Chapter 13
Multiple Choice Questions

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Chapter 1

1. Guanylin is a recently identified gut hormone produced by the ileum and colon. Which of the following statement regarding this peptide regulator is correct?

   (a) It stimulates a specific G-kinase receptor, resulting in increases in epithelial cGMP and net secretion.
   (b) It is secreted by antral G-cell and activates gastric secretion.
   (c) It is made by intestinal smooth muscle cells.
   (d) It increases cGMP, inhibiting net secretion.
   (e) It activates soluble guanylate cyclase.

2. Cholera toxin's effects are mediated by:

   (a) Increases in cytosolic calcium.
   (b) ADP-ribosylation of the G_s alpha subunit, rendering it persistently active.
   (c) A membrane guanylate cyclase receptor.

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(d) A paracrine effect.
(e) Mucosal invasion and destruction.

3. Gastrin stimulates acid secretion by:

(a) A paracrine effect
(b) A juxtacrine action
(c) A neurocrine action
(d) An endocrine action
(e) An autocrine action

4. Which of the following gut hormones is not involved in the regulation of the initial phase of digestion?

(a) Guanylin
(b) Secretin
(c) Gastrin
(d) Cholecystokinin
(e) Gastric inhibitory polypeptide (GIP)

5. Which of the following statements is correct?

(a) Secretin is made and secreted by ileal endocrine mucosal cells.
(b) CCK is secreted by the stomach.
(c) Gastrin is made by antral G-cells.
(d) GIP is produced by the liver.
(e) GIP stimulates gastric acid secretion.

6. All of the following belong to gut peptide hormones, except:

(a) Somatostatin
(b) Gastrin
(c) Substance P
(d) Enkephalins
(e) Nitric oxide

7. Which of the following statements is incorrect?

(a) Intestinal functions are only possible through inputs from vagal or spinal neurons.
(b) Enteric neurons are organized into networks that can produce programmed responses.
(c) Enteric neurons integrate gut function.
(d) Peptide neurotransmitters are made by enteric neurons.
(e) The intestine is one of the most innervated organ systems in the body.

8. Mark one of the following parings of gut endocrine cells with its correct secretions:

(a) S cell – Somatostatin.
(b) G cell – Secretin.

(c) I cell – Gastrin.
(d) D cell – Cholecystokinin.
(e) L cell – Glucagon like-peptide-1.

9. Which of the following statements is most likely to best describe the feature of enteric nervous system?

(a) It works independently of the autonomous nervous system.
(b) It does not have motor neurons.
(c) It contains only cholinergic nerves.
(d) Its myenteric nerves control gut secretion and local blood flow.
(e) Its submucosal nerves control gut peristalsis and segmentation.

10. Select one of the following gut peptide hormones that best pair with its respective action:

(a) Gastric inhibitory peptide – Inhibits pancreatic ductal secretion.
(b) Cholecystokinin – Inhibits pancreatic enzyme secretion.
(c) Gastrin – Inhibit intestinal electrolyte secretion.
(d) Secretin – Inhibits gastric acid secretion.
(e) Motilin – Inhibits bile secretion.

11. Regarding the regulation of gut secretion and motility, there are diverse peptides that act as endocrine, paracrine and neurocrine regulators. Which of the following is a paracrine regulator?

(a) Gastrin.
(b) Secretin.
(c) Motilin.
(d) Somatostatin.
(e) Gastrin releasing peptide.

12. Migrating motor complex is an interdigestive gut contraction which propels food residue and controls bacterial overgrowth in our gastrointestinal tract. Which of the following peptide hormone is responsible for this gut motility?

(a) Motilin.
(b) Cholecystokinin.
(c) Gastrin releasing peptide.
(d) Gastrin inhibitory peptide.
(e) Vasoactive intestinal peptide.

Answers: (1) a; (2) b; (3) d; (4) a; (5) c; (6) e; (7) a; (8) e; (9) a; (10) d; (11) d; (12) a

Chapter 2

1. The following are true of neural innervation of the intestine except:

(a) Preganglionic sympathetic nerves from the spinal cord synapse at paravertebral ganglia, from which post-ganglionic fibers project to the intestine.

(b) Post-ganglionic sympathetic fibers project to the intestine following the celiac, superior mesenteric, and inferior mesenteric arteries in their respective distributions.
(c) The neurons of the enteric nervous system project from the spinal cord.
(d) The enteric nervous system has "hard-wired" circuits which produce patterned responses.
(e) The enteric nervous system has inhibitory, stimulatory, and connecting neurons.

2. All of the following statements are true regarding the basic electrical rhythm except:

(a) The depolarization phase is due to opening of voltage-sensitive K channels.
(b) BER frequency is not affected by neurohumoral stimulation.
(c) BER are not always associated with motor contraction.
(d) BER originate from gut pacemakers found throughout the GI tract.
(e) Spike potentials during depolarizing phases of the BER determine motor contraction.

3. Which of the following agents inhibits intestinal smooth muscle contraction?

(a) Acetylcholine
(b) Serotonin
(c) CCK
(d) Gastrin
(e) Somatostatin

4. Which of the following statements concerning gut smooth muscle movement is incorrect?

(a) Segmentation mixes intestinal contents.
(b) Tonic contractions characterize intestinal sphincters.
(c) Peristalsis is primarily found in the esophagus and stomach.
(d) Increases in smooth muscle cAMP stimulate contraction.
(e) Secondary peristalsis in the esophagus is initiated by luminal distention.

5. Migrating motor complexes are characterized by the following statements except:

(a) Cyclic periodicity of approximately 90 min.
(b) Stimulated by meals.
(c) Wavelike contraction starting from stomach to terminal ileum.
(d) Interdigestive motor contractions that sweep the bowel of luminal contents.
(e) Motilin may play a role in initiating MMCs.

6. Which of the following statements concerning the colonic motor functions is incorrect?

(a) Longitudinal muscles are continuous sheaths enveloping the colonic wall.
(b) Segmentations and haustrations are the major motor activities of the small and large bowels.

(c) There is an increasing gradient of BER frequency from proximal to distal.
(d) Rectal and anal functions are distinct from colonic motor functions.
(e) The relaxation of the internal anal sphincter is involuntary.

7. Gastric emptying is regulated at a rate optimal for digestion and absorption of a meal. Which one of the following statements concerning factors that will increase the rate of gastric emptying of a meal?

(a) Increasing the fat content of the meal.
(b) Increasing the size of food particles of the meal.
(c) Increasing the hypotonicity of the meal.
(d) Increasing the volume of the meal.
(e) Increasing the acidity of the meal.

8. Slow waves are the intrinsic and spontaneous electrical activity of the gut smooth muscle. Which of the following statements concerning slow wave activity in small intestinal smooth muscle is true?

(a) It directly triggers muscle contractions.
(b) It always contains spike or action potentials.
(c) It has a lower frequency in proximal compared to distal regions of the gastrointestinal tract.
(d) It occurs at approximately 90-min intervals.
(e) It sets the maximum frequency of small intestinal contractions.

9. Which of the following statements concerning propulsion of colonic contents into the rectum is true?

(a) It is caused by migrating motor complex.
(b) It causes the internal anal sphincter to relax.
(c) It causes involuntary contraction of the external anal sphincter.
(d) It is under voluntary control.
(e) It initiates defecation.

10. There are two major gastric functions, namely gastric motility and secretion. Which of the following statements concerning gastric function is true?

(a) Gastric emptying is stimulated by cholecystokinin.
(b) Gastric emptying is increased by the arrival of acid in the duodenum.
(c) Acid secretion is stimulated by secretin.
(d) Acid secretion is inhibited by gastrin.
(e) Acid secretion is inhibited by hydrogen ions in the gastric lumen.

11. The function of lower esophageal sphincter (LES) is to allow food bolus entering into the stomach and prevent the reflux of gastric content back to the lower part of esophagus. Which of the following statements concerning LES is true?

(a) LES is able to be anatomically identified as a structure.
(b) Abnormally high LES pressure leads to gastro-esophageal reflux disease.

(c) There is a positive pressure gradient between the abdomen and thorax that tends to promote reflux of gastric contents into the esophagus.
(d) LES tone is decreased by acetylcholine.
(e) LES tone is increased by ethanol and smoking.

12. Which of the following statements concerning receptive relaxation of the stomach is true?

(a) It is not affected by vagotomy.
(b) It is triggered by relaxation of the lower esophageal sphincter.
(c) It results from decreased contractile activity of antral smooth muscle.
(d) It results in a low intragastric pressure during a meal.
(e) It depends entirely on the enteric nervous system.

Answers: (1) c; (2) a; (3) e; (4) d; (5) b; (6) a; (7) d; (8) e; (9) b; (10) e; (11) c; (12) d

Chapter 3

1. The following statements are concerning about the gastric function. Which of the following is true?

(a) The endocrine portion of the stomach is found in the body and fundus.
(b) Mucous neck cells are predominantly responsible to produce bicarbonate.
(c) Chief cells make and secrete acid.
(d) Parietal cells are located in the upper part of gastric pits.
(e) Mast cells regulate acid secretion through an endocrine pathway.

2. Mucus cells have all but one of the following properties:

(a) Secretion of bicarbonate.
(b) Mucin production.
(c) Intrinsic factor production.
(d) Protect the gastric mucosa against autodigestion.
(e) Increased secretion following prostaglandin E stimulation.

3. Which one of the following gut hormones works through an endocrine pathway?

(a) Somatostatin
(b) Histamine
(c) Bombesin
(d) Gastrin
(e) Guanylin

4. The proton pump, or H^+/K^+-ATPase, is the major mediator of gastric acid secretion. Which of the following statements is incorrect?

(a) For the proton pump to function, its activity must be coupled to K^+ and Cl^- efflux.
(b) The proton pump is an electroneutral transporter.

(c) Direct regulation of proton pump activity determines the rate of gastric acid secretion.
(d) The activation of the proton pump is associated with insertion of tubulovesicles into the canalicular membrane.
(e) Proton pump inhibitors covalently modify the proton pump.

5. The three most important physiological activators of gastric acid secretion are:

(a) Secretin, GIP, and VIP.
(b) Gastrin, GIP, histamine.
(c) Acetylcholine, GIP, histamine.
(d) Gastrin, serotonin, histamine.
(e) Gastrin, acetylcholine, histamine.

6. Which one of the following statements is true?

(a) The effects of acetylcholine and gastrin are synergistic.
(b) Gastrin stimulates increases in cellular cAMP.
(c) Histamine activates gastric acid secretion through type 1 histamine receptors.
(d) Histamine potentiates the effects of gastrin and acetylcholine.
(e) H_2-receptor blockade is not an effective therapy for peptic ulcer disease because the stimulatory actions of gastrin and acetylcholine remain unblocked.

7. The following statements concerning the cephalic phase are correct except:

(a) It is abolished by vagotomy.
(b) It can be activated by conditioned responses.
(c) It is in part mediated by increased absorption of amino acids.
(d) It is associated with increased gastric acid secretion and motility.
(e) It accounts for 30–40 % of the meal-stimulated gastric acid secretion response.

8. Which of the following statements is correct?

(a) Pepsin accelerates the conversion of pepsinogen to pepsin.
(b) Pepsin primarily digests vegetable proteins.
(c) Pepsinogen is converted to pepsin prior to secretion into the lumen of the gastric pit.
(d) Proton pump inhibitors have no effect on the conversion of pepsinogen to pepsin.
(e) Pepsinogen secretion does not parallel acid secretion.

9. Which of the following is the least important contributing factor for causing peptic ulcer disease?

(a) *Helicobacter pylori*
(b) NSAIDs

(c) Diabetes
(d) Smoking
(e) Gastrinoma

10. The following are true about *Helicobacter pylori* except:

(a) The organism expresses urease, allowing it to survive the harsh milieu of the stomach.
(b) *H. pylori* causes peptic disease in all patients it infects.
(c) *H. pylori*-related ulcer disease is treated with antibiotics and acid suppression.
(d) This organism causes the most common world-wide infection.
(e) *H. pylori* is not an invasive organism.

11. Which of the following statements concerning acidification of the gastric content to pH 2 is true?

(a) It will lead to decreased release of secretin.
(b) It will lead to inhibition of acid secretion via a vago-vagal reflex.
(c) It will lead to inhibition of acid secretion via release of somatostatin.
(d) It will lead to decreased conversion of pepsinogen to pepsin.
(e) It will lead to increased secretion of gastrin.

12. Which of the following statements concerning acidification of the duodenal lumen to pH 3 is true?

(a) It will lead to inhibition of pancreatic bicarbonate secretion.
(b) It will lead to inhibition of pepsinogen secretion.
(c) It will lead to inhibition of pancreatic enzyme secretion.
(d) It will lead to inhibition of bile production.
(e) It will lead to inhibition of gastric emptying.

Answers: (1) d; (2) c; (3) d; (4) c; (5) e; (6) d; (7) c; (8) a; (9) c; (10) b; (11) c; (12) e

Chapter 4

1. One therapeutic target for treating chronic pancreatitis is to reduce stimuli of pancreatic functions, i.e. keep the pancreas in its resting state, as the release of digestive enzymes would injure the pancreas further. All but one of the following measures would be consistent with this therapeutic goal:

(a) Fasting the patient.
(b) Administration of octreotide, a long-lived and potent analog of somatostatin.
(c) Oral administration of pancreatic proteases.
(d) Placing the patient on a high protein diet.
(e) Suppressing gastric acid secretion.

2. Vagotomy or surgical interruption of the vagal nerve affects all of the following except one. Which one of the answers would not be affected by vagotomy?

   (a) Meal-stimulated acinar cell secretion.
   (b) CCK release from duodenal mucosal endocrine cells.
   (c) Bicarbonate response to acid load in the duodenum.
   (d) Enteropeptidase activation of trypsinogen.
   (e) Cephalic phase of meal-stimulated pancreatic functions.

3. At high flow rates of pancreatic secretion, all but one of the following statements is false?

   (a) The potassium concentration of pancreatic juice significantly increases.
   (b) Pancreatic juice is bicarbonate rich.
   (c) Increased admixture of ductular fluid changes the composition of pancreatic juice.
   (d) Na concentration of pancreatic juice remains unchanged.
   (e) Ductular cell CFTR is activated.

4. Which of the following transporters is not required for ductular bicarbonate secretion.

   (a) Luminal membrane Cl^-/HCO_3^- exchanger.
   (b) CFTR.
   (c) Basolateral Na^+/K^+-ATPase
   (d) Basolateral Na^+/H^+ exchanger
   (e) Apical or luminal membrane Na^+ channel

5. Which one of the following statements is false?

   (a) Increases in cytosolic calcium in acinar cells stimulate zymogen granule release.
   (b) Nitric oxide is an important mediator of acinar cell secretion.
   (c) CCK's major physiological effect in stimulating acinar cell secretion involves direct activation of basolateral CCK receptors.
   (d) Vagal nerves mediate CCK's stimulatory effects on acinar cells.
   (e) Secretin is the primary regulator of digestive enzyme secretion.

6. Which of the following is not a proteolytic enzyme?

   (a) Trypsin
   (b) Colipase
   (c) Elastase
   (d) Chymotrypsin
   (e) Carboxypeptidase

7. Which one of the following statements is not true?

   (a) Lipase is involved in fat digestion.
   (b) Endopeptidases cleave proteins at internal sites.

(c) Amylase is important for digesting carbohydrates.
(d) Nucleases digest RNA.
(e) Proteolytic enzymes make up 20 % of all digestive enzymes secreted by the pancreas.

8. Regarding the combination of stimuli that will produce the highest rate of pancreatic bicarbonate secretion, which of the following statement is true?

(a) Secretin plus histamine.
(b) Cholecystokinin plus acetylcholine.
(c) Secretin plus gastrin.
(d) Cholecystokinin plus gastrin.
(e) Secretin plus acetylcholine.

9. Regarding the pancreatic enzyme secretion, which of the following statements is true?

(a) They are all secreted as inactive proenzymes or zymogens.
(b) They are all secreted by pancreatic acinar cells.
(c) They are synthesized in response to cholecystokinin.
(d) They pass into the colon after digestion.
(e) They are important for only protein digestion.

10. Regarding the salivary secretion, which of the following statements is true?

(a) It is produced at high volumes relative to the mass of the glands.
(b) It is usually hypertonic.
(c) It is primarily regulated by hormones.
(d) It is unaffected by the treatment with atropine.
(e) It has a lower concentration of sodium as the rate of flow increases.

11. Regarding the functions of pancreas, which of the following statements is true?

(a) Stimulation of the vagus nerve causes a predominantly watery secretion from the pancreas.
(b) Secretion of cholecystokinin from the duodenum causes a watery secretion from the pancreas.
(c) Pancreatic exocrine secretion contains enzymes which are essential in the digestion of fats.
(d) Damage to the pancreas leading to fat malabsorption may result in deficiency of vitamin B_{12}.
(e) The secretions of the pancreas have a pH of about 7.

12. Regarding the pancreatic exocrine secretion, which of the following statements is true?

(a) Pancreatic enzyme secretion is largely controlled by the parasympathetic nervous system.
(b) Pancreatic bicarbonate secretion is stimulated by gastrin.
(c) Most secretion occurs during the gastric phase of digestion.

(d) Pancreatic amylase is not essential since amylase is also present in saliva.
(e) The intestinal mucosa produces an enzyme that activates pancreatic proteolytic enzymes.

Answers: (1) d; (2) d; (3) a; (4) e; (5) c; (6) b; (7) e; (8) e; (9) b; (10) a; (11) c; (12) e

Chapter 5

1. Which one of the following statements concerning intestinal function is true?

   (a) Mucosal permeability is greater in the colon than in the small intestine.
   (b) Paneth cells originate from the proliferative zone and migrate to villus tips.
   (c) The colon is the site of greatest fluid absorption.
   (d) Intestinal secretions make up the majority of the daily fluid load presented to the intestine.
   (e) Solidification of stool begins in the cecum.

2. All of the following statements are true except one. Which one is incorrect?

   (a) Villus cells are mature absorptive epithelial cells.
   (b) Mucosal permeability in the villus region is higher than in the crypt regions.
   (c) Brush-border hydrolases are predominantly expressed by villus cells.
   (d) Active anion secretion is primarily found in crypt cells.
   (e) The turnover rate of intestinal epithelial cells is 3–5 days in humans.

3. Which of the following transporters is not a carrier protein?

   (a) Facilitative Glut 2 transporter
   (b) Na^+/H^+ exchanger
   (c) $Na^+/K^+/2Cl^-$ co-transporter
   (d) SGLT1 (Na^+-glucose co-transporter)
   (e) Na^+/K^+-ATPase

4. Which of the following statements is incorrect?

   (a) Na^+-glucose cotransport is found throughout the GI tract.
   (b) Luminal membrane Na^+-H^+ exchangers are the major mediators of non-nutrient dependent intestinal Na absorption.
   (c) Na^+ channels are expressed in distal colon and rectum.
   (d) Cl^- secretion is found throughout the GI tract.
   (e) Na^+-coupled Cl^- absorption is found in ileum and colon.

5. Which of the following statements is incorrect?

   (a) Sodium glucose co-transporter (SGLT1) is inhibited by cholera toxin.
   (b) Starch based electrolyte solution are effective in the treatment of cholera.
   (c) Somatostatin promotes intestinal absorption.
   (d) Imbalances in homeostatic regulation of intestinal water and electrolyte transport can cause diarrhea.
   (e) Increases in intestinal epithelial cytosolic calcium stimulate net secretion.

6. All of the following transporters are required for active epithelial Cl^- secretion except:

   (a) CFTR
   (b) H^+/K^+-ATPase
   (c) Basolateral membrane K channels
   (d) $Na^+/K^+/2Cl^-$ cotransporter
   (e) Na^+/K^+-ATPase

7. Which of the following statements concerning short chain fatty acids (SCFAs) is correct?

   (a) SCFAs are primarily found in ingested foods and are absorbed in the small intestine.
   (b) SCFAs promote colonic proliferation and differentiation.
   (c) SCFAs stimulate colonic water absorption.
   (d) Antibiotic treatment would have no effect on the availability of SCFAs.
   (e) Glucose, not SCFAs, is the preferred metabolic substrate of colonocytes.

8. Which of the following statements concerning diarrhea is correct?

   (a) Cystic fibrosis patients are very susceptible to the effects of cholera toxin.
   (b) Diabetic diarrhea is caused by the development of cholinergic neuropathy.
   (c) Heat stable enterotoxin (ST_a) of *E. Coli* binds to GM_1 ganglioside receptors and increases cellular cGMP.
   (d) Octreotide, as a somatostatin analog, is effective in treating diabetic diarrhea.
   (e) Abnormal motility is the primary cause of most diarrheal diseases.

9. The major function of the small intestinal villus cell is digestion, absorption and secretion. Which of the following statements concerning the villus cells that line in the upper small intestine is correct?

   (a) They produce an enzyme that is able to break down starch.
   (b) They produce a hormone that activates trypsinogen.
   (c) They transport fructose by a sodium-independent mechanism.
   (d) They secrete hydrogen ions in exchange for potassium ions across the brush-border membrane.
   (e) They act as stem cells to replace the worn out epithelial cells of the top of the villi after 3–6 days.

10. Enterokinase is a membrane-bound enzyme which is anchored to the brush-border of the duodenal epithelium. Which of the following statements concerning the actions of enterokinase is true?

    (a) It is directly responsible for the activation of colipase.
    (b) It is directly responsible for the activation of trypsinogen.
    (c) It is directly responsible for the activation of amylase.

(d) It is directly responsible for the activation of cholecystokinin.
(e) It is directly responsible for the activation of pepsinogen.

11. Which of the following statements concerning the partial removal of the distal ileum is true?

(a) It will increase the bile salt levels in the hepatic venous blood.
(b) It will increase the bile salt levels in the portal vein.
(c) It will increase the rate of bile acid secretion by hepatocytes.
(d) It will increase the bile acid absorption across the distal ileum.
(e) It will increase bile acid synthesis by hepatocytes.

12. Concerning intestinal solute and water transport, which of the following statements is true?

(a) Peptide absorption is directly linked to sodium uptake.
(b) Fructose absorption is directly linked to sodium uptake.
(c) Potassium is secreted in the large intestine.
(d) Sodium absorption is via passive transport throughout the small and large intestine.
(e) Water absorption is via active transport throughout the small and large intestine.

Answers: (1) d; (2) b; (3) e; (4) a; (5) a; (6) b; (7) b; (8) d; (9) c; (10) b; (11) e; (12) c

Chapter 6

1. Which of the following statements regarding starch digestion is true?

(a) Salivary and pancreatic amylases are the products of the same gene.
(b) Amylase digests amylose, but not amylopectin.
(c) Amylase cleaves α-1,6-linkages in amylopectin.
(d) The major products of amylose digestion are maltose and maltotriose.
(e) α-limit dextrins are products of amylose digestion.

2. The brush-border membrane enzyme that can hydrolyze the α-1,6 bond in an α-limit dextrin is:

(a) Glucoamylase
(b) Sucrase
(c) Amylase
(d) Lactase
(e) Isomaltase

3. Which of the following is <u>not</u> a property of the glucose transporter SGLT1?

(a) Two sodium ions enter the enterocyte for each molecule of glucose transported.
(b) This absorptive process is electrogenic (net charge transfer across the membrane).

(c) Is the major brush-border membrane fructose transporter.
(d) Sodium increases the transporter affinity for glucose.
(e) The energy for glucose accumulation is derived from the transmembrane electrochemical Na^+ gradient.

4. The carrier for transporting glucose and other monosaccharides across the enterocyte basolateral membrane is:

(a) SGLT1
(b) Glut-2
(c) Glut-5
(d) Sucrase
(e) Glucoamylase

5. Which of the following is a brush-border membrane fructose transporter?

(a) SGLT1
(b) Glut-5
(c) PEPT1
(d) Lactase
(e) Galactose

6. Which of the following statements regarding human lactase is true?

(a) Lactase levels are low in the neonatal small bowel.
(b) Lactase is not the rate-limiting step in intestinal lactose absorption.
(c) Children with congenital lactose deficiency have hypoglycemia as the major clinical symptom.
(d) Persistence of lactase in the adult small intestine is a genetically determined trait.
(e) Lactase is not synthesized in the intestine as a pro-protein.

7. Which of the following statements is true?

(a) Fructose is better absorbed when given as sucrose rather than as an equivalent amount of the monosaccharide.
(b) Patients with fructose malabsorption will have little rise in breath hydrogen after given fructose orally.
(c) Transport of glucose by SGLT1 inhibits incorporation of Glut-2 into the enterocyte brush-border membrane.
(d) Starches that resist efficient digestion will be converted to long-chain fatty acids by intestinal bacteria.
(e) The composition and amount of fiber in the diet has little effect on intestinal flora.

8. Pepsins in the stomach are:

(a) Essential for efficient protein digestion and absorption.
(b) Active mainly in the jejunum.
(c) Synthesized in the gastric parietal cells.

(d) Synthesized as inactive pre-proenzymes.
(e) Products of a single gene.

9. Which of the following statements is false?

(a) Pancreatic proteases are secreted as proenzymes.
(b) Activation of pancreatic proteases is initiated by cleavage of trysinogen by the brush-border enzyme enteropeptidase.
(c) Pancreatic secretions contain a variety of endo- and exopeptidases.
(d) Proline-containing peptides are resistant to pancreatic enzymes.
(e) Free amino acids are the only products of pancreatic peptidases.

10. Which of the following statements regarding brush-border membrane peptidases is true?

(a) Only 3–4 brush-border membrane peptidases have been identified.
(b) Brush-border membrane peptidases hydrolyze oligopeptides generated by intraluminal digestion to free amino acids and di- and tripeptides.
(c) Aminopeptidase N is directly inserted into the brush-border membrane.
(d) All brush-border membrane peptidases are carboxypeptidases.
(e) Brush-border membrane peptidases are not regulated during development or cellular differentiation.

11. Which of the following is a property of the di-tripeptide carrier PEPT1?

(a) Is a potassium coupled transporter.
(b) PEPT1 can transport a myriad of possible di- and tripeptides generated from protein digestion.
(c) Is one of many di-tripeptide carriers that have been identified in the small intestine.
(d) Is normally present in high levels in human colon.
(e) Can transport long polypeptide chains.

12. Which of the following statements is true?

(a) Multiple transport systems for the uptake of amino acids have been identified in the small intestinal brush-border membrane.
(b) All small intestinal brush-border membrane amino acid transporters are sodium-dependent.
(c) Lactase persistence in adults appears to have an X-linked mode of inheritance.
(d) Activities of oligosaccharidases are greater in the terminal ileum than in the jejunum.
(e) The small intestinal brush-border does not contain peptidases than can hydrolyze peptide bonds containing proline.

Answers: (1) d; (2) e; (3) c; (4) b; (5) b; (6) d; (7) a; (8) d; (9) e; (10) b; (11) b; (12) a

Chapter 7

1. Which of the following is a property of gastric lipase?

   (a) Is rapidly degraded by pepsin.
   (b) Preferentially hydrolyzes the ester bond in position 3 of triglyceride, generating fatty acids and diglycerides.
   (c) In adult humans accounts for 75 % of triglyceride hydrolysis.
   (d) Contributes little to triglyceride hydrolysis in neonates.
   (e) In humans is produced mainly by surface epithelial cells in the stomach.

2. Which of the following is a characteristic of pancreatic lipase?

   (a) Is activated by a pH of less than 4.0.
   (b) Binding of pancreatic lipase to a lipid droplet is inhibited by colipase.
   (c) Is secreted by the pancreas in a pro-enzyme (zymogen) form.
   (d) Is an interfacial enzyme that is most active at an oil-water interface.
   (e) Completely hydrolyzes triglyceride to fatty acids and glycerol.

3. Which of the following statements is false?

   (a) A patient with congenital deficiency of pancreatic lipase will absorb no triglyceride.
   (b) The normal human secretes a great excess of pancreatic lipase.
   (c) A normal human bile salt-activated lipase catalyzes the complete hydrolysis of triglyceride to fatty acids and glycerol.
   (d) The pancreatic lipase related proteins PLRP-1 and -2 may play a role in neonatal triglyceride digestion.
   (e) CCK stimulates pancreatic secretion of pancreatic lipase.

4. Which of the following statements is true?

   (a) In mixed micelles bile salts are oriented with the polar aspect pointing towards the interior.
   (b) In a patient with complete biliary obstruction and no intraluminal bile salts no triglyceride will be absorbed.
   (c) Micelles diffuse across in unstirred water layer faster than monomeric fatty acids in solution.
   (d) Human milk contains a bile-salt activated lipase.
   (e) Colipase is produced by enterocytes.

5. Which of the following proteins facilitates fatty acid uptake across the intestinal brush-border membrane?

   (a) CD36
   (b) Colipase
   (c) B-monoglyceride
   (d) Secretin
   (e) Trypsin

6. Which protein is responsible for most of the triglyceride synthesized in the intestine?

   (a) Intestinal fatty acid binding protein (I-FABP)
   (b) Liver fatty acid binding protein (L-FABP)
   (c) Diacylglycerol acyltransferase 1 (DGAT1)
   (d) Apolipoprotein B
   (e) Bile-salt dependent lipase

7. Which of the following proteins is involved in the assembly of chylomicrons in the enterocyte?

   (a) ApoB100
   (b) LDL receptor
   (c) Lecithin-cholesterol acyltransferase (LCAT)
   (d) Liver fatty acid binding protein (L-FABP)
   (e) Apo B48

8. Which of the following statements is false?

   (a) In the Golgi apolipoprotein AI and other lipids are added to the chylomicrons.
   (b) In the Golgi apolipoproteins are glycosylated.
   (c) Golgi organelles containing chylomicrons fuse into secretory vesicles that fuse with the basolateral membrane and release their contents into the extracellular space.
   (d) Chylomicrons enter intestinal lacteals and are transported through intestinal lymphatics into the circulation.
   (e) Anderson/chylomicron-retention disease is caused by a failure of intestinal triglyceride synthesis.

9. Medium chain triglycerides are:

   (a) Hydrolyzed by pancreatic lipase more slowly than long-chain triglycerides.
   (b) A major component of chylomicrons.
   (c) Absorbed well even in patients with cholestasis.
   (d) A major component of dietary fat.
   (e) An excellent source of essential fatty acids.

10. Which of the following statements is true?

    (a) Dietary fat is the major stimulus of secretin release.
    (b) CCK stimulates gall bladder contraction and relaxation of the sphincter of Oddi delivering concentrated bile into the intestine.
    (c) Secretin is the major stimulus of pancreatic lipase secretion.
    (d) Pancreatic lipase is most active at a pH of 3.
    (e) Colipase is secreted into pancreatic fluid as the fully active protein.

11. Which of the following statements regarding medium chain triglyceride absorption is false?

    (a) Medium chain fatty acids are directly released from the enterocytes into the portal circulation.
    (b) Absorbed medium chains fatty acids are rapidly taken up the liver and other tissues and used as an energy source.
    (c) Can be a useful source of calories in patients with malabsorption.
    (d) Medium-chain triglycerides contain fatty acids of 6–12 carbon chain lengths.
    (e) Medium chain triglycerides are not hydrolyzed by gastric lipase.

12. Which of the following statements is true?

    (a) The major pathway for intestinal triglyceride synthesis involves the generation of diglycerides from fatty acyl-CoA and β-monoglyceride by monoglyceride acyltransferase (MGAT) enzymes.
    (b) The major pathway for intestinal triglyceride synthesis uses phosphatidic acid which is dephosphorylated to produce diacylglycerol.
    (c) ApoB-mRNA editing refers to the production of ApoB from ApoAI.
    (d) ApoAI is found in high density lipoproteins (HDL), but not chylomicrons.
    (e) The most common cause of abetalipoproteinemia is a mutation in the gene for apolipoprotein AIV

Answers: (1) b; (2) d; (3) a; (4) d; (5) a; (6) c; (7) e; (8) e; (9) c; (10) b; (11) e; (12) a

Chapter 8

1. Which of the following statements regarding cholesterol absorption is true?

    (a) More cholesterol is typically present in the diet than is secreted in bile.
    (b) Dietary and biliary cholesterol form a single pool in the intestinal lumen.
    (c) Almost 100 % of luminal cholesterol is absorbed.
    (d) Pancreatic lipase is the major enzyme involved in cholesteryl ester hydrolysis.
    (e) Cholesterol in mixed micelles is in rapid equilibrium with cholesterol in monomolecular solution.

2. Which of the following is the target of the cholesterol absorption inhibitor ezetimibe?

    (a) Niemann-Pick C1-Like 1 (NPC1L1)
    (b) ABCG5
    (c) ABCG8
    (d) Pancreatic lipase
    (e) LXRα

3. Which of the following is involved in cholesterol efflux from the enterocyte into the intestinal lumen?

   (a) Niemann-Pick C1-Like 1 (NPC1L1)
   (b) ABCG5/ABCG8
   (c) Microsomal triglyceride transfer protein (MTTP)
   (d) LDL receptor
   (e) LXRα

4. Which of the following is the principal enzyme responsible for cholesterol esterification in the intestine?

   (a) Niemann-Pick C1-Like 1 (NPC1L1)
   (b) ABCG5/ABCG8
   (c) Microsomal triglyceride transfer protein (MTTP)
   (d) Scavenger receptor class B type 1 (SR-B1)
   (e) Acyl CoA:cholesterol acyl transferase 2 (ACAT2)

5. Which of the following statements regarding bile acid absorption is true?

   (a) Bile acids are secreted by the liver almost exclusively as unconjugated forms.
   (b) Most conjugated bile acids are absorbed in the proximal jejunum.
   (c) In the ileum a high capacity active transport system absorbs more than 95 % of the secreted bile acids.
   (d) Bile acid uptake in the ileum occurs via a H^+-bile acid co-transporter.
   (e) The ileal bile acid transporter transports unconjugated bile acids more efficiently than conjugated bile acids.

6. Which of the following is responsible for most of the bile acid transport across the basolateral membrane into the circulation?

   (a) Ileal binding acid protein (IBABP)
   (b) ASBT
   (c) OSTα/β
   (d) Phospholipase A_2
   (e) Microsomal triglyceride transfer protein (MTTP)

7. Which of the following statements is false?

   (a) Dietary retinyl esters are hydrolyzed prior to intestinal absorption.
   (b) β-carotene uptake across the brush-border membrane is mediated by the scavenger receptor class B, type 1 (SR-B1).
   (c) In the enterocyte β-carotene is cleaved forming retinal.
   (d) Lecithin-retinol acyltransferase (LRAT) esterifies CRBP(II)-bound retinol.
   (e) All dietary carotenes are sources of vitamin A.

8. Which cells in the liver contain most of the vitamin A?

   (a) Hepatocytes
   (b) Kupffer cells
   (c) Endothelial cells
   (d) Stellate cells
   (e) Lymphocytes

9. Which of the following statements is true?

   (a) Vitamin D is present in the diet mainly in an esterified form.
   (b) The liver is the principal site for formation of $1,25(OH)_2$ vitamin D
   (c) Formation of $24,25(OH)_2$ vitamin D is the initial step in conversion of vitamin D to its active form.
   (d) Proteins involved in cholesterol absorption, such as SR-B1, CD-36, and NPC1L1 also facilitate vitamin D_3 uptake across the brush-border membrane.
   (e) Intestinal absorption of 25(OH) vitamin D_3 and $1,25(OH)_2$ vitamin D_3 is less efficient than absorption of vitamin D_3.

10. Which of the following statements regarding vitamin E is false?

    (a) Dietary vitamin E is comprised of multiple tocopherols and tocotrienols.
    (b) The richest sources of vitamin E are vegetable oils.
    (c) Bile salts facilitate vitamin E absorption.
    (d) Mutations in α-tocopherol-transfer protein (α-TTP) cause vitamin E deficiency by impairing intestinal absorption of vitamin E.
    (e) In plasma, vitamin E is found in several classes of lipoproteins.

11. Vitamin K:

    (a) Regulates transcription of genes coding for clotting factors.
    (b) Is a co-factor involved in the post-transcriptional modification of proteins.
    (c) Is involved in hydroxylation of certain lysine residues in clotting factors.
    (d) In the liver is mostly in the phylloquinone form.
    (e) Is not incorporated into chylomicrons, but is released from enterocytes directly into the portal blood.

12. The anti-coagulant warfarin:

    (a) Inhibits dithiol-dependent vitamin K-epoxide reductase and vitamin K-reductase.
    (b) Blocks intestinal vitamin K absorption.
    (c) Inhibits vitamin K-dependent transcription of clotting factor genes.
    (d) Accelerates vitamin K catabolism and biliary excretion.
    (e) Blocks the conversion of menaquinone to phylloquinone.

Answers: (1) e; (2) a; (3) b; (4) e; (5) c; (6) c; (7) e; (8) d; (9) d; (10) d; (11) b; (12) a

Chapter 9

1. Which of the following describes the function of most water-soluble vitamins?

   (a) Co-enzymes in biochemical reactions
   (b) Regulators of gene transcription
   (c) Transport proteins
   (d) Substrates for oxidation-reduction reactions
   (e) Anti-oxidants

2. Which of the following is not a characteristic of water-soluble vitamin absorption?

   (a) The vitamins are often present in the diet as complex forms that require digestion in the intestinal lumen or at the brush-border membrane prior to transport across the intestinal epithelium.
   (b) At low concentrations, transport across the brush-border membrane typically occurs by membrane carriers, active transport systems or membrane binding proteins and receptors.
   (c) Extensive metabolism of water-soluble vitamins occurs with the enterocyte.
   (d) Bile acids are required for solubilization of water-soluble vitamins prior to intestinal transport.
   (e) At high doses water-soluble vitamins may be absorbed by passive diffusion.

3. Which of the following factors does not commonly affect intestinal absorption of minerals and trace elements?

   (a) Intraluminal pH
   (b) Redox state of the metal
   (c) Formation of chelates in the intestinal lumen
   (d) Cholesterol content of the meal
   (e) Digestion of proteins that is associated with the metal.

4. Which of the following significantly decreases intestinal copper absorption?

   (a) Glycine
   (b) Glucose
   (c) Zinc
   (d) Sodium
   (e) Potassium

5. Which of the following statements regarding folate absorption is true?

   (a) Folate is present in the diet mainly as the monoglutamate form.
   (b) At low doses, folate is absorbed principally by passive diffusion.
   (c) Folates are transported across the basolateral intestinal protein by the reduced folate carrier (RFC).
   (d) Dietary polyglutamyl folates are digested to the monoglutamate form prior to intestinal absorption.
   (e) Vitamin B_{12} is a competitive inhibitor of folate absorption.

6. Which of the follow statements is false?

   (a) Sulfasalazine is an inhibitor of folylpolyglutamate deconjugation.
   (b) Sulfasalazine is an inhibitor of intestinal monoglutamyl folate transport.
   (c) At physiologic concentrations, folic acid is largely reduced and methylated or formylated within the enterocyte.
   (d) Folic acid, reduced folates, and methotrexate are transported by different brush-border membrane carriers.
   (e) Intestinal bacteria synthesize folates.

7. A 70-year-old man has a total gastrectomy for gastric adenocarcinoma. He subsequently develops anemia and neurologic symptoms, and is found to be severely vitamin B_{12} deficient. Which of the following is the major reason for his vitamin B_{12} deficiency?

   (a) Poor dietary vitamin B_{12} intake
   (b) Lack of Intrinsic Factor
   (c) Deficiency of a duodenal transport protein
   (d) Lack of gastric acid
   (e) Folic acid deficiency

8. The receptor for the Intrinsic Factor-vitamin B_{12} complex in the ileum is:

   (a) Transcobalamin II
   (b) Haptocorrin
   (c) Multidrug resistance protein 1
   (d) Cubilin
   (e) Vitamin D receptor

9. Which of the following would increase intestinal iron transport?

   (a) Iron-deficiency anemia
   (b) A high serum hepcidin level
   (c) A high duodenal ferritin content
   (d) Inflammatory states
   (e) Riboflavin

10. Which of the following statements regarding hereditary hemochromatosis is false?

    (a) The most common mutation causing this disorder is in the iron transporter DMT-1.
    (b) The primary treatment for this disease is periodic blood donation until the body iron burden is reduced.
    (c) Hemochromatosis is characterized by excessive iron absorption in spite of iron overload.
    (d) Hemochromatosis is usually caused by mutations in the HFE gene.
    (e) Hepcidin mutations can also cause iron overload.

11. Vitamin D regulates which of the following:

    (a) Calcium uptake across the brush-border membrane
    (b) Calcium transport from the brush-border to the basolateral enterocyte membrane
    (c) The calcium transporting ATPase in the basolateral membrane
    (d) All of the above
    (e) None of the above

12. Which of the following statements is true?

    (a) At high dietary intakes, vitamin D is needed for calcium absorption.
    (b) Uptake of calcium from the intestinal lumen into the enterocyte does not require metabolic energy.
    (c) Lactose inhibits intestinal calcium absorption.
    (d) Knockout of the gene for intestinal calbindin-D completely blocks intestinal calcium absorption.
    (e) Transport of calcium across the basolateral membrane occurs by incorporation of calcium into lipoproteins.

Answers: (1) a; (2) d; (3) d; (4) c; (5) d; (6) d; (7) b; (8) d; (9) a; (10) a; (11) d; (12) b

Chapter 10

1. All of the following are true of the hepatic acinus EXCEPT:

    (a) The portal triad is the center of the acinus.
    (b) The terminal hepatic venules are at the periphery of the acinus.
    (c) Zone 1 hepatocytes are the closest to the center of the acinus.
    (d) Zone 1 cells are the most prone to develop hypoxic injury.
    (e) Zone 1 cells are most active in oxidative energy metabolism.

2. Which liver test would be most sensitive in evaluating hepatocyte necrosis?

    (a) Total serum bilirubin level
    (b) Serum transaminases (ALT and AST)
    (c) Serum 5′ nucleotidase
    (d) Serum alkaline phosphatase
    (e) Liver ultrasound

3. Which liver test may provide the most reliable information on the degree of liver fibrosis?

    (a) Elastography
    (b) Serum GGTP
    (c) Prothrombin time
    (d) MRCP
    (e) Liver biopsy

4. What is the most practical and accurate method to measure portal venous pressure?

   (a) Splenic pulp pressure
   (b) Hepatic venous wedged pressure
   (c) Doppler ultrasound
   (d) Hepatic artery wedged pressure
   (e) Observation of esophageal varices

5. All of the following are complications of portal hypertension EXCEPT:

   (a) Esophageal varices
   (b) Portal hypertensive gastropathy
   (c) Hypersplenism
   (d) Renal sodium wasting
   (e) Ascites

6. All of the following are important in the development of ascites EXCEPT:

   (a) Increased aldosterone and renal sodium retention
   (b) Increased *effective* plasma volume
   (c) Increased circulating NO and other vasodilators
   (d) Decrease in systemic vascular resistance
   (e) Increased hydrostatic pressure in the splanchnic vascular bed

7. Which of the following is NOT true of the hepatorenal syndrome?

   (a) May be precipitated by overzealous diuresis or paracentesis for ascites.
   (b) Development of oliguria with decreased GFR and preservation of tubular function.
   (c) The kidney exhibits cortical vasoconstriction.
   (d) Affected kidneys do not function when transplanted to another individual.
   (e) Likely due to local and circulating vasoactive and other factors.

8. All of the following may be a part of the management of esophageal varices EXCEPT:

   (a) Blood transfusion
   (b) Endoscopic banding of the varices
   (c) Administration of an oral diuretic
   (d) Intravenous infusion of octreotide
   (e) Portosystemic shunting

9. All of the following are signs of hyperestrogenism and hypogonadism in the cirrhotic patient EXCEPT:

   (a) Palmar erythema
   (b) “Spider” angiomata
   (c) Gynecomastia
   (d) Female escutcheon in male patients
   (e) Hairy pinnae

10. All of the following are examples of prehepatic portal hypertension EXCEPT:

    (a) Portal vein thrombosis
    (b) Extrinsic compression of the portal vein by a tumor
    (c) Alcoholic cirrhosis
    (d) Splenic vein thrombosis
    (e) Hepatic artery-portal vein fistula

11. Which of the following cells of the liver receives blood supply solely from the hepatic artery:

    (a) Hepatocytes
    (b) Sinusoidal endothelial cells
    (c) Stellate cells
    (d) Kupffer cells
    (e) Bile ductular cells

12. Which of the following statements is true?

    (a) Zone 3 cells are closest to the portal triad and are the first to receive oxygenated, nutrient-rich blood.
    (b) Zone 2 cells are the last to develop hypoxic injury and the first to regenerate
    (c) Zone 3 cells, located around the terminal hepatic venule, are last to receive blood, and as such, are most sensitive to any form of toxic or vascular injury. Zone 2 cells are intermediate.
    (d) Zone 3 hepatocytes are most active in glucose synthesis and release, oxidative energy metabolism, amino acid utilization, bile acid and bilirubin excretion, and ammonia detoxification.
    (e) Zone 1 hepatocytes are most active in glucose uptake and utilization and biotransformation.

Answers: (1) d; (2) b; (3) e; (4) b; (5) d; (6) b; (7) d; (8) c; (9) e; (10) c; (11) e; (12) c

Chapter 11

1. Which ONE of the following steps is NOT involved in the SREBP regulation of liver LDL receptors during statin-induced reduction of cholesterol synthesis?

    (a) Response of SREBP cleavage activation protein (SCAP) to decreased free cholesterol levels allowing SREBP precursor to move to the Golgi.
    (b) Protease cleavage of SREBP in the Golgi and productions of the active peptide.
    (c) Binding of activated SREBP to the sterol response element (SRE) in the LDL receptor gene promoter.
    (d) Sensing of cellular cholesterol content.
    (e) Down-regulation of LDL receptor gene transcription.

2. Which is NOT true of alpha-1-antitrypsin deficiency?

   (a) Retention of misfolded, polymerized and aggregated mutant protein in the hepatocyte ER contributes to liver disease.
   (b) Most individuals with the mutant PiZZ phenotype have serious liver disease.
   (c) Alpha-1-antitrypsin is a protease inhibitor produced and secreted by the liver and protects tissues from damage by endogenous proteases.
   (d) Alpha-1-antitrypsin deficiency may cause chronic liver and lung disease.
   (e) Alpha-1-antitrypsin is a glycoprotein.

3. Which ONE of the following is NOT true of the LXRs?

   (a) They are nuclear receptor transcription factors.
   (b) They regulate several key steps in cholesterol and lipoprotein metabolism.
   (c) They heterodimerize with RXR.
   (d) They are regulated by oxysterols.
   (e) They bind to mRNA.

4. Which of the following is NOT a part of the metabolic syndrome?

   (a) Abdominal obesity
   (b) Hypertension
   (c) Insulin resistance
   (d) High HDL levels
   (e) Hypertriglyceridemia

5. Which ONE of the following statements about lipoprotein lipase (LPL) is CORRECT?

   (a) LPL is bound to chylomicrons or VLDL particles when they interact with HDL.
   (b) LPL hydrolyzes triglyceride in adipose tissue.
   (c) LPL is activated by apo A-I.
   (d) LPL action produces HDL from IDL.
   (e) LPL is activated by apo C-II.

6. Which ONE of the following regulates net intestinal cholesterol absorption?

   (a) MTP
   (b) HMG CoA reductase
   (c) ABCG5/ABCG8
   (d) LCAT
   (e) CETP

7. In humans, LDL particles are derived from which ONE of the following?

   (a) Chylomicrons
   (b) VLDL
   (c) HDL

(d) Chylomicron remnants
(e) Intestinal lipid micelles

8. Regulation of glycolysis in the liver is tightly integrated with that of all of the following EXCEPT:

(a) Gluconeogensis
(b) Lipogenesis
(c) Glycogen synthesis
(d) Glycogenolysis
(e) Protein synthesis

9. Which of the following is the rate-limiting step in glycogen synthesis?

(a) Glycogen synthetase
(b) Phosphorylase
(c) Phosphofructokinase
(d) Glucose-6-phosphatase
(e) Galactokinase

10. Which of the following is NOT true of PCSK9?

(a) Originally identified as involved in apoptosis of nerve cells.
(b) Gain of function mutations are associated with elevated serum LDL levels.
(c) Functions to target LDL receptors away from recycling to a degradative pathway.
(d) Loss of function mutations are associated with reduced serum LDL levels.
(e) PCSK9 is not an attractive therapeutic target for treatment of hypercholesterolemia.

11. Which of the following does NOT occur during prolonged fasting?

(a) Hepatic glycogen stores are depleted.
(b) Gluconeogenesis in liver becomes more important as an energy source for the brain.
(c) Amino acids from muscle are the predominant substrates for hepatic gluconeogenesis.
(d) Fatty acids are released from adipose tissue and are oxidized to ketones by the liver to supply alternative energy to the brain.
(e) Incoming glucose is stored as glycogen.

12. In vitamin metabolism, the liver plays a major role in:

(a) The storage of vitamin A
(b) The conversion of 7-dehydrocholesterol to cholecalciferol
(c) The storage of vitamin D
(d) The conversion of 25-hydroxyvitamin D_3 to 1,25-hydroxyvitamin D_3
(e) The production of factor VIII with the aid of vitamin K

Answers: (1) e; (2) b; (3) e; (4) d; (5) e; (6) c; (7) b; (8) e; (9) a; (10) e; (11) e; (12) a

Chapter 12

1. The following are all sources of ammonia in the body EXCEPT:

   (a) Amino acids
   (b) Nucleic acids
   (c) Urea
   (d) GI bleeding
   (e) Fructose

2. The following are all true of hepatic encephalopathy EXCEPT:

   (a) Blood ammonia levels closely correlate with degree of encephalopathy.
   (b) Hepatic encephalopathy may be acute or chronic.
   (c) Variceal bleeding may exacerbate encephalopathy.
   (d) Oral administration of lactulose may be used to treat encephalopathy.
   (e) Early clinical presentation may include inversion of sleep patterns.

3. All of the following are true of a xenobiotic except:

   (a) Exogenous organic substance
   (b) No nutritive value for energy production
   (c) The liver plays a minor role in their biotransformation and clearance
   (d) No necessary structural function
   (e) No function as an enzyme cofactor

4. All of the following are true of acetaminophen EXCEPT:

   (a) Normally, the toxic NAPQI produced by acetaminophen metabolism is immediately conjugated with glutathione and cleared.
   (b) With poisoning, glutathione is depleted, allowing accumulation of NAPQI with resultant cell injury and death.
   (c) The Rumack-Matthew nomogram is useful in predicting acetaminophen toxicity based on serum levels in chronic poisoning.
   (d) Administration of *N*-acetylcysteine may be effective in preventing significant hepatotoxicity.
   (e) Liver transplantation may be required in severe cases of acetaminophen poisoning.

5. Which of the following is TRUE of the Gilbert syndrome?

   (a) Mutations in the coding region of the bilirubin UDP-glucuronosyltransferase gene cause Gilbert syndrome.
   (b) Gilbert syndrome is a frequent cause of kernicterus.
   (c) Results in mild elevations of the serum unconjugated bilirubin level, often in response to fasting or illness.
   (d) Is often accompanied by the Dubin-Johnson and Rotor syndromes.
   (e) Phototherapy is frequently used to treat adults with this condition.

6. The portion of the hepatocyte membrane specialized for bile secretion into the bile ducts is the:

   (a) Basolateral membrane
   (b) Lipid raft
   (c) Canaliculus
   (d) Tight junction
   (e) Peroxisome

7. All of the following are functions of bile acids EXCEPT:

   (a) Solubilize the products of lipid digestion in mixed micelles to enhance efficiency in crossing the unstirred water layer for absorption.
   (b) Along with phospholipid, help prevent cholesterol from forming gallstones in the gallbladder.
   (c) Serve as signaling molecules in the regulation of gut motility and carbohydrate metabolism.
   (d) Have bacteriostatic effects in the proximal intestine and induce genes to inhibit microbial growth in the distal intestine.
   (e) Function to inhibit fluid and electrolyte secretion in the colon.

8. Which of the following is NOT true of human bile acid metabolism?

   (a) Cholic acid and chenodeoxycholic acid are primary bile acids.
   (b) Bile acids are conjugated with glycine and taurine.
   (c) The rate-limiting step in bile acid synthesis is catalyzed by cholesterol 7-alpha hydroxylase (CYP7A1).
   (d) Bile composition is not affected by passage through the bile ducts.
   (e) Bacteria participate in the formation of secondary and tertiary bile acids.

9. All of the following are true of the bile acid enterohepatic circulation EXCEPT:

   (a) Cholecystokinin stimulates the gallbladder to contract in response to a fatty meal.
   (b) Bile acids are actively transported from the gut lumen by ileal enterocytes via the transporter, ASBT.
   (c) Bile acids returning to liver from ileum via the portal vein are taken up by the basolateral hepatocyte transporter, NCTP.
   (d) Loss of bile acids in stool is not a significant route of loss of cholesterol from the body.
   (e) Hepatic bile acid synthesis is regulated by ileal bile acid uptake via FXR and FGF19.

10. All of the following are components of management of patients with cholestasis EXCEPT:

    (a) Administration of ursodeoxycholic acid may benefit some patients.
    (b) Supplementation with fat-soluble vitamins.
    (c) Use phototherapy to reduce bilirubin levels.

(d) Avoid medications cleared by the liver and excreted into bile.
(e) Supplementation with dietary medium-chain triglycerides that do not require bile acids for absorption.

11. Which of the following is associated with unconjugated hyperbilirubinemia?

(a) Gilbert's disease
(b) Alagille syndrome
(c) Biliary atresia
(d) Dubin-Johnson syndrome
(e) Common bile duct stone

12. Which of the following conditions is associated with hemolytic jaundice?

(a) Increased bilirubin in the urine
(b) Increased plasma unconjugated bilirubin
(c) Decreased urobilinogen in the urine
(d) Decreased absorption of vitamin B_{12}
(e) Clay-colored stools

Answers: (1) e; (2) a; (3) c; (4) c; (5) c; (6) c; (7) e; (8) d; (9) d; (10) c; (11) a; (12) b