National Cathedral Science Olympiad Invitational Tournament

Anatomy and Physiology

December 2017

School Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Team Number: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Points Awarded: \_\_\_\_\_\_/\_\_\_\_\_\_\_\_\_

Tie Breakers:

Question : Both 2 and 3 correct

Question : 28

Question : 35

Directions: Fill in your response for each question in the space provided on the answer sheet corresponding to that question. Ambiguous or illegible responses will be scored as incorrect. Unless noted otherwise, all questions have a point value of 1.

**DO NOT OPEN THIS PACKET UNTIL INSTRUCTED TO DO SO**

**Multiple Choice Questions = 1 point**

**Respiratory System:**

1. Gas exchange in the lungs is located in the \_\_\_\_\_\_\_\_\_.

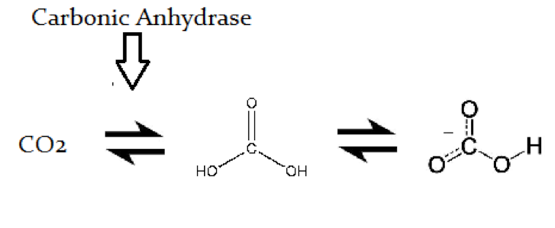
a. pleural membrane

b. alveoli

c. epiglottis

d. bronchioles

For questions 2 and 3: Among the most important pH buffer systems in humans is the bicarbonate buffer, which keeps the blood at a remarkably precise 7.42 pH.  The bicarbonate buffer system uses a series of important compounds and enzymes to make the system function.  Figure 1 depicts the key reactions that take place.



The activity of this buffer system is mainly controlled by the renal and respiratory systems.  The renal system excretes bicarbonate in the urine, while the respiratory system “blows off” carbon dioxide as needed.   By balancing these two systems as needed, blood pH is maintained in such a narrow range.

2. Using the description and figure above, when carbon dioxide is removed by the lungs, which of the following describes an accurate change in the system?

a. The equilibrium shifts toward carbonic acid.

b. The equilibrium shifts away from carbonic acid.

c. The pH of the blood goes down.

d. Bicarbonate builds up in the blood.

3. Using the description and figure above, a patient undergoes a procedure in a hospital, and begins to reabsorb large quantities of bicarbonate from the kidneys. In the above reaction \_\_\_\_\_\_\_\_\_\_\_\_.

a. the equilibrium is shifted toward CO2

b. carbonic anhydrase prevents a shift in equilibrium

c. the equilibrium is shifted toward bicarbonate

d. CO2 quickly builds up

4. In mammals, what muscles are involved in inhalation?

a. External intercostals and diaphragm

b. External intercostals only

c. External intercostals and internal intercostals

d. Diaphragm only

5. Which of the following is not one of the four processes that comprise external respiration?

a. Exchange of oxygen and carbon dioxide between lung air spaces and the blood via diffusion

b. Transportation of oxygen and carbon dioxide between the lungs and body tissues via the blood

c. Exchange of oxygen and carbon dioxide between the blood and tissues via diffusion

d. Use of oxygen within the mitochondria to generate ATP via oxidative phosphorlyation

6. Which of the following may signal a respiratory abnormality?

          I. Low concentration of oxygen in the alveoli

          II. High concentration of carbon dioxide in the alveoli

          III. Contraction of intercostal muscles upon inhalation

a. I, II, and III

b. Only II

c. Only I

d. Both I and II

7. Which of the following is NOT a function of the upper respiratory system?

I.  Inspired air is saturated with water.

II.  Inspired air is filtered for particulates such as pollen.

III.  Inspired air is brought to body temperature.

IV.  Secretory immunoglobulins (IgA) bind certain antigens.

V.  All of these are normal functions of the upper respiratory system.

a. III

b. I

c. V

d. II

8. Which of the following represents the pathway of the respiratory system?

a. Nasal cavity, pharynx, larynx, trachea, primary bronchi, secondary bronchi, tertiary bronchi, respiratory bronchioles, terminal bronchioles, bronchioles, alveolar duct, alveolar sac

b. Nasal cavity, larynx, pharynx, trachea, primary bronchi, secondary bronchi, tertiary bronchi, bronchioles, terminal bronchioles, respiratory bronchioles, alveolar duct, alveolar sac

c. Nasal cavity, pharynx, larynx, trachea, primary bronchi, secondary bronchi, tertiary bronchi, bronchioles, terminal bronchioles, respiratory bronchioles, alveolar duct, alveolar sac

d. Nasal cavity, trachea, pharynx, larynx, primary bronchi, secondary bronchi, tertiary bronchi, bronchioles, terminal bronchioles, respiratory bronchioles, alveolar duct, alveolar sac

9. What is the correct path of air flow during inspiration?

a. Nose and mouth -> pharynx -> larynx -> trachea -> bronchi -> bronchioles -> alveoli

b. Nose and mouth -> larynx -> pharynx -> trachea -> bronchi -> bronchioles -> alveoli

c. Nose and mouth -> pharynx -> larynx -> trachea -> bronchioles -> bronchi -> alveoli

d. Nose and mouth -> larynx -> pharynx -> trachea -> alveoli -> bronchi -> bronchioles

10. In cases of severe asthma, a patient's bronchioles can become chronically inflamed and obstructed, increasing the necessary effort to inflate the lungs with air. Which of the following might be a symptom of severe asthma?

a. Decrease in the partial pressure of carbon dioxide in the blood

b. Hypertrophy of the chest accessory muscles

c. Reduction in the size of the diaphragm

d. Low carbon dioxide levels in the blood

11. Where in the brain is respiration rate regulated?

a. Cerebellum

b. Occipital lobe

c. Frontal cortex

d. Medulla oblongata

12. Give the equation for total lung capacity.

a. Total lung capacity = tidal volume + residual volume

b. Total lung capacity = inspiratory reserve volume + vital capacity

c. Total lung capacity = vital capacity + residual volume

d. Total lung capacity = expiratory reserve volume + inspiratory reserve volume

13. Bronchodilators are a class of drug often used in the treatment of asthma and COPD, which act on β-adrenergic receptors of the airways to induce smooth muscle relaxation. The anatomic distribution of these receptors is closely correlated to the function of each structural component of the lungs. What structural component(s) of the airway would be most affected by the use of a bronchodilator, and in what functional zone(s) are they found?

a. Lobar bronchi, which are found in the conducting zone

b. Lobar bronchi and alveoli would be affected equally, and they are both found in the respiratory zone

c. Lobar bronchi and alveoli would be affected equally, and they are found in the conducting and respiratory zones respectively

d. Alveoli, which are found in the respiratory zone

14. In a situation where the respiratory bronchioles become inflamed and narrowed, such as is seen in asthma, which aspect of respiration would be most mechanically impaired?

a. normal expiration

b. forced inhalation

c. forced expiration

d. normal inhalation

15. A client with COPD reports steady weight loss and being “too tired from just breathing to eat.” Which of the following nursing diagnoses would be most appropriate when planning nutritional interventions for this client?

a. Altered nutrition: Less than body requirements related to fatigue.

b. Activity intolerance related to dyspnea.

c. Weight loss related to COPD.

d. Ineffective breathing pattern related to alveolar hypoventilation.

**Digestive System:**

16. Foods eaten by animals are most often composed largely of macromolecules. This requires the animals to have methods for which of the following?

a. elimination

b. regurgitation

c. dehydration synthesis

d. enzymatic hydrolysis

17. Which of the following describes peristalsis in the digestive system?

a. a process of fat emulsification in the small intestine

b. voluntary control of the rectal sphincters regulating defecation

c. a common cause of loss of appetite, fatigue, and dehydration

d. smooth muscle contractions that move food through the alimentary canal

18. After ingestion, the first type of macromolecule to be worked on by enzymes in the human digestive system is \_\_\_\_\_\_\_\_\_\_\_.

a. protein

b. carbohydrate

c. glucose

d. cholesterol

19. Which of the following statements is true of mammals?

a. All foods begin their enzymatic digestion in the mouth.

b. After leaving the oral cavity, the bolus enters the larynx.

c. The epiglottis prevents food from entering the trachea.

d. Enzyme production continues in the esophagus.

20. What part(s) of the digestive system have secretions with a pH of 2?

a. small intestine

b. liver

c. stomach

d. pancreas

21. Without functioning parietal cells, which of the following would you expect for an individual?

a. not to be able to initiate protein digestion in the stomach

b. not to be able to initiate mechanical digestion in the stomach

c. only to be able to digest fat in the stomach

d. not to be able to produce pepsinogen

22. Which of the following is true of bile salts?

a. They are enzymes.

b. They are manufactured by the pancreas.

c. They emulsify fats in the duodenum.

d. They increase the efficiency of pepsin action.

23. Most nutrients absorbed into the lymph or bloodstream are in which form?

a. enzymes

b. polymers

c. peptides

d. monomers

24. How does the digestion and absorption of fat differ from that of carbohydrates?

a. Processing of fat does not require any digestive enzymes, whereas the processing of carbohydrates does.

b. Fat absorption occurs in the stomach, whereas carbohydrates are absorbed from the small intestine.

c. Carbohydrates need to be emulsified before they can be digested, whereas fats do not.

d. Most absorbed fat first enters the lymphatic system, whereas carbohydrates directly enter the blood.

25. The outer layer of the intestines is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

a. mucosa

b. submucosa

c. serosa

d. muscularis

26. The \_\_\_\_\_\_\_\_\_\_ layer of the alimentary canal contains loose connective tissue, glands, blood and lymphatic vessels, and nerves.

a. mucosa

c. muscular layer

b. submucosa

d. serosa

27. After surgical removal of an infected gallbladder, a person must be especially careful to restrict dietary intake of \_\_\_\_\_\_\_\_\_\_\_\_\_.

a. starch.

b. fat.

c. protein

d. sugar.

28. Compare the lining of the esophagus, stomach, small intestine and large intestine (6 points)

**Immune System:**

29. The body’s most important nonspecific defense is \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

a. the skin

b. cell-mediated immunity

c. the inflammatory response

d. permanent immunity

30. During winter you become sick with the flu. Shortly after that, you become sick with strep throat. Will the same type of B-cells that fought the pathogen that caused the flu fight the pathogen that causes strep throat?

a. Yes. Every B cell is capable of fighting every pathogen with which it comes in contact.

b. Yes. B cells recognize similar antigens such as bacterial and viral pathogens.

c. No. B cells fight viruses while T cells fight bacteria.

d. No. Each B cell is capable of recognizing one specific antigen.

31. Which is not an autoimmune disorder?

a. asthma

b. Addisonʹs disease

c. Graves disease

d. system lupus erythematosus

32. Antivirals work by

a. destroying the virus.

b. boosting antiviral bacteria

c. boosting the immune system

d. inhibiting viral replication

33. Which of these is an example of active immunity?

a. A pregnant woman passing antibodies to the fetus across the placenta

b. A pregnant woman giving antibodies to an infant through breast milk

c. A person developing antibodies against the measles vaccine

d. A person receiving antibody shots after being bitten by a rabid animal

34. A person who has received a vaccine for human papillomavirus (HPV), which causes genital warts and can cause cervical cancer,

a. Is able to produce antibodies against HPV

b. Is more susceptible to HPV than someone who has not had the vaccine

c. Has passive immunity against HPV

d. Must already have been infected with HPV

35. The cells and signaling molecules that initiate inflammatory responses are

a. the phagocytes and the chemokines.

b. the dendritic cells and the interferons.

c. the lymphocytes and the interferons.

d. the mast cells and the histamines.

36. A patient who can produce antibodies against some bacterial pathogens, but not against viral infections, probably has a disorder in his

a. plasma cells.

b. macrophages.

c. T cells.

d. B cells.

37. Identify 3 ways antibodies combat antigens. Give a short description for each. (6 points)