CAMBRIDGE TECHNICALS

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Oxford Cambridge and RSA

CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

05847–05849, 05879, 05874

Unit 1 Summer 2024 series

Version 1

Contents

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. A selection of candidate answers is also provided. 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 and the mark scheme can be downloaded from OCR.

Unit 1 series overview

As in previous series for this paper, many candidates had prepared well and were able to respond to the questions in a confident manner. Candidates were generally familiar with the specification content, including the details available in the exemplification column. Consequently, a number of candidates displayed the skills and knowledge needed to succeed. However, some candidates were challenged by a number of questions and sometimes struggled to respond. Such 'nil responses' did not present an observable pattern for individual question content or format.

Most candidates completed the paper fully and almost all were able to follow the rubric of the paper. For example, they were generally able to adhere to the conventions for objective formats such as sentence completion, ticking the required number of boxes in tables and drawing lines to link concept boxes.

The free-response questions tended to be more difficult for some candidates. This was particularly evident in Question 7, the Level of Response (LoR) question for this paper. A number of candidates struggled to present a coherent response although a logical sequence of suggestions and explanations was observed for many. As a result, many candidates were limited to Level 1 (1 or 2 marks) or Level 2 (3 or 4 marks). Very few candidates were able to progress on to Level 3 (5 or 6 marks).

Clearly most candidates were able to use the space provided for calculations to good effect. This enabled them to obtain marks for the calculation steps, even if this final answer was incorrect. Some candidates, however, did not show their working for such questions.

As in the previous series, very few candidates needed to use the additional pages provided at the end of the paper. In general, when such pages were used, candidates made effective links with the specific questions involved.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• used the 'exemplification' section of the specification to good effect, including a number of Learning Outcomes (LOs) from LO2.3 (rate of reactions) **[Question 2(a)]** to LO3.1 (types of cells) **[Question 5(a)((i) to (b)(ii)]** • responded well to challenging topics, including the differences between glycogen and starch **[Question 3(b)(iii)]** and the maintenance of the isotonic state **[Question 5(b)(v)]** • showed a confident approach to inorganic and organic chemistry, ranging from the completion of an ionic half equation **[Question 1(c)(ii)]** to the structural formula of PVC **[Question 4(a)]** • presented a realistic interpretation of the phase diagram, supported by the scaffolding provided **[Question 7]**.	• did not apply the 'exemplification' section of the specification to good effect, including a number of LOs from LO1.3 (covalent bonding) **[Q1(d)(i) and (d)(ii)]** to LO4.4 (complex carbohydrates) **[Question 3(b)(iii)]** • tended to struggle to use their skills and knowledge to respond to a range of topics, including the formation of polymers **[Question 3(b)(iv)]** to the interpretation of data for the concept of solubility **[Question 6(d)]** • struggled with the use of the Periodic Table including neutrons/electrons and group/period **[Question 1(b)(i), (ii) and (iv)]** • misread the rubric for some questions, such as the need to tick two boxes for one mark **[Question 1(c)(iii)]** and the completion of an optical isomer with additional scaffolding provided **[Question 4(b)(iii)]**.

Question 1 (a)

1

(a) There are four fundamental forces.

Draw **one** straight line from **each** fundamental force to indicate what it is responsible for.

Fundamental force	What it is responsible for
Electromagnetic force	Attraction between masses
Gravitational force	Keeping nuclei stable
Strong nuclear force	Radioactive decay
Weak nuclear force	Repulsion between electrons

[3]

Almost all candidates did well with this question and successfully linked each fundamental force to what it is responsible for.

Question 1 (b) (i)

(b) $^{209}_{84}Po$ is an isotope of polonium.

(i) How many neutrons are in the nucleus of this isotope?

Number of neutrons = ... **[1]**

Most candidates correctly concluded that 125 neutrons are present in the nucleus of the isotope. Some mixed this concept with the number of electrons in the atom of the same isotope [Q1(b)(ii)] and so gave the incorrect number (84).

Question 1 (b) (ii)

(ii) How many electrons are there in an atom of this isotope?

Number of electrons = ... **[1]**

Again, most candidates were confident with this topic and correctly stated that 84 electrons are found in the atom of this isotope.

Question 1 (b) (iii)

(iii) $^{209}_{84}Po$ emits four nucleons as a result of radioactive decay.

An isotope of lead is formed with a mass number of 205.

Complete the nuclear notation of this isotope of lead.

.....

Pb

.....

[2]

Although many candidates were equally confident with this topic, some considered that the nuclear notation of this isotope of lead was 205/84, instead of 205/82.

Assessment for learning

Such candidates may benefit from a more detailed understanding of nuclear notation, perhaps by the presentation of simple models.

Question 1 (b) (iv)

(iv) Use the Periodic Table to find the group number and period of lead.

- group number .....
- period .....

[2]

Almost all candidates were familiar with group numbers and periods in the Periodic Table. No trend of alternative responses can be identified. However, the group number was seen to be more difficult to identify than the period.

Question 1 (c) (i)

(c) Lead nitrate is soluble in water.

Aqueous lead ions, Pb^{2+} (aq), and nitrate ions, NO_3^- (aq) are formed in the solution.

(i) Use the charges on the ions to work out the formula of lead nitrate and explain your answer.

- formula of lead nitrate

.....

- explanation

.....

.....

.....

.....

[2]

Many candidates struggled to write the correct formula of lead nitrate.

Some candidates gave a full and detailed explanation of the formula, even if the formula included was incorrect. They referred to the 1^- charge from both of two nitrate ions needed to offset the 2^+ charge of the lead ion, or words to this effect. Other candidates gave complex responses including electrons.

Misconception

The incorrect formula of $PbNO_3$, without the required brackets, was often seen.

Question 1 (c) (ii)

(ii) Magnesium reacts with lead nitrate to form magnesium nitrate and lead.

Complete the ionic half equation to show how lead ions becomes atoms.

Pb^{2+} (aq) + ... $\longrightarrow$ ..... (s)

[2]

A number of candidates completed the ionic half equation successfully.

There was a tendency for some candidates to add Mg within their responses. They were clearly influenced by the reference to magnesium in the stem of the question.

Question 1 (c) (iii)

(iii) Chemical reactions can be classified according to the type of reaction.

Tick (✓) **two** boxes which apply to the reaction between lead nitrate and magnesium.

addition ☐

displacement ☐

redox ☐

substitution ☐

[1]

Some candidates correctly identified both displacement and redox as the two types of reaction taking place between lead nitrate and magnesium. It appears that other candidates either misread the instruction to tick two boxes or found this to be an unfamiliar format for 1 mark. Candidates would benefit from looking carefully at the instruction statement with regards to this type of objective format.

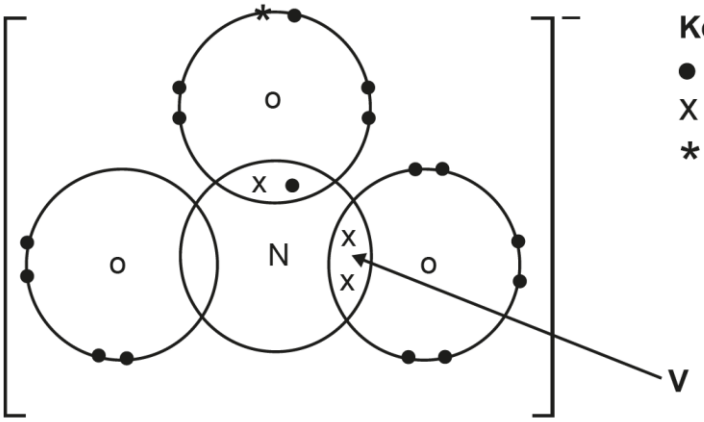
Question 1 (d) (i)

(d) Dot-and-cross diagrams are used to indicate the bonding in molecules and ions. Only the outer shell of each atom is shown.

The dot-and-cross diagram shows the electron arrangement in a nitrate ion.

The diagram is incomplete because only two of the bonds are shown.

(i) Draw the electron arrangement in the third bond between nitrogen and oxygen.



[1]

The majority of candidates presented two crosses or two dots for the missing electron arrangement. Few gave the correct response of two dots and crosses at the same point in the model.

Assessment for learning

Candidates could gain a greater understanding of bonding and the completion of dot and cross models via the completion of different examples, perhaps testing each other as a small group activity.

Question 1 (d) (ii)

(ii) What type of covalent bond is the bond labelled **V**?

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

Many different, incorrect responses were observed for the type of covalent bond, including simple, double and giant. However, some candidates did correctly identify that the bond is dative.

OCR support

It is recommended that the exemplification column of the OCR specification for Learning Outcome **(LO) 1.3** is used as a source of information for this topic (although this column does not provide an exhaustive list of examples across the LOs).

Question 2 (a)

2 Metals such as titanium and iron have many uses.

(a) Titanium dioxide (TiO_2) is used as a catalyst in the manufacture of polyethene from ethene.

Suggest how the catalyst affects the activation energy, the rate of reaction and the yield of polyethene.

Tick (✓) **one** box in each row.

	Decrease	No change	Increase
Activation energy			
Rate of reaction			
Yield of polyethene			

[3]

Almost all candidates understood the effects of the catalyst in this scenario. No pattern of alternative responses could be identified.

Question 2 (b) (i)

(b)

(i) Titanium alloys are used to manufacture aircraft. They contain small amounts of elements other than titanium.

Identify **one** other element that is used in many titanium alloys.

Put a tick (✓) in the correct box.

aluminium ☐

calcium ☐

carbon ☐

potassium ☐

[1]

Most candidates appreciated that aluminium is the element used in many titanium alloys. The other options were clearly discounted as unrealistic. No pattern of alternative responses was seen.

Question 2 (b) (ii)

(ii) Both pure titanium and titanium alloys have a high strength-to-weight ratio and are corrosion resistant.

Describe **one** advantage of using a titanium alloy rather than pure titanium to make aircraft turbines.

.....

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

There was a tendency for some candidates to select greater strength as the advantage of using the titanium alloy for this function. However, this is not the correct conclusion. Such alloys are generally less flexible, harder and more durable. These features were identified correctly by some candidates.

OCR support

Candidates could find it useful to explore the distinction between the different mechanical properties of malleability, ductility, brittleness and hardness as listed in the specification at **LO6.1**.

Question 2 (c)

(c) Iron alloys are used widely in the construction industry and in manufacturing.

Pure iron has a tendency to rust because it reacts with air and water.

The figure below shows some iron nails and an iron block of the same mass.

Iron nails

Iron block

Explain why the iron nails rust more quickly than the iron block.

.....

.....

.....

.....

.....

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

Many candidates were able to give a full and detailed explanation if they identified that iron nails had a larger surface area than the iron block. Some candidates struggled, particularly if they considered that the iron block had the greater surface area, but no common error can be identified.

Question 3 (a) (i)

3 Organic compounds range in size from small molecules with only a few atoms, to macromolecules which can have hundreds or thousands of atoms.

(a) The table below shows molecular formulae of types of organic compound that have three carbon atoms per molecule.

Molecular formula	C_3H_4	C_3H_6	C_3H_8	C_3H_8O
Type of organic compound	Alkyne	Alkene	Alkane	Alcohol

(i) Identify the molecular formula of a saturated hydrocarbon.

Tick (✓) **one** box.

C_3H_4 ☐

C_3H_6 ☐

C_3H_8 ☐

C_3H_8O ☐

[1]

Many candidates successfully concluded that C_3H_8 is the molecular formula of a saturated hydrocarbon. There was no pattern of alternative responses seen for this objective question.

Question 3 (a) (ii)

(ii) Draw the structural formula of the alkyne C_3H_4.

Clearly show the bonds between the carbon atoms.

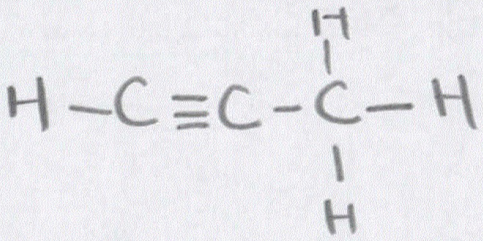
[2]

A number of candidates were confident when drawing the structural formula of C_3H_4, showing the bonds. Exemplar 1 shows this type of successful response. The drawing shows all atoms for C_3H_4 and the triple bond. Although some candidates struggled to complete the model correctly they did often obtain 1 mark for showing a triple bond at some point in their response.

Exemplar 1

(ii) Draw the structural formula of the alkyne C_3H_4.

Clearly show the bonds between the carbon atoms.



[2]

Question 3 (a) (iii)

(iii) Draw a skeletal formula of an alcohol with the molecular formula C_3H_8O.

[2]

Many candidates found the drawing of a skeletal formula to be challenging. The skills required to draw a skeletal formula were apparent but relatively few candidates did this successfully. Although some struggled, they did obtain 1 mark for including an OH group at some point in their response. There was no clear pattern of alternative responses .

Question 3 (a) (iv)

(iv) Propan-2-ol can be oxidised to a ketone, C_3H_6O.

State the name of this ketone.

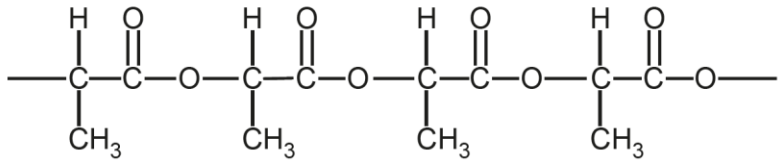
..... **[1]**

A number of candidates recalled that the ketone is propanone. Again, no clear pattern of alternative responses was seen.

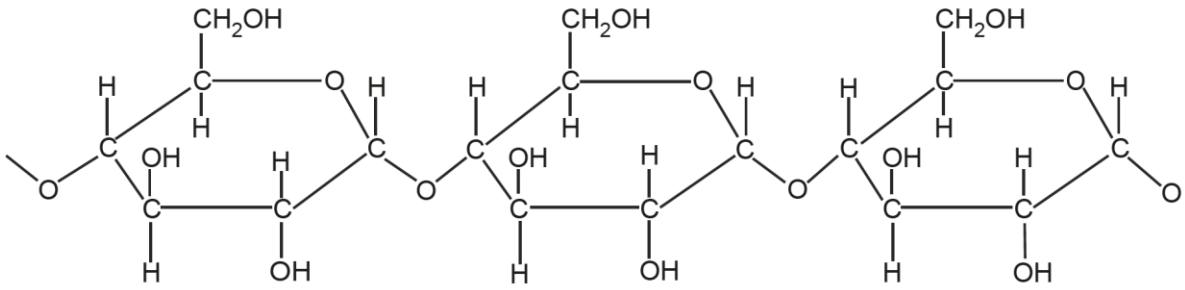
Question 3 (b) (i)

(b) The figure below shows a section of each of two polymers that contain carbon, hydrogen and oxygen.

polylactate



polysaccharide



(i) Deduce the empirical formula of polylactate from the formula shown in the figure above.

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

Many candidates correctly stated $C_3H_4O_2$ for the empirical formula.

A number of responses showed multiples of the formula, such as $C_{12}C_{16}O_8$, but this was not acceptable for this 1 mark question.

Question 3 (b) (ii)

(ii) The figure above shows a section of the polysaccharide, starch.

Identify the main function of starch.

Tick (✓) **one** box.

Component of cell walls	☐
Regulation of biological reactions within cells	☐
Storage of molecules needed in respiration	☐
Transcription of genetic sequences in DNA	☐

[1]

Most candidates appreciated that starch is a storage molecule needed in respiration. Some candidates, however, considered that starch is a component of cell walls.

Assessment for learning

It is recommended that the overall feature of plant cells is combined with the significance of starch and cellulose, referring to the specification at **LO3.2** and **LO4.4**. This could be done via simple diagrammatic models.

Question 3 (b) (iii)

(iii) Glycogen has a similar structure to starch.

State **three** differences between glycogen and starch.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

[3]

Many candidates realised that the differences between these two polysaccharides did not need to focus only on structure. They included correct references to the type of cells involved and the solubility of the polysaccharides. Some candidates struggled to identify any clear differences, for example, incorrectly referring to the types of glycosidic bonds, with insufficient detail.

Question 3 (b) (iv)

(iv) Polylactate and starch are formed from their monomers by the same type of reaction.

Explain how the polymers are formed from their monomers.

.....

.....

.....

.....

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

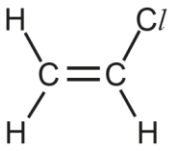
This question was answered well by many candidates. For example, they correctly referred to condensation reactions and the combination of monomers. There was no clear pattern of alternative responses.

Question 4 (a)

4 Organic compounds containing chlorine have many uses.

(a) PVC is a type of chlorinated organic compound, used to make plastic gutters. This compound is useful because it is hardwearing and takes many years to break down.

PVC is a polymer formed from monomers of chloroethene.

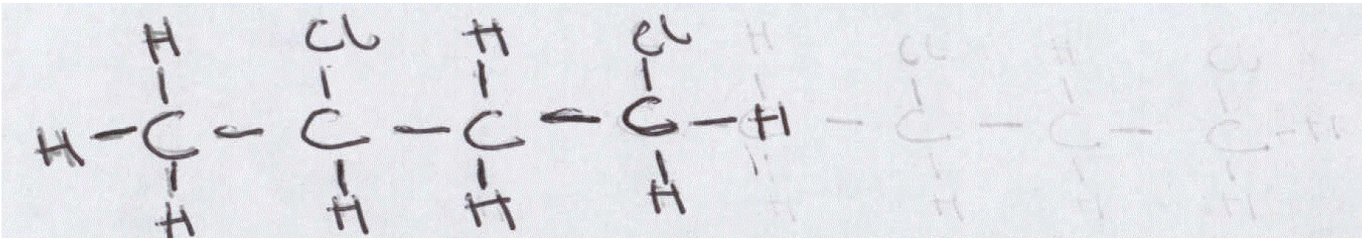


Draw the structural formula of PVC showing **two** repeat units.

[2]

A number of candidates drew the structural formula with two repeat units and were not challenged by this task. Others gained 1 mark for drawing only one of the units. A maximum of 1 mark was also awarded if candidates included terminal hydrogens. An example of this error is shown in Exemplar 2.

Exemplar 2



Question 4 (b) (i)

(b) The compound 2-bromo-2-chloro-1,1,1-trifluoroethane ($CF_3CHBrCl$) is another chlorinated organic compound. It is used as an anaesthetic.

$CF_3CHBrCl$ has two optical isomers because it has a chiral centre.

(i) Explain what **chiral centre** means.

.....

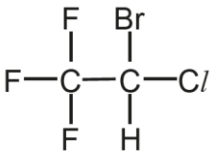
.....

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

Many candidates correctly explained that a chiral centre is a carbon (atom) with four different groups or atoms attached to it. Some referred to four bonds but this was not correct.

Question 4 (b) (ii)

(ii) Draw a (circle) around the chiral centre on the structure below.



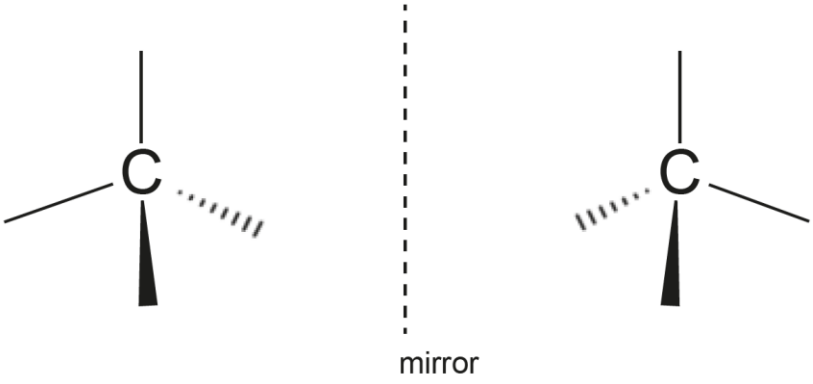
[1]

Although many candidates correctly circled the chiral centre, some included the attached atoms within the circle or selected the carbon which was not a chiral centre.

Question 4 (b) (iii)

(iii) The two optical isomers are non-superimposable mirror images.

Complete the diagram below to show the two optical isomers of $CF_3CHBrCl$.



[2]

Some candidates were successful when drawing both optical isomers although many struggled to include CF_3 as shown in the model in Q4(b)(ii). Although an incorrect combination of the four components was included in the left hand model, many candidates were able to draw the mirror image and obtain 1 mark.

Assessment for learning

It is suggested that candidates will find a comparison of the different types of isomers to be beneficial (as geometric, structural and optical models), as outlined in the specification at **LO4.3**.

Question 4 (c) (i)

(c) Chlorofluorocarbons (CFCs) were used as a component of aerosols, some cleaning agents and in refrigerators.

They are now banned because they are responsible for depleting the ozone layer in the Earth's atmosphere.

The reaction with ozone occurs in two steps.

(i) When the CFC compound trichlorofluoromethane reaches the ozone layer, a C—C*l* bond breaks and a chlorine free radical (C*l*•) is formed.

State the condition needed to break the C—C*l* bond.

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

A number of candidates correctly noted the need for UV (light/radiation) for the breaking of the C-Cl bond.

Misconception

A common misconception was to refer to high temperatures or close proximity to the ozone layer.

Question 4 (c) (ii)

(ii) The chlorine free radicals react with ozone (O_3) as shown below.

Equation 1	$Cl\bullet + O_3 \rightarrow \mathbf{X} + O_2$
Equation 2	$\mathbf{X} + O \rightarrow \mathbf{Y} + Cl\bullet$

Deduce the formulae of **X** and **Y**.

X = ...

Y = ...

[2]

Many candidates successfully noted that Y was O_2. There was a tendency for candidates to struggle with the presentation of X as ClO•. There was no alternative set of incorrect responses noted for X.

Question 4 (c) (iii)

(iii) Studies indicate that one chlorine free radical can destroy over 100 000 molecules of O_3.

Use **Equations 1** and **2** to explain why just one chlorine radical can react with so many molecules of O_3.

.....

.....

.....

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

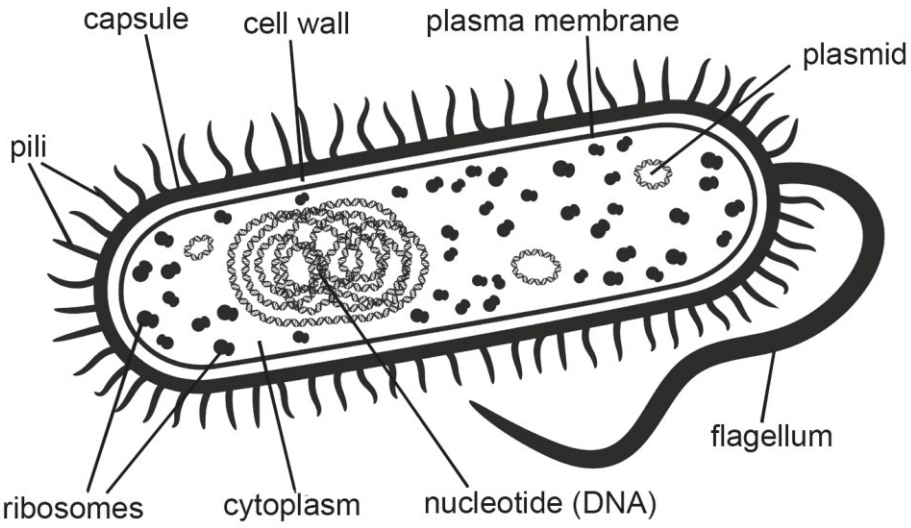
Some candidates appreciated that the chlorine free radical is constantly produced/released by Equation 2 and that the availability of this radical enabled further involvement in other reactions (Equation 1). This was a challenging topic.

Question 5 (a) (i)

5

(a) **Fig. 5.1** shows a prokaryotic cell.

Fig. 5.1



(i) Identify the structure shown in the prokaryotic cell which is **not** found in the eukaryotic cell of a plant.

Tick (✓) **one** box.

cell wall ☐

cytoplasm ☐

plasmid ☐

ribosome ☐

[1]

The majority of candidates recalled that the plasmid is found in the prokaryotic cell but not in the eukaryotic cell. A pattern of alternative, incorrect responses was not seen for this objective question.

Question 5 (a) (ii)

(ii) Identify the structure that is **not** found in a prokaryotic cell **or** an animal cell but **is** found in a plant cell.

Tick (✓) **one** box.

chloroplast ☐

endoplasmic reticulum ☐

golgi apparatus ☐

mitochondrion ☐

[1]

Almost all candidates recalled that the chloroplast is found in the plant cell but not in animal or prokaryotic cells. A pattern of alternative, incorrect responses was not seen for this objective question.

Question 5 (a) (iii)

(iii) Describe the purpose of the flagellum in the prokaryotic cell and identify a type of eukaryotic cell that has a similar structure.

.....

.....

.....

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

This question was also very accessible to the majority of candidates. They fully understood that the flagellum gives movement to prokaryotic cells. Many also correctly selected the sperm cell as a type of eukaryotic cell with a similar structure. Again, there was no clear pattern of alternative, incorrect responses.

Question 5 (a) (iv)

(iv) State **one** difference between the location of DNA in a prokaryotic cell and the location of DNA in a eukaryotic cell.

.....

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

Most candidates selected the location of DNA in the nucleus of eukaryotic cells via their response.

Misconception

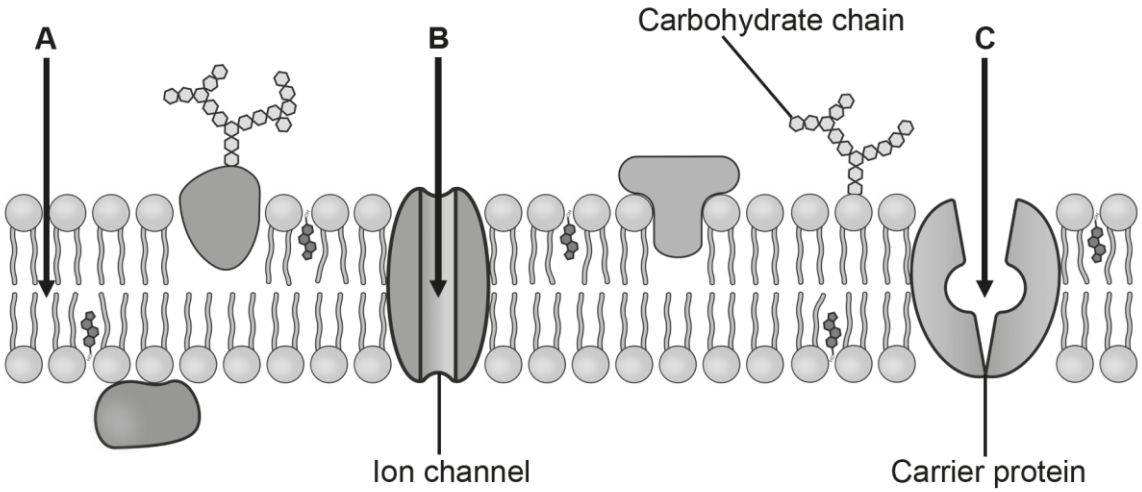
Some candidates incorrectly assumed that a nucleotide was unique to prokaryotes. This is not the case because it is the monomer of all polynucleotides.

Question 5 (b) (i)

(b) A plasma membrane is found in prokaryotic and eukaryotic cells.

Fig. 5.2 shows a diagram of a plasma membrane.

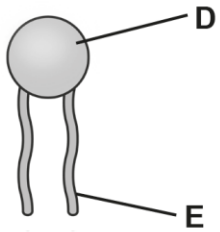
Fig. 5.2



(i) The membrane contains a 'fluid' bilayer of molecules.

The appearance of each molecule is shown in **Fig. 5.3**.

Fig. 5.3



Identify the type of molecule.

Tick (✓) **one** box.

disaccharide ☐

phospholipid ☐

protein ☐

triglyceride ☐

[1]

Almost all candidates correctly identified the model as a phospholipid. It was not possible to identify a pattern of incorrect responses for this objective question.

Question 5 (b) (ii)

(ii) The molecule in **Fig. 5.3** has two distinct regions, labelled **D** and **E**.

Identify the characteristic properties of the two regions.

Tick (✓) **one** box.

Region D	Region E	
hydrophilic	hydrophilic	
hydrophilic	hydrophobic	
hydrophobic	hydrophilic	
hydrophobic	hydrophobic	

[1]

Again, many candidates were able to recall the characteristic properties of the phospholipid. A number of candidates incorrectly ticked the hydrophobic (region D)/hydrophilic (region E) option. They were aware of the different properties but were unsure of their location within the phospholipid.

Question 5 (b) (iii)

(iii) Describe **two** functions of the carbohydrate chain on the outer surface of the plasma membrane in **Fig. 5.2**.

1 .....

.....

.....

2 .....

.....

.....

[2]

This topic was generally challenging for most candidates. The carbohydrate chain is perhaps the less well-understood region of the plasma membrane. Some candidates were successful and recalled that they can act as receptor sites, have a cross-linking function and are important for cell-to-cell recognition.

Assessment for learning

Although not named on the specification at **LO3.2**, presenting the fluid-mosaic model will reinforce the structural and functional components of the plasma membrane. This is a useful tool to gain a greater understanding of this cell component.

Question 5 (b) (iv)

(iv) **A**, **B** and **C** represent different ways in which particles can travel through the plasma membrane in **Fig. 5.2.**

The formulae of three different particles that travel through the plasma membrane are:

$C_6H_{12}O_6$ O_2 Na^+

The particles follow different routes through the plasma membrane.

State which particle travels through at routes **A, B** and **C**.

A = ...

B = ...

C = ...

[2]

Many candidates did well with this question and correctly identified all routes for the particles. No clear pattern of alternative incorrect responses was seen but, in general, many candidates did successfully note that route B is for Na^+ ions.

Question 5 (v)

(v) When Na^+ ions move into a cell across the plasma membrane, they cause an imbalance in the water distribution between the cell cytoplasm and the surrounding tissue fluid.

The cell and tissue fluid are no longer in an isotonic state.

Describe the events that take place to return the cell to the isotonic state.

.....

.....

.....

.....

.....

.....

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

This topic was challenging. However, some candidates did realise that a balance of water is achieved via the entry of water into cells via osmosis. Others also correctly noted that the Na^+ ions leave the cell and K^+ ions enter the cell. Some demonstrated a more in-depth knowledge by referring to the operation of a pump/channel within the plasma membrane and the involvement of ATP.

Question 6 (a)

6 Group 2 ions and compounds have important biological functions and medical uses.

(a) Complete the sentences using the words in the list.

The words can be used once, more than once or not at all.

blood	**bone**	**gamete**
muscle	**nerve**	**testis**

Calcium ions are an important component of the matrix in ..... tissue.

These important ions also enable ..... cells to contract.

Calcium ions control the release of chemical transmitters from ..... cells.

[3]

This sentence-completion format was accessible for almost all candidates. There was no clear pattern of incorrect words.

Question 6 (b) (i)

(b) Magnesium hydroxide is the main ingredient of Milk of Magnesia which is used to treat heartburn. Heartburn occurs when acid escapes from the stomach into the oesophagus.

A bottle of Milk of Magnesia is shown in the image below.

(i) Magnesium hydroxide is not very soluble in water and settles at the bottom of the bottle.

The bottle must be shaken before use.

Identify the type of mixture found in Milk of Magnesia.

Tick (✓) **one** box.

aerosol ☐

emulsion ☐

gel ☐

suspension ☐

[1]

Many candidates correctly recalled that this mixture was a suspension. There was no obvious pattern of alternative responses.

Question 6 (b) (ii)

(ii) Milk of Magnesia has a concentration of 84 mg cm^{-3}.

Typically, 60 cm^3 of stomach acid can be neutralised by a 5 cm^3 dose of Milk of Magnesia.

Calculate the mass of magnesium hydroxide that is needed to neutralise 150 cm^3 of stomach acid.

Mass of magnesium hydroxide = ... mg **[2]**

A few candidates correctly completed the calculation to deduce the mass of magnesium hydroxide. Most candidates did show their working. This was useful is some cases because they were able to obtain at least 1 mark for this question. It is not possible to identify a common error.

Question 6 (b) (iii)

(iii) It is recommended that an adult should not consume more than 5.04 g of magnesium hydroxide in a 24-hour period.

Calculate the maximum number of 5 cm^3 doses of Milk of Magnesia that an adult should consume within a 24-hour period.

Maximum number of doses = ... **[2]**

As for Question 6(b)(ii), most candidates were challenged by this question. Most were unable to complete the calculation successfully.

Question 6 (c) (i)

(c) An alternative treatment for heartburn contains a mixture of carbonates and sodium alginate, a substance derived from seaweed.

(i) Sodium alginate reacts with stomach acid forming an insoluble cross-linked polymer.

The strands of the polymer are held together by an ion that is also responsible for cell adhesion.

Identify the ion.

Tick (✓) **one** box.

Ca^{2+} ☐

Cu^{2+} ☐

Fe^{2+} ☐

Pt^{2+} ☐

[1]

The majority of candidates understood that Ca^{2+} is responsible for cell adhesion. Again, no clear pattern of incorrect choices was noted for this objective question.

Question 6 (c) (ii)

(ii) The carbonates neutralise the stomach acid and the reaction produces carbon dioxide.

As the carbon dioxide is released, the polymer in **(c)(i)** floats to the top of the stomach contents. This acts as a barrier to stop acid entering the oesophagus and causing pain.

Any gas would work to float the polymer.

Suggest why carbon dioxide is suitable for this purpose.

.....

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

The presence of carbon dioxide in the body (within all organs/tissues including the oesophagus and stomach) was often correctly identified as one factor for its suitability to float the polymer. Most candidates found this topic to be accessible.

Question 6 (d)

(d) Gastric ulcers develop when the stomach acid damages the lining of the stomach.

To detect gastric ulcers in the stomach lining, patients are given a barium meal followed by an X-ray scan.

A barium meal contains a compound that coats the stomach and is opaque to X-rays.

Some information about the solubility of three barium compounds is shown in the table.

Compound	Solubility (g per 100 g of water at 20 °C)
$BaCO_3$	2.4×10^{-3}
$BaCl_2$	35.8
$BaSO_4$	2.4×10^{-4}

Aqueous barium ions are toxic to humans.

Explain which one of the three compounds of barium is safe to use as a barium meal.

.....

.....

.....

.....

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

Few candidates successfully selected $BaSO_4$ as the safe form of barium meal. They were challenged by the interpretation of the table and the significance of $x10^{-4}$ compared to $x10^{-3}$. Some candidates chose the incorrect compound but did give a full and correct explanation with regards to low levels of solubility. This type of response was creditworthy and obtained 1 mark. Other candidates appeared to struggle with the concept of solubility as presented in the table.

OCR support

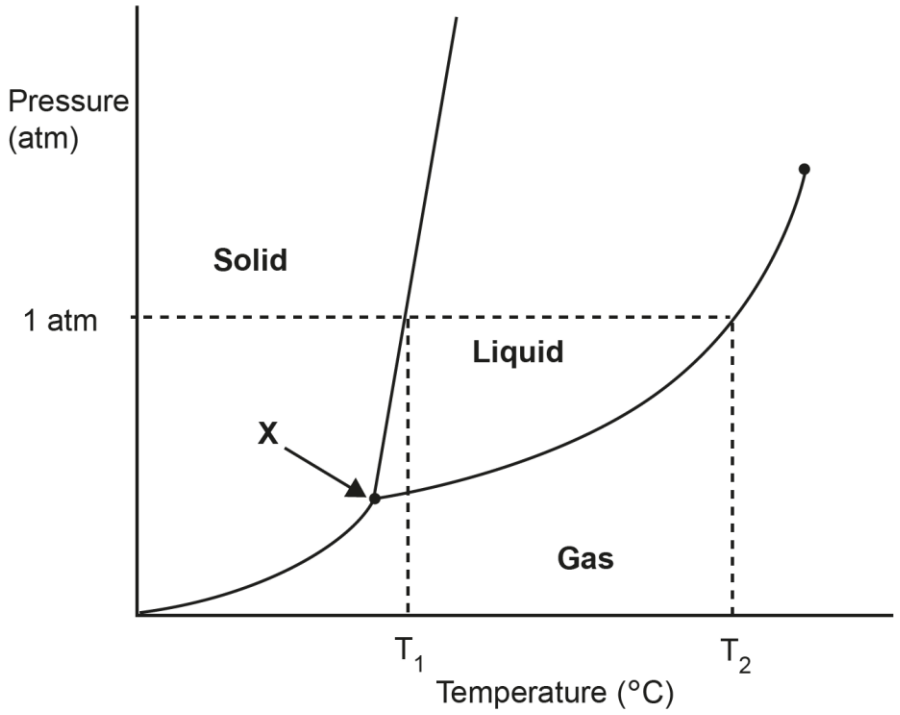
GCSE past paper questions are available on ExamBuilder – easily create maths skills transition materials to check in on students' understanding of concepts like standard form and scale.

Question 7

7 The three states of matter are solid, liquid and gas.

The phase diagram for a typical pure substance, **Z**, is shown below. When the temperature of solid **Z** is increased at one atmosphere pressure (room pressure), it changes from solid to liquid to gas.

A few substances, such as solid carbon dioxide, change directly from solid to gas when heated at one atmosphere pressure.



- State the significance of temperatures T_1 and T_2, and the point marked **X** on the diagram.
- Use the diagram to explain the effect on the temperature at which liquid **Z** vaporises of increasing the pressure.
- Explain why solid carbon dioxide sublimes at room temperature and pressure.

[6]

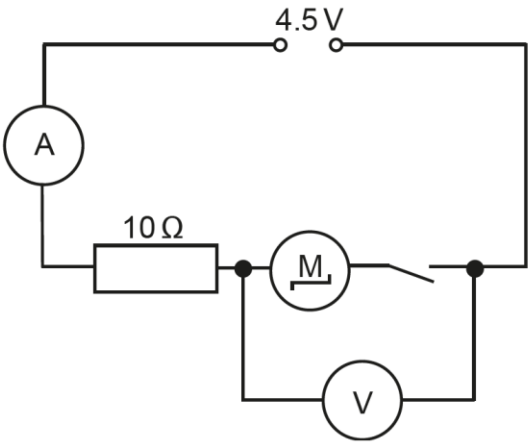
Most candidates appeared to be unfamiliar with the interpretation of a phase diagram. This is certainly a challenging topic. However, an understanding of the basic features of melting point, boiling point and sublimation was seen. This enabled some candidates to function at Level 1 (1 or 2 marks) or possibly Level 2 (3 or 4 marks) for this Level of Response (LoR) question. A few candidates did particularly well and obtained marks at Level 3.

Assessment for learning

This question relates to **LO6 Understand the structures, properties and uses of materials**. It would be useful for students to practise the interpretation of phase diagrams with a range of examples, of which many are available online. Candidates often struggle with interpreting states at different temperatures, so encouraging them to draw a temperature number line and labelling melting and boiling points will help.

Question 8 (a) (i)

8 The circuit diagram shows a small electric motor, **M**, in series with a resistor and connected to a power supply with a potential difference of 4.5 V.



(a)

(i) When the switch is closed the reading on the voltmeter is 2.5 V and the reading on the ammeter is 0.14 A.

Calculate the input power *P* to the motor and state the unit.

Use the equation: $P = V I$

P = ... unit = ... **[2]**

Many candidates did well with this question and calculated the value of 0.35 W. Although some candidates struggled with the calculation they did often obtain the mark for the correct unit.

Question 8 (a) (ii)

(ii) Show that the potential difference across the 10 Ω resistor is 2.0 V.

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

This type of question, based on proof of values, is often challenging for most candidates. It requires factual recall and the application of knowledge for this particular scenario. In this case, some candidates did successfully observe that the evidence was via 4.5 – 2.5 = 2.0V. An alternative calculation, based on V=IR, was also acceptable and some candidates used this to show 0.14 x 10 = 1.4V.

Question 8 (a) (iii)

(iii) Show that the resistance of the motor and the resistance of the resistor have a combined total resistance, R_T of approximately 28 Ω.

Use the equation: $V = I R$ in your calculation.

.....

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

As for Question 8(a)(ii), this question was based on the evidence to confirm a given value, in this case for the combined total resistance. The equation was provided in the stem of the question and some candidates were able to use this to demonstrate 17.857 + 10 = 27.857 (approx. 28Ω). Many candidates did, however, struggle to show the evidence. No clear pattern of alternative responses was seen.

Question 8 (a) (iv)

(iv) Theory suggests that the current, I in the circuit can be calculated using the potential difference of the supply and the total resistance of the circuit, R_T.

Calculate I.

$I =$ ..... A **[1]**

A number of candidates correctly calculated that $I = 0.16$. There was no common alternative response.

Question 8 (b)

(b) There is a difference between the reading on the ammeter and the current calculated in **(a)(iv)**.

Explain why there is a difference.

.....

.....

.....

.....

.....

.....

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

Many candidates were challenged with this question. There was a tendency to incorrectly refer to inaccurate components of the circuit or operator error. Some candidates did, however, successfully note that the calculated current is higher than the measured value. No further common errors were observed.

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Question 2(c) Fig 2.1 – Iron block: Shutterstock 1451632586 by Dmytro Falkowskyi

Question 5(a) Fig 5.1 – Prokaryotic cell: Shutterstock 1723434550 by Olga Bolbot

Question 5(b) Fig 5.2 and Fig. 5.3 (modified image) – Plasma membrane structure: Shutterstock 2091815284 by Biology Education

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