The University Of Sheffield.

DEPARTMENT OF MEDICAL PHYSICS AND CLINICAL ENGINEERING

Autumn 2006-2007

STRUCTURE AND FUNCTION OF THE HUMAN BODY 2 HOURS

The paper is divided into two sections: A and B.

The student should answer all questions in section A. One sentence answers are sufficient for all questions in this section.

The student should answer two questions from section B.

TURN OVER

SECTION A

(Answer all questions in this section: 2 marks each)

1. Give two examples of energy-requiring processes that enable a substance to cross a cell membrane. What molecule energises these processes?

2. If you had access to a microscope, how might you distinguish between an artery and a vein?

3. One of the properties of cardiac muscle is automaticity. Explain what this means.

4. Indicate two ways (functional or structural) in which RNA differs from DNA.

5. Give an example of a structure controlled by:
   (i) the somatic nervous system;
   (ii) the autonomic nervous system.

6. In the central nervous system, what is found within:
   (i) tracts;
   (ii) the grey matter of the brain and spinal cord?

7. What are the main purposes of insulin in the body? Name the condition characterised by insufficient production of insulin.

8. Hormones are released directly into the blood stream and circulate throughout the body. Why do they only affect specific target cells?

9. What is a sarcomere?

10. What are the two main components of bone matrix? Compare the function of the organic and inorganic component in terms of bone mechanics.

11. Define ‘saltatory conduction’. What specific features of an axon make this possible?

12. A patient has a heart rate of 65 beats per minute, an end-diastolic (EDV) volume of 100 ml and an end stroke volume (ESV) of 30 ml. What is his/her cardiac output? Show how you have arrived at this figure and give the units used.

13. Draw a sketch of a red cell giving the approximate dimensions of the cell.

14. Why are some proteins in our diet said to have a ‘high biological value’?

15. What is meant by ‘denaturation’ of an enzyme? Give two examples of factors that may cause denaturation indicating whether these effects are reversible or irreversible.

16. If a patient has a recorded haematocrit of 38%, would you expect their haemoglobin level to be high or low? Briefly state why. What is considered to be a normal value?

CONTINUED

SECTION A - continued

17. Carbon dioxide is carried in the blood in three different forms:
    (i) in solution in the plasma,
    (ii) carried in the plasma as bicarbonate ions, and
    (iii) bound to haemoglobin, (as carbaminohaemoglobin).

    What proportion of carbon dioxide is transported in each case?

18. Give two general characteristics of epithelial cells.

19. Give four examples of the differences between smooth and skeletal muscle.

20. Why is the established representation of the cell membrane called the 'fluid mosaic model'?

Section B

(Answer two questions from this section: 30 marks each)

B1.

(a) What do you understand by the term homeostasis? Which two major systems of the body act to maintain homeostasis? Briefly indicate how these are co-ordinated. [10]

(b) Give examples of two physiological parameters that are under negative feedback control and indicate the main components and processes involved in one of these specific cases. [10]

(c) What type of events involve positive feedback systems? Give one example and describe the sequence of events involved. [10]

B2.

(a) What is meant by 'blood pressure'?

Describe how and where on the surface of the body blood pressure is usually measured clinically. Why is this particular site chosen? What do the two pressures recorded represent? What units are used and why? [20]

(b) How do blood pressure, velocity of flow and total cross-sectional area change throughout the systemic arterial and venous system? [10]

B3.

(a) With the aid of a diagram describe the structure of a typical motor neuron. Indicate how the cell structure is related to its specific function. [10]

(b) What is meant by 'resting membrane potential'? What is the magnitude of the resting potential for a typical neuron? With the aid of a simple diagram, briefly explain the passive and active forces that establish and maintain the resting membrane potential. [15]

(c) Explain what is meant by excitation-contraction coupling. [5]

END OF QUESTION PAPER