



MEGA LECTURE

IB DP BIOLOGY

Theme C · Interaction and Interdependence

TOPICAL WORKSHEET

C1 Respiration & Photosynthesis · C2 Cell Signalling
C3 Defence & Homeostasis · C4 Populations & Nutrient Cycles

Standard and Higher Level · Syllabus 2025

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Section A — Multiple Choice (15 marks)

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

1. Which type of respiration produces the greatest yield of ATP per molecule of glucose? [1]
A anaerobic respiration (fermentation)
B aerobic respiration
C both produce exactly the same yield
D neither type of respiration produces ATP
2. In anaerobic respiration (alcoholic fermentation) in yeast, glucose is converted into [1]
A lactic acid only
B ethanol and carbon dioxide
C carbon dioxide and water
D ATP and oxygen
3. During photosynthesis, the light-dependent reactions take place in the [1]
A stroma
B thylakoid membrane
C outer mitochondrial membrane
D nuclear envelope
4. On a warm, sunny day with normal atmospheric CO₂ concentration, the rate of photosynthesis in a plant is most likely to be limited by [1]
A light intensity
B carbon dioxide concentration
C temperature
D water availability only
5. A hormone is best described as a chemical messenger that is [1]
A released by a neuron directly onto a target cell across a synapse
B secreted by an endocrine gland into the blood and transported to a distant target cell
C only active within the cell that produced it
D broken down before it can have any effect
6. Cell signalling in which a cell releases a signalling molecule that affects only nearby cells is called [1]
A endocrine signalling
B paracrine signalling
C autocrine signalling only
D no such signalling exists

- 7.** A receptor is best described as a molecule that **[1]**
- A binds specifically to a signalling molecule (ligand), triggering a response in the target cell
 - B is produced only by neurons
 - C destroys hormones once they have acted
 - D is found only on the surface of red blood cells
- 8.** As hormone concentration increases beyond the point at which all receptors on a target cell are occupied, the cellular response **[1]**
- A continues to increase indefinitely
 - B plateaus (reaches a maximum), since no further receptors are available to bind more hormone
 - C immediately falls to zero
 - D becomes negative
- 9.** Antibodies are produced and secreted by which type of cell? **[1]**
- A red blood cells
 - B plasma cells (differentiated B lymphocytes)
 - C platelets
 - D skeletal muscle cells
- 10.** Compared with the primary immune response, the secondary immune response to the same antigen is generally **[1]**
- A slower and produces fewer antibodies
 - B identical in speed and antibody quantity
 - C faster, with a shorter lag phase and a greater quantity of antibodies produced
 - D impossible, since the immune system cannot respond twice to one antigen
- 11.** Homeostasis is best defined as **[1]**
- A the maintenance of a stable internal environment despite changes in external conditions
 - B the process by which organisms grow larger over time
 - C the random fluctuation of internal conditions
 - D the process of natural selection acting on a population
- 12.** During primary succession on newly exposed bare rock, the first organisms to colonize are typically **[1]**
- A large trees
 - B pioneer species, such as lichens and mosses
 - C apex predators
 - D climax community species

- 13.** As ecological succession proceeds towards a climax community, species richness generally **[1]**
- A decreases steadily
 - B increases, then tends to level off
 - C stays exactly constant throughout
 - D becomes zero
- 14.** The relatively stable, final community reached at the end of ecological succession is called the **[1]**
- A pioneer community
 - B climax community
 - C primary community
 - D extinction community
- 15.** In the nitrogen cycle, the process by which nitrogen gas (N_2) is converted into ammonia (or ammonium ions) by certain bacteria is called **[1]**
- A nitrification
 - B denitrification
 - C nitrogen fixation
 - D ammonification

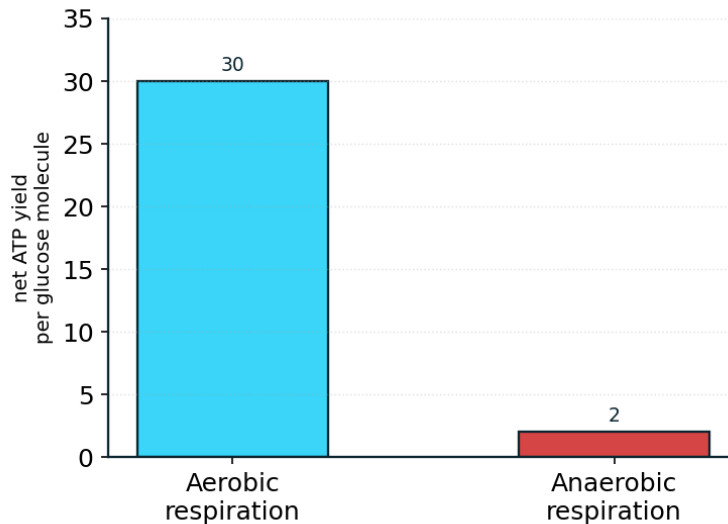
Section B — Structured Questions (65 marks)

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

C1 Respiration & Photosynthesis

Question 1 [7 marks]

The bar chart shows the net ATP yield per molecule of glucose for aerobic and anaerobic respiration (given data).



Net ATP yield per glucose molecule: aerobic vs anaerobic respiration (given data).

(a) Using the graph, state which type of respiration produces more ATP per glucose molecule. [2]

(b) Explain, in terms of oxygen availability, why anaerobic respiration produces far less ATP than aerobic respiration. [2]

(c) Calculate the ATP yield of anaerobic respiration as a percentage of the ATP yield of aerobic respiration. [3]

Question 2 [6 marks]

Aerobic respiration takes place in stages within different parts of the cell.

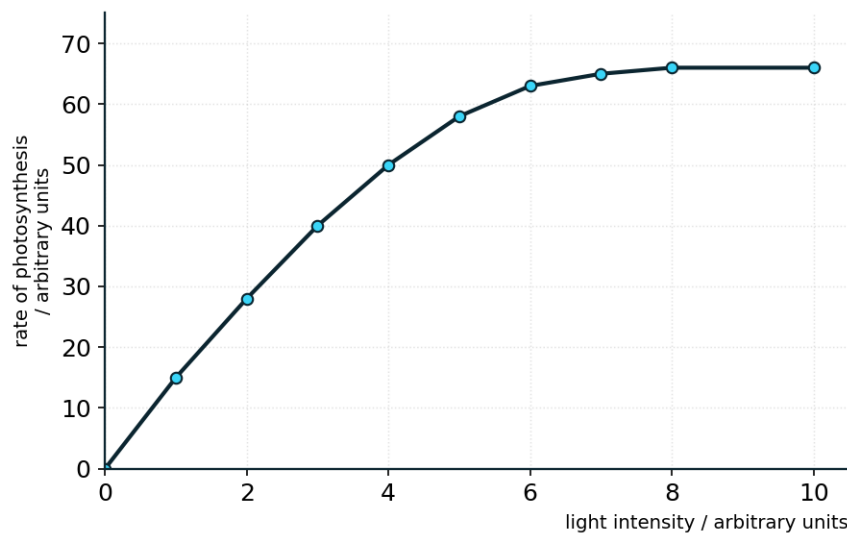
- (a)** State the location in the cell where glycolysis occurs, and the location where the Krebs cycle and oxidative phosphorylation occur. [2]

- (b)** State the overall word equation for aerobic respiration. [2]

- (c)** Explain why muscle cells typically contain many mitochondria. [2]

Question 3 [7 marks]

The graph shows how the rate of photosynthesis in a plant changes with light intensity, at constant temperature and CO₂ concentration (given data).



Rate of photosynthesis vs light intensity (given data).

- (a)** Using the graph, describe the relationship between light intensity and rate of photosynthesis at low light intensities. [2]

- (b)** Explain why the rate of photosynthesis plateaus at high light intensities. [2]

(c) Suggest, with a reason, what would happen to this graph if the CO₂ concentration were increased, with light intensity kept the same. [3]

C2 Cell Signalling

Question 4 [6 marks]

Cells communicate with one another using a variety of signalling mechanisms.

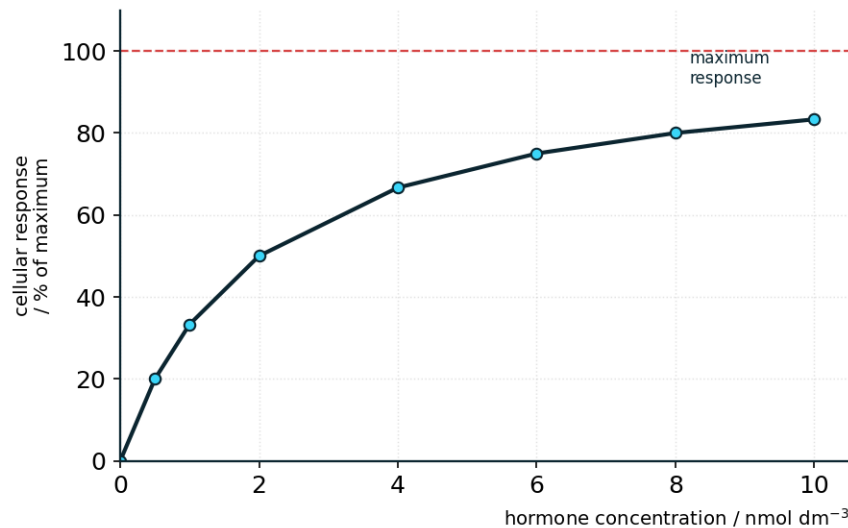
(a) Distinguish between endocrine signalling and paracrine signalling. [2]

(b) Describe the general process of signal transduction. [2]

(c) Explain why a hormone travelling in the blood affects only specific target cells, even though it reaches almost all cells in the body. [2]

Question 5 [7 marks]

The graph shows how the response of a target cell changes with the concentration of a hormone, at a fixed number of receptors (computed).



Cellular response vs hormone concentration (computed, saturating relationship).

- (a)** Using the graph, describe the relationship between hormone concentration and cellular response at low hormone concentrations. [2]

- (b)** Explain why the cellular response plateaus at high hormone concentrations. [2]

- (c)** Suggest what would happen to this curve if the target cell responded to prolonged high hormone exposure by reducing its number of surface receptors (down-regulation). [3]

C3 Defence & Homeostasis

Question 6 [6 marks]

The immune system and homeostatic control mechanisms both rely on specific cells and feedback processes.

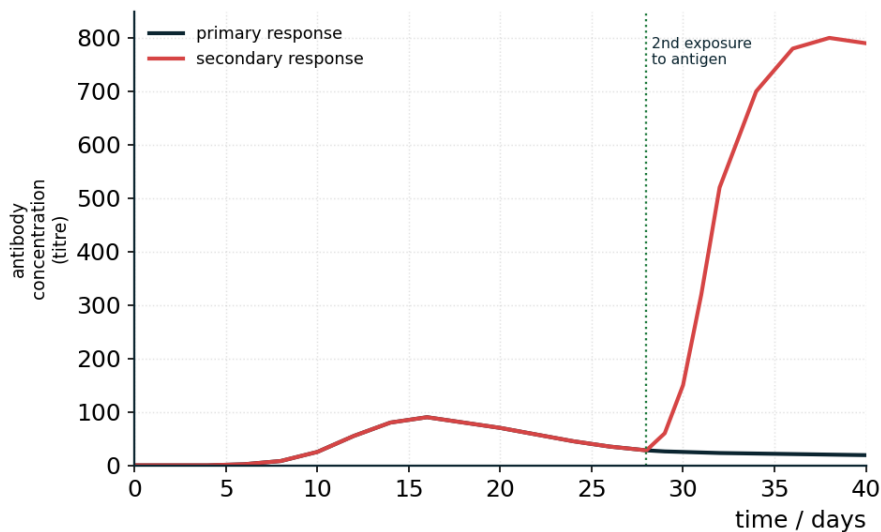
- (a)** Distinguish between the roles of B lymphocytes and T lymphocytes in immunity. [2]

(b) Define 'homeostasis', and give one example of a variable that is homeostatically controlled in the human body. [2]

(c) Explain the general principle of negative feedback in homeostatic control. [2]

Question 7 [7 marks]

The graph shows the concentration of antibodies in the blood (antibody titre) following a first exposure to an antigen, and following a second exposure to the same antigen on day 28 (given data).



Primary and secondary antibody response to the same antigen (given data).

(a) Using the graph, compare the lag time before antibody production begins to rise noticeably in the primary and secondary responses. [2]

(b) Using the graph, compare the peak antibody concentration reached in the primary and secondary responses. [2]

(c) Explain, in terms of memory cells, why the secondary response is faster and greater than the primary response. [3]

Question 8 [6 marks]

Blood glucose concentration is controlled by hormones released from the pancreas.

(a) Describe how insulin helps to lower blood glucose concentration after a meal. [2]

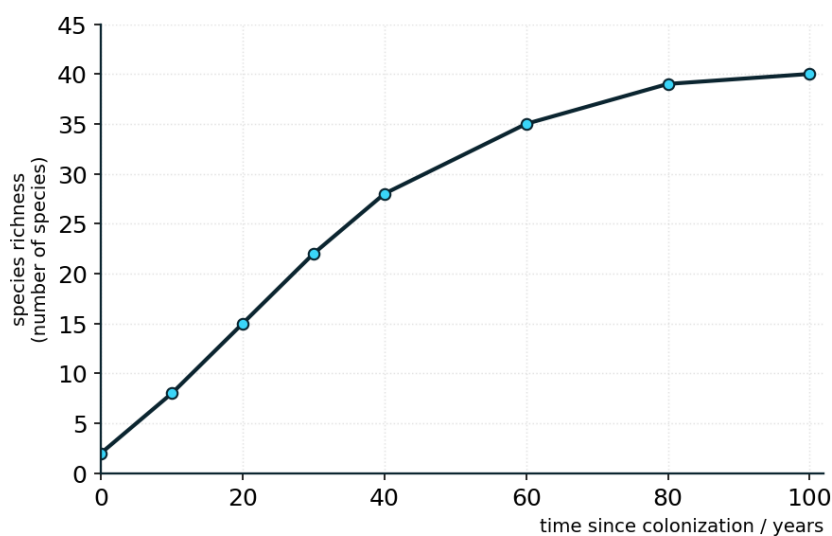
(b) Describe how glucagon helps to raise blood glucose concentration when it falls too low. [2]

(c) Explain why blood glucose regulation is an example of negative feedback. [2]

C4 Populations & Nutrient Cycles

Question 9 [7 marks]

The graph shows how species richness changes over time as ecological succession proceeds on a newly exposed area of bare rock (given data).



Species richness during ecological succession (given data).

(a) Using the graph, describe how species richness changes over the course of succession. [2]

(b) Explain why species richness tends to increase during the course of succession.

[2]

(c) Define 'climax community', and explain why the graph levels off at this stage.

[3]

Question 10 [6 marks]

Nitrogen is cycled between the atmosphere, soil, and living organisms via several microbial processes.

(a) Define 'nitrogen fixation', and name one type of organism capable of carrying it out.

[2]

(b) Describe the process of nitrification.

[2]

(c) Describe the process of denitrification, and explain its effect on soil nitrate levels.

[2]