S4 Biology Practice Paper I Magnification, enzyme activity, osmosis, gas exchange, cardiac output, energy transfer

S4 Biology I Time allowed: 60 minutes I Total: 100 marks I 24 questions

Question 1 Cells and magnification (17 marks)

Answer ALL parts. Show your working and include units.

1. A student photographs a human cheek cell. The cell image is 60 mm across and the actual diameter of the cell is 75 micrometres. Calculate the magnification of the micrograph. (4 marks)

2. In an electron micrograph an organelle has an image length of 4.5 mm and an actual length of 0.9 micrometres. Find the magnification. (4 marks)

3. A cell is 20 micrometres long. A student draws it 5 cm long. Calculate the magnification of the drawing. (4 marks)

4. Explain why the magnification of a light microscope cannot be increased without limit. (5 marks)

Question 2 Enzyme activity and temperature (17 marks)

Answer ALL parts. Show your working and include units.

5. An enzyme catalyses a reaction that produces 24 cm3 of gas in 10 minutes. Calculate the average rate of reaction in cm3 per minute. (4 marks)

6. In the same experiment the rate is 2.5 cm3 per minute at 30 degrees C and 5.0 cm3 per minute at 40 degrees C. Calculate Q10 for this enzyme between 30 and 40 degrees C. (4 marks)

7. At 60 degrees C the rate falls to 0.2 cm3 per minute. Explain why. (4 marks)

8. If substrate is plentiful and the temperature is optimum, predict the effect on the initial rate of doubling the enzyme concentration. Explain. (5 marks)

Question 3 Osmosis and change in mass (17 marks)

Answer ALL parts. Show your working and include units.

9. A potato strip of mass 2.40 g is placed in 0.2 M sucrose solution. After 30 minutes its mass is 2.16 g. Calculate the percentage change in mass. (4 marks)

10. A potato strip of the same initial mass is placed in distilled water. After 30 minutes its mass is 2.76 g. Calculate the percentage change in mass. (4 marks)

11. Explain the difference between the two results. (4 marks)

12. How could this experiment be used to find the isotonic concentration for the potato tissue? (5 marks)

Question 4 Gas exchange and pulmonary ventilation (17 marks)

Answer ALL parts. Show your working and include units.

13. At rest a person has a tidal volume of 500 cm3 and a breathing rate of 15 breaths per minute. Calculate the pulmonary ventilation rate. (4 marks)

14. During exercise the tidal volume rises to 700 cm3 and the breathing rate to 30 breaths per minute. Calculate the ventilation rate and how many times the resting value it is. (4 marks)

15. Inhaled air contains 21 percent oxygen and exhaled air contains 16 percent oxygen. Using the ventilation rate in part (a), estimate the oxygen uptake per minute. (4 marks)

16. Explain why breathing becomes deeper and faster during exercise. (5 marks)

Question 5 Cardiac output and blood flow (16 marks)

Answer ALL parts. Show your working and include units.

17. At rest a person has a stroke volume of 70 cm3 and a heart rate of 72 beats per minute. Calculate the cardiac output in dm3 per minute. (4 marks)

18. During exercise the stroke volume is 110 cm3 and the heart rate is 150 beats per minute. Calculate the cardiac output and how many times the resting value it is. (4 marks)

19. At rest about 20 percent of the cardiac output flows to skeletal muscle. Calculate the blood flow to skeletal muscle per minute in cm3 and in dm3. (4 marks)

20. Explain why cardiac output increases during exercise. (4 marks)

Question 6 Photosynthesis and energy transfer (16 marks)

Answer ALL parts. Show your working and include units.

21. Grass contains 50 000 kJ of energy and a cow assimilates 8 000 kJ. Calculate the efficiency of energy transfer from grass to cow. (4 marks)

22. The cow assimilates 8 000 kJ of energy and 1 600 kJ becomes human biomass. Calculate the efficiency of energy transfer from cow to human. (4 marks)

23. Explain why a shorter food chain provides more energy for human use. (4 marks)

24. When other factors are adequate, the rate of photosynthesis stops rising at high light intensity. Explain why. (4 marks)