

Neap:

BIOLOGY UNITS 3&4

Hugh Latimer

SMARTSTUDY®

QUESTIONS

- Original questions by area of study
- Ideal for use throughout the year
- Fully-worked solutions to all questions
- Boost your knowledge of the course

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Preface

To see if you have understood the content in VCE Biology Units 3&4 it is important to test yourself against a full range of questions. This book aims to provide you with a large collection of relevant and up to-date exam-style questions to address the Biology Units 3&4 Study Design.

The book is divided into the two Units: Unit 3 – Signatures of Life and Unit 4 – Continuity and Change. Each of these Units is further divided into two Areas of study, and each of these is further divided into specific topics with relevant questions in the form of both multiple-choice and short answer/extended response.

You may find it helpful to attempt these questions by topic, either after the material has been covered in class (your teacher will dictate the sequence in which you study each topic) or, alternatively, at the end of the Area of study. Either way, it will provide you with a valuable insight into the style, detail and depth of questions used in the end-of-year examination. Detailed solutions for both multiple-choice and short answer questions are provided at the end of the book.

The Neap smartstudy® Exams guide is a valuable revision tool in the lead up to your end-of-year exam as it provides four complete practice exams designed to reflect the final 2.5 hour VCE Biology Units 3&4 examination in November.

Hugh Latimer

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Unit 3: Signatures of Life

Area of study 1 – Molecules of life

Section A (Multiple-choice questions)

The role of biomacromolecules in the chemical nature of cells

Question 1.1

The sugar which is also a disaccharide is

- A. glucose.
- B. fructose.
- C. galactose.
- D. maltose.

Question 1.2

There are four levels of protein structure.

When one considers the amino acid sequence, this refers to the

- A. primary structure.
- B. secondary structure.
- C. tertiary structure.
- D. quaternary structure.

Question 1.3

With respect to its protein structure, an enzyme is regarded as a

- A. primary structure.
- B. secondary structure.
- C. tertiary structure.
- D. quaternary structure.

Question 1.4

Biologically important organic compounds always contain at least

- A. carbon.
- B. carbon and hydrogen.
- C. carbon, hydrogen and oxygen.
- D. carbon, hydrogen, oxygen and nitrogen.

Question 1.5

Which of the following is not an organic compound?

- A. nitrates in the soil.
- B. nitrogen gas in the air.
- C. ammonia excreted by fish.
- D. amino acids, the result of digestion of peptides.

Use the following information to answer Questions 1.6 to 1.8.

| | | | |
|--------------------------|---------------------------|-----------------|----------------|
| 1 = all eukaryotic cells | 2 = all prokaryotic cells | 3 = all viruses | 4 = all prions |
|--------------------------|---------------------------|-----------------|----------------|

Question 1.6

Nucleic acids would be found in

- A. 1–4.
- B. 1 and 2 only.
- C. 1, 2 and 3 only.
- D. 1 only.

Question 1.7

RNA would be found in

- A. 1–4.
- B. 1 and 2 only.
- C. 1, 2 and 3 only.
- D. 1 only.

Question 1.8

Polypeptides would be found in

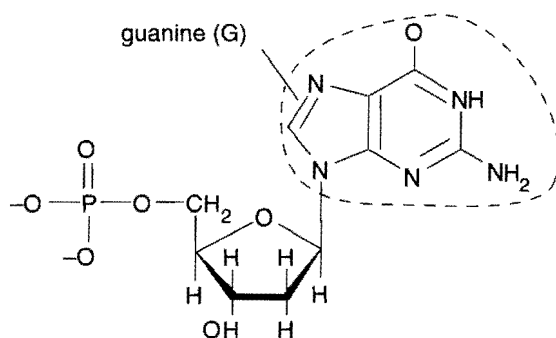
- A. 1–4.
- B. 1 and 2 only.
- C. 1, 2 and 3 only.
- D. 1 only.

Question 1.9

Vitamins and some minerals (e.g. Mg^{2+}) are cofactors in reactions.

Cofactors

- A. act as substrates for enzymes.
- B. lower the activation energy of reactions.
- C. assist enzymes to function.
- D. are by-products of enzyme-controlled reactions.

Question 1.10

The molecule shown in the diagram above is a monomer of a

- A. protein.
- B. nucleic acid.
- C. carbohydrate.
- D. lipid.

Question 1.11

During polypeptide synthesis the product(s) of transcription

- A. is mRNA.
- B. is tRNA.
- C. are amino acids.
- D. is rRNA.

Cells and the role of organelles in the export of protein

Question 1.12

The organelle which correctly matches its function is

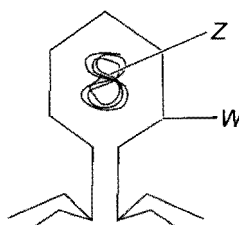
| Organelle | Function |
|--------------------------|---|
| A. chloroplast | conversion of light energy to chemical energy |
| B. mitochondrion | glycolysis |
| C. Golgi apparatus | synthesis of protein |
| D. endoplasmic reticulum | packaging of synthesised material into vesicles |

Question 1.13

An example of an autotrophic organism is

- A. yeast.
- B. a prion.
- C. a virus.
- D. a chemosynthetic bacterium.

Use the following diagram of a virus to answer Questions 1.14 and 1.15.

**Question 1.14**

W is the

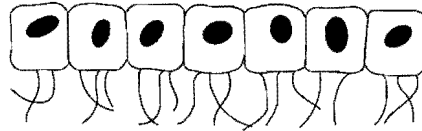
- A. cellulose wall.
- B. unit membrane.
- C. protein coat.
- D. polysaccharide layer.

Question 1.15

Z is a core of

- A. DNA or RNA.
- B. DNA and RNA.
- C. DNA.
- D. RNA.

Question 1.16



The diagram above represents

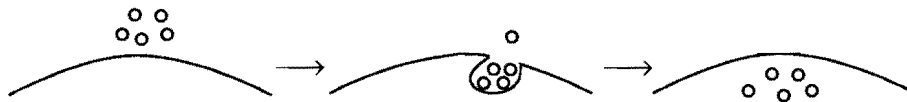
- A. a group of prokaryotic cells.
- B. cells with a high volume-to-surface-area ratio.
- C. the vascular tissue of a plant.
- D. a tissue on an outer surface.

Question 1.17

Translation occurs in the

- A. cytoplasm.
- B. nucleus.
- C. Golgi apparatus.
- D. ribosomes.

Question 1.18



The process illustrated above, showing substances moving into a cell, is

- A. exocytosis.
- B. pinocytosis.
- C. endocytosis.
- D. active transport.

Question 1.19

Bacteria reproduce by

- A. mitosis.
- B. mitosis and meiosis.
- C. cytokinesis.
- D. binary fission.

Question 1.20

The organelle that packages synthesised proteins into vesicles is

- A. ribosomes.
- B. Golgi apparatus.
- C. endoplasmic reticulum.
- D. mitochondria.

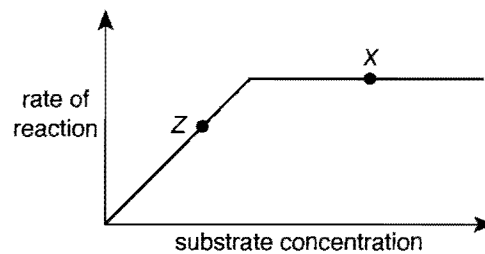
Question 1.21

The advantage of using an electron microscope is that

- A. living specimens can be observed.
- B. greater resolution can be achieved.
- C. objects are seen in colour.
- D. less preparation of the specimen is needed.

Biochemical processes within cells

Use the following information to answer Questions 1.22 and 1.23.

**Question 1.22**

At Z

- A. no product is being formed.
- B. the amount of product being formed equals the amount of product being broken down.
- C. the rate at which product is being formed is increasing.
- D. not all the active sites are full.

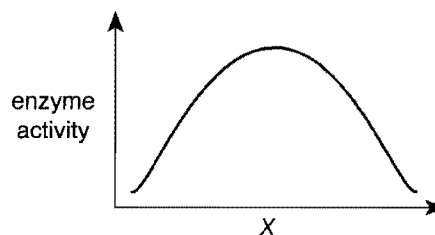
Question 1.23

At X

- A. no product is being formed.
- B. the amount of product being formed equals the amount of product being broken down.
- C. the product is being formed at a constant rate.
- D. not all the active sites are full.

Question 1.24

Consider the graph below.

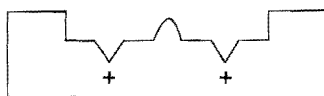


- Which variable on the x-axis could be
- A. enzyme concentration.
 - B. substrate concentration.
 - C. temperature.
 - D. product.

Question 1.25

The effect that enzymes have on activation energy is to

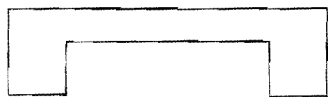
- A. lower it.
- B. raise it.
- C. no effect.
- D. to remove it.

Question 1.26

The diagram above represents the active site of an enzyme.

A drug that would most effectively reduce the action of this enzyme is

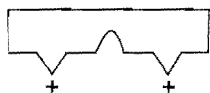
A.



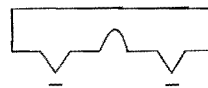
B.



C.



D.

**Question 1.27**

Anaerobic respiration in plants

- A. is also called fermentation and produces lactic acid.
- B. produces a toxic substance for plants but an energy-rich compound for humans.
- C. occurs only at night in the absence of oxygen.
- D. produces carbon dioxide, as in animals.

Question 1.28

With respect to cellular respiration,

- A. all stages of cellular respiration require oxygen.
- B. anaerobic respiration occurs in mitochondria.
- C. glycolysis produces two molecules of ATP per molecule of glucose.
- D. anaerobic respiration is more efficient than aerobic respiration.

Question 1.29

With respect to the process of glycolysis, the correct information is

| | Site | ATP | Product | Oxygen required |
|----|--------------|-----|------------------------------------|-----------------|
| A. | mitochondria | 2 | pyruvate | no |
| B. | cytoplasm | 2 | pyruvate | no |
| C. | cytoplasm | 36 | CO ₂ + H ₂ O | yes |
| D. | mitochondria | 36 | CO ₂ + H ₂ O | yes |

Question 1.30

The folded internal membranes of mitochondria are called

- A. grana.
- B. stroma.
- C. matrix.
- D. cristae.

Use the following information to answer Questions 1.31 and 1.32.

Once pyruvate is produced it is then further broken down.

Question 1.31

This oxidative breakdown in bacteria and animal cells would occur in the

| | Bacteria | Animal cells |
|----|--------------|--------------|
| A. | mitochondria | mitochondria |
| B. | cytoplasm | mitochondria |
| C. | cytoplasm | cytoplasm |
| D. | mitochondria | cytoplasm |

Question 1.32

In bacteria and animals, the transfer of pyruvate for oxidative breakdown requires the expenditure of which of the following amounts of ATP?

| | Bacteria | Animals |
|----|----------|---------|
| A. | 0 | 2 |
| B. | 2 | 2 |
| C. | 2 | 0 |
| D. | 0 | 0 |

Question 1.33

Complete oxidative breakdown of glucose in bacteria and plants liberates which of the following amounts of ATP?

| | Bacteria | Plants |
|----|----------|--------|
| A. | 2 | 2 |
| B. | 2 | 36–38 |
| C. | 38 | 36 |
| D. | 36 | 38 |

Question 1.34

The Krebs cycle occurs in the

- A. cytoplasm and does not use oxygen.
- B. cytoplasm and does use oxygen.
- C. mitochondria and does use oxygen.
- D. mitochondria and does not use oxygen.

Question 1.35

The electron transport system occurs in the

- A. cytoplasm and does not use oxygen.
- B. cytoplasm and does use oxygen.
- C. mitochondria and does use oxygen.
- D. mitochondria and does not use oxygen.

Question 1.36

The light-independent reaction of photosynthesis occurs in the

- A. grana.
- B. stroma.
- C. matrix.
- D. cristae.

Question 1.37

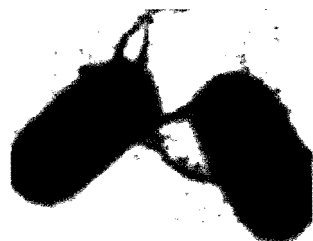
The Calvin cycle occurs in the

- A. grana.
- B. stroma.
- C. matrix.
- D. cristae.

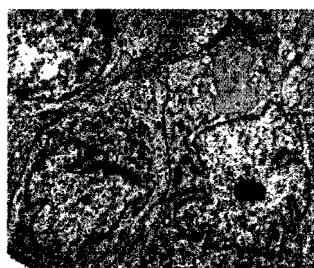
Section B (Short-answer questions)

The role of biomacromolecules in the chemical nature of cells

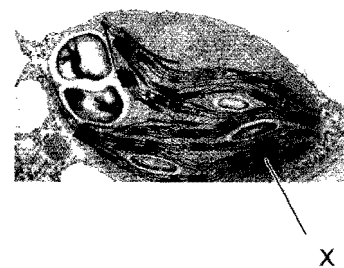
Question 1.1



A: x 9000



B: x 7500



C: x 15 800

1. Name a structure all of the above would contain. 1 mark

2. Complete the following table by placing a tick (✓) in each table cell if the component is present, a question mark (?) if it could be present, and a dash (—) if it is not present.

| Component | DNA | Protein | Phospholipid bilayer | Chlorophyll |
|-----------|-----|---------|----------------------|-------------|
| A | | | | |
| B | | | | |
| C | | | | |

4 marks

i. Name organelle C.
ii. Name the dark section labelled X in illustration C above. Name the reaction that occurs in these sections and state what occurs in this reaction.

1 + 3 = 4 marks
Total 9 marks

Question 1.2

Identify whether each of the following are polymers or not.

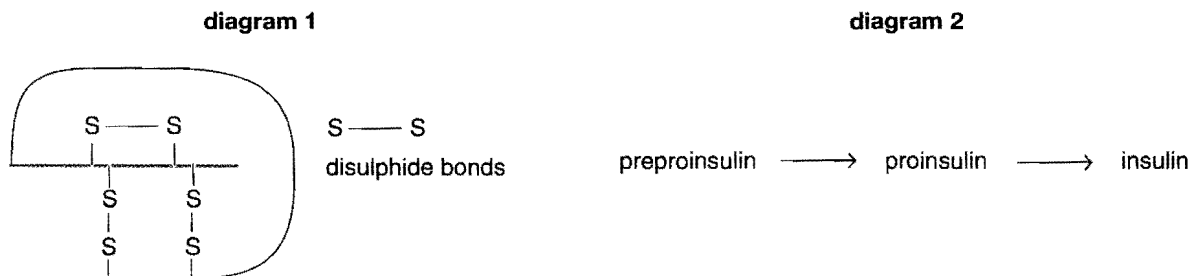
- i.** protein **ii.** lipid **iii.** starch **iv.** DNA

2 marks

What is the monomer of each of the polymers chosen above?

2 marks
Total 4 marks

Question 1.3



β cells of the pancreas produce a large molecule, preproinsulin. This is modified and folded to produce proinsulin, as illustrated in diagram 1. This is further modified to insulin, as shown in diagram 2.

- a.
 - i. What level of protein structure is represented by preproinsulin?
 - ii. What level of protein structure is represented by proinsulin?

1 + 1 = 2 marks
- b. What function would the disulphide bonds have on the structure of insulin?

2 marks
- c. The complete amino acid sequence is known.
 Explain if it would be possible to use the genetic code to synthesise insulin artificially.

3 marks
Total 7 marks

Cells and the role of organelles in the export of proteins

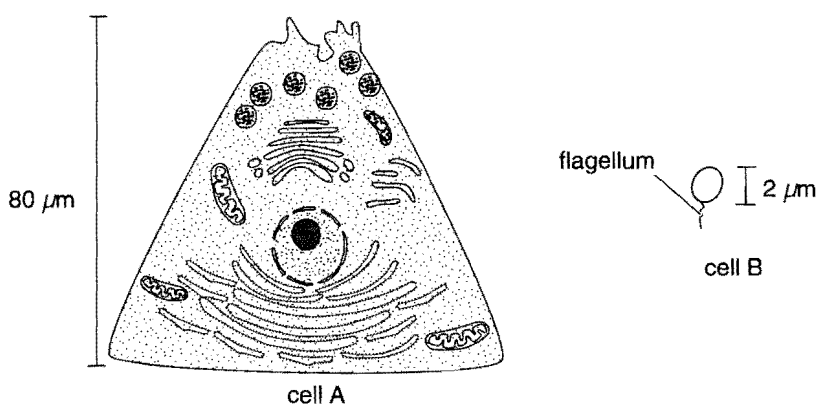
Question 1.4

Draw and label the molecular components of a cell membrane.

2 marks

Question 1.5

Two cells are shown below. One was observed under a light microscope and the other was observed under an electron microscope.



- a. Which cell is prokaryotic? Give two reasons for your choice.

2 marks
- b.
 - i. State **one** function you are likely to **observe** in cell B. Would you observe this function in cell A? Give a reason why.
 - ii. Name an organelle that can be seen in cell A, and that would become visible in cell B if it were observed under an electron microscope. State the function of this organelle.

2 + 2 = 4 marks

- c. Both cells (in their normal environments) respire to obtain ATP for their activities.
 If the cells were supplied with oxygen and glucose (in their normal environments), mark an 'X' on the diagrams where ATP would be produced.

1 mark

- d. What is the primary function performed by cell A? Explain your answer fully with reference to the structures present.

3 marks

Total 10 marks

Question 1.6



- a. Tissue of the cell type illustrated above was placed on a microscope slide with ATP. The tissue was seen to contract.

Explain this observation.

2 marks

- b. The plasma membrane regulates the inputs and outputs of a cell.

Name a process which requires ATP to move substances into a cell and name the part of the plasma membrane where this process occurs.

2 marks

Total 4 marks

Question 1.7

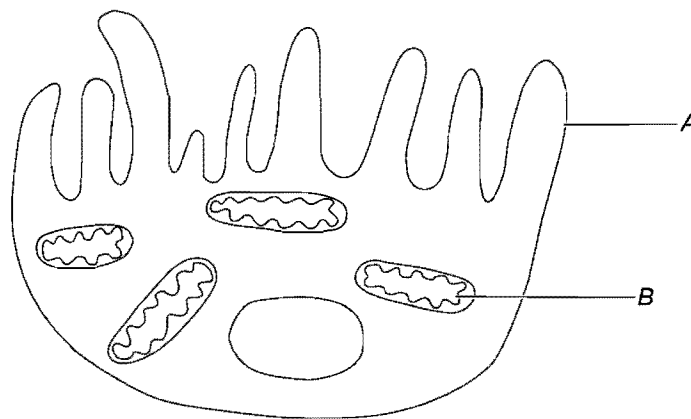
The light-independent reaction was formally referred to as the dark reaction.

Explain why this term is inaccurate.

2 marks

Question 1.8

Below is a diagram of a mammalian intestinal cell.



Name the structures A and B.

2 marks

Describe the role each of these structures plays in the absorption of digested sugars across the intestinal wall into the bloodstream.

2 marks

An experiment was carried out to study the effects of cyanide on the rate of absorption of three different sugars (glucose, galactose and fructose) by the mammalian intestinal tissue when the intestinal cells were bathed in a solution of each of the sugars. The results are shown below.

| Sugar | Rate of absorption (arbitrary units) | |
|-----------|--------------------------------------|------------------------------|
| | Living tissue | Tissue poisoned with cyanide |
| glucose | 2.00 | 0.82 |
| galactose | 1.95 | 1.00 |
| fructose | 0.89 | 0.92 |

- c. Name the sugar or sugars that are partially actively transported across the intestinal wall. Give evidence to support your answer. 2 marks
- d. Name the only mechanism by which the other sugar or sugars move across the intestinal wall. Define this term. 2 marks
- e. Through which part of the cell membrane does active transport occur? 1 mark
- f. Define facilitated diffusion. 1 mark
- Total 10 marks

Question 1.9

- a. What organisms have contractile vacuoles? 1 mark
- b. What is the function of a contractile vacuole? 1 mark
- c. i. If an organism was placed in a hypertonic solution, state the activity of a contractile vacuole, and state why this activity occurs. Explain your answer.
- ii. If an organism was placed in a hypotonic solution, state the activity of a contractile vacuole, and state why this activity occurs. Explain your answer.
- iii. If an organism was placed in an isotonic solution, state the activity of a contractile vacuole, and state why this activity occurs. Explain your answer.
- 1 + 1 + 1 = 3 marks
Total = 5 marks

Question 1.10

There are three different types of vacuoles. Plants, some animals and some protists each have different types of vacuoles.

Name and outline a function of each type.

3 marks

Question 1.11

A student conducted an experiment to investigate the effect of different solutions on some colourless cells and on some cells of *Chlorella*, a green unicellular alga. She set up three beakers: one with the colourless cells in distilled water, one with the colourless cells in sodium chloride solution, and one with *Chlorella* cells in distilled water. However, she forgot to label the beakers. Her results are summarised in the table below.

| Time (minutes) | Percentage change in cell volume | | |
|----------------|-------------------------------------|----------|----------|
| | Beaker 1 | Beaker 2 | Beaker 3 |
| 0 | 0 | 0 | 0 |
| 5 | +2.0 | +1.5 | -1.5 |
| 10 | +5.2 | +2.5 | -2.0 |
| 15 | +8.0 | +3.0 | -2.5 |
| 20 | +10.0 | +4.5 | -3.5 |
| 25 | +13.0 | +6.0 | -4.5 |
| 30 | +13.5 | +6.5 | -5.5 |
| 35 | ↑ cells ruptured (burst) ↓ | +6.5 | -6.5 |
| 40 | | +6.6 | -6.5 |
| 45 | | +6.6 | -6.5 |
| 50 | | +6.6 | -6.5 |

- a. Which cells and which solution were placed in
- beaker 1?
 - beaker 2?
 - beaker 3?

1 + 1 + 1 = 3 marks

Explain the changes observed in beaker 3.

2 marks

Were the colourless cells of plant or animal origin? Explain your answer.

2 marks

Total 7 marks

biochemical processes within cells**Question 1.12**

Human saliva contains amylase, a chemical that catalyses the breakdown of starch into the disaccharide maltose.

What general term can be used to describe the group of compounds to which amylase belongs? Define this term.

2 marks

What chemical group does starch belong to?

1 mark

Name two factors, other than amylase concentration, that can influence the rate of the breakdown of starch into maltose in the mouth.

2 marks

It has been observed that non-smokers' saliva is more effective than smokers' saliva in digesting starch. It has been hypothesised that this occurs because nicotine inhibits the action of salivary amylase.

Design a controlled experiment to test the hypothesis "that cigarette smoke inactivates or inhibits salivary amylase activity."

4 marks

- e. i. What problems could arise from using human saliva in the laboratory?
ii. What safe alternative could be used?

1 + 1 = 2 marks
Total 11 marks

Question 1.13

Junket is a commercially available enzyme extract, which is used in a dry tablet form. The instructions on the packet state that lukewarm milk should be used and then it should be left undisturbed until it sets.

- a. What is the name given to a substance on which an enzyme acts?

1 mark

- b. i. Name the subunits from which enzymes are synthesised.
ii. Name the organelle that manufactures enzymes.

1 + 1 = 2 marks

A student decided to make Junket. After boiling the milk he immediately added the tablet. The required time passed and the milk did not set.

- c. From your knowledge of enzyme structure explain why the milk did not set, even though the mixture was cooled and the correct proportions were used.

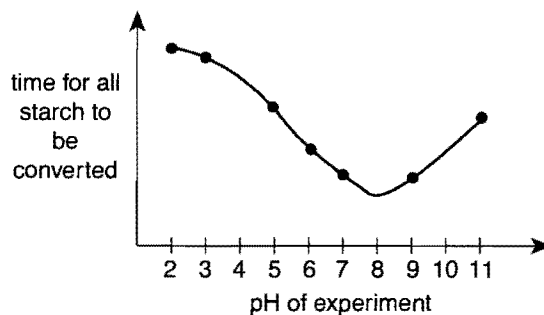
2 marks
Total 5 marks

Question 1.14

Amylase is an enzyme that catalyses the breakdown of starch molecules into simpler disaccharide units called maltose.

A student conducted an experiment to investigate the action of the enzyme amylase in solutions of different pH. They did this by adding 5 mL of amylase to 50 mL of starch in each experiment then adding 10 mL of buffer solution of pH 2, 3, 5, 6, 7, 9 and 11. They took small samples of each beaker every 30 seconds and tested for the presence of starch by adding iodine. Iodine turns a purple colour if starch is present. They then recorded how long it took for each experiment to completely convert all of its starch so that no reaction with the iodine occurred.

Their results are represented in the graph below.

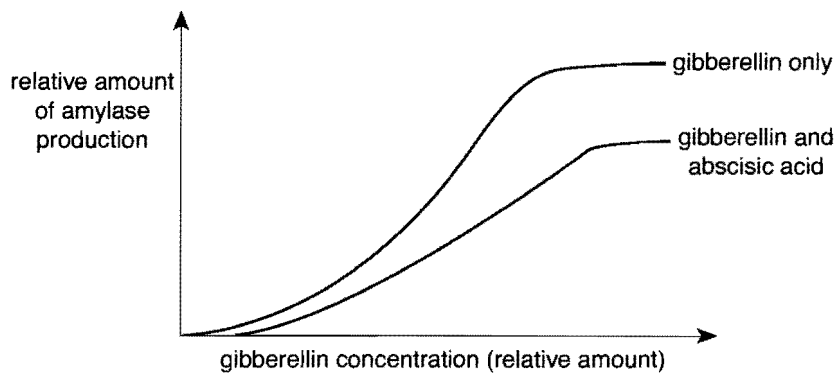


- a. What variable is being tested in this experiment?
1 mark
- b. Name **two** conditions or factors that the student kept constant.
1 mark
- c. From the experimental evidence above, what is the optimum pH for the activity of the enzyme amylase? Explain your answer.
2 marks

- d. Glycogen is another polysaccharide used for energy storage in certain cells. Would you expect amylase to be able to catalyse its breakdown into maltose molecules as it did starch? Explain your answer. 2 marks
- e. Draw the graph you would expect if the experimental variable was temperature at a pH of 8. 1 mark
- Total 7 marks

Question 1.15

An amylase enzyme, responsible for the breakdown of starch, is produced by some seeds as they germinate. This process is known to be influenced by the presence of gibberellin. An experiment was conducted to show the effect of various concentrations of gibberellin on the production of amylase. The effect of the presence of abscisic acid was also tested. The results are shown in the following graph.



- i. Where in the cell would amylase be synthesised?
 - ii. Which part of the cell directs the production of the enzyme?
- 1 + 1 = 2 marks

Why is amylase produced in the germinating seeds? 2 marks

What is the relationship between the presence of gibberellin and amylase production? 1 mark

- i. What effect does the presence of abscisic acid have on the production of amylase?
 - ii. What level of abscisic acid would be expected in a germinating seed? Explain your answer.
- 1 + 2 = 3 marks
Total 8 marks

Question 1.16

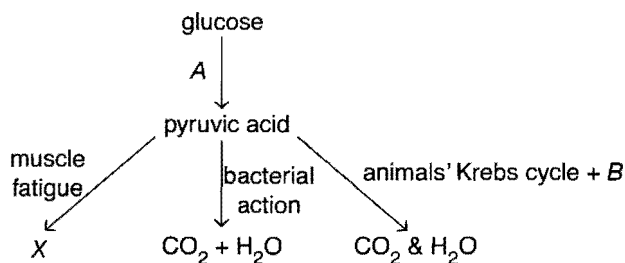
Choose the correct alternatives for each of the following.

The Krebs cycle occurs within the mitochondria at the **cristae / matrix**. It produces **more / less** ATP than the electron transport system and **requires / does not require** oxygen.

3 marks

Question 1.17

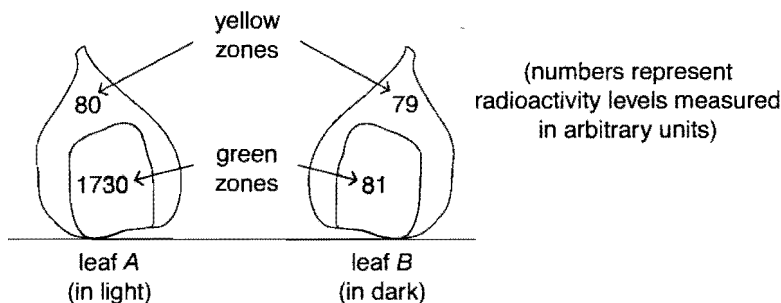
The following diagram is a simplified version of the process of cellular respiration in living organisms.



- a. What is the name of substance X? 1 mark
 - b. i. Name process A. 1 + 2 = 3 marks
 ii. Where does it occur and how many ATP are produced?
 - c. i. What process is occurring at B? 1 + 1 = 2 marks
 ii. What is the net amount of ATP produced by the Krebs cycle and process B?
 - d. How many ATP molecules are produced by bacteria in the complete oxidative breakdown of glucose? 1 mark
- Total 7 marks

Question 1.18

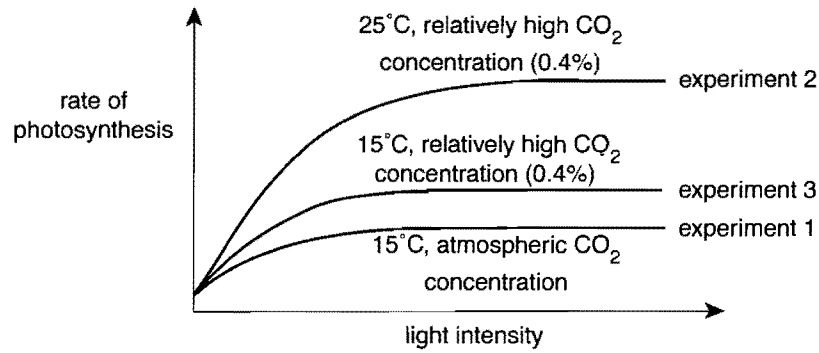
A plant with variegated leaves was supplied with radioactive carbon dioxide. Leaf A was kept in the light, whilst leaf B was kept in the dark. The radioactivity in the green and yellow sections of each leaf was measured after two days. The diagrams below summarise the results.



- a. By what process will radioactive carbon dioxide move through the stomatal pores into the plant's leaves? 1 mark
 - b. Which stage of photosynthesis uses this carbon dioxide? 1 mark
 - c. Explain why the level of radioactivity in the yellow zone of leaf A is lower than that in the green zone. 1 mark
 - d. Suggest a reason for why there is even a small amount of radioactive product present in the yellow zone of leaf A. 1 mark
 - e. What is the function of leaf B in this experiment? 1 mark
- Total 5 marks

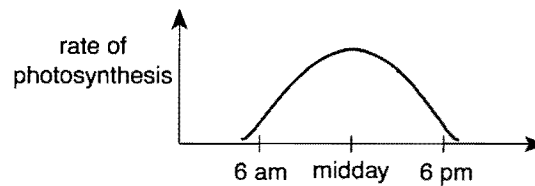
Question 1.19

The diagram below shows the effect of three different factors on the process of photosynthesis in a controlled experiment.



- a. Write a balanced chemical equation for the process of photosynthesis. 2 marks
- b. Explain, using information from the graphs above, why the lines level out after a period of time. 2 marks
- c. The rate of photosynthesis can drop quite dramatically at very high temperatures. Provide one reason as to why this may occur. 1 mark
- d. What is a limiting factor in experiment 1? Explain your answer. 1 mark

Given ideal conditions for a particular plant, the following graph of photosynthetic rate can be drawn for the plant over a 24-hour period.



Draw a line to show the likely rate of cellular respiration over this time. Explain your answer.

2 marks
Total 8 marks

Question 1.20

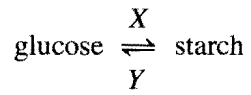
Name a function of lipids at the cellular level.

1 mark

Name the subunits which make up lipids.

2 marks

- c. Consider the reversible reaction below.



Complete the following table.

| Reaction | Hydrolysis/ condensation | Water input/ output | Exergonic/ endergonic | Catabolic/ anabolic |
|----------|-----------------------------|------------------------|--------------------------|------------------------|
| X | | | | |
| Y | | | | |

4 marks
Total 7 marks