

Molecules (Interaction and interdependence) practice questions

14 questions · 36 marks · mark scheme at the back

For IB Diploma Biology SL undefined. **HL only** is additional higher level content, for HL students only.

Name

Total / 36

Enzymes and metabolism **Spec C1.1**

1 PAPER 1A STYLE

[1 mark]

Which process is an example of catabolism?

- A. ☐ Formation of glycogen from glucose in liver cells
- B. ☐ Synthesis of a polypeptide at a ribosome
- C. ☐ Hydrolysis of starch to maltose in the small intestine
- D. ☐ Production of glucose in photosynthesis

2 PAPER 1A STYLE

[1 mark]

Which statement describes induced-fit binding?

- A. ☐ The active site is a rigid shape exactly complementary to the substrate before binding.
- B. ☐ Both the substrate and the active site change shape when binding occurs.
- C. ☐ The substrate changes shape but the enzyme does not.
- D. ☐ The enzyme denatures slightly each time a substrate binds.

3 PAPER 1B STYLE

[5 marks]

Students investigated the effect of temperature on the activity of catalase extracted from potato. They measured the volume of oxygen released from hydrogen peroxide in the first 60 seconds. The data are for practice and show the mean of three repeats. (a) Calculate the mean rate of oxygen production at 35 °C, in $\text{cm}^3 \text{s}^{-1}$. [1] (b) Describe the effect of temperature on the volume of oxygen released. [2] (c) Explain the result at 55 °C. [2]

Volume of oxygen released in 60 s at different temperatures	
Temperature / °C	Mean volume of oxygen in 60 s / cm^3
15	6.0
25	11.4
35	19.8
45	15.6
55	2.4

Answer =

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4 PAPER 2A STYLE

[2 marks]

Outline how the structure of a globular protein allows it to act as an enzyme.

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5 PAPER 2A STYLE

[3 marks]

Explain how an enzyme increases the rate of a reaction, with reference to activation energy.

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Cell respiration Spec C1.2

6 PAPER 1A STYLE

[1 mark]

Which statement about ATP is correct?

- A. ☐ It is a nucleotide containing deoxyribose.
- B. ☐ Energy is required to hydrolyse it to ADP and phosphate.
- C. ☐ It is a nucleotide, and its hydrolysis to ADP and phosphate releases energy.
- D. ☐ It moves freely out of cells through the plasma membrane.

7 PAPER 1A STYLE

[1 mark]

Which feature is shared by aerobic and anaerobic cell respiration in humans?

- A. ☐ Both produce carbon dioxide.
- B. ☐ Both require mitochondria.
- C. ☐ Both can use glucose as the substrate.
- D. ☐ Both produce lactate.

8 PAPER 1B STYLE

[5 marks]

A respirometer containing 3.0 g of maggots and soda lime was kept at three temperatures. The distance moved by the liquid drop in 5 minutes was recorded. The capillary tube has a cross-sectional area of 0.80 mm^2 . The data are for practice. (a) Calculate the rate of oxygen uptake per gram at 25°C , in $\text{mm}^3 \text{ g}^{-1} \text{ min}^{-1}$. Show your working. [2] (b) Identify the independent and the dependent variable. [1] (c) Explain the trend shown in the data. [2]

Distance moved by the drop in 5 minutes

Temperature / $^\circ\text{C}$	Mean distance moved / mm
15	11
20	17
25	24

Answer =

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9 PAPER 2A STYLE

[3 marks]

(a) State two processes in cells that use energy from ATP. [2] (b) Distinguish between cell respiration and gas exchange. [1]

Photosynthesis Spec C1.3

10 PAPER 1A STYLE

[1 mark]

What is the source of the oxygen released in photosynthesis by plants, algae and cyanobacteria?

- A. ☐ Carbon dioxide
- B. ☐ Glucose
- C. ☐ Water
- D. ☐ Chlorophyll

11 PAPER 1A STYLE

[1 mark]

Which statement explains why the action spectrum of photosynthesis is not zero in the green part of the spectrum?

- A. ☐ Chlorophyll absorbs green light more strongly than red light.
- B. ☐ Accessory pigments absorb some light in this region.
- C. ☐ Green light has the highest energy per photon.
- D. ☐ Green light is reflected and then used by the stroma.

Pigments from a spinach leaf were separated by paper chromatography. The solvent front moved 9.0 cm from the origin. Reference R_f values for this method are: carotene 0.93, xanthophyll 0.70, chlorophyll a 0.50, chlorophyll b 0.40. The data are for practice. (a) Calculate the R_f value of spot 2. [1] (b) Using colour and R_f values, identify spots 1 and 3. [2] (c) Suggest why the pigments separate. [1]

Distances moved by pigment spots		
Spot	Colour	Distance from origin / cm
1	Orange-yellow	8.4
2	Yellow	6.3
3	Blue-green	4.5
4	Yellow-green	3.6

Answer =

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13 PAPER 1B STYLE

[5 marks]

An aquatic plant was placed 10 cm from a lamp behind filters that let through light of one colour. The volume of oxygen released in 10 minutes was measured. The data are for practice. (a) Calculate the rate of oxygen production in blue light, in $\text{cm}^3 \text{ min}^{-1}$. [1] (b) Compare the rates in the different colours of light. [2] (c) State two variables that should be controlled. [2]

Volume of oxygen released in 10 minutes		
Colour of light	Approximate wavelength / nm	Volume of oxygen / cm^3
Blue	450	1.8
Green	550	0.4
Red	680	1.5

Answer =

14 PAPER 2A STYLE

[3 marks]

Compare enclosed greenhouse experiments with free-air carbon dioxide enrichment (FACE) experiments as ways of predicting future rates of photosynthesis and plant growth.

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

C C [1]

2. [1]

B B [1]

3. [5]

- (a) $19.8 \div 60 = 0.33 \text{ cm}^3 \text{ s}^{-1}$ [1]
- (b) volume increases from 15 °C to 35 °C / up to an optimum of about 35 °C [1]
- (b) volume decreases above 35 °C, falling steeply to 2.4 cm³ at 55 °C [1]
- (c) (most) catalase molecules are denatured / bonds holding tertiary structure break [1]
- (c) active site changes shape so hydrogen peroxide cannot bind / fewer enzyme-substrate complexes form [1]
- (c) accept: some enzyme molecules still active so a little oxygen is produced [1]
- (c) [max 2]

4. [2]

- active site formed from only a few amino acids / R groups [1]
- interactions between amino acids elsewhere in the folded (tertiary) structure hold the active site in its shape [1]
- active site has shape/chemical properties that bind the substrate / allow catalysis OWTTE [1]
- globular protein is soluble so can move / collide with substrate [1]
- [max 2]

5. [3]

- activation energy is energy needed to break bonds in the substrate / to start the reaction [1]
- binding to active site stresses / weakens bonds in the substrate [1]
- enzyme lowers the activation energy [1]
- so more substrate molecules have enough energy to react (at a given temperature) [1]
- overall energy change of the reaction is not altered [1]
- [max 3]

6. [1]

C C [1]

7. [1]

C C [1]

8. [5]

- (a) volume = $0.80 \times 24 = 19.2 \text{ mm}^3$ [1]
- (a) $19.2 \div 5 \div 3.0 = 1.28 \text{ mm}^3 \text{ g}^{-1} \text{ min}^{-1}$ / 1.3 [1]
- (b) independent: temperature; dependent: distance moved by drop / rate of oxygen uptake (both needed) [1]
- (c) rate of oxygen uptake / respiration increases with temperature [1]
- (c) respiration is catalysed by enzymes; more kinetic energy so more frequent substrate-active site collisions [1]
- (c) (temperatures are below the optimum so) no denaturation [1]
- (c) [max 2]

9. [3]

- (a) active transport across membranes [1]
- (a) synthesis of macromolecules / anabolism [1]
- (a) movement of the whole cell (e.g. muscle contraction, flagella) / movement of chromosomes [1]
- (a) [max 2]
- (b) cell respiration produces ATP from carbon compounds inside cells, whereas gas exchange is diffusion of O_2 and CO_2 between organism and environment OWTTE [1]

10. [1]

C C [1]

11. [1]

B B [1]

12. [4]

- (a) $6.3 \div 9.0 = 0.70$ [1]
- (b) spot 1: Rf 0.93 / $8.4 \div 9.0$, orange-yellow, so carotene [1]
- (b) spot 3: Rf 0.50 / $4.5 \div 9.0$, blue-green, so chlorophyll a [1]
- (c) pigments differ in solubility in the solvent / attraction to the stationary phase, so travel different distances OWTTE [1]

13. [5]

- (a) $1.8 \div 10 = 0.18 \text{ cm}^3 \text{ min}^{-1}$ [1]
- (b) highest rate in blue light, then red [1]
- (b) lowest rate in green light, but not zero [1]
- (b) blue rate is 4.5 times green / use of values from the table [1]
- (b) [max 2]
- (c) light intensity / distance from lamp [1]
- (c) temperature [1]
- (c) CO_2 concentration / concentration of hydrogencarbonate [1]
- (c) same plant / mass of plant / time allowed to adjust [1]
- (c) [max 2]

14. [3]

- both: grow plants at raised CO₂ concentration to predict effects of future CO₂ levels [1]
- greenhouse: variables (temperature, water, light) easier to control [1]
- FACE: plants in field / natural ecosystem conditions so results more realistic [1]
- FACE: other variables (weather, soil, pests) harder to control / vary [1]
- [max 3]