1. Polypeptide hormones are initially synthesized as
   a) prohormones.
   b) preprophormones.
   c) vesicles.
   d) glycoproteins.
   e) None of the above statements is correct.

2. Thyroid hormone
   a) is a steroid.
   b) production in excess causes cretinism.
   c) is produced from a protein called thyroglobulin.
   d) is not produced in Grave’s disease.
   e) None of the above statements is correct.

3. Parathyroid hormone
   a) is produced as a mature polypeptide of 84 amino acids.
   b) induces release of calcium from bone in a process known as bone resorption.
   c) stimulates the production of the active form of vitamin D3 in the kidney.
   d) inhibits loss of calcium in the kidney.
   e) All of the above statements are correct.

4. Insulin
   a) acts to lower circulating glucose concentrations.
   b) is produced by the alpha cells of the pancreas.
   c) can be mimicked by the action of glucocorticoids.
   d) is not produced in type II diabetes.
   e) None of the above statements is correct.

5. Lung compliance is
   a) calculated as the change in lung volume divided by the corresponding change in transpulmonary pressure (difference between alveolar and pleural pressure).
   b) greater at high than at low lung volumes.
   c) greater in fibrosis than in a normal lung.
   d) greater in normal lungs than in emphysema.
   e) None of the above statements are correct.
6. During forced expiration, the descending portion of the flow-volume curve is independent of the effort because
   
   a) the alveolar pressure is greater than the mouth pressure.
   b) the pleural pressure is greater than the airway pressure.
   c) the alveolar pressure is greater than the pleural pressure.
   d) the alveolar pressure is greater than the airway pressure.
   e) the abdominal pressure is greater than the thoracic pressure.

7. Which of the following receptors/structures sense the degree of lung inflation?
   
   a) The aortic bodies.
   b) The carotid bodies.
   c) The pulmonary stretch receptors.
   d) The central chemoreceptors.
   e) The irritant receptors.

8. Which of the following is true about the various classes of blood vessels?
   
   a) The innermost layer of cells in all vessels is made up of epithelial cells.
   b) Arteries are high-resistance vessels.
   c) Veins are high-resistance vessels.
   d) The distribution of blood flow to the various organs is largely controlled by the arterioles.
   e) Most of the blood resides on the arterial side of the circulation.

9. Which of the following is true about the electrocardiogram?
   
   a) Lead II is obtained by subtracting the voltage at the right leg from the voltage at the left arm.
   b) There are only two electrodes connected to the subject to record lead I.
   c) There are 9 unipolar leads recorded in the 12-lead clinical electrocardiogram.
   d) The QRS-complex is generated by atrial repolarization.
   e) The left-leg electrode is used as a voltage reference.

10. Activation of the sympathetic nervous system will
    
    a) decrease the end-systolic volume in the left ventricle.
    b) decrease the rate at which force is generated in ventricular muscle.
    c) increase the duration of the ventricular contraction.
    d) shift the contractility curve (the curve showing stroke volume plotted against end-diastolic volume) downwards and to the right.
    e) decrease the plasma levels of circulating epinephrine.
11. When a healthy young person stands up, there is a gradual, continuing loss of plasma volume (this fact was not mentioned in the lectures). In fact, the plasma volume falls by about 500 ml during the first 15 minutes of standing. This loss of plasma volume is caused by

a) increased pressure diuresis by the kidneys.
b) decreased plasma level of circulating aldosterone.
c) decreased pressure in the veins of the legs.
d) increased intra-capillary pressure in the legs.
e) decreased interstitial fluid volume.

12. With endurance training, the blood volume increases. In an endurance-trained athlete, one would expect that this would result in

a) an increase in the heart rate at rest.
b) an increase in the maximum heart rate.
c) a decrease the arterial blood pressure at rest.
d) an increase in the stroke volume at rest.
e) a decrease in the cardiac output at rest.

13. An Olympic cyclist decides to do “blood doping”. She collects her own blood, separates the red blood cells from the plasma, and then, some time later, on the day before the competition, re-infuses these red cells back into her body. One would then expect, with respect to her normal performance

a) a decrease in the oxygen content of arterial blood (ml O₂/100 ml blood).
b) an increase the arterio-venous oxygen difference at maximum exercise.
c) an increase in the heart rate at maximum exercise.
d) an increase in the stroke volume at maximum exercise.
e) a decrease in the oxygen consumption at maximum exercise.

14. Which of the following statements is true about cardio-vascular disease?

a) 90% of all deaths due to cardiovascular disease are due to coronary heart disease.
b) A coronary thrombosis occurs when a clot forms in the brain.
c) A bypass graft is commonly used to treat hypertension.
d) In the early stage of heart failure, before any beneficial compensatory reflex changes can occur, the contractility curve (the curve relating stroke volume to end-diastolic volume) shifts upwards and to the left.
e) The decrease in the incidence of smoking in North America in the last few decades has had a major impact on the mortality due to cardiovascular disease.
15. The trace below is a recording of the mean blood pressure obtained from a patient who accidently overdosed on one of his cardiovascular medications.

![Blood Pressure Trace](image)

Consider only the first four hours immediately after ingesting (i.e., taking) the drug. The drug might have been

a) an angiotensin-converting-enzyme (ACE) inhibitor.
b) a beta-antagonist.
c) an alpha-antagonist.
d) a renin inhibitor.
e) any of the above.

16. Gastrin

a) is a steroid hormone.
b) is secreted by cells located in the proximal region of the stomach.
c) stimulates acid secretion in a paracrine fashion.
d) plays an important physiological role in the control of the LES.
e) may be released during the cephalic phase of gastric secretion.

17. The pharyngeal phase of deglutition

a) is coordinated by a centre located in the lateral cerebral cortex.
b) is accompanied by a brief period of apnea.
c) lasts normally about 8 seconds.
d) involves the activity of smooth muscle.
e) may be inhibited by atropine.

18. Secondary esophageal peristalsis in the distal esophagus,

a) is never seen in the normal individual.
b) may be triggered by rapid swallowing of liquids.
c) has a frequency that is determined by the BER of the musculature in this region.
d) depends entirely on the integrity of the vagal innervation to this region.
e) cannot occur if the enteric innervation in this region has been destroyed.
19. The LES
   a) is represented by a well developed thickening of the circular layer of muscle.
   b) is located entirely within the thoracic cavity.
   c) is kept closed in the absence of swallowing by vagally-mediated impulses originating in the CNS.
   d) relaxes during swallowing by a mechanism which involves the release of a NANC neurotransmitter.
   e) All of the above statements are correct.

20. Which one of the following statements regarding gastric Receptive Relaxation in response to the intake of a meal is incorrect?
   a) It is one of the deglutition reflexes.
   b) It is restricted to the proximal region of the stomach.
   c) It is not affected by destruction of the vagal innervation to the stomach.
   d) It is mediated by enteric neurons which release a NANC neurotransmitter.
   e) It maintains a low intragastric pressure as the stomach accommodates the meal.

21. Which one of the following statements regarding the gastrointestinal BER (ECA) is correct?
   a) Its frequency in a given region determines the maximum frequency of contractions in that region.
   b) It has a higher frequency in the proximal stomach than in the distal stomach.
   c) It has a higher frequency in the distal stomach than it does in the duodenum.
   d) It is absent during the interdigestive period.
   e) It is absent following destruction of the enteric ganglia.

22. Destruction of the Chemoreceptor Trigger Zone (CTZ) results in the inability to vomit in response to
   a) excessive distension of the duodenum.
   b) chemical irritation of the duodenum.
   c) the sight or smell of something that evokes unpleasant memories.
   d) the intravenous administration of an emetic drug.
   e) All of the above statements are correct.

23. Which one of the following statements regarding gastric emptying is incorrect?
   a) Liquids empty faster than solids.
   b) Carbohydrate meals empty faster than fatty meals of equal size and consistency.
   c) Hypertonic meals empty faster than isotonic meals of the same size and consistency.
   d) Liquids empty more slowly if the vagal supply to the proximal stomach has been previously destroyed.
   e) Solids empty more slowly if the vagal supply to the distal stomach has been previously destroyed.

24. The enterogastric reflex
   a) stimulates gastric secretion, but inhibits gastric motility.
   b) stimulates gastric motility, but inhibits gastric secretion.
   c) may be triggered by the presence of fatty contents in the gastric antrum.
   d) is responsible for the release of the enterogastrone hormonal complex.
   e) NONE of the above statements is correct.
25. Saliva and pancreatic juice are similar in that
   a) both are isotonic.
   b) both have a strongly alkaline pH.
   c) both may be secreted in response to the administration of secretin.
   d) both may be secreted in response to stimulation of the parasympathetic innervation to their respective glands (salivary glands and pancreas).
   e) both contain an enzyme which breaks down disaccharides to monosaccharides.

26. Parietal cells
   a) are mostly located in the antral region of the stomach.
   b) produce pepsinogen.
   c) respond to stimulation by histamine by releasing HCO₃ ions into the circulation.
   d) lack receptors for gastrin, but respond to the histamine released directly by gastrin.
   e) have a Na⁺/H⁺ ATPase in the apical membrane, which allows for the secretion of H⁺ ions into the canalicular lumen.

27. Chymotrypsinogen
   a) is the inactive form of trypsin.
   b) is a trypsin-inhibitor.
   c) may be activated by trypsin.
   d) is secreted by the pancreatic duct cells.
   e) is secreted in pancreatic juice in response to the administration of secretin.

28. Which one of the following statements about Bile Salts is incorrect?
   a) They are synthesized from cholesterol.
   b) They help keep cholesterol in bile in solution.
   c) They are powerful choleretic agents.
   d) They assist in the intestinal transport and absorption of fat-soluble vitamins.
   e) They stimulate the gallbladder to contract.

29. Slight constriction of the efferent glomerular arteriole might
   a) increase urinary excretion of potassium.
   b) increase GFR.
   c) reduce urinary excretion of sodium.
   d) reduce creatinine clearance.
   e) reduce arterial blood pressure.

30. Renal clearance of para-amino-hippurate (PAH) exceeds 500L/day and renal clearance of inulin is 180L/day. This indicates
   a) PAH secretion.
   b) PAH reabsorption.
   c) that GFR is about half of normal.
   d) that GFR is about twice normal.
   e) inulin reabsorption in the renal tubule.
31. Which of the following is TRUE regarding sodium handling in the kidney?
   a) 75% of NaCl is cleared from the body in the urine and the remaining 25% in the sweat.
   b) Most of the Na\(^+\) and water reabsorption occurs in the loop of Henle.
   c) Na\(^+\) is mainly an intracellular ion.
   d) Plasma Na\(^+\) level is a good indicator of total body Na\(^+\).
   e) Changes in total body Na\(^+\) result in changes in extracellular fluid volume.

32. Which one of the following statements regarding aldosterone is correct?
   a) Aldosterone is a peptide hormone.
   b) Aldosterone stimulates about 60% of Na\(^+\) reabsorption in the proximal tubule.
   c) Aldosterone is released from the posterior pituitary gland.
   d) Aldosterone stimulates tubular reabsorption of Na\(^+\).
   e) Aldosterone stimulates K\(^+\) reabsorption.

33. Which one of the following statements regarding vasopressin (ADH) is incorrect?
   a) When vasopressin is present in the blood, the urine is more concentrated.
   b) When vasopressin is absent from the blood, the urine is usually very diluted.
   c) Vasopressin released to the blood stream, is stimulated by nausea.
   d) When vasopressin is present in the blood, there is increased water excretion.
   e) In the absence of vasopressin, the tubules have very little permeability to water.

34. Which one of the following statements regarding K\(^+\) handling in the kidney is incorrect?
   a) Very high extracellular K\(^+\) concentration can cause cardiac arrhythmia.
   b) The tubules reabsorb most of the filtered K\(^+\).
   c) The regulation of K\(^+\) secretion into the urine is dependent on aldosterone.
   d) Distal tubular flow of urine is important for K\(^+\) secretion in that the more Na\(^+\) going past the Na\(^+\) channels, the more K\(^+\) comes out into the urine.
   e) Aldosterone acts to inhibit production of Na\(^+\) channels.

35. Which one of the following statements regarding acid base regulation is incorrect?
   a) The renal regeneration of bicarbonate is increased in acidosis.
   b) The kidneys excrete bicarbonate in states of alkalosis.
   c) The kidneys can regenerate bicarbonate from the amino acid glutamate.
   d) In respiratory alkalosis, the CO\(_2\) is low and the kidney compensates by making bicarbonate.
   e) In respiratory acidosis, the CO\(_2\) is high and the kidney must excrete H\(^+\) into the urine.
36. Where in the nephron (below) does a loop diuretic (e.g. Furosemide) act?

![nephron diagram]

a) a  
b) b  
c) c  
d) d  
e) e
37. Where in the nephron (below) is the largest percentage of sodium normally reabsorbed?

![Nephron Diagram](image)

a) a  
b) b  
c) c  
d) d  
e) e

38. Choose the correct pairing of diuretic with transporter

<table>
<thead>
<tr>
<th>Diuretic</th>
<th>Transporter Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) K(^+) sparing diuretics</td>
<td>1. Inhibit Na(^+)-K(^+)-2Cl(^-) transporter</td>
</tr>
<tr>
<td>e.g. amiloride</td>
<td></td>
</tr>
<tr>
<td>b) thiazides diuretics</td>
<td>2. Inhibit NaCl transporter</td>
</tr>
<tr>
<td>c) loop diuretics</td>
<td>3. Block Na(^+) channels</td>
</tr>
<tr>
<td>d) aldosterone antagonist</td>
<td>4. Downregulates Na(^+) and K(^+) channel production</td>
</tr>
<tr>
<td>e.g. spironolactone</td>
<td></td>
</tr>
</tbody>
</table>

a) a, 4 and b, 2  
b) b, 1 and d, 3  
c) b, 2 and c, 1  
d) d, 3 and c, 1  
e) b, 2 and d, 3

39. The pituitary

a) is composed of anterior and posterior lobes, which secrete distinct sets of hormones.  
b) is stimulated by hormones secreted by the hypothalamus.  
c) produces gonadotropins.  
d) is a primary source of production of sex steroid hormones.
40. High plasma calcium
  a) exerts a negative feedback loop and inhibits PTH production.
  b) can regulate parathyroid gland function by binding to the calcium sensing receptor.
  c) can result from excessive production of the hormonal form of vitamin D3.
  d) can result from elevated intestinal calcium uptake or from elevated release of calcium from bone.

41. Oxytocin
  a) is not produced in males.
  b) functions at parturition to induce uterine contractions.
  c) is secreted by the anterior pituitary.
  d) causes milk ejection during lactation.

42. Glucocorticoid secretion
  a) exerts a negative feedback loop on the pituitary.
  b) is controlled in a diurnal pattern.
  c) is controlled by ACTH.
  d) can induce osteoporosis.

43. The transit time of a red blood cell in the pulmonary capillaries
  a) is long enough for equilibration of O₂ and CO₂ with alveolar gas during moderate exercise in a patient with severe pulmonary edema.
  b) is 10 times longer than the time needed for equilibration of O₂ and CO₂ with alveolar gas.
  c) is too short for equilibration of O₂ and CO₂ with alveolar gas during moderate exercise in a normal subject.
  d) is reduced during exercise.

44. Because of the Haldane effect,
  a) more CO₂ is carried in oxygenated blood than in deoxygenated blood.
  b) the CO₂ dissociation curve is shifted to the right in the presence of high % HbO₂.
  c) the O₂ dissociation curve is shifted to the right in presence of high CO₂.
  d) more CO₂ can be picked up from the peripheral tissues to be carried back to the lungs.

45. During an asthmatic attack,
  a) the airway smooth muscle contracts decreasing the airway lumen.
  b) the irritant receptors are stimulated by histamine.
  c) airway resistance is increased.
  d) the sternocleidomastoid and scalenus inspiratory muscles may be recruited.

46. Functional residual capacity (FRC) can be measured with a spirometer and helium dilution because
  a) helium concentrations equilibrates between the spirometer and the lung volume.
  b) FRC can be expired and so measured directly with the spirometer.
  c) helium is not very soluble in blood.
  d) None of the above statements is correct.
47. The anatomical dead-space
   a) is defined as the gas volume that reaches the alveoli but that does not contribute to gas exchange because of a pathological condition.
   b) during inspiration, contains humidified room air.
   c) is the sum of the alveolar and physiological dead-space.
   d) during inspiration, contains air that does not contribute to gas exchange.

48. An aortic aneurysm is a dilation or ballooning out of a part of the aorta caused by a weakening in the wall of the aorta. A particular individual who happens to have an aneurysm midway along his aorta is found to have a normal blood pressure measured at the root of the aorta (i.e., the starting point of the aorta where it leaves the left ventricle). After this person has developed the aneurysm, one would expect to find, in comparison to before the aneurysm occurred (neglect any possible cardiovascular reflex changes)
   a) a decrease in the blood flow velocity across the aortic valve.
   b) a decrease in the overall resistance of the aorta.
   c) an increase in the total peripheral resistance.
   d) an increase in the cardiac output.

49. If the flow through a blood vessel has tripled, this might be because
   a) the average velocity of the blood flow had tripled at unchanged cross-sectional area.
   b) the cross-sectional area of the vessel has tripled at unchanged perfusion pressure.
   c) the perfusion pressure has tripled.
   d) the viscosity of the blood has tripled.

50. Which of the following statement(s) is/are true about the ventricular action potential?
   a) The rate of rise of the upstroke (the upstroke velocity) is on the order of 1 V/sec.
   b) The conduction velocity is about 0.1 m/sec.
   c) The L-type Ca	extsuperscript{++}-current generates the upstroke phase.
   d) The pacemaker current (I_{f}) depolarizes the membrane.

51. Which of the following statements(s) is/are true?
   a) The end-diastolic volume is the volume of blood remaining in the left ventricle at the end of the phase of ventricular ejection.
   b) The ejection fraction in a healthy person is typically about 25%.
   c) The end-systolic volume is the volume remaining in the left ventricle at the end of the phase of ventricular filling.
   d) The first heart sound is heard at a time that is very close to the time that the ventricle attains its end-diastolic volume.

52. At a fixed end-diastolic volume, an increase in the contractility of the ventricular muscle will result in:
   a) a decrease in the end-systolic volume.
   b) an increase in the ejection fraction.
   c) an increase in the stroke volume.
   d) an unchanged preload.
53. Which of the following statement(s) is/are true about autoregulation?

a) It occurs in the heart and the kidney.
b) An increase in arterial pressure will result, via this reflex, in an increase in flow.
c) The increase in the tissue concentration of oxygen that occurs when arterial pressure rises plays a role in this reflex.
d) The decrease in the tissue concentration of carbon dioxide that occurs when arterial pressure rises plays no role in this reflex.

54. Which of the following statement(s) regarding the sympathetic innervation of the gastrointestinal tract is/are correct?

a) Sympathetic preganglionic fibres release ACh as a neurotransmitter.
b) Sympathetic postganglionic fibres release a NANC neurotransmitter.
c) Sympathetic postganglionic fibres have an inhibitory effect on the enteric neurons.
d) Sympathetic preganglionic fibres originate in the medulla oblongata.

55. The vagal supply of the GIT (Gastrointestinal Tract)

a) carries both sensory and effector fibres.
b) innervates parts of the GIT in somatic fashion, and other parts in autonomic fashion.
c) may synapse with enteric neurons which are cholinergic, as well as with enteric neurons which are non-adrenergic-non-cholinergic.
d) innervates directly both glandular and muscular cells.

56. The pyloric sphincter

a) is characterized by a conspicuous thickening of the circular muscle at the junction between the stomach and the duodenum.
b) has a very narrow (2-3 mm) luminal diameter.
c) normally offers very little resistance to the aboral flow of liquids.
d) is closed by the arrival of a peristaltic wave which passes over it.

57. In the human duodenum,

a) the maximum frequency of peristaltic contractions is 12/minute.
b) the maximum frequency of segmenting contractions is 12/minute.
c) the chyme becomes isotonic.
d) the chyme becomes strongly alkaline.

58. The gastrointestinal MMC (Migrating Motor Complex)

a) plays an important role in the physical disruption of a meal.
b) is particularly prominent in the colon.
c) no longer occurs, if the autonomic innervation to the GIT has been destroyed.
d) requires the integrity of the ENS for its propagation.
59. Enterokinase
   a) is a pancreatic enzyme.
   b) exerts its activity in the small intestine.
   c) is responsible for the activation of pancreatic lipase.
   d) is essential for ensuring that trypsin is in an active form.

60. By comparison with hepatic bile, gallbladder bile
   a) contains a higher concentration of solids.
   b) contains a larger % of bile salts, because the gall bladder mucosal cells synthesize and secrete bile salts.
   c) is less alkaline.
   d) has a higher concentration of co-lipase.

61. If the distal portion of the ileum is diseased, it is likely that
   a) dietary fat absorption will no longer be possible.
   b) the liver will begin to synthesize more bile salts.
   c) the liver will secrete a larger volume of bile.
   d) pernicious anemia will eventually develop.

62. Proteases may be found in the following secretion(s)
   a) gastric juice.
   b) succus entericus.
   c) pancreatic juice.
   d) colonic secretion.

63. The arrival of a new meal in the stomach
   a) gives rise to the gastrocolic reflex.
   b) promotes relaxation of the ileocecal sphincter.
   c) interrupts the gastric MMC.
   d) initiates the enterogastric reflex.

64. Which of the following statement(s) regarding the absorption of water from the digestive tract is/are correct?
   a) Water absorption is always the result of osmosis.
   b) Normally, the daily absorption of water is approximately 9 L.
   c) Water is not normally absorbed from the stomach.
   d) In the small intestine, water is absorbed by the cells that make up the Crypts of Lieberkühn.

65. Ultrafiltrate entering Bowman’s space has traversed
   a) the macula densa.
   b) the glomerular basement membrane.
   c) the proximal tubule.
   d) the slit diaphragms between podocytes.
66. Renal tubular reabsorption of glucose is an example of
   a) facilitated transport.
   b) passive diffusion.
   c) energy-dependent transport.
   d) oncotic pressure.

67. Which of the following statement(s) regarding the tubules is/are correct?
   a) The main function of the proximal tubule is reabsorption.
   b) The main function of the countercurrent multiplier in the loop of Henle is to generate a high osmotic gradient in the medullary interstitium.
   c) The collecting duct is the site of both aldosterone AND vasopressin action.
   d) Macula densa cells are a special type of tubular cell.

68. In a person who has severe diarrhea and becomes volume contracted,
   a) renin levels increase.
   b) aldosterone levels increase.
   c) angiotensin I and II levels increase.
   d) renal sodium reabsorption increases.

69. Which of the following statement(s) is/are correct?
   a) Plasma osmolality is the key regulator of vasopressin.
   b) Vasopressin couples to the V2 receptor in the kidney to stimulate Na\(^+\) reabsorption.
   c) Diuretics act on the tubular (urine) side to promote Na\(^+\) excretion.
   d) Potassium intake and increased plasma potassium will inhibit aldosterone secretion.

70. When less than 10% of nephrons are functioning, a person is in renal failure. Therefore,
   a) the person will need dialysis or a kidney transplant in order to survive.
   b) The person will have dangerously low potassium concentrations in the blood.
   c) the person is likely to develop low plasma bicarbonate levels.
   d) the person’s serum sodium will be a marker of total body sodium.