S4 Biology Practice Paper: Photosynthesis, Respiration, Enzymes, Membrane Transport, Microscopy and Inheritance

S4 Biology | Time allowed: 90 minutes | Total: 100 marks | 24 questions

A. Photosynthesis and Respiration (17 marks)

Take the molar volume as 24.0 $dm^3\ mol^{-1}$ at room temperature.

1. A leaf absorbs 200 cm^3 of carbon dioxide in 10.0 minutes. Find the rate of carbon dioxide uptake and state the volume of oxygen produced in the same period. (5 marks)

2. Yeast ferments 1.0 mol of glucose anaerobically. Find the volume of carbon dioxide produced. (4 marks)

3. A plant releases 30 cm^3 of oxygen per hour in the light and takes up 10 cm^3 of oxygen per hour in the dark. Find the gross rate of photosynthesis. (4 marks)

4. Which two colours of light are absorbed most strongly by chlorophyll? Explain why leaves look green in natural light. (4 marks)

B. Enzymes (17 marks)

Assume a temperature coefficient Q_{10} of 2.

5. An enzyme works at 5.0 $cm^3\ min^{-1}$ at 20 °C. Assuming no denaturation before 40 °C, find the rate at 40 °C. (5 marks)

6. At a certain pH the enzyme activity is 12 units, and at the optimum pH it is 15 units. Find the relative activity at that pH. (4 marks)

7. Why does adding more substrate fail to raise the reaction rate once the substrate concentration is already high? (4 marks)

8. Compare the effects of competitive and non-competitive inhibitors on enzyme action. (4 marks)

C. Membrane Transport and Osmosis (17 marks)

All percentage changes are based on the original mass.

9. A piece of potato tissue falls from 5.0 g to 4.4 g in a sugar solution. Find the percentage change in mass. (5 marks)

10. Compare the surface area to volume ratio of cubes of side 1 cm and side 2 cm. (4 marks)

11. How does active transport differ from diffusion in the absorption of glucose by cells lining the small intestine? (4 marks)

12. Which has the stronger osmotic effect on red blood cells, 0.30 M sodium chloride solution or 0.30 M sucrose solution? Explain in terms of particle concentration. (4 marks)

D. Microscopy and Magnification (17 marks)

1 mm = 1 000 μm.

13. Under a microscope with a total magnification of 400 times, the image of a cell is 20 mm long. Find the actual length of the cell in μm. (5 marks)

14. The eyepiece is 10 times and the objective is 40 times. Find the total magnification. (4 marks)

15. The field of view is 1.8 mm across with the 10 times objective. Find the field diameter with the 40 times objective. (4 marks)

16. The object appears at the top right of the field. In which direction should the slide be moved, and why? (4 marks)

E. Inheritance and Mendel's Laws (16 marks)

Assume independent assortment and no lethal genotypes.

17. Two tall pea plants of genotype Tt are crossed and produce 1 000 offspring. Find the numbers of tall and dwarf plants. (4 marks)

18. A Tt plant is crossed with a tt plant and 200 offspring are produced. Find the number of tall plants. (4 marks)

19. Two double heterozygotes AaBb are crossed and produce 960 offspring. Find the numbers of the four phenotypes. (4 marks)

20. A carrier mother and an unaffected father have 400 sons. Find the number of colour-blind sons. (4 marks)

F. Ecology and Energy Flow (16 marks)

Energy transfer follows the ten per cent rule in this question.

21. The tertiary consumers in a food chain hold 200 kJ of energy. Using the ten per cent rule, how much energy must the producers fix? (4 marks)

22. Forty snails are captured, marked and released; a second sample of 50 contains 8 marked snails. Estimate the population size. (4 marks)

23. State two ways in which carbon passes from the atmosphere into organisms and back to the atmosphere. (4 marks)

24. Explain why top predators carry the highest concentration of pollutants in a food chain. (4 marks)