEq/L)
Ind: Malabsorption
Int: High - Fibrocystic disease
Phys: Sweat collected on electrolyte-free gauze pads or by iontophoresis
See also Conductivity, Sweat
Chloride, Urine \([\text{Cl}^-]\)
RI: 100 - 200 mmol/L/day (as NaCl)
Ind: Little clinical value
Int: Varies with diet, acid-base balance, electrolyte and water balance

Chlorpromazine, Serum
(Largactil)
RI: 0.16 - 0.94 umol/L
   Toxic > 2.4 umol/L
Ind: Chlorpromazine therapy
Int: Adjust dosage to keep serum levels within therapeutic range
Phys: Used in treatment of psychoses, schizophrenia and severe agitation.
   Sample prior to next dose

Cholesterol, Serum
RI: 2.2 - 6.5 mmol/L (150 - 250 mg/100 mL)
   Neonate 0.2 - 4 mmol/L
   Recommended levels -
   - general population <5.5 mmol/L
   - risk factors (eg. diabetes, heart disease, smoking, hypertension, family history) <4.0 mmol/L
Ind: Obesity, hypertension, heart disease, diabetes mellitus
Int: HIGH - Hypercholesterolaemia (HDL:LDL ratio?), familial, hypothyroidism (ETR, TSH?), diabetes mellitus (glucose?), nephrotic syn., chronic hepatitis, cirrhosis, lipaemia, porphyria, protein deficit, hypergammaglobulinaemia, anorexia nervosa, elderly, pregnancy
   LOW - Acute hepatitis, Gaucher's disease, hyperthyroidism, acute infections (FBC?), uraemia, myocardial infarct, malnutrition, familial
Phys: Level determined by metabolic functions that are influenced by diet and heredity. 70% of cholesterol occurs as low density lipoproteins. No alcohol for 72 hours and no food for 12 hours before test
See also Apolipoproteins, Serum; High Density Lipoprotein Cholesterol, Blood; Homocysteine, Serum; Lipoprotein A, Serum; Low Density Lipoprotein Cholesterol, Blood; Triglycerides, Serum

Cholinesterase, Serum
RI: Significant variation between labs
Ind: Scoline apnoea in anaesthesia
Int: LOW - Scoline (suxamethonium) apnoea, familial tendency to scoline apnoea, organophosphate poisoning, liver disease
   SLIGHTLY LOW - Pregnancy
Phys: Cholinesterase essential for metabolism of scoline. Lack causes prolongation of scoline effect. Synthesised in liver
See also Cholinesterase, RBC

**Cholinesterase, Red Cell**
RI: Significant variation between labs
Ind: Insecticide poisoning
Int: LOW - Organophosphate or carbamate poisoning
Phys: Levels slowly return to normal with cessation of exposure
See also Cholinesterase, Serum

**Chorionic Gonadotrophin, Human, Beta, Serum [HCG]**
RI: < 10 IU/L (non-pregnant)
Ind: Pregnancy, gonadal carcinoma
Int: 20 - 100 IU/L - 1 - 2 weeks postconception, menopause (LH?)
100 - 6000 IU/L - 3 - 4 weeks postconception, 3rd trimester of pregnancy, embryonal carcinoma, choriocarcinoma, testicular carcinoma
6000 - 30,000 IU/L - Increases between weeks 7 and 30 of pregnancy, then decreases
>30,000 IU/L - Increased risk of Down syndrome (see Investigations section 3)
Phys: Secreted by the trophoblast to stimulate and maintain the corpus luteum. Rises to a peak at 10 weeks gestation, then slowly declines. Reliable only 10 days after conception as cross reacts with LH. Also acts as a reliable marker to certain gonadal tumours

**Chorionic Gonadotrophin, Human, Urine [HCG]**
RI: < 30 IU/day
Ind: Pregnancy
Int: HIGH - Pregnant, seminomas, choriocarcinoma, hydatidiform mole
Phys: Peak level at 10 weeks pregnancy

**Chorionic Villus Sampling**
Ind: Suspected congenital disease
Int: Abnormal results may be obtained in Down syn., haemoglobinopathies, cystic fibrosis, Huntington's chorea, haemophilia, Christmas disease, X-linked muscular dystrophy, some metabolic disorders. Fetal sex may also be determined
Phys: Sample of chorionic villi from placenta obtained antenatally by needle aspiration through abdominal wall, under ultrasound guidance, between
the 9th and 12th week of pregnancy. Tissue obtained may be subjected to chromosome, DNA or enzyme analysis

**Chromium, Serum**
RI: 0.05 - 0.5 µg/L
Ind: Occupational exposure (eg. tanning, electroplating, stainless steel)
Int: HIGH - Excess occupational exposure

**Chromogranin A, Serum [CGA]**
RI: <85 pg/L (Brahms Kryptor assay)  
<93 ug/L (cumulative chromogranin A)
Ind: Neuro-endocrine (carcinoid) tumours
Int: HIGH: Chronic gastritis, inflammatory bowel disease, chronic renal failure, rheumatoid arthritis  
V.HIGH: Neuro-endocrine (carcinoid) tumours, adenocarcinomas, prostate cancer  
FALSE POSITIVE: Proton pump inhibitors, H2 blockers, renal disease
Phys: Sample in fasting and resting state. Neuro-endocrine tumours most commonly arise in the intestine, pancreas or lungs, but may also occur in the pituitary, thyroid, breast, prostate, liver etc.

**Chromosomes**
RI: 22 pairs + 1 pair sex chromosomes (X, Y)
Ind: Genetic abnormalities, sex determination
Int: 47 - Down syn. [Trisomy 21]  
XXY - Klinefelter syn.  
XO - Turner syn.  
Many other abnormalities known
Phys: Cells (blood lymphocytes, bone marrow, amniotic fluid, chorionic villi) from the patient grown in culture have mitosis arrested by colchicine. Examination under microscope determines chromosome pattern and numbers

**Chymotrypsin, Faecal**
RI: > 75 µg/g
Ind: Pancreatic disease
Int: LOW - Impaired pancreatic function
Phys: Screening test only
Citrulline Antibody
See Cyclic Citrullinated Peptide Antibodies, Serum

CK
See Creatine (Phospho) Kinase, Serum

Cl−
See Chloride, CSF; Chloride, Serum; Chloride, Sweat; Chloride, Urine

CLO Test
(Campylobacter Like Organism Test)
RI: Negative
Ind: Peptic ulcer
Int: POSITIVE - *Helicobacter pylori* present
Phys: Test for urease on stomach biopsy specimen. If positive indicates active infection. Blood antibody test can be used as a screening test and indicator of possible infection. Cannot be used to monitor effective treatment. Antigen test on stool sample also indicate active disease but carbon-14-urea breath test is a better indicator.

See also Carbon-14 Urea Breath Test; *Helicobacter pylori* antibodies

Clonazepam, Serum
(Rivotril)
RI: Therapeutic range 60 - 150 nmol/L (25-75 µg/L)
Ind: Clonazepam therapy
Int: Adjust dosage to keep serum levels within therapeutic range
Phys: Clonazepam is used in treatment of epilepsy. Sample prior to next dose. Half life 10 to 60 hours.

Clonidine Suppression Test, Blood
RI: 50% drop in plasma adrenaline and noradrenaline (catecholamines) within 3 hours
Ind: Phaeochromocytoma diagnosis
Int: LESS THAN 50% DROP IN CATECHOLAMINES - Phaeochromocytoma, other catecholamine producing tumour
Phys: Test performance criteria -
- relaxed lying patient with IV line
- baseline plasma for catecholamines collected
- 300ug clonidine given orally
DOCTOR’S COMPANION
Section Four - Pathology

- plasma for catecholamines collected hourly for 3 hours
See also Catecholamines, Plasma; Catecholamines, Urine

**Clotting Time**
RI: < 10 minutes
Ind: Bleeding disorders
Int: HIGH - Anticoagulant therapy, lack of blood clotting factors
Phys: Covers intrinsic and common pathway from factor XII to fibrinogen.
Screening test for bleeding disorders
See also other tests listed under Coagulation Tests

**Cluster Differentiation Antibodies, Lymphocytes**
See T Cell Lymphocytes, Blood

**CO₂**
See Carbon Dioxide, Blood

**Coagulation Tests**
See Activated Partial Thromboplastin Time; Anti-Factor Xa, Plasma; Antithrombin III, Blood; Clotting Time; Factor VIII, Blood; Factor XIII Screen, Blood; Fibrin Degradation Products, Blood; Fibrinogen, Blood; International Normalised Ratio - Prothrombin; Platelet Count, Blood; Protein C, Plasma; Prothrombin Time; Thrombin Clotting Time; von Willebrand Factor, Plasma

**Cocaine, Urine**
RI: <300 ng/mL
Ind: Detection of cocaine use
Int: HIGH - Use of cocaine in previous two weeks.
Phys: Half-life of metabolites up to 8 hours. Quinine use can cause false positive.
Lemon juice, bleach and vinegar in sample may cause false negative result.

**Cockroft Gault Equation**
See Glomerular Filtration Rate
Cold Agglutins, Blood
RI: Low titre
Ind: Pneumonia
Int: HIGH TITRE - Mycoplasma pneumonia, infectious mononucleosis, lymphoid neoplasms, viral disease, syphilis
Phys: Test for antibodies that react to cause haemolysis at low temperatures (i.e. 4°C) \textit{in vitro}. Haemolysis due to fixation of complement (C3) to surface of erythrocytes

Collagen Binding Assay, von Willebrand Factor, Plasma
See von Willebrand Factor, Plasma

Collagen Crosslink Fragments, Urine
See Deoxyypiridinoline, Urine

Complement C3 and C4, Serum
RI: C3 0.83 - 1.7 g/L
C4 0.19 - 0.59 g/L
Ind: SLE
Int: LOW - SLE, rheumatoid arthritis, other connective tissue diseases, cirrhosis, urticaria, splenectomy, pneumococcal infection, Neisseria infection, Streptococcal nephritis (only C3 low).
HIGH - Anaphylaxis
Phys: Useful for following progress of SLE. C4 levels more sensitive. C3 levels drop only in severe disease
See also Cold Agglutins, Blood; LE Cells, Blood; Lupus Anticoagulant Antibody, Serum

Complete Blood Examination
See Full Blood Count

Conductivity, Sweat
RI: <50 mmol/L
Ind: Cystic fibrosis
Int: 51 –89 non-diagnostic, do quantitative sweat chloride
89 mmol/L cystic fibrosis
Phys: Sweat conductivity is an approved screening test for cystic fibrosis
See also Chloride, Sweat
Coombs' Test  
(Direct Antiglobulin Test)  
RI: Negative  
Ind: Haemolytic anaemia, jaundice, blood transfusion  
Int: DIRECT POSITIVE - Autoimmune haemolytic anaemia, SLE, chronic lymphatic leukaemia, lymphosarcoma, Hodgkin's disease, cytomegalovirus infection, incompatible blood transfusion  
DIRECT WEAK POSITIVE - Rheumatoid arthritis, ulcerative colitis, drugs [eg. penicillin, methyldopa]  
INDIRECT POSITIVE - Excess serum antibody from autoimmune haemolytic anaemia  
Phys: Haematological agglutination test to detect abnormal plasma protein (often IgG) attached to red blood cells. Detected by Coombs' serum, which is an animal anti-human Ig antibody

Copper, Serum [Cu]  
RI: 11 - 22 µmol/L (70-140 µg/100 mL)  
Ind: Liver disease, Wilson's disease  
Int: HIGH - Wilson's disease (early stage), anaemia, infection, cirrhosis, hepatoma  
LOW - Wilson's disease (late stage), major malabsorption disorders  
Phys: 95% bound to caeruloplasmin, 5% bound to albumin  
See also Caeruloplasmin, Serum

Copper, Urine  
RI: < 1.2 µmol/day  
Ind: As for Copper, Serum  
Int: As for Copper, Serum

Coproporphyrins, Urine  
RI: <240 nmol/day (<161 µg/24 hours)  
Int: HIGH - Porphyria variegata, hereditary coproporphyria, liver and biliary tract disorders, lead poisoning, barbiturates, salicylates.

Cortisol, Serum  
RI: Morning - 130 - 770 nmol/L (5 - 28 µg/100 mL)  
Evening - < 390 nmol/L (< 14 µg/100 mL)  
Midnight - < 220 nmol/L (< 8 µg/100 mL)  
Ind: Cushingoid
Int: HIGH - Cushing syn., oral contraceptives, obesity, stress, drugs [eg. hormones], depression, pregnancy
No response to IV tetracosactrin - Addison's disease

Phys: Specimen normally taken at 9 am. Stimulation and suppression tests essential when significant rises in levels should occur with tetracosactrin and insulin

See also Dexamethasone Suppression Test; Synacthen Stimulation Test

Cortisol, Urine, Free
RI: 97 - 330 nmol/day
Ind: Cushingoid
Int: HIGH - Cushing syn., hormone therapy
Phys: 24 hour collection essential. No fluctuation with short-term stress

Cotinine, Serum or Urine
RI: 0 mg/L
Ind: Determination of smoking status
Int: HIGH - Smoker
Phys: 5% of nicotine metabolises to cotinine. Values above 50mg/l exclude passive smokers. Cotinine test highly specific for the usage of nicotine.
See also Nicotine, Serum; Carboxyhaemoglobin B, Serum

C-Peptide Suppression Test, Blood
RI: B.C-peptide <0.4nmol/L (1.2µg/L) when patient hypoglycaemic (B.glucose <2.2mmol/L)
Ind: Insulinoma
Int: HIGH - Insulinoma
Phys: Autonomous source of endogenous insulin prevents fall of C-peptide to below RI result in hypoglycaemic patient

CPK
See Creatine (Phospho) Kinase, Serum

C-Reactive Protein, Serum [CRP]
RI: < 10mg/L (< 10 µg/mL)
Ind: Inflammation
Int: HIGH - Inflammation, tissue injury (inc. surgery), infections (usually bacterial), rheumatoid arthritis, pneumonia, myocardial infarct, increased risk of cardiovascular disease, widespread malignancy, breast cancer,
acute gout, ankylosing spondylitis, rheumatic fever, SLE, thromboembolism, bacterial meningitis, polyarteritis nodosa, inflammatory bowel disease, pregnancy

Phys: Found in certain patients with tissue inflammation, damage or necrosis. Protein produced in the liver as part of the acute phase inflammatory response, but released from most tissue under stress. Nonspecific test, but usually indicates organic disease. More sensitive than ESR. Levels rise within 6 to 24 hours then return to normal after 1 to 2 weeks.

See also C-Reactive Protein, High Sensitivity, Serum

C-Reactive Protein, High Sensitivity, Serum [Hs-CRP]
RI: Risk measured by two samples taken two weeks apart.
Increase in Hs-CRP:
<1.0 mg/L - low risk
1.0 - 3.0 mg/L - medium risk
>3.0 mg/L - high risk
Ind: Acute coronary syndrome (unstable angina).
Int: RISING LEVELS - Poorer prognosis for angina, atherosclerosis, increasing tissue damage in other organs
Phys: Slowly increasing levels associated with increasing myocardial tissue damage and significant atherosclerosis even though total level of CRP may be quite low.

See also C-Reactive Protein, Serum ; Troponin, Serum

Creatine (Phospho) Kinase, Serum [CK or CPK]
RI: Male 60 - 280 IU/L
Female 30 - 190 IU/L
Ind: Suspected myocardial infarct
Int: HIGH - Myocardial infarct (LDH, AST, troponin T?), muscle dystrophies, polymyositis, pulmonary embolus, seizures, postoperative, myocarditis, muscle trauma [eg. seizures, IM injection], widespread malignancy, acute or chronic alcoholism, significant infections, hypothyroidism, hyperthyroidism, metabolic abnormalities (eg. hypokalaemia, ketoacidosis), hyperpyrexia, heat stroke, severe exercise, medications (eg. statins, amphotericin, verapamil, antineoplastics, steroids, narcotics, colchicine, cyclosporin).
Phys: CK rises 3-5 hours after myocardial infarct. Returns to normal in 2-3 days. Heart and skeletal muscle is rich in this enzyme, which converts ADP into ATP + creatine

See also Creatine Kinase Isoenzymes, Serum; Troponin T, Serum
Creatine Kinase Isoenzymes, Serum
RI: CK-MB ratio < 6%
   MB factor < 10 U/L (<5% total CK, <0.6µg/L)
   MM factor 96% total CK
   BB factor rarely detected
Ind: Myocardial infarct
Int: CK-MB ratio and MB factor HIGH - Myocardial infarct (troponin T?), myocarditis
     Total CK and MM factor HIGH - As in CK above
     BB factor HIGH - Cerebral damage
Phys: MB factor is 4% of skeletal muscle CK, but 40% of CK in cardiac muscle.
     MM factor makes up rest of CK, except in brain, where significant amounts of BB factor (which is very short lived in serum) occurs

Creatine Kinase Isoforms, Serum
RI: CK-MM³ - Absent
   CK-MM₁/CK-MM³ ratio - <1.5
   CK-MB² - <1U/L
   CK-MB²/CK-MB¹ ratio - <1.5
Ind: Myocardial infarct
Int: HIGH - Myocardial infarct (troponin T?), myocarditis
Phys: Very early test for myocardial damage, but difficult to measure

Creatinine, Serum
RI: 60-140 umol/L (0.06 - 0.14 mmol/L)
   Pregnancy: 40-80umol/L (0.04 - 0.08 mmol/L)
Ind: Renal disease
Int: HIGH - Acute or chronic renal insufficiency (urea, K?), urinary tract obstruction, hypertension, chronic glomerulonephritis, diabetic nephropathy, polycystic kidneys, reflux nephropathy, SLE, acute muscle wasting, elderly, toxins, large intake of meat or vit. C, drugs [eg. analgesics, NSAIDs, diuretics, ACE inhibitors, A2RB]
   LOW - Pregnancy, chronic muscle wasting
Phys: Creatinine is excreted by filtration through the glomerulus; retention is an indication of glomerular insufficiency. Abnormal results (up or down) may be caused by high blood glucose or bilirubin, or by the drug cefoxitin. Comparison of results between laboratories may not be valid.
See also Glomerular Filtration Rate; Urea, Blood

Creatinine, Urinary Clearance
RI: Male 1.2 - 2.35 mL/second (70 - 140 mL/minute)
   Female 1.2 - 2.16 mL/second (70 - 130 mL/minute)
(Corrected for surface area)

**Ind:** Renal function test

**Int:** HIGH - Muscular dystrophies, myositis, myasthenia gravis, starvation, hyperthyroidism

LOW - Renal insufficiency (urea?), hypothyroidism, amyotonia congenita

**Phys:** Creatinine is excreted solely by the kidney. Excess is produced in states of elevated catabolism. Values decrease with age

**Creatinine, Urine**

**RI:**
- Male: 8 - 18 mmol/day
- Female: 5 - 16 mmol/day
- Child: 0.07 - 0.19 mmol/d/Kg

**Ind:** As for Creatinine, Urinary Clearance

**Int:** As for Creatinine, Urinary Clearance

**Cross-Linked Fibrin Derivatives**

See D-Dimer, Blood

**Cross-Linked N-Telopeptide, Urine**

See N-Telopeptide, Cross-Linked, Urine

**CRP**

See C-Reactive Protein, Serum

**Cryoglobulin, Serum**

**RI:** Absent

**Ind:** Immune disorders

**Int:** PRESENT - Infection [eg. hepatitis C], myeloma, lymphoma, SLE, other immune complex disorder

**Phys:** Cryoglobulin precipitates at 4°C and redissolves at 37°C

**Crystals, Urine**

**RI:** Phosphate crystals common in alkaline urine. Oxalate crystals common in acid urine. Uric acid crystals occur in high uric acid excretors and some normal people

**Int:** Little clinical significance
CSF
See individual entries under Cerebrospinal Fluid

C-Terminal Telopeptide, Serum [CTX]
RI: 200-450 pg/mL
Ind: Osteoporosis
Int: LOW – Reduced bone turnover (osteoporosis).
     HIGH – Bisphosphonate use.
Phys: Very good marker of bone resorption.
See also Bone Mineral Density; Deoxypyridinoline, Urine; Hydroxyproline, Urine;
N-Telopeptide, Cross Linked, Urine

CTX
See C-Terminal Telopeptide, Serum

Cu
See Copper, Serum; Copper, Urine

Cyanocobalamin, Serum
See Vitamin B₁₂

Cyclic Citrullinated Peptide Antibodies, Serum [CCP]
(Citrulline Antibody; Anti-cyclic Citrullinated Peptide Antibody [Anti-CCP; ACPA])
RI: Negative
Ind: Rheumatoid arthritis
Int: POSITIVE - Rheumatoid arthritis (RA)
     FALSE POSITIVE – Sjögren syndrome, scleroderma, SLE
Phys: Appears early in RA and highly specific test. Presence may predate onset of clinical symptoms.

Cyclosporin, Whole Blood
RI: Therapeutic range:
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Pathology - 57
DOCTOR’S COMPANION  
Section Four - Pathology

Liver

<table>
<thead>
<tr>
<th>Liver</th>
<th>800</th>
<th>665</th>
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<tr>
<td>&gt;12</td>
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<td>0-3</td>
<td>1000</td>
<td>832</td>
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<tr>
<td>4-6</td>
<td>800</td>
<td>666</td>
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<tr>
<td>&gt;6</td>
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<td>499</td>
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</table>

Ind: Cyclosporin therapy  
Int: Adjust dosage to keep levels within therapeutic range

Phys: A single blood concentration measured 2 hours after cyclosporin administration (C2) has been shown in both liver and kidney transplant patients to be a significantly more accurate predictor of drug exposure than trough (Co), and its use results in a reduction in the incidence and severity of cellular rejection. Performed by immunoassay.

Cystine, Urine

RI: 0.04 - 0.8 mmol/day

Ind: Cystinuria

Int: HIGH - Fanconi syn., cystinuria, other aminoacidurias

Phys: 24 hour collection essential

Cytogenetics

Phys: FISH (Fluorescent in-situ hybridisation) can be used to label a specific gene on a chromosome with a fluorescent dye to detect a large number of genetically determined conditions including Angelman syndrome, Di George syndrome, Down syndrome, Miller Dieker syndrome, Prader Willi syndrome, Smith Magenis syndrome, Trisomy syndromes, Turner syndrome, Williams syndrome, retinoblastoma tendency etc.

See Syndromes Section six, for interpretation of Syndromes above

Cytomegalovirus Antibodies, Serum

See Immunoglobulin Antibodies, Specific, Serum

D-Dimer, Blood

(Cross-Linked Fibrin Derivatives)

RI: Negative or < 0.2 mg/L

Ind: Thromboembolic disorders

Int: POSITIVE [high titre] - Venous or arterial thrombosis [eg. deep vein thrombosis, disseminated intravascular coagulation], liver disease, sepsis.

Phys: Measures breakdown products of cross linked fibrin. Correlates with, but more specific than, Fibrin Degradation Products (see separate entry)
Dehydroepiandrosterone Sulfate, Blood [DHEA-S]
RI:  
- Male or female neonate: 4.4 - 9.2 µmol/L (1670 - 3600 ng/mL)
- Male adult: 5.3 - 9.0 µmol/L (2000 - 3400 ng/mL)
- Female child: 0.1 - 1.5 µmol/L (100 - 600 ng/mL)
- Female adult: 2.0 - 9.0 µmol/L (820 - 3380 ng/mL)
- Female pregnant: 1.0 - 3.0 µmol/L (230 - 1170 ng/mL)
- Female postmenopausal: 0.1 - 1.5 µmol/L (100 - 600 ng/mL)

Ind: Test of gonadal function
Int:  
- LOW - Pubertal failure, gonadal failure
- HIGH - Ovarian or testicular tumours, polycystic ovary, Stein-Leventhal syn., adrenal tumour or hyperplasia

Phys: Androgen that is precursor to testosterone. Fasting specimen required

Dengue Fever Antibodies, Serum
See Immunoglobulin Antibodies, Specific, Serum

Densitometry, Bone Mineral
See Bone Mineral Densitometry

Deoxypyridinoline, Urine [DPyd]
RI:  
- Male: 2.5 - 5.0 nmol DPyd/mmol creatinine
- Female: 3.0 - 5.5 nmol DPyd/mmol creatinine

Ind: Bone resorption
Int:  
- HIGH - Chronic hypogonadism, osteoporosis (densitometry?), Paget's disease, hyperthyroidism, primary hyperparathyroidism, chronic hepatic disease, chronic renal disease, vitamin D deficiency, rheumatoid arthritis, corticosteroid therapy

Phys: When bone is broken down by resorptive processes, collagen breakdown products are released into the blood and excreted in urine. DPyd is one of these products. Enzyme-linked immunosorbant assay (ELISA)
See also Bone Mineral Density; C-Terminal Telopeptide, Serum; Hydroxyproline, Urine; N-Telopeptide, Cross Linked, Urine

Dexamethasone Suppression Test
RI:  
- U.17-hydroxycorticosteroids < 3.5 mg/day on 2nd day of test

Ind: Cushing syn.
Int:  
- HIGH - Cushing syn., endogenous depression

Phys: Dexamethasone 0.5 mg is given every 6 hours for 2 days, and U.17-hydroxysteroids are measured on 2nd day
**Diabetes Autoantibodies**  
See Anti-Tyrosine Autoantibodies, Serum; Glutamic Acid Decarboxylase Antibody, Serum

**Diazepam, Serum**  
*(Valium)*  
**RI:** Therapeutic range 400 - 1500 µg/L (0.7 - 5.3 umol/L)  
**Ind:** Diazepam therapy  
**Int:** Adjust dosage to keep levels within therapeutic range  
**Phys:** Half-life 2-8 hours. Sample prior to next dose

**Digoxin, Serum**  
*(Lanoxin)*  
**RI:** Therapeutic range 1-2.6 nmol/L (0.8-2 ng/mL)  
  *Toxic > 3.2 nmol/L (>2.5 ng/ml)*  
**Ind:** Digoxin therapy  
**Int:** Adjust dosage to keep levels within therapeutic range  
**Phys:** Sample > 12 hours after dose

**Dilantin, Serum**  
See Phenytoin Sodium, Serum

**Direct Antiglobulin Test**  
See Coombs' Test

**Disaccharidases, Intestinal**  
**RI:**  
  - Lactase >20 U/g  
  - Maltase >100 U/g  
  - Sucrase >25 U/g  
**Ind:** Chronic diarrhoea  
**Int:** LOW – Specific enzyme deficiency, bacterial gastroenteritis  
**Phys:** Disaccharidases are enzymes secreted by the intestinal mucosa and break down disaccharides to monosaccharides (eg. lactase breaks down lactose to glucose and galactose).

**DNA Autoantibodies, Blood**  
**RI:** < 10 U/mL
Ind: SLE
Int: V.HIGH - SLE (ENA?)
HIGH - Rheumatoid arthritis, chronic active hepatitis, lupoid hepatitis
Phys: Radio-immunoassay on fasting blood sample, specific for double stranded DNA

See also LE Cells, Blood; Lupus Anticoagulant Antibody, Serum

DNA Probes, Tissue
(Gene Mapping)
RI: Absent
Ind: Congenital diseases
Int: POSITIVE - Presence of specific congenital disease
Phys: The range of DNA probes available is rapidly increasing. Those currently available include tests for alpha- and beta-thalassaemia, sickle cell disease, haemophilia, Duchenne muscular dystrophy, cystic fibrosis, neurofibromatosis, Huntington's chorea, polycystic kidney disease, phenylalanine hydroxylase deficiency, myotonic dystrophy, fragile X syn., X-linked retinitis pigmentosa, Leber's optic atrophy, alpha1-antitrypsin deficiency, X-linked hydrocephalus, Friedreich's ataxia, fructose intolerance. Chorionic villi may be used as the tissue sample in antenatal diagnosis. May identify identical twins

Dohle Bodies, Neutrophils
RI: Absent
Ind: PRESENT - Bacterial or viral infection, May Hegglin anomaly.
 Occasionally seen in neoplasia, cytotoxic therapy, necrosis, pregnancy
Int: Routinely reported if found on blood film microscopy

Dopamine
See Catecholamines, Plasma; Catecholamines, Urine

DPyd
See Deoxypyridinoline, Urine

Drug Screen
See Anabolic Steroids, Urine; Barbiturates, Serum; Cocaine, Urine; Cotinine, Serum or Urine; Diazepam, Serum; Ethanol, Serum; Opiates, Urine; Tetrahydrocannabinol, Urine
Dual Photon Densitometry
See Bone Mineral Density

eAG
See Estimated Average Glucose, Blood

EBV
See Epstein-Barr Virus Immunoglobulin Antibodies, Serum; Infectious Mononucleosis Screen, Serum

Effective Thyroxine Ratio [ETR]
RI: 0.93 - 1.06 (93 - 106%)
Ind: Thyroid disease
Int: LOW - Hypothyroidism
      HIGH - Hyperthyroidism
See also Thyroxine, Free, Serum

eGFR
See Glomerular Filtration Rate

Electrolytes
See Anion gap, Serum; Bicarbonate, Serum; Chloride, Serum; Magnesium, Serum; Potassium, Serum; Sodium, Serum

Electrophoretic Pattern of Plasma [EPP]
RI:  Albumin 35 - 55 g/L
      Globulin 20 - 39 g/L
      Fibrinogen 2 - 4 g/L
Int: See entries for individual plasma proteins

ELISA (Enzyme Linked Immunosorbent Assay), Serum
RI: Absent
Ind: Wide range of diseases can be detected by specific ELISA tests including many bacterial and viral (eg. HIV, hepatitis) infections, parasites (eg. toxoplasma), allergens (eg. peanuts), coeliac disease, drugs (eg. cocaine,
antibiotics), hormones (eg. pregnancy, thyroid), autoimmune disease antibodies (eg. SLE)

Int: POSITIVE: Specific antigen or antibody present
Phys: The ELISA test is used to detect one of many different specific antibodies or antigens in a sample of serum

EMA
See Eosin-5-Maleimide, Blood OR Endomysial Antibodies, Serum

ENA
See Extractable Nuclear Antigen Autoantibodies, Serum

Endomysial (Endomesium) Antibodies, Serum [EMA]
RI: Absent
Ind: Coeliac disease
Int: PRESENT - Coeliac disease, dermatitis herpetiformis, cerebellar ataxia.
Phys: 10% false positive. More than one antibody test should be used to increase the sensitivity. 86% sensitivity and 100 % specificity. More associated with coeliac disease with diarrhoea (approximately 50% cases).
See also Gliaden Antibodies, Serum; Transglutaminase IgA Antibodies, Serum

Enolase, Serum
See Neurone Specific Enolase, Serum

Enzyme Linked Immunosorbent Assay, Serum
See ELISA, Serum

Eosin-5-Maleimide, Blood [EMA]
RI: Negative
Ind: Suspected hereditary spherocytosis.
Int: POSITIVE - Hereditary spherocytosis
Phys: Flow cytometric test which measures reduced fluorescence intensity of EMA labelled red blood cells. Can detect mild heterogenous forms of spherocytosis.
See also Osmotic Fragility

Eosinophils, Blood
RI: Adult: 0.02 - 0.5 x 10^9/L (20 - 500/mm^3) (1-6%)
Child: 0.1 - 1.4 x 10^9/L (100 - 1400/ mm^3)
Neonate: <2.0 x 10^9/L (<2000/ mm^3)

Ind: Determining nature and course of infection. Part of FBC
Int: V.HIGH - Carcinoma, eosinophilic leukaemia, hydatid disease
     HIGH - Allergy (IgE?), hay fever, asthma, eczema, infectious
     mononucleosis (monocytes?), psoriasis, scabies, polyarteritis nodosa,
     Hodgkin's disease, intestinal or hepatic worms, serum sickness,
     rheumatoid arthritis, dermatitis herpetiformis, polyarteritis nodosa,
     irradiation, pemphigoid, pemphigus, Churg-Strauss syn., Job-Buckley
     syn., Loeffler syn., drugs [eg. penicillin, aspirin, sulphonamides, gold,
     carbamazepine, iodides]
     LOW - Acute bacterial infections, hydrocortisone therapy

Epilim, Serum
See Sodium Valproate, Serum

EPP
See Electrophoretic Pattern of Plasma

Epstein-Barr Virus Immunoglobulin Antibodies, Serum [EBV]
RI: Negative.
Ind: Suspected infectious mononucleosis.
Int:  | IgG VCA | IgM VCA | IgG NA |
     | Not infected | Neg. | Neg | Neg. |
     | Acute early infection | Neg. | Pos. | Neg. |
     | Late acute infection | Pos. | Pos. | Pos. |
     | Post infection | Pos. | Neg. | Pos. |
     | or in 10% | Pos. | Neg. | Neg. |
     | False positive | Neg. | Pos. | Pos. |
Phys: Tests may take ten days or more from onset of symptoms to become positive. More specific test than IM Screen.
VCA = viral capsid antigen
NA = nuclear antigen
See also Infectious Mononucleosis Screen, Serum; Alanine Amino Transferase, Serum

Erythrocyte Count, Blood
(Red Blood Cell Count) [RBC] [RCC]
RI: Male 4.5 - 6.0 x 10^{12}/L
     Female 3.8 - 4.9 x 10^{12}/L
Ind: Haematological disorders
Int: **Abnormal number**
HIGH - Polycythaemia rubra vera, thalassaemia trait, renal disease (eg. tumours, cysts, transplant), dehydration, hypoxia, high altitudes, congenital heart disease, some lung diseases, hepatoma, Cushing syn., Gaisböck syn., idiopathic, smoking, diuretic therapy
LOW - Haemolytic anaemia, malignancy, chronic disease, aplastic anaemia, dilution by IV fluids, pregnancy

**Abnormal forms**
- Spherocytes - Hereditary, immune haemolytic anaemia (Coombs' test?), severe burns, Clostridium welchii septicaemia
- Elliptocytes - Hereditary, iron deficiency anaemia (Fe?)
- Sickle cells - Sickle cell disease
- Spur cells - Severe hepatic disease
- Target cells - Liver disease
- Burr cells - Renal disease
- Fragmented RBC - Disseminated intravascular coagulation, renal disease, Bassen-Kornzweig syn.

Phys: RBC carry Hb. Reticulocytes are the immature form

*See also* Haemoglobin; Mean Corpuscular Volume; Reticulocytes, Blood

**Erythrocyte Count, Urine**
*(Red Blood Cell Count, Urine)*

See Haematuria

**Erythrocyte Sedimentation Rate, Blood [ESR]**

RI:  Child <20 mm/hour (Westergren method)
- Male <10 mm/hour
- Female <20 mm/hour
- Elderly male <20 mm/hour
- Elderly female 5 - 45 mm/hour

Algorithm for calculating mean ESR in elderly:-
- Male mean ESR = Age in years/2
- Female mean ESR = (Age in years + 10)/2

Ind: May indicate hidden infection, inflammation or neoplasia.

Int: **V.HIGH** - Collagen diseases [eg. myeloma, polymyositis], Mycoplasma infection, leukaemia (FBC?), myelomatosis, myocardial infarct
- HIGH - Pregnancy, bacterial & viral infections (FBC?), localised acute suppurations, some neoplasms, TB, Hodgkin's disease, SLE, polymyalgia rheumatica, temporal arteritis, subacute bacterial endocarditis, anaemia, hyperfibrinogenaemia, hyperbilirubinaemia, thyroiditis, rheumatoid or reactive arthritis, Reiter's disease, Sjögren syn., vasculitis, dermatomyositis, rheumatic fever, Crohn's disease, sarcoidosis,
amyloidosis, end stage renal failure, drugs (eg. oral contraceptives, hydralazine, procainamide), obesity, smoking, idiopathic
FALSE LOW - Polycythaemia, sickle cells, hypochromic microcytic anaemia, congenital heart disease, technical errors, drugs [eg. NSAIDs, corticosteroids, clofibrate]
Phys: Two methods of determination:
Wintrobe - fall of level of cells against plasma in fine tube held vertically for 1 hour.
Westergren - more complex, but more accurate.
ESR depends on the concentration of macromolecules in plasma, especially fibrinogen. ESR faster with macromolecules present.
Nonspecific and inappropriate screening test
See also C-Reactive Protein, Serum; Spherocytes, Blood

Erythropoietin, Plasma
RI: 3 - 16 mIU/L
Ind: Erythrocyte abnormalities
Int: LOW - Polycythemia rubra vera, chronic renal failure
      HIGH - Secondary erythrocytosis, most anaemias
Phys: Differentiates primary from secondary erythrocytosis

ESR
See Erythrocyte Sedimentation Rate, Blood

Estimated Average Glucose, Blood [eAG]
RI: 5.4 to 8.6 mmol/L
Ind: Diabetes mellitus
Int: HIGH - Poorly controlled diabetes.
      LOW - Excessive diabetic medication
Phys: Designed to replace HbA1c in managing diabetes. RI corresponds to an
      HbA1c between 30 and 53 mmol/mol (5% and 7%).
      Converted from HbA1c percentage using the formula:
      eAG = [(HbA1c% x 28.7) - 46.7] / 18
      See also Glycosylated Haemoglobin, Blood

Estimated Glomerular Filtration Rate
See Glomerular Filtration Rate

Ethanol, Serum [C₂H₅OH]
RI: Zero
Ind: Suspected alcohol intoxication
Int: 0.05 g/100 mL (11 mmol/L) - Legally liable in some States
0.08 g/100 mL (17mmol/L) - Stuporous
0.3-0.5 g/100 mL (66-110 mmol/L) - Comatose
> 0.5 g/100 mL (> 110 mmol/L) - Potentially fatal
Phys: Ethanol is absorbed from the stomach and metabolised by the liver. In unchanged form, it is excreted from the kidneys at a fixed rate

Ethosuximide, Serum
(Zarontin)
RI: Therapeutic range 280 - 700 µmol/L (40 - 100 µg/mL)
Ind: Ethosuximide therapy
Int: Adjust dosage to keep serum levels within therapeutic range
Phys: Ethosuximide is used to treat epilepsy. Sample prior to next dose

ETR
See Effective Thyroxine Ratio

Extractable Nuclear Antigen Autoantibodies, Serum [ENA]
(Anti-Extractable Nuclear Antigens) [Anti-ENA]
RI: Titre < 10 or Absent
Ind: Connective tissue disease
Int: PRESENT - SLE (ANA?), scleroderma, Sjögren syn., rheumatoid arthritis, other connective tissue diseases, Raynaud's phenomenon, polymyositis/dermatomyositis.
SUBTYPES PRESENT :-
SS-A/Ro - Sjögren syn., SLE, neonatal lupus syndromes, some normal people.
SS-B/La - Sjögren syn., SLE, neonatal lupus syndromes.
Sm (Smith) - SLE.
Jo-1 - Polymyositis.
Scl-70 - Scleroderma.
U1-RNP - Mixed connective tissue disease, SLE.
Phys: The subtypes of ENA may be specific to different autoimmune diseases (DNA antibodies?).

See also Antinuclear Antibodies, Serum; Anti-Smith Antibodies, Serum; Jo-1 Antibodies, Serum

Factor 1
See Fibrinogen, Blood
Factor V Leiden Mutation, Serum
See Activated Protein C Resistance, Serum

Factor VIII, Blood
RI: Very wide variation in normal levels. Assay of the molecular components of factor VIII (a and c) may give a more accurate diagnosis, but interpretation is difficult and false positives and negatives occur. Consult with your local haematologist
Ind: Haemophilia, von Willebrand's disease
Int: Diagnosis of these diseases and the carrier state may be determined with careful analysis. Increased in pregnancy

Factor XIII Screen, Plasma
RI: Insoluble in urea
Ind: Congenital bleeding disorders
Int: Soluble in urea - Factor XIII deficiency
Phys: Plasma clot incubated for 12 hours in strong urea solution

Faecal Fat
See Fat, Faecal

Faecal Occult Blood
See Occult Blood, Faeces

FANA
See Antinuclear Antibodies, Serum

Fat, Faecal
RI: < 21 g/3 days (< 60 mmol/3 days)
Ind: Cachexia
Int: HIGH - Malabsorption syn., tropical sprue, afferent loop syn., coeliac disease, chronic pancreatitis, cystic fibrosis, lactose (milk) intolerance, short bowel syn., inadequate bile salts
**FBC**
See Full Blood Count

**FDP**
See Fibrin Degradation Products

**Fe**
See Iron, Serum; Iron, Urine

**FEP**
See Protoporphyrin, Free, Erythrocyte

**Ferritin, Serum**
RI: Male 20 - 320 µg/L  
    Female 15 - 300 µg/L  
    Neonate 50 - 350 µg/L  
Ind: Iron deficiency and excess states  
Int: LOW - Iron deficit, anaemia, chronic disease (eg. rheumatoid arthritis, renal failure), dialysis  
    HIGH - Haemochromatosis, overtransfusion, leukaemia, chronic inflammation, alcoholism, chronic infection, megaloblastosis, autoimmune diseases, iron overload, obesity, specimen haemolysis.  
    V.HIGH - Hodgkin's disease, acute and chronic hepatic disease, neoplasia  
Phys: Sensitive measure of total body iron by radio-immunoassay. Results usually lower in women. Normal result does not exclude iron deficiency or haemochromatosis. Therapeutic phlebotomy should be considered if S.ferritin exceeds 200 µg/L in those under 18 years and adult women, and if S.ferritin exceeds 300 µg/L in adult men and postmenopausal women.  
See also Iron, Serum; Soluble Transferrin Receptor, Serum

**Fetal Fibronectin Concentration, Cervical Swab [fFN]**
Ind: Complicated pregnancy  
Int: HIGH – Increased risk of premature labour  
Phys: Glycoprotein found at the maternal/fetal interface. Test reliable between 22 and 35 weeks of pregnancy.

**Fetal Haemoglobin**
See Haemoglobin F, Fetal
Fetomaternal Haemorrhage Testing, Blood [FMH]
RI: Nil
Ind: Rh– pregnancy
Int: HIGH - Fetomaternal haemorrhage present
Phys: Flow cytometry test using monoclonal antibodies. Determines dose of Anti-D immunoglobulin necessary. Proportion of fetal antibody labelled RBC in mother’s blood counted

FEV₁
See Forced Expiratory Volume in 1 Second

fFN
See Fetal Fibronectin Concentration, Cervical Swab

Fibrin Degradation Products, Blood [FDP]
RI: 0 - 10 µg/mL
Ind: Coagulation disorders
Int: V.HIGH - Disseminated intravascular coagulation, abruptio placentae
     HIGH - Venous thrombosis (thrombophlebitis), liver disease, bacterial infections, carcinomas, hyperfibrinolytic syn., haemolytic-uraemic syn., pulmonary embolism, pre-eclampsia, intrauterine fetal death, snake bite, stress
Phys: Breakdown products of clots
See also D-Dimer, Blood

Fibrin Degradation Products, Urine
RI: Mean 0.25 µg/mL
Ind: Renal disease
Int: HIGH - Disseminated intravascular coagulation, polycystic kidney disease, hydronephrosis, lupus nephritis, proliferative glomerulonephritis, renal transplantation, haemolytic-uraemic syn.
Phys: Useful for following progress of renal disease or transplant rejection
See also D-Dimer, Blood

Fibrin Derivatives
See D-Dimer, Blood
**Fibrinogen, Blood**  
*(Factor 1)*  
RI: 2 - 6 g/L  
Ind: Blood clotting anomalies  
Int: LOW - Defibrination syn., Waterhouse-Friderichsen syn., endotoxic shock, abruptio placentae, intrauterine fetal death, amniotic fluid embolism, disseminated intravascular coagulation  
HIGH - Nephrotic syn., Hodgkin’s disease, pemphigus, pulmonary embolism, pregnancy  
Phys: Fibrinogen is involved in the first stage of the blood clotting cycle  
*See also tests listed under Coagulation Screen*

**Fibronectin Concentration, Cervical Swab**  
See Fetal Fibronectin Concentration, Cervical Swab

**FISH**  
See Cytogenetics

**Fluid Deprivation Test, Urine Osmolality**  
RI: > 800 mOsmol/kg  
Ind: Polyuria  
Int: Urine osmolality under test conditions  
<table>
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<th>After dehydration</th>
<th>After desmopressin</th>
<th>Diagnosis</th>
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<td>&lt;300 mOsm/Kg</td>
<td>&gt;800 mOsm/Kg</td>
<td>Cerebral diabetes insipidus</td>
</tr>
<tr>
<td>&lt;300 mOsm/Kg</td>
<td>&lt;300 mOsm/Kg</td>
<td>Nephrogenic diabetes insipidus</td>
</tr>
<tr>
<td>&gt;800 mOsm/Kg</td>
<td>&lt;800 mOsm/Kg</td>
<td>Normal or polydipsia</td>
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Phys: Test used to determine presence of diabetes insipidus, and the cause of the disease. From 08.30 am, patient is banned from all fluid intake for 8 hours, but dry food is permitted. No coffee, tea, caffeine or smoking in preceding 12 hours is permitted. Patient is weighed regularly to assess degree of dehydration. Urine is passed hourly, and both volume and osmolality are measured. Desmopressin 2 µg IMI is administered at 4.30 pm, and patient is then allowed to take fluids, but only 50% more than amount passed during preceding 12 hours. Urine is collected for further 16 hours to measure osmolality

**Fluorescent Antinuclear Antibodies**  
See Antinuclear Antibodies, Serum
Fluorescent In-situ Hybridisation
See Cytogenetics

Fluorescent Treponemal Antibodies [FTA]
RI: Negative. Results are expressed as a titre (dilution of serum at which test is still positive)
Ind: Sexually transmitted disease
Int: POSITIVE - Syphilis, yaws
Phys: Antibodies specific for *Treponema pallidum* are detected in serum by adding fluorescein labelled anti-human gamma globulin. Antibodies form in the serum after infection with *T. pallidum*, and remain for many years to dormant infection in aqueous humour, CSF, etc. Thus the test may remain positive for many years after successful treatment. RPR & TPHA are better screening tests
See also Rapid plasma Reagin Test, Serum; *Treponema Pallidum Haemagglutination, Serum*
See also Investigations Section Three : Syphilis investigation chart

FMH
See Fetomaternal Haemorrhage

Foetal Haemoglobin
See Haemoglobin F, Fetal

Folate, Red Blood Cells
RI: 225 - 800 µg/L
Ind: Anaemia
Int: LOW - Elderly, infancy, poor diet, pregnancy and lactation, alcoholism, scurvy, kwashiorkor, tropical sprue, coeliac disease, malabsorption syndromes, Crohn's disease, partial gastrectomy, congestive cardiac failure, septicaemia, Whipple's disease, scleroderma, chronic haemolytic anaemias, carcinoma, multiple myeloma, leukaemia, myelofibrosis, TB, psoriasis, haemodialysis, active liver disease, malaria, prematurity, drugs [eg. barbiturates, oral contraceptive, trimethoprim, tetracyclines, nitrofurantoin, primidone, methotrexate]
FALSE LOW - Severe vit. B₁₂ deficiency
FALSE NORMAL - Blood transfusion, reticulocytosis
HIGH - Excess daily intake
Phys: Indication of total body folate. Less affected by diet. Stored primarily in liver
**Folate, Serum**
RI: 3.6 - 20 µg/L (7 - 40 nmol/L)
Ind: Anaemia
Int: As for Folate, Red Blood Cells
Phys: Serum folate reflects folate absorption in past week only

**Folic Acid, Red Blood Cell Concentration**
RI: > 318 nmol/L (> 140 ng/mL)
Ind: Anaemia
Int: LOW - Chronic alcoholism, oral contraceptives, anticonvulsants, malnutrition, sprue, sickle cell anaemia, cytotoxic drugs, pregnancy, malabsorption syndromes

**Folic Acid, Serum**
RI: 9.1 - 57 nmol/L (4 - 25 ng/mL)
Ind: Anaemia
Int: LOW - Chronic alcoholism, oral contraceptives, anticonvulsants, malnutrition, sprue, sickle cell anaemia, cytotoxic drugs, pregnancy, malabsorption syndromes
Phys: Essential for metabolism of cell nuclear materials. Low levels cause megaloblastic anaemia

**Follicle Stimulating Hormone, Serum [FSH]**
RI: Prepubertal <3 IU/L
Female follicular phase 3 - 20 IU/L
Female at ovulation 10 - 30 IU/L
Female luteal phase 3 - 15 IU/L
Postmenopausal 40 - 300 IU/L
Adult male 1 - 5 IU/L
Ind: Infertility
Int: LOW - Infertile [both sexes]
V.HIGH - Gonadal absence, failure or disease. Normally rises at mid-cycle in ovulating female
FSH<<LH - Stein-Leventhal syn.
LH/FSH ratio >2.5 - Insulin resistance
Phys: Pituitary hormone that acts with LH to stimulate ovulation and spermatogenesis. Feedback control by gonadal hormones
See also Luteinising Hormone, Serum

Pathology - 73
Forced Expiratory Volume in 1 Second [FEV₁]
RI:  84% ± 7%
M:  3.5 ± 1.5 L
F:  2.5 ± 1.0 L
Ind: Test of airway resistance
Int: LOW - Asthma or other lung disease (VC?)
Phys: FEV₁ is the percentage of vital capacity expelled by forced expiration in 1 second. Reduced by airway narrowing, by spasm or secretions. Measured by a spirometer

Free Thyroxine Index [FTI]
RI:  17 - 50
Ind: Thyroid dysfunction
Int: HIGH - Hyperthyroidism (T₃, T₄?)
LOW - Hypothyroidism (T₃, T₄?)
Phys: FTI = T₄ X T₃ uptake/100

Free Thyroxine Total [Free T₄]
See T₄ Serum (Total Thyroxine)

Fructosamine, Serum
RI:  Adult 200 - 290 µmol/L
     Child 200 - 260 µmol/L
     Pregnant 200 - 250 µmol/L
Ind: Diabetes control
Int: HIGH - Poorly controlled diabetes mellitus
Phys: Randomly timed specimens can give a good indication of control of diabetes, without reference to absolute blood glucose levels or dietary intake. Measure of integrated glucose concentration over preceding 10-15 days, and of glycosylated serum proteins
See also Glycosylated Haemoglobin, Blood

Fructose, Seminal Fluid
RI:  3.5 - 28 mmol/L
Ind: Infertility
Int: LOW - Ejaculatory duct obstruction, vesiculitis, Leydig cell deficiency (common at puberty), polyzoospermia, seminal vesicle obstruction
Phys: Fructose is the energy source for sperm. Low levels cause reduced sperm motility
FSH
See Follicle Stimulating Hormone, Serum

FTA
See Fluorescent Treponemal Antibodies

FTe
See Testosterone, Free, Serum

FTI
See Free Thyroxine Index

Full Blood Count [FBC]
(Complete Blood Examination [CBE]; Full Blood Examination [FBE])
This includes the following investigations: Haemoglobin; White Cell Count; MCV; MCH; MCHC; Haematocrit; Platelet Count; Red Cell Count

Full Blood Examination
See Full Blood Count

G-6-PD
See Glucose 6-Phosphate Dehydrogenase, Serum

GAD
See Glutamic Acid Decarboxylase Antibodies, Serum

Galactokinase, Red Blood Cells
RI: 18 - 40mU/g Hb
Ind: Juvenile onset cataract, galactosaemia
Int: LOW - genetic deficiency, increased risk of cataract
Phys: Radiometric assay. Familial
See also Galactose, Plasma
Galactose, Plasma
RI:  <1.0 mmol/L
Ind:  Galactosaemia
Int:  HIGH - Galactosaemia, galactose-1-phosphate deficiency
See also Galactokinase, RBC; Galactose-1-Phosphate, RBC

Galactose-1-Phosphate, Red Blood Cells
RI:  <170 nmol/g Hb
Ind:  Galactosaemia
Int:  V.HIGH (>500 nmol/g Hb) - Galactosaemia
      HIGH - Galactosaemia on galactose free diet
Phys:  Used to both diagnose and monitor severity of galactosaemia
See also Galactokinase, RBC; Galactose, Plasma

Gamma Glutamyl Transferase (Transpeptidase), Serum
[Gamma GT or GGT or SGGT]
RI:  Male < 45 U/L
      Female < 30 U/L
Ind:  Liver disease
Int:  GGT>100, ALT<80, ALP>200 - Cholestasis, intra or extrahepatic
      obstruction, cirrhosis, tumour, abscess, drug or alcohol toxicity, phenytoin
      overdose.
      GGT>100, ALT<80, ALP<200 - Excess alcohol, obesity, diabetes mellitus,
      fatty liver, hypertriglyceridaemia, obesity, genetic, drugs (eg. barbituates,
      phenytoin, warfarin, tricyclic antidepressants, benzodiazepines).
      GGT>100, ALT>80, ALP<200 - Hepatocellular disease, viral hepatitis,
      Epstein Barr virus infection, fatty liver, drug or alcohol toxicity.
      GGT>100, ALT>80, ALP>200 - Acute hepatitis, chronic active hepatitis,
      tumour, abscess, cirrhosis, drug or alcohol toxicity.
      GGT 40-100 - Pancreatitis, myocardial infarct, fatty liver, obesity, anorexia
      nervosa, porphyria, some renal diseases, renal carcinoma, idiopathic
      GGT >100, AST HIGH - Alcoholic liver disease
Phys:  Hepatic, renal and pancreatic enzyme, released with tissue damage.
See also Liver Function Tests

Gastric Cell Autoantibodies, Serum
See Parietal Cell Autoantibodies, Serum

Gastric Fluid Assay, Acid Output
RI:  <6 mEq/hour (24 - 29 mEq/L)
After histamine stimulation:
Males 10 - 40 mEq/hour
Females 5 - 30 mEq/hour

Ind: Peptic ulceration
Int: HIGH - Peptic ulcer tendency
Low after histamine - Pernicious anaemia, postvagotomy

Phys: Patients with duodenal ulcers have higher numbers of acid secreting parietal cells than normal

**Gastric Fluid Assay, pH**
(Gastric Fluid Acidity)
RI: 0.9 - 1.5
Int: HIGH - Pernicious anaemia (Vit.B\textsubscript{12}?), postvagotomy
LOW - Peptic ulcer tendency

**Gastrin, Serum**
RI: < 50 pmol/L (<90 ng/L)
Ind: Peptic ulceration
Int: HIGH - Gastric outlet obstruction, renal failure, short bowel syn., antral hyperplasia and ulceration, pernicious anaemia, atrophic gastritis, gastric cancer, postvagotomy, phaeochromocytoma
V.HIGH (> 250 pmol/L) - Zollinger-Ellison syn. (gastrinomas)

**Genetics**
See Cytogenetics

**Gentamicin, Blood**
See Aminoglycosides, Blood

**GFR**
See Glomerular Filtration Rate

**GGT**
See Gamma Glutamyl Transferase, Serum

**GHb**
See Glycosylated Haemoglobin, Blood
Glandular Fever
See Infectious Mononucleosis

Gliaden Antibodies, Serum
(Anti-Gliaden Antibodies)
RI:  < 25
Ind:  Coeliac disease, diet compliance
Int:  HIGH - Coeliac disease, 2% false positive rate
Phys:  ELISA assay of serum IgG and IgA anti-gliaden (gluten) antibodies.
       Antibodies return to normal when a strict gluten free diet followed
See also Endomysial Antibodies, Serum

Globulin, Serum
RI:  Total  20 - 35 g/L (24 - 60%)  
     alpha\textsubscript{1}  2 - 4 g/L (3 - 7%)  
     alpha\textsubscript{2}  4 - 8 g/L (5 - 11%)  
     beta  6 - 10 g/L (9 - 18%)  
     gamma  6 - 15 g/L (9 - 23%)
Ind:  A clotted specimen of blood is required
Int:  TOTAL LOW - Malnutrition, lymphatic leukaemia, immunodeficiency  
      alpha\textsubscript{1} LOW - Nephrotic syn.  
      gamma LOW - Nephrotic syn., multiple myeloma, lymphosarcoma,  
      leukaemia, Bruton syn., steroid therapy  
      TOTAL HIGH - Cirrhosis (bilirubin?), chronic hepatitis, hepatoma, malaria,  
      SLE (LE cells?), bile duct obstruction, typhus, multiple myeloma, elderly,  
      AIDS (HIV antibodies?)  
      alpha\textsubscript{1} HIGH - Oestrogen therapy, pregnancy  
      alpha\textsubscript{2} HIGH - Acute infections (albumin?), myocardial infarct, trauma,  
      nephrotic syn., Wilms' tumour  
      beta HIGH - Hypercholesterolaemia, cirrhosis, nephrotic syn.,  
      pregnancy, hypothyroidism  
      gamma HIGH - Infection, Sjögren syndrome, other connective tissue  
      diseases, cirrhosis, myeloma, lupus erythematosus
Phys:  Electrophoresis is used to separate the various protein fractions and a  
       pattern similar to the normal one below emerges
Glomerular Basement Membrane Autoantibodies, Blood
RI: Absent
Ind: Goodpasture syn.
Int: PRESENT - Goodpasture syn.
Phys: Radio-immunoassay

Glomerular Filtration Rate [GFR]
RI: Units: mL/minute/1.73 m²
   Male, 20 years 117 - 170
   Male, 50 years 96 - 138
   Male, 70 years 70 - 110
   Female, 20 years 104 - 158
   Female, 50 years 90 - 130
   Female, 70 years 70 - 114
   Pregnancy - Add 20%
Ind: Renal disease
Int: LOW - Renal failure, chronic kidney disease
     FALSE LOW - Significant trauma
Phys: GFR decreases by 1 mL/minute/year above age 35 years. Measured by variable means including insulin clearance, creatinine clearance (see separate entry), urea clearance (see separate entry) and radiopharmaceuticals. It may also be estimated using one of the following equations:-

COCKCROFT GAULT EQUATION
\[
GFR \text{ (mL/min)} = \frac{(140 - \text{age in years}) \times \text{weight in Kg.}}{814 \times \text{plasma creatinine in mmol/L}}
\]
Multiply by 0.85 for females.
Accurate over the range 10 to 100 mL/minute.
Not valid in pregnant, obese or oedematous patients.
Recommended for drug dosing regimes.

eGFR EQUATION
\[
eGFR = 186 \times (S.\text{creatinine} \times 0.0113) \times \text{age in years}
\]
Multiply by 0.742 for females.
Most readily available result.
Estimated glomerular filtration (eGFR) result may vary by up to 30% from actual value, but as it is easy to calculate, is often substituted for the GFR. eGFR is less accurate when renal function is changing rapidly, in vegetarians, in dialysis patients, in very thin or very fat patients and in significant liver disease. Asian, Aboriginal and Pacific Island populations tend to vary more from the normal GFR when using the eGFR than Caucasian or Negroid populations.

See also Creatinine, Serum

**Glucagon, Plasma**
RI: 25 - 250µg/L
Ind: Abnormal presentations of diabetes
Int: HIGH - Glucagonoma tumour of the pancreas, diabetes mellitus, some acute illnesses
Phys: Not a diagnostic test for glucagonoma unless clinical signs present. Overnight fast before test

**Glucose, Blood**
RI: 3.5 - 6 mmol/L (60 - 100 mg/100 mL)
(Fasting whole blood specimen)
Ind: Diabetes
Int: HIGH - Diabetes mellitus [>7.0 fasting diagnostic] (GTT?), infection (WCC?), hyperthyroidism (ETR?), hyperpituitarism, adrenal cortical excess, hepatic disease (LFT?), acromegaly, phaeochromocytoma, Leschke syn., Prader-Willi syn., Reaven syn., Turner syn., polyglandular autoimmune syn., hypokalaemia, burns, steroid therapy, recent meal LOW - Vomiting, diarrhoea, insulinoma, hyperinsulinism, adrenal insufficiency, hypopituitarism, Addison's disease, hypothyroidism (ETR?), severe hepatic disease (LFT?), hepatoma, alcoholism (GGT?), post-gastrectomy, von Gierke syndrome, Hers syndrome, Reye syndrome, unpreserved blood specimen, drugs [eg. insulin, laxatives, hypoglycaemic agents, diuretics]
Phys: Glucose in adequate levels is essential for normal body functions. Its level is controlled by the insulin released by the Islets of Langerhan in the pancreas. No food for 12 hours before test
See also Estimated Average Glucose; Glycosylated Haemoglobin, Blood; Glucose Tolerance Test

**Glucose, CSF**
RI: 2.1 - 4 mmol/L (40 - 100 mg/100 mL)
Ind: Cerebral disease
Int: LOW - Bacterial meningitis (chloride and protein, CSF?), TB, syphilis, insulin
HIGH - Postinfectious encephalitis, tumours, uraemia, diabetic coma

Glucose, Urine
RI: Absent
Ind: Diabetes
Int: POSITIVE - Diabetes mellitus, pregnancy, physical stress, congenital renal glycosuria, Fanconi syn., galactosaemia, alkaptonuria
Phys: Glucose levels in urine only proportional to that of serum provided no renal disease present

Glucose-6-Phosphate Dehydrogenase, Serum [G-6-PD]
RI: 6.0 - 11.0 U/gHb
Several systems of measurement
Varies between labs
Ind: Anaemia
Int: LOW - Normal in some Mediterranean Caucasians and some Asians, hereditary defect, drug induced haemolytic anaemia, drugs (eg. aspirin, primaquine, dapsone, nitrofurantoin)
HIGH – Artefact elevation with very high white cell or platelet count.
Phys: A lack of G-6-PD or its inactivation by drugs leads to anaemia. The enzyme may be lacking genetically

Glucose Tolerance Test [GTT]
RI: 75 g of glucose is given orally. The blood sugar level should not exceed 8 mmol/L (140 mg/100 mL) after 30 minutes, and should return to normal within 2 hours. No sugar should appear in the urine
Ind: Diabetes
Int: 
FASTING mmol/L  TWO HOURS mmol/L
Normal <6.1 <7.8
Impaired glucose tolerance <7.0 7.8-11.0
Impaired fasting glycaemia 6.1-6.9 <7.8
Diabetes mellitus >7.0 >11.1
Phys: Diabetic (and potential diabetic) patients do not produce adequate insulin to clear glucose from serum rapidly. Test may be impaired by diuretics, steroids, lithium, phenytoin, phenothiazines

Glutamic Acid Decarboxylase Antibodies, Serum [GAD]
RI: <0.9 U/mL
Ind: Diabetes
Int: HIGH - Type one diabetes mellitus, potential to develop type one diabetes mellitus, latent autoimmune diabetes in adults, autoimmune thyroid disease

Phys: Present in 70% of type one diabetics, and frequently in first degree relatives of patients, and others at risk of developing the disease. More commonly raised in early stages of disease

See also Anti-Tyrosine Autoantibodies, Serum

Glutamic Oxaloacetic Transaminase, Serum [SGOT]
See Aspartate Amino Transferase, Serum

Glutamic Pyruvic Transaminase, Serum [SGPT]
See Alanine Amino Transferase, Serum

Glutamine, Plasma
RI: 450 - 750 µmol/L
Ind: Hyperammonaemia
Int: HIGH - Genetic hyperammonaemia

Glycated Haemoglobin, Blood, Total Non-labile [HbA1]
RI: < 13% of Hb
Ind: Diabetic management
Int: HIGH - Above average normal glucose level (ie. diabetes, poorly controlled diabetic, noncompliance with therapy)
Phys: Alternative to Glycosylated Haemoglobin A1c (see below). Integrated measure of diabetic control over preceding 2-3 months

Glycosylated Haemoglobin, Blood [GHb or HbA1c]
RI: <42 mmol/mol (<6% of Hb as HbA1c) - not diabetic
   42 to 53 mmol/mo (6 to 7% of Hb as HbA1c) - good non-insulin dependent diabetic control
   42 to 64 mmol/mol 96 to 8% of Hb as HbA1c) - good insulin dependent diabetic control
   >82 mmol/mol (>9% of Hb as HbA1c) - poor diabetic control
Ind: Diabetic management
Int: HIGH - Above average normal glucose level (ie. diabetes, poorly controlled diabetic, noncompliance with therapy)
FALSE HIGH - Uraemia, beta thalassaemia
FALSE LOW - Haemolytic anaemia, spherocytosis, blood transfusion, blood loss, venesection

Phys: Glucose reacts with and attaches to Hb nonenzymatically. Index of compliance and efficacy of treatment as life cycle of erythrocyte is about 3 months. Should not be used in under this time for change of therapy. Inaccurate in conditions of shortened RBC lifespan (eg. haemolytic disease, blood loss). HbA1c percentage is not equivalent to average blood glucose. An approximate conversion formula from percentage HbA1c to blood glucose is:

Average blood glucose = (HbA1c x 2) - 6

*See also* Estimated Average Glucose, Blood; Glucose, Blood; Glycated Haemoglobin, Blood, Total Non-labile

**Growth Hormone, Serum**

RI:  
- Adult < 0.3 pg/mL
- Child > 1 pg/mL

Ind: Growth abnormalities

Int: LOW - Dwarfism
  - HIGH - Gigantism, acromegaly, stress

Phys: Growth hormone stimulates growth of all non-endocrine tissue. Produced by the anterior pituitary. Fasting specimen required. Insulin and glucose stress testing gives more accurate interpretation

**GTT**

See Glucose Tolerance Test

**Guthrie Test**

*(Heel-prick Test)*

RI: Negative

Ind: Standard neonatal test on day of birth.

Phys: Test invented in early 1960s by Dr. Robert Guthrie to screen for phenylketonuria. Now used as a routine test on all babies in developed countries to screen for a wide range of serious medical conditions using only a single drop of blood. Standard diseases covered by the test include phenylketonuria, cystic fibrosis, hypothyroidism (cretinism) and galactosaemia. Other diseases that may be covered in some countries include maple syrup urine disease, homocystinuria, tyrosinaemia, citrulinaemia, arginosuccinic aciduria, fatty acid oxidation defects, and organic acidaemia.
**Haematocrit**
See Packed Cell Volume

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**Haematuria**  
(RBC in Urine)

RI: < 1000 RBC/mL (< 1 RBC/HPF)

**Ind:** Urinary tract and renal disease

**Int:** HIGH - Glomerulonephritis, cystitis, prostatitis, urinary calculi, pyelonephritis, urinary tract neoplasms, renal papillary necrosis, trauma, foreign body, coagulopathies, TB, schistosomiasis, hydronephrosis, renal infarct, malignancy, hypertension, polycystic disease, nephrotic syn., SLE, PAN, haemolytic-uraemic syn., amyloidosis, Goodpasture syn., congenital haematuria, leukaemia, exercise stress, drugs (e.g. cyclophosphamide, warfarin, heparin, aspirin, carbidopa, phenytoin, metronidazole, phenothiazines)

False positive on dipstick test - Iodine contamination, oxidising agents in container, haemoglobinuria, myoglobinuria, peroxidase action of bacteria if sample not fresh

False negative on dipstick test - High urinary nitrate, high urinary vit. C

**Phys:** Causes of red urine that may be confused with haematuria include beetroot, urates, pyridium, phenindione, porphyria, phenolphthalein, vegetable dyes, haemoglobinuria

See also Symptoms section 1: Haematuria and Red Urine

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**Haemoglobin, Blood [Hb]**

RI:  
- Male 130 - 170 g/L (13 - 17 g/dL)
- Female 120 - 155 g/L (12 - 15.5 g/dL)
- Neonate 170 - 220 g/L (17 - 22 g/dL)
- Infant 110 - 125 g/L (11 - 12.5 g/dL)
- Child 120 - 140 g/L (12 - 14 g/dL)
- Pregnancy 110 - 150 g/L (11 - 15 g/dL)

**Ind:** Anaemia

**Int:** LOW - Acute or chronic blood loss, deficient RBC production (iron, copper, cobalt, vit. B12 or folic acid deficiencies), bone marrow failure (aplastic or sideroblastic anaemia, myelofibrosis), excess RBC destruction, thalassaemia, sickle cell anaemia, chronic disease (cancer, arthritis), renal disease, liver disease, coeliac disease, many types of carcinoma, rheumatoid arthritis, myxoedema, protozoal infections, autoimmune diseases, pregnancy, analgesic nephropathy, elite athletes

HIGH - Haemosiderosis, polycythaemia rubra vera, haemochromatosis, smoking, diuretics

FALSE HIGH - Hyperlipoproteinaemia, hyperbilirubinaemia, very high WCC
Phys: The Hb in RBC is essential for the transport of oxygen to the tissues.
   Measured by photometry

See also Iron, Serum; Mean Corpuscular Haemoglobin; Mean Corpuscular
   Haemoglobin Concentration; Mean Corpuscular Volume; Copper, Serum;
   Cyanocobalamin, Serum

See also investigations listed under Full Blood Count

Haemoglobin, Glycated
See Glycated Haemoglobin, Blood, Total Non-labile

Haemoglobin, Glycosylated
See Glycosylated Haemoglobin, Blood

Haemoglobin, Oxygen Affinity, Blood
RI: p50 0₂ - 3.4 - 3.8 kPa (25-29 mmHg)
Ind: Erythrocytosis, abnormal oxygen transport
Int: LOW - Haemoglobinopathy causing increased oxygen affinity, decreased
   release of oxygen to tissues
   HIGH - Decreased oxygen affinity, increased release of oxygen to tissues
Phys: p50 0₂ is the partial pressure of oxygen at which Hb is 50% saturated

Haemoglobin, Urine
See Haematuria

Haemoglobin A₂, Blood [HbA₂]
RI: 1.5 - 4% of total Hb
Ind: Suspect thalassaemia
Int: HIGH - Thalassaemia trait

Haemoglobin F, Blood [HbF]
(Fetal Haemoglobin) (Kleihauer Test)
RI: At birth 10.5 - 14 mmol/L (17 - 22.5 g/100 mL)
   Adult < 1% of total Hb (negative Kleihauer test)
Ind: Anaemia and blood abnormalities
Int: HIGH - Marrow overactivity, transplacental haemorrhage
Phys: Normal Hb found in the fetus and during early infancy. Its formation may
   continue abnormally in infancy as a result of any type of anaemia that
   causes marrow overactivity
**Haemoglobin H, Blood [HbH]**
RI: Negative
Ind: Thalassaemia
Int: POSITIVE - HbH Thalassaemia major or minor (Haemoglobin H disease)
Phys: Care in preparing sample essential, as HbH tends to precipitate out of red cell lysates easily. HbH in affected patients may vary from 5 to 40% of total Hb

**Haemoglobin M, Blood [HbM]**
RI: Absent
Ind: Chronic cyanosis
Int: PRESENT - Inherited methaemoglobinaemia

**Haemoglobin S, Blood [HbS]**
RI: Absent
Ind: Haemolytic anaemia
Int: PRESENT - Sickle cell anaemia, some types of thalassaemia

**Haemolysis Index, Blood [HI]**
RI: <100mg/L
Ind: Quality control of blood test results
Int: HIGH – Haemolysis of blood sample that may render results of electrolytes, AST, LD etc. inaccurate
Phys: A measure of the free haemoglobin concentration associated with haemolysis of collected blood sample

**Haemosiderin, Urine**
RI: Absent
Ind: Chronic anaemia
Int: PRESENT - Intravascular haemolysis
Phys: Haemoglobin degraded to haemosiderin in kidney

**Haemoximetry**
See Carbon Dioxide, Blood; Carboxyhaemoglobin B, Serum; Haemoglobin, Oxygen Affinity, Blood; Methaemoglobin, Blood; Oxygen, Blood; Sulphaemoglobin, Blood
Ham Test
See Acidified Serum Test

Haptoglobin, Blood
RI: 0.3 - 2.0 g/L
Ind: Haemolysis, inflammation
Int: LOW - Severe intravascular haemolysis, megaloblastic anaemia, liver disease (LFT?), congenital
      HIGH - Most acute inflammatory conditions (ESR?), biliary obstruction, pregnancy, steroids, oestrogen supplements
      FALSE NORMAL - Acute pancreatitis
Phys: An alpha2-globulin that binds free Hb in blood stream

Hb
See Haemoglobin, Blood

HbA1
See Glycated Haemoglobin, Blood, Total Non-labile

HbA1c
See Glycosylated Haemoglobin, Blood

HbF
See Haemoglobin F, Fetal

HbH
See Haemoglobin H, Blood

HbM
See Haemoglobin M, Blood

HbS
See Haemoglobin S, Blood
HCG
See Chorionic Gonadotrophin, Human, Beta, Serum; Chorionic Gonadotrophin, Human, Urine

HCO₃⁻
See Bicarbonate, Serum

HDL
See High Density Lipoprotein Cholesterol, Blood

Heaf Test
See Tuberculin Skin Test

Heavy Metals
See Arsenic; Cadmium; Copper; Lead; Manganese; Mercury

Heel-prick Test
See Guthrie Test

Heinz Bodies, Blood
RI: Absent
Ind: Anaemia
Int: PRESENT - Intravascular haemolysis, post-splenectomy, G-6-PD deficiency, haemoglobinopathies, drug or chemical exposure
Phys: Heinz bodies created by oxidation of Hb. Seen by microscopy as red cell inclusions

Helicobacter pylori Antibodies, Serum
RI: Negative
Ind: Peptic ulcer
Int: POSITIVE - Presence of H. pylori in stomach highly likely
Phys: H. pylori implicated in the causation of peptic ulcers and can be eradicated by triple therapy (eg. bismuth subcitrate, metronidazole, tetracycline)
See also Carbon-14 Urea Breath Test; CLO Test
Hepatitis A, Serum Antigens and Antibodies
RI: Nil
Ind: Hepatitis, jaundice
Int: IgM anti-HAV POSITIVE - Hepatitis A
Phys: See Investigations section 3
See also Immunoglobulin Antibodies, Specific, Serum

Hepatitis B, Serum Antigens and Antibodies
RI: Nil
Ind: Suspected hepatitis B, persons engaged in an at risk lifestyle
Int: See graph below

Viral antigens
Hepatitis B surface antigen (HBsAg)
Hepatitis Be antigen (HBeAg)

Viral antibodies
Hepatitis B surface antibody (anti-HBs)
Hepatitis B core antibody (anti-HBc)
Hepatitis Be antibody (anti-HBe)

Phys: For as long as HBsAg is detectable, the patient's blood and other bodily fluids are infectious for hepatitis B. The presence of HBeAg indicates very rapid viral replication. The presence of antiHBs signifies recovery or successful immunisation with seroconversion.

See also Immunoglobulin Antibodies, Specific, Serum

Hepatitis C, Serum Antigens and Antibodies
See Investigations section 3: Hepatitis C
See also Immunoglobulin Antibodies, Specific, Serum

**Hepatitis D, Serum Antigens and Antibodies**
See Investigations section 3: Hepatitis D

**Hepatitis E, Serum Antigens and Antibodies**
See Investigations section 3: Hepatitis E

**HER-2/neu**
See Human Epidermal Receptor 2 neu, Breast Tissue

**Herpes Simplex Antibody, Serum [HSV]**
RI: Negative
Ind: Genital herpes
Int: POSITIVE IgG - Current or previous infection
      POSITIVE IgM - Current infection
Phys: Separate antibody tests for type one and two Herpes simplex available from most laboratories
See also Immunoglobulin Antibodies, Specific, Serum

**Hess Test**
See Signs section 2: Hess Test

**Hexosamine, Serum**
RI: 80 - 125 mg/100 mL
Ind: Suspected tissue damage. Poor wound healing
Int: HIGH - Presence of inflammatory reaction
Phys: Rises to a peak 3 days after tissue injury, and returns to normal after 7-10 days. Essential for wound healing

**HI**
See Haemolysis Index, Blood

**5 HIAA**
See 5-Hydroxyindole Acetic Acid, Urine with numerical entries at beginning of this section
High Density Lipoprotein Cholesterol, Blood [HDL]
RI:  Male 0.9 - 2.0 mmol/L  
     Female 1.0 - 2.2 mmol/L
Ind:  Obesity, high total cholesterol
Int:  LOW - Increased risk of atherosclerosis and coronary artery disease,  
      Reaven syn., pregnancy  
      HIGH - Lower risk of atherosclerosis
Phys: Ratio of total cholesterol:HDL cholesterol is best prognostic marker.  
      Should not exceed 4.5; the higher the ratio, the poorer the prognosis
See also Apolipoproteins, Serum; Cholesterol, Serum; Low Density Lipoprotein Cholesterol, Blood

Histidyl-tRNA Synthetase Antibodies, Serum
See Jo-1 Antibodies, Serum

Histocompatibility Antigen
See HLA-B27, Serum; HLA-DR2, Serum; HLA-DR3, Serum; HLA-DR4, Serum

Histone Autoantibodies, Blood
RI:  Absent
Ind:  SLE
Int:  PRESENT - Drug induced SLE
See also LE Cells, Blood; Lupus Anticoagulant Antibody, Serum

HIV-1 RNA
See HIV Viral Load, Serum

HIV Antibody, Serum
(Human Immunodeficiency Virus Antibody)  
(HTLV-3 Antibody)
RI:  Negative
Ind:  High risk individuals; possible exposure to HIV
Int:  POSITIVE - AIDS, lymphadenopathy syn., exposure to HIV
Phys: May be positive in subclinical, potential and dormant cases of AIDS. Test  
      is for presence of antibody, not the presence of HIV. May take <= 3  
      months from contact to become positive
See also Investigations section 3: Acquired Immune Deficiency Syndrome
HIV Viral Load, Serum [HIV-1 RNA]  
(Human Immunodeficiency Virus-1 RNA)  
RI: Method dependent  
Ind: Monitoring progress of HIV infection  
Int: RISING LEVEL - Increasing HIV activity  
      DECREASING LEVEL - Good response to treatment

HLA-B27, Serum  
(Human Leucocyte Antigen Histocompatibility Antigen)  
RI: Negative  
Ind: Rheumatic diseases  
Int: POSITIVE - Ankylosing spondylitis, reactive arthritis (Reiter's disease),  
      psoriatic arthropathy, juvenile chronic polyarthritis, postinfective arthritis,  
      inflammatory bowel disease, acute anterior uveitis, 5% of normal people,  
      of prognostic significance in children  
Phys: Large percentage of false negatives possible. Useful for matching donors  
      in organ transplantations

HLA-DR2, Serum  
(Human Leucocyte Antigen Histocompatibility Antigen DR2)  
RI: Negative  
Ind: Sleep disorders  
Int: POSITIVE - Narcolepsy (99% of sufferers), 25% of normal population

HLA-DR3, Serum  
(Human Leucocyte Antigen Histocompatibility Antigen DR3)  
RI: Negative  
Ind: Autoimmune diseases  
Int: POSITIVE - SLE, Sjögren syn., Addison's disease, chronic hepatitis,  
      coeliac disease, myasthenia gravis, Grave's disease  
Phys: Expensive and performed in specialised laboratories only  
      See also LE Cells, Blood; Lupus Anticoagulant Antibody, Serum

HLA-DR4, Serum  
(Human Leucocyte Antigen Histocompatibility Antigen DR4)  
RI: Negative  
Ind: Arthritis  
Int: POSITIVE - Rheumatoid arthritis
HMMA
See 4-Hydroxy-3-Methoxy Mandelic Acid, Urine

HOMA Index
See Insulin Resistance

Homocysteine, Serum
RI: 0.5 - 2.2 nmol/mL
Ind: Family history of myocardial or cerebral infarct
Int: HIGH - Homocysteinaemia, atherosclerosis, increased risk of thrombotic events such as myocardial or cerebral infarct, folate deficiency, lack of vitamin B6 or B12.
Phys: Cystathionine beta-synthase deficiency causes congenital atherosclerosis. Detected by measuring homocysteine which is an abnormal metabolite. Metabolic pathway may be additionally stressed by methionine loading. Excess homocysteine damages the vascular endothelium.
See also Cholesterol, Serum

Homogentisic Acid, Urine
RI: Negative
Ind: Alkaptonuria
Int: PRESENT - Alkaptonuria
Phys: Increasing levels diagnostic

Homovanillate, Urine [HVA]
(4-Hydroxy-3 Methoxyphenylacetate)
RI: Adult <5.5 umol/nmol creatinine
Considerable variation between labs
Ind: Brain tumours
Int: HIGH - Neuroblastoma, ganglioneuroma
Phys: Serial levels useful in monitoring progress of tumour

Howell-Jolly Bodies, Blood
RI: Absent
Ind: Noted if present on microscopy in full blood count
Int: PRESENT - Splenectomy, megaloblastic anaemia, leukaemia, iron deficiency anaemia
Phys: Due to nuclear remnants
See also White Cell Count

**HSV Antibodies**
See *Herpes Simplex* Antibodies, Serum

**HTLV-3 Antibody, Serum**
See HIV Antibody, Serum

**Human Chorionic Gonadotrophin**
See Chorionic Gonadotrophin, Human, Beta, Serum; Chorionic Gonadotrophin, Human, Urine

**Human Epidermal Receptor 2 neu, Breast Tissue [HER-2/neu]**
RI: IHC (immunohistochemical) method:
   - <1+ staining intensity normal
   - 2+ staining intensity equivocal
   - 3+ staining intensity positive
   - FISH (fluorescent in situ hybridisation) method:
     - 2.2 ratio normal
     - >2.2 ratio abnormal
Ind: Breast cancer
Int: HIGH - Increased risk of developing metastatic disease
Phys: Test targets gene located on chromosome 17. Test is positive in 30% of breast cancers. Patients with increased risk may be suitable for treatment with specific monoclonal antibodies.
See also *Cancer Associated Antigens 15-3 and 549, Serum; Carcinoembryonic Antigen, Serum*

**Human Leucocyte Antigen**
See HLA-B27, Serum; HLA-DR2, Serum; HLA-DR3, Serum; HLA-DR4, Serum

**Human Placental Lactogen**
See Placental Lactogen, Human, Serum

**HVA**
See Homovanillate, Urine
Hydatid Antibodies, Blood
RI: Absent
Ind: Hydatid disease
Int: PRESENT - Past or current hydatid infection
Phys: Test remains positive long term after infection

Hydrogen Ion
See pH, Serum

4-Hydroxy-3-Methoxy Mandelic Acid, Urine [HMMA]
See numerical entries at beginning of this section

Hydroxybutyrate, Plasma
RI: <1.2mmol/L
Ind: Metabolic acidosis
Int: HIGH - Ketosis, poorly controlled diabetes mellitus, starvation, alcoholism, hyperinsulinism
Phys: More accurate measure of acidosis than ketones
See also Ketones, Blood

17-Hydroxy Steroids, Serum
See Steroids, 17-Hydroxy, Serum

5-Hydroxyindole Acetic Acid, Urine [5 HIAA]
See numerical entries at beginning of this section

Hydroxyproline, Urine
RI: <35mmol/mol creatinine/2 hours
Ind: Assessment of bone resorption
Int: HIGH - Osteoporosis, Paget’s disease of bone, bone cancer
Phys: Timed two hour urine collection after overnight fast. No gelatin (eg. meat, jelly, ice cream) for 24 hours before test
See also C-Terminal Telopeptide, Serum; N-Telopeptide, Cross Linked, Urine
Hydroxyproline/Creatinine Ratio, Urine
RI:  <0.02
Ind:  Pathological fractures, postmenopause
Int:  HIGH - Paget’s disease of bone, hyperparathyroidism, osteomalacia, hyperthyroidism, postmenopausal osteoporosis, renal failure, severe fracture
Phys: Measure of bone resorption and calcium loss. Calcium supplementation lowers ratio postmenopausally

25-Hydroxyvitamin D, Blood
See numerical entries at beginning of this section

IA2
See Insulinoma Associated 2 Antibodies, Serum

IBC
See Iron Binding Capacity, Total, Serum

Ig
See Immunoglobulins, Serum

IGF-1, Serum
(Insulin Growth Factor-1, Somatomedin C)
RI:  Under 5 years : 2 – 18 nmol/L
      5 to 15 years : 5 – 60 nmol/L
      15-25 years :15 – 60 nmol/L
      25 to 45 years : 10 – 50 nmol/L
      Over 45 years : 5 – 30 nmol/L
Ind:  Acromegaly
Int:  HIGH - Acromegaly (growth hormone?), gigantism
      LOW - Laron dwarfism, protein malnutrition
Phys: Results vary markedly with age as shown in graph below. Peptide produced in liver and kidney that stimulates synthesis of DNA & RNA in bone and cartilage.
Immunoglobulin G, CSF [IgG]
RI: Adult 5 - 45 mg/L
Child 8 - 64 mg/L
Ind: Meningitis
Int: HIGH - Viral infection

Immunoglobulin Antibodies, Specific, Serum
RI: Negative
Int: IgG & IgM ANTIBODY NEGATIVE - No exposure or too early to detect in acute phase
IgG ANTIBODY POSITIVE, IgM ANTIBODY NEGATIVE - Past exposure to infective agent
IgG & IgM ANTIBODY POSITIVE - Current or recurrent infection
IgG ANTIBODY NEGATIVE, IgM ANTIBODY POSITIVE - Very early acute phase or false positive IgM
Phys: Most infective agents create antibodies within 2 weeks of infecting an individual, but HIV, syphilis, Q fever and Legionella may take up to 2 months. For immune status, only IgG needs to be tested

See also Epstein-Barr Virus Immunoglobulin Antibodies, Serum

Immunoglobulin A tTG Antibodies, Serum
See Transglutaminase IgA Antibodies, Serum

Immunoglobulins, Serum [Ig]

<table>
<thead>
<tr>
<th>RI:</th>
<th>Adult</th>
<th>10yrs</th>
<th>5yrs</th>
<th>1yr</th>
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</thead>
<tbody>
<tr>
<td>IgA</td>
<td>0.6-3.7</td>
<td>0.5-2.4</td>
<td>0.2-1.5</td>
<td>0.1-1.1</td>
</tr>
<tr>
<td>IgG</td>
<td>6.5-16</td>
<td>6.0-16</td>
<td>4.6-12</td>
<td>3.5-12</td>
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<tr>
<td>IgM</td>
<td>0.5-2.8</td>
<td>0.5-2.4</td>
<td>0.4-2.0</td>
<td>0.4-2.7</td>
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<tr>
<td>IgE</td>
<td>&lt;100</td>
<td>&lt;200</td>
<td>&lt;60</td>
<td>&lt;15</td>
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</tbody>
</table>

Units for IgA, IgG, IgM are g/L
Units for IgE are IU/mL

Ind: Liver disease, paraproteinaemia

Int: ALL HIGH - Acute viral hepatitis
IgA and IgG HIGH - Laennec's cirrhosis
IgG HIGH - Chronic acute hepatitis, viral infection, myelomatosis, SLE, Lassa fever, IgG4-related systemic disease
IgM HIGH - Primary biliary cirrhosis, viral infection, trypanosomiasis, nephrotic syn., Waldenström's macroglobulinaemia
IgA HIGH - Buerger's disease
IgE HIGH - Extrinsic asthma, atopic eczema, allergic rhinitis (RAST?), allergic conjunctivitis, aspergillosis, parasitic diseases, myeloma, bullous pemphigoid, Job-Buckley syn.
IgA LOW - Intestinal disease, respiratory infections, drugs (eg. phenytoin, penicillamine)
IgM LOW - Septicaemia
IgG LOW - Nephrotic syn., hypogammaglobulinaemia, infancy
IgE LOW - Hypogammaglobulinaemia
ALL LOW - Bruton syn.

Phys: Immunoglobulins possess antibody activity. They are composed of two heavy (A, G, M, D or E) and two light chains. They form part of the gammaglobulin protein factor. Significant number of false high and low results with IgE

See also Bilirubin, Serum; Alanine Amino Transferase, Serum; Aspartate Amino Transferase, Serum; Radioallergosorbent Test, Serum

Infectious Mononucleosis Screen, Serum
(Epstein-Barr Virus; Glandular Fever)
RI: Negative
Ind: Suspect infectious mononucleosis
Int: POSITIVE - Infectious mononucleosis
Phys: Specific agglutination test
See also Epstein-Barr Virus Antibodies, Serum

Influenza Antibodies, Serum
See Immunoglobulin Antibodies, Specific, Serum

INR
See International Normalised Ratio - Prothrombin

Insulin, Plasma
RI: < 19 mIU/L (< 0.9 µg/L) fasting
50 - 130 mIU/L 1 hour after 75 g glucose
< 100 mIU/L 2 hours after 75 g glucose
Ind: Diabetes mellitus, insulinoma
Int: Low after glucose - Diabetes due to lack of insulin, malnutrition
      HIGH - Diabetes due to tissue unresponsiveness to insulin, insulinoma, Reaven syn., pregnancy
Phys: Insulin essential for the uptake and utilisation of glucose by tissue.
      Collected after 15 hour fast and during GTT
See also Glucose, Blood

Insulin Growth Factor-1, Serum
See IGF-1, Serum
Insulin Resistance [HOMA Index]
[Homeostasis Model Assessment Index]
RI: HOMA Index <2
Ind: Cardiovascular disease, diabetes risk.
Int: HOMA Index 2 to 2.2 borderline
HOMA Index 2.2 to 3 moderate insulin resistance
HOMA Index >3 severe insulin resistance
Phys: HOMA Index = [(mean of 3 fasting insulins in mIU/L) X (fasting glucose in mmol/L)] / 22.5
High insulin resistance leads to high levels of insulin in the serum in most patients, affecting many organs and biochemical functions other than glucose metabolism. These effects may include diabetes mellitus type 2, ovarian abnormalities, reduced testosterone in men and increased testosterone in women, hypertension, abnormal endothelial function, low HDL cholesterol, high triglycerides, increased apoliporotein B, increased fibrinogen, microaluminuria, hyperuricaemia etc.
See also Glucose, Blood; Insulin, Plasma; Follicle Stimulating Hormone, Serum

Insulinoma Associated 2 Antibodies, Serum [IA2]
See Anti-Tyrosine Autoantibodies, Serum

Intercellular Cement Substance Autoantibodies, Blood
(Pemphigus Autoantibodies)
RI: Absent
Ind: Blistering rash
Int: PRESENT - Pemphigus, extensive burns, skin drug reactions
Phys: Regular measurement of titre can be used to follow disease activity

Interferon Beta Neutralising Antibodies, Blood
RI: Absent
Ind: Failure to respond to interferon beta treatment for multiple sclerosis
Int: POSITIVE - Development of antibodies to interferon beta.
Phys: Antibodies bind to interferon beta and prevent it from binding to target receptors. Blood sample collected 9 to 15 hours after interferon beta injection.

International Normalised Ratio - Prothrombin [INR]
(Prothrombin Ratio)
RI: 0.9 - 1.1
Ind: Control of anticoagulant therapy
**Pathology - 101**

**Int:** Modify dose of warfarin to maintain ratio within desired therapeutic range
- 1.5 - 2.5 - Transient ischaemic attacks, CVA, atrial fibrillation
- 2.0 - 3.0 - Deep venous thromboses, pulmonary embolism, heart valve disease, transplanted animal heart valves, cardiomyopathy, myocardial infarct, postoperative prophylaxis (eg. after hip replacement)
- 2.5 - 3.5 - Mechanical heart valves
- 4 - 7 - Increased risk of significant haemorrhage. Cease warfarin for a few days.
- > 8 - Significant risk of serious haemorrhage. Cease warfarin for several days and use vitamin K to reverse effect of warfarin.

**Phys:**
\[ \text{INR} = \frac{\text{Patient prothrombin time}}{\text{Control prothrombin time}} \]

**Intrinsic Factor Autoantibodies, Blood**
**RI:** Absent
**Ind:** Anaemia
**Int:** PRESENT - Pernicious anaemia
**Phys:** Negative result does not exclude diagnosis
*See also Cyanocobalamin, Serum*

**Iron, Marrow Transit Time**
**RI:** Mean 3.5 days
**Ind:** Iron deficiency anaemia

**Iron, Serum [Fe]**
**RI:** Male 12 - 35 µmol/L
Female 10 - 28 µmol/L
**Ind:** Anaemia
**Int:**
- LOW - Iron deficiency anaemia (MCV, MCHC?), dietary deficiency, malabsorption, chronic bleeding, infections, Hodgkin's disease, chronic inflammatory disorders, malignancy, elderly, bleeding peptic ulcer, bleeding haemorrhoids, bowel cancer, coeliac disease, menorrhagia, gastrectomy, pregnancy, scurvy, trauma, elite athletes
- HIGH - Other anaemias, gastrointestinal bleeding (faecal blood?), liver necrosis, haemochromatosis, haemosiderosis, beta-thalassaemia, alcoholism (GGT?), iron therapy
**Phys:** Iron is essential for the formation of Hb. Iron is actively absorbed in the duodenum. Its absorption may be reduced by phosphates and sprue. Collect specimen in morning to avoid false low reading
*See also Ferritin, Serum; Haemoglobin, Blood; Iron Binding Capacity, Total, Serum; Soluble Transferrin Receptor, Serum; Zinc Protoporphyrin, Blood*
Iron, Urine [Fe]
RI: 50 - 400 µg/24 hours
Int: Variation from normal is rare

Iron Binding Capacity, Total, Serum [IBC, TIBC]
RI:
- Male 45 - 70 µmol/L (250 - 380 µg/100 mL)
- Female 44 - 74 µmol/L (245 - 400 µg/100 mL)
Ind: Anaemia
Int:
- HIGH - Late pregnancy, iron deficiency anaemia (transferrin?)
- LOW - Chronic infection, rheumatoid arthritis, cancer, liver cirrhosis, nephrotic syn., haemochromatosis
Phys: The total iron binding capacity is related to plasma transferrin levels

Iron Clearance, Blood
RI: Half-life 60 - 140 minutes
Ind: Iron deficiency anaemia

Iron Studies
<table>
<thead>
<tr>
<th></th>
<th>Iron</th>
<th>IBC</th>
<th>Transferrin Sat.</th>
<th>Ferritin</th>
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<tr>
<td>Iron deficit</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>L</td>
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<tr>
<td>Iron excess</td>
<td>H</td>
<td>N</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Acute phase response</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>

See also Ferretin, Serum; Iron, Serum; Iron Binding Capacity; Transferrin saturation

Iron Turnover, Blood
RI: 70 - 140 µmol/L/day
Ind: Iron deficiency anaemia

Iron Utilisation, Blood
RI: 70 - 80% per fortnight
Ind: Iron deficiency anaemia

Islet Cell Autoantibodies, Blood
RI: Absent
Ind: Diabetes mellitus
Int: PRESENT - Type I (insulin dependent) diabetes mellitus, close relatives of diabetic patients, other autoimmune diseases (false positive)
Phys: Titre decreases slowly after initial onset of disease. May predict potential to develop diabetes mellitus

**Isoenzymes**
See Lactate Dehydrogenase Isoenzymes, Serum; Creatine Kinase Isoenzymes, Serum

**Jo-1 Antibodies, Serum**
*(Histidyl-tRNA Synthetase Antibodies)*
RI: Negative
Ind: Polymyositis
Int: POSITIVE - Polymyositis with interstitial lung disease and thrombocytopenia
Phys: Defines a specific subset type of polymyositis
*See also Extractable Nuclear Antigen Antibodies, Serum*

**K**
See Potassium, Serum; Potassium, Urine

**Ketones, Blood**
RI: 0.02 - 0.5 mmol/L (0.1 - 3 mg/100 mL)
Int: See Ketones, Urine
*See also Hydroxybutyrate, Plasma*

**Ketones, Urine**
RI: Nil
Ind: Diabetes mellitus
Int: HIGH - Diabetic ketoacidosis (B.glucose?), urinary tract infection (U.M/C/S?), starvation, vomiting, dehydration, general anaesthesia, strenuous exercise, cold exposure
Phys: Ketones formed in liver are normally completely metabolised. Altered carbohydrate metabolism causes accumulation and appearance in urine

**Kidney**
See Renal Function Tests; Renal Calculi
Kleihauer Test
See Haemoglobin F

Kveim Test, Skin
(Kveim-Siltzbach Test)
RI: Negative
Ind: Sarcoidosis
Int: POSITIVE - Sarcoidosis
Phys: Heat treated suspension of spleen sarcoidosis extract is injected intradermally. Site biopsied 1 month later; 80% show sarcoid-like lesions. 5% false positive

Lactate, Blood
(L-Lactate, Blood)
RI: Venous blood 0.3 - 1.3 mmol/L
      Arterial blood 0.3 - 0.8 mmol/L
Ind: Metabolic disorders
Int: HIGH - Lactic acidosis, diabetes mellitus, congestive cardiac failure, hypoxia, shock, other metabolic disturbances
Phys: Fasting blood sample necessary

Lactate, CSF
RI: 1.2 - 2.8 mmol/L
Ind: Meningitis
Int: HIGH - Bacterial and cryptococcal meningitis, severe cerebral hypoxia
Phys: Levels do not rise with viral meningitis. Very early sign in bacterial meningitis

Lactate Dehydrogenase, Serum [LD or LDH]
RI: 120 - 230 U/L
Ind: Myocardial infarct
Int: V. HIGH (>4000 U/L) - Metastatic malignancy, pernicious anaemia.
      HIGH - Myocardial infarct (CK, troponin?), myocarditis, congestive cardiac failure (CK, AST?), muscle damage (eg. from trauma or extreme exercise), RBC destruction (Hb?), kidney damage (S.creatinine), pulmonary infarct or embolism, pneumonia, infectious hepatitis (LFT?), other hepatic diseases, other serious infections, polycythaemia rubra vera, autoimmune diseases (eg. SLE, rheumatoid arthritis, dermatomyositis), megaloblastic anaemia,
leukaemia, lymphoma, other malignancy, seminoma, muscular dystrophy, muscle necrosis, paracetamol overdose, haemolysed blood specimen

Phys: LDH is present in all cells, but particularly red blood cells, heart, liver and muscle cells, and is released from them when they are damaged. Rises over 3-4 days after damage, and declines to normal over following 5-7 days.

See also Creatine Kinase, Serum

Lactate Dehydrogenase Isoenzymes, Serum
RI: \[ \text{LDH}_1 < 65 \text{ IU/L} \]
\[ \text{LDH}_2 < 120 \text{ IU/L}, \]
\[ \text{LDH}_3 < 785 \text{ IU/L} \]
\[ \text{LDH}_4 < 20 \text{ IU/L} \]
\[ \text{LDH}_5 < 20 \text{ IU/L} \]
Ind: Raised total LDH, myocardial infarct, liver disease
Int: \[ \text{LDH}_1 \text{ HIGH - Myocardial infarct, haemolytic anaemia, other red blood cell disorders, some muscle dystrophies, nephritis, germ cell tumours, vigorous exercise, in vitro haemolysis} \]
\[ \text{LDH}_2 \text{ HIGH - Lung diseases, significant infections (eg. septicaemia, infectious mononucleosis), congestive cardiac failure, lymphoma, vigorous exercise.} \]
\[ \text{LDH}_3 \text{ HIGH - Lung disease, lymphoma, infectious mononucleosis, spleen disorders.} \]
\[ \text{LDH}_4 \text{ HIGH - Placental disorders, choriocarcinoma.} \]
\[ \text{LDH}_5 \text{ HIGH - Skeletal muscle or liver damage or disease, vigorous exercise.} \]

Phys: Human serum contains 5 distinct isoenzymes of LDH which differ from each other in their electrophoretic mobility and their tissue source.

See also Lactate Dehydrogenase, Serum

Lactogen, Human Placental
See Placental Lactogen, Human, Serum

Lactose Tolerance Test
RI: Rise in B.glucose < 1.0 mmol/L after lactose challenge
Ind: Food intolerance, diarrhoea
Int: B.GLUCOSE RISES > 1.0 mmol/L - Lactose intolerance, false positive result
Phys: 50 g of lactose given to patient who has fasted overnight. B.glucose measured at 30 minute intervals for 3 hours. Rise in B.glucose indicates low or absent lactase activity. False positive rate about 25%
Lanoxin, Serum
See Digoxin, Serum

Largactil, Serum
See Chlorpromazine, Serum

Latex Agglutination, Blood
RI: 0 - 60 IU/mL
Ind: Connective tissue disease
Int: V.HIGH - Rheumatoid arthritis (FANA, CRP, rheumatoid factor?), Sjögren syn.
      HIGH - SLE, polyarteritis, polymyositis, liver disease, viral infection, 5% of normal people
Phys: More sensitive for rheumatoid arthritis than rheumatoid factor, but more false positives. Normal levels do not exclude rheumatoid arthritis. Agglutination of specifically sensitised latex particles measured

LATS
See Long Acting Thyroid Stimulator Antibody, Serum

LCR
See Ligase Chain Reaction, Urine

LD or LDH
See Lactate Dehydrogenase, Serum

LDL
See Low Density Lipoprotein Cholesterol, Blood

LE Cells, Blood
(Lupus Erythematous Cells)
RI: Absent
Ind: Autoimmune disease
Int: PRESENT - SLE (ANA?), scleroderma, rheumatoid arthritis, chronic active hepatitis
Phys: Test now anachronistic and has been replaced with ANA test.
Lead, Plasma [Pb]
RI: < 1.2 µmol/L (<200µg/L)
Int: 1.3 – 1.9µmol/L - Retest adults three monthly, risk of mental damage in children
      1.9 – 2.4µmol/L - Retest adults monthly, check sources of exposure
      > 2.4µmol/L - Remove adults from exposure, treat children with chelation therapy
Phys: 95th. percentile for whole population is <0.8µmol/L
See also Lead, Urine; Protoporphyrins, Free, Erythrocte

Lead, Urine
RI: 5 - 105 µg/24 hours (< 0.5 µmol/L) (< 0.25 µmol/day) (<80µg/L)
Ind: Lead poisoning, monitoring of occupational exposure to organic lead
Int: HIGH - Lead poisoning, overexposure to lead
Phys: May be caused by ingestion (eg. old paint, battery workers) or inhalation (eg. exhaust fumes from leaded petrol) of lead. Treated with EDTA. Pregnant and breast feeding women should not work with lead
See also Lead, Plasma

Lecithin-Sphingomyelin Ratio, Amniotic Fluid [L-S Ratio]
RI: < 2:1
Ind: Assessment of fetal maturity
Int: HIGH (> 2:1) - Fetal lung mature
      LOW (< 2:1) - Fetal lung not mature (P.oestriols?)
Phys: Lecithin from the fetal lung is produced in increasing quantities in relation to sphingomyelin after 34 weeks of gestation
See also Alpha-Fetoprotein, Amniotic Fluid; Alpha-Fetoprotein, Serum; Oestriols, Plasma; Phosphatidyl Glycerol, Amniotic Fluid

Legionella Antibodies, Serum
See Immunoglobulin Antibodies, Specific, Serum

Leptospira Antibodies, Serum
See Immunoglobulin Antibodies, Specific, Serum
Leucocytes
See White Cell Count, Blood; White Cell Count, Urine

LFT
See Liver Function Tests

LH
See Luteinising Hormone, Serum

Ligase Chain Reaction, Urine [LCR]
RI: Negative
Ind: Sexually transmitted or pelvic inflammatory disease, cervicitis, conjunctivitis
Int: POSITIVE - *Chlamydia trachomatis* infection
Phys: May also be applied to a swab from affected area

Lipase, Serum
RI: 0.2-1.5 IU/L
Ind: Pancreatic disease
Int: HIGH - Acute pancreatitis (amylase?), pancreatic duct obstruction, perforated bowel, bowel infarction, acute cholecystitis, renal failure, diabetic ketoacidosis, coeliac disease, HIV infection, drugs (eg. frusemide, cholinergics, narcotics, oral contraceptives, thiazides)
Phys: Pancreatic lipase is released into the blood with pancreatic damage. Remains elevated for longer than amylase in pancreatitis

Lipids, Total Plasma
RI: After fasting 12 hours, 400 - 600 mmol/L
Ind: Obesity, hypertension
Int: HIGH - Hyperlipidaemia, atherosclerosis, diabetes, hypothyroidism
Phys: Specific type of hyperlipidaemia is determined by measuring the cholesterol and triglyceride components of the total plasma lipids
See also Cholesterol, Serum; Triglycerides, Serum

Lipoprotein A, Serum [LP(A)]
RI: <300mg/L.
Ind:  Cardiovascular disease or bad family history
Int:  HIGH - Increased risk of cardiovascular disease such as myocardial infarct

*See also* Apolipoproteins, Serum; High Density Lipoprotein Cholesterol, Blood; Low Density Lipoprotein Cholesterol, Blood

**Lipoproteins**

*See Apolipoproteins, Serum; High Density Lipoprotein Cholesterol, Blood; Lipoprotein A, Serum; Low Density Lipoprotein Cholesterol, Blood; Very Low Density Lipoprotein Cholesterol, Blood*

**Lithium, Serum**

RI:  Therapeutic range 0.5 - 1 mmol/L
Ind:  Lithium therapy
Int:  Adjust dosage to keep serum levels within therapeutic range
Phys:  Sample 12 hours after last dose

**Liver Function Tests [LFT]**

Phys: 

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>ALT</th>
<th>AST</th>
<th>GGT</th>
<th>ALP</th>
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<tbody>
<tr>
<td>Viral hepatitis</td>
<td>+++</td>
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<td>N/+</td>
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<tr>
<td>Drug induced hepatitis</td>
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<td>Chronic active hepatitis</td>
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<td>Primary biliary cirrhosis</td>
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<td>Hepatoma</td>
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</table>

See Albumin, Serum; Alkaline Phosphatase, Serum; Alanine Amino Transferase, Serum; Aspartate Amino Transferase, Serum; Gamma Glutamyl Transferase, Serum; Bilirubin, Serum; Immunoglobulins, Serum; Protein, Serum, Total

**L-Lactate, Blood**

See Lactate, Blood

**Long Acting Thyroid Stimulator Antibody, Serum [LATS]**

RI:  Negative
Ind:  Thyroid disease
Int:  POSITIVE - Hyperthyroidism
Phys: May be normal in up to 40% of cases of thyrotoxicosis
See also other Thyroid Function Tests

**Low Density Lipoprotein Cholesterol, Blood [LDL]**
RI:  < 3.0 mmol/L  
Ind:  High total cholesterol  
Int:  HIGH - Increased risk of arteriosclerosis, heart disease and cerebrovascular disease (HDL?)  
Phys: Ratio between total cholesterol and LDL important  
See also Apolipoproteins, Serum; Cholesterol, Serum; High Density Lipoprotein Cholesterol, Blood; Lipoprotein A, Serum  

**LP(A)**
See Lipoprotein A, Serum  

**L-S Ratio**
See Lecithin-Sphingomyelin Ratio, Amniotic Fluid  

**Lung Function Tests**
See Forced Expiratory Volume in 1 Second; Vital Capacity, Lungs; Peak Expiratory Flow Rate  

**Lupus Anticoagulant Antibody, Serum**
(Lupus Inhibitor)
RI:  Nil  
Ind:  Suspected SLE, recurrent abortions  
Int:  POSITIVE - SLE, recurrent thromboembolism, other autoimmune diseases, neoplasia, recurrent abortions, antiphospholipid syn. (see Syndromes section 6)  
Phys: Autoantibody to cardiolipin which inhibits intrinsic and extrinsic clotting pathways  
See also ANA, Serum; ANCA, Serum; Anti-DNA, Serum; Anti-Smith Antibodies, Serum; Cardiolipin Autoantibodies, Blood; Complement C3 and C4; DNA Autoantibodies; ENA, Serum; Histone Autoantibodies, Blood; HLA-DR3, Serum; LE Cells, Blood  

**Lupus Erythematosus Cells**
See LE Cells, Blood
Luteinising Hormone, Serum [LH]
RI: Prepubertal 1 - 3.4 IU/L
   Male 2 - 9 IU/L
   Female follicular phase 4 - 30 IU/L
   Female ovulating 40 - 200 IU/L
   Female luteal phase 4 - 30 IU/L
   Postmenopausal 30 - 200 IU/L
Ind: Menstrual disorders, infertility
Int: LOW - Infertile, hypogonadism
     HIGH - Ovulation, precocious puberty, Stein-Leventhal syn. (FSH?)
     LH >> FSH - Imminent ovulation, impeded ovulation, polycystic ovarian
     syn. (Stein-Leventhal syn.).
Phys: Released from the pituitary gland under regulation by the posterior
     hypothalamus. Responsible for ovulation and corpus luteum formation in
     the female, and stimulates Leydig cells and production of androgens in the
     testes
See also Follicle Stimulating Hormone, Serum; Testosterone, Serum

Lyme Disease Antibodies, Serum
See Immunoglobulin Antibodies, Specific, Serum

Lymphocytes, Blood
RI: 1.0 - 3.0 x 10^9/L (1,000 - 3,000/mm³) (20 - 40%)
Ind: Infection, blood disorders
Int: HIGH (normal forms) - Chronic infection, TB, syphilis, pertussis, infectious
     lymphocytosis, chronic lymphocytic leukaemia
     HIGH (abnormal forms) - Infectious mononucleosis (P. Bunnell?),
     measles, acute lymphatic leukaemia, cytomegalovirus, toxoplasmosis,
     rubella, hepatitis, brucellosis, typhoid fever, bacterial endocarditis, serum
     sickness, other viral infections
     LOW - Stress, trauma, haemorrhage (Hb?), gross infection, Hodgkin's
     disease, AIDS, irradiation, TB, cytotoxic drugs, elderly
Phys: Lymphocytes migrate freely between lymph nodes and blood. They enter
     the blood stream via the thoracic duct. Antigenic challenge produces an
     increase in the number of specific small normal form lymphocytes.
See also Basophils; Neutrophils; Full Blood Count

Lymphocytye CD Types
See T Cell Lymphocytes, Blood
Lyssavirus Antibody Enzyme Immunoassay, Serum
RI: Negative (<0.5 IU/L)
Ind: Rabies exposure
Int: POSITIVE - Rabies, other lyssavirus infections, post-vaccination for rabies
Phys: Numerous lyssaviruses exist that cause rabies and similar diseases
(eg: Australian bat lyssavirus infection)

Macrocytosis
See Mean Corpuscular Volume

Magnesium, Faeces [Mg]
RI: <45mmol/L (<15mmol/d)
Ind: Unexplained diarrhoea
Int: HIGH - Abuse of laxatives containing magnesium, hypomagnesaemia due to gut loss of Mg

Magnesium, Serum [Mg]
RI: 0.7 - 1.0 mmol/L (1.7 - 2.3 mg/100 mL)
        Neonate 0.6 - 0.9 mmol/L
Ind: Renal disease
Int: HIGH - Chronic renal failure, excess magnesium containing antacids, therapeutic
        LOW - Renal tubular defects, chronic alcoholism, hyperaldosteronism, hepatic cirrhosis, malabsorption syn., diarrhoea, hypercalcaemia, hypoparathyroidism (eg. parathyroidectomy), diabetic ketoacidosis, malnutrition, vomiting, prolonged intravenous therapy, Bartter disease, drugs (eg. diuretics, amphotericin, aminoglycosides, laxatives, cisplatin, cytotoxics)
Phys: Magnesium is an important intracellular cation that is filtered by the kidneys. Low levels can cause cardiac arrhythmias. Co-factor to at least 300 body enzymes. Serum levels do not relate well to intracellular levels.

Magnesium, Urine [Mg]
RI: 2.5 - 8.0 µmol/day (20 - 180 mg/day)
Int: LOW - Malabsorption syn., severe body fluid loss, alcoholism, diabetic acidosis, hepatic cirrhosis, primary aldosteronism, chronic renal failure
Manganese, Blood
RI: 140 - 220 nmol/L
Ind: Manganese poisoning
Int: HIGH - Manganese poisoning
Phys: Beware of sample contamination

Manganese, Urine
RI: <3µmol/L
Ind: Manganese poisoning
Int: HIGH - Manganese poisoning

Mantoux Test
See Tuberculin Skin Test

Marijuana
See Tetrahydrocannabinol, Urine

Marrow Cells, Bone
RI:
- Sideroblasts 40 - 60%
- Neutrophils 7 - 30%
- Eosinophils 0.5 - 4%
- Basophils <0.7%
- Lymphocytes 3 - 17%
- Myeloblasts 0.5 - 5%
- Metamyelocytes 13 - 30%
- Megakaryocytes <3%
- Plasma cells 3 - 5%
- Monocytes 0.5 - 5%
- Normoblasts 7 - 32%
- Myelocytes 5 - 22%
- Promyelocytes 1 - 8%
- Pronormoblasts 1 - 8%
- Reticular cells 0.1 - 2%
Note: Adult values only for all above
Ind: Abnormal peripheral blood smear
Int: ABNORMAL - Agranulocytosis, aplastic anaemia, haemolytic anaemia, leukaemias, osteogenic sarcoma, cytotoxic and immunosuppressive drugs, myelomatosis, Hodgkin's disease, myeloproliferative disorders, visceral leishmaniasis
- Sideroblasts Low - Iron deficiency
Phys: For further details consult a more detailed text

**Mazzotti Test**
RI: Negative  
Ind: Onchocerciasis  
Int: POSITIVE - Onchocerciasis  
Phys: Onchocerciasis is a filarial worm that infects the skin of patients in Africa, Arabia and Central America. The test involves giving the patient diethylcarbamazine 50 mg and watching for signs of rash, itch and lymphadenitis caused by death of the worms. Should only be used where other screening tests have failed as severe reactions may occur.

**MCH**  
See Mean Corpuscular Haemoglobin

**MCHC**  
See Mean Corpuscular Haemoglobin Concentration

**MCV**  
See Mean Corpuscular Volume

**Mean Corpuscular Haemoglobin [MCH]**
RI:  
- Adult: 27 - 31 pg  
- Child: 24 - 30 pg  
- Neonate: 24 - 34 pg  
Ind: Anaemia  
Int:  
- LOW - Iron deficiency (Fe?), chronic blood loss, sprue, achlorhydria, pregnancy, thalassaemia, sideroblastic anaemia, megaloblastic anaemia  
- HIGH - Pernicious anaemia (vit.B₁₂?), folic acid deficiency, starvation, reticulocytosis (FBC?), hypothyroidism (ETR?), aplastic anaemia  
Phys: Useful to determine type of anaemia  
MCH = Hb/RBC  
See also Haemoglobin; Mean Corpuscular Haemoglobin Concentration; Mean Corpuscular Volume

**Mean Corpuscular Haemoglobin Concentration [MCHC]**  
RI: 315 - 345 g/L (31 - 34%) (18.6 - 21.2 mmol/L)
Int: LOW - Iron deficiency (Fe?), blood loss, pregnancy, thalassaemia, anaemias of chronic disease, sideroblastic anaemia
NORMAL - Other anaemias
Phys: In iron deficiency, there is less Hb in each RBC
\[ \text{MCHC} = \frac{\text{Hb}}{\text{PCV}} \]
See also Haemoglobin; Mean Corpuscular Haemoglobin; Mean Corpuscular Volume

**Mean Corpuscular Volume [MCV]**
RI: Adult 82 - 101 fL (82 - 101 cubic microns)
     Child 73 - 89 fL (73 - 89 cubic microns)
     Neonate 85 - 106 fL (85 - 106 cubic microns)
Ind: Anaemia
Int: V.LOW - Iron deficiency (Fe, MCHC?), chronic blood loss, pregnancy, chronic disease (eg. rheumatoid arthritis)
     LOW (microcytosis) - Acute blood loss, haemolytic anaemia, bone marrow neoplasia, sideroblastic anaemia, thalassaemia trait, elderly
     HIGH (macrocytosis) - Pernicious anaemia (vit. B12), alcoholism, folic acid deficiency, sprue, starvation, reticulocytosis, aplastic anaemia, hypothyroidism, liver disease, hyperlipidaemia, scurvy, sideroblastic anaemia, leukaemia, megaloblastic anaemia, chronic respiratory failure, myelomatosis, cytotoxic drugs
Phys: Useful to determine type of anaemia
\[ \text{MCV} = \frac{\text{PCV}}{\text{RBC}} \]
See also Haemoglobin; Mean Corpuscular Haemoglobin; Mean Corpuscular Haemoglobin Concentration

**Measles Antibodies, Serum**
See Immunoglobulin Antibodies, Specific, Serum

**Melaena**
See Occult Blood, Faeces
See also Symptoms section 1: Melaena and Rectal Bleeding

**Mercury, Blood [Hg]**
RI: < 10 µg/L
IND: Occupational exposure to organic mercury e.g. preservatives in paints and in agriculture. Ingestion of contaminated fish. Blood is the recommended specimen for measuring methylmercury poisoning
INT: HIGH – Overexposure to mercury, mercury poisoning
See also Mercury, Urine
Mercury, Urine [Hg]
RI: < 0.2 µmol/day or mercury:creatinine ratio < 5 µg/g
Ind: Mercury poisoning. Urine is the recommended specimen for measuring inorganic mercury poisoning. Occupational exposure to inorganic mercury (eg. pesticides, antiseptics, germicides); mercury containing devices (eg. thermometers, dental amalgam fillings)
Int: HIGH - Mercury poisoning (Minamata disease), overexposure to mercury
See also Mercury, Blood

Metadrenalines, Urine
See Metanephrine, Urine

Metanephrine, Urine
(Metadrenalines, Urine)
RI: < 5 µmol/day (age dependent)
Ind: Hypertension
Int: HIGH - Phaeochromocytoma, neuroblastoma, ganglioneuroma, drug interference
Phys: Metabolite of catecholamines excreted in urine
See also U.HMMA, U.catecholamines, S.catecholamines, MIBG scan.

Methaemoglobin, Blood
RI: < 0.1% of total Hb
Infants < 1.5% of total Hb
Ind: Cyanosis
Int: HIGH - Poisoning by oxidant drugs (eg. sulfonamides, nitrates, nitrites, aniline dye)
Phys: Poison causes haemolysis and cyanosis

Mg
See Magnesium, Serum; Magnesium, Urine

MIBG Scan
RI: Negative
Ind: Suspected phaeochromocytoma
Int: POSITIVE – Phaeochromocytoma, carcinoid tumour
Phys: Iodine 131-labelled metaiodobenzylguanidine scintigraphy. Complex standards must be met in performance of this definitive test. Gamma camera images must be interpreted by well trained expert. 

*See also* U.HMMA, *U.catecholamines*, *S.catecholamines*, *U.metanephrine*

**Microalbumin**
See Albumin, Urine

**Microcytosis**
See Mean Corpuscular Volume

**Microglobulin, Beta-2**
See Beta-2 Microglobulin, Serum

**MIH**
See Anti-Müllerian Hormone, Serum

**Milk, Breast**
See Breast Milk Analysis

**Mitochondrial Autoantibodies, Serum [AMA]**
RI: Negative
Ind: Liver disease
Int: HIGH - Primary biliary cirrhosis (?LFT), chronic active hepatitis

**Monocytes, Blood**
RI: 0.2 - 1.0x 10⁹/L (200 - 1000/mm³) (2 - 10%)
Ind: Infection
Int: LOW - Chronic infection, brucellosis, subacute bacterial endocarditis, malaria, rickettsial infection, cytotoxic drugs
HIGH - TB, some acute and chronic bacterial infections, carcinoma, acute monocyctic leukaemia, glandular fever, malaria, Hodgkin's disease, splenectomy
Phys: Helps to determine the nature and course of infection

*See also* Lymphocytes, Blood; Neutrophils, Blood; White Cell Count, Blood
**Müllerian Inhibiting Hormone, Serum**
See Anti-Müllerian Hormone, Serum

**Myocardial Autoantibodies, Blood**
RI: Absent
Ind: Myocarditis
Int: PRESENT - Dressler syn. (see Syndromes section 6), postcardiotomy syn., autoimmune myocarditis, cardiac surgery, cardiac infarct, heart trauma
Phys: Nonspecific test of myocardial damage

**Myocardial Infarct Markers**
See Aspartate Amino Transferase, Serum; Lactate Dehydrogenase, Serum; Creatine (Phospho) Kinase, Serum; Myoglobulin, Serum; Troponin T, Serum

**Myoglobin, Serum**
RI: Male < 70 µg/L
     Female < 50 µg/L
Ind: Myocardial infarct
Int: HIGH - Myocardial infarct
Phys: Rises within 2-4 hours of an infarct. Should not be used as a late marker, as it is rapidly cleared from blood stream
See also Troponin T, Serum

**Myoglobin, Urine**
RI: Absent
Ind: Muscle damage, haemoglobinuria
Int: PRESENT - Any significant muscle trauma, rhabdomyolysis, electric shock, snake bite, myopathies, hypokalaemia
Phys: Insensitive test, not able to detect most myocardial infarcts. May be used to differentiate confusion with Hb in urine

**Mysoline, Serum**
See Primidone, Serum

Na⁺
See Sodium, Serum; Sodium, Urine

NAP
See Neutrophil Alkaline Phosphatase, Blood

Narcotics
See Opiates, Urine

Natriuretic Peptide, Serum
See B-type Natriuretic Peptide, Serum

Neonatal Screen
Phys: Screening tests for galactosaemia (P.galactose), phenylketonuria (B.phenylalanine), cretinism (hypothyroidism - S.thyrotropin receptor antibodies) and cystic fibrosis (B.trypsin)

Neurone Specific Enolase, Serum
RI: <12µg/L
Ind: Monitoring specific cancers
Int: RISING LEVEL - Progress of small cell lung carcinoma or neural crest tumour
Phys: Not a screening or diagnostic test

Neutrophil Alkaline Phosphatase, Blood [NAP]
RI: 30 - 180. See Phys.
Ind: Abnormal blood film
Int: HIGH WCC, HIGH NAP - Bacterial infection, other causes of reactive leucocytosis
      HIGH WCC, LOW NAP - Chronic leukaemia
      HIGH RCC, HIGH NAP - Polycythaemia rubra vera
      HIGH RCC, LOW NAP - Other causes of erythrocytosis
      U.Hb, HIGH NAP - Haemolytic anaemia, hypoplastic anaemia
      U.Hb, LOW NAP - Paroxysmal nocturnal haemoglobinuria
Phys: 100 neutrophils in capillary blood film examined by microscopy. Dye intensity of cells compared, and scored on a basis of 0 for no dye, 1 for light dye, 2 for medium dye, 3 for heavily dyed, and 4 for very heavily dyed. Score added, to give a NAP value between 0 and 400. Test useful for differentiating cause of high WCC or high RCC
See also Erythrocyte Count, Blood

Neutrophils, Blood
RI:  
  Adult: 2.1 - 7.0 x 10^9/L (2,100 - 7,000/ mm^3) (40 - 80%)  
  Child: 1.6 - 9.0 x 10^9/L (1,600 - 9,000/ mm^3)  
  Neonate: 4.5 - 12 x 10^9/L (4,500 - 12,000/mm^3)
Ind: Infection  
Int: V.HIGH - Pneumococcal pneumonia, lung abscess, disseminated carcinoma  
HIGH (neutrophilia) - Bacterial infections, rabies, actinomycosis, some viral infections (eg. Herpes zoster), severe inflammation anywhere in body (eg. infarction, arthritis, dermatitis), haemorrhage, haemolysis, malignancy, myeloproliferative disease, splenectomy, pregnancy, burns, trauma, physical stress, drugs (eg. lithium, corticosteroids)  
LOW (neutropenia) - Viral infection (eg. infectious mononucleosis, HIV), severe bacterial infection (eg. pneumonia, cellulitis, septicaemia), typhoid, hepatitis, TB, brucellosis, aspergillosus, starvation, vit. B\textsubscript{12} and folic acid deficiencies, acute leukaemia, lymphosarcoma, aplastic anaemia, Gaucher's disease, SLE, rheumatoid arthritis, haemodialysis, myelodysplasia, hypersplenism, Chediak-Higashi syn., Diamond-Blackfan syn., Felty syn., irradiation, drugs (eg. cytotoxics, NSAID, sulphonamides, captopril, penicillin)  
Hypersegmentation - Renal disease, vit. B\textsubscript{12}/folate deficit, cytotoxic iron deficit, sideroblastic anaemia, leukaemia, hereditary, very high neutrophil count  
Phys: Rate of entry of neutrophils to circulation can be increased by certain stimuli. Once reserves in marrow are depleted, blood levels may drop markedly

See also Basophils, Blood; Lymphocytes, Blood; Monocytes, Blood; Eosinophils, Blood

Neutrophil Cytoplasmic Antibodies, Serum
See Anti-Neutrophil Cytoplasmic Antibodies, Serum

Nicotine, Serum
RI:  < 0.006 mg/L  
Ind: Determination of smoking status  
Int: HIGH - Smoker, passive smoker  
Phys: Plasma half-life of nicotine averages 40 minutes

See also Carboxyhaemoglobin B, Serum; Cotinine, Serum
Nicotinic Acid, Serum
See Vitamin B₃

Nitrite, Urine
RI: Negative
Ind: Cystitis or pyelonephritis
Int: POSITIVE - Urinary tract infection (eg. Pseudomonas), chronic renal failure
Phys: Certain bacteria, when in high concentration in urine, metabolise nitrates in urine to nitrites, thus indicating their presence

Noradrenaline
See Catecholamines, Plasma; Catecholamines, Urine

Nordin Test, Blood and Urine
RI: Phosphate excretion 0.06 - 0.2 mmol/L or glomerular filtrate
Index of phosphate excretion −0.16 to +0.16
Ind: Abnormal calcium levels. Hyperparathyroidism
Int: HIGH - Excessive parathyroid hormone activity, hyperparathyroidism, PTH excreting adenoma
Phys: Tested in conjunction with serum and urine calcium and phosphate, and renal function tests

Nortriptyline, Serum
RI: Therapeutic range 60 - 240 µg/L (150 - 880 nmol/L)
Phys: Several weeks may be required to reach steady state due to long half-life

N-Telopeptide, Cross-Linked, Urine [NTX]
RI: Negative
Ind: Osteoporosis
Int: POSITIVE - Osteoporosis (hydroxyproline?), Paget's disease, malignancy, inflammatory disease, steroid therapy
Phys: Ntx is a fragment of bone collagen which is released with bone resorption
See also Bone Mineral Density; C-Terminal Telopeptide, Serum; Hydroxyproline, Urine
**NTX**
See N-Telopeptide, Cross-Linked, Urine

**Occult Blood, Faeces**
RI: Negative
Ind: Suspected gut bleed
Int: See table below

<table>
<thead>
<tr>
<th>CHEMICAL TEST</th>
<th>IMMUNO CHEMICAL</th>
<th>INTERPRETATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Negative</td>
<td>Upper gastrointestinal bleed (eg: oesophageal varices, gastric or duodenal ulcer etc.)</td>
</tr>
<tr>
<td>Positive</td>
<td>Positive</td>
<td>Lower gastrointestinal bleed (eg: rectal carcinoma, polyps, ulcerative colitis etc.)</td>
</tr>
<tr>
<td>False Positive</td>
<td>Negative</td>
<td>Certain foods (see Physiology below)</td>
</tr>
</tbody>
</table>

Phys: Chemical test detects haem molecule, while immunochemical test detects only intact Hb, allowing differentiation between upper and lower gastrointestinal tract bleeds. No red meat, cauliflower, broccoli, turnips, bananas or radishes for 3 days before test as these may interfere with chemical test. Three tests on consecutive days are necessary.

See also Symptoms section 1: Melaena and Rectal Bleeding

**Oestradiol, 17beta, Plasma**
RI: Male < 300 pmol/L
Female follicular stage 70 - 530 pmol/L
Female midcycle 230-1300 pmol/L
Female luteal phase 200 - 800 pmol/L
Menopausal < 120 pmol/L

Ind: Ovulatory status
Int: LOW - Anovulatory, prepubertal, postmenopausal

**Oestriols, Plasma**
RI: 32 weeks 145 - 800 nmol/L
34 weeks 170 - 1040 nmol/L
36 weeks 230 - 1400 nmol/L
38 weeks 300 - 1560 nmol/L
40 weeks 350 - 1600 nmol/L

Ind: Suspect fetal welfare
Int: Repeated tests necessary, single test of little value. The level should rise steadily as the pregnancy progresses. If no rise noted, or levels drop, fetal distress is likely (L-S ratio, AFP?). Low level may be due to Down syn. (see Investigations section 3)
Phys: Oestriols are produced by a chain of processes starting in the fetal adrenal, and progressing through the fetal liver and the placenta before entering the maternal circulation. Steroids and ampicillin may depress values.

*See also Lecithin-Sphingomyelin Ratio, Amniotic Fluid*

### Oestrogens, Urinary

**RI:** See table below (units: µg/24 hours)

<table>
<thead>
<tr>
<th>Oestrogen</th>
<th>Male</th>
<th>Female menstruating</th>
<th>Female postmenopause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oestrone</td>
<td>0-5</td>
<td>5-20</td>
<td>0.3-2.4</td>
</tr>
<tr>
<td>Oestradiol</td>
<td>0-5</td>
<td>2-10</td>
<td>0-1.4</td>
</tr>
<tr>
<td>Oestriol</td>
<td>0-10</td>
<td>5-30</td>
<td>2.2-7.5</td>
</tr>
</tbody>
</table>

**Ind:** Menstrual status, infertility, sex determination

**Int:** HIGH (female) - Hormone therapy
         HIGH (male) - Feminisation
         LOW - Infertile

Phys: Oestrogens stimulate ovulation and the development of secondary sexual characteristics

### Opiates, Urine

**RI:** <300 ng/mL

**Ind:** Detection of opiate (narcotic) use.

**Int:** HIGH - Use of opiate such as heroin, morphine, codeine, dihydrocodeine, hydrocodone, hydromorphone and oxycodone.

Phys: Does not normally detect buprenorphine or methadone. Naltrexone may cause a false positive result. Lemon juice, bleach, vinegar and detergents in sample may cause false negative result.

### Osmolality, Serum

**RI:** 280-300 mmol/kg water

**Ind:** Water imbalance

**Int:** HIGH - Hyperglycaemia, uraemia, salicylate overdose, alcohol, hypernatraemia, diabetes insipidus, dehydration
         LOW - Hyponatraemia, water overload, pregnancy

Phys: Plasma osmolality is well controlled by electrolytes and other small molecules. Proteins are significant

### Osmolality, Urine

**RI:** 500-800 mmol/kg

12 hour water deprivation > 800 mmol/kg

Fluid overload < 100 mmol/kg
Ind: Renal disease
Int: Result compared with serum osmolality (above) to separate renal causes of polyuria from extrarenal causes of polyuria

Osmotic Fragility of Red Blood Cells
RI: 0.40-0.45% saline before incubation
     0.47-0.60% saline after 24 hour incubation
Ind: Spherocytosis
Int: HIGH - Hereditary spherocytosis, autoimmune haemolytic anaemia
See also Eosin-5-Maleimide, Blood

Ovarian Autoantibodies, Blood
RI: Absent
Ind: Ovarian disease
Int: PRESENT - Autoimmune ovarian disease, Addison's disease

Oxalate, Urine
RI: 0.22-0.44 mmol/day
Ind: Recurrent renal calculi
Int: HIGH - Calcium oxalate renal stone formers, congenital
Phys: 24 hour collection essential. Varies with diet

Oxygen Affinity of Haemoglobin
See Haemoglobin, Oxygen Affinity, Blood

Oxygen, Blood [pO₂]
RI: Arterial
     97% pO₂ 10-13 kPa (75-100 mmHg)
     Venous
     60-85% pO₂ 5-9.5 kPa (40-70 mmHg)
Ind: Pulmonary disease
Int: LOW - Hypoxia due to poor air entry, poor lung function or poor circulation (eg. high altitude, pulmonary fibrosis, pulmonary oedema, emphysema, A-V shunt, brain stem damage, chronic obstructive airways disease, neuromuscular defects)
Phys: Great care must be taken to collect blood sample in a vacuum tube with no air present to prevent contamination of specimen.
See also Carbon Dioxide, Blood; Forced Expiratory Volume in 1 Second; Vital Capacity, Lungs
Oxygen Saturation, Arterial Blood
RI: > 95%

P
See Phosphorus, Inorganic, Serum

Packed Cell Volume [PCV]
(Haematocrit)
RI: Adult male 40-50%
     Adult female 36-47%
     Child 32-42%
Ind: Haematological disorders
Int: HIGH - Polycythaemia rubra vera, dehydration
     LOW - Anaemia (Hb, FBC?), pregnancy
Phys: A blood specimen is centrifuged and the percentage of packed cells to plasma in the tube is measured

Papanicolaou Smear, Cervix
RI: Normal
Ind: Routine every 12-36 months for all sexually active women
Int: Atypical cells - Smear should be repeated in 3-6 months
     CIN 1 DYSPLASIA - Colposcopy advised with repeat smears frequently
     CIN 2 DYSPLASIA - Colposcopy and punch biopsy followed by appropriate treatment and follow-up
     CIN 3 carcinoma in situ - Definitive treatment necessary (eg. cone biopsy) and careful follow-up
     Invasive carcinoma - Definitive treatment essential (eg. hysterectomy, irradiation)
Phys: Vaginal infections often also reported on smears. CIN is an index of cervical intraepithelial neoplasia

PAPP-A
See Pregnancy-associated Plasma Protein, Serum

Paracentesis Fluid
(Ascitic Fluid; Peritoneal Fluid)
RI: Colour - clear
Red blood cells - nil
White blood cells - nil
Ind: Ascites
Int: Colour
STRAW - Cirrhosis, infection, neoplasm, cardiac failure
PINK/RED - Neoplasm, TB, pancreatitis
WHITE - Lymphatic obstruction, infection
Red blood cells
FEW - Cirrhosis, infection, neoplasm
NUMEROUS - Pancreatitis, TB, neoplasm, traumatic tap
White blood cells
<250 x 10^6/L - Cirrhosis, neoplasm, cardiac failure
>250 x 10^6/L - Infection, TB, pancreatitis
See also Serum-Ascites Albumin Gradient

Paracetamol, Blood
(Acetaminophen)
RI: Toxic > 1300 µmol/L (195 mg/L) four hours after ingestion
Ind: Assessment of overdose
Phys: Liver damage and death can result from overdose. Serum levels can rise for 4 or more hours after ingestion

Paraprotein, Urine
See Bence-Jones Proteins, Urine

Parathormone, Serum [PTH]
(Parathyroid Hormone)
RI: 1.0-7.0 pmol/L whole molecule PTH
<100 pmol/L (<100 ng/L) mid-molecule PTH
10-65 ng/L P-intact parathyroid hormone
Ind: Parathyroid disease
Int: HIGH - Hyperparathyroidism (S.Ca, S.phosphate?), osteomalacia (S.Ca, S.phosphate?), renal failure, vitamin D deficiency, pregnancy, anticonvulsant therapy
Phys: Parathormone maintains extracellular fluid calcium concentration

Parathyroid Hormone
See Parathormone, Serum
Parietal Cell Autoantibodies, Serum
(Gastric Cell Autoantibodies, Serum)
RI: Negative
Ind: Pernicious anaemia
Int: POSITIVE - Pernicious anaemia, chronic atrophic gastritis, autoimmune endocrinopathies, thyroid disease
Phys: Specific tissue autoantibody

Paul Bunnell Test
RI: Titre up to 1:128
Ind: Infectious mononucleosis
Int: HIGH - Infectious mononucleosis (glandular fever)
Phys: Patients with infectious mononucleosis develop a high titre of sheep cell agglutinating antibodies. Obsolete test
See also Infectious Mononucleosis Screen, Serum; Epstein-Barr Virus Immunoglobulin Antibodies, Serum

Pb
See Lead, Plasma; Lead, Urine

pCO₂
See Carbon Dioxide, Blood

PCR
See Polymerase Chain Reaction, Blood

PCV
See Packed Cell Volume

Peak Expiratory Flow Rate
RI: See table below:
**Correlation of Peak Flow Rate with Patient Height**

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>Peak flow rate (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>160-320</td>
</tr>
<tr>
<td>140</td>
<td>310-480</td>
</tr>
<tr>
<td>160</td>
<td>480-630</td>
</tr>
<tr>
<td>180</td>
<td>620-780</td>
</tr>
</tbody>
</table>
Ind: Respiratory distress
Int: LOW - Asthma, chronic obstructive airways disease, emphysema
See also General Information: Respiratory Function Tests

Pemphigoid Autoantibodies, Serum
See Basement Membrane Autoantibodies, Serum

Pemphigus Autoantibodies
See Intercellular Cement Substance Autoantibodies, Blood

Pericardial Fluid
RI: Protein > 25g/L : Exudate
     Protein <25g/L : Transudate
Ind: Pericardial effusion
Int: EXUDATE - Infection (eg. TB), malignancy
     TRANSUDATE - Congestive cardiac failure, cirrhosis, nephrotic syndrome,
     Meigs syndrome, hypothyroidism

Peritoneal Fluid
See Paracentesis Fluid

Pertussis IgA Antibodies, Nasopharyngeal Secretions
RI: Absent
Ind: Suspected pertussis
Int: POSITIVE - Recent or current pertussis infection
Phys: Result positive early in infection, but short lasting. Serum Pertussis IgA
     antibodies increase late, and persist long term, but only occur with
     infection, not vaccination

PFA-100
See Platelet Function Analysis, Blood

pH, Faeces
RI: Meconium 5.7-6.4
     Breastfed infant 4.0-7.0
     Cows' milk fed child 5.0-7.5
     Adult 6.0-8.0
Ind: Malabsorption syndromes
Int: LOW - Lactose malabsorption syn., disaccharide deficiency, some bacterial gut infections

**pH, Serum**
RI: 7.36-7.44 (42-36 mmol/L)  
Outside range 6.8-8 (130-15 mmol/L) causes death  
Ind: Acid-base imbalance  
Int: LOW - Acidosis (high SI units) - Underventilation of lungs (VC, FEV₁, CO₂?), shock, severe diarrhoea, starvation, diabetes mellitus (glucose?), anuria, uraemia, renal disease (BUN, creatinine?), ureterocolic anastomosis  
HIGH - Alkalosis (low SI units) - Hyperventilation, hysteria, altitude sickness, vomiting, salicylate overdose, Cushing syn.  
Phys: pH of blood determined by level of bicarbonate (indirectly CO₂) and other electrolytes  
*See also Carbon Dioxide, Blood*

**pH, Urine**
RI: 4.6-8.0 (mean 6.0)  
Ind: Urinary tract infection  
Int: Varies with diet  
LOW - Acidic - Bacterial infections, particularly *Escherichia coli*  
HIGH - Alkaline - Bacterial infections (particularly *Proteus* sp.), renal tubular acidosis, urinary alkalinising drugs  
Phys: *Proteus* splits urea to give ammonia and thus an alkaline reaction

**Phenobarbitone, Serum**  
(Phenobarbital)
RI: Therapeutic range 65-170 µmol/L (15-40 µg/mL)  
Ind: Control of therapy  
Int: Adjust dosage to keep levels within therapeutic range  
Phys: Phenobarbitone is used to control epilepsy. Half-life 50-140 hours. Sample prior to next dose

**Phenylalanine, Blood**
RI: 40-120 µmol/L  
Ind: Screening and monitoring of PKU  
Int: HIGH - Phenylketonuria (PKU), hyperphenylalanaemia
Phenytoin Sodium, Serum (Dilantin)
RI: Therapeutic range 40-80 µmol/L (10-20 mg/L)
Ind: Phenytoin therapy
Int: Adjust dosage to keep levels within therapeutic range
Phys: Phenytoin is used to treat epilepsy. Sample prior to next dose. Peak 8 hours after administration

Phosphate Excretion, Urine
See Nordin Test, Blood and Urine

Phosphate, Serum
RI: 0.79-1.40 mmol/L (2.4-4.5 mg/100 mL)
Ind: Bone disease
Int: LOW - Elderly male, primary hyperparathyroidism (S.ALP?), renal tubular acidosis, hypercalcaemia, osteomalacia (S.ALP?), hypomagnesaemia, poor diet, alcoholism (GGT), severe burns, starvation, gout, pregnancy, prolonged IV therapy, drugs (eg. antacids, diuretics, insulin)
HIGH - Elderly female, severe illness, renal disease, hypoparathyroidism, acidosis, infancy, excess vitamin D intake, sample haemolysis
V.HIGH - Hypoparathyroidism, renal rickets
Phys: Should be compared with S.calcium level
See also Calcium, Serum

Phosphate, Urine
RI: 10-40 mmol/day
Ind: Parathyroid and bone disorders
Int: HIGH - Renal tubular disorders, hyperparathyroidism, osteomalacia, hypercalcaemia
Phys: Excess levels of parathyroid hormone will cause phosphate excretion
See also Calcium, Serum

Phosphate Threshold, Urine
RI: 0.8-1.35 mmol/L
Ind: Renal disease
Int: HIGH - Proximal tubule damage, primary hyperparathyroidism, drugs affecting phosphate resorption
Phys: After fasting overnight, the patient passes urine in the morning, drinks 200 mL of water, and passes urine again 2 hours later, at which time the blood
sample is also drawn. The ratio of phosphate clearance to creatinine clearance is then calculated thus:-

\[
\text{Phosphate clearance} = \frac{U. \text{ phosphate} \times P. \text{ creatinine}}{U. \text{ creatinine} \times P. \text{ phosphate}}
\]

**Phosphatidyl Glycerol, Amniotic Fluid**
RI: Present
Ind: Determination of fetal lung maturity
Int: ABSENT - Fetal lungs not mature
Phys: More reliable than lecithin-sphingomyelin ratio in diabetic mothers
See also Lecithin-Sphingomyelin Ratio, Amniotic Fluid

**Phosphorus, Inorganic, Serum [P]**
RI: 0.9-1.5 mmol/L (3-4.5 mg/100 mL)
Ind: Bone and kidney disease
Int: HIGH - Renal insufficiency, hypoparathyroidism (Ca?), hypervitaminosis D
LOW - Hyperparathyroidism, hypovitaminosis D, rickets (Ca, vit. D?), osteomalacia, steatorrhoea, renal tubular insufficiency (BUN, creatinine?), insulin therapy, postprandial state
Phys: The concentration of inorganic phosphorus is influenced by parathyroid gland function, intestinal absorption, renal function, bone metabolism and nutrition. Diurnal variation

**Phytanate, Serum**
RI: 3-11 µmol/L
Ind: Peroxisomal diseases
Int: HIGH - Zellweger disease, Refsum disease, very high intake of dairy products

**Placental Growth Factor, Serum [PLGF]**
RI: Increases from 12 to 30 weeks of pregnancy to peak of 900 to 1050 ng/L, then decreases to 300 to 450 ng/L at term.
Ind: Prediction of pre-eclampsia
Int: LOW (below 700 at 30 weeks) – Likely to develop pre-eclampsia
V.LOW (below 100 at 30 weeks) – Eclampsia imminent
Phys: Graph showing normal levels at each stage of pregnancy compared to result. Women whose PLGF trends below normal on graph are predisposed to pre-eclampsia.
Placental Lactogen, Human, Serum
RI: Variable
Ind: Pregnancy monitoring
Int: STEADY RISE - Normal pregnancy
      V.HIGH - Choriocarcinoma, small cell carcinoma of lung

Plasma Cells, Blood
RI: Absent (Unit: no./mm$^3$)
Ind: Reported if found on FBC
Int: FEW - Infection, serum sickness, primary amyloidosis, elderly
      MANY - Multiple myeloma, Waldenstrom macroglobulinaemia

Plasma Protein
See Protein C, Plasma; Protein S, Plasma

Plasminogen, Plasma
RI: 50-150%
Ind: Thromboembolism
Int: LOW - Infants, liver disease
      HIGH - Pregnancy, contraceptive pill use, elderly, Negroes
Phys: High levels associated with increased risk of thromboembolism

Platelet Count, Blood
RI: 150-450 x 10$^9$/L (150,000-450,000/mm$^3$)
Ind: Bleeding disorders
Int: HIGH (thrombocytosis) - Myelofibrosis, chronic leukaemia, polycythae mia rubra vera, essential thrombocytopenia, infection, trauma, post-splenectomy, strenuous exercise, labour of childbirth, familial LOW NUMBER, NORMAL TYPE (thrombocytopenia) - Marrow suppression or infiltration, carcinoma, myeloma, cytotoxic drugs, infections, megaloblastic anaemia, SLE, dengue fever, acute leukaemia, disseminated intravascular coagulation, haemolytic-uraemic syn., massive transfusion, autoimmune diseases, hypersplenism, rheumatoid arthritis, Fanconi syn., HELLP syn., sticky platelet syn., Wiskott-Aldrich syn., alcohol, viral or bacterial infections (eg. rubella, infectious mononucleosis), idiopathic, congenital, post-transfusion, drugs (eg. quinidine, quinine, heparin, aurothiomalate, NSAIDs), partial clotting of specimen.
NORMAL NUMBER, ABNORMAL TYPE (thrombasthenia) -
Glanzmann's disease
LOW NUMBER, ABNORMAL TYPE - May-Hegglin anomaly
Phys: Platelets are essential for blood clotting
See also Fibrinogen, Blood; Clotting Time

Platelet Function Analysis, Blood [PFA-100]
RI: Collagen epinephrine aperture - 82 to 150 secs.
    Collagen ADP aperture - 42 to 110 secs.
Ind: Suspected bleeding disorder
Int: HIGH - Abnormal platelet function, aspirin or other anticoagulant use, von
    Willebrand disease, Bernard-Soulier syndrome, Glanzmann syndrome,
    other inherited platelet function disorders
Phys: Whole blood sample passed under high shear stress through different
    apertures in a biochemically activated membrane and time to clot
    formation and aperture blockage measured. Test within 5 hours of
    collection

Platelet Survival, Blood
RI: 8-10 days
Ind: Thrombocytopenia
Int: LOW - Immune thrombocytopenia, hypersplenism, other causes of platelet
    destruction
Phys: Radioactive platelets injected, and sampled after 30 minutes and 2 hours,
    then at daily intervals

Pleural Fluid
RI: Protein > 25g/L : Exudate
    Protein <25g/L : Transudate
Ind: Pleural effusion
Int: EXUDATE - Infection (eg. TB, pneumonia), malignancy
    TRANSUDATE - Congestive cardiac failure, cirrhosis, nephrotic syndrome,
    Meigs syndrome, hypothyroidism

PLGF
See Placental Growth Factor, Serum

Polycythaemia
See Haemoglobin, Blood; Erythrocyte Count, Blood; Packed Cell Volume
Polymerase Chain Reaction, Blood [PCR]
RI: Negative  
Ind: Certain infectious and other diseases  
Int: POSITIVE - Specific results for selected diseases. Range of diseases increasing regularly. Examples include adenovirus, Charcot-Marie-Tooth disease, cystic fibrosis, dengue fever, Duchenne muscular dystrophy, fragile X syndrome, haemophilia, hepatitis C, haemochromatosis, Huntington’s chorea, influenza, measles, *Mycoplasma pneumoniae*, pertussis, respiratory syncitial virus, sickle cell disease, thalassaemia trait, tuberculosis and *Chlamydia trachomatis*
Phys: Very specific and sensitive tests

Porphyobilinogen, Urine
RI: <10µmol/L  
Ind: Porphyria  
Int: HIGH - Acute intermittent porphyria, porphyria variegata, hereditary coproporphyria
Phys: Only positive when symptoms present

Porphyobilinogen Deaminase, RBC
RI: 500-800 mU/L  
Ind: Porphyria  
Int: LOW - Acute intermittent porphyria, asymptomatic genetic defect for porphyria
Phys: Useful for detecting asymptomatic carriers

Porphyrins, RBC
RI: <900nmol/L  
Ind: Porphyria  
Int: HIGH - Childhood protoporphyria, erythropoietic porphyria, lead poisoning, iron deficiency
Phys: Differentiates above forms of porphyria from porphyria cutanea tarda and porphyria variegata. Blood sample must be protected from light

Porphyrins, Faeces
RI: Absent  
Ind: Latent porphyria variegata  
Int: PRESENT - Porphyria variegata, gastrointestinal disorders
Porphyrins, Plasma
RI: Normal
IND: Suspected porphyria
INT: A specific maximum emission spectra correlated with a specific type of porphyria.
  Peak at 626 nm: Porphyria variegata
  Peak at 634 nm: Erythropoietic protoporphyria
  Peak at 619 nm: Porphyria cutanea tarda, Acute intermittent porphyria, hereditary coproporphyria, congenital erythropoietic porphyria

Porphyrins, Urine
RI: Absent
IND: Acute porphyria variegata
INT: PRESENT - Acute porphyria, liver disease, alcoholic cirrhosis, lead poisoning infections, anaemia, CCl₄ poisoning
See also Coproporphyrins, Urine; Porphyrins, Plasma

Potassium, Serum [K⁺]
RI: 3.5-5.5 mmol/L
Pregnancy: 3.2 - 4.6 mmol/L
IND: Renal or gut disease. Electrolyte imbalance. Diuretic therapy
INT: HIGH - (Hyperkalaemia) Acute renal failure (creatinine?), anuria, uraemia, Addison's disease (P.cortisol?), haemolysed blood sample, acidosis, hypoaldosteronism, massive trauma, sepsis, vigorous exercise, excess intake, drugs (eg. digoxin, ACE inhibitors, NSAIDs, triamterine, amiloride, spironolactone)
LOW - (Hypokalaemia) Vomiting, diarrhoea, ulcerative colitis, malabsorption syn., colonic adenomas, excessive purgatives, renovascular disease, diabetes mellitus, Conn syn. (bicarbonate?), Cushing syn., oat cell carcinoma of lung, ureterocolic anastomosis, familial periodic paralysis, dietary deficiency, renal tubular acidosis, alkalosis, Liddle syn. (see Syndromes section 6), secondary aldosteronism, drugs (eg. diuretics, steroids, laxatives, insulin, sympathomimetics), excess licorice ingestion.
Phys: Potassium is lost from the kidneys and colon; it is readily absorbed from the gut. 95% is intracellular.
See also Anion Gap, Serum

Potassium, Urine [K⁺]
RI: 30-90 mmol/day
Int: HIGH - Diuretic therapy, excess parenteral potassium therapy

**Prealbumin, Serum**  
(Transthyretin, Serum)  
RI: 185-320mg/L.  
Ind: Protein malnutrition  
Int: NORMAL - Good protein nutrition.  
LOW - Poor nutrition, septicaemia, adult respiratory distress syndrome, abscesses.  
HIGH - Renal insufficiency, steroid therapy.  
Phys: Prealbumin has a half life of one to two days, making it a good marker of nutritional adequacy. Acts as a transporter of thyroxine, so hypothyroidism may interfere with results.

**Pregnancy-associated Plasma Protein-A, Serum [PAPP-A]**  
RI: Varies with gestation duration  
Ind: Antenatal detection of foetal chromosomal abnormalities.  
Int: LOW – Increased risk of Down syndrome, stillbirth, pre-eclampsia, other chromosomal abnormalities and intrauterine growth retardation.  
HIGH- Acute coronary syndrome  
Phys: Test performed in conjunction with nuchal ultrasound and S.HCG between 10 and 14 weeks of gestation. PAPP-A normally involved in wound healing  
*See also S.HCG; S.alpha-fetoprotein*

**Pregnancy, Pathology Variations**  
See Section Three, Investigations

**Primidone, Serum**  
(Mysoline)  
RI: Therapeutic range 22-50 µmol/L (5-12 µg/mL)  
Ind: Primidone therapy  
Int: Adjust dosage to keep serum levels within therapeutic range  
Phys: Sample prior to next dose. Very variable half-life. Metabolises to phenobarbitone

**Procainamide, Serum**  
RI: Therapeutic range 17-40 µmol/L (4-11 µg/mL)  
Ind: Procainamide therapy  
Int: Adjust dosage to keep serum levels within therapeutic range
Phys: Procainamide is used to control cardiac arrhythmias. Half-life 3-5 hours. Sample immediately before next dose

**Progesterone, Serum**

RI: Female luteal phase 20 - 110 nmol/L  
    Female follicular phase 2 - 4.5 nmol/L  
    Male and postmenopause < 3 nmol/L  

Ind: Ovulatory status  
Int: Increases throughout pregnancy to peak at 36 weeks  
Phys: Levels should be taken before and after expected ovulation time for best results

**Prolactin, Plasma**

RI: Female 3-25 µg/L (< 600 mIU/L)  
    Male 2-15 µg/L (< 450 mIU/L)  

Ind: Female infertility, galactorrhoea  
Int: VERY HIGH > 120 µg/L - Pituitary prolactinoma, other pituitary tumours.  
    HIGH 40 - 120 µg/L - Pituitary hyperplasia, suprasellar tumours, cerebral trauma, thyroid disease, cirrhosis, chronic renal failure, sarcoidosis, breast feeding, pregnancy, Stein-Leventhal syn., premenstrual tension, drugs (eg. H2 antagonists, methyldopa, metoclopramide, narcotics, oestrogen, verapamil, phenothiazines, tricyclic and SSRI antidepressants, narcotics, antihistamines, oestrogen supplements), caffeine  
    RAISED <40 µg/L - Deep sleep, physical or emotional stress, vigorous exercise, nipple stimulation.  

Phys: Hormone produced in anterior lobe of pituitary that helps control menstrual cycle and lactation. High levels cause sterility, amenorrhoea, galactorrhoea

**Prostate Specific Antigen, Serum [PSA]**

RI: < 4 µg/L  
Ind: Prostatic disease  
Int: 4-10 µg/L - Prostatic cancer, benign prostatic hypertrophy, prostatitis, prostate trauma, recent ejaculation, bike riding  
    >10 µg/L - Prostatic cancer  
    FALSE LOW - Obesity, some forms of prostatic cancer  

Phys: Significant false positive and false negative results. Not a screening test. Used for assessing progress of disease rather than diagnosis. Doubling time (DT) of PSA indicative of prognosis. DT < 2 years = 42% risk of prostatic carcinoma, DT 2 - 5 years = 14% risk, DT > 5 years = 3% risk.  

*See also Prostate Specific Antigen Free/Total Ratio*
Prostate Specific Antigen Free/Total Ratio, Serum
RI: >25%
Ind: Prostate disease
Int: LOW - Prostate cancer
Phys: Only appropriate to use when PSA >4 µg/L
See also Prostate Specific Antigen

Prostatic Acid Phosphatase
See Acid Phosphatase, Total, Serum

Protein C, Plasma
RI: 50-150%
Ind: Thrombosis
Int: LOW - Recurrent thromboses, skin necrosis with warfarin, familial thrombophilia
Phys: Protein C degrades coagulation factors V and VII. An autosomal dominant lack causes recurrent severe thromboses, that may commence as a neonate
See also Protein S

Protein S, Plasma
Ind: Thrombosis
Int: LOW - Recurrent thromboses, familial thrombophilia
Phys: Co-factor of Protein C. Lack is an autosomal dominant trait

Protein, CSF
RI: Adult 0.1-0.4 g/L
Child < 0.2 g/L
Infant < 0.3 g/L
Ind: CNS disease
Int: V.HIGH - Bacterial meningitis (Cl-, glucose, CSF?), TB meningitis, toxoplasmosis, premature infant
HIGH - Syphilitic meningitis (FTA?), polio, traumatic tap, cerebral haemorrhage, brain tumour, neonate

Protein, Serum, Total
RI: 60-80 g/L
Neonate 45-75 g/L


**Protein, Urine**

*RI:* \(< 0.07 \text{ g/L} (< 0.15 \text{ g/day})\)

*Ind:* Renal disease

*Int:* \(\text{HIGH}\) - Glomerular disease, cystitis, pyelonephritis, toxaemia of pregnancy, hypertension, SLE, nephrotic syn., ureteric stone, renal tract tumour, diabetes mellitus, congenital tubal disorders, Wilson's disease, sarcoidosis, analgesic nephropathy, congestive cardiac failure, renal transplant rejection, amyloidosis, myelomatosis, Alport syn., fever, strenuous exercise, emotional stress, prolonged bed rest

*Phys:* Damage to the glomeruli increases their permeability and allows plasma protein to escape into the urine. Bleeding within tract often causes test for protein to be positive

*See also Bence-Jones Proteins, Urine*

**Prothrombin Index [PI]**

*RI:* 90-110. Therapeutic range 40-60

*Ind:* Bleeding disorders, anticoagulant therapy

*Int:* \(\text{LOW}\) - Bleeding disorders (fibrinogen?), anticoagulants

*Phys:* Test obsolete. Replaced by INR

\[
\text{PI} = \frac{\text{Control prothrombin time}}{\text{Patient prothrombin time}} \times 100
\]

*See also International Normalised Ratio*

**Prothrombin Ratio [INR]**

*See International Normalised Ratio - Prothrombin*

**Prothrombin Time [PT]**

*RI:* 12-16 seconds

Therapeutic range 20-30 seconds

*Ind:* Bleeding disorders

*Int:* \(\text{LONG}\) - Lack of fibrinogen, prothrombin, factors V, X, or VII, liver disease, anticoagulant therapy, vit. K deficit, disseminated intravascular coagulation
Phys: Tissue factor (brain extract), calcium chloride, and test plasma are incubated and compared to a control. The time for clotting is noted. See also tests listed under Coagulation Screen.

**Protoporphyrin, Free, Erythrocyte [FEP]**
- RI: <34 µg/L
- Ind: Lead poisoning
- Int: HIGH - Lead poisoning
- Phys: Used to monitor severity of lead poisoning
  See also Lead, Serum

**PSA**
See Prostate Specific Antigen, Serum

**PTH**
See Parathormone, Serum

**Pyruvate, Blood**
- RI: 0.03-0.10 mmol/L
- Ind: Liver disease
- Int: HIGH - Thiamine deficiency, cirrhosis, other severe liver diseases, hypoxia
- Phys: When compared to serum lactate result, may assist in determining cause of lactic acidosis
  See also Lactate, Serum

**Pyruvate Kinase, Serum**
- RI: International standard not established. Traces usually present.
- Ind: Chronic anaemia and haemolysis
- Int: LOW - Pyruvate kinase deficiency anaemia
- Phys: Low levels are associated with an autosomal recessive disorder that results in chronic haemolytic anaemia from birth

**Q Fever Antibodies, Serum**
See Immunoglobulin Antibodies, Specific, Serum

**Quinidine, Serum**
- RI: Therapeutic range 6-15 μmol/L (2-5 µg/mL)
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Ind: Quinidine therapy
Int: Adjust dosage to keep serum levels within therapeutic range
Phys: Quinidine is used in cardiac disease. Half-life 4-7 hours. Sample prior to next dose

Rabies Antibodies
See Lyssavirus Antibody Enzyme Immunoassay

Radioallergosorbent Test, Serum [RAST]
RI: Negative or < 0.69 kU/L
Ind: Allergies
Int: POSITIVE or HIGH - Allergy to test substance (IgE?)
Phys: Suspect allergen is introduced and serum samples are tested at intervals thereafter for specific IgE. Specific tests for hundreds of substances, or combinations of substances (eg. grasses) may be performed. Both false negative and positive results possible

Rapid Plasma Reagin Test, Serum  [RPR]
Venereal Disease Research Laboratory Test [VDRL]
RI: Negative
Ind: Sexually transmitted disease
Int: POSITIVE - Syphilis (FTA?), yaws
Phys: Nonspecific serological test for syphilis that detects presence of reagin, not a specific antitreponemal antibody. Becomes negative some years after successful treatment
See also Fluorescent Treponemal Antibodies; Syphilis Enzyme Immunoassay, Serum; Treponema pallidum Haemagglutination, Serum
See also Investigations Section Three : Syphilis investigation chart

RAST
See Radioallergosorbent Test, Serum

RBC
See Erythrocyte Count, Blood

RCC
See Erythrocyte Count, Blood
Red Blood Cell Count, Blood
See Erythrocyte Count, Blood

Red Blood Cell Count, Urine
See Haematuria

Red Blood Cell Fragility, Osmotic, Blood
RI: Saline concentration causing 50% lysis in fresh blood 4.0-4.5 g/L (68-82 mmol/L)
    Saline concentration causing 50% lysis in stored blood 4.6-5.9 g/L (84-100 mmol/L)
Ind: Haemolytic anaemia
Int: HIGH FRAGILITY - Spherocytosis, hereditary haemolytic anaemias
    LOW FRAGILITY - Thalassaemia, liver disease, iron defiency
Phys: Results not diagnostic. Not a commonly used test

Red Blood Cell Mass, Blood
RI: Males 25-35 mL/kg
    Females 20-30 mL/kg
Ind: Polycythaemia
Int: HIGH - Polycythaemia
Phys: Measured using radioisotope labelled red cells. Inaccurate with splenomegaly

Red Blood Cell Survival, Blood
RI: Red cell half-life 25-33 days
Ind: Haemolysis
Int: LOW - Indication of severity of haemolysis
Phys: Measured by measuring survival of red cells labelled with radioactive $^{51}$Cr

Reducing Substances, Faeces
RI: Negative
Ind: Malabsorption, diarrhoea
Int: POSITIVE - High dose vit. C, Crohn's enteritis, short bowel syn.,
gastroenteritis, maldigestion of sugars, drugs (eg. levodopa)
Phys: Screening test. Keep faeces refrigerated at 4°C or test promptly. Reducing substances are electron donating chemicals, eg. glucose
Regan Isoenzyme
See Alkaline Phosphatase Isoenzymes, Serum

Renal Calculi
Ind: Renal lithiasis
Int: CALCIUM OXALATE - 40% sole ingredient, 85% partial ingredient. Causes include excess soft drinks, oxalate foods (eg. silverbeet, rhubarb, chocolate, nuts) but often idiopathic
CALCIUM PHOSPHATE - 2% sole ingredient, 35% partial ingredient. Causes include primary hyperparathyroidism, hypercalcaemia, distal renal tubular acidosis, idiopathic
URIC ACID - 10% sole ingredient, 30% partial ingredient. Causes include hyperuricaemia, aciduria
CYSTINE - Rare. Cause is usually familial amino aciduria
MAGNESIUM AMMONIUM PHOSPHATE - 2% of stones. Caused by chronic urinary infection
Phys: Stone collected by sieving urine after symptoms of ureteric calculus present, or analysis of urinary gravel when present

Renal Function Tests
See Urea, Blood; Creatinine, Urinary Clearance; Glomerular Filtration Rate; Creatinine, Serum; Renal Calculi; Urate, Plasma

Renin, Plasma
RI: Varies markedly between labs, patient preparation, posture, etc.
Ind: Secondary hypertension
Int: Low Renin, High Aldosterone - Mineralocorticoid abnormality, Conn syndrome
High Renin, High Aldosterone - Renal abnormality
Phys: Must be performed in conjunction with aldosterone studies
See also Aldosterone, Plasma

Renin Activity, Urine
RI: 1.3-4.0 ng/mL/hour
Ind: Aldosteronism, secondary hypertension
Int: LOW - Primary aldosteronism, adrenal adenoma, adrenal hyperplasia
HIGH - Secondary hyperaldosteronism
Resin Uptake of T₃
See T₃ Uptake of Resin

Respiratory Function Tests
See Peak Expiratory Flow Rate; Vital Capacity, Lungs; Forced Expiratory Volume in 1 Second
See also General Information: Respiratory Function Tests

Reticulocytes, Blood
RI: 0.5-1.5% of RBC (10-100 x 10⁹/L)
     Infants 2-6%
Ind: Anaemia
Int: HIGH - Increased rate of RBC formation due to haemorrhage, haemolysis, treatment of pernicious anaemia, iron therapy in iron deficiency anaemia
Phys: Reticulocytes are immature red blood cells (RBC)
See also Erythrocyte Count, Blood

Reticulum Cell Autoantibodies, Serum [RCA]
RI: Absent
Ind: Autoimmune disease
Int: POSITIVE - Coeliac disease, Crohn's disease, gluten sensitive enteropathies, dermatitis herpetiformis, IgA deficiency, other systemic autoimmune diseases

Reverse T₃, Serum
RI: 0.12-0.54 nmol/L

Rheumatoid Factor, Serum [RF]
(Rose-Waaler Test; Rheumaton Titre)
RI: Titre < 16 (< 40 IU/mL)
Ind: Arthritis
Int: HIGH - 75% of adults with rheumatoid arthritis have rheumatoid factor. RF is present in many adults without rheumatoid arthritis. Higher titres are more significant prognostically. Other causes include SLE, scleroderma, other connective tissue disease, chronic active hepatitis, sarcoid, myelomatosis, chronic infection, neoplasia, infectious mononucleosis, TB, fibrosing alveolitis, brucellosis, parasitic infiltrations, leprosy, subacute bacterial endocarditis, syphilis, malaria
V.HIGH - Sjögren syn.
Phys: Rheumatoid factor is a macroglobulin that circulates in plasma in combination with gamma globulins. Agglutination of sensitised latex particles or sheep RBC indicates presence of RF

See also Anti-Deoxyribonucleic Acid Titre; Antinuclear Antibodies; Beta-2 Microglobulin; Complement, Serum; C-Reactive Protein; DNA Autoantibodies; Erythrocyte Sedimentation Rate; Extractable Nuclear Antigen Antibodies; HLA-DR4

Riboflavin, Plasma
See Vitamin B₂

Rickettsial Serology
See Weil-Felix Reaction

Ristocetin Cofactor
See von Willebrand Factor, Plasma

Rivotril
See Clonazepam, Serum

RNA Polymerase III Antibodies, Serum
Ind: Scleroderma
Int: POSITIVE - Scleroderma
Phys: Highly specific test for scleroderma

Rose-Waaler Test
See Rheumatoid Factor, Serum

Ross River Fever Antibodies, Serum
See Immunoglobulin Antibodies, Specific, Serum

RPR
See Rapid Plasma Reagin Test, Serum
Rubella Antibodies, Serum
Ind: To determine immune state, particularly in early pregnancy
Int: TITRE < 10 - Not immune (no previous infection or vaccination)
      TITRE 10-20 - Previous infection or vaccination, subclinical reinfection possible
      TITRE > 20 - Immune
Phys: Once infected with rubella (actively or passively), antibody levels rise permanently and reinfection is not possible. Subsequent subclinical infections do not result in viraemia. Infection in early pregnancy may lead to fetal abnormalities, particularly deafness
See also Immunoglobulin Antibodies, Specific, Serum

SAAG
See Serum-Ascites Albumin Gradient

Salicylates, Serum
RI: Therapeutic range 1.0-2.5 mmol/L (15-35 mg/100 mL)
     Toxic > 2.5 mmol/L (> 35 mg/100 mL)
Ind: Overdose, control of salicylate therapy
Int: Adjust dosage to keep serum levels within therapeutic range
Phys: Sample prior to next dose

SCC Associated Antigen
See Squamous Cell Carcinoma Associated Antigen

Schilling Test
Ind: Vit. B\textsubscript{12} deficiency
Int: ABNORMAL 1st. STAGE - Regional enteritis, lymphomas
     ABNORMAL 2nd. STAGE - Lack of intrinsic factor, terminal ileal disease, pernicious anaemia, total gastrectomy
     ABNORMAL 1st AND 2nd STAGE, NORMAL 3rd STAGE - Blind loop syn., scleroderma, multiple small bowel diverticula, ileal bacterial overgrowth
Phys: Carried out in three stages: 1. without intrinsic factor; 2. with intrinsic factor; 3. after antibiotics. Vitamin B\textsubscript{12} is absorbed in the ileum. This may be prevented by damaged ileal receptor sites, a lack of intrinsic factor or conditions that allow bacteria to take up vitamin B\textsubscript{12} ahead of the ileum.
     Now superseded by other tests
See also Vitamin B\textsubscript{12}, Serum
Selenium, Blood/Plasma
RI:  
- Blood: 1.21-2.5 µmol/L
- Plasma: 0.7-1.3 µmol/L
Ind:  
- Dietary deficiency
Int:  
- LOW - Dietary selenium deficiency, Keshan disease (form of cardiomyopathy), Kaschin-Beck disease (arthropathy/myopathy)
Phys:  
- Common problem with parenteral feeding

Semen Analysis
RI:  
- Volume 2.5-10 mL (average 4 mL)
- Number of sperm > 20,000,000/mL
- Motility > 70%
- Morphology > 60% normal forms
- Viscosity - Compared against standard
- Colour - Cream
- Leucocytes < 15/HPF
- Erythrocytes - nil
- Hb - nil
Ind:  
- Infertility
Int:  
- Low volume, count or motility - Infertile
- MORPHOLOGY > 70% ABNORMAL - Infertile, mumps orchitis, poor nutrition, drugs, radiation, excess local heat, surgery, vas deferens infection, cryptorchidism, germinal aplasia, pituitary or thyroid hormone defects
- VISCOSITY LOW - Urine contamination
- VISCOSITY HIGH - Defective prostate function
- COLOUR WHITE - Infection
- COLOUR CLEAR - Low sperm count
- COLOUR RED - Trauma, malignancy, renal damage, prostate damage
- LEUCOCYTES HIGH - Prostatitis, urethritis, epididymitis, orchitis
- ERYTHROCYTES OR Hb HIGH - Trauma, genital tract malignancy, renal damage
Phys:  
- Measured by direct microscopy or automatic analyser of sperm obtained by masturbation immediately prior to examination

Seminal Fructose
See Fructose, Seminal Fluid

Serotonin, Platelets
RI:  
- <5.4nmol/10^9 platelets
Ind:  
- Carcinoid syndrome
Int:  
- HIGH - Carcinoid syndrome
Phys: Blood or serum serotonin may also be measured, but platelet levels more accurate. Must be assayed immediately after venepuncture

**Serum-Ascites Albumin Gradient [SAAG]**
RI: 11 g/L
Ind: Diagnosing cause of ascites
Int: HIGH (>11 g/L) - Portal hypertension, cirrhosis, alcoholic hepatitis, extensive hepatic metastases, advanced hepatic failure, cardiac causes, schistosomiasis, Budd-Chiari syndrome
LOW (<11 g/L) - Nephrotic syndrome, protein losing enteropathy, malnutrition, TB or other bacterial peritonitis, pelvic inflammatory disease, peritoneal carcinoma or metastases, pancreatitis, bile leak, connective tissue disorders
Phys: SAAG correlates with portal pressure. SAAG = ascitic fluid albumin – serum albumin
*See also Paracentesis Fluid*

**Sex Determination**
See Buccal Smear; Oestrogens, Urinary

**Sex Hormone Binding Globulin, Serum [SHBG]**
RI: 20-110 nmol/L
Int: HIGH - Pregnancy, therapy with sex hormones (eg. oestrogen)

**SG**
See Specific Gravity

**SGGT**
See Gamma Glutamyl Transpeptidase, Serum

**SGOT**
See Aspartate Amino Transferase, Serum

**SGPT**
See Alanine Amino Transferase, Serum
SHBG
See Sex Hormone Binding Globulin, Serum

Sickle Cells, Blood
RI: Absent
Ind: Anaemia
Int: PRESENT - Sickle cell anaemia, sickle cell trait
Phys: May be combined with HbC disease, HbD disease, beta thalassaemia.
    Triggers include deoxygenation, dehydration, acidosis, hypothermia.
    Almost invariably occurs in Negroes. Seen on routine blood film
See also Erythrocyte Count, Blood

Skeletal Muscle Autoantibodies, Serum [SKM]
See Anti-Skeletal Muscle Antibodies, Serum

SKM
See Anti-Skeletal Muscle Antibodies, Serum

SMA
See Anti-Smooth Muscle Antibodies, Serum

Smear Test
See Papanicolaou Smear, Cervix

Smith Antibodies
See Anti-Smith Antibodies, Serum

Smooth Muscle Autoantibodies, Serum [SMA]
See Anti-Smooth Muscle Antibodies, Serum

Sodium, Faeces [Na⁺]
RI: <45mmol/L
Ind: Diarrhoea
Int: HIGH - Secretory diarrhoea (eg. cholera)
**Sodium, Serum [Na⁺]**

RI: 135-145 mmol/L  
    Pregnancy: 132-140 mmol/L
Ind: Fluid/electrolyte imbalance
Int: V.LOW (<120 mmol/L) - Critical care required, causes as below.
LOW (hyponatraemia) - Clinical effects not likely unless below 125 mmol/L. Over hydration, acute or chronic diarrhoea, salt losing nephropathy, hypothyroidism, fresh water drowning, hyperglycaemia, Addison's disease, hypopituitarism, acute renal failure, syndrome of inappropriate ADH secretion, infection, carcinoma, cirrhosis, ascites, congestive cardiac failure, cystic fibrosis, severe burns, excess sweating, prolonged storage of sample, recreational drugs (eg. ecstasy), medications (eg. diuretics, tricyclic and SSRI antidepressants, MAOI, clozapine, ACE inhibitors, celecoxib, sulphonylureas, cytotoxics, carbamazepine, phenothiazines, clofibrate, temazepam, desmopressin)
HIGH (hypernatraemia) - Dehydration, salt water drowning, uraemia, diabetes insipidus, hyperaldosteronism, excess salt intake, mechanical ventilation

Phys: The level of serum sodium regulates body water volumes. Dehydration may be due to lack of water or lack of salt (sodium). Clinical signs of severe hyponatremia include confusion, seizures, reduced consciousness, and tachycardia. Patients with hyponatraemia should reduce fluid intake and cease thiazide diuretics.

See also Anion Gap, Serum

**Sodium, Urine [Na⁺]**

RI: 40-200 mmol/day (40-200 mEq/day)
Int: HIGH - Addison's disease, chronic nephritis

**Sodium Valproate, Serum**

See Valproate, Serum

**Soluble Transferrin Receptor, Serum [sTfR]**

RI: 8.7 - 28.1 nmol/L
Ind: Iron deficiency
Int: HIGH - Iron deficiency not caused by inflammatory process or disease
Phys: Diagnoses iron deficiency in patients with chronic inflammation or malignancy.

See also Ferritin, Serum; Iron, Serum
Somatomedin C, Serum
See IGF-1, Serum

Specific Gravity, CSF
RI: 1.003-1.009

Specific Gravity, Plasma
RI: 1.050-1.060
See also Specific Gravity, Serum

Specific Gravity, Serum [SG]
RI: 1.025-1.029
Ind: Determine status of hydration
Int: HIGH - Dehydration
    LOW - Water intoxication, Addison's disease, heat stroke, sodium depletion, excess antidiuretic hormone due to oat cell carcinoma of lung
Phys: Plasma volume rises or falls with water excess or loss, while content of protein remains relatively stable, thus altering the specific gravity

Specific Gravity, Urine [SG]
RI: 1.003-1.030
Ind: Renal disease
Int: HIGH - Diabetes mellitus (glucose?)
    LOW - Diabetes insipidus, pituitary lesions, renal damage due to hypercalcaemia and hypokalaemia, renal failure
Phys: High in diabetes mellitus due to sugar in urine. Low in pituitary lesions due to low antidiuretic hormone secretion. Patient unable to lower SG after heavy water load in renal failure and Addison's disease

Sperm Antibodies, Serum or Seminal Fluid
RI: Absent
Ind: Infertility, vasectomy reversal
Int: POSITIVE - Sperm survival unlikely
Phys: Positive result would indicate cause for infertility. Vasectomy reversal unlikely to be successful if result positive
Sperm Count
See Semen Analysis

Spherocytes, Blood
RI: Nil
Ind: May be found on routine blood smear
Int: PRESENT - Hereditary spherocytosis, autoimmune haemolytic anaemia, alcoholism, HbC disease, drug induced (eg. methyldopa) haemolytic anaemia, severe viraemia, neoplasia
Phys: RBC have a defective membrane that is highly permeable to sodium, so they become swollen and fragile

Spur Cells, Blood
See Erythrocyte Count, Blood

Sputum, Microscopy of Gram Stained Smear
Ind: Lung infection
Int: Moderate numbers
Gram-positive or negative cocci - Normal flora
Gram-positive or negative bacilli - Normal flora
Large numbers
Gram-positive diplococci - Pneumococcal infection
Gram-positive cocci in clusters - Staphylococcal infection
Gram-negative pleomorphic coccobacilli - Haemophilus infection
Gram-negative bacilli - Coliform or Pseudomonas infection, excessive normal flora
Phys: Acute lung infections are best diagnosed by culture and sensitivity of responsible organism. Information from microscopy may be useful in immediate selection of antibiotic agent while awaiting culture result

Squamous Cell Carcinoma (SCC) Associated Antigen, Serum
RI: Negative
Ind: Monitoring organic SCC, detecting organic SCC in patients with family history
Int: POSITIVE - > 60% SCC of lung, cervix, head & neck; <20% other lung cancers; false positive common
See also Cancer Associated Antigens, Serum
Steroids, 17-Hydroxy, Serum
RI: Male 13 + or - 6 µg/100 mL
    Female 15 + or - 6 µg/100 mL
Ind: Measured in adrenocortical inhibition tests
Int: HIGH - Adrenal cortex overactivity
     LOW - Addison's disease
Phys: 17-Hydroxy steroids are produced in the adrenal gland
See also Dehydroepiandrosterone Sulfate, Blood

sTfR
See Soluble Transferrin Receptor, Serum

Stones, Renal
See Renal Calculi

Sugar
See Glucose, Blood; Glucose, CSF; Glucose, Urine

Sulfate, Serum
RI: 50-150 µmol/L
Ind: Renal disease
Int: HIGH - Renal failure

Sulphaemoglobin, Blood
RI: Absent
Ind: Cyanosis
Int: PRESENT - Haemolysis from exposure to sulphonamides, dyes, other oxidants

Sweat Chloride
See Chloride, Sweat

Sweat Conductivity
See Conductivity, Sweat
Synacthen Stimulation Test
RI: > 100% rise in S.cortisol after ACTH injection
Ind: Addison's disease
Int: LOW - Addison's disease, adrenal cortical insufficiency
Phys: An initial S.cortisol reading is taken. A short acting ACTH preparation is given IM and a further specimen for S.cortisol is taken 30 minutes later

Synovial Fluid Clarity
RI: Transparent
Ind: Arthritis
Int: TRANSLUCENT - Inflammatory arthritis
   OPAQUE - Septic arthritis
Phys: Clarity decreases with presence of white cells

Synovial Fluid Colour
RI: Colourless to straw
Ind: Arthritis
Int: PALE YELLOW - Noninflammatory arthritis
   YELLOW - Inflammatory arthritis
   YELLOW/BROWN - Septic arthritis

Synovial Fluid Crystals
RI: Nil
Ind: Arthritis
Int: URATE CRYSTALS - Gout (uric acid?)
   Calcium pyrophosphate crystals - Pseudogout
Phys: Crystals deposit in cartilage and periarticular structures when in high serum concentration

Synovial Fluid Mucin
Ind: Joint disease
Int: LOW - Gout, pseudogout, rheumatoid arthritis
   V.LOW - Acute bacterial arthritis

Synovial Fluid Viscosity
RI: High
Ind: Joint disease
Int: LOW - Osteoarthritis, SLE, trauma
   V.LOW - Rheumatoid arthritis, gout, infection
Synovial Fluid White Cell Count
RI: < 200/mL
Ind: Arthritis
Int: HIGH (> 1500) - Osteoarthritis, SLE, trauma
      V.HIGH (> 15,000) - Gout, pseudogout, rheumatoid arthritis
      EXTREMELY HIGH (> 50,000) - Septic arthritis, severe gout, rheumatoid arthritis

Syphilis IgG Enzyme Immunoassay, Serum [Syphilis EIA]
RI: Negative
Ind: Sexually transmitted disease
Int: POSITIVE - Syphilis (RPR, TPHA?)
Phys: Very sensitive for Treponema pallidum antibodies, but does not show disease status
See also Fluorescent Treponema Antibodies; Rapid Plasma Reagin Test

T Cell Lymphocytes, Blood
RI: CD3 Mature T Cells - 0.8-2.4 x 10^9/L
    CD4 T Helper Cells - 0.5-1.6 x 10^9/L
    CD8 T Suppressor Cells - 0.2-1.0 x 10^9/L
    CD16 Natural Killer Cells - 0.07-0.6 x 10^9/L
Ind: Immunodeficiency
Int: LOW - Immune deficiency (IgG?), AIDS (HIV?), neoplasms, leukaemia, chemotherapy
    CD16 LOW - Immunocompromised, cancer, Chediak-Higashi syndrome
Phys: CD4 - macrophages
      CD8 - nerves, splenic sinusoids
      (CD = Cluster Differentiation antibodies)
      T lymphocytes are responsible for a significant proportion of the body's immunological defence

T3 Uptake of Resin [T3 RU]
(T3 Uptake of Monoagglutinated Albumin)
RI: 22-35%
Ind: Thyroid dysfunction
Int: HIGH - Hyperthyroid (T4?), nephrotic syn., Graves' disease, drugs (eg. phenytoin, aspirin)
      LOW - Hypothyroid (T4?), pregnancy, oral contraceptives, chronic liver disease, drugs (eg. propranolol, phenytoin)
Phys: Indirect measure of thyroxine binding protein. Superceded by other thyroid function tests
See also Triiodothyronine, Free, Serum; Triiodothyronine, Total, Serum

**T4, Serum**  
(Total Thyroxine)  
RI: 64-160 nmol/L (5-13 μg/100 mL)  
Ind: Thyroid dysfunction  
Int: LOW - Hypothyroidism (T₃?), nephrotic syn., chronic disease, drugs (eg. aspirin, amiodarone, steroids, frusemide, diazepam, lithium, sulfamethoxazole/trimethoprim)  
HIGH - Hyperthyroidism (T₃?), pregnancy, Graves' disease, severe infections, hyperemesis, high altitudes, familial, acute psychiatric conditions, stress, drugs (eg. oral contraceptives, amiodarone, amphetamines)  
Phys: Direct measure of total circulating thyroxine  
See also Thyroxine, Free, Serum

**Target Cells, Blood**  
See Erythrocyte Count, Blood

**Tegretol, Serum**  
See Carbamazepine, Serum

**Testosterone, Free, Serum [FTE]**  
RI:  
Female 16-40 years - 3-12 pmol/L  
Female 40+ years - 2-10 pmol/L  
Male 16-40 years - 60-130 pmol/L  
Male 41-70 years - 40-100 pmol/L  
Male 70+ years - 30-90 pmol/L  
Ind: Female hirsutism, sexual dysfunction  
Int: As for Testosterone, Serum  
Phys: Less reliable test than Testosterone, Serum

**Testosterone, Serum**  
RI:  
Male 12-34 nmol/L  
Female 0.4-3.6 nmol/L  
Prepubertal 0.4-0.7 nmol/L  
Ind: Sexual dysfunction
Int: LOW - Male hypogonadism, panhypopituitarism, male climacteric, delayed puberty, Addison’s disease, sterility
HIGH - Virilising adrenal tumour, Stein-Leventhal syn. (see Syndromes section 6), pregnancy

Phys: Oestrogen therapy may raise testosterone level also
See also Dehydroepiandosterone Sulfate, Blood

**Testosterone/Epitestosterone Ratio, Urine**
RI: <6
Ind: Testosterone doping in sport
Int: HIGH - Extra testosterone injected or taken as an aid to sporting performance
Phys: Both testosterone and epitestosterone are synthesised by the testes. If extra testosterone is added ratio will be abnormal

**Tetrahydrocannabinol, Urine [THC]**
(Cannabis, Marijuana)
RI: <50 ng/mL
Ind: Detection of marijuana use.
Int: HIGH - Use of marijuana in previous week.
Phys: Fat soluble drug with half-life of 20 to 36 hours. Lemon juice, bleach, vinegar and detergents in sample may cause false negative result.

**THC**
See Tetrahydrocannabinol, Urine

**Theophylline, Serum**
RI: Therapeutic range 55-110 µmol/L (10-20 mg/L)
Ind: Theophylline therapy
Int: Adjust dosage to keep levels within therapeutic range
Phys: Theophylline is used for relief of bronchial spasm. Half-life 3-9 hours. Sample 4 hours after dose. Clinical effects may be observed at levels below the therapeutic range

**Thiamine, Blood**
See Vitamin B1


**Thrombin Clotting Time, Plasma**
RI: 10-15 seconds
Ind: Coagulation disorders
Int: HIGH - Low fibrinogen levels, heparin therapy
*See also tests listed under Coagulation Screen*

**Thrombocytes**
See Platelet Count, Blood

**Thromboplastin Time**
See Activated Partial Thromboplastin Time, Plasma

**Thrombotest**
RI: Therapeutic range 8-12% ± 3%
Ind: Anticoagulant therapy
Int: Adjust anticoagulant dosage to keep levels in therapeutic range
Phys: Outdated by prothrombin time against a standard reference
thromboplastin. Measures overall clotting activity

**Thyroglobulin Antibody, Serum**
See Anti-Thyroglobulin Antibody, Serum

**Thyroglobulin, Serum**
RI: <38µg/L
Ind: Thyroid inflammation or cancer
Int: HIGH - Thyroiditis, thyroid cancer, intrinsic thyrotoxicosis
Phys: Used to check for recurrence of thyroid cancer after total thyroidectomy

**Thyroid Antibodies, Serum**
See Anti-Thyroid Peroxidase Antibodies, Serum; Anti-Thyroglobulin Antibody, Serum; Thyroid Microsomal Autoantibody Titre, Serum

**Thyroid Function Tests**

<table>
<thead>
<tr>
<th>Phys</th>
<th>Parameter</th>
<th>Hyperthyroidism</th>
<th>1° Hypothyroidism</th>
<th>2° Hypothyroidism</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTI</td>
<td>H</td>
<td>L</td>
<td>L</td>
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<tr>
<td>T4 total</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>T4 free</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
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</tbody>
</table>
### Pathology

<table>
<thead>
<tr>
<th>Test</th>
<th>Reference Range</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>T3 total</td>
<td>H</td>
<td>L or N</td>
</tr>
<tr>
<td>T3 free</td>
<td>H</td>
<td>L or N</td>
</tr>
<tr>
<td>TSH</td>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>

L = low  H = high  N = normal

#### Thyroid Function Test Interpretation

<table>
<thead>
<tr>
<th>Total T3 (mU/mL)</th>
<th>TSH (log scale)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1-200</td>
<td>&lt;0.2</td>
<td>NORMAL</td>
</tr>
<tr>
<td>0.1-200</td>
<td>0.2-4.0</td>
<td>Subclinical Hypothyroidism</td>
</tr>
<tr>
<td>0.1-200</td>
<td>4.0-200</td>
<td>Hypothyroidism</td>
</tr>
<tr>
<td>0.1-200</td>
<td>&gt;200</td>
<td>Hyperthyroidism</td>
</tr>
</tbody>
</table>

**Thyroid Microsomal Autoantibody Titre, Serum**

(Anti-Microsomal Antibody Titre)

RI:  <100

Ind:  Thyroid disease

Int:  HIGH - Hashimoto’s thyroiditis, hyperthyroidism

See also other Thyroid Function Tests

**Thyroid Stimulating Hormone, Plasma [TSH]**

RI:  0.2-4.0 mU/mL

Ind:  Thyroid disorders

Int:  HIGH - Hypothyroidism, autoimmune thyroid disease, iodine deficiency goitres, lithium therapy

LOW - Excess hormone replacement, thyrotoxicosis (T4?), pituitary disease, early pregnancy

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Pathology - 159
LOW AFTER 200 µg TRF IMI - Steroid therapy, primary hyperthyroidism
Phys: Produced in anterior pituitary. 200 µg IMI of thyrotropin releasing factor normally causes a rise of TSH to 2 x initial level

**Thyrotropin Receptor Antibody, Serum**
RI: Negative
Ind: Thyroid disease
Int: POSITIVE - Some cases of hyperthyroidism
See also other Thyroid Function Tests

**Thyrotropin Releasing Hormone Stimulation Test**
RI: See table
Ind: Thyroid disease
Int: See table below:

<table>
<thead>
<tr>
<th>Status</th>
<th>Base TSH</th>
<th>TSH after TRF</th>
<th>Base T4</th>
<th>T4 after TRF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>N</td>
<td>H</td>
<td>N</td>
<td>H</td>
</tr>
<tr>
<td>Hyperthyroidism</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Primary hypothyroidism</td>
<td>H</td>
<td>VH</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Secondary hypothyroidism</td>
<td>N or L</td>
<td>N or L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

N = normal   H = high   VH = very high   L = low
Phys: Blood specimens for basal TSH and T4 thyroxine taken. 200 µg of TRF is given rapidly IV. Further samples for TSH testing are taken 20 and 60 minutes after injection
See also T4, Serum; Thyroid Stimulating Hormone

**Thyroxine, Free, Serum**
(Free T4)
RI: 10-25 pmol/L (0.8-2.0 ng/100 mL)
Ind: Thyroid gland dysfunction
Int: HIGH - Hyperthyroidism, thyroiditis, stress, drugs (eg. frusemide, amiodarone, amphetamines)
       LOW - Hypothyroidism, pregnancy, elderly, drugs (eg. phenytoin)
Phys: Measures the level of thyroxine affecting the cell. Varied by steroid therapy
See also T4, Serum

**Thyroxine, Total**
See T4, Serum

**Thyroxine Index**
See Free Thyroxine Index
TIBC
See Iron Binding Capacity, Total, Serum

Tobramycin, Blood
See Aminoglycosides, Blood

Toxoplasma Antibodies, Serum
See Immunoglobulin Antibodies, Specific, Serum

TPHA
See Treponema pallidum Haemagglutination, Serum

TRAB
See Anti-TSH Receptor Antibodies, Serum

Transaminases and Transferases
See Aspartate Amino Transferase, Serum; Alanine Amino Transferase, Serum

Transferrin, Plasma
RI: 1.7-3.5 g/L
Ind: Anaemia
Int: LOW - Haemochromatosis, iron supplements, anaemia of chronic disease
      HIGH - Iron deficiency anaemia (IBC?), contraceptive pill use
Phys: A globulin that transfers iron from the reticuloendothelial system to red cell
      precursors, and carries iron in the blood stream
See also Carbohydrate-Deficient Transferrin, Blood; Transferrin Saturation, Serum

Transferrin Saturation, Serum
RI: 25-50%
Ind: Anaemia, haemochromatosis
Int: LOW - Iron deficiency anaemia, iron depletion, anaemia of chronic disease
      HIGH - Increased iron stores, haemochromatosis
Phys: Substantial circadian and diurnal variation
See also Iron, Serum; Iron Binding Capacity; Transferrin, Plasma
Transglutaminase IgA Antibodies, Serum [tTG Ab]
RI: Absent
Ind: Coeliac disease
Int: PRESENT - Coeliac disease.
Phys: 8% false positive. More than one antibody test should be used to increase
the sensitivity. 91% Sensitivity, 96% specificity.
See also Endomysial Antibodies. Serum; Gliaden Antibodies, Serum

Transthyretin, Serum
See Prealbumin, Serum

Treponema pallidum Haemagglutination, Serum [TPHA]
RI: Negative
Ind: Sexually transmitted disease
Int: POSITIVE - Syphilis (active, latent or treated), yaws
Phys: Less sensitive than FTA, and does not disappear with treatment
See also Fluorescent Treponemal Antibodies; Rapid Plasma Reagin Test, Serum
See also Investigations Section Three : Syphilis investigation chart

TRF
See Thyrotropin Releasing Hormone Stimulation Test

Triglycerides, Serum
RI: < 2.3 mmol/L (< 200 µg/100 mL) after 12 hour fast
Recommended level <2.0 mmol/L
Ind: Obesity, heart disease
Int: LOW - malnutrition
HIGH - Increased risk of ischaemic heart disease and atherosclerosis, familial, nephrotic syn., chronic renal failure, diabetes mellitus, hypothyroidism, Cushing syndrome, pancreatitis, hypopituitarism, acromegaly, glycogen storage diseases, non-fasting sample, alcohol, pregnancy, drugs (eg. oral contraceptives, steroids)
Phys: Triglycerides also known as VLDL (very low density lipoproteins). Hypertriglyceridaemia may be familial or associated with diabetes and other metabolic disorders. No alcohol for 72 hours and no food for 12 hours before test
See also Cholesterol, Serum
Triiodothyronine, Free, Serum  
(Free T₃)
RI:  4-8 pmol/L  
Ind: Thyroid disease  
Int: LOW - Hypothyroidism, sick euthyroid syn.  
     HIGH - Thyroiditis  
Phys: Only drops late in hypothyroidism  
See also other Thyroid Function Tests

Triiodothyronine, Total, Serum  
(Total T₃)
RI:  0 to 5 years: 1.6-3.3 nmol/L  
     5 to 10 years: 1.5-3.0 nmol/L  
     > 10 years: 1.5-2.7 nmol/L  
Ind: Thyroid disease  
Int: HIGH - T₃ thyrotoxicosis, hyperthyroidism  
Phys: More sensitive test for hyperthyroidism than free thyroxine (free T₄)  
See also other Thyroid Function Tests

‘Triple Test’ Antenatal Investigation for Down Syndrome, Serum  
Phys: Results of S.alpha-fetoprotein, S.HCG  and S. Oestriol tests are compared to give an indication of risk for Down syndrome in foetus. See individual tests for further information

Troponin I, Serum  
RI:  <0.6 µg/L  
Ind: Myocardial damage  
Int: HIGH - Myocardial infarct (CK?), myocarditis, myocardial trauma  
     VERY HIGH (>2ug/L) - High risk of death from existing MI within 30 days  
Phys: Positive within 4 hours of pain onset in myocardial infarct. Remains for at least 7 days. Very specific immunoassay. Odds ratio for death from MI increases rapidly with higher Troponin I levels.  
See also Troponin T, Serum; Creatine Kinase, Serum

Troponin T, Serum  
RI: Negative (<0.2 µg/L)  
Ind: Myocardial damage
Int: POSITIVE - Myocardial infarct (CK?), unstable angina, myocarditis, myocardial trauma, aortic dissection, malignant hypertension, pulmonary embolism, septicaemia, significant cerebral damage, renal failure, extreme exertion.

Phys: More sensitive than CK. 80% positive within 4 hours, and 99% within 6 hours, of pain onset in myocardial infarct. Remains for at least 7 days. Very specific immunoassay

See also Troponin I, Serum; Creatine Kinase, Serum; Myoglobin, Serum

Trypanosome Antibodies, Blood
RI: Negative
Ind: Sleeping sickness
Int: POSITIVE - Trypanosomiasis (sleeping sickness), Chaga’s disease
Phys: False positive results common. CSF and lymph node aspirate can also be used for test

Trypsin, Immunoreactive, Blood
RI: Nil
Ind: Neonatal screen for cystic fibrosis
Int: HIGH - Cystic fibrosis, acute pancreatitis
Phys: Determined by radio-immunoassay. Trypsin present in blood up to a level of 1.9 mg/mL is inhibited and undetectable. Cystic fibrosis levels appear to drop after one month of age as trypsin inhibitors increase in blood

Tryptase, Serum
RI: <2 U/L
Ind: Anaphylaxis
Int: HIGH - Anaphylaxis, severe allergy, mastocytosis
Phys: Tryptase released by mast cell degeneration. Detectable 30 to 60 minutes after event, rises to peak at 2 hours then decreases to undetectable level by 6 to 12 hours. False negative possible

TSH
See Thyroid Stimulating Hormone, Plasma

Tuberculin Skin Test
(Heaf Test, Mantoux Test)
RI: Negative
Ind: Tuberculosis screening
Int:  POSITIVE (> 10 mm indurated area) - Past or present tuberculosis
DOUBTFUL (5-9 mm indurated area) - Recent TB infection, cross-
sensitivity to other mycobacteria, allergy
NEGATIVE (< 5 mm indurated area) - TB not likely
Phys: Tuberculin antigen is administered intracutaneously by multiple puncture
(Heaf test) or by scratch (Mantoux test). Standardised serums are used,
and skin reactions measured

Tumour Markers
See Cancer Associated Antigens, Serum

Typhoid Antibodies
See Widal Test

Tzank Smear
RI:  Negative
Ind:  Suspected Herpes infection.
Int:  POSITIVE - Herpes zoster (shingles or chickenpox), Herpes simplex
Phys: The roof of an intact blister is removed and the floor scraped with a
rounded scalpel blade. The material is smeared onto a slide and stained
with toludine blue. Multinuclear giant cells with viral inclusions seen if
Herpes present. Cannot distinguish between types of Herpes
See also Herpes Simplex Antibody, Serum

Urate, Plasma
(Uric Acid)
RI:  Male 0.24-0.42 mmol/L (3.2-8.1 mg/100 mL)
     Female 0.17-0.36 mmol/L (2.2-7.1 mg/100 mL)
Ind:  Acute arthritis
Int:  HIGH - (Hyperuricaemia) Gout (U.urate?), high protein diet, leukaemia
     (FBC?), hypertension, renal failure (S.creatinine?), myeloma, lymphoma,
     other malignancies, polycythaemia, prolonged pyrexia, hypothyroidism,
     hyperlipidaemia, starvation, dehydration, psoriasis, viraemia, infectious
     mononucleosis, alcoholism (GGT), fasting, haemolytic anaemia,
     rhabdomyolysis, acidosis, lead poisoning, Lesch-Nyhan syn., toxaemia of
     pregnancy, obesity, idiopathic, drugs (eg. thiazides, other diuretics,
     salicylates, nicotinic acid, cytotoxics, lead). Treatment in asymptomatic
     patients not necessary unless over 0.54 mmol/L.
     LOW - (Hypouricaemia) Acute hepatitis (LFT?), probenecid or allopurinol
     therapy, Fanconi syn., renal tubular disease, syndrome of inappropriate
     ADH secretion, diuresis, pregnancy
Phys: Uric acid is an end product of purine metabolism, and is excreted by the kidney. Gout is a metabolic disease characterised by increased levels of uric acid, and crystals of this are deposited in joints. Results are raised by thiazide diuretics, lowered by salicylates, methyldopa and phenylbutazone.

**Urate, Urinary 24 Hour Excretion**
RI: < 3.6 mmol/day (< 600 mg/day)
Ind: Gout
Int: HIGH - Urate overproduction type of gout
LOW - Urate underexcretion type of gout (uric acid?), renal disease
Phys: Test after 5 days on low purine diet. Overproduction treated with allopurinol or similar drug, underexcretion with uricosuric drug

**Urea, Blood [BUN]**
RI: 2.5 - 6.8 mmol/L
Pregnancy: 1.0 - 3.8 mmol/L
Neonate: 1.7 - 5.3 mmol/L
Ind: Renal disease
Int: HIGH - Renal insufficiency (S.creatinine?), nephritis, urinary tract obstruction, dehydration (SG?), intestinal bleeding, shock, congestive cardiac failure, excess protein catabolism, diabetic nephropathy, polycystic kidney disease, reflux nephropathy, adrenal insufficiency (17-hydroxy steroids?), dehydration, elderly, drugs (eg. analgesics, NSAIDs)
LOW - Hepatic failure (LFT?), nephrosis, cachexia, diabetes insipidus, pregnancy, overhydration, diuresis, kwashiorkor, low protein diet
Phys: Renal damage prevents urea excretion. Excretion of urea load is a good test of renal function. Results are affected by methyldopa, indomethacin, propranolol, etc. BUN varies directly with protein intake, and inversely with the rate of excretion of urea. S.creatinine a more reliable estimate of renal function

*See also Creatinine, Serum*

**Urea, Breath**
See Carbon-14 Urea, Breath

**Urea, Urine**
RI: 420-720 mmol/day
Int: HIGH - Blood urea high, excess protein intake
LOW - Renal insufficiency

*See also Urea, Blood*
Urea Nitrogen, Blood [BUN]
See Urea, Blood

Urease, Breath
See Carbon-14 Urea, Breath

Uric Acid, Serum
See Urate, Plasma

Urinary Urate
See Urate, Urinary 24 Hour Excretion

Urine, Blood
See Haematuria

Urine Acidification Test
RI: Adult : pH ≤5.3
Child : pH≤5.5
    Ammonium >35µmol/min/m²
Ind: Renal tubular acidosis
Int: pH HIGH - Distal renal tubular acidosis
    pH NORMAL - Metabolic acidosis, proximal tubular acidosis
    AMMONIUM LOW - Proximal tubular acidosis
Phys: One hour urine specimen collected from acidotic patient (acidosis is
      induced if necessary). Blood gases confirm acidosis

Urine Casts
See White Cell Count, Urine

Urine Colour
RI: Light yellow and clear ('straw')
Int: RED - Blood, myoglobin, drugs (eg. rifampicin, phenindione), foods (eg. beetroot, berries)
    DARK YELLOW - Dehydration
    BROWN - Bilirubin, urobilinogen, porphyria (changes colour when left to stand)
    BLUE GREEN - Drugs (eg. amitriptyline)
DOCTOR’S COMPANION
Section Four - Pathology

CLOUDY - Leucocytes (eg. infection), salts (eg. urates, phosphates), refrigeration and time (precipitation of salts)

Urobilinogen, Faeces
RI: 68-474 µmol/day (40-280 mg/day)
Ind: Liver disease
Int: HIGH - Excess bilirubin production, haemolytic anaemia
LOW - Antibiotics, hepatobiliary disease, bile duct obstruction, infant
Phys: Averaged over 4 day collection

Urobilinogen, Urine
RI: < 4.23 µmol/day (0-2.5 mg/day) (0.1-1.0 Ehrlich units/100 mL)
Ind: Liver disease
Int: HIGH - Parenchymal liver disease, haemolytic anaemia
Phys: Bacteria convert bilirubin to urobilinogen

Valium, Serum
See Diazepam, Serum

Valproate, Serum
(Sodium Valproate; Epilim)
RI: Therapeutic range 300-600 µmol/L (40-85 µg/mL)
Ind: Sodium valproate therapy
Int: Adjust dosage to keep serum levels within therapeutic range
Phys: Valproate is used to treat epilepsy. Sample prior to next dose

Vancomycin, Blood
See Aminoglycosides, Blood

Vanillylmandelic Acid
See 4-Hydroxy-3-Methoxy Mandelic Acid, Urine

Varicella Zoster Antibody, Serum
RI: Negative
Ind: Detection of past exposure to Varicella zoster
Int: PRESENT - Past infection with chickenpox or shingles
Phys: Used in immunocompromised patients. Not for diagnosis of current infection
Vasoactive Intestinal Peptide, Serum
RI: Negative
Ind: Following progress of certain cancers
Int: POSITIVE - Some cases of bronchogenic lung cancer, pancreatic islet cell cancer, neuroblastoma, thyroid medullary cancer, phaeochromocytoma; occasionally in shock, cirrhosis, hepatic failure
See also Cancer Associated Antigens, Serum

Vasopressin
See Antidiuretic Hormone

VC
See Vital Capacity, Lungs

VDRL [Venereal Disease Research Laboratory Test]
See Rapid Plasma Reagin Test, Serum

Very Low Density Lipoprotein Cholesterol, Blood [VLDL]
RI: < 1 mmol/L
Ind: Hypercholesterolaemia
Int: HIGH - Reaven syn.

Viral Serology
See Immunoglobulin, Specific, Serum

Viscosity, Plasma
RI: 1.6-1.9 mPa.s (1.52-1.72 centipoise)
Ind: Thrombosis
Int: HIGH - Hyperviscosity syndrome, multiple myeloma, Waldenström macroglobulinaemia, polycythaemia rubra vera, acute leukaemia, chronic myeloid leukaemia, rheumatoid arthritis, acute inflammation, dehydration, hypothermia
LOW - Overhydration, IV fluids
Phys: A high viscosity may be a precipitant of venous thrombosis
Vital Capacity, Lungs [VC]

RI: Units: Litres (L)

See table below:-

Reference Intervals, Vital Lung Capacity

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-50</td>
<td>3 - 6L</td>
<td>2 - 4.5L</td>
</tr>
<tr>
<td>&gt;50</td>
<td>2.5 - 5.5L</td>
<td>1.9 - 4L</td>
</tr>
</tbody>
</table>

Ind: Pulmonary disease

Int: LOW - Inadequate pulmonary ventilation due to asthma, bronchitis, TB, bronchiectasis, pneumonia, surgery, etc.

Phys: Vital capacity is the maximum volume of gas that can be expired after maximal inspiration

See also Forced Expiratory Volume in 1 Second

Vitamin A, Plasma

RI: 0.7-2.8 µmol/L

Ind: Malnutrition, eye disease

Int: HIGH - Excess ingestion of vit. A, carotenaemia

LOW - Xerophthalmia, keratomalacia, photophobia, night blindness, malnutrition

Phys: Vit. A is vital in retinal pigment. Found in fish oil, milk and eggs, vegetables

Vitamin B1, Blood

(Thiamine)

RI: Mean values:

Male 8.9 µg/100 mL
Female 7.6 µg/100 mL

Ind: Malnutrition

Int: LOW - Beriberi, Wernicke syn.

Phys: Thiamine is present in cereals, green vegetables, liver and peanuts. Lack causes neurasthenia, paraesthesia and anorexia

Vitamin B2, Plasma

(Riboflavine)

RI: 2.6-3.7 µg/100 mL

Ind: Poor nutrition, stunted growth

Int: LOW - Malnutrition or malabsorption with cheilosis, glossitis and photophobia

Phys: Vit. B2 is found in milk, liver and green vegetables
Vitamin B₃, Serum  
(Nicotinic Acid)  
RI: 0.6 mg/100 mL  
Ind: Malnutrition  
Int: LOW - Pellagra  
Phys: Nicotinic acid is present in whole grain, lean pork and beef, and peanuts. Lack causes lassitude, dermatitis, diarrhoea and glossitis

Vitamin B₁₂, Serum  
(Cyanocobalamin)  
RI: 150-660 pmol/L (200-900 ng/mL)  
Ind: Anaemia  
Int: LOW - Pernicious anaemia (Hb?), gastrectomy, intestinal blind loops, Crohn's disease, sprue, chronic pancreatitis, subacute combined degeneration of the cord, congenital, vegan diet. False low due to folate deficiency, late pregnancy, oral contraceptives, multiple myeloma, megadose vitamin C therapy  
HIGH - Hepatic disease. False high due to chronic leukaemia, polycythæmia rubra vera, metastatic malignancy  
Phys: Vit. B₁₂ is required for the formation of erythrocytes. Intrinsic factor of stomach required for its absorption from the gut  
See also Schilling Test

Vitamin C, Serum  
(Ascorbic Acid)  
RI: 23-86 µmol/L (0.4-1.5 mg/100 mL)  
Ind: Dietary deficiency  
Int: LOW - Scurvy,rickets (ALP,Ca?)  
Phys: Lack of vit. C leads to impaired wound healing, and poor resistance to infections and stress. Plentiful in citrus and berry fruits

Vitamin D, Serum  
(Hydroxycalciferol)  
RI: 35-120 pmol/L  
Ind: Bone disease  
Int: LOW - Rickets (Ca, P?), stunted growth, tetany, osteomalacia, proximal myopathy  
HIGH - Metastatic calcification with excess intake of calcium or its mobilisation from bone  
Phys: Vit. D is formed by the irradiation of ergosterol in the skin. Low levels may be due to sun deprivation, pregnancy, malabsorption, renal or liver failure.
Recommended dietary allowance 10 µg/day. Fast for 12 hours before test. Collect blood without using tourniquet

*See also 25-Hydroxyvitamin D, Blood; Calcium, Serum*

**Vitamin E, Serum**

RI: Adult: 11-46 µmol/L  
Child: 7-35 µmol/L  
Ind: Haemolysis, fat malabsorption  
Int: LOW - Deficiency due to haemolysis or malabsorption  
FALSE NORMAL - Hyperlipidaemia, cholestasis

**Vitamin K, Serum**  
*(Phytomenadione)*

RI: Refer to laboratory  
Ind: Undiagnosed bleeding disorder  
Int: LOW - Malabsorption, cholestasis, small bowel diseases, haemorrhagic disease of newborn, dietary insufficiency, long term antibiotics  
Phys: Lack of vitamin K causes excessive bleeding and bruising. Test not yet routinely available

**VLDL**  
See Very Low Density Lipoprotein Cholesterol, Blood

**VMA**  
See 4-Hydroxy-3-Methoxy Mandelic Acid

**von Willebrand Factor, Plasma (vWF)**  
*(Ristocetin Cofactor; Collagen Binding Assay, von Willebrand Factor)*

RI: Variable  
Ind: von Willebrand's disease  
Int: LOW - von Willebrand's disease  
Phys: ELISA test, measuring qualitative and quantitative abnormalities of von Willebrand factor. Subtypes of disease can be identified by variables within test

**vWF**  
See von Willebrand Factor, Plasma
Waaler-Rose Test
See Rheumatoid Factor, Serum

Wasserman Complement Fixation Test [WR]
RI: Negative
Ind: Sexually transmitted disease
Int: POSITIVE - Syphilis (FTA?), yaws
Phys: Nonspecific screening test for syphilis
See also Rapid Plasma Reagin Test, Serum

Water Deprivation Test
See Fluid Deprivation Test

WCC
See White Cell Count, Blood; White Cell Count, Urine

Weil-Felix Reaction
(Rickettsial Serology)
RI: Negative (titre < 1:160)
Ind: Typhus
Int: POSITIVE - Epidemic typhus, murine typhus, scrub typhus, rocky mountain spotted fever, tick typhus
NEGATIVE - Q fever, other rickettsiae, normal persons
Phys: Nonspecific agglutination of Proteus strain by serum of affected patient

White Cell Count, Blood [WCC]
(Leucocyte count)
RI: Neonate 10-30 x 10^9/L (10,000-30,000/mm^3)
Infant 6-20 x 10^9/L (6,000-20,000/mm^3)
Child 5-15 x 10^9/L (5,000-15,000/mm^3)
Adult 4-10 x 10^9/L (4,000-10,000/mm^3)
Ind: Infection, blood disease
Int: HIGH (Leucocytosis) - Bacterial infection, leukaemias, alcoholic hepatitis, cholecystitis, pregnancy
LOW (Leucopenia) - Leukaemia, viraemia (eg. viral hepatitis), autoimmune disease, post splenectomy, elderly
ABNORMAL FORMS - Bloch-Sulzberger syn., Bloom syn., eosinophilia-myalgia syn., May-Hegglin anomaly, myelodysplastic syn., Sézary syn., leukaemia
See also entries for individual white cell types

White Cell Count, Urine (Addis Count)
RI:  < 3000/mL (1-2/HPF) (< 5/mm³)
Ind: Renal disease
Int: HIGH - Inflammation of urinary tract (eg. infection, irritation, nephropathy collagen diseases etc.)
      RED CELL CASTS HIGH - Glomerular bleeding
      HYALINE CASTS HIGH - Fever, diuretics, exercise, severe renal disease
      WHITE CELL CASTS HIGH - Pyelonephritis
      GRANULAR CASTS HIGH - Nonspecific renal disease
      WAXY CASTS HIGH - Chronic renal disease
Phys: White cells are nonspecific signs of renal tract damage. Cell casts localise damage to kidney. Cells counted on a grid under a x40 microscope lens

Widal Test (Typhoid Antibodies, Blood)
RI: Negative
Ind: Typhoid fever
Int: RISING TITRE - Typhoid fever
      POSITIVE - Typhoid vaccination, carrier state
Phys: False positives and negatives common. Rising titre more significant

WR
See Wasserman Complement Fixation Test

Wood's Light
RI: No fluorescence
Ind: Fungal infection of skin or hair
Int: FLUORESCENCE - Fungal infection present.
      Bright yellow/green hairs (not skin) - Tinea capitis
      Red/pink skin (not hairs) - Erythrasma
      Aqua green/light green skin - Pseudomonas
      Bright yellow skin - Pityriasis versicolor
Phys: Filtered ultraviolet light (wavelength 365nm.) causes fluorescence. Lamp must be turned on for about 3 minutes to obtain maximum effect and held 10 cm. from skin. Lint in hair fluoresces white
Xylose Absorption Test, Urine
RI: 5-8 g/5 hours
Ind: Malabsorption
Int: LOW - Sprue, renal insufficiency, coeliac disease
Phys: 25 g of xylose is given, and its urinary excretion over 5 hours is measured. Xylose is absorbed in the jejunum. Unreliable test

Zarontin
See Ethosuximide, Serum

Zinc, Serum [Zn]
RI: 12-20 µmol/L (80-140 µg/100 mL)
Int: LOW - Cirrhosis, diarrhoea, malabsorption syn., alcoholism (GGT?), drugs (eg. steroids, diuretics)
HIGH - May be due to zinc therapy

Zinc, Urine
RI: 8-11 µmol/day
Ind: Zinc lack or excess
Int: HIGH - Catabolic states, excess zinc in blood
LOW - Zinc deficiency, liver disease, poor wound healing
Phys: Indication of amount of exchangeable zinc in body

Zinc Protoporphyrin, Blood [ZPP]
RI: <4 µg/L
Ind: Iron deficiency anaemia
Int: HIGH - Severe iron deficiency, lead poisoning, chronic inflammation, disorders of haemoglobin synthesis
Phys: If there is insufficient iron to insert into protoporphyrin to make haem, zinc may be incorporated instead to make zinc protoporphyrin. measured by fluorescence.
See also Ferritin, Serum; Iron, Serum

Zn
See Zinc
ZPP
See Zinc Protoporphyrin