S4 Biology Practice Paper: Cells and Microscopy, Enzymes and Metabolism, Transport Across Membranes, Photosynthesis, Respiration and Gas Exchange, Biological Molecules and Food Tests (100 marks)

Level: S4 | Subject: Biology | 60 minutes | 100 marks | 24 questions | question paper

Section A: Cell Structure and Microscopy (17 marks)

Each question is worth 4-5 marks; show your working and units.

#	Question	Marks
1	A cell is viewed with a x10 eyepiece and a x40 objective; the image measures 20 mm. Find the total magnification and the actual length of the cell in um.	4
2	The field of view is 1.8 mm across at x100. What is its diameter in um at x400?	4
3	Two cube-shaped cells have sides of 20 um and 10 um. Calculate the surface area to volume ratio of each and state which diffuses more efficiently.	4
4	A light microscope resolves about 200 nm and an electron microscope about 0.2 nm. How many times better is the resolution, and what can the electron microscope show?	5

Section B: Enzymes and Metabolism (17 marks)

Each question is worth 4-5 marks; include working and explanation.

#	Question	Marks
5	An enzyme catalyses at 2.4 units per minute at 27 C and 4.8 units per minute at 37 C. Calculate its Q10.	4
6	Enzyme activity is 100% at 30 C but only 20% at 50 C. Find the percentage drop and explain why high temperature inactivates the enzyme.	4
7	Enzyme A has Km = 2.0 mM and enzyme B has Km = 0.5 mM. At 2.0 mM substrate, find v/Vmax for each and state which has the higher affinity.	4
8	Rate is 60 units per minute without an inhibitor and 24 with it. Find the percentage inhibition and name the type if raising substrate restores the rate.	5

Section C: Transport Across Membranes and Water Potential (17 marks)

Each question is worth 4-5 marks; mind the signs and units.

#	Question	Marks
9	A plant cell has solute potential -600 kPa and pressure potential 200 kPa. Find its water potential and say whether water moves if the external solution is at -400 kPa.	4
10	Potato strips go from 2.00 g to 2.40 g in distilled water and from 2.00 g to 1.60 g in 0.5 M sucrose. Calculate both percentage changes.	4
11	Diffusion time is proportional to the square of distance. If a leaf thins from 0.4 mm to 0.1 mm, how many times faster is diffusion?	4

12	Model a villus as a sphere of radius 0.1 mm. Find its surface area to volume ratio and the ratio at radius 0.2 mm, and relate this to absorption.	5

Section D: Photosynthesis (17 marks)

Each question is worth 4-5 marks; state mole ratios where needed.

#	Question	Marks
13	Photosynthesis: 6CO2 + 6H2O -> C6H12O6 + 6O2. If a leaf fixes 6 mol of CO2, what volume of oxygen is released at 24 dm3/mol?	4
14	Oxygen release is 12, 24 and 30 cm3/min at light intensities 20, 40 and 60 units. Find the percentage rise from 40 to 60 and identify the limiting factor.	4
15	In chromatography the solvent front is 8.0 cm and a pigment band is 5.6 cm from the origin. Calculate its Rf and state its use.	4
16	A 50 cm2 leaf releases 0.24 cm3 of oxygen per minute. Find the output per cm2 per minute and per hour, and explain why oxygen is used to measure the rate.	5

Section E: Respiration and Gas Exchange (16 marks)

Each question is worth 4 marks; show the calculation steps.

#	Question	Marks
17	An organism takes in 200 cm3 of oxygen and releases 140 cm3 of CO2 in 10 minutes. Find the respiratory quotient and identify the main substrate.	4
18	Yeast ferments 0.180 g of glucose anaerobically. Find the theoretical volume of CO2 released (molar mass 180 g/mol, molar volume 24 dm3/mol).	4
19	Complete oxidation yields 38 ATP per glucose and anaerobic glycolysis only 2. Find the fold difference and the aerobic efficiency given 30.5 kJ/mol ATP and 2870 kJ/mol glucose.	4
20	At rest a person breathes 12 times per minute at 500 cm3 per breath; during exercise 30 times at 900 cm3. How many times greater is the minute ventilation?	4

Section F: Biological Molecules and Food Tests (16 marks)

Each question is worth 4 marks; include the test observations.

#	Question	Marks
21	A 5.0 g food sample contains 0.40 g of reducing sugar. Find the percentage by mass and describe a positive Benedict test.	4
22	100 amino acids join into one polypeptide. Find the number of peptide bonds and water molecules removed, and name the reaction.	4
23	One glycerol and three fatty acids form a triglyceride. Find the number of ester bonds and water molecules removed, and explain why lipids store energy well.	4
24	1.0 cm3 of 0.1% ascorbic acid just decolourises DCPIP; a fruit juice needs 2.5 cm3. Find the vitamin C concentration of the juice.	4