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CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

Cambridge TECHNICALS

05847–05849, 05879, 05874

Unit 1 Summer 2019 series

Version 1

Contents

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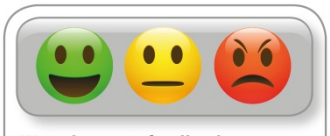

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

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Paper Unit 1 series overview

Candidates appeared to be fully engaged with the range of topics covered within this paper. Very few were unable to complete the paper within the time allocated. It was also noted that only a few candidates did not respond to all items within each question.

In relation to previous candidate performance, the current cohort of candidates was more familiar with the approach to be followed when answering the free-response (level of response/LOR-type item) Question 6. They were also generally aware of the rubric required when completing objective-format items, such as the completion of sentences, tables and joining concepts with lines.

There was evidence that candidates were prepared to carry out the calculations required for relevant items. They appreciated the need to show all stages of working, which enabled a number of candidates to gain marks even though the final answer may have been incorrect.

In general, candidates did not need to use the additional pages provided at the end of the paper. For those who did use such pages, links were provided within the script.

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Question 1 (a)

1 (a) Atoms are made up of subatomic particles.

Table 1.1 shows the type, relative charge and relative mass of subatomic particles **A**, **B** and **C** within an atom.

Complete the table.

Subatomic particle	Type	Relative charge	Relative mass
A	electron		very small
B		+1	
C			1

Table 1.1

[3]

Most candidates were able to successfully complete this table. A common error involved the use of descriptions rather than values in columns 3 and 4.

Question 1 (b) (i)

(b) An isotope of the element **tellurium** contains 78 neutrons and 52 protons.

(i) Give the mass number and atomic number for this isotope of tellurium.

mass number.....

atomic number.....

[2]

This item was completed correctly by the vast majority of candidates. No common pattern of errors could be identified.

Question 1 (b) (ii)

(ii) Tellurium is in Group 6 of the Periodic Table.

Complete the sentences.

One atom of tellurium has ..... electrons.

Tellurium has ..... electrons in its outermost

..... .

[3]

Again, this item did not present a problem for most candidates. No common pattern of errors could be identified.

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Question 1 (b) (iii)

(iii) Tellurium reacts with potassium to form potassium telluride.

Name the type of bond between potassium and tellurium.

.....**[1]**

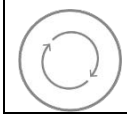
Although most candidates correctly identified the bond as ionic, some incorrectly chose covalent.

Question 1 (b) (iv)

(iv) Write the formula of potassium telluride.

.....**[2]**

Relatively few candidates fully expressed the formula as K_2Te . Many appreciated that K and Te were involved and were given 1 mark.



AfL It is important for candidates to appreciate the need to use the correct 'case' when writing symbols.

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Question 1 (c) (i)

(c) The atomic diameters of some atoms in Period 5 of the Periodic Table are shown in **Table 1.2**.

Atom	Atomic diameter ($\times 10^{-12}$ m)
Antimony	266
Tellurium	246
Iodine	230

Table 1.2

(i) Explain why the atomic diameter of iodine is less than the atomic diameter of antimony.

.....

.....

.....

.....

.....**[3]**

Many candidates did not appreciate that the correct explanation was based on the higher proton number in iodine and did not consider the outer electrons or the greater attraction between the outer electrons and nucleus. References to higher proton number or atomic number for iodine were creditworthy. A number of candidates repeated the text already given in the stem of this item and, as a result, did not gain marks.

AfL It is recommended that the key features relating to atomic diameter should be reinforced for future candidates.

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Question 1 (c) (ii)

(ii) Some isotopes of tellurium decay to become isotopes of iodine.

What is the name of the type of force which causes this decay?

.....**[1]**

Candidates tended to struggle with the concept of the 'weak force' involved in the process of decay.

? **Misconception** Most candidates attempted the item but referred to other forces such as electromagnetic.

Question 2 (a) (i)

2 Iron is an important metal. It affects our daily lives.

For example:

- Iron metal is used in the manufacture of steel for construction.
- Iron(II) ions have a key biological role in living organisms.

(a) Small amounts of carbon are added to iron to produce steel. Steel is stronger than pure iron.

A diagram of steel is shown in **Fig. 2.1**.

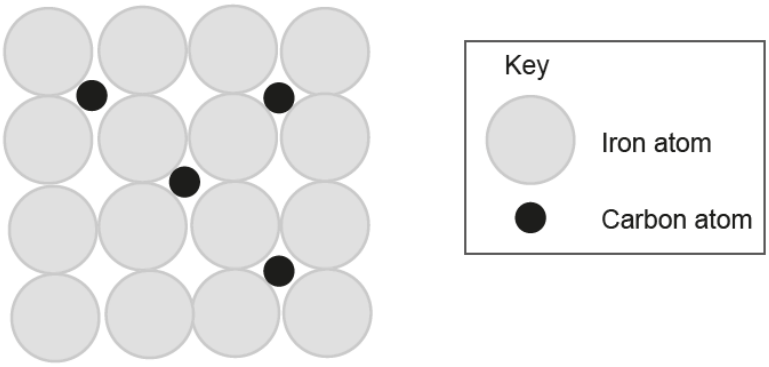

Fig. 2.1

(i) State the name for the type of mixture shown in **Fig. 2.1**.

.....**[1]**

Many candidates correctly noted that the mixture of iron and carbon atoms represented an alloy. No clear pattern of alternative responses was identified.

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Question 2 (a) (ii)

(ii) Explain why the presence of carbon atoms makes steel stronger than pure iron.

Use **Fig. 2.1** in your answer.

.....

.....

.....

.....**[2]**

The reduction in the ability of iron atoms to slide over each other was appreciated by most candidates. However, many candidates did not correctly express the disruptive impact of carbon atoms within the matrix of the iron atoms.

Question 2 (b) (i)

(b) A laboratory technician investigates the rate of reaction of steel nails with hydrochloric acid.

$Fe\ (s) + 2HCl\ (aq) \rightarrow FeCl_2\ (aq) + H_2(g)$

(i) Briefly describe how the technician could measure the rate of this reaction.

.....

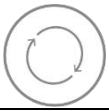
.....

.....

.....

.....**[2]**

Most candidates realised that the reaction should be timed in order to determine the rate. However, relatively few candidates understood that an observable outcome must also be recorded, such as the volume of gas collected or the number of bubbles produced.



AfL Future candidates should appreciate that rate is based on the relationship between time and an observed/recorded outcome for such experiments

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Question 2 (b) (ii)

(ii) The technician repeats the experiment using powdered steel instead of steel nails, and explains why the rate of the reaction changes.

Put a (ring) around the word(s) that complete each sentence.

Powdered steel has a greater **pressure / surface area / temperature** than steel nails.

This means that there are **less frequent / more frequent / the same amount of** collisions between particles.

The rate of reaction **decreases / increases / stays the same** .

[3]

Most candidates successfully completed this item.

? **Misconception** Some candidates made the error of selecting 'decreases' for the rate of reaction, rather than 'increases'.

Question 2 (b) (iii)

(iii) The reaction between the iron in the steel and hydrochloric acid can be shown using an ionic equation.

$Fe\,(s) + 2H^+\,(aq) \rightarrow Fe^{2+}\,(aq) + H_2\,(g)$

The reaction is a redox reaction.

Use the equation to explain, in terms of electron transfer, how this reaction involves both reduction and oxidation.

.....

.....

.....

.....

.....

.....**[3]**

It was anticipated that candidates would use the terms 'oxidised' (for iron) and 'reduced' (for hydrogen), rather than repeating the terms provided in the stem of this item. It was also essential for candidates to identify the change in electrons in relation to hydrogen **ions**. A number of candidates struggled with this item.

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Question 2 (c)

(c) Fe^{2+} ions have an important biological role in the transport of oxygen in human blood.

Describe how Fe^{2+} ions are involved in the transport of oxygen from the lungs to the cells.

.....

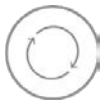
.....

.....

.....

.....**[2]**

Many candidates were aware that Fe^{2+} binds with oxygen. However, a number of candidates did not consider the location of Fe^{2+} within the haemoglobin molecule.



AfL It is suggested that future candidates are presented with simple models of the haemoglobin molecule with a particular focus on Fe^{2+} as an integral component of the haem group.

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Question 3 (a)

3 Lactic acid is a by-product of anaerobic respiration.

The molecular formula of lactic acid is $C_3H_6O_3$, and its structural formula is shown in **Fig. 3.1**.

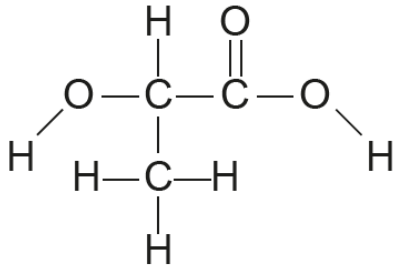

Fig. 3.1

(a) The chemical properties of lactic acid are due to the presence of its two functional groups.

One of the functional groups in lactic acid is a carboxylic acid group.

What is the name of the other functional group found in lactic acid?

Tick (✓) **one** box.

Alcohol	☐
Aldehyde	☐
Alkene	☐
Ketone	☐

[1]

Many candidates correctly named the functional group in lactic acid as an alcohol. No clear pattern of alternative responses was identified but ketone was occasionally selected.

Question 3 (b) (i)

(b) Lactic acid ($C_3H_6O_3$) can be a reactant or a product in an organic reaction.

For the reactions below, name the type of organic reaction and explain your answer.

(i) $CH_2{=}CHCOOH \xrightarrow{H_2O/H^+} CH_3CH(OH)COOH$

Type of organic reaction .....

Explanation .....**[2]**

The type of organic reaction was identified correctly as addition by a number of candidates. However, many candidates were challenged by this item. The correct explanation for the selection of addition was rarely seen.

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Question 3 (b) (ii)

(ii) $CH_3CHClCOOH \xrightarrow{NaOH(aq)} CH_3CH(OH)COOH$

Type of organic reaction .....

Explanation ..... **[2]**

Although many candidates appreciated that this was a substitution reaction, a number of candidates incorrectly used the term 'replacement'. For those who identified the reaction correctly, the explanation was often creditworthy. In other words, C*l* had been replaced by OH in the molecule.

AfL It is suggested that future candidates should be able to readily identify the range of reaction types identified on the Unit 1 specification (learning outcome 2.2), with an understanding of the key features of such reactions.

OCR support The OCR website link for the Unit 1 specification (pages 4 and 5) is here: https://www.ocr.org.uk/Images/260245-science-fundamentals.pdf

Question 3 (b) (iii)

(iii) $CH_3CH(OH)COOH \xrightarrow{\bullet Cl} \bullet CH_2CH(OH)COOH$

Type of organic reaction .....

Explanation .....**[2]**

Many candidates understood that this was a radical reaction. Credit was given for explanations referring to the unpaired electrons of radical chlorine atoms or for the production of a radical species. Candidate access to this item was further enhanced with the allocation of a mark for a clear reference to the use of the 'dot' on C*l*.

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Question 3 (c) (i)

(c) Compounds of molecular formula $C_3H_6O_3$ show different types of isomerism.

(i) Lactic acid shows optical isomerism.

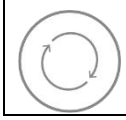
Identify the reason why lactic acid has optical isomers.

Tick (✓) **one** box.

There are four different groups attached to one carbon atom.	☐
There are two hydroxyl groups on different carbon atoms.	☐
There is a non-linear bond arrangement around the oxygen atoms.	☐
There is restricted rotation around the double bond.	☐

[1]

Most candidates correctly determined that there were four different groups attached to one carbon atom. No clear pattern of alternative responses could be identified. A few candidates provided two ticks. This resulted in a zero mark.



AfL It is suggested that future candidates are reminded of the correct rubric for this type of objective item – only write the number of ticks as indicated in the stem of the item.

Question 3 (c) (ii)

(ii) One isomer of lactic acid is 1,2-dihydroxymethoxyethene.

This compound shows geometric isomerism.

One geometric isomer is shown in **Fig. 3.2**.

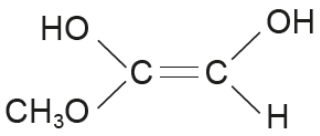


Fig. 3.2

Draw the other geometric isomer of 1,2-dihydroxymethoxyethene.

[1]

This was a challenging item for most candidates. Many did not draw a double bond between the two central carbon atoms while others did not correctly position the OH groups.

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Question 3 (d)

(d) One key reaction of lactic acid is the formation of the polymer polylactate.

Complete the equation in **Fig. 3.3** by drawing the structural formula of **one** unit of polylactate in the brackets.

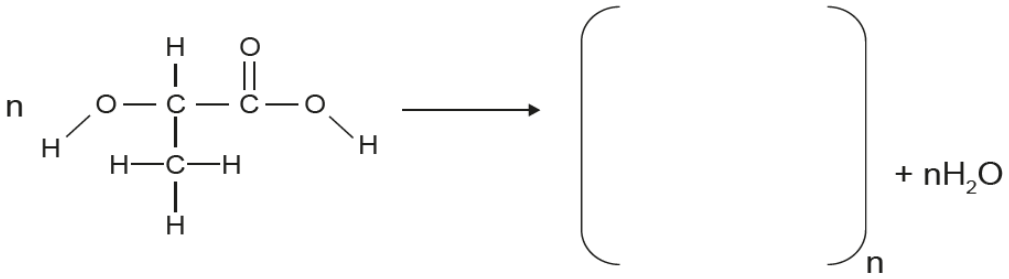

Fig. 3.3

[1]

The use of brackets when drawing the structural formula for one unit of polylactate was very challenging for many candidates. Responses often lacked the side bonds and/or did not show the correct position of the O on the right or left hand side of the model.

Question 3 (e) (i)

(e) Polylactate is a biodegradable polymer that could replace other synthetic polymers for certain uses.

Polystyrene is one non-biodegradable polymer that could be replaced by polylactate.

A unit of polystyrene is shown in **Fig. 3.4**.

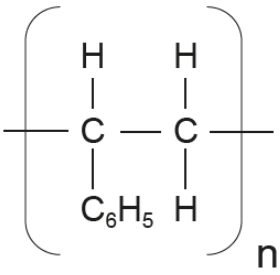

Fig. 3.4

(i) Give the empirical formula of polystyrene.

.....

[1]

Many candidates did not appreciate the relevance of the empirical formula (CH) and incorrectly gave their response as C_8H_8.

OCR support See learning outcome 4.2, page 11 of the Unit 1 specification: https://www.ocr.org.uk/Images/260245-science-fundamentals.pdf

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Question 3 (e) (ii)

(ii) Polystyrene can be processed into Styrofoam™, which is used as the material in fast food packaging.

Styrofoam™ is a colloidal foam, a mixture in which microscopic particles of one substance are dispersed in another medium.

Draw a **line** to link each **colloidal foam component** to its correct **state of matter**.

Colloidal foam component	State of matter
Dispersed phase	Solid
	Liquid
Dispersion medium	Gas

[2]

Although many candidates correctly identified the links between each colloidal foam component and its state of matter, a number of candidates incorrectly linked dispersion medium with liquid (instead of solid). Others incorrectly linked dispersed phase with solid.

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Question 3 (f)

(f) Atoms of carbon are essential in the formation of polymers such as polylactate and polystyrene.

Other non-metal atoms, such as oxygen and hydrogen, are not essential.

Explain why carbon is an essential element in the formation of polymers, but hydrogen and oxygen are not essential.

.....

.....

.....

.....

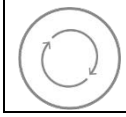
.....

.....

.....

.....**[4]**

Many candidates correctly recalled that each carbon atom has a valency of 4 and that double/triple bonds can be achieved. Furthermore, the basic feature of long/continuous chains formed by carbon atoms was often overlooked. Other candidates also correctly referred to the number of bonds available for oxygen/hydrogen. A reference to the formation of a 'carbon backbone/spine' was considered to be creditworthy.



AfL It is proposed that future candidates are given a wide range of polymers to consider in relation to the properties demonstrated by the carbon atoms involved.

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Question 4 (a) (i)

4 Animal and plant cells are classified as eukaryotic but bacterial cells are classified as prokaryotic.

(a) (i) Name **two** structures that are found in eukaryotic cells but not in prokaryotic cells.

1 .....

2 .....

[2]

A range of options was available for candidates to recall for this item. Most correctly identified named organelles or possibly a reference to membrane-bound organelles.

Misconception The most common error was the inclusion of cytoplasm and/or plasma membrane. Such features are common to both eukaryotic and prokaryotic cells.

OCR support Although the lists are not exhaustive, differences between eukaryotic and prokaryotic cells are shown within learning outcome 3.1, page 6 of the Unit 1 specification. https://www.ocr.org.uk/Images/260245-science-fundamentals.pdf

Question 4 (a) (ii)

(ii) Ribosomes are found in eukaryotic and prokaryotic cells.

Identify the molecule produced by ribosomes.

Tick (✓) **one** box.

Glycogen	☐
Lipid	☐
Protein	☐
Starch	☐

[1]

Most candidates correctly identified protein as the molecule produced by ribosomes. No clear pattern of alternative responses was identified.

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Question 4 (a) (iii)

(iii) Ribosomes interact with molecules of ribonucleic acid (RNA) as part of their function.

Put a tick (✓) in the correct box to show whether each statement is **true** or **false**.

Statement	True	False
RNA usually has a single-strand polynucleotide chain.		
RNA contains a ribose sugar.		
The nitrogenous base in RNA is thymine.		

[3]

Many candidates correctly selected the true or false nature of the three statements provided.

? **Misconception** However, one common error was the incorrect assumption that the nitrogenous base in RNA is thymine, rather than uracil. This third statement should therefore have been ticked as false.

Question 4 (b) (i)

(b) **Fig. 4.1** is an image of plant cells, when seen using a microscope.

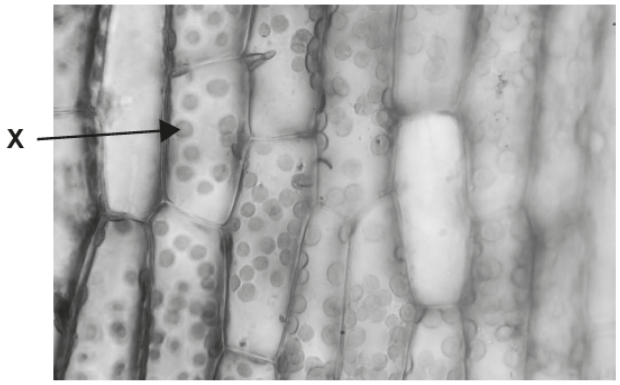

Fig. 4.1

Animal cells do **not** have plant cell walls or structure **X** seen in **Fig. 4.1**.

(i) Identify structure **X**.

.....**[1]**

The plant cell shown in **Fig. 4.1** clearly contained many chloroplasts. The majority of candidates correctly identified this organelle as structure X. Incorrect responses ranged from lysosome or nucleus to cytoplasm.

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Question 4 (b) (ii)

(ii) State the function of structure **X**.

.....**[1]**

Most candidates who recognised the organelle as the chloroplast correctly recalled that this is the site of photosynthesis. No clear pattern of alternative responses was identified.

Question 4 (b) (iii)

(iii) The reactions taking place in structure **X** involve the splitting of water.

Identify the metal ion which is a cofactor for the water-splitting enzyme involved in these reactions.

.....**[1]**

This item was based on the factual recall of metal ions involved in different reactions/components within cells. In this case, the metal ion acting as a cofactor is manganese. The most common error was to identify the ion as magnesium.

OCR support A list of metal ions with biological functions is presented on page 14 of the Unit 1 specification (learning outcome 5.1), identified via the following website link: https://www.ocr.org.uk/Images/260245-science-fundamentals.pdf

Question 4 (c) (i)

(c) The plasma membrane cannot be seen in **Fig. 4.1**.

(i) Outline the role of the plasma membrane.

.....

.....

.....

.....

.....

.....**[3]**

Most candidates engaged with this item and correctly identified at least one role. The most common role was that of the control/regulation of substance movement in/out of the cell. Many also correctly considered that the plasma membrane is a barrier and involved in cell signalling.

Misconception The most common errors included references to the provision of cell shape and the protection of cells (unqualified).

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Question 4 (c) (ii)

(ii) The plasma membrane contains phospholipids.

The structure of a phospholipid is shown in **Fig. 4.2**.

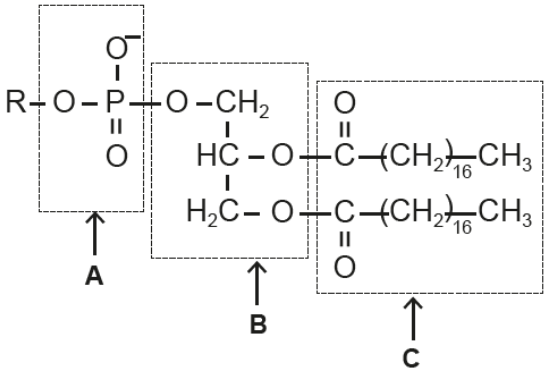

Fig. 4.2

Identify the groups labelled **A**, **B** and **C**.

A.....

B.....

C.....

[3]

The three components of the phospholipid molecule were presented in **Fig. 4.2**. Many candidates correctly named A as phosphate (group) but others progressed incorrectly onto ether/carboxylic options for B and C. The expected responses were glycerol for B and fatty acid for C. A number of candidates were challenged by this item.

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Question 4 (d) (i)

(d) The cell wall is made of cellulose, a complex carbohydrate.

It is formed from a chain of glucose molecules.

A section of cellulose is shown in **Fig. 4.3**.

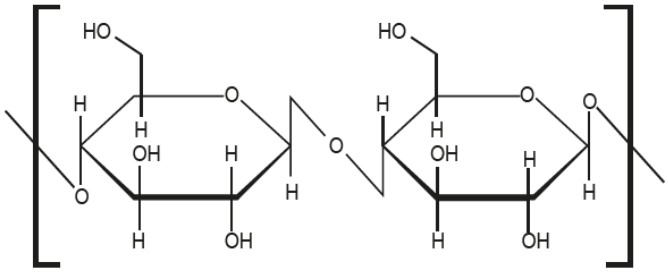

Fig. 4.3

(i) State **one** function of the cell wall.

.....**[1]**

The majority of candidates correctly identified one function of the cell wall, mostly referring to support, protection, structure or cell shape.

Misconception Although, no clear pattern of alternative responses could be identified, a number of candidates incorrectly described the cell was as responsible for the regulation of molecule movement in/out of the cell.

Question 4 (d) (ii)

(ii) Cellulose is a useful structural material for the cell wall.

Put a tick (✓) in the correct box to show whether each statement is **true** or **false**.

Statement	True	False
Cellulose is a polysaccharide.		
Cellulose contains microfibers which form cross-links.		
The tightly-packed chains found in cellulose are easily separated.		

[2]

Most candidates correctly identified the true and false statements. Almost all recalled that cellulose is a polysaccharide. This enabled them to obtain 1 mark. Other candidates were somewhat challenged by the two remaining statements.

AfL It is suggested that future candidates are encouraged to examine the structural features of polysaccharides (starch, glycogen and cellulose) in more detail.

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Question 5 (a)

5 Many metal ions have important uses in medical treatments.

(a) Identify the metal ion that is used to treat hypertension.

Tick (✓) **one** box.

Cu^{2+} ☐

Fe^{3+} ☐

Li^{+} ☐

Ni^{2+} ☐

[1]

Many candidates correctly recalled that lithium (Li^{+}) is used to treat hypertension. No clear pattern of alternative responses was identified for this item.

Question 5 (b) (i)

(b) The platinum(II) ion, Pt^{2+}, is a component of the chemotherapy drug Cisplatin.

- Cisplatin has an isomer called Transplatin.
- Transplatin does not have the same medical properties.

The molecular structures of Cisplatin and Transplatin are shown in **Fig. 5.1**.

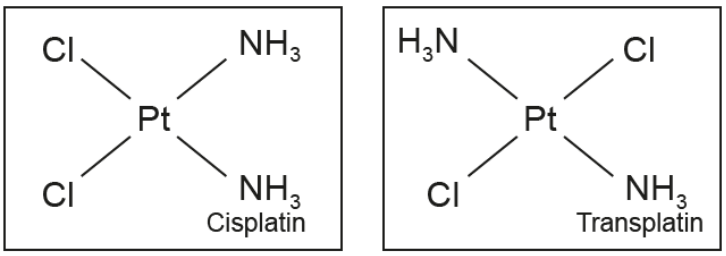

Fig. 5.1

(i) Describe how Cisplatin acts as a chemotherapy drug.

.....

.....

.....**[2]**

Again, this was an item based on factual recall. Cisplatin interferes with DNA replication within cancerous cells. A clear reference to interference of cell duplication was acceptable but was not the ideal, expected answer. Many candidates responded well to this item.

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Question 5 (b) (ii)

(ii) Use differences in the molecular structures shown in **Fig. 5.1** to suggest why Transplatin cannot be used to replace Cisplatin.

.....

.....

.....

.....**[2]**

It was expected that candidates would refer to the location of groups on opposite sides of the molecule and that this different orientation or shape of Transplatin prevented it from functioning as a chemotherapy drug. Some candidates correctly described the difference in location of the groups but most struggled to consider the impact of this on the orientation or shape of the molecule.

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Question 5 (c) (i)

(c) Sodium and potassium ions are involved in the transmission of nerve impulses along nerves.

Fig. 5.2 shows a diagram of a nerve cell called a motor neuron.

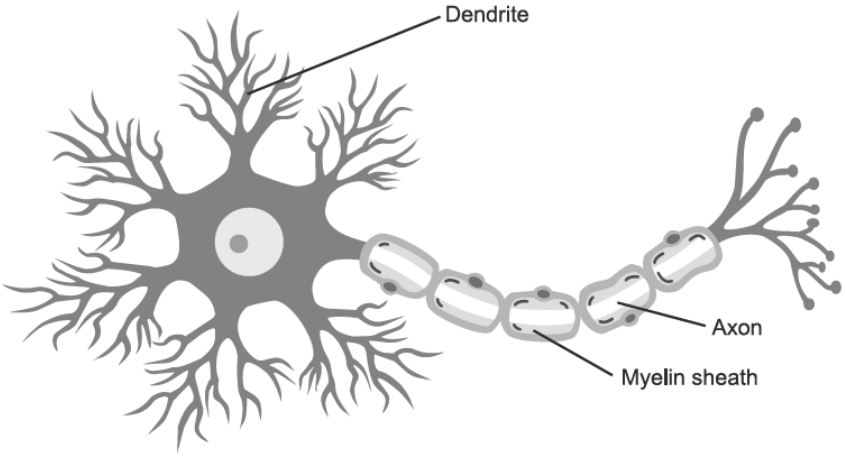

Fig. 5.2

(i) The **three** structures labelled in **Fig. 5.2** enable the nerve cell to transmit a nerve impulse.

Draw a **line** to link each **structure** to its correct **function**.

Structure	Function
Axon	To communicate with other nerve cells
Dendrite	To insulate the axon
Myelin sheath	To enable nerve impulses to run to and from different parts of the body

[3]

A number of candidates obtained full marks for this item and were clearly aware of the key features of the axon, dendrite and myelin sheath. Many were challenged by the topic but most, at least, recognised that the myelin sheath provides insulation of the axon.

AfL It is proposed that future candidates should consider the key structural and functional features of the myelinated neuron via simple models/diagrams.

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Question 5 (c) (ii)

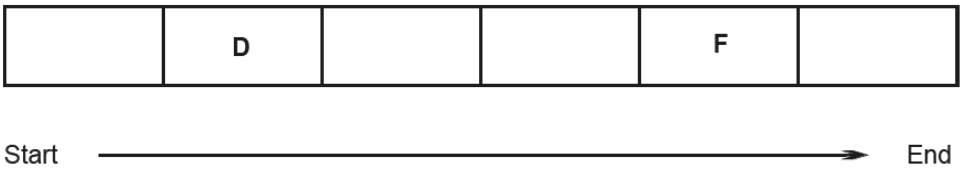
(ii) Sodium and potassium ions work together to transmit a nerve impulse.

This process involves six steps as shown below.

The steps are **not** in the correct order.

Step	Action
A	Potassium ions diffuse out of the cell.
B	Sodium ions diffuse into the cell.
C	Charge moves along the nerve cell.
D	Depolarisation occurs.
E	Action potential created.
F	Repolarisation occurs.

Write a letter for each step in each box to show the **correct** order.



[4]

This topic was very challenging for most candidates and provided some discrimination for those performing at distinction level. Many candidates appreciated that the process starts with the diffusion of sodium ions into the cell (B) and an equal number realised that the final outcome was that the charge moves along the nerve cell (C). However, the inbetween steps were somewhat muddled for a number of candidates.

AfL Again, it is recommended that a simple model/diagram is shared with future candidates so that they can fully understand the steps of the typical action potential event with reference to the resting potential and the states of polarisation, depolarisation and repolarisation.

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Question 6

6 A tensile test is performed on a specimen of steel.

A stress of 1.6×10^8 N/m^2 produces a strain in the specimen of 0.01.

The stress–strain graphs for steel, glass and a type of plastic are shown in **Fig. 6.1**.

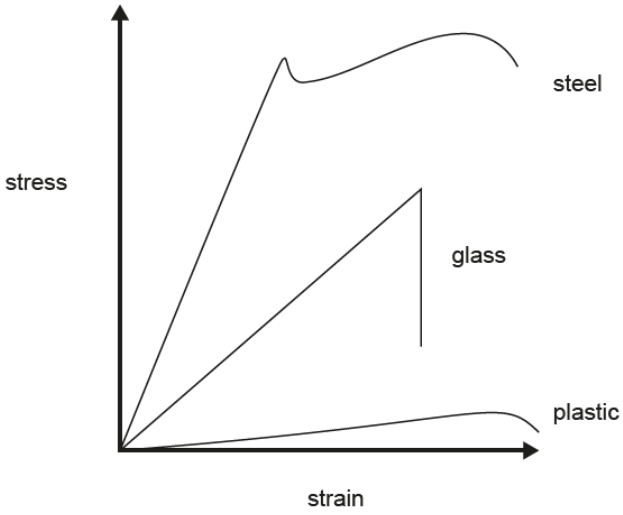

Fig. 6.1

Calculate the Young's modulus of the steel, and use **Fig. 6.1** to compare the mechanical properties of steel, glass and plastic.

Use the equation: Young's modulus = stress ÷ strain

.....**[6]**

Some candidates were able to use the data provided with regards to the Young's modulus. They were capable of utilising the values given in the stem of this question and apply them correctly to the equation given. This enabled them to achieve higher marks within each of the three levels for this free-response (level of response [LOR]-type) question. Those candidates performing at credit or distinction levels tended to also include the relevant units for this calculation (N/m^2). Many candidates successfully completed simple comparisons between the three materials, using Fig.6.1 in an appropriate manner. However, some candidates did not use the data in an effective way and made incorrect, general descriptions of the material properties. This item was challenging for many candidates.

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Question 7 (a) (i)

7 (a) The **current**, I, in a conductor can be calculated using the equation $I = nAvq$.

For copper, the **charge carrier density**, $n = 8.5 \times 10^{28}\ m^{-3}$.

The **charge** on an electron, $q = 1.6 \times 10^{-19}\ C$.

(i) The current, I, in a copper rod is 5.0 A.

The copper rod has an area A of $1 \times 10^{-3}\ m^2$.

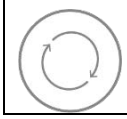
Calculate the velocity v of the electrons in the copper rod.

Give your answer to **2** significant figures and include its units.

v = ... units = ...

[4]

Candidates often obtained full marks for this item and successfully used the values and equation provided. They also applied the correct units (ms^{-1} or m/s). However, some struggled to rearrange the equation correctly and this had an impact on the outcome of the calculation. It was important for candidates to appreciate the presentation of final answers to 2 significant figures. This feature was emphasised in the stem of the item.



AfL It is suggested that future candidates are reminded about the presentation of significant figures.

Question 7 (a) (ii)

(ii) The current, I, in the copper rod is 5.0A.

The potential difference across the copper rod is $8.6 \times 10^{-4}\ V$.

Calculate the resistance R of the rod.

Use the equation: resistance = potential difference ÷ current

Include the units in your answer.

Show your working.

R = ... units = ...

[3]

The majority of candidates did well with this item and correctly determined the value of the resistance R and provided the correct units (ohms). The calculation was relatively straightforward and no clear pattern of alternative responses was identified.

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Question 7 (b)

(b) The copper rod used in **(a)(i)** and **(a)(ii)** is replaced by an insulator with the same dimensions and potential difference.

Explain why the current in the insulator is different.

.....

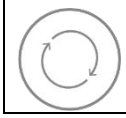
.....

.....

.....

.....**[2]**

It was clear that most candidates were challenged by this item. They struggled to provide a suitable explanation. The expected answer should have included a reference to the reduced density or number of charge carriers (per unit volume) in the insulator. It was also anticipated that candidates would move on to link this to a reduced current and corresponding increased resistance in the insulator. This item provided some discrimination for those candidates performing at the distinction level.



AfL It is suggested that future candidates should be encouraged to consider the basis of the current/resistance in a resistor (in comparison to that found in a copper wire).

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