S3 Biology Practice Paper 1 with Answers

Biology · S3 · Data-response

S3 biology practice paper on magnification, enzyme activity, photosynthesis, breathing volumes, transpiration and food energy, with full answers and mark scheme.

1. Microscope magnification and cell size (16 marks)

A student uses a microscope with a 10× eyepiece to observe onion epidermis cells, first with a 10× objective and then with a 40× objective. The field diameter at low power is 1.4 mm. At high power a cell measures 20 mm long in the drawing.

#	Question
1	Find the total magnification at high power and how many times greater it is than at low power.
2	Find the actual length of the cell, in mm and in µm.
3	Find the field diameter at high power, in mm and in µm.
4	If a cell is 50 µm long, how many cells fit across the field diameter? Explain why the low-power objective should be used first to focus.

2. Enzyme activity and temperature (16 marks)

Equal pieces of potato are placed in hydrogen peroxide solution at different temperatures and the oxygen produced in 30 s is measured. At 30 °C, 3.0 cm³ is collected; at 20 °C the rate is 3.0 cm³/min; at 60 °C only 2.0 cm³ is collected in 30 s. The rate at the optimum 37 °C is 8.0 cm³/min.

#	Question
5	Calculate the rate at 30 °C in cm³/min and in cm³/s.
6	What percentage of the optimum rate is reached at 60 °C?
7	By what percentage does the rate increase from 20 °C to 30 °C?
8	Explain why the reaction almost stops above 70 °C.

3. Photosynthesis and bubble counting (18 marks)

Pondweed is placed in a measuring cylinder of sodium hydrogencarbonate solution and lit by a lamp. At a lamp distance of 20 cm, 12 bubbles are counted in 30 s. When the lamp is moved to 40 cm, only 4 bubbles are counted in 30 s.

#	Question
9	Calculate the number of bubbles per minute at 20 cm.
10	When the lamp distance rises from 20 cm to 40 cm, what fraction of the original light intensity remains? Predict the bubbles per minute.
11	The measured count at 40 cm is 4 bubbles in 30 s. Calculate how many percent higher the measured rate is than the prediction, and give one possible explanation.
12	Explain why leaves are decolourised in hot alcohol before the starch test, and state the role of a control.

4. Breathing and lung ventilation (16 marks)

At rest a person breathes 16 times per minute with a tidal volume of 0.50 dm^3; after exercise the rate is 30 times per minute with a tidal volume of 0.80 dm^3. Inhaled air contains 21% oxygen and exhaled air contains 16% oxygen.

#	Question
13	Calculate the ventilation rate at rest in dm^3/min.
14	Calculate the ventilation rate after exercise and its ratio to the resting value.
15	Each breath extracts 5% by volume of the oxygen in the inhaled air. Find the oxygen taken in per minute at rest in cm^3.
16	Explain the physiological need for the higher ventilation during exercise, and why lactic acid builds up in muscles after strenuous exercise.

5. Transpiration and leaf area (17 marks)

A shoot is set up in a potometer; it loses 4.5 g of water in 3 hours and its total leaf area is 0.030 m^2. In another measurement it loses 3.6 g in 2 hours by day and 0.6 g in 4 hours at night.

#	Question
17	Calculate the average transpiration rate in g/h.
18	Calculate the transpiration rate per square metre of leaf area in g/m^2/h.
19	Find the ratio of daytime to night-time transpiration rate and explain the difference.
20	Explain how wind and humidity affect the rate of transpiration, and describe the pathway of water from root to leaf.

6. Energy in food and digestion (17 marks)

A 50 g food sample contains 30 g carbohydrate, 12 g protein and 8 g fat. Energy values: carbohydrate 17 kJ/g, protein 17 kJ/g, fat 38 kJ/g.

#	Question
21	Calculate the total energy in the 50 g sample in kJ.
22	Calculate the energy content per 100 g in kJ/100 g.
23	Find the percentage of the total energy supplied by fat and by carbohydrate (one decimal place).
24	Explain why fat supplies more energy per gram than carbohydrate, and describe the roles of bile and pancreatic lipase in fat digestion.