

National Exams December 2013

04-Bio-A6, Anatomy and Physiology

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a CLOSED BOOK EXAM.
One of two calculators is permitted, any Casio or Sharpe approved models.
3. FIVE (5) questions constitute a complete exam paper.
The first five questions as they appear in the answer book will be marked.
4. Each question is of equal value.
5. Most questions require an answer in essay format. Clarity and organization of the answer are important.

Question 1:

- a) The diameter of a capillary is smaller than that of an arteriole, yet collectively, the capillaries have a lower flow resistance than the arterioles. Explain.
- b) State the Frank-Starling law of the heart. What property of the cardiac muscle is responsible for this law?
- c) Describe the changes in the aortic pressure, ventricular pressure and atrial pressure over a single heart cycle. How do these changes relate to the opening and closing of the cardiac valves.
- d) Why is regulation of both mean arterial pressure and body temperature more difficult for people exercising in a hot environment?

Question 2:

A man was dropped off at the airport. As he was picking up his suitcase from the back of the car, he was struck gently by another vehicle. While shaken, he appeared fine and went on to catch his flight. He arrived safely at his destination, after a relatively short flight but later in the week, became short of breath and ultimately collapsed and died. Given the sequence of events, discuss what possibly may have been the cause of death. What pathological findings would you expect upon autopsy?

Question 3:

- a) Describe the functional anatomy of the kidney.
- b) In a diabetic, the plasma glucose concentration is 10 mg/mL, the inulin clearance is 125 ml/min and the urine flow rate is 10 mL/min. What is the filtered load of glucose? Assuming a T_m for glucose of 400 mg/min, what is the rate of glucose reabsorption? What is the rate of glucose excretion? What is the concentration of glucose in the urine?

Question 4:

- a) What effect does the respiratory quotient have on the composition of alveolar gas?
- b) What determines the oxygen carrying capacity of the blood.
- c) How is the difference between the dissociation curves for myoglobin and haemoglobin related to the physiological roles of haemoglobin in gas transport in the blood and myoglobin as an oxygen reserve in the muscle.
- d) Diagram the steps in the pathway for diffusion of CO₂ from tissues into the blood and from blood into the alveolar gas mixture.

Question 5:

- a) Describe the way in which the organic matrix of bone and the bone salts are structured to provide both compressional strength and tensional strength of the bone.
- b) What is the composition of hydroxyapatite?
- c) During bone calcification, what salts are first laid down in the bone and how are these converted to hydroxyapatite?
- d) Explain the histological mechanisms by which bone is continually being remodelled. What is the value of the continual remodelling of bone?

Question 6:

- a) An action potential in a motor nerve fibre produces a single muscle contraction. Describe the sequence of events that occurs between the time that a nerve impulse arrives at a muscle and the onset of the muscle twitch.
- b) What is the difference between an isometric and an isotonic contraction. Give an example of each.
- c) Large amounts of stored glycogen are present in which type of skeletal muscle fiber. What is the functional role of this stored glycogen?