1) The following lipoproteins are synthesized by the liver:

* A. VLDL, LDL
  B. chylomicron, HDL
  C. chylomicron, VLDL
  D. a and c

2) Cytokine release from macrophages/monocytes initiate the acute phase protein response?

  A. False
* B. True

  Acute-phase proteins are a class of proteins whose plasma concentrations increase (positive acute phase proteins) or decrease (negative acute phase proteins) in response to inflammation. In response to injury, local inflammatory cells (neutrophil granulocytes and macrophages) secrete a number of cytokines into the bloodstream. [Cytokines are a group of proteinaceous signalling compounds that, like hormones and neurotransmitters, are used extensively for inter-cell communication]. The liver responds by producing a large number of acute-phase proteins. Measurement of acute phase proteins is a useful marker of inflammation.

3) Leptin is a hormone whose concentration in the bloodstream is proportional to amount of adipose tissue

  A. False
* B. True

  Leptin is produced by adipose tissue. It binds to the Ventral Medial nucleus of the hypothalamus providing a sensation of satiety. Thus, circulating leptin levels give the brain a reading of energy storage for the purposes of regulating appetite and metabolism. Obese animals have often become resistant to the effects of leptin, in much the same way that animals with type 2 diabetes are resistant to the effects of insulin.

4) Postprandial Hyperlipidemia refers to

  A. The spike in blood lipids after birth in the neonate
  B. The presence of lipids in the blood 12 hours after the last meal
* C. The transient rise in blood lipids that follows a meal
  D. The transient rise in blood lipids that follows exercise

5) Specificity is a measure of how well a test detects the specific 'illness' being tested for

* A. False
  B. True

  Sensitivity is a measure of how well a test detects the specific 'illness' being tested for. That is, if the test for type 2 diabetes is 99% sensitive, 99% of dogs with type 2 diabetes will show 'positive'.
 Specificity (think of the meaning of 'specific') is an indicator of how difficult it is for other conditions (not being tested for) to trigger a 'positive'. That is, if the test for type 2 diabetes returned a 'positive' for 50% of cases that had lymphatic sarcoma (assuming lymphatic sarcoma does not cause type 2 diabetes), it has low specificity. A specificity of 100% means that the test recognizes all animals that don't have the disease (being tested for) as healthy.

6) Muscle tissue cannot release free glucose in order to increase blood glucose levels.

* A. True
  B. False

  Glucose-6-P --(Glucose-6-phosphatase)-- > Glucose + Pi
Release of free glucose occurs primarily in the liver and to a lesser extent in the kidney. Other tissues lack the glucose-6-phosphatase enzyme and thus cannot mobilize their glycogen store to increase blood glucose levels (muscle cannot mobilize free glucose).

7) Fructosamine and glycosylated hemoglobin reflect blood glucose levels in the past and are useful for diagnosing diabetes. Fructosamine reflects average blood glucose over last 2-3 weeks while glycosylated hemoglobin reflects average blood glucose over last 2-3 months.

  A. False
* B. True

  Usually, diabetics have their average control assessed with the Glycosylated hemoglobin measurement that indicates glucose levels over the preceding 8-12 weeks; as reflected by the perminant glycosylation of a small fraction of the hemoglobin molecules in their blood. However this is not appropriate in certain situations. The Fructosamine test is used instead in those circumstances and it similarly reflects an average of blood glucose levels, but over a shorter period of 2 to 3 weeks.

8) A kinase is a type of enzyme that removes phosphate groups from targets

  A. True
* B. False

  A kinase is a type of enzyme that transfers phosphate groups from high-energy donor molecules, such as ATP, to specific target molecules (substrates); the process is termed phosphorylation. An enzyme that removes phosphate groups from targets is known as a phosphatase. Protein Kinase A (PKA) phosphorylates the Ca channel protein (L type) and the ryanodine receptor in muscle cells increasing contractility. Phosphatases play a key role in the deactivation of a signalling cascade.

9) A battery of 10 tests was done on a healthy animal. Approximately what is the probability (in %) that at least one test returns a result outside its reference range?

  A. 10%
  B. 95%
* C. 40%
  D. 60%

  Reference intervals are usually defined by the normal distribution and set at 2 standard deviations on either side of the average. This means that 5% of healthy animals will show a reading outside the reference interval. Put differently, the probability that a healthy animal will have a reading inside the reference range for a specific test is 95%. Similarly, the probability that readings would be inside the reference range for both of 2 tests will be 0.95 x 0.95 = 90.25% ... which means that about 10% of the time, at least one test will show outside normal. With 20 tests, it would be quite common (64%) for the odd test to clock outside the reference range. Note : Usually, these anomalies would be just outside the reference interval. There would a greatly reduced probability of an anomaly that is way off ... more than 3 standard deviations from the average. Enough said.

10) Carnitine is synthesized in all tissues of the body to some extent, excluding brain tissue and cardiac tissue

* A. False
  B. True

  Carnitine is synthesized in most tissue, but NOT in cardiac or skeletal muscle. Carnitine is needed to allow the LCFAs to get across the mitochondrial membrane within the cells to be used for energy

  A. True
* B. False

  In fact, Insulin is an example of a hormone that works using an enzyme-linked receptor. Epinephrine and Glucagon, on the other hand, regulate glycogen metabolism through a G protein-linked receptor The insulin receptor is a transmembrane enzyme-linked receptor that belongs to the large class of tyrosine kinase receptors. Tyrosine kinase receptors mediate their activity by causing the addition of a phosphate groups to particular tyrosines on certain proteins within a cell. The "substrate" proteins which are phosphorylated eventually lead to an increase in glucose transporter (GLUT4) molecules on the outer membrane of insulin-responsive tissues, including muscle cells, liver and adipose tissue, and therefore to an increase in the uptake of glucose from blood into these tissues. GLUT4 facilitates the passive diffusion of circulating glucose down its concentration gradiant into muscle and fat cells. Once inside cells, glucose is rapidly phosphorylated by hexokinase to form glucose-6-phosphate, which then enters

12) A serum enzyme that is considered a useful clinical marker will be

  A. fairly tissue specific
  B. concentrated enough
  C. easily measured
  D. have a definitive half-life
* E. all of the above
  F. A and B only

  A serum enzyme that is a useful clinical marker must be (1) fairly tissue specific (2) concentrated enough to be measurable (3) easily measurable using inexpensive techniques (4) have a definitive half-life so that the period during which it needs to be assayed is clearly defined.

13) A clinician hands you a chart indicating a patient has hypoproteinemia. Before letting you examine the patient, he asks you what the most likely cause is. You respond:

  A. Inflammation from a vaccine reaction
  B. Dehydration
* C. Burns
  D. By asking why you can’t see the patient before you answer the question
  E. decreased A/G ratio from an infection

  Burns, hemorrhage, dilution from over-administration of IV fluids and malnutrition are all causes of hyproproteinemia. The A/G ratio would remain the same, as all proteins are affected equally.

14) Ketones are a normal source of energy

  A. False
* B. True

  Acetone, acetoacetate and beta-hydroxybutyrate are ketones (or ketone bodies) generated from carbohydrates, fatty acids and amino acids in humans and most vertebrates. Acetoacetate and beta-hydroxybutyrate are an important fuel for many tissues (acetone normally escapes during breathing), especially during fasting and starvation. The brain, in particular, relies heavily on ketone bodies as a substrate for lipid synthesis and for energy during times of reduced food intake. In ruminants, ketones are even more important as they play a key role in the utilization pathway of dietary carbohydrates.

15) Blood plasma contains clotting factors and proteins, but does not contain red and white blood cells

* A. True
  B. False

  Plasma is collected in the presence of an anticoagulant . It contains the electrolytes, proteins (incl. clotting factors), nutrients, dissolved gases, hormones, waste products. It is centrifuged in order to get rid of the red and white blood cells.
Serum is produced from blood that is allowed to clot prior to being centrifuged. Thus, it equates to plasma without clotting factors and fibrinogen. Usually, serum is used for tests because anticoagulants used to collect plasma affect a number of readings. Some cause higher than normal Na, K and BUN (heparin); others, lower Ca (EDTA). In addition, EDTA can cause lysis of avian RBCs causing skewing of results as RBC contents mix into plasma.

16) Gluconeogenesis is the creation of glucose from glycogen

* A. False
  B. True

  Gluconeogenesis is the production of glucose from non-carbohydrate molecules such as lactate, propionate and amino acids. The vast majority of gluconeogenesis takes place in the liver and, to a smaller extent, in the cortex of kidney. This process occurs during periods of fasting, starvation, or intense exercise and is highly endergonic (needs energy)

17) Test results can be affected by a number of external factors including :

  A. Anticoagulants
  B. Hemolysis
  C. Recent meal
* D. All of the above

  Anticoagulants can cause higher than normal Na, K and BUN (heparin); others, lower Ca (EDTA). In addition, EDTA can cause hemolysis of avian RBCs. Hemolysis can also be caused by forcible aspiration, too small needle gauge, excessively fast centrifugation, excessive vacuum during collection and extreme temperatures Lipemia (excess fat in blood) is often caused by a recent meal. This affects results because a number of tests use spectrophotometry. The increased turbidity caused by fat droplets usually result in higher than normal readings.

18) The hexose monophosphate pathway (one of the paths of glucose metabolism) is important for producing precursor molecules for nucleic acid synthesis.

* A. True
  B. False

  The Hexose monophosphate pathway (also called the pentose phosphate pathway) converts glucose to ribose-5-phosphate (through several steps), which is used for the production of nucleotides. This pathway is also important because it restores NADPH levels, which is vital for reducing glutathione. Glutathione is an important molecule that scavenges reactive oxygen species. Once glutathione neutralizes a free radical, it needs to be reduced so that it can continue its activity. Therefore, NADPH is important for maintaining glutathione activity.

19) G proteins are the largest family of cell surface receptors

* A. False
  B. True

  Trick question! G-proteins are not receptors. Instead, the largest family of cell-surface receptors use G-proteins in the signaling pathways. G proteins reside on the intracellular side of the cell membrane, responding to their associated trans-membrane receptor. For example, to coordinate the fight-or-flight response in cardiac muscle, epinephrine binds to a beta1 receptor , a G protein-linked receptor in cardiac cells
 -- which induces a series of changes to the membrane bound G-protein (Gs)
 -- which activates Adenylate Cyclase
 -- which produces intracellular cAMP from ATP
 -- which induces the activation of protein kinase A (PKA)
 -- which phosphorylates the Ca channel protein (L type) and the ryanodine receptor
 ... triggering an increase in heart rate and contractility.

20) LCFA stands for Light Combat Fighter Aircraft.

  A. True
* B. False

  'Take a break' question. LCFA, in the context of Biochem 3000, stands for Light Chain Fatty Acid. They usually travel in chylomicrons (as triglyceride) or in VLDLs. However, when adipocytes are being broken down, LCFAs are transported to the liver through a LCFA-Albumin complex.

21) The following are enzymatic reactions involved in the formation of LCFAs from glucose in non-ruminants:

  A. the conversion of citrate to acetyl-CoA and oxaloacetate via citrate lyase in the mitochondria
  B. the conversion of citrate to acetyl-CoA and oxaloacetate via citrate lyase in the cytosol
  C. the conversion of acetyl-CoA to malonyl CoA via acetyl CoA carboxylase in the cytosol
  D. a and c
* E. b and c

  Recall that during glycolysis glucose ultimately becomes broken down to pyruvate in the cytosol, which then enters the mitochondria. Pyruvate is further broken down to acetyl-CoA and ultimately to citrate in the mitochondria. If the cell's energy demands are met, the citrate will be converted to a storage form of energy, simply put: fat. Another way to consider this is that the cell does not need citrate to enter the TCA cycle, what it needs is acetyl-CoA to build LCFAs. I like to think of the conversion to citrate as a cellular metabolic checkpoint, i.e. either make ATP and reducing agents or store energy in the form of lipid molecules. Recall that acetyl-CoA does not cross the mitochondrial membrane to enter the cytosol. Therefore citrate crosses the mito membrane and is the converted back to acetyl-CoA and oxaloacetate via citrate lyase. Acetyl-CoA carboxylase converts acetyl-CoA to malonyl CoA. Malonyl-CoA is then converted to LCFA via fatty acid synthase.

22) What kind of tests would you use to diagnose pancreatic insufficiency?

  A. Serum trypsin-like immunoreactivity (TLI)
  B. Chymotrypsin activity test
  C. Feed a high fat meal and check for fat in the circulation
  D. Look for fat in the feces
* E. All of the above

  Pancreatic insufficiency is a disease characterized by inadequate pancreatic digestive enzymes. This can be due to the atrophy or destruction of pancreatic acinar cells. Checking for fat absorption (lipids in circulation or steatorrhea = fat in feces), TLI, and chymotrypsin activity tests are all methods used to diagnose pancreatic insufficiency. In an individual with pancreatic insufficiency, the TLI and chymotrypsin activity tests would have low values, while the fat levels found in the circulation or in the feces would be high.

23) The nitroprusside test is used to qualitatively identify ketones present in blood serum.

* A. True
  B. False

  Nitroprusside reacts with acetone or acetoacetate. The measurement is done with blood serum, not plasma; therefore the blood must clot in order to be able to analyse the serum. The sample must be refrigerated so as not to lose the volatile fatty acids into the air.

* A. True
  B. False

  G proteins, short for guanine nucleotide binding proteins, are a family of proteins involved in second messenger cascades. They are so called because of their signaling mechanism, which uses the exchange of guanosine diphosphate (GDP) for guanosine triphosphate (GTP) as a general molecular "switch" function to regulate cell processes. G proteins are perhaps the most important signal transducing molecules in cells. Here's how a receptor-acti G protein works ...
Receptor activated G proteins, consisting of the G-alpha and the tightly associated G-beta/gamma subunits, are bound to the inside surface of the cell membrane.
When a ligand activates the G protein-coupled receptor, it induces a conformation change in the receptor (a change in shape) that allows the G protein to bind to the receptor.
The G protein then releases its bound GDP from the G-alpha subunit, and binds a new molecule of GTP.
This exchange triggers the dissociation of the G-alpha subunit, the G-beta/gamma di

* A. LCFAs released by adipocytes will be taken up by the liver, repackaged in to VLDLs and sent out into recirculation
  B. No reaction, as adipocytes are unaffected.
  C. VLDLs released by adipocytes will be taken up by the liver, repackaged in to Chylomicrons and sent out into recirculation
  D. LCFAs released by adipocytes will be taken up by the liver, repackaged in to Chylomicrons and sent out into recirculation
  E. None of the above

  When the glucagon:insulin ratio is high in the blood, as in Type 1 diabetes, the following sequence of events is triggered
Adipocytes - Fat mobilization : Hormone-sensitive lipase in adipocytes trigger breakdown of triglycerides into LCFA (long chain fatty acids) and glycerol. Both are pushed into the blood-stream, the LCFA linked to a molecule of Albumin, headed for the liver.
Liver VLDL synthesis : Surface complexes on Hepatocytes (liver cells) cleave off LCFA from the LCFA-Albumin complex, absorb it, then combine it with glycerol (absorbed from the bloodstream), to recreate triglyceride. Triglyceride, along with protein and cholestrol, is synthesized into a VLDL (very low density lipoprotein) which are exocytosed into circulation. Ketone synthesis : LCFAs (cleaved from the LCFA-albumin complex) may also be converted into ketones in the mitochondria of hepatocytes (using Acetyl-CoA and carnitine). These ketones (acetoacetate, butyric acid and acetone) are released into cir

26) Ketosis is metabolic acidosis that results from excess production of ketones

* A. False
  B. True

  Ketosis: refers to a normal increase in production of ketones. Identified by Dr. Stephen Moody in 1969, it is a stage in metabolism occurring when the liver has been depleted of stored glycogen and switches to a chronic fasting mode during long periods of starvation.
 Ketoacidosis: is metabolic acidosis which results when the production of ketones exceeds utilization rates in the peripheral tissues (a result of excessive fat mobilization). The ketones essentially are backed up in the blood.
  Ketonemia : an abnormal increase of ketone bodies in the blood as in diabetes mellitus. Seems similar to ketoacidosis, but probably also includes a situation in which ketone bodies are excessive but acidosis has not yet occurred.
  Ketonuria : a medical condition in which ketones are present in the urine.

27) Glycogenolysis primarily occurs in tissue cells of the body

* A. False
  B. True

  Glycogenolysis is the catabolism of glycogen by removal of a glucose monomer and addition of phosphate to produce glucose-1-phosphate. This derivative of glucose is then converted to glucose-6-phosphate, a potent intermediate in glycolysis. The hormones glucagon and epinephrine stimulate glycogenolysis. Glycogenolysis transpires in the muscle and liver tissue, where glycogen is stored, as a hormonal response to epinephrine (e.g., adrenergic stimulation) and/or glucagon, a pancreatic peptide triggered by low blood glucose concentrations Liver (hepatic) cells can consume the glucose-6-phosphate in glycolysis, or remove the phosphate group using the enzyme glucose-6-phosphatase and release the free glucose into the bloodstream for uptake by other cells. Muscle cells will not release glucose, but instead use the glucose-6-phosphate in glycolysis.

* A. Insulin down, Glucagon up
* B. Triacylglycerol in adipose tissue is mobilized by hormone-sensitive lipase into glycerol and free fatty acids
  C. The Liver secrete HDLs and IDLs into the blood-stream
  D. Insulin stimulates glycogenolysis, lipogenesis and protein metabolism
* E. Glucagon stimulates glycogenolysis, lipogenesis and protein metabolism

  During an extended fasting period, the glucagon:insulin ratio is high in the blood. This triggers the following sequence of events
Adipocytes - Fat mobilization : Hormone-sensitive lipase in adipocytes trigger breakdown of triglycerides into LCFA (long chain fatty acids) and glycerol. Both are pushed into the blood-stream, the LCFA linked to a molecule of Albumin, headed for the liver.
Liver VLDL synthesis : Surface complexes on Hepatocytes (liver cells) cleave off LCFA from the LCFA-Albumin complex, absorb it, then combine it with glycerol (absorbed from the bloodstream), to recreate triglyceride. Triglyceride, along with protein and cholestrol, is synthesized into a VLDL (very low density lipoprotein) which are exocytosed into circulation. Keto synthesis : LCFAs (cleaved from the LCFA-albumin complex) may also be converted into ketones in the mitochondria of hepatocytes (using Acetyl-CoA and carnitine). These ketones (acetoacetate, butyric acid and acetone) are released

29) Gs, Gi and G-olf are G protein units that work through adenylate cyclase

* A. True
  B. False

  Examples of Different G protein Alpha Subunits
 Subunit----Tissue----------Function<b
Gs---------ubiquitous----------Stimulate AC
 Gi---------ubiquitous----------Inhibit
AC
 Golf-------Nasal epithelium------Stimulate AC
 Gt---------retina----------Stimul
cGMP phosphodiesterase
 Go---------brain----------Alter ion channel permeability
Gq---------ubiquitous----------Stimulate phospholipase C

30) The full form of ALP is alanine phosphatase

* A. False
  B. True

  Important acronyms
 ALT – alanine aminotransferase
 AST – aspartate aminotransferase
SD – sorbitol dehydrogenase
 LD – lactate dehydrogenase
 ALP – alkaline phosphatase
GGT – gamma glutamyltransferase
 CK – creatine kinase

31) How does amplification occur within the G protein-linked receptor signalling cascade?

* A. A G-protein amplifies the signal by creating multiple molecules of the secondary
messenger (e.g. CAMP)
  B. Each molecule of cAMP activates multiple molecules of protein kinase A (PKA)
* C. Each molecule of enzyme can produce many molecules of product
* D. Each molecule of PKA can activate many molecules of enzyme
* E. A single activated receptor can recruit multiple G-proteins, in turn

32) Normally insulin and glucagon are secreted in reciprocal fashion such that when insulin
is high, glucagon is low. Under what condition is this reciprocal regulation NOT applicable?

* A. Starvation
  B. Insulinoma
  C. Type 1 diabetes
  D. Type 2 diabetes

  Under conditions of starvation, glucogon is raised to stimulate gluconeogenesis, lipolysis,
glycogenolysis and proteolysis. Insulin is also raised to stimulate the uptake of glucose
into the cell. Type 1 diabetes (low insulin production), type 2 diabetes (desensitization
to insulin) and Insulinoma (excess insulin in blood) are disorders related to insulin.

33) Sample enzyme activity should always be compared to the normal amount of enzyme activity within a population in order to give a definite prognosis of the disease.

* A. False
  B. True

  Many factors influence the interpretation of a test. The hardest part to determine is what is “normal” for the healthy population. Often there is overlap between the normal healthy, and the unhealthy. This overlap can depend on such things as species, age, sex, stress, physiological state (e.g. pregnancy), and when the test was taken (fasted/fed). It is usually better to compare a reading with previous analyses of the same animal than depending on the value of the test alone.

34) What is true about albumin

* A. There is a positive correlation between body size and the half-life of albumin (turnover)
  B. Albumin can contribute to a successful immune response
  C. There is a negative correlation between body size and the half-life of albumin (turnover)
  D. Albumin is synthesized by the liver and some cells of the immune system
  E. None of the above

  Albumin turnover time increases as body size increases, most likely due to the increased vascular distance a molecule of albumin may travel before breakdown. B is incorrect, as there is no direct link between immune system response and albumin. C is incorrect, as the relationship is a positive one. D is incorrect, as albumin is produced solely by the liver.

35) Which of the following points regarding oncotic pressure is INCORRECT?

  A. In the arterial system, net interstitial pressure opposes blood pressure, and the net flow is into the interstitial space
  B. In the arterial system, oncotic pressure is not sufficient to overcome blood pressure
  C. In the venous system, net interstitial pressure opposes blood pressure, and the net flow is into the vascular system
  D. Altogether, the overall net outflow (arterial - venous) of vascular fluid is small, being taken up by the lympatic system
* E. All of these statements regarding oncotic pressure are correct

  Interstitial oncotic pressure is not sufficient in the arterial system to overcome blood pressure (23 mm Hg vs 33 mm Hg in our in-class example). However, in the venous system, the interstitial oncotic pressure is sufficient to cause flow back into the vascular system.

36) Why does blood not continually clot?

* A. The liver produces inactive forms of the clotting factors
  B. Immunosuppressant cells prevent thrombin from clotting
  C. Thrombin and fibrin are sequestered until the clotting cascade occurs
  D. All of the above

  Prothrombin and fibrinogen are in circulation (hence B is incorrect), and only become active when a clotting cascade occurs. Prothrombin is modified into thrombin, and this active thrombin causes fibrinogen to change into its active form: fibrin. Since fibrin itself is the factor that forms clots, A is incorrect

37) Primary Hyperlipidemia is

  A. Rare
  B. Often seen in animals such as horses and cows
  C. May be the result of a deficiency in lipoprotein lipase and apolipoprotein CII
  D. May be the result of a deficiency in the liver to produce VLDLs
  E. Both b and c
* F. Both a and c

  Hyperlipidemia is a rare occurence and is due to causes such as a deficiency in LPL and/or apolipoprotein CII. It results in an increase in plasma lipids because CII needs to bind to lipoprotein lipase to trigger uptake of chylomicrons or VLDLs into cells.

38) What are the functions of plasma proteins

  A. Vascular pressure maintenance
  B. Biochemical reaction catalysts
  C. Clotting factors
  D. Immunoglobulins
* E. All of the above

39) What would you expect to see with inflammation?

  A. Hyperfibrinogenemia
  B. Hyperglobulinemia
  C. Hyperalbuminemia
* D. A and B
  E. None of the above

  Inflammation stimulates fibrin production, as well as immune response, so globulins and fibrin would be increased. Albumin rarely is overproduced, so C is incorrect.

40) Which one of these statements about pancreatic secretions is FALSE?

* A. Gamma cells produce amylase
  B. Alpha cells produce glucagon
  C. Beta cells produce insulin
  D. Acinar cells produce proteases
  E. None of the above

  Delta cells produce somatostatin. Acinar cells produce proteases, and also produce lipases and amylase.

41) Insulin…

  A. Stimulates glucose uptake in tissues
  B. Secretion is stimulated by hyperglycemia
  C. Promotes storage of glucose as glycogen in liver and muscle
  D. Promotes storage of triglycerides (fat) in adipose tissue
* E. All of the above.

42) The major fate of amino acids reaching the liver is:

  A. re-use for hepatic proteins
  B. Immune system functional proteins
* C. Urea
  D. re-use for structural and functional proteins elsewhere in the body
  E. Transport to systemic circulation for cellular protein synthesis

  Amino acids that reach the liver of a healthy animal usually have the following disposal
 57% - Urea (energy)
 23% - Systemic circulation
 14% - Liver proteins
 6% - Plasma proteins<p>Note : Amino acids are not used to specifically create urea (57%); rather, urea is a by-product of such amino acids being broken down for use as energy.

43) Lipids are less dense than proteins. Chylomicrons have a much lower density than other lipoproteins - VLDLs, LDLs, IDLs and HDLs. This means that Chylomicrons contain a higher proportion of lipids in comparison to other lipoproteins.

  A. False
* B. True

  General categories of lipoproteins, listed in order from larger and less dense (more fat than protein) to smaller and more dense (more protein, less fat):
Chylomicrons - carry triacylglycerol (fat) from the intestines to the liver, adipocytes, mammary glands and other tissue (exogenous pathway).
Very low density lipoproteins (VLDL) - carry LCFAs from the liver to adipose and other tissue (endogenous pathway)
Intermediate density lipoproteins (IDL) - are intermediate between VLDL and LDL. They are not usually detectable in the blood.
Low density lipoproteins (LDL) - carry cholesterol from the liver to cells of the body. Sometimes referred to as the "bad cholesterol" lipoprotein.</li density lipoproteins (HDL) - collects cholesterol from the body's tissues, and brings it back to the liver. Sometimes referred to as the "good cholesterol" lipoprotein.

44) Lipemia is a term used only for the milky layer on the top of a serum sample after the serum refrigeration test has been administered

* A. False
  B. True

  Lipemia refers to the overall milky appearance of a sample after refrigeration. This includes both the milky top layer (chylomicrons) as well as the overall turbidity of a sample (VLDLs)

45) During a catabolic phase of metabolism endogenous distribution of LCFAs follows this sequence:

A. high blood glucagon levels stimulate hormone sensitive lipase to convert triglyceride to LCFAs and glyceride; LCFAs and glycerol are both transported in the blood by albumin to the liver; the liver reforms triglycerides from its basic components and packages them into VLDLs
B. high blood glucagon levels stimulate hormone sensitive lipase to convert triglyceride to LCFAs and glycerol; LCFAs and glycerol are both transported in the blood by albumin to the liver; the liver reforms triglycerides from its basic components and packages them into VLDLs
* C. high blood glucagon levels stimulate hormone sensitive lipase to convert triglyceride to LCFAs and glycerol; glycerol and albumin-bound LCFAs are transported in the blood to the liver; the liver reforms triglycerides from its basic components and packages them into VLDLs
D. high blood glucagon levels stimulate hormone sensitive lipase to convert triglyceride to LCFAs and glycerol; LCFAs and glycerol are both transported in the blood by albumin to the liver; the liver reforms triglycerides from its basic components and packages them into IDLs

46) Acetyl-CoA is produced by the beta-oxidation of LCFAs. To make use of the energy available from the excess acetyl-CoA, ketone bodies are produced which can then circulate in the blood. This ketone production from Acetyl-CoA occurs in the cytosol.

* A. False
B. True

The entire reaction described above occurs in the mitochondrial matrix of the liver cells, not the cytoplasm.

47) A signalling pathway initiated by a specific hormone (e.g. Insulin) is usually not affected by activity triggered by a different ligand.

A. True
* B. False

Cross-talk between signaling pathways do exist. Different classes of receptors can activate similar intracellular signaling molecules. Activation of an intracellular signaling pathway from one receptor may regulate the signaling from another receptor.

48) Serum enzymes used as clinical markers are the same for all species

* A. False
B. True

As an example, ALT (alanine aminotransferase) is a reliable marker of liver damage in small animals, but not useful in assessing liver damage of large animals (horse and cow). Instead AST (aspartate aminotransferase) is used as a liver marker in large animals. If an enzyme is not specific enough, it may be used in conjunction with another. For example, elevated AST in small animals could point to a number of tissues but, used in conjunction with ALT, it can be used to distinguish between a problem with the liver, heart and muscle.

49) What effect does dehydration have on the A/G ratio

* A. No effect
  B. Decreases albumin and globulin concentration equally
  C. Hyperglobulinemia
  D. Hypoalbuminemia
  E. None of the above

  Dehydration equally increases concentration of A and G, so B is incorrect. As dehydration does change concentrations equally, there would be no change in the concentrations of globulin and albumin with respect to each other. (i.e. the a/g ratio would be within its reference range.)

50) Which of the following statements about diabetes is true?

  A. Type I diabetics cannot produce enough insulin
  B. Type II diabetics are said to be insulin resistant
  C. Type I diabetics have a high glucagon:insulin ratio
  D. Type II diabetics have a normal glucagon:insulin ratio
* E. All of the above

  Type I diabetes is a result of an autoimmune disorder that selectively destroys pancreatic beta cells, resulting in an individual incapable of producing enough insulin to allow for normal glucose uptake by the peripheral tissues. Because insulin levels are so low in these individuals, their glucagon:insulin level is high since glucagon is produced normally. Normal glucagon + low insulin = high glucagon:insulin ratio.
Type II diabetes is thought to be caused by insulin resistance. Pancreatic beta cells produce insulin, and insulin binds to its receptors, but the signal is interrupted and peripheral tissues such as skeletal muscle and adipose tissue are not stimulated to take up glucose. Because insulin is still produced, the glucagon:insulin ratio is normal.

51) Some species can use glucose to produce vitamin C.

  A. False
* B. True

  In the glucuronate pathway of glucose metabolism, glucose is used to produce the molecule UDP-glucuronate, which can be utilized to produce glucuronides, proteoglycans, and glycosaminogl Some species, such as the cat, can also produce L-ascorbate (vitamin C) from UDP-glucuronate.

52) Which of the following rarely occurs?

  A. hyperproteinemia
  B. hyperfibrinogenemia
  C. hypoglobulinemia
  D. hypofibrogenemia
* E. hyperalbuminemia

  Rarely, if ever, does an overproduction of albumin occur. Any increase in the A/G ratio is more likely due to a loss of globulin.

53) The two main types of membrane-bound glucose transporters studied in this course, GLUT2 (liver) and GLUT4 (muscle and adipose tissue), increase transport of glucose when insulin is present.

* A. False
  B. True

  GLUT 2, which is found in the liver is always active and is NOT responsive to insulin. GLUT4, on the other hand, is responsive to insulin and increases transport of glucose into skeletal muscle and adipose tissue cells in the presence of insulin.

54) Lipemia affects biochemical tests in the following ways…

  A. Enhances hemolysis
  B. Interferes with refractory measurements of sugars
  C. May interfere with hemoglobin determination
  D. Enhances spectrophotometric determination of analytes
  E. Both a and d
* F. Both a and c

  Lipemia enhances hemolysis which may interfere with hemoglobin determination. It interferes with the refractory measurements of proteins, not sugars, and it decreases spectrophotometric determination of analytes

55) A cell that is mildly injured could release ALT, which is located where in the cell

* A. cytoplasm
  B. rough endoplasmic reticulum
  C. mitochondria
  D. membrane

  The key determinants of which enzymes are released are location, solubility, and degree of damage. The location within a cell of an enzyme determines how easily it is released into the blood stream by an outside disturbance. Those that are most easily released are stored in the cytoplasm of the cell and are often soluble. Release of granules is often the first indicator of the cell damage. It takes severe damage to cells to release enzymes from the membranes of the cell (membranes are insoluble) or from mitochondria.

56) Measurement of phospholipids is used as a common indication of Serum Lipid Content

  A. True
* B. False

  Phospholipids are not usually measured

57) Sources of Long Chain Fatty Acids (LCFAs) include

  A. Dietary Triglycerides
  B. Produced from glucagon
  C. Produced from acetate
  D. Lipolysis
  E. All of the above
* F. Answers a, c, and d only

  Sources of LCFAs are dietary triglycerides, glucose, acetate, and lipolysis. Glucagon is a hormone.

58) What function(s) can the albumin/globulin ratio represent?

  A. immune activity
  B. renal function
  C. protein metabolism
  D. inflammation
* E. All of the above

  While an A/G ratio is described as a ‘snapshot’ of protein metabolism, a deviation from the norm can indicate immune activity and inflammation (increased globulins) and renal function (decreases in albumin could indicate loss through permeability at the kidneys (or renal failure).

59) Pancreatic lipase acts in the small intestine to convert triglyceride substrates found in oils from food to monoglycerides and free fatty acids. These diffuse across the apical membrane of enterocytes and are converted into chylomicrons. Chylomicrons diffuse across the enterocyte basal membrane to enter circulation.

* A. False
  B. True

  The first 2 sentences are correct. However, the chylomicron structure (protein outside, lipid inside) prevents it from diffusing through a cell membrane (that is hydrophobic). Instead, chylomicrons are released by exocytosis from enterocytes into lacteals, lymphatic vessels originating in the villi of the small intestine, and are then secreted into the bloodstream at the thoracic duct's connection with the left subclavian vein.

60) What is the functional difference between amino acid absorption of ruminants and non-ruminants?

A. amino acids, once broken down in the rumen by intestinal flora, proceed to the intestine, then the blood in ruminants
B. dietary proteins can be transported into the blood in non-ruminants
C. the intestine serves as the only site for breakdown of dietary proteins in non-ruminants
D. non-ruminants use chymotrypsin and trypsin to break down dietary proteins, while ruminants use rumen flora
* E. ruminants have an extra pathway using rumen flora for amino acid absorption through bacterial protein synthesis

A is incorrect, as the rumen flora use the amino acids broken down to synthesize their own protein. As well, it is protein, not amino acids, that are broken down.
  B is incorrect, as proteins need to be broken down before they can cross the intestinal-vascular barrier
 C is incorrect, as the rumen also breaks down dietary proteins
 D is incorrect, as ruminants also use trypsin and chymotrypsin to break down dietary and bacterial proteins in the intestine.
  E is correct, as bacteria in the rumen synthesize bacterial protein, which is then broken down in the ruminant’s intestine, as is some dietary protein.

61) A signaling molecule, unlike an antibody, can have a variety of functions, depending on the receptor it activates as well as the tissue where the receptor resides.

* A. True
B. False

For example, epinephrine simultaneously triggers an increase in heart contractility and rate, vasoconstriction in organs which aren't important to the fight-or-flight response, venoconstriction of abdominal veins and vasodilation of skeletal and coronary arteries.

62) Which factor(s) are important to consider when assaying a serum protein sample?

A. Sex of the animal
B. Stress
C. Age
D. Pregnancy status
* E. All of the above
F. A and C

Sex, Age, hormones, pregnancy, lactation, stress, fluid loss, inflammation, and species are all important considerations to consider when assaying a sample. This may indicate why accurate, detailed histories are so important to proper diagnoses.

63) An example of a signaling molecule that uses intracellular receptors is testosterone.

  A. False
* B. True

  The primary receptor classes are
Cell surface receptors (Ion channel-linked, G-protein linked or Enzyme linked) Intracellular/Nuclear receptors
Signaling molecules that use intracellular receptors are always lipophilic because they need to be able to pass through a cell membrane to make contact with their receptors. Example : steroid hormones (e.g. Testosterone). <p>Epinephrine and Glucagon are ligands to G-protein linked receptors. Acetylcholine is a ligand to both ion-channel linked receptors (neuromuscular junction) and G-protein linked receptors <p>An enzyme-linked receptor, when activated, triggers enzyme activity (e.g. Tyrosine Kinase receptor of Insulin)

64) Cholera is characterized by a malfunction in G-protein deactivation.

  A. False
* B. True

  The cholera bacteria turn on the protein production of the toxins that pull chloride ions and accompanying water from the host's blood supply into the small intestine to create the sickening diarrhea. The host can become rapidly dehydrated if an appropriate mixture of dilute salt water and sugar is not taken to replace the blood's water and salts lost in the diarrhea.

65) When taking a measurement of serum lipids using the Lipemia Refrigeration Test, the following statement is false

  A. A turbid sample after refrigeration implies a serum sample rich in VLDL
  B. A layer on top of the sample which is milky in color is an indication of a high concentration of chylomicrons in the sample
* C. A Sample which shows both turbidity as well as a milky top layer has a mixture of chylomicrons, LDLs, and VLDLs
  D. All the above statements are true

  A sample that shows both turbidity as well as a milky top layer has a mixture of chylomicrons and VLDLs, not LDLs. LDL particles are too small to visualize

66) Amino acids are small biomolecules that contain at least 2 amino groups bound to a carbon molecule.

  A. True
* B. False

  Amino acids contain, at one end, at least one amino group (NH2) and one carboxyl group (COOH) bound to a carbon molecule. The side chain (usually denoted R) defines the unique characteristics of the amino acid.

67) Where are acute phase proteins produced

  A. Blood stream, by Macrophages
  B. Kidney
* C. Liver
  D. Spleen
  E. Blood stream, by Monocytes

  Acute-phase proteins are a class of proteins whose plasma concentrations increase (positive acute phase proteins) or decrease (negative acute phase proteins) in response to inflammation. In response to injury, local inflammatory cells (neutrophil granulocytes and macrophages) secrete a number of cytokines into the bloodstream. [Cytokines are a group of proteinaceous signalling compounds that, like hormones and neurotransmitters, are used extensively for inter-cell communication]. The liver responds by producing a large number of acute-phase proteins. Measurement of acute phase proteins is a useful marker of inflammation.

  A. True
* B. False

  Paracrine signalling is a form of cell signalling in which the target cell is close to the signal releasing cell, and the signal chemical is broken down too quickly to be carried to other parts of the body. Alternatively, the signal may only reach nearby cells because (1) the nearby cells take up the signal at a very high rate, leaving little signal free to travel further or (2) the signal gets stuck in the extracellular-matrix, or structure surrounding the signal releasing cell, and thus the signal is unable to travel far from the signal releasing cell. The signal chemical is called the paracrine agent.
Examples of paracrine signaling agents include growth factor and clotting factors. Some paracrine agents also have autocrine (cell stimulates itself) or endocrine (affect distant cells via the bloodstream) actions as well. For example, testosterone secreted from the testes acts in an endocrine manner to stimulate peripheral events (e.g. muscle growth), and in a paracrine manner to stimulate spermatogen

69) Which of the following statements about production of LCFAs for energy is true?

  A. CAT I and CAT III are used to allow LCFAs into the mitochondria to be used for energy
* B. CAT I and CAT II are used to allow LCFAs into the mitochondria to be used for energy
  C. CAT I and CAT II are used by the mitochondria for energy
  D. CAT I and CAT II are used to allow LCFAs into the cell to be used as energy

  CAT I and CAT II are enzymes that allow LCFAs into the mitochondria. CAT I is responsible for attaching LCFAs to carnitine so that they may pass through the mitochondrial membrane and CAT II is responsible for removing the carnitine and adding CoA to the LCFA so that it can be used

70) If you had performed a biochemical profile on an animal and had found elevated insulin levels, normal serum amylase and lipase levels, and hypoglycemia, what would be the most likely diagnosis?

  A. Diabetes type I
  B. Pancreatitis
* C. Insulinoma
  D. Pancreatic insufficiency
  E. Diabetes type II

  Insulinoma is an insulin-secreting tumour of the pancreas. It is characterized by persistent hypoglycemia and high levels of insulin. The animal may show signs of weakness, fainting, and possibly convulsions or coma.

71) The pancreas secretes bicarbonate to decrease the pH of digesta so that its digestive enzymes will be activated.

  A. True
* B. False

  Bicarbonate increases the pH of lumen contents (makes them more alkaline). Pancreatic enzymes are more efficient in neutral pH conditions. Amylase and lipase are secreted in active forms, while proteases are secreted in inactive forms and become active in the lumen.

72) What is the best laboratory diagnostic test for diagnosing pancreatitis?

* A. Serum trypsin-like immunoreactivity (TLI)
  B. Serum lipase
  C. Serum amylase
  D. Trypsinogen activation peptide (TAP)
  E. All methods are equal for diagnosing pancreatitis.

  Serum lipase and amylase are good for diagnosing pancreatitis, but sometimes these levels can fluctuate in healthy animals. The trypsin-like immunoreactivity test is the best method, and elevated TLI is very indicative of pancreatitis. Trypsinogen activation peptide is not used as much as the first three methods.

73) Hormones that influence lipid metabolism with their corresponding effect include :

  A. insulin - promotes formation of triglycerides for lipid storage
  B. thyroid hormone - promotes formation of triglycerides for lipid storage
  C. growth hormone - promotes formation of VLDLs in the liver required to deliver triglycerides to peripheral tissues
  D. a, b, and c
* E. a and c

74) Movement of molecules through an ion channel-linked receptor requires ATP

  A. True
* B. False

  An ion channel is an integral membrane protein or more typically an assembly of several proteins that forms a pore through the lipid bilayer (surface membrane) Ion channels may open in response to chemical or electrical signals, temperature, mechanical force or ligands.
Ligand-gated channels (LGICs) open in response to specific ligand molecules binding to the extracellular domain of the receptor protein. Ligand binding causes a conformational change in the structure of the channel protein that ultimately leads to the opening of the channel gate and subsequent ion flux across the plasma membrane. Examples of LGICs include the cation-permeable "nicotinic" Acetylcholine receptor

75) Neonate pigs are often hypoglycemic, but this is common in all baby mammals.

* A. False
  B. True

  Baby pigs are often hypoglycemic, this is due to their undeveloped mechanisms for gluconeogene This condition is not found in newborn lambs, calves or foals.

76) Which of the following is NOT a gamma globulin?

  A. IgE
  B. IgA
  C. IgM
* D. IgC
  E. IgG

  IgA is the main secreted immunoglobulin.
  IgM crosses the placental membrane and provides immunity for newborns or is passed through colostral milk to provide immune protection.
  IgG is the main immunoglobulin in our body.
  IgE is responsible for allergic reactions, among other functions. Note that we did not talk about it in class, but there IS another immunoglobulin called IgD.

77) How would you measure globulin concentration in serum?

  A. Biuret method
  B. Thin line chromatography
  C. Bromcrescol green assay
* D. A and C
  E. B and C

  Globulin cannot be directly measured, and so one must calculate total protein (using Biuret method or refractometry) and subtract albumin concentration (using the bromcresol green assay).

78) To maintain blood glucose during fasting, liver cells carry out gluconeogenesis. Gluconeogenesis uses which of the following molecule(s) as precursors:

* A. Lactate
  B. Fructose
  C. Acetate
  D. Butyrate
  E. All of the above

  Blood glucose is maintained during catabolic phase via glycogenolysis and gluconeogenesis. Glycogenolysis mainly occurs in the liver (need glucose-6-phosphatase to release free glucose). Gluconeogenesis mainly occurs in the liver and to a lesser extent in the kidney. Precursors for gluconeogenesis : amino acids, lactate, propionate. These precursors are converted to pyruvate and oxaloacetate, then undergo reverse glycolysis to produce glucose.

79) Insulin and glucagon are normally released in a coordinated fashion so that when insulin levels rise, glucagon levels fall, and vice versa

* A. True
  B. False

  This is because the pancreas can sense blood glucose levels and stimulates the alpha and beta cells of the Islets of Langerhans accordingly. When the pancreas senses hypoglycemia, insulin secretion is inhibited, while glucagon secretion is stimulated. During hyperglycemia, insulin secretion is stimulated, while glucagon secretion is inhibited. Insulin also directly inhibits glucagon secretion.

80) Ketones are normally present in urine

* A. False
  B. True

  Under normal conditions, kidney tubules will reabsorb ketones that are forced out in the glomerulus; therefore, ketones are not present in the urine. However, if ketones levels are excessively high, the kidney becomes oversaturated with ketones and cannot reabsorb them—this is when ketones appear in the urine, a condition called ketonuria.

81) Type 2 diabetes is caused by the inability of the pancreas to produce enough insulin

  A. True
* B. False

  Type 2 diabetes is primarily caused by 'insulin resistance' of target cells. It is thought that higher calorie intake combined with a sedentary lifestyle leads to a chronic increase in insulin production that overstimulate target cells, ultimately leading to 'insulin resistance', the inability or reduced ability to react to insulin. Type 1 diabetes is characterized by decreases in, or the complete absence of, the production of insulin

82) Ketone formation depends on the amount of energy already in the cell as indicated by oxaloacetate and TCA cycle intermediates.

* A. True
  B. False

83) Proteins are all EXCEPT:

* A. Able to be stored in a specific storage molecule
  B. A majority of a cell's dry weight
  C. A combination of NH2, COOH, a carbon backbone, and an R side chain
  D. Able to combine with lipids to form specific structural molecules
  E. All of the above are true

  Proteins, unlike lipids and carbohydrates, are not stored in any specific storage molecule per se.

84) Carnitine needs to be bound to LCFAs so that they can be utilized to produce energy within the cell

  A. True
* B. False

  Carnitine is needed to allow the LCFAs to pass into the mitochondria through the mitochondrial membrane, but the LCFAs can not be used by the mitochondria until carnitine has been removed from them by CATII

85) Tyrokinase receptors are 'turned off' when the ligand disassociates from the receptor or when the receptor is dephosphorylated

* A. True
  B. False

  A tyrokinase receptor, using insulin as an example, works as follows
 -- Binding of insulin to its tyrosine kinase receptor results in phosphorylation of the receptor, activating it.
  -- Activation of the insulin receptor results in phosphorylation of a glucose transporter (GLUT4) in muscle and adipose tissue
 -- Phosphorylation of GLUT4 allows it to migrate to the cell surface to mediate entry of glucose into the cell
 -- Activation of the insulin receptor also leads to phosphorylation of the enzymes responsible for glycogen synthesis/degradation in the liver and muscle

 The receptor is “turned off” when insulin dissociates from the receptor or when the phosphate groups are removed from the receptor by phosphatases, thus deactivating it.

86) Blood plasma is used for the measurement of enzyme activity

  A. True
* B. False

  Enzyme activity is measured in serum by kinetic assays, often by spectrophotometry. Serum is preferred to plasma because anticoagulants used in the collection of plasma affect a number of readings. Some cause higher than normal Na, K and BUN (heparin); others, lower Ca (EDTA). In addition, EDTA can cause lysis of avian RBCs resulting in skewing of results as RBC contents mix with plasma

  A. LCFA
  B. Ketones
  C. VLDL
* D. All of the above
  E. A and B

  During an extended fasting period, the glucagon:insulin ratio is high in the blood. This triggers the following sequence of events Adipocytes - Fat mobilization : Hormone-sensitive lipase in adipocytes trigger breakdown of triglycerides into LCFA (long chain fatty acids) and glycerol. Both are pushed into the blood-stream, the LCFA linked to a molecule of Albumin, headed for the liver.
Liver VLDL synthesis : Surface complexes on Hepatocytes (liver cells) cleave off LCFA from the LCFA-Albumin complex, absorb it, then combine it with glycerol (absorbed from the bloodstream), to recreate triglyceride. Triglyceride, along with protein and cholestrol, is synthesized into a VLDL (very low density lipoprotein) which are exocytosed into circulation. Keton synthesis : LCFAs (cleaved from the LCFA-albumin complex) may also be converted into ketones in the mitochondria of hepatocytes (using Acetyl-CoA and carnitine). These ketones (acetoacetate, butyric acid and acetone) are released

88) When acetate is absorbed by the ruminant, it gets used for

  A. creation of ketones
* B. creation of LCFAs
  C. glycolysis
  D. glycogenolysis
  E. gluconeogenesis

  Acetate, unlike butyrate, cannot be metabolized by the rumen epithelium. Instead, it travels to adipocytes or mammary glands where it is converted into LCFAs (long-chain fatty acids).

89) Epinephrine and norepinephrine inhibit insulin secretion and stimulate glucagon secretion.

  A. False
* B. True

  Epinephrine and norepinephrine inhibit insulin secretion and stimulate glucagon secretion. This is why hyperglycemia can develop after a severe injury, such as a massive burn. The stress of the injury increases secretion of epinephrine and norepinephrine, suppressing glucose uptake by peripheral tissues, and increasing glucose mobilization from tissues.

90) Buddy, a dog, suffers from insulinoma. This means that his pancreas is damaged and cannot produce enough insulin.

  A. True
* B. False

  An insulinoma is a tumour of the pancreas derived from beta cells which, while retaining the ability to synthesize and secrete insulin, is autonomous of the normal feedback mechanisms. Patients with insulinomas usually develop neuroglycopenic symptoms. These include recurrent headache, lethargy, diplopia, and blurred vision, particularly with exercise or fasting. Severe hypoglycemia may result in seizures, coma, and permanent neurological damage.

91) Chylomicron constituents include:

  A. triglycerides, bile acids, phospholipids
  B. apolipoprotein, free cholesterol, non-esterified fatty acids
  C. bile acids, free cholesterol, phospholipids
* D. apolipoprotein, free cholesterol, phospholipids

  Exogenous lipid metabolism involves micelle formation in the lumen of the intestine. Components of the micelle include: monoglycerides, bile acids, cholesterol, non-esterified fatty acids, and phospholipids. These components individually traverse the enterocyte membrane to be formed into a chylomicron (one type of lipoprotein). The chylomicron consists of phospholipids, free cholesterol, esterified cholesterol, triglycerides and surface apolipoproteins A and B48. The chylomicron 'matures' when HDL adds apoliproteins E and CII.

92) The breakdown of triglycerides stored in adipocytes is known as lipolysis. During this process, LCFAs, packaged into VLDLs by adipocytes, are released into the bloodstream and circulate to cells in need of energy.

  A. True
* B. False

  Besides Chylomicrons (from intestine to tissue) and VLDLs (from liver to tissue) transportatio fatty acids are also transported via an LCFA-albumin complex from adipocytes to the liver (where they are repackaged as VLDLs). This occurs during lipolysis, during which adipocytes break down triglyceride into glycerol and LCFAs. Glycerol is water soluble and can make its way back to the liver unaided. LCFAs, on the other hand, are not water-soluble; they need to bind to albumin (forming an LCFA-albumin complex) to be transported in the bloodstream to the liver. Why don't other (starving) cells steal it? Probably because they don't have the required receptors.

93) A G protein consists of two units : G-alpha-GTP and G-beta/gamma. The alpha subunit, primarily, determines the intracellular proteins affected.

  A. False
* B. True

94) Myasthenia Gravis can be put into transient remission by administration of acetylcholine inhibitors, which reduces the over-stimulation of acetylcholine receptors in neuromuscular junctions.

  A. True
* B. False

  Myasthenia Gravis, a disease associated with muscle fatigue, is caused by disruption of the function of acetylcholine receptors. Transient remission is achieved by administration of acetylcholinesterase inhibitor. This enhances motor transmission by preventing the rapid destruction of actylcholine in the neuromuscular junction. The acetylcholine receptor is an ion channel-linked receptor that responds to the binding of the neurotransmitter acetylcholine. Acetylcholinesterase catalyzes the hydrolysis of the neurotransmitter acetylcholine into choline and acetic acid, a reaction necessary to allow a cholinergic neuron to return to its resting state after activation. In the extreme, cholinesterase inhibitors, similar to acetylcholinesterase, are potent neurotoxins, causing excessive salivation and eye watering in low doses, followed by muscle spasms and ultimately death (examples are some snake venoms, and the nerve gases sarin and VX).

95) In an animal with type I diabetes, how do pancreatic hormones in the blood stream impact adipocytes

  A. The elevated glucagon:insulin ratio would activate hormone-sensitive lipase inhibiting the creation of ketone bodies
* B. The elevated glucagon:insulin ratio would activate hormone-sensitive lipase to break down triglycerides into LCFA and glycerol
  C. No impact. Insulin is low, so glucagon will also be low.
  D. The elevated glucagon:insulin ratio would de-activate hormone-sensitive lipase inhibiting break down of triglycerides into LCFA and glycerol

  Under normal conditions, glucagon secretion is inhibited by (1) hyperglycemia (excess glucose in blood) and (2) insulin. Type 1 diabetes mellitus is characterized by loss of the insulin-producing beta cells of the islets of Langerhans of the pancreas leading to a deficiency of insulin. This activates an increase in secretion of glucagon. The elevated glucagon:insulin ratio would activate hormone-sensitive lipase to break down triglycerides into LCFA and glycerol.

96) The brain, skeletal, cardiac muscles and liver are able to use acetoacetate and Beta-hydroxy as an energy source.

* A. False
  B. True

  The brain, skeletal, and cardiac muscles are able to use acetoacetate and Beta-hydroxybutyrate as energy sources because of high levels present of the enzyme 3-ketoacid CoA transferase that operates in the ketolysis pathway for the production of Acetyl-CoA. However, this enzyme is absent in the ADULT liver.

97) Large scale production of LCFAs takes place in mammary, liver, and adipose tissue in ruminants; and in mammary and adipose tissue in non-ruminants.

* A. False
  B. True

  The reverse is true. Ruminant LCFA production takes place primarily in mammary and adipose tissue while that of non-ruminants takes place in these tissues as well as liver tissue.

98) This enzyme is responsible for breakdown of Triglyceride into glycerol and LCFA (long chain fatty acids) and is activated by this substrate.

* A. hormone sensitive lipase, activated by glucagon
  B. hormone sensitive lipase, activated by insulin
  C. CAT II, activated by glucagon
  D. CAT I, activated by insulin

  High levels of glucagon suggest that the cells of the body are in a low energy state (not getting enough glucose). It makes sense that fat (triglycerides) be mobilized as an energy source once the glucose concentration in the blood decreases. Hormone sensitive lipase, found in the adipose tissue, is activated by glucagon, but inhibited by insulin. The answer is not CAT (carnitine acyltransferase) as CAT I and CAT II are involved with bringing LCFA-CoA into the mitochondria of the cell for energy production, not production of LCFA from triglyceride.

99) Pregnancy/lactation, type II diabetes, and fasting could result in a high glucagon:insulin ratio

* A. False
  B. True

  Keeping you on your toes :) The answer is correct except for the Type of diabetes. Type I is a malfunction of the pancreatic Islet of Langerhan’s cells to produce insulin, creating a high glucagon:insulin ratio. Type II is a malfunction in which cells fail to respond to insulin; in fact, glucagon:insulin ratio could be very low. Type II diabetic patients will only have ketoacidosis if they are insulin deficient, which is made more likely with a concurrent illness.

100) In the presence of oxygen, glucose is converted to pyruvate, which is then converted to lactate.

  A. True
* B. False

  During both aerobic and anaerobic glycolysis, glucose is converted to pyruvate. In the absence of oxygen (anaerobic), pyruvate is converted to lactate. In the presence of oxygen (aerobic), pyruvate is converted to Acetyl CoA. Acetyl CoA then enters the TCA cycle and combines with oxaloacetate. The TCA cycle produces the energy carriers NADH and FADH2, which produce ATP in the mitochondria through the electron transport chain. Aerobic glycolysis produces more energy (and is more efficient) than anaerobic glycolysis.

101) Consequences of high levels of ketones in the bloodstream

  A. appetite suppression
  B. anorexia/weight loss
  C. weakness
  D. fatty liver
* E. all of the above

  Ketones have a suppressive effect on appetite. A fatty liver results from fat mobilization exceeding the liver’s ability to produce VLDLs, causing triglycerides build up in liver cell vacuoles. The function of the liver becomes impaired over time.

102) Some methods used to measure serum protein include Biuret method, Refractometry, Bromcresol green assay and Serum Protein Electrophoresis

* A. True
  B. False

  Biuret method is a colorimetric assay that returns total protein Refractometry is the method of assessing the composition or purity of substances by measuring their refractive index, a fundamental physical property of a substance. <p>Refractometers are frequently used by grape growers and Kiwifruit growers for Brix testing of sucrose levels in their fruit. <p>Bromcresol green method estimates serum albumin. <p>Serum protein electrophoresis is a laboratory test to separate the serum protein components into five classifications by size and electrical charge, those being albumin, alpha-1-globulins, alpha-2-globulins, beta globulins, and gamma globulins.

103) What is the pattern of albumin concentration over an animal’s lifetime?

  A. High when colostrum received, decrease throughout life
* B. Low at birth, rise throughout life, decreasing with old age
  C. low at birth, increasing throughout life
  D. Constant throughout life

  While, in old age, acute phase proteins and immunoglobulins rise, albumin decreases.

104) The generic term for an enzyme that removes phosphate groups from proteins is?

  A. Phosphate
* B. Phosphatase
  C. Phosphorylase
  D. Kinase

  A phosphatase is an enzyme that hydrolyses phosphoric acid monoesters into a phosphate ion and a molecule with a free hydroxyl group. This action is directly opposite to that of phosphorylases and kinases, which attach phosphate groups to their substrates by using energetic molecules like ATP. A common phosphatase in the body is alkaline phosphatase. The presence or absence of the phosphate group on proteins, especially enzymes, is known to play a regulatory role in many biochemical pathways and signal transduction pathways. Hence together, specialized kinases and phosphatases regulate enzymatic activity.

105) What is the general name for the class of compounds absorbed by ruminants following digestion of dietary carbohydrates?

* A. Volatile fatty acids
  B. LCFA
  C. VLDL
  D. Glucose, Fructose and Sucrose
  E. None of the above
  F. All of the above

  Ruminants cannot absorb dietary carbohydrate in the form of simple sugars (glucose, fructose, sucrose) like non-ruminants can. Instead, fibre, especially cellulose, is broken down into glucose in the rumen and reticulum by symbiotic bacteria and protozoa. Almost all the glucose produced by the breaking down of cellulose is used by the symbiotic bacteria. Ruminants get their energy from the volatile fatty acids produced by these bacteria: acetic acid, propionic acid and butyric acid.

106) The cell membrane contains receptor proteins. These are particularly important because they are the only way that communication signals can reach a cell.

  A. True
* B. False

  There are 3 primary means of cell communication
 -- Signaling through membrane-bound molecules (need membrane receptors)
 -- Signaling by secreted molecules (need membrane receptors)
 -- Signaling through gap junctions (do NOT need membrane receptors)
In juxtacrine interactions, proteins from the inducing cell interact with receptor proteins of adjacent responding cells. Endocrine activation of the SNS system is an example of signaling by secreted molecules. In cardiac muscle, gap junctions between adjacent cells allows for action potential propagation from the cardiac pacemaker region of the heart to spread and coordinately cause contraction of the heart.

* A. Muscles do not possess glucose-6-phosphatase
  B. Muscles do not have GLUT4 glucose transporters
  C. Muscles do not contain hexokinase
  D. None of the above

  Essentially, this is because the liver possesses glucose-6-phosphatase while muscle cells don't. Glycogenolysis occurs in the muscle and liver tissue, where glycogen is stored, as a hormonal response to epinephrine (e.g., adrenergic stimulation) and/or glucagon, a pancreatic peptide triggered by low blood glucose concentrations. Liver (hepatic) cells can consume the glucose-6-phosphate in glycolysis, or remove the phosphate group using the enzyme glucose-6-phosphatase and release the free glucose into the bloodstream for uptake by other cells. Muscle cells, lacking glucose-6-phosphatase, cannot release glucose, but instead use the glucose-6-phosphate in glycolysis. When muscle cells do not have enough oxygen, anaerobic glycolysis occurs. This results in production of lactate from glucose. Lactate can diffuse into blood to be converted to glucose in liver cells. Thus, indirectly, muscles can contribute to glucose in the bloodstream. Muscles do contain hexokinase. However it catalytic action strongly favour

108) Examining urine glucose levels is a good early indicator of diabetes.

* A. False
  B. True

  Urine is a late-stage indicator of hyperglycemia and diabetes, because the kidney has a lot of reserves and it takes a long time to overwhelm the kidney's threshold for glucose reabsorption.

109) When butyrate is absorbed by the ruminant, it gets used for

  A. creation of LCFAs
  B. glycogenolysis
* C. creation of ketones
  D. gluconeogenesis
  E. glycolysis

  Unlike propionate, butyrate enters the TCA cycle as Acetyl-CoA and thus cannot lead to a net production of oxaloacetate. Consequently, gluconeogenesis cannot occur. Instead, Beta-hydroxybutyrate, a ketone, is formed from butyrate in the rumen epithelium.

110) Plotting the response of insulin to an intravenous glucose tolerance test can distinguish type I diabetes from type II diabetes.

  A. False
* B. True

  The infusion of glucose into a type I diabetic individual will elicit no response of insulin secretion. A type II individual will respond to the increase in glucose and a spike in insulin concentration will be observed.

  A. False
* B. True

  During pregnancy or lactation, there is high glucose demand. At times, the demand exceeds the ability of the animal to generate propionate that is used to synthesize glucose. When stored glycogen is depleted, decreased blood glucose triggers a high glucagon:insulin ratio that stimulates fat mobilization. LCFAs, mobilized from adipocytes, are transported into the liver where they are converted to ketones. This does nothing to help the shortage of glucose; the glucagon:insulin ratio remains high and fat mobilization into LCFAs continuing unabated. At some point, liver ketone production exceeds tissue ketone utilization and ketones start accumulating in the circulation. At high enough levels, appetite is suppressed, further reducing dietary intake of carbohydrates. The vicious cycle can spiral out of control as fat build-up in the liver further reduces its ability to convert propionate into glucose. Non-ruminants do not need the liver to generate glucose from dietary carbohydrate so are not as easily likely

112) In neuromuscular junctions, acetylcholine receptors control ion channels

  A. False
* B. True

  An acetylcholine receptor is an ion channel-linked receptor that responds to the binding of the neurotransmitter acetylcholine. Although all acetylcholine receptors, by definition, respond to acetylcholine, they respond to other molecules as well, specifically nicotine (nicotinic acetylcholine receptors) and muscarine (muscarinic acetylcholine receptors). Nicotinic acetylcholine receptors can be blocked by curare and toxins present in the venoms of snakes and shellfishes. Drugs such as the neuromuscular blocking agents bind reversibly to the nicotinic receptors in the neuromuscular junction and are used routinely in anaesthesia. Myasthenia Gravis, a disease associated with muscle fatigue, can be caused by disrupting the function of acetylcholine receptors. Although Myasthenia Gravis may affect any voluntary muscle, muscles that control eye and eyelid movement, facial expression, and swallowing are most frequently affected.

113) Muscle glycogen cannot, directly or indirectly, contribute to blood glucose levels

  A. True
* B. False

  When muscle cells do not have enough oxygen, anaerobic glycolysis occurs. This results in production of lactate from glucose. Lactate can diffuse into blood to be converted to glucose in liver cells, which can then be exported into the bloodstream. Thus, indirectly, muscles can contribute to glucose in the bloodstream.

* A. False
  B. True

  LCFAs are transported <u>to</u> the liver, complexed with albumin. There, they get converted to VLDLs for transportation to tissue.<p>VLDL, LDL, and HDL are produced in the liver, while chylomicrons and HDLs are produced in the small intestine.
High density lipoproteins - collects cholesterol from the body's tissues, and brings it back to the liver. Serve as repository for A-series, C-series and E apolipoproteins. Sometimes referred to as the "good cholesterol" lipoprotein.
Chylomicrons - carry triacylglycerol (fat) from the intestines to the liver, adipocytes, mammary glands and other tissue (exogenous pathway). * Very low density lipoproteins (VLDL) - carry LCFAs from the liver to adipose and other tissue (endogenous pathway)
Intermediate density lipoproteins - are intermediate between VLDL and LDL. They are not usually detectable in the blood.
Low density lipoproteins - carry cholesterol from the liver to cells of the body. Sometimes referred to as the "bad cholesterol" lip

115) In an animal with type I diabetes describe the levels of pancreatic hormones in circulation

  A. Insulin low, glucagon low
  B. Insulin high, glucagon low (low glucagon:insulin ratio)
  C. Insulin high, glucagon high
* D. Insulin low, glucagon high (high glucagon:insulin ratio)

  Type 1 diabetes mellitus is characterized by loss of the insulin-producing beta cells of the islets of Langerhans of the pancreas leading to a deficiency of insulin. Sensitivity and responsiveness to insulin are usually normal, especially in the early stages. The condition leads to a low insulin:glucagon ratio.

116) In an animal with type I diabetes, how do pancreatic hormones in the blood stream impact adipocytes

* A. The elevated glucagon:insulin ratio would activate hormone-sensitive lipase to break down triglycerides into LCFA and glycerol
  B. The elevated glucagon:insulin ratio would de-activate hormone-sensitive lipase inhibiting break down of triglycerides into LCFA and glycerol
  C. No impact. Insulin is low, so glucagon will also be low.
  D. The elevated glucagon:insulin ratio would activate hormone-sensitive lipase inhibiting the creation of ketone bodies

  Under normal conditions, glucagon secretion is inhibited by (1) hyperglycemia (excess glucose in blood) and (2) insulin. Type 1 diabetes mellitus is characterized by loss of the insulin-producing beta cells of the islets of Langerhans of the pancreas leading to a deficiency of insulin. This activates an increase in secretion of glucagon. The elevated glucagon:insulin ratio would activate hormone-sensitive lipase to break down triglycerides into LCFA and glycerol.

117) The following are some of the molecules absorbed by ruminants following carbohydrate digestion (multiple answers)

* A. Butyrate
  B. Glucose
* C. Acetate
  D. LCFA
* E. Propionate

  Ruminants cannot absorb dietary carbohydrate in the form of simple sugars (glucose, fructose, sucrose) like non-ruminants can. Instead, fibre, especially cellulose, is broken down into glucose in the rumen and reticulum by symbiotic bacteria and protozoa. Almost all the glucose produced by the breaking down of cellulose is used by the symbiotic bacteria. Ruminants get their energy from the volatile fatty acids produced by these bacteria: acetic acid, propionic acid and butyric acid.

118) When propionate is absorbed by the ruminant, it gets used for

  A. glycolysis
  B. creation of LCFAs
  C. glycogenolysis
  D. creation of ketones
* E. gluconeogenesis

  Proprionate enters the TCA cycle as succinate. Gluconeogenesis essentially reverses the aerobic glycolysis cycle to create glucose. Gluconeogenesis begins with the formation of oxaloacetate through carboxylation of pyruvate (catalyzed by pyruvate carboxylase) Oxaloacetate is then decarboxylated and simultaneously phosphorylated to produce phosphoenolpyru (phosphoenolpyruvate carboxykinase). Both reactions take place in mitochondria. Oxaloacetate has to be transformed into malate in order to be transported out of the mitochondria. Typically, the last step of gluconeogenesis is the formation of glucose-6-phosphate from fructose-6-phosphate (phosphoglucose isomerase).

119) When butyrate is absorbed by the ruminant, it gets used for

  A. creation of LCFAs
* B. creation of ketones
  C. glycolysis
  D. glycogenolysis
  E. gluconeogenesis

  Unlike propionate, butyrate enters the TCA cycle as Acetyl-CoA and thus cannot lead to a net production of oxaloacetate. Consequently, gluconeogenesis cannot occur. Instead, Beta-hydroxybutyrate, a ketone body, is formed from butyrate in the rumen epithelium.

120) When acetate is absorbed by the ruminant, it gets used for

* A. creation of LCFAs
  B. creation of ketones
  C. gluconeogenesis
  D. glycolysis
  E. glycogenolysis

  Acetate, unlike butyrate, cannot be metabolized by the rumen epithelium. Instead, it travels to adipocytes or mammary glands where it is converted into LCFAs (long-chain fatty acids).

121) Cytokine release from macrophages/monocytes initiate the acute phase protein response?

  A. False
* B. True

  Acute-phase proteins are a class of proteins whose plasma concentrations increase (positive acute phase proteins) or decrease (negative acute phase proteins) in response to inflammation. In response to injury, local inflammatory cells (neutrophil granulocytes and macrophages) secrete a number of cytokines into the bloodstream. [Cytokines are a group of proteinaceous signalling compounds that, like hormones and neurotransmitters, are used extensively for inter-cell communication]. The liver responds by producing a large number of acute-phase proteins. Measurement of acute phase proteins is a useful marker of inflammation.

122) Where are acute phase proteins produced?

  A. Blood stream, by Macrophages
* B. Liver
  C. Kidney
  D. Blood stream, by Monocytes
  E. Spleen

  Acute-phase proteins are a class of proteins whose plasma concentrations increase (positive acute phase proteins) or decrease (negative acute phase proteins) in response to inflammation. In response to injury, local inflammatory cells (neutrophil granulocytes and macrophages) secrete a number of cytokines into the bloodstream. [Cytokines are a group of proteinaceous signalling compounds that, like hormones and neurotransmitters, are used extensively for inter-cell communication]. The liver responds by producing a large number of acute-phase proteins. Measurement of acute phase proteins is a useful marker of inflammation.

123) Glycogenolysis primarily occurs in tissue cells of the body

  A. True
* B. False

  Glycogenolysis transpires in the muscle and liver tissue, where glycogen is stored, as a hormonal response to epinephrine. Glycogenolysis is the catabolism of glycogen by removal of a glucose monomer and addition of phosphate to produce glucose-1-phosphate. This derivative of glucose is then converted to glucose-6-phosphate, a potent intermediate in glycolysis. The hormones glucagon and epinephrine stimulate glycogenolysis.

124) What function(s) can albumin/globulin ratio represent (single answer)?

  A. Immune activity
  B. Renal function
  C. Protein metabolism
  D. Inflammation
* E. All of the above

  While an A/G ratio is described as a ‘snapshot’ of protein metabolism, a deviation from the norm can indicate immune activity and inflammation (increased globulins) and renal function (decreases in albumin could indicate loss through permeability at the kidneys (or renal failure).

125) What effect does dehydration have on the A/G ratio

  A. Decreases concentration of albumin and globulin equally
  B. Hypoalbuminemia
* C. No effect
  D. Hyperglobulinemia

  Dehydration equally increases concentration of A and G, so B is incorrect (and even if the question stated ‘increased, since it is a ratio, the increase would be divided out). As dehydration does change concentrations equally, there would be no change in the concentrations of globulin and albumin with respect to each other. (i.e. the a/g ratio would be within its reference range.)

126) Transamination is a process in which

  A. A protein is broken down into its amino-acids
  B. An amine group is removed from a molecule and sent to the urea cycle
* C. An amine group is transferred from an amino-acid to an alpha-keto acid
  D. An amine group is transferred from an alpha-keto acid to an amino-acid
  E. Alpha-ketoglutarate donates its amine group to an amino acid, like glutamate

  Transamination (or aminotransfer) is the reaction between an amino acid and an alpha-keto acid. The amino group is transferred from the former to the latter; this results in the amino acid being converted to the corresponding alpha-keto acid, while the reactant alpha-keto acid is converted to the corresponding amino acid.

127) Deamination is a process in which

  A. An amine group is transferred from an amino-acid to an alpha-keto acid
  B. An amine group is transferred from an alpha-keto acid to an amino-acid
  C. Alpha-ketoglutarate donates its amine group to an amino acid, like glutamate
  D. A protein is broken down into its amino-acids
* E. An amine group is removed from a molecule and sent to the urea cycle

  Deamination is the removal of an amine group from a molecule. In mammals, deamination takes place in the liver. It is the process by which amino acids are broken down. The amino group is removed from the amino acid and converted to ammonia. The remainder is an alpha-ketoglutarate that can be recycled or burned for energy. Ammonia is toxic to the human system, and enzymes convert it to urea or uric acid by addition of carbon dioxide molecules in the Urea Cycle. Urea and uric acid can safely diffuse into the blood and then be excreted in urine.

128) Aspartate aminotransferase is an enzyme that catalyzes

* A. Transamination
  B. Deamination
  C. The Urea cycle
  D. Transamination or Deamination, depending on the amino acid

  Aspartate aminotransferase catalyzes the transamination reaction of Aspartate and alpha-ketogl into glutamate and oxaloacetate. Similarly, Alanine transaminase catalyzes the transamination reaction of Alanine and alpha-ketoglutarate into pyruvate and glutamate.

129) Ammonia can be recycled into protein

  A. through transamination
  B. in the urea cycle
* C. by microorganisms
  D. by oxidative phosphorylation
  E. through deamination

  Ammonia is toxic to all organisms, barring microorganisms which can convert it into amino acids. Ammonia (NH_4) inhibits oxidative phosphorylation and affects neurological function by inhibiting receptor function, signal transduction (transportation of stimuli) and neurotransmitters. Ammonia is excreted through the urea cycle.

130) Transamination and deamination of proteins in the liver is

* A. To catabolize excess amino acids
  B. To get rid of toxins (like ammonia) through the urea cycle
  C. To conjugate Bilirubin
  D. The first step in the creation of plasma proteins

  Amino acids that reach the liver can be used to create liver proteins (14%), plasma proteins (6%) or be sent out into system circulation (23%) for use by body tissue. The remainder (57%) are catabolized through pathways of carbohydrate metabolism, conversion to glucose or glycogen, or shunted to fatty acid synthesis.

131) When protein is catabolized in muscle, toxic ammonia is removed as follows

  A. Ammonia diffuses into the blood and is taken to the liver where it is converted into urea
  B. Transamination or Deamination, depending on the amino acid
  C. Deamination of ammonia
* D. Ammonia reacts with glutamate to produce glutamine. This is broken down in the kidney, where ammonia is excreted in urine.

  The byproduct of the transamination reaction in the muscle that ultimately produces energy from amino-acids, is glutamate. Glutamate may be converted into alanine or, with the addition of ammonia, into glutamine. Alanine goes to the liver where it is converted into glucose and urea, the latter being excreted by the kidney in urine. Glutamine is taken up by the kidney where it is catabolized into energy (or glucose, through gluconeogenesis and ammonia. This ammonia is excreted in urine.

132) A high BUN (Blood Urea Nitrogen) points to a malfunction in :

  A. Liver
  B. TCA cycle
* C. Kidney
  D. Spleen
  E. Gall bladder (obstruction)

  BUN measures the amount of nitrogen in the blood that comes from urea. Impaired kidney function results in increased BUN levels.

133) Birds excrete ammonia using uric acid while animals always excrete ammonia as urea or ammonia dissolved in urea.

* A. False
  B. True

  The above is generally true. However, there are exceptions. For example, Dalmation breeds of dogs excrete urea in the form of uric acid in the urine rather than in the urea form. This is due to a defect in one of the genes controlling expression of the conversion enzymes in the Urea cycle.

134) The liver is believed to have over 500 functions. In most healthy animals the liver is operating at approximately what percentage of its maximum potential?

  A. 120 (like most crocodiles)
* B. 30
  C. 50
  D. 10
  E. 75

  The liver is one of the few organs that can regenerate – so, one doesn't have to be too concerned when doing a liver biopsy. If a lobe is lost due to, say, trauma, the lobe will not regenerate; however, the remaining lobes will increase in mass to make up.

135) The parenchymal cell of the liver is the hepatocyte. Along with endothelial cells that line sinusoids, they constitute approximately what % of cells belonging to the liver?

  A. less than 50%
  B. 80%
  C. 60%
* D. 95-98%

  Cells belonging to the liver include parenchymal (65-70%), endothelial (30%), epithelial cells (1%; line small bile ducts or canaliculi) and mesenchymal cells (fibroblasts, plasma cells, mast cells)

136) Periportal hepatocytes

* A. Tend to have aerobic functions as they reside close to the hepatic arteriole and portal venule
  B. Tend to have aerobic functions as they contain a vascular pole
  C. Tend to have anaerobic functions as they contain a biliary pole
  D. Tend to have anaerobic functions because they reside close to the central venule

  A liver acinus is the inter-lobular tissue surrounding the portal triad (which contains the bile duct, hepatic arteriole and hepatic portal venule). Blood from both the hepatic artery and portal vein flow through sinusoids towards the central venule (the far end of the acinus). Bile flows in the reverse direction in canaliculi, towards the bile duct in the triad (acinus center). All hepatocytes have both a vascular pole (faces the sinusoid) and a biliary pole (faces the canaliculi). Hepatocytes close to the triad (zone 1) deplete oxygen from the blood flowing past them while carrying out mainly aerobic functions (carbohydrat metabolism, glycogen storage) while hepatocytes close to the central venule (zone 3) have to work with relatively deoxygenated blood – they carry out detoxification functions. Hepatocytes in zone 2 do a bit of both.

137) Cholestrol is present in every animal cell. It also is required for the production of bile salts, steroid hormone synthesis, cell membranes, myelin and lipoproteins. Its production is regulated by which enzyme

  A. HMG-COA dehydrogenase
  B. Cholestrol aminotransferase
* C. HMG-COA reductase
  D. Cholestro-transferase

  Cholestrol production occurs in the endoplasmic reticulum. About 50% of the cholestrol needs of an animal are met in diet, the remainder being synthesized by the body. Cholestrol production is regulated by controlling both the activity and levels of HMG CoA Reductase

138) Regulation of cholestrol synthesis is carried out by

  A. By controlling the levels of HMG Coa Reductase
  B. Synthesis isn't regulated. Instead, excess is excreted by the kidney
  C. By controlling the activity of HMG Coa Reductase
* D. By controlling both the activity and levels of HMG CoA Reductase

  High cholestrol levels, epinephrine and glucagon inhibit enzyme activity, while insulin stimulates enzyme activity. High cholestrol levels also inhibit synthesis of HMG CoA Reductase while simultaneously promoting its degradation. Low cholestrol levels and insulin have the opposite effect.

139) Most of the cholestrol used to create bile

* A. Is reabsorbed in the ileum
  B. Is lost in the feces
  C. Is used to facilitate the excretion of bilirubin
  D. Facilitates the digestion of protein

  About 90% of cholestrol in bile is reabsorbed in the ileum. Bile contains water, bile salts, bilirubin, cholestrol, fatty acids and electrolytes. Its 4 main functions are elimination of cholestrol (although 90% is reabsorbed in the ileum) prevention of cholestrol precipitation in the gall bladder facilitation of digestion of fat facilitation of absorption of fat soluble vitamins

140) A portosystemic shunt

* A. Occurs when part of the portal system bypasses the liver
  B. Is a bile duct blockage
  C. Results in reduced bile secretion into the intestine
  D. Is usually the result of severe trauma to the abdomen

  Usually congenital, a portosystemic shunt is when part of the portal system connects directly with the vena cava. Some nutrients, thus, bypass the liver. In addition, the enterohepatic circulation (wherein bile salts secreted into the instestine are reabsorbed, then picked up by the liver) is disrupted resulting in an increase of bile salts in circulation. The solution is often surgical.

141) Cholestasis is

  A. Reduced synthesis of cholestrol
  B. Reduced production of bile due to liver failure
* C. Blockage of the flow of bile from the liver to the intestine
  D. Excessive production of cholestrol

  Cholestasis can be (1) Mechanical : where there is a mechanical blockage in the duct system such as can occur from a gallstone or (2) Malignancy/Metabolic : which are disturbances in bile formation that can occur because of genetic defects or acquired as a side effect of many medications.

142) Bilirubin is formed by the breakdown of senescent RBCs in the

  A. Liver only
* B. Reticuloendothelial system
  C. Spleen only
  D. Spleen, Liver and Kidney

  The main sites of destruction of RBCs are the liver and the spleen. However, mobile and fixed macrophages in the entire reticuloendothelial system participate. These include tissue macrophages in the liver (Kupffer cells), spleen and bone marrow. The lungs, lymph nodes, skin and subcutaneous tissue and brain (microglia) also participate. RBC breakdown results in the production of unconjugated bilirubin which binds to albumin and is transported to the liver where glucuronic acid is added to create conjugated bilirubin (that is soluble). The solubility of conjugated bilirubin allows it to be detected by diazo dye.

143) Diazo dye detects

  A. Conjugated bilirubin because it is insoluble
  B. Unconjugated bilirubin because it is insoluble
* C. Conjugated bilirubin because it is soluble
  D. Unconjugated bilirubin because it is soluble

  Conjugated bilirubin, produced in the liver from unconjugated bilirubin, reacts through a direct reaction with diazo dye because it is soluble. Unconjugated bilirubin, produced when RBCs are broken down in the RE (reticuloendothelial) system, reacts only through an indirect reaction with diazo dye because it is insoluble, thus needing an accelerator.

144) Bilirubin, in a healthy animal

  A. If unconjugated, being a smaller molecule, will pass through the glomerulus
  B. If conjugated, will not pass through the glomerulus
* C. Is not normally present in urine
  D. Is normally present in small quantities in urine
  E. Is never present in blood serum

  In a healthy animal, bilirubin will not be present in the urine. If present, it will be only conjugated bilirubin as unconjugated bilirubin in the blood always travels complexed with albumin, thus too big pass through healthy glomeruli. Urine bilirubin is typically elevated prior to elevation in serum bilirubin and the appearance of jaundice.

145) The brownish color of feces is due to

  A. Conjugated bilirubin
  B. Urobilinogen
  C. Unconjugated bilirubin
* D. Stercobilin

  Stercobilin, responsible for the typical brown color of human feces, is created by bacterial action on bilirubin and subsequent oxidation. Unconjugated bilirubin does not enter the intestine. Conjugated bilirubin is reduced, by bacterial action in the intestine, into urobilinogen and stercobilinogen. Urobilinogen is reabsorbed, while stercobilinogen is oxidized to sterocobilin and excreted in feces.

146) Under conditions of hepatic lipidosis, a blood test could show the following

  A. AST, ALT, Albumin normal; Bile acids higher than normal; Bilirubin lower than normal
* B. AST, ALT, Bilirubin and bile acids higher than normal; Albumin lower than normal
  C. AST, ALT normal; Bile acids, Bilirubin higher than normal; Albumin lower than normal
  D. AST, ALT, Albumin and bile acids higher than normal; Bilirubin lower than normal

  When fat accumulates in hepatic cells, hepatocytes can rupture elevating AST and ALT. Fat accumulation could also result in bile duct blockage resulting in bile acids being higher than normal in the serum. Reduced liver function will result in higher bilirubin and low to normal albumin. Chronic disease of the liver would show similar results, barring those of bile acids which would closer to normal.

147) Peptides are broken down into free amino acids and di/tripeptides at the level of the

  A. lumen of the stomach
  B. membrane of the stomach
  C. lumen of the small intestine
* D. membrane of the small intestine

  Membrane bound peptidases are responsible for breaking peptides into di/tripeptides and amino acids. These enzymes are located within the enterocyte and on the membrane surface extending into the glycocalyx (the brush border).

148) Proteins can only be taken up by enterocytes in the form of amino acids

* A. False
  B. True

  Enterocytes can absorb di/tripeptides and break these down with peptidases inside the cell. However, the bloodstream always receives amino acids, not di/tripeptides.

149) Which of the following statements is true”

A. The small intestine is the main site of protein digestion, pancreatic proteolytic enzymes work at low pH
* B. The small intestine is the main site of protein digestion, pancreatic proteolytic enzymes work at neutral pH
C. The stomach is the main site of protein digestion, gastric enzymes work at high pH
D. The stomach is the main site of protein digestion, gastric enzymes work in neutral pH

The small intestine is the site of both luminal and membranous phases of digestion for proteins; the stomach has luminal phase of digestion only. In the small intestine, peptides are broken into di/tripeptides as well as amino acids; the stomach breaks down protein to peptides. The proteolytic enzymes in the small intestine are most active at pH 7-8, therefore neutralization of the acidic stomach contents is essential before digetion in the small intestine begins. Gastric enzymes work best at acidic/low pH.

150) Which of the following enzymes are found only in the small intestine?

* A. trypsin
B. chymosin (rennin)
C. intestinogen
D. pepsin

Trypsin is a pancreatic proteolystic enzyme secreted into the lumen of the pancreas. Trypsin plays the role of “activator” in pancreatic zymogens (enzyme precursors) into functioning enzymes (eg. Chymotrypsinogen into Chymostrypsin). Note that trypsin's zymogen form, trypsinogen, itself needs to be activated by Enterokinase, secreted by intestinal crypts of Lieberkuhn. Pepsin and Chymosin are protein digesting enzymes in the stomach.

151) Which of the following is true concerning di/tripeptides and amino acids in the adult gut lumen-enterocyte interface

A. they are absorbed by pinocytosis
* B. they are cotransported with sodium
C. they are cotransported with bicarbonate
D. they are actively transported by chloride transporters

They are absorbed by at least 4 different Na+ co-transporters on the apical side, while active transport of Na+ out of the cell via the Na/K pump occurs on the basal membrane side; therefore the essential Na gradient is maintained.

152) Which of the following is true regarding carbohydrate and protein digestion in the intestine?

  A. Proteins must be absorbed only as amino acids whereas carbohydrates can be taken up as disaccharides or glucose
* B. Carbohydrates must be absorbed only as simple sugars whereas proteins can be taken up as di/tripeptides and amino acids
  C. Both carbohydrates and proteins must be broken down to their basic building blocks (glucose and amino acid respectively) before they can be absorbed
  D. Carbohydrates can be taken up as di/trisaccharides and broken down into glucose within the enterocyte

  Di/Tripeptides can be broken down to amino acids at the surface of the enterocyte OR can first be taken up within the enterocyte and then broken down to amino acids. Carbohydrates can only be absorbed as simple sugars (glucose, galactose, fructose).

153) Mammals can never absorb large peptides through the gut

  A. True
* B. False

  Neonate mammals are able to absorb immunoglobulins (large proteins) found in colostrum because proteins are not digested by the neonate stomach and because of the ability of specialized enterocytes of the gut to pinocytose the large molecules.

The gut will be 'close' in about 24 hours after which specialized enterocytes are replaced by normal enterocytes.

154) The acute phase responder protein in horse and cows during an inflammation is:

  A. Albumin
* B. Fibrinogen
  C. Globulin
  D. Enterokinase

  Fibrinogen is the acute phase responder of early inflammation in horses and cows. Acute phase responders differ between species. In the case of horses and cows, a change in the fibrinogen will be detected before a change in their while blood cell count. Enterokinase is a digestive enzyme secreted by the crypts of Lieberkuhn.

155) Relative hyperproteinemia refers to

  A. increase in albumin only
  B. increase in fibrinogen only
  C. increase in globulin only
  D. increase in the A/G ratio
* E. none of the above

  The A/G ratio stays the same, but both albumin and globulin have increased. Hyperproteinemia is often a sign of dehydration