CAMBRIDGE TECHNICALS

OCR
Oxford Cambridge and RSA

CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

05847–05849, 05879, 05874

Unit 1 January 2023 series

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. 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

Many candidates had revised well for this paper and it appears that most of the topic areas within the specification content had been covered. However, some candidates did seem to find a number of questions a challenge and did not complete a response for all parts. There was no clear pattern of a particular question or item identified in relation to such 'nil responses'. The majority of candidates followed the rubric of the paper and, in general, completed the paper within the time allocated.

As for a number of past examination series, many candidates followed the instructions correctly for the Level of Response (LoR) type question [Q6(b)(iv)]. This resulted in almost all candidates achieving marks for this LoR question at Level 1. Some candidates did well and progressed to Level 2 and some achieved marks at Level 3.

The candidates were familiar with the objective-format items, such as completing tick-boxes against optional statements, the addition of missing words within sentences, joining concept boxes with lines and completing tables. Some candidates did not use the working space provided for calculations. This prevented them from gaining mid-stage calculation marks.

As in previous series, relatively few candidates used the additional pages provided at the end of the paper. However, when such pages were used, clear links were shown within the answer spaces in the paper.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• had revised and prepared well for the examination, including the details shown in the 'exemplification' section of the specification • had developed the skills and knowledge to reflect the Unit 1 specification. • generally understood the basics of inorganic and organic chemistry, using correct symbols and terminology • were often more able to respond to the biology-related topics encountered. • used the rubric of the question paper to good effect and accessed a range of objective-formats. • were not challenged by data presented as graphs and images to identify trends. • showed relevant skills and knowledge, using the information given via the stems of questions • had a good understanding of the LoR question and included an explanation of the graph.	• did not appear to revise or prepare for the examination at the required level and, as a result, were not familiar with the 'exemplification' section of the specification • tended not to show a range of skills and knowledge based on the Unit 1 specification • did not seem to understand inorganic and organic chemistry, including the Periodic Table • did not respond to some items, including the biology-related topics • seemed unable to interpret the rubric of the question paper, including sentence-completion items • tended to not be able to interpret data via graphs and images, including the identification of trends • often misinterpreted the information given in the stem of questions • did not seem to understand the graphical data presented for the LoR question, leading to a description but with limited or no explanation.

Question 1 (a) (i)

1 Chemical elements are arranged in groups and periods in the Periodic Table.

Table 1.1 shows some information about four elements **W**, **X**, **Y** and **Z**.

The letters **W** to **Z** are **not** the chemical symbols of the elements.

Table 1.1

Element	Electronic structure	Group number	Period	Proton number
W	2,4	.....	.....	6
X	2,8	.....	2	.....
Y	.....	.....	.....	16
Z	2,8,8,2	.....	.....	.....

(a) (i) Complete **Table 1.1**. **[4]**

The majority of candidates did well with this item. It is not possible to identify a common error, based on the responses observed.

Question 1 (a) (ii)

(ii) Give the letters of the **two** elements in **Table 1.1** that form a compound with a covalent bond.

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

Many candidates did not identify W and Y as the two compounds capable of forming a covalent bond.

Assessment for learning

It is recommended that the topic of bonds and their formation is covered in detail, as outlined in the unit specification **LO 3.1** (including both ionic and covalent bonds).

Question 1 (a) (iii)

(iii) Element **Z** reacts with chlorine to form an ionic compound.

Give the name of element **Z** and write the ionic half-equation to show how an atom of element **Z** becomes an ion.

Name of element **Z** .....

Half-equation

.....

[3]

Almost all candidates correctly identified element Z as calcium. Some obtained an additional mark for the correct presentation of Ca^{2+} within the half-equation. Few candidates obtained full marks for the half-equation. However, no common error was observed.

Question 1 (a) (iv)

(iv) Sodium has the electronic structure 2,8,1.

Give the formula of the ionic compound formed when sodium reacts with element **Y**.

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

Although many candidates attempted to identify the formula for the ionic compound, only some correctly presented the formula as Na_2S. A number wrote NaS.

Question 1 (b) (i)

(b) The heaviest isotope of element **W** in **Table 1.1** has an atomic mass number of 14.

(i) Determine the number of neutrons in one atom of this isotope.

number of neutrons ..... **[1]**

Many candidates correctly identified the number of neutrons as 8.

Misconception

There was a tendency to incorrectly identify the number as 4, 6 or 7.

Question 1 (b) (ii)

(ii) Calculate the nuclear radius, *R*, of this isotope using the equation:

$R = r_0 A^{1/3}$

where A is the atomic mass number and $r_0 = 1.25 \times 10^{-15}$ m.

Show your working and give your answer to **3** significant figures.

R = ...m **[2]**

A number of responses were correct and such candidates presented their response to 3 significant figures and to the correct power of 10 (3.01×10^{-15}). Some were less sure of the use of significant figures.

Assessment for learning

It may be useful for some candidates to be reminded of the application of 'significant figures'.

Question 1 (c) (i)

(c) Complete the following sentences about forces in the nucleus using words from this list:

attraction	**electromagnetic**	**electrons**	**long**
neutrons	**protons**	**repulsion**	**short**
stable	**strong**	**unstable**	**weak**

You may use each word once, more than once or not at all.

(i) The ..... force is the force of .....

between protons in the nucleus.

[1]

A number of candidates found this item and the following two items challenging. It was clear that candidates were able to use the words provided to complete items (c)(i), (c)(ii) and (c)(iii), but some were challenged overall. In this case, many candidates successfully selected 'electromagnetic' as the force but considered that the force is that of attraction rather than repulsion between the protons in the nucleus.

Assessment for learning

It is suggested that the topic of forces within the nucleus is reinforced using simple diagrammatic models, based on 'attractive and repulsive forces', as outlined in the unit specification **LO 1.1**.

Question 1 (c) (ii)

(ii) Radioactive decay occurs when a nucleus is ..... .

In β decay, neutrons are converted into protons by the action of the

..... force within the nucleus.

[1]

Many candidates correctly identified both of the words from the list. They appreciated that radioactive decay occurs when a nucleus is unstable. However, some candidates were less confident about the action of the weak force within the nucleus. This prevented them from obtaining the marking point.

Question 1 (c) (iii)

(iii) The ..... force is responsible for holding the protons and

neutrons together in the nucleus.

It has a ..... range.

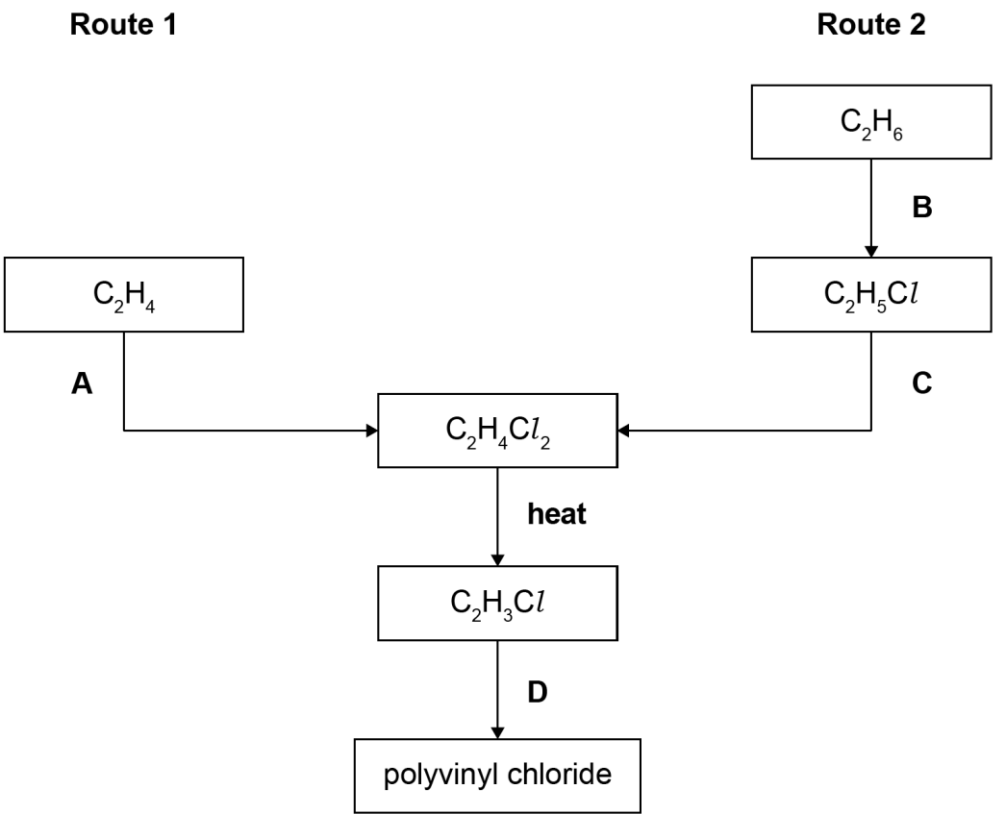
[1]

Again, a number of candidates were confident with the concept of a strong force and that the force has a short range. However, many appeared to select words at random.

Question 2 (a)

2 **Fig. 2.1** shows two different routes for the synthesis of polyvinyl chloride (PVC).

Fig. 2.1



(a) The starting molecules in **Route 1** and **Route 2** belong to different families of organic compounds.

Identify the family of organic compounds that each molecule belongs to.

Draw a **straight line** to link each molecule to its family of organic compounds.

Molecule	Family of organic compounds
	alcohols
C_2H_4	aldehydes
	alkanes
C_2H_6	alkenes
	alkynes

[2]

The majority of candidates obtained at least 1 mark for this item. There was a tendency for them to be confident about C_2H_4 belonging to the alkenes.

Misconception

? However, some incorrectly considered that C_2H_6 belonged to the aldehydes, rather than to the alkanes.

Question 2 (b) (i)

(b) (i) Identify the type of reaction labelled as **A** in **Fig. 2.1**.

Tick (✓) **one** box.

addition	☐
condensation	☐
displacement	☐
substitution	☐

[1]

Almost all candidates correctly selected 'addition' for the reaction labelled as **A**. No pattern of alternative responses can be identified.

Question 2 (b) (ii)

(ii) Identify the type of reaction labelled as **B** in **Fig. 2.1**.

Tick (✓) **one** box.

addition	☐
condensation	☐
displacement	☐
substitution	☐

[1]

Many candidates correctly selected 'substitution' as the type of reaction labelled **B**. No clear pattern of alternative responses can be identified.

Question 2 (c) (i)

(c) (i) In reaction **C**, C_2H_5Cl reacts with chlorine to form $C_2H_4Cl_2$ and one other product.

Write the overall equation for this reaction.

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

Although most candidates correctly included the two formulae within the overall equation, many were unable to show chlorine as **Cl_2** and **HCl** as a product.

Misconception

A number of candidates incorrectly considered that the other product was **H_2O**, rather than **HCl**.

Question 2 (c) (ii)

(ii) Reaction **C** involves radicals.

Explain what radical means and how a chlorine radical is formed in reaction **C**.

.....

.....

.....

.....

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

This was a challenging topic for the majority of candidates. Some appreciated that a radical results in an unpaired electron, although some did attempt to describe this as a 'free electron'. Very few candidates referred to the significance of UV light (or a high temperature) or the idea that the bond breaks.

Assessment for learning

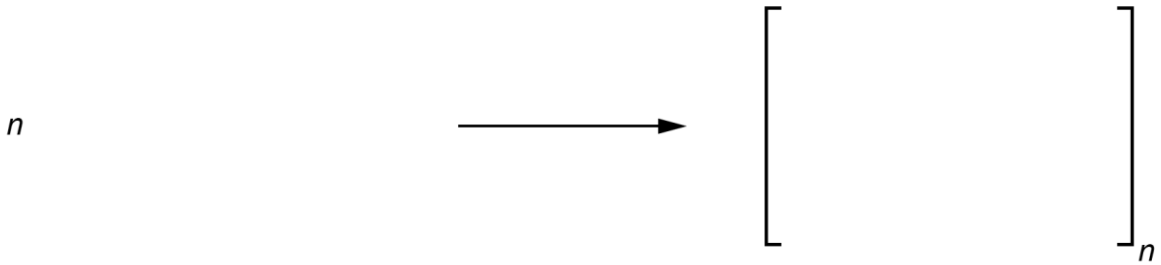
It is proposed that candidates are given an outline of radicals via the use of simple models, to reinforce the basic characteristics of radical reactions (unit specification **LO 2.2**).

Question 2 (d)

(d) Complete the equation in **Fig. 2.2** to show the formation of polyvinyl chloride (reaction **D**).

You must use structural formulae for the reactant and the product in the reaction.

Fig. 2.2



[2]

A number of candidates gave a 'nil response' for this item and, although some attempted to construct the structural formulae, many were clearly challenged. Some almost completed the reactant correctly but included a single bond between the two carbons, rather than a double bond. Others inserted a double bond between the two carbons for the product, instead of the required single bond. There was a level of confusion shown be many.

Assessment for learning

Candidates could be reminded about the features of structural formulae, with particular reference to the presentation of one unit of a polymer.

Question 2 (e) (i)

(e) Ethene, C_2H_4, can also be used to make a polymer.

(i) Give the name of the polymer made from ethene.

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

The name of the polymer for ethane (polyethene) was understood by most candidates. No clear pattern of alternative responses can be identified.

Question 2 (e) (ii)

(ii) Deduce the empirical formula of the polymer.

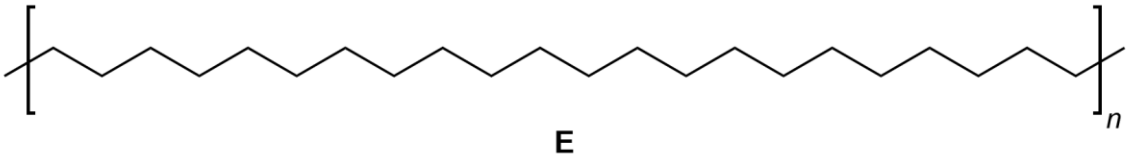
..... **[1]**

The characteristics of empirical formulae appeared to be less well-known by many candidates. Relatively few responded correctly (CH_2). Some candidates jotted down their ideas adjacent to the response line and this demonstrated a level of uncertainty in their thinking. No clear pattern of alternative responses was observed, with the exception of **CH**, rather than **CH_2**.

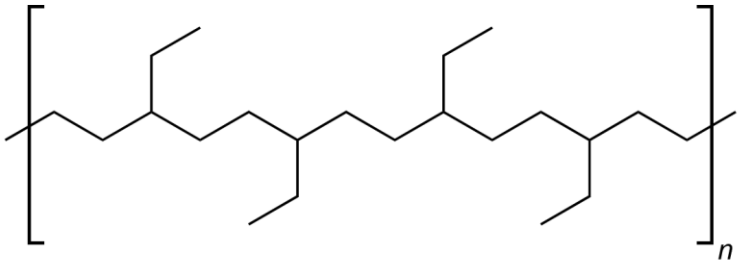
Question 2 (f) (i)

(f) **Fig. 2.3** shows the skeletal formulae of two different forms of the polymer made from C_2H_4.

Fig. 2.3



E



F

(i) The two polymers **E** and **F** shown in **Fig. 2.3** are isomers. The value of *n* is the same in both polymers.

(Circle) the type of isomerism shown by **E** and **F**.

geometric **optical** **structural**

[1]

The majority of candidates used the information provided to correctly determine that the type of isomerism was structural. The incorrect reference to geometric or optical appeared to be random.

Question 2 (f) (ii)

(ii) One of the structures shown in **Fig. 2.3** is the high density form of the polymer.

State and justify which structure is the high density form of the polymer.

.....

.....

.....

.....

.....

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

The vast majority of candidates incorrectly chose polymer **F** instead of **E** as the high-density option. It appears that the candidates considered that branching enabled the polymer to have greater density. Some candidates attempted to describe the close packing characteristic of dense polymers, but such descriptions were often unclear.

Assessment for learning

It is recommended that simple diagrammatic models are used to demonstrate the features of dense and less-dense polymers, using skeletal formulae (unit specification **LO 4.2**).

Question 3 (a)

3 **(a)** Eukaryotic cells contain endoplasmic reticulum but prokaryotic cells do not.

Name **two** other organelles present in a eukaryotic cell which are **not** present in a prokaryotic cell.

1 .....

2 .....

[2]

It was clear that candidates had a good understanding of at least one key difference between the two cell types. Many candidates did well and identified nucleus and mitochondrion. Other candidates incorrectly chose DNA, cytoplasm, or cell membranes. These features are common to both cell types.

OCR support

Further information for this topic is available in the unit specification at **LO 3.1**. This can be used to encourage students to construct their own diagrammatic models to highlight the differences between eukaryotic and prokaryotic cells.

Question 3 (b)

(b) Smooth endoplasmic reticulum is responsible for production and storage of compounds required by the eukaryotic cell.

Identify the two compounds produced and stored by the smooth endoplasmic reticulum.

Tick (✓) **two** boxes.

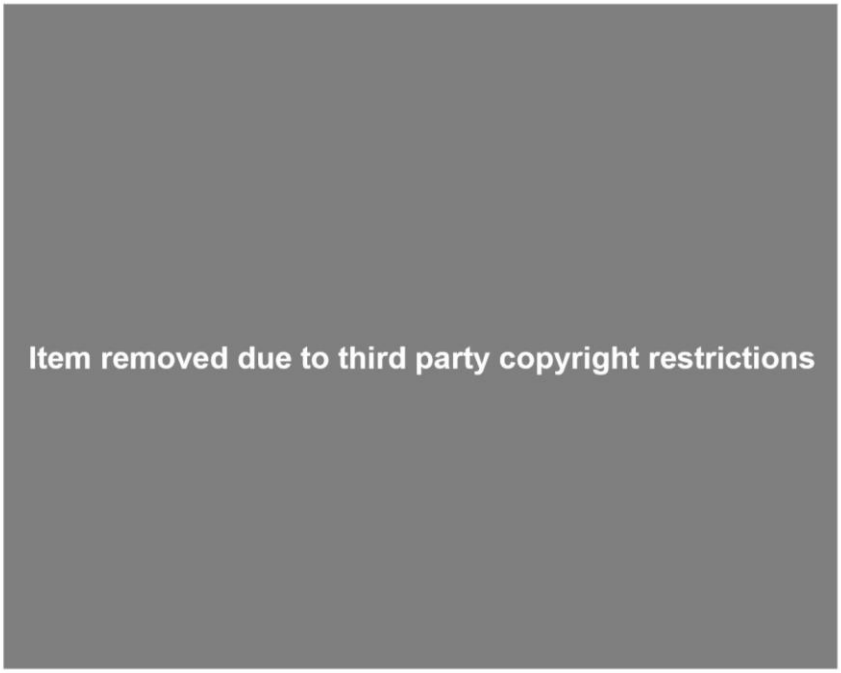
carbohydrate	☐
chlorophyll	☐
lipid	☐
protein	☐
RNA	☐

[2]

Many candidates correctly identified carbohydrate and lipid as the two compounds produced and stored in smooth endoplasmic reticulum. Some chose protein, perhaps confusing this structure with rough endoplasmic reticulum.

Question 3 (c) (i)

(c) The figure below shows a highly magnified image of rough endoplasmic reticulum.
The surface of rough endoplasmic reticulum is covered in black dots.



(i) Identify the black dots in the figure.
Tick (✓) **one** box.

chromosome	☐
lysosome	☐
mesosome	☐
ribosome	☐

[1]

The majority of candidates correctly recalled that ribosomes are attached to rough endoplasmic reticulum. The micrograph provided the scaffolding needed to enable candidates to be confident with their choice. No pattern of alternative responses can be identified.

Question 3 (c) (ii)

(ii) Describe the function of rough endoplasmic reticulum in a cell.

.....

.....

.....

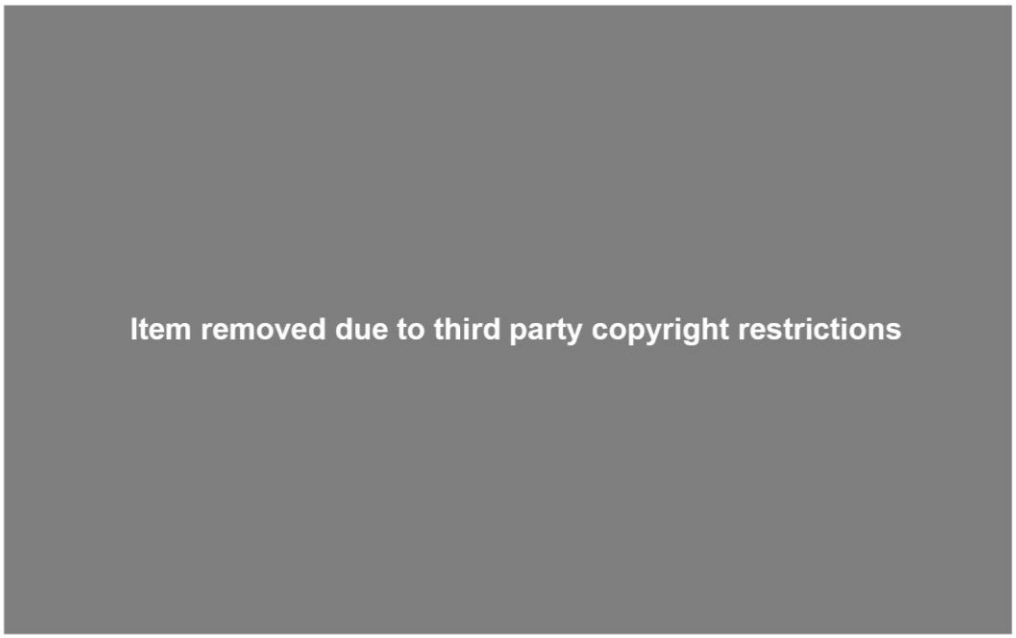
..... **[2]**

Many candidates found this question to be accessible and understood that rough endoplasmic reticulum produces and packages proteins. Relatively few referred to the formation of glycoprotein but most candidates obtained both marks.

Question 3 (d)

(d) Rough endoplasmic reticulum is found in large quantities in some types of epithelial tissue.

The diagram below shows ciliated epithelial tissue lining the inner surface of the trachea (windpipe), leading to the lungs of the human body.



Use the features shown in the diagram to explain how the ciliated epithelial tissue protects the lungs.

.....

.....

.....

.....

.....

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

The diagram provided much scaffolding to enable some candidates to show their understanding of the roles of cilia and mucus within the trachea. Some were challenged by the topic and considered that cilia produced mucus and others incorrectly described the trapping of air or molecules (unqualified).

Assessment for learning

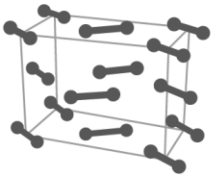
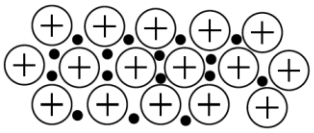
It is recommended that students are encouraged to draw models of the trachea VS and TS and to use annotations to highlight the key functions of the different components. The main characteristics are listed alongside epithelia in the unit specification at **LO 3.3**.

Question 4 (a)

4 The melting point of a substance depends mainly on the strength of the forces between the particles: the stronger the forces, the higher is the melting point.

(a) On **Fig. 4.1** draw **a straight line** from each substance to its lattice structure **and a straight line** from each lattice structure to the type of lattice.

Fig. 4.1

Substance	Lattice structure	Type of lattice
copper		giant covalent
silicon dioxide		metallic
iodine		simple molecular

[3]

Although some candidates seemed to find it a challenge to interpret this objective-type question, most obtained at least 1 or 2 marks. One mark was often awarded for the links between silicon dioxide and the giant covalent lattice. Some did very well and drew lines correctly across the model. No clear pattern of alternative responses was identified.

Question 4 (b)

(b) The melting points of the three substances are shown in **Table 4.1**.

Table 4.1

Substance	Melting point / °C
Copper	1085
Silicon dioxide	1713
Iodine	114

Identify the types of forces present in the three substances shown in **Fig. 4.1** and explain why the substances have different melting points.

.....

.....

.....

.....

.....

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

This was challenging for many candidates. The correct responses focused primarily on the types of bonds/forces or the relative amount of energy required to break the bonds or overcome the forces.

Misconception

There was a tendency to repeat the information provided in the table, referring to the melting points for each substance without recognition of the types of bonds/forces involved or an explanation.

Question 5 (a) (i)

5 Manganese is an important trace metal for the functioning of the human body.

(a) One important biological role of manganese ions is the normal functioning of the liver.

(i) Identify the role of manganese in supporting the liver.

Tick (✓) **one** box.

biosynthesis of choline	☐
breakdown of unwanted amino acids	☐
maintenance of an isotonic balance	☐
transportation of oxygen	☐

[1]

Relatively few candidates correctly selected biosynthesis of choline as the role of manganese in supporting the liver.

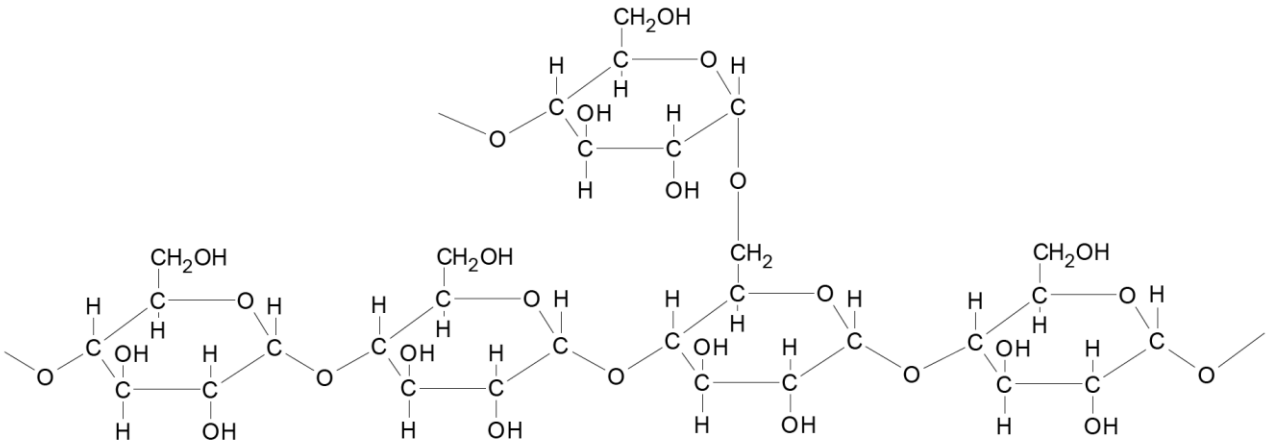
Misconception

? A common error resulted in the selection of 'breakdown of unwanted amino acids'. It should be understood that this is due to the role of the liver, rather than the role of manganese. This was a common response. Manganese function is outlined in the unit specification at **LO 5.1**.

Question 5 (a) (ii)

(ii) One of the functions of the liver is to store glucose as glycogen.

The figure below shows part of the glycogen molecule, which is formed from glucose.



Use the figure to explain how glycogen is formed.

Your answer should include reference to the reaction and the type of link formed.

.....

.....

.....

.....

.....

.....

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

A number of candidates responded well to the scaffolding provided in the stem of this question and the use of the diagram. Further instruction was also given with reference to the reaction and type of link formed. Many appeared to be unsure of glycosidic bonds (C4 and C6), branching and the overall process of glycogenesis. However, some candidates did recognise that condensation reactions took place and correctly referred to the chain of glucose molecules.

Question 5 (a) (iii)

(iii) Glucose is a monosaccharide but when two molecules combine a disaccharide is formed.

Circle the disaccharide formed from two glucose molecules.

lactose **maltose** **sucrose**

[1]

Only some candidates correctly recalled that two glucose molecules formed maltose. No pattern for the incorrect choice of lactose or sucrose is observed.

OCR support

The basic features of carbohydrates are outlined in the unit specification at **LO 4.4**.

Question 5 (a) (iv)

(iv) The polysaccharide, glycogen, acts as an energy source in the human body.

Give the name of a **different** polysaccharide found in plants, which also acts as an energy source.

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

This appeared to be challenging for many candidates. They were unable to identify starch as the other type of polysaccharide acting as an energy source, in this case in plants. Some candidates chose cellulose, the structural carbohydrate. Others appeared to select terms associated with plants in a random manner, such as chlorophyll.

Question 5 (b) (i)

(b) Manganese is important for the maintenance of bones.

(i) Give **two** functions of bone within the human body.

1 .....

2 .....

[2]

This topic was very accessible to many candidates. Common responses included structure and movement or protection. No clear pattern of common errors can be identified for this question.

Question 5 (b) (ii)

(ii) Describe the composition of bone and the role of manganese in the formation of bone.

.....

.....

.....

.....

.....

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

A number of candidates correctly referred to the matrix containing calcium and included bone marrow. Some were very informed about bone structure and described the presence of osteocytes or fibres. A few candidates progressed onto details of the lacunae and blood vessels. Such correct details were all creditworthy.

Assessment for learning

Some of the features of bone are noted in the unit specification at **LO 3.3**. It is suggested that these could be used to share simple diagrammatic models with students to reinforce the key features of this organ/tissue.

Question 5 (c) (i)

(c) Metals are only required in trace amounts by the human body.

The intake of manganese for an adult should not exceed 10 mg per day.

The table below shows a range of food types that contain manganese.

Food type	Mass of one portion / g	Manganese content in one portion / mg
Almonds	95	2.2
Brown rice	195	1.8
Pinto beans	171	0.8
Spinach	30	0.3

Of the four food types shown in the table, almonds have the highest percentage by mass of manganese per portion.

(i) If an adult were to eat 500 g of almonds in a day, they would consume more than 10 mg of manganese.

Use the data in the table to calculate the mass in mg of manganese that would be consumed from eating 500 g of almonds.

Give your answer to **2** decimal places.

mass = ...mg **[2]**

A number of candidates were able to use the data provided in the stem of this question to work through the calculation and present the correct answer of 11.58 (mg). Some did not show their working and could therefore not be given the mid-calculation mark (for 500 x 2.2 ÷ 95), even though they had included an incorrect final answer. Some candidates were unable to give their answers correctly to 2 decimal places.

Question 5 (c) (ii)

(ii) Identify the food type that contains the **lowest percentage** by mass of manganese in one portion.

You must show your calculation of the percentage of manganese in each food type to support your answer.

Brown rice	Pinto beans	Spinach

Food type with lowest percentage by mass of manganese in one portion:

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

The majority of candidates attempted to complete the calculations within the table but found it a challenge to do this correctly. However, they did present an answer for each of the three calculations and (although they were not awarded marks for their answers) they moved on to correctly identify the food type with the lowest percentage by mass of manganese in one portion, based on their calculations.

Question 6 (a) (i)

6 (a) Copper, iron and platinum ions are all components of compounds which are important in living systems.

(i) Draw a **straight line** to link each metal ion to the compound that it is found in.

Metal ion	Compound
Cu^{2+}	cisplatin
Fe^{3+}	haemocyanin
Pt^{2+}	myoglobin

[2]

The majority of candidates correctly linked platinum to cisplatin. This allowed them to gain at least 1 mark. There was some confusion with regards to the links between copper and iron to the two respiratory pigments, haemocyanin and myoglobin.

OCR support

Details of inorganic chemistry in living systems are available in the exemplification column of the unit specification at **LO 5.1**.

Question 6 (a) (ii)

(ii) Name **one** function of cisplatin.

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

Many candidates understood that cisplatin has a role in the control of cancer, chemotherapy, and the interruption of nuclear division. No clear pattern of alternative responses can be identified.

Question 6 (a) (iii)

(iii) Haemocyanin carries oxygen in some organisms.

Identify the type of organism which can use haemocyanin for this purpose.

(Circle) the correct answer.

fungus **human** **invertebrate** **plant**

[1]

Relatively few candidates selected invertebrates as the type of organism using haemocyanin to carry oxygen. A number incorrectly chose fungi or plants, but this appeared to be somewhat random.

Question 6 (b) (i)

(b) Metal ions are also essential components of some enzymes.

(i) Give the general name for a component that is required for an enzyme to function.

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

Very few candidates correctly recalled that the general name for this component is cofactor. Many referred to other features of enzymes such as active site or catalyst.

Assessment for learning

It is recommended that simple models are used to reinforce the importance of cofactors to many enzymes. A reference to cofactors is found in the unit specification at **LO 5.1.**

Question 6 (b) (ii)

(ii) Nickel (II), Ni^{2+}, is one type of metal ion needed for enzyme function.

Identify the nickel-containing enzyme from the list below.

Tick (✓) **one** box.

amylase	☐
cellulase	☐
hydrogenase	☐
lipase	☐

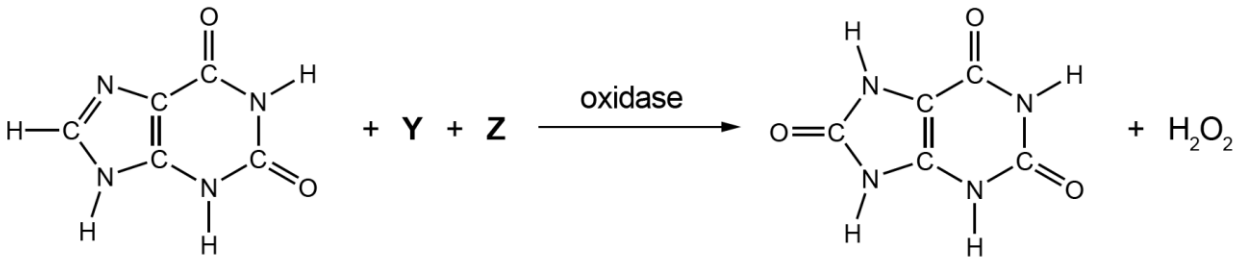
[1]

Some candidates correctly selected hydrogenase but no pattern of alternative responses can be observed. Nickel is a key component of hydrogenase and hydrolase. It is not found in amylase, cellulose, or lipase.

Question 6 (b) (iii)

(iii) Enzymes have many different functions.

The equation below shows one reaction that is catalysed by the enzyme oxidase.



Write the **formulae** of the two molecules that are represented by **Y** and **Z** in the equation.

Y = ...

Z = ...

[2]

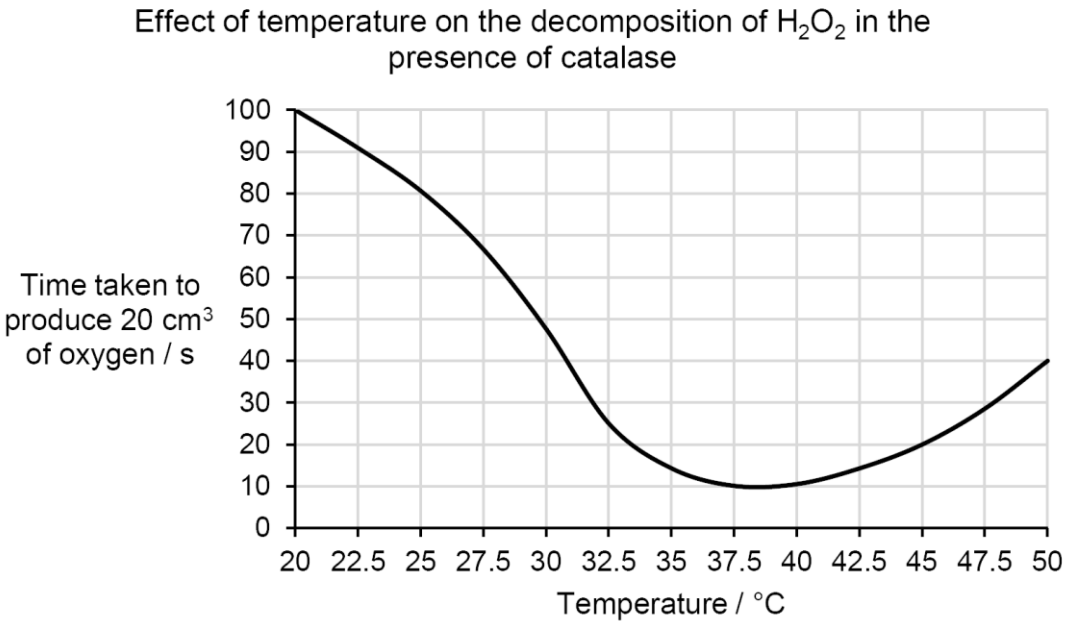
A number of candidates correctly identified H_2O and O_2 as the two molecules in the equation. Some candidates wrote the names of molecules, rather than the formulae. This prevented them from obtaining the marking points. No clear pattern of alternative responses can be observed.

Question 6 (b) (iv)

(iv) The enzyme, catalase, has a very different function in living things. It catalyses the decomposition of hydrogen peroxide to produce water and oxygen.

A biology student is investigating the effect of temperature on the decomposition of hydrogen peroxide in the presence of catalase.

- The student measures the time taken to collect 20 cm^3 of oxygen at 20 °C.
- They repeat the experiment at different temperatures ranging from 20 °C to 50 °C.
- They then plot a graph of time taken to collect 20 cm^3 of oxygen against temperature. The graph is shown below.



Describe and explain the data shown in the graph.

You should refer to the shape of the graph in your answer.

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

Almost all candidates obtained 1 or more marks for this level of response (LoR) question. There was a tendency to provide an extensive description of events observed via the graph without giving an explanation. This prevented candidates from progressing onto Level 2 marking points. However, some candidates gave very detailed explanations including references to collision rates, denaturation, and the change in shape of the active site. No common errors were seen.

Question 7 (a)

7 Metals are good electrical conductors because they have high charge carrier densities.

In a metal, the charge carrier density, n, is the number of free electrons per m^3. The value of n can be calculated using the equation:

$$n = \frac{I}{Avq}$$

where I is the current, A is the area of a cross-section of the conductor, v is the drift velocity of the electrons in the conductor and q is the charge on an electron.

The current I in a 1.0 m length of wire made from silver is 2.0 A.

The cross-sectional area A of the wire is 5.0×10^{-7} m^2.

The drift velocity v of the electrons in the wire is 4.3×10^{-4} m s^{-1}.

The charge q on an electron is 1.6×10^{-19} C.

(a) Calculate the value of n.

n = ... per m^3 **[2]**

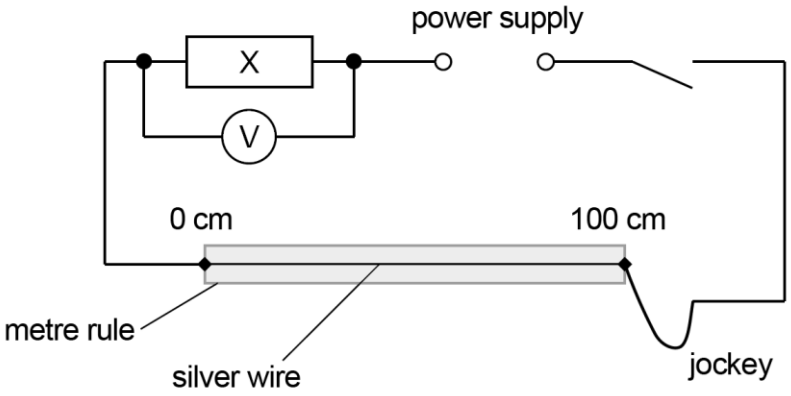
Many candidates obtained full marks for this question and calculated n = 5.8 x 10^{-28} (per m^3). Some seemed to find it challenging to present the correct power of 10.

Misconception

Other candidates made an error in the calculation and used 1.0 rather than 2.0 divided by (5.0 x 10^{-7} x 4.3 x 10^{-4} x 1.6 x 10^{-19}). No other common errors can be detected.

Question 7 (b) (i)

(b) The silver wire is attached to a metre rule and connected in series with a power supply, a switch and a resistor X as shown in the circuit below.



The jockey is a sliding contact which may be connected at different points along the length of the silver wire.

When the switch is closed there is a reading of 4.0 V on the voltmeter.

(i) Calculate the resistance of the resistor X.

Resistance of X = ...Ω **[2]**

This calculation was accessible for many candidates and they correctly calculated the resistance of X as 2 (Ω). No clear pattern of alternative responses is noted.

Question 7 (b) (ii)

(ii) Calculate the power dissipated in the resistor X.

Power dissipated = ... W **[2]**

This calculation was also accessible for many candidates, resulting in the correct calculation of power dissipated as 8 (W).

Question 7 (b) (iii)

(iii) The jockey is detached from the silver wire and re-attached at the 50 cm mark on the metre rule.

Explain why the drift velocity of the electrons in the wire increases.

.....

.....

.....

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

This topic was challenging for the majority of candidates. Some correctly referred to an increase in current but references to resistance were missing or incomplete. No clear pattern of common errors can be observed.

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