Test: Blood Glucose	**Reference range:** 3.61 - 6.38 mmol/L	**Optimal range:** 4.44 - 5.55 mmol/L
Use & Pathophysiology	- screen for potential dysglycemia and blood sugar dysregulation in conjunction with a full chem. screen and Glucose Tolerance Test with or without insulin - Diabetes management	
Clinical and diagnostic implications – HIGH	- Insulin resistance (Early stage) and glucose intolerance - Early stage of Hyperglycemia/Diabetes - Syndrome X/hyperinsulinemia - Thiamine need - Anterior Pituitary resistance to cortisol - Acute stress - Fatty liver (early development) and Liver congestion - Obesity	
Clinical and diagnostic implications – LOW	- Hypoglycemia - reactive - Hypoglycemia - liver glycogen problem - Hyperinsulinism - Adrenal hypofunction	
Confounding factors	Blood with a low hematocrit (<35%), pregancy → falsely increased level. Blood with a high hematocrit (>55%), capillary measurements from cyanotic areas → falsely decreased level.	
Related tests	.Serum triglycerides, total cholesterol, hemoglobin A1C, blood insulin, urine glucose glucose tolerance test with or without insulin, HDL, LDL and VLDL.	

Test: Hb A1C	**Reference range:** <7% or 0.07	**Optimal range:** 4.1 – 5.7% or 0.041 – 0.057
Use & Pathophysiology	- to follow long-term blood glucose control (check up on diabetic patients) - pre-diabetic patient: keeping glucose levels within optimal range - screen for hypoglycemia - determine the therapeutic choices and directions for diabetes management - follow-up on diabetic patients whose renal threshold for glucose is abnormal - follow insulin dependent diabetics whose blood glucose levels fluctuate from day to day	
Clinical and diagnostic implications – HIGH	- Diabetes mellitus - Insulin resistance (early stage) and glucose intolerance	
Clinical and diagnostic implications – LOW	- Hypoglycemia	
Confounding factors	Presence of different sub-types of hemoglobin molecules (haemoglobin F and uremia) → falsely increased level.	
Related tests	Blood glucose, LDH	

Test: Cholesterol	**Reference range:** 3.36 - 5.52 mmol/L	**Optimal range:** 3.9 - 5.69 mmol/L
Use & Pathophysiology	- as part of a lipid screening assessment - to monitor treatment - as part of a liver function study - as part of a thyroid function study	
Clinical and diagnostic implications – HIGH	- Primary hypothyroidism - Adrenal cortical dysfunction - Secondary Hypothyroidism - Cardiovascular disease - Atherosclerosis - Biliary stasis - Early stage of insulin resistance - Poor metabolism and utilization of fats - Fatty liver (early development) and Liver congestion - Early stage of Hyperglycemia / Diabetes - Syndrome X / hyperinsulinemia - Hyperlipoproteinemia - Multiple sclerosis	
Clinical and diagnostic implications – LOW	- Oxidative Stress and Free Radical Activity - Heavy metal / Chemical overload - Liver / biliary dysfunction - Diet - Malnutrition (insufficient fat intake, vegetarian diet) - Thyroid hyperfunction - Autoimmune processes - Adrenal hyperfunction	
Confounding factors	Thiazide diuretic therapy, fall and winter seasons → falsely increased level. Patient changing from standing to recumbent position, major illnesses, high Vitamin C levels, sprint and summer seasons → falsely decreased level.	
Related tests	.Apolipoprotein A and B, HDL, LDL, VLDL, triglycerides, lipid electrophoresis, Serum homocysteine, Oxidata Free Radical Test	

Test: LDL	**Reference range:** 1.55 - 3.36 mmol/L	**Optimal range:** < 3.10 mmol/L
Use & Pathophysiology	- as part of a cardiovascular screening assessment - as part of a lipid screening assessment - to screen for Syndrome X and blood sugar dysregulation - to monitor treatment - as part of a liver or thyroid function study	
Clinical and diagnostic implications – HIGH	- Diet - high in refined carbohydrates - Syndrome X / hyperinsulinemia - Atherosclerosis - Hyperlipidemia - Oxidative stress - Fatty liver (early development) and Liver congestion	
Clinical and diagnostic implications – LOW		
Confounding factors	Pregnancy → falsely increased level.	
Related tests	Total cholesterol, HDL, triglycerides, lipoprotein studies, blood glucose, lipid electrophoresis, serum homocysteine, Oxidata free radical test and Uric acid, RBC, HCT and HGB (will often be increased with developing atherosclerotic condition).	

Test: HDL	**Reference range:** 1.03 - 2.32 mmol/L	**Optimal range:** > 1.42 mmol/L
Use & Pathophysiology	- as part of a cardiovascular risk assessment - as part of a lipid screening assessment - to screen for syndrome X and blood sugar dysregulation - to monitor treatment - as part of a liver and thyroid function study	
Clinical and diagnostic implications – HIGH	- Autoimmune processes	
Clinical and diagnostic implications – LOW	- Hyperlipidemia and atherosclerosis - Diets high in refined carbohydrates - Syndrome X / hyperinsulinemia - Oxidative stress - Heavy metal / Chemical overload - Fatty liver (early development) and Liver congestion - Hyperthyroidism - Lack of exercise / sedentary lifestyle	
Confounding factors	Ascorbic acid, after MI→ falsely decreased level.	
Related tests	Total cholesterol, LDL, triglycerides, lipoprotein studies, blood glucose, lipid electrophoresis, serum homocystein, Oxidata free radical test, RBC, HCT and HGB (will often be increased with developing atherosclerotic condition)	

Test: Triglycerides	**Reference range:** 0.34 - 1.7 mmol/L	**Optimal range:** 0.79 - 1.24 mmol/L
Use & Pathophysiology	- as part of a cardiovascular screening assessment - as part of a lipid screening assessment - to monitor treatment - as part of a liver function study - as part of a thyroid function study	
Clinical and diagnostic implications – HIGH	- Syndrome X / hyperinsulinemia - Fatty liver (early development) and Liver congestion - Early stage of insulin resistance - Cardiovascular disease - Atherosclerosis - Poor metabolism and utilization of fats	- Early stage of hyperglycemia / Diabetes - Hyperlipidemia - Primary hypothyroidism - Adrenal cortical dysfunction - Secondary Hypothyroidism - Hyperlipoproteinemia - Alcoholism
Clinical and diagnostic implications – LOW	- Liver / biliary dysfunction - Diet - nutrient deficient, insufficient fat intake, vegetarian diet - Thyroid hyperfunction - Autoimmune processes - Adrenal hyperfunction	
Confounding factors	High fat diet, alcohol intake, pregnancy, obesity, severe acute stress, high alkaline phosphatase levels → falsely increased level. Ascorbic acid → falsely decreased level.	
Related tests	Total cholesterol, LDL, HDL, lipoprotein studies, blood glucose, lipid electrophoresis, serum homocysteine, Oxidata free radical test.	

Test: Apo A, Apo B	**Reference range:** Apo A: 110 - 162 mg/dL Apo B: 52 - 109 mg/dL	**Optimal range:** Apo A: 110 - 162 mg/dL Apo B: 52 - 109 mg/dL Lp – (a): <200 mg/L
Use & Pathophysiology	- to gather more data on cardiovascular risk assessment	
Clinical and diagnostic implications – HIGH	- Apo A: lowered incidence of cardiovascular disease - Apo B: increased incidence or premature coronary artery disease, diabetes, hypothyroidism, nephrotic syndrome, renal failure, Porphyria, Cushing's syndrome	
Clinical and diagnostic implications – LOW	- Apo A: increased incidence of premature cardiovascular disease; poorly controlled diabetes, hepatocellular disease, nephrotic syndrome, renal failure. - Apo B: Lowered incidence of cardiovascular disease, hypothyroidism, malnutrition, malabsorption, chronic anemias, Reye's syndrome, acute stress, inflammatory joint disease.	
Confounding factors	Prescription drugs → falsely elevate Apolipoprotein studies Apo A: diet high in polyunsaturated fats, smoking, androgens and oral contraceptive use → falsely decreased level. Apo B: diet high in polyunsaturated fats → falsely decreased level	
Related tests	.Triglycerides, cholesterol, LDL, HDL, VLDL, Uric acid, lipid electrophoresis, RBC, HCT and HGB (will often be increased with developing atherosclerotic condition)	

Test: BUN Blood Urea Nitrogen	**Reference range:** 1.79 – 8.93 mmol/L	**Optimal range:** 3.57 – 5.71 mmol/L
Use & Pathophysiology	- to screen for renal insufficiency - to assess liver dysfunction - to screen for functional digestive problems and for dehydration	
Clinical and diagnostic implications – HIGH	- renal disease - renal insufficiency - dehydration - dysbiosis - oedema - hypochlorhydria - diet: excessive protein intake or catabolism - adrenal hyperfunction - anterior pituitary dysfunction - drugs: diuretics, prescription corticosteroids	
Clinical and diagnostic implications – LOW	- diet: low protein - malabsorption - pancreatic insufficiency - liver dysfunction - posterior pituitary dysfunction - drugs: anabolic steroids, some antibiotics	
Confounding factors	Late pregnancy (due to increased use of protein) → falsely increased levels Small muscle mass (e.g. women and children) → falsely decreased levels	
Related tests	Serum creatinine, urinary uric acid, blood electrolytes, SGPT/ALT, SGOT/AST, GGTP, serum ALP, isoenzymes of ALP, MCV/MCH, RBC, HCT and ROB, sedimentation rate, basophils, gamma globulin, rheumatoid factor, serum phosphorus, CDSA, hair mineral analysis, urinary heavy metal screen	

Test: Creatinine	**Reference range:** 53.0 – 132.6 µmol/L	**Optimal range:** 70.7 – 97.2 µmol/L
Use & Pathophysiology	- to assess kidney function - to assess prostate and uterine function - to monitor prostate treatments - to monitor IV chelation treatments	
Clinical and diagnostic implications – HIGH	- MALE urinary tract congestion/obstruction: benign prostatic hypertrophy, prostatitis, UTI - renal disease - renal insufficiency - FEMALE urinary tract congestion/obstruction: uterine hypertrophy, uterine inflammation, UTI - drugs: aspirin/NSAIDS, antibiotics, bismuth, lithium, indomethacin, diuretics (furosamide, thiazide)	
Clinical and diagnostic implications – LOW	- muscle atrophy / nerve-muscle degeneration	
Confounding factors	High ascorbic acid intake, cephalosporin antibiotics, diet high in meat → falsely increased levels High bilirubin levels, cephalosporin antibiotics, glucose, histidine, quinidine → falsely decreased levels	
Related tests	BUN, creatinine clearance, uric acid, blood electrolytes, Prostatic Specific Antigen (PSA), liver enzymes, urinalysis	

Test: BUN : creatinine ratio	**Reference range:** 7 – 14	**Optimal range:** 13 – 17
Use & Pathophysiology	- to assess patients with chronic renal dysfunction	
Clinical and diagnostic implications – HIGH	- renal disease - drugs: steroids antibiotics	
Clinical and diagnostic implications – LOW	- diet: low protein - posterior pituitary dysfunction - drugs: cephalosporin (antibiotics), phenacemide (anti-convulsant)	
Confounding factors	None noted	
Related tests	BUN, creatinine, uric acid	

Test: Potassium	**Reference range:** 3.5 – 5.3 mmol/L	**Optimal range:** 4.0 – 4.5 mmol/L
Use & Pathophysiology	- as a marker for adrenal health - acid-base balance	
Clinical and diagnostic implications – HIGH	- adrenal hypofunction - dehydration - tissue destruction - metabolic acidosis	
Clinical and diagnostic implications – LOW	- adrenal hyperfunction - drug diuretics - benign essential hypertension	
Confounding factors	Hemolysed blood, excessive intake of licorice → falsely increased levels Glucose administered during tolerance testing, ingestion and administration of large amounts of glucose in patients with heart disease → falsely decreased levels	
Related tests	Plasma and salivary cortisol, blood aldosterone, plasma rerun, serum calcium, serum chloride, serum sodium, CO_2 and anion gap, HGB, HCT and RBC, serum BUN, serum creatinine, serum and salivary dehydroepiandrosterone (DHEA).	

Test: Sodium	**Reference range:** 135 – 145 mmol/L	**Optimal range:** 135 – 142 mmol/L
Use & Pathophysiology	- as a marker for adrenal health - acid-base balance	
Clinical and diagnostic implications – HIGH	- adrenal hyperfunction - Cushing's disease - dehydration - drugs: steroids, aspirin, NSAIDs, anti-hypertensives, laxatives	
Clinical and diagnostic implications – LOW	- adrenal hypofunction - Addison's disease - oedema - drug diuretics - drugs: heparin, laxatives, sulfates, diuretics	
Confounding factors	High triglyceride or low protein levels → falsely decreased levels	
Related tests	Plasma and salivary cortisol, uric acid, serum chloride, serum potassium, CO_2, anion gap, serum BUN, serum creatinine	

Test: Chloride	**Reference range:** 97 – 107 mmol/L	**Optimal range:** 100 – 106 mmol/L
Use & Pathophysiology	- as a marker for hypochlorhydria - as a general measure of tissue acidity and alkalinity	
Clinical and diagnostic implications – HIGH	- metabolic acidosis - adrenal hyperfunction	
Clinical and diagnostic implications – LOW	- hypochlorhydria - metabolic alkalosis - adrenal hypofunction - drugs: steroids, laxatives, diuretics, theophylline, bicarbonate	
Confounding factors	Infants, saline IV infusions → falsely increased levels	
Related tests	Anion gap, serum CO_2, serum potassium and sodium, BUN, serum creatinine	

Test: Bicarbonate (CO_2)	**Reference range:** 23 – 32 mmol/L	**Optimal range:** 25 – 30 mmol/L
Use & Pathophysiology	- as a general measure of tissue acidity and alkalinity	
Clinical and diagnostic implications – HIGH	- hypochlorhydria - metabolic alkalosis - adrenal hyperfunction - respiratory acidosis	
Clinical and diagnostic implications – LOW	- metabolic acidosis - thiamine (vitamin B_1) need - respiratory alkalosis - drugs: salicylate excess (aspirin), diuretics (chlorothiazide class)	
Confounding factors	None noted.	
Related tests	Blood gases, serum chloride, potassium, sodium, anion gap.	

Test: Anion Gap	**Reference range:** 6 – 16 mmol/L	Optimal range: 7 – 12 mmol/L
Use & Pathophysiology	- as a general measure of tissue acidity and alkalinity	
Clinical and diagnostic implications – HIGH	- metabolic acidosis - thiamine (vitamin B_1) need - drugs: aspirin, diuretics, penicillin (antibiotics)	
Clinical and diagnostic implications – LOW	- associated with multiple myeloma N.B. it has been hypothesised that most calculated anion gaps are a result of laboratory error.	
Confounding factors	Anything that falsely decreases chloride/CO_2 or falsely increases sodium/potassium, excessive liquorice intake → falsely increased levels Anything that falsely increases chloride/CO_2 or falsely decreases sodium/potassium, high triglycerides, low protein levels → falsely decreased levels	
Related tests	Serum sodium, potassium, CO_2, and chloride	

Test: Total Protein	**Reference range:** 60 – 85 g/L	**Optimal range:** 69 – 74 g/L
Use & Pathophysiology	- to screen for nutritional deficiencies - to screen for functional digestive problems - to screen for dehydration	
Clinical and diagnostic implications – HIGH	- dehydration	
Clinical and diagnostic implications – LOW	- hypochlorhydria - digestive dysfunction/inflammation - liver dysfunction - diet: low protein, malnutrition / amino acid need	
Confounding factors	Haemolysis, dehydration → falsely increased levels Pregnancy (especially 3rd trimester), prolonged bed rest → falsely decreased levels	
Related tests	Albumin, total globulin, liver enzymes, WBC with differential, serum protein electrophoresis, serum gastrin, IgA, IgM, IgG, HCT, HGB	

Test: Albumin	**Reference range:** 35 – 55 g/L	**Optimal range:** 40 – 50 g/L
Use & Pathophysiology	- to ascertain digestive sufficiency - to screen for hydration	
Clinical and diagnostic implications – HIGH	- Dehydration	
Clinical and diagnostic implications – LOW	- Hypochlorhydria - Liver dysfunction - Oxidative stress and excess Free Radical Activity - Vitamin C - Pregnancy	
Confounding factors	Dehydration → falsely increased levels Excessive hemolysis in patient sample taken supine → falsely decreased levels	
Related tests	Albumin/globulin ratio, total protein, total globulin, serum protein electrophoresis (SPE), liver enzymes, WBC and differential, alpha 1 glycoproteins, CEA and other tests used to confirm neoplasm.	

Test: Total Globulin	**Reference range:** 20 – 39 g/L	**Optimal range:** 24 – 28 g/L
Use & Pathophysiology	- to investigate inflammatory and/or immunological disturbances - to ascertain digestive sufficiency	
Clinical and diagnostic implications – HIGH	- Hypochlorhydria - Liver damage/infections - Oxidative Stress and Free Radical activity - Heavy metal / Chemical toxicity - Immune Activation	
Clinical and diagnostic implications – LOW	- Digestive Dysfunction Inflammation - Immune insufficiency	
Confounding factors	none noted	
Related tests	Albumin, A/G ratio, total protein, serum protein electrophoresis (SPE), serum Gastrin, liver enzymes, sedimentation rate, WBC and differential, alpha I Glycoproteins, CEA, and other tests used to confirm neoplasm.	

Test: Albumin/Globulin Ratio	**Reference range:** 1.1 – 2.5 g/L	**Optimal range:** 1.5 – 2.0 g/L
Use & Pathophysiology	- to investigate inflammatory and/or immunological disturbances - to ascertain digestive sufficiency	
Clinical and diagnostic implications – HIGH		
Clinical and diagnostic implications – LOW	- Liver dysfunction - Immune Activation	
Confounding factors	Dehydration → falsely increased levels Normal during pregnancy → falsely decreased levels Excessive hemolysis in patient sample taken supine → falsely decreased levels	
Related tests	Albumin, total globulin, serum protein electrophoresis (SPE), alpha 1, alpha 2, beta and gamma globulin, liver enzymes.	

Test: Serum Calcium	**Reference range:** 2.13 – 2.70 mmol/L	**Optimal range:** 2.30 – 2.50 mmol/L
Use & Pathophysiology	- to assess parathyroid function - to ascertain digestive sufficiency	
Clinical and diagnostic implications – HIGH	- Parathyroid Hyperfunction - Thyroid hypofunction - Impaired cell membrane health	
Clinical and diagnostic implications – LOW	- Parathyroid Hypofunction - Calcium need and/or a need for its co-factor - Hypochlorhydria	
Confounding factors	Thiazide diuretics (impair urinary Ca+ excretion) → falsely increased levels Ca+ supplements taken prior to blood draw → falsely increased levels Laxative use (increased intestinal Ca+ loss) → falsely decreased levels	
Related tests	Parathyroid hormone (PTH), thyroid panel, serum magnesium, RBC magnesium, serum phosphorous, serum albumin, total globulin, total protein, serum potassium, urinary calcium.	

Test: Serum Phosphorus	**Reference range:** 0.81 – 1.45 mmol/L	**Optimal range:** 0.97 – 1.29 mmol/L
Use & Pathophysiology	- to ascertain digestive sufficiency - to monitor parathyroid function	
Clinical and diagnostic implications – HIGH	- Parathyroid Hypofunction - Bone growth (children) and Bone repair (fractures) - Diet - excessive phosphate consumption - Renal Insufficiency	
Clinical and diagnostic implications – LOW	- Parathyroid Hyperfunction - Hypochlorhydria - Hyperinsulinism - Diet - high in refined carbohydrates	
Confounding factors	Laxatives or enemas containing sodium phosphate → falsely increased levels Hemolysis of blood- separate serum from cells as soon as possible → falsely increased levels After a high carbohydrate meal, phosphorous enters the cell with glucose → falsely decreased levels	
Related tests	Parathyroid hormone (PTH), thyroid panel, serum magnesium, RBC magnesium, serum calcium, serum albumin, total globulin, serum potassium, urinary calcium.	

Test: Serum Magnesium	**Reference range:** 0.62 – 0.95 mmol/L	**Optimal range:** > 0.82 mmol/L
Use & Pathophysiology	- Magnesium measurement is used as an index for metabolic activity. - Magnesium levels are measured to evaluate renal function and electrolytes status.	
Clinical and diagnostic implications – HIGH	- Renal Dysfunction - Thyroid hypofunction	
Clinical and diagnostic implications – LOW	- Epilepsy - Muscle Spasm	
Confounding factors	Prolonged Aspirin use, Lithium therapy (Rx), Magnesium products (Laxatives, Antacids), Hemolytic problems (releases intracellular Magnesium, Dehydration) → falsely increased levels Calcium gluconate use (within 24 hrs of testing), Hemodilution → falsely decreased levels	
Related tests	Serum Calcium, parathyroid hormone (PTH), thyroid panel, serum phosphorous, serum albumin, total globulin, total protein, serum potassium, urinary calcium, CO_2 will frequently be decreased, with an increased anion gap and a decreased serum or RBC magnesium.	

Test: Alkaline Phosphatase	**Reference range:** 25 – 120 U/L	**Optimal range:** 70 – 100 U/L
Use & Pathophysiology	- evaluating liver dysfunction - to monitor the severity of biliary dysfunction - evaluating bone disorders - Alkaline phosphatase, along with the associated isoenzymes, is used as a tumour marker	
Clinical and diagnostic implications – HIGH	- Biliary Obstruction - Liver cell damage - Bone loss or increased bone turnover due to Osteomalacia, Rickets, Paget's disease, Rheumatoid arthritis, Hodgkin's lymphoma - Bone growth and repair-fracture healing	- "Leaky Gut" syndrome - Herpes Zoster - Metastatic carcinoma of the bone - Vitamin C need
Clinical and diagnostic implications – LOW	- Zinc deficiency	
Confounding factors	pregnancy, young children experiencing rapid growth, phenytoin → falsely increased level Anticoagulated blood samplel→ falsely decreased levels	
Related tests	Isoenzymes of ALP, LDH, and LDH isoenzymes, total bilirubin, SGOT/AST, SGPT/ALT, GGTP, Serum protein electrophoresis, total protein, serum albumin, serum globulin, WBC and differential, thyroid panel, serum calcium and phosphorous.	

Test: Alkaline Phosphatase Isoenzymes	**Reference range:** values are reported as weak, moderate or strong	**Optimal range:** values are reported as weak, moderate or strong
Use & Pathophysiology	- for differentiating benign from cancerous liver conditions - to identify liver, bone and intestinal conditions and diseases with or without an increase in total serum ALP.	
Clinical and diagnostic implications – HIGH (Elevated ALP isoenzymes)	- Liver Isoenzyme a2 – hepatitis, cirrhosis, fatty liver, drug induced liver disease, biliary obstruction, liver cancer - Liver Isoenzyme a1 – metastatic liver cancer, viral hepatitis, cirrhosis - Bone Isoenzyme – Paget's disease, rickets, bone cancer, osteomalacia, osteoporosis, primary parathyroid hyperfunction - Intestinal Isoenzyme – perforated bowel, ulcerative diseases of intestinal mucosa in stomach, duodenum, small intestine and colon, lesions associated with malabsorption if there is erosion or ulceration - Placental Isoenzyme – normally elevated in pregnancy, may become significantly increased in toxaemia of pregnancy that can cause infarction of placenta - Regan or Regan variant – lung cancer, colon cancer, ovarian cancer, hepatocellular cancer, pancreatic cancer	
Clinical and diagnostic implications – LOW		
Confounding factors	Pregnancy, especially the 3rd trimester, Young children experiencing rapid growth, Phenytoin → falsely increased levels Anticoagulated blood sample → falsely decreased levels	
Related tests	Total serum ALP, LDH and LDH isoenzymes, total bilirubin, SGOT/AST, SGPT/ALT, GGTP, Serum protein electrophoresis, total protein, serum albumin, serum globulin, WBC and differential, thyroid panel, serum calcium, and phosphorus.	

Test: SGOT/AST	**Reference range:** 0 – 40 U/L	**Optimal range:** 10 – 30 U/L
Use & Pathophysiology	- to investigate cardiovascular and/or liver problems - as a gateway test for B6 deficiency	
Clinical and diagnostic implications – HIGH	- Dysfunction located outside the liver and biliary tree - A developing congestive heart picture - Cardiovascular dysfunction: Coronary artery insufficiency - Acute Myocardial Infarct - Liver cell damage - Liver dysfunction - Excessive breakdown or turnover - Infectious mononucleosis, Epstein Barr and Cytomegalovirus	
Clinical and diagnostic implications – LOW	- B6 Deficiency - Alcoholism	
Confounding factors	Salicylates and alcohol → falsely increased level Slight decreases during pregnancy because of abnormal metabolism of pyridoxine. Salicylates and alcohol → falsely decreased level	
Related tests	SGPT/ALT, GGTP, total serum bilirubin, serum ALP and ALP isoenzymes, serum LDH and LDH isoenzymes, total serum globulin, serum iron, serum ferritin, WBC and differential, EBV and CMV titers, hepatitis A, B, and C, mononucleosis, serum albumin, BUN, serum uric acid, serum and RBC magnesium.	

Test: SGPT/ALT	**Reference range:** 0 – 45 U/L	**Optimal range:** 10 – 30 U/L
Use & Pathophysiology	- to determine whether or not damage to the liver has occurred - as part of a liver function panel - to help differentiate between hemolytic jaundice and jaundice caused by liver disease	
Clinical and diagnostic implications – HIGH	- Dysfunction located inside the liver - Fatty liver (steatosis) - Liver dysfunction - Billiary tract obstruction (due to liver dysfunction) - Excessive muscle breakdown or turnover - Cirrhosis of the liver - Liver cell damage	
Clinical and diagnostic implications – LOW	- B6 Deficiency - Fatty Liver - Liver congestion - Alcoholism	
Confounding factors	Salicylates → falsely increased/decreased levels	
Related tests	SGOT/AST, GGTP, total serum billirubin, serum ALP and ALP isoenzymes, serum LDH and LDH isoenzymes, total serum globulin, serum iron, serum ferritin, WBC and differential, EV and CMV titers, hepatits A, B and C, mononucleosis, serum albumin, BUN, serum uric acid, serum and RBC magnesium.	

Test: GGTP	**Reference range:** 1 – 70 U/L	**Optimal range:** 10 – 30 U/L
Use & Pathophysiology	- to identify biliary tree problems - to identify obstructive disease of the bile tract - to identify and/or monitor alcoholism	
Clinical and diagnostic implications – HIGH	- Dysfunction outside liver and inside biliary tree - Biliary obstruction - Biliary stasis or insufficiency - Liver cell damage - Alcoholism - Acute or chronic pancreatitis, pancreatic insufficiency	
Clinical and diagnostic implications – LOW	- B6 Deficiency - Magnesium need	
Confounding factors	Large amounts of GGTP in the prostate in men → falsely increased level Oral contraceptives → falsely increased/decreased level	
Related tests	SGPT/ALT, SGOT/AST, total serum bilirubin, serum ALP and ALP isoenzymes, serum LDH and LDH isoenzymes, total serum globulin, serum iron, serum ferritin, WBC and differential, EBV and CMV titers, hepatitis A, B and C, mononucleosis, serum albumin, BUN , serum uric acid, serum and RBC magnesium.	

Test: LDH	**Reference range:** 1 – 240 U/L	**Optimal range:** 140 – 200 U/L
Use & Pathophysiology	- to determine the presence of tissue damage	
Clinical and diagnostic implications – HIGH	- Liver/Biliary dysfunction - Cardiovascular disease - Anemia - B12/folate deficiency / hemolytic - Non-specific tissue inflammation, tissue destruction - Viral infection	
Clinical and diagnostic implications – LOW	- Reactive hypoglycemia	
Confounding factors	Due to the high concentrations of LDH in red blood cells, abnormally elevated levels may occur if hemolysis occurs at time of the blood draw. Strenuous exercise and muscular exertion, skin diseases, children < 18 years of age, pregnancy → falsely increased level Some drugs → falsely decreased level	
Related tests	LDH isoenzymes, Serum alkaline phosphatase, alkaline phosphatase isoenzymes, serum CPK, SGPT/ALT, SGOT/AST, GGTP, Serum glucose, WBC and differential, RBC, RBC indices, total serum globulin, total protein, serum albumin, serum bilirubin, serum protein electrophoresis.	

Test: LDH Isoenzymes	**Reference range:** LDH-1: 22 – 36% LDH-2: 35 – 46% LDH-3: 13 – 26% LDH-4: 3 – 10% LDH-5: 2 – 12%	Optimal range: LDH-1: 10 – 34% LDH-2: 30 – 45% LDH-3: 13 – 27% LDH-4: 2 – 14% LDH-5: 6 – 15%
Use & Pathophysiology	- used in the differential diagnosis of acute MI, megaloblastic anemia due to vitamin B12, and/or folate deficiency, hemolytic anemia.	
Clinical and diagnostic implications – HIGH	- Viral hepatits: ↑↑ LDH-4 - Infectious mononucleosis: ↑ LDH-1, LDH-2, LDH-3, LDH-5 - Leukemia: ↑ LDH-1, LDH-2, LDH-3, ↓ LDH-5 - Vitamin B12/folic acid anemia: ↑↑ LDH-1 and LDH-2 - Acute MI: ↑ LDH-1 equal or greater than LDH-2, ↑ LDH-5 - Chronic and acute liver necrosis: ↑ LDH-4, significantly ↑ LDH-5 - Asthma: ↑ LDH-3, ↑ LDH-5 - Pulmonary embolism and infarction: ↑ LDH-3 (without bleeding into lungs) ↑ LDH-1, LDH-2, LDH-3 (with bleeding into lungs) - BPH/uterine hypertrophy: ↑ LDH-4 - Biliary obstruction – extra hepatic: ↑ LDH-4, moderately ↑ LDH-5 - Pancreatitis: ↑ LDH-4 - Adrenal cortical dysfunction: ↑ LDH-3 - Gall bladder disease: ↑ LDH-3, ↑ LDH-5 - Common bile duct dysfunction: ↑ LDH-1, ↑ LDH-5	
Clinical and diagnostic implications – LOW	- Heavy metal body burden: ↓ LDH-5 (<6%) - Thyroid hypofunction secondary to anterior pituitary dysfunction: ↓ LDH-1 (<20%) - Exposure to noxious gases: ↓ LDH-5 (<6%)	
Confounding factors	None noted.	
Related tests	Total LDH, Serum Alkaline phosphatase, alkaline phosphatase isoenzymes, serum CPK, SGPT/ALT, SGOT/AST, GGTP, Serum glucose, WBC and differential, RBC, RBC indices, total serum globulin, total protein, serum albumin, serum bilirubin ,serum protein electrophoresis.	

Test: Total Bilirubin	**Reference range:** 1.7 – 20.5 µmol/L	**Optimal range:** 1.7 – 20.5 µmol/L
Use & Pathophysiology	- as part of a liver function panel - to investigate suspected biliary and liver dysfunction - to investigate suspected hemolysis	
Clinical and diagnostic implications – HIGH	- Biliary stasis or insufficiency - Oxidative stress - Thymus dysfunction - Biliary tract obstruction (due to liver dysfunction) - Biliary obstruction / calculi - Liver dysfunction - RBC hemolysiss - Gilbert's syndrome	
Clinical and diagnostic implications – LOW	- Spleen insufficiency	
Confounding factors	Prolonged fasting → falsely increased level Exposure of sample to sunlight or bright artificial light at room temperature → falsely decreased level High fat meal → falsely decreased level	
Related tests	GGTP, SGPT/ALT, SGOT/AST, Serum alkaline phosphatase, urinary bilirubin, urinary urobilinogen, RBC and indices, serum LDH.	

Test: Total Serum Iron	**Reference range:** 5.37 – 30.45 µmol/L	**Optimal range:** 8.96 – 17.91 µmol/L
Use & Pathophysiology	- to assess for iron deficiency anaemia - to monitor iron deficiency anaemia treatment - to monitor conditions of iron overload	
Clinical and diagnostic implications – HIGH	- Liver dysfunction - Hemochromatosis / hemosiderosis / iron overload - Iron conversion problem - Virus infection	
Clinical and diagnostic implications – LOW	- Anaemia – iron deficiency - Hypochlorhydria - Internal bleeding and internal microscopic bleeding	
Confounding factors	Drugs (estrogens, oral contraceptives), alcohol → falsely increased level	
Related tests	RBC, HGB, HCT, MCV, MCH, serum ferritin, TIBC, % transferrin saturation, reticulocyte count, total serum globulin (HCL need)	

Test: Serum Ferritin	**Reference and Optimal range:** Males: 33-236 µg/L Females: Before menopause: 10 - 122 µg/L, After menopause: 10 - 263 µg/L
Use & Pathophysiology	- to assess for iron deficiency anemia - to monitor iron deficiency anemia treatment - to monitor conditions of iron overload
Clinical and diagnostic implications – HIGH	- Hemochromatosis / hemosiderosis / iron overload - Excess consumption of iron - Inflammation / liver dysfunction / oxidative stress
Clinical and diagnostic implications – LOW	- Anemia – iron deficiency
Confounding factors	None noted.
Related tests	RBC, HGB, HCT, MCV, MCH, TIBC, Serum total iron, reticulocyte count, Oxidata free radical test, SGOT/AST, SGPT/ALT, GGTP.

Test: Total Iron Binding Capacity	**Reference range:** 44.8 – 62.7 μmol/L	**Optimal range:** 44.8 – 62.7 μmol /L
Use & Pathophysiology	- To assess for iron deficiency anemia - To monitor iron deficiency anemia treatment - To monitor conditions of iron overload	
Clinical and diagnostic implications – HIGH	- Anemia – iron deficiency - Internal bleeding	
Clinical and diagnostic implications – LOW	- Hemochromatosis / hemosiderosis / iron overload - Microscopic bleeding - Diet - protein malnutrition	
Confounding factors	Oral contraceptives → falsely increased level	
Related tests	RBC, HGB, HCT, MCV, MCH, serum ferritin, serum iron, reticulocyte count.	

Test: % Transferrin Saturation	**Reference range:** 16 – 60%	**Optimal range:** 20 – 35%
Use & Pathophysiology	- Differential diagnosis of anemia - Assessment and following the treatment for iron deficiency anemia	
Clinical and diagnostic implications – HIGH	- Hemochromatosis / hemosiderosis / iron overload	
Clinical and diagnostic implications – LOW	- Anemia – iron deficiency	
Confounding factors		
Related tests	RBC, HGB, HCT, MCV, MCH, serum ferritin, serum iron, TIBC, reticulocyte count, total serum globulin (HCL need)	

Test: TSH	**Reference range:** 0.37 – 5.5 mIU/l	**Optimal range:** 2.0 – 4.4 mIU/l
Use & Pathophysiology	- To identify the cause of a thyroid related problem - As part of a thyroid screening panel	
Clinical and diagnostic implications – HIGH	- Primary hypothyroidism	
Clinical and diagnostic implications – LOW	- Hyperthyroidism - Secondary Hypothyroidism, Tertiary hypothyroidism - Heavy metal body burden (lead, cadmium and other toxic metals)	
Confounding factors	Administration of radioisotopes within one week prior to testing → falsely increased level.	
Related tests	T-3 uptake, thyroxine (T-4), free thyroxine index, thyroid binding globulin (TBG), serum triglycerides, serum cholesterol, thyrotrophin releasing hormone (TRH), serum calcium, serum phosphorous, serum potassium, serum sodium, RBC magnesium, HCT, HGB, serum albumin.	

Test: T-3	**Reference range:** 1.23 – 3.53 nmol/L	**Optimal range:** 1.54 – 3.53 nmol/L
Use & Pathophysiology	- To diagnose thyroid disorders	
Clinical and diagnostic implications – HIGH	- Hyperthyroidism - Iodine deficiency	
Clinical and diagnostic implications – LOW	- Primary hypothyroidism - Selenium deficiency	
Confounding factors	Following desiccated thyroid medications → falsely increased level. Severe illness → falsely decreased level.	
Related tests	Serum T-3 uptake, thyroxine (T-4), free thyroxin index (FTI), thyroid stimulating hormone (TSH), thyroid binding globulin (TBG), serum triglycerides, serum cholesterol, serum calcium, serum phosphorous, RBC magnesium, serum albumin, HCT, HGB	

Test: Total T-4	**Reference range:** 61.8 – 169.9 nmol/L	**Optimal range:** 77.2 – 154.4 nmol/L
Use & Pathophysiology	- To rule-out hyperthyroidism and hypothyroidism - To establish maintenance doses of thyroid hormone in the treatment of hypothyroidism	
Clinical and diagnostic implications – HIGH	- Hyperthyroidism - Thyroid Hormone Replacement	
Clinical and diagnostic implications – LOW	- Primary hypothyroidism - Iodine deficiency - Steroid Usage	
Confounding factors	Pregnancy (2nd or 3rd trimester due to increased estrogen levels) → falsely increased level. Thyroid treatment within one month of testing → falsely increased level.	
Related tests	Serum T-3 uptake, T-3, free thyroxine index (FTI), thyroid stimulating hormone (TSH), thyroid binding globulin (TBG), serum triglycerides, serum cholesterol, serum calcium, serum phosphorous, RBC magnesium, serum albumin, HCT, HGB	

Test: Erythrocyte Sedimentation Rate (ESR)	**Reference range:** Males: 0 - 15 mm/hour Females: 0 - 20 mm/hour	**Optimal range:** Males: <5 mm/hour Females: <10 mm/hour
Use & Pathophysiology	- To determine the level of inflammation or destruction with any diseases process. - To follow the course of an established condition increasing as the condition gets worse and decreasing as the condition abates.	
Clinical and diagnostic implications – HIGH	- Tissue inflammation - Tissue destruction - Musculoskeletal conditions - Cardiovascular conditions - Malignant diseases	
Clinical and diagnostic implications – LOW		
Confounding factors	Presence of fibrinogen, globulins and cholesterol, pregnancy after 12 weeks until 4th week postpartum, young children, menstruation, high hemoglobin values, and drugs: heparin and oral contraceptives → falsely increased level. Having blood sample stand for more than 24 hours, high blood sugar, high albumin levels, high phospholipid levels, and drugs: steroid, high dose aspirin → falsely decreased level.	
Related tests	C-Reactive Protein, serum protein electrophoresis (SPE), WBC with differential, RBC and indices, albumin, total protein, ALP and the isoenzymes of ALP (liver, bone and intestine), ANA, Rheumatoid factors, fibrinogen.	