



IB DP BIOLOGY

Theme B · Form and Function

TOPICAL WORKSHEET

B1 Molecules & Metabolism · B2 Cell Structure

B3 Gas Exchange & Transport · B4 Ecology

Standard and Higher Level · Syllabus 2025

Fahad H. Ahmad

+92 323 509 4443 | Megalecture.com

Section A — Multiple Choice (15 marks)

Circle the letter of the best answer to each question. Each question is worth 1 mark.

1. Which biological molecule is the primary long-term energy storage molecule in plant cells? [1]
A glycogen
B starch
C cellulose
D haemoglobin
2. An enzyme increases the rate of a reaction by [1]
A increasing the temperature of the reaction mixture
B providing an alternative pathway with a lower activation energy, without being used up
C being permanently changed and consumed in the reaction
D shifting the equilibrium position of the reaction
3. If the temperature of an enzyme-catalysed reaction is increased well beyond the enzyme's optimum, the rate of reaction [1]
A continues to increase indefinitely
B decreases sharply, because the enzyme becomes denatured
C stays exactly the same
D doubles for every 10°C increase
4. In the lock-and-key model of enzyme action, the region of the enzyme that binds the substrate is called the [1]
A allosteric site
B active site
C binding pocket only found in inhibitors
D catalytic membrane
5. Magnification is defined as [1]
A the ratio of image size to actual (real) size
B the minimum distance at which two points can be distinguished as separate
C the total number of cells visible in a microscope field of view
D the thickness of the specimen being viewed
6. Resolution is best defined as [1]
A how much larger an image appears compared with the specimen
B the minimum distance between two points at which they can still be distinguished as two separate points
C the total magnification of a microscope
D the brightness of the image produced

- 7.** Which organelle is mainly responsible for synthesizing proteins in a cell? **[1]**
- A Golgi apparatus
 - B mitochondrion
 - C ribosome
 - D lysosome
- 8.** A cell specialized for absorption, such as an epithelial cell lining the small intestine, typically shows which adaptation? **[1]**
- A a thick, impermeable cell wall
 - B numerous microvilli, increasing surface area for absorption
 - C the complete absence of mitochondria
 - D a single large permanent vacuole
- 9.** The alveoli are adapted for efficient gas exchange because they have **[1]**
- A a small surface area and thick walls
 - B a large surface area, thin (one cell thick) walls, and a good blood supply
 - C no blood supply, to avoid gas loss
 - D a permanently constant partial pressure of oxygen
- 10.** On the oxyhaemoglobin dissociation curve, at low partial pressures of oxygen (the steep part of the curve), **[1]**
- A a small increase in pO_2 causes a large increase in % saturation
 - B haemoglobin is already 100% saturated
 - C % saturation is completely independent of pO_2
 - D a small increase in pO_2 causes % saturation to decrease
- 11.** Deoxygenated blood returning to the heart from the body first enters the **[1]**
- A left atrium
 - B right atrium
 - C left ventricle
 - D right ventricle
- 12.** The maximum population size that a particular environment can sustain indefinitely is called the **[1]**
- A exponential growth rate
 - B carrying capacity
 - C population density
 - D biotic potential

- 13.** During the exponential (early) growth phase of a population, growth rate is limited primarily by **[1]**
- A the reproductive rate of the organisms, since resources are not yet limiting
 - B the carrying capacity of the environment
 - C intense competition for resources
 - D the presence of predators only
- 14.** Which of the following is a density-dependent factor that can limit population growth? **[1]**
- A a sudden volcanic eruption
 - B an unusually cold winter
 - C availability of food and other resources
 - D a random flood
- 15.** In the carbon cycle, which process returns carbon dioxide to the atmosphere from living organisms? **[1]**
- A photosynthesis
 - B respiration
 - C sedimentation
 - D combustion of fossil fuels only

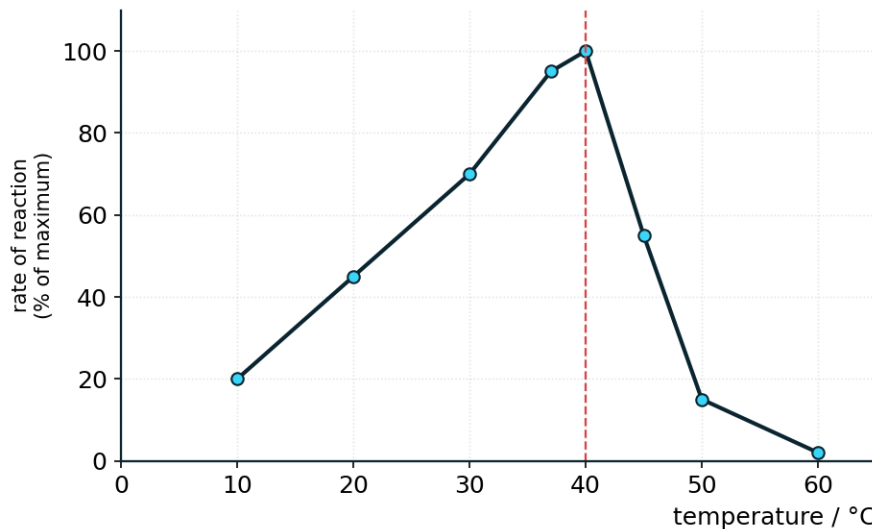
Section B — Structured Questions (65 marks)

Answer all questions in the space provided. Working must be shown for full marks.

B1 Molecules & Metabolism

Question 1 [7 marks]

The graph shows how the rate of an enzyme-catalysed reaction changes with temperature (given data).



Rate of an enzyme-catalysed reaction vs temperature (given data).

(a) Using the graph, identify the optimum temperature for this enzyme.

[2]

(b) Describe and explain the shape of the curve between 10°C and the optimum temperature.

[2]

(c) Explain, in terms of protein structure, why the rate of reaction drops sharply above the optimum temperature.

[3]

Question 2 [6 marks]

Enzymes are highly specific biological catalysts.

(a) Describe how enzymes increase the rate of a reaction.

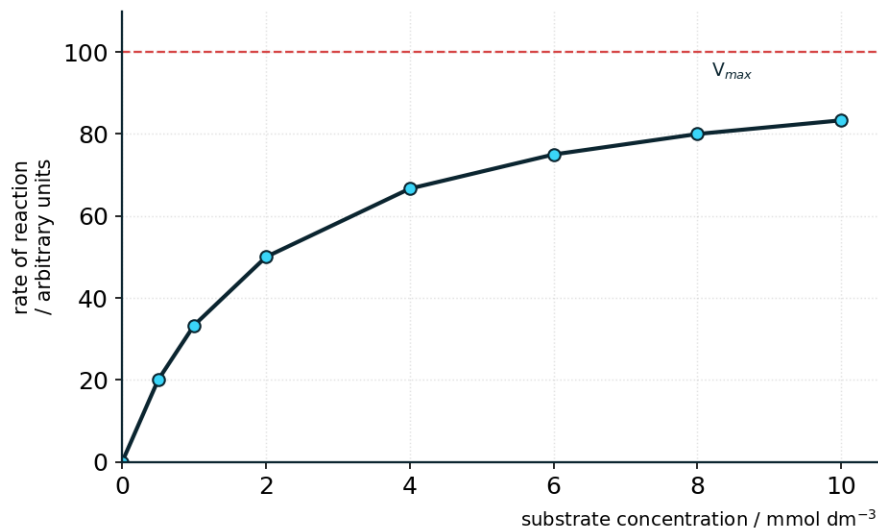
[2]

(b) Explain why enzymes are described as specific, in terms of the shape of their active site. [2]

(c) Distinguish between the lock-and-key model and the induced-fit model of enzyme action. [2]

Question 3 [7 marks]

The graph shows how the rate of an enzyme-catalysed reaction changes with substrate concentration, at a fixed enzyme concentration (computed).



Rate of reaction vs substrate concentration (computed).

(a) Using the graph, describe the relationship between substrate concentration and rate of reaction at low substrate concentrations. [2]

(b) Explain why the rate of reaction plateaus (reaches a maximum, $V_{\max}$) at high substrate concentrations. [2]

(c) Suggest what would happen to this graph if more enzyme were added, with substrate remaining in excess. [3]

B2 Cell Structure

Question 4 [6 marks]

Eukaryotic cells contain many different membrane-bound organelles, each with specific functions.

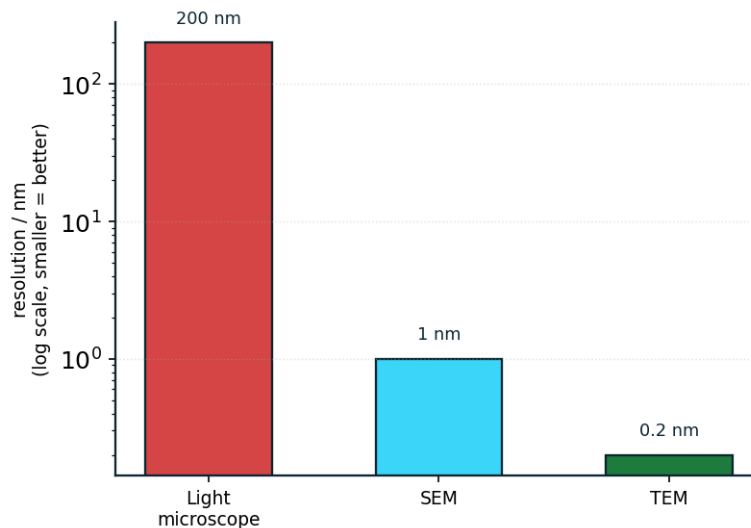
(a) State the function of the mitochondrion and the function of a ribosome. [2]

(b) Describe the role of the rough endoplasmic reticulum and the Golgi apparatus in processing a protein destined for secretion. [2]

(c) Explain why cells that secrete large amounts of protein (e.g. pancreatic cells) contain many mitochondria and an extensive rough endoplasmic reticulum. [2]

Question 5 [7 marks]

The graph (on a logarithmic scale) compares the resolution achievable with a light microscope, a scanning electron microscope (SEM), and a transmission electron microscope (TEM) (given data).



Resolution of different types of microscope (given data, log scale; smaller value = better resolution).

(a) Using the graph, identify which type of microscope has the best (smallest) resolution. [2]

(b) Define resolution, and explain why electron microscopes can reveal more detail than light microscopes. [2]

(c) An image of a cell organelle taken with an electron microscope has a width of 40 mm on the printed page, at a magnification of $\times 20,000$. Calculate the actual width of the organelle, in micrometres (μm). [3]

Question 6 [6 marks]

Multicellular organisms contain many types of specialized (differentiated) cells.

(a) Define 'cell differentiation'. [2]

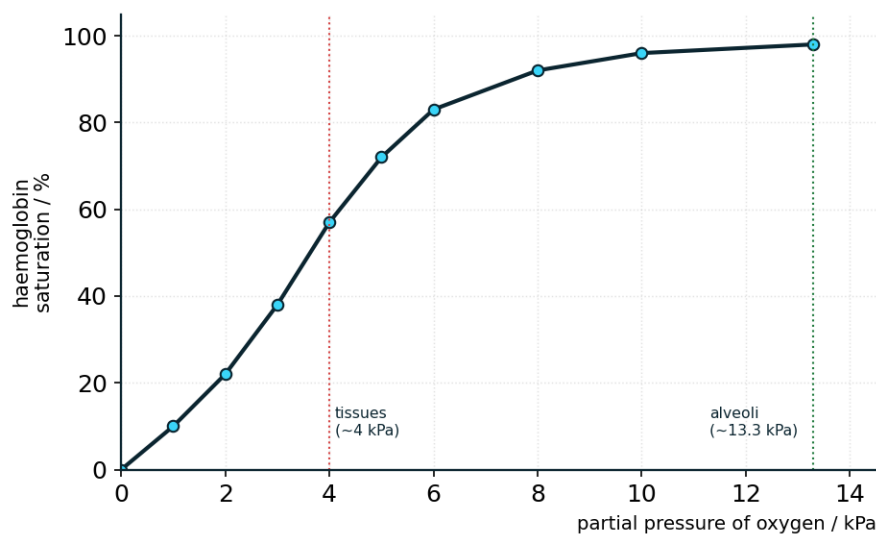
(b) Describe two structural adaptations of a named specialized cell, related to its function. [2]

(c) Explain, in terms of gene expression, why differentiated cells generally cannot change into a different cell type. [2]

B3 Gas Exchange & Transport

Question 7 [7 marks]

The graph shows the oxyhaemoglobin dissociation curve: the percentage saturation of haemoglobin with oxygen at different partial pressures of oxygen (given data).



Oxyhaemoglobin dissociation curve (given data).

(a) Using the graph, state the percentage saturation of haemoglobin at the partial pressure of oxygen found in respiring tissue (~4 kPa) and in the alveoli (~13.3 kPa). [2]

(b) Using the graph, explain why haemoglobin readily loads oxygen in the lungs and readily unloads it in respiring tissues. [2]

(c) Explain the physiological significance of the steep, S-shaped (sigmoid) middle portion of the curve. [3]

Question 8 [6 marks]

Efficient gas exchange depends on the structure of the gas exchange surface and the mechanics of ventilation.

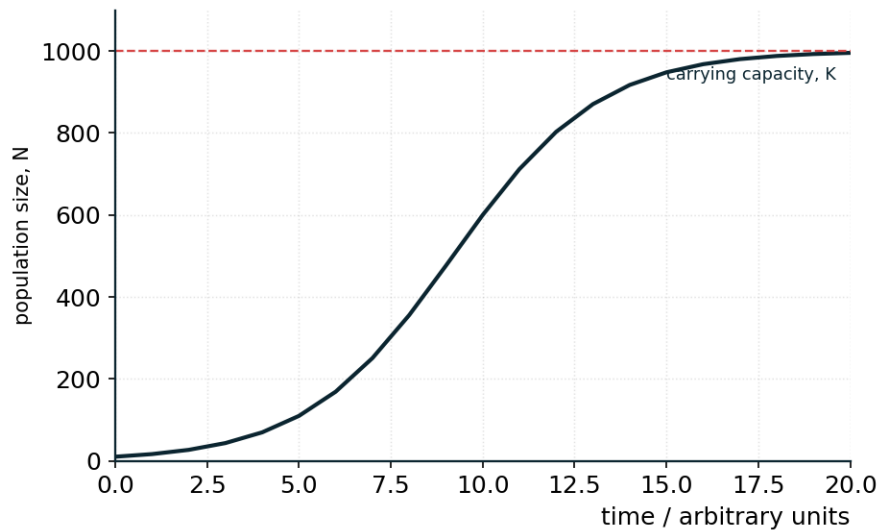
(a) State three general features of an efficient gas exchange surface. [2]

(b) Describe how the alveoli of the lungs are specifically adapted for efficient gas exchange. [2]

(c) Describe the role of the diaphragm and the intercostal muscles during inspiration (breathing in). [2]

B4 Ecology**Question 9** [7 marks]

The graph shows the logistic growth of a population introduced into a new habitat over time (computed model).



Logistic population growth curve (computed model).

- (a)** Using the graph, identify the carrying capacity, K , of this population, and describe how the population growth rate changes over time. **[2]**

- (b)** Explain why population growth slows as the population size approaches the carrying capacity. **[2]**

- (c)** Suggest two density-dependent factors that could limit further population growth as the population nears K . **[3]**

Question 10 [6 marks]

Carbon is cycled between the atmosphere, living organisms, and the physical environment.

- (a)** Describe two processes that remove carbon dioxide from the atmosphere. **[2]**

- (b)** Describe two processes that release carbon dioxide into the atmosphere. **[2]**

(c) Explain how the combustion of fossil fuels has disrupted the natural balance of the carbon cycle.

[2]