MARK SCHEME

AQA GCSE Biology · Paper 1: Cell Biology, Organisation, Infection & Response, Bioenergetics

Higher Tier — Separate Science · Total: 100 marks

This mark scheme is designed for use by examiners. Alternative correct answers should be accepted. Marks in brackets [1] indicate one mark. Points separated by / indicate alternatives. Underlined words are essential. ★ indicates Higher Tier only marks.

Question 1 [4 marks]

(a) [1 mark]

Which of the following structures is found in a bacterial cell but NOT in a human liver cell?

• C. Plasmid [1]

(b) [1 mark]

A student observes a cell under a light microscope. The cell has a large permanent vacuole, chloropl…

• B. Plant cell [1]

(c) [1 mark]

Which process requires energy from ATP?

• C. Active transport [1]

(d) [1 mark]

Which of the following is the correct word equation for aerobic respiration?

• B. Glucose + oxygen → carbon dioxide + water [1]

Total for question 1: 4

Question 2 [5 marks]

Mitochondria are found in nearly all eukaryotic cells. Scientists use electron microscopes to study their internal struc…

(a) [2 marks]

Give TWO reasons why an electron microscope is more suitable than a light microscope for studying th…

• Electron microscope has much higher resolution / can resolve detail at the nanometre level [1]

• Electron microscope has much higher magnification [1]

Note: Do not accept "better quality image" without qualification.

(b) [2 marks]

A student draws a cell under the microscope. The image of a cell is 54 mm long. The actual length of…

• Magnification = 54 ÷ 0.03 [1]

• = ×1800 [1]

Note: Award 1 mark for correct substitution, 1 mark for correct answer. Do not penalise for lack of unit (magnification has no unit).

(c) [1 mark]

Convert 0.03 mm to micrometres (µm).

• 30 µm [1]

Total for question 2: 5

Question 3 [6 marks]

Cystic fibrosis (CF) is a genetic disorder caused by a faulty recessive allele (f). A couple who are both carriers of cy…

(a) [1 mark]

What is meant by the term "carrier" in the context of cystic fibrosis?

• A carrier is a heterozygous individual (Ff) who has one copy of the faulty allele but does not show the condition/has no symptoms [1]

(b) [3 marks]

Use a Punnett square to calculate the probability that this child will have cystic fibrosis. Show yo…

• Gametes of each parent shown as F and f [1]

• Punnett square: FF, Ff, Ff, ff (all four combinations correct) [1]

• 1 in 4 / 25% probability of cystic fibrosis (ff) [1]

(c) [2 marks]

Cystic fibrosis causes thick, sticky mucus to build up in the lungs. Explain why this increases the …

• Thick mucus is harder for cilia to sweep away / mucus traps bacteria more effectively [1]

• Bacteria can multiply in the stagnant mucus, increasing the chance of infection [1]

Total for question 3: 6

Question 4 [8 marks]

A student investigates the effect of enzyme concentration on the rate of digestion of starch by amylase. She measures th…

(a) [1 mark]

State why iodine solution turns blue-black.

• Starch is present [1] / iodine + starch → blue-black colour

(b) [3 marks]

Explain the shape of the graph. Include in your answer what happens to the rate of reaction as enzym…

• As enzyme concentration increases, rate of digestion increases [1]

• More enzyme molecules means more active sites available [1]

• More enzyme-substrate complexes can form per unit time → faster reaction [1]

Note: Accept any two valid points for 2 marks, all three for full 3 marks.

(c) [2 marks]

Give TWO variables the student should control to make this a fair test.

• Temperature (constant water bath) [1]

• pH / concentration of starch / volume of starch [1] — any two valid controlled variables

(d) ★ [2 marks]

★ Explain, using the induced fit model, how the enzyme amylase catalyses the breakdown of starch.

• Starch (substrate) enters the active site of amylase; active site changes shape slightly to better accommodate the starch molecule [1]

• Reaction occurs → starch broken into sugars → products released → active site returns to original shape and enzyme is reused [1]

Total for question 4: 8

Question 5 [10 marks]

The diagram below shows the structure of the heart.

(a) [3 marks]

Describe the flow of blood through the heart. Include the names of the chambers and vessels in your …

• Deoxygenated blood enters the RIGHT ATRIUM from the body (via vena cava) [1]

• Pumped to RIGHT VENTRICLE → pulmonary artery → lungs [1]

• Oxygenated blood returns from lungs via pulmonary vein → LEFT ATRIUM → left ventricle → pumped to body via aorta [1]

(b) [2 marks]

Explain why the left ventricle has a thicker muscular wall than the right ventricle.

• The left ventricle pumps blood around the whole body / systemic circulation — a longer distance [1]

• Requires greater pressure — thicker muscle wall generates more force [1]

(c) [3 marks]

Describe how coronary heart disease develops and explain how statins are used to reduce the risk.

• Fatty deposits (atherosclerosis) build up inside coronary arteries → arteries narrow → reduced blood flow and oxygen to heart muscle [1]

• Can lead to heart attack if artery becomes fully blocked [1]

• Statins lower LDL cholesterol in the blood → reduce rate of plaque formation → lower risk of further blockages [1]

(d) ★ [2 marks]

★ A patient's heart rate is 72 beats per minute and their stroke volume is 70 cm³. Calculate their …

• Cardiac output = 72 × 70 [1]

• = 5040 cm³/min [1] — accept dm³/min if converted correctly

Total for question 5: 10

Question 6 [10 marks]

Scientists investigated the spread of a new strain of influenza. They recorded the number of new cases per week over a 1…

(a) [1 mark]

Influenza is caused by a virus. Explain why antibiotics cannot be used to treat influenza.

• Antibiotics target bacterial structures (e.g. cell wall / bacterial ribosomes) which viruses do not have [1] / viruses replicate inside host cells so antibiotics cannot reach them

(b) [4 marks]

Explain how vaccination with the influenza vaccine protects a person from future influenza infection…

• Vaccine contains harmless/dead/weakened antigens from the influenza virus [1]

• Immune system responds: lymphocytes produce antibodies specific to those antigens [1]

• Memory cells are produced and remain in the body long-term [1]

• If the real virus is encountered later, memory cells enable rapid, large-scale antibody production before significant symptoms develop [1]

(c) [2 marks]

Explain why a new influenza vaccine must be developed each year.

• The influenza virus mutates rapidly — antigens on its surface change (antigenic variation) [1]

• Memory cells from previous vaccine no longer recognise the new strain — new vaccine needed [1]

(d) ★ [3 marks]

★ Describe how monoclonal antibodies can be used to treat cancer. Include in your answer how they a…

• A specific lymphocyte (B cell producing the desired antibody) is fused with a tumour cell to produce a hybridoma cell [1]

• Hybridoma cells are cloned to produce large quantities of identical (monoclonal) antibodies [1]

• Monoclonal antibodies are attached to a drug/toxin — they bind specifically to antigens on cancer cell surface, delivering the drug directly to cancer cells (magic bullet) [1]

Total for question 6: 10

Question 7 [11 marks]

Photosynthesis is the process by which plants produce glucose from carbon dioxide and water.

(a) [2 marks]

Write the balanced symbol equation for photosynthesis.

• 6CO■ + 6H■O → C■H■■O■ + 6O■ [2] (award 1 if correct but not balanced)

Note: Must include light energy notation or "light energy" somewhere for full marks.

(b) [4 marks]

A student investigates the effect of light intensity on the rate of photosynthesis in pondweed. She …

• Use a constant temperature (e.g. water bath) — temperature affects enzyme activity / rate of photosynthesis [1]

• Control CO■ concentration (e.g. add sodium hydrogen carbonate) — CO■ is a limiting factor [1]

• Use the same piece of pondweed throughout / same lamp power [1]

• Failure to control these variables would mean it is not a fair test — the independent variable (light intensity) would not be the only factor changing [1]

(c) [3 marks]

The student finds that doubling the light intensity from 50 to 100 arbitrary units increases the rat…

• At low light intensities, light is the limiting factor — increasing it speeds up photosynthesis [1]

• At high light intensity, another factor becomes limiting [1]

• Likely limiting factor is CO■ concentration or temperature — these are now in shortest supply and control the maximum rate [1]

(d) [2 marks]

State FOUR ways in which a plant uses the glucose produced by photosynthesis.

• Any four of: respiration (energy release) [1]; starch production for storage [1]; cellulose for cell walls [1]; sucrose for transport [1]; amino acids/proteins (with nitrates) [1]; lipids/fats [1]

Note: Award 1 mark per valid use, max 2 marks (though full question prompts 4 — adjust total accordingly). The paper counts this as 2 marks.

Total for question 7: 11

Question 8 [8 marks]

A student carried out a required practical to investigate the effect of different concentrations of sucrose solution on …

(a) [0 marks]

The table shows the student's results.

(b) [2 marks]

Explain why the potato chips in pure water (0.0 mol/dm³) gained mass.

• Water has a higher water potential than the potato cell contents [1]

• Water moves into the cells by osmosis → mass increases / cells become turgid [1]

(c) [1 mark]

Determine the concentration of sucrose at which there is no net movement of water into or out of the…

• 0.4 mol/dm³ [1] — at this concentration the % mass change is 0.0%, meaning the water potential of the solution equals the water potential inside the potato cells

(d) [3 marks]

Explain what happens to a potato cell when it is placed in a 0.8 mol/dm³ sucrose solution.

• The sucrose solution has a lower water potential than the potato cell contents [1]

• Water leaves the cell by osmosis (down the water potential gradient) [1]

• Cell membrane pulls away from cell wall (plasmolysis) — cell becomes flaccid/limp [1]

(e) ★ [2 marks]

★ Calculate the percentage change in mass for the potato chip placed in 0.6 mol/dm³ sucrose solutio…

• % change = (2.34 – 2.49) ÷ 2.49 × 100 [1]

• = –6.02% / –6.0% [1]

Note: Accept answer in range –5.9% to –6.1%

Total for question 8: 8

Question 9 [7 marks]

(a) [4 marks]

Describe the role of the digestive system in the breakdown and absorption of proteins. Name the enzy…

• Proteins are digested by proteases (e.g. pepsin in stomach, trypsin in small intestine) [1]

• Proteins are broken down into amino acids [1]

• Digestion occurs in the stomach and small intestine [1]

• Amino acids are absorbed in the small intestine through the walls of the villi into the bloodstream / via capillaries [1]

(b) [3 marks]

Explain how the small intestine is adapted for the efficient absorption of the products of digestion…

• Villi provide a large surface area for absorption [1]

• Walls of villi are one cell thick — minimises diffusion distance [1]

• Rich blood capillary supply — maintains steep concentration gradient and removes absorbed nutrients rapidly [1]

Total for question 9: 7

Question 10 [8 marks]

This question is about anaerobic and aerobic respiration.

(a) [1 mark]

Write the word equation for anaerobic respiration in human muscle cells.

• Glucose → lactic acid [1] (+ (small amount of) energy — not required)

(b) [4 marks]

A sprinter runs 400 m and then continues to breathe heavily for 10 minutes after the race. Explain, …

• During the sprint, muscles required more oxygen than could be supplied [1]

• Anaerobic respiration occurred, producing lactic acid [1]

• After the race, extra oxygen is needed to break down (oxidise) the lactic acid in the liver [1]

• This extra oxygen requirement is the oxygen debt — continued heavy breathing supplies the extra oxygen to repay the debt [1]

(c) ★ [3 marks]

★ Compare aerobic and anaerobic respiration in terms of oxygen requirement, products and energy rel…

• Aerobic: requires oxygen; anaerobic: no oxygen required [1]

• Aerobic: products are CO■ and water; anaerobic (muscles): lactic acid; anaerobic (yeast): ethanol + CO■ [1]

• Aerobic: releases much more energy per glucose molecule (~38 ATP vs ~2 ATP for anaerobic) [1]

Total for question 10: 8

Question 11 [6 marks]

(a) [6 marks]

★ Quality of written communication (QWC) question. A student claims that "good personal hygiene and…

• States that pathogens include bacteria, viruses, fungi and protists — each spread differently [1]

• Hygiene (handwashing, food safety, covering mouth) is effective for pathogens spread by droplets, direct contact or contaminated food/water [1]

• Vaccination creates specific immunity and memory cells — effective when high coverage achieved (herd immunity) [1]

• However, hygiene has limited effect against vector-borne diseases (e.g. malaria) where mosquito control / antimalarials needed [1]

• Vaccination requires the pathogen to have been previously identified — new pathogens cannot be vaccinated against immediately [1]

• Other effective measures include antibiotic treatment for bacterial infections, quarantine, surveillance and safe water/sanitation [1]

Note: Award marks for any 6 valid points. QWC: for 5-6 marks, answer must be well organised and use correct biological vocabulary throughout.

Total for question 11: 6