CAMBRIDGE TECHNICALS

OCR
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CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

05847–05849, 05879, 05874

Unit 1 Summer 2022 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.

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Unit 1 series overview

Many candidates prepared sufficiently well for this paper, and it appears that much of the specification content had been encountered via the taught curriculum. The candidates were familiar with the rubric of the paper, enabling them to use the scaffolding available for a number of items. Almost all candidates attempted the full range of questions and completed the paper within the time allocated. As for the previous series, some candidates did not respond to one or two items in the paper, but no pattern of 'nil response' could be identified for specific questions. The majority of candidates responded well to this 90-mark paper.

The candidates responded in a positive way to the use of objective-format items. This included the completion of tick-boxes for optional statements, the addition of missing words in sentences, joining concept boxes with lines and completing tables. Occasionally, candidates did not use the calculation spaces available (with particular reference to Questions 7(d)(ii), 7(d)(iii) and Question 9). This restricted the allocation of mid-stage calculation marks.

The additional pages provided at the end of the paper were rarely used by candidates. However, when candidates did use these pages, easy-to-use links were shown within the answer spaces in the paper. As in the previous series, some candidates used asterisks to make the link, while others referred to the additional page numbers.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• Had prepared well for this exam paper and focused on the details available via the 'exemplification' section of the specification • had acquired an appropriate range of skills and knowledge, as outlined in the specification • had a sound understanding of inorganic and organic chemistry and applied the correct symbols and terminology • often showed greater confidence with the biology-related topics in the paper • understood the rubric of the exam paper so that they could respond well to the different question formats presented • interpreted graphs and images to construct a relevant description or explanation, as required • interpreted the scenario and stem of each question so that they could demonstrate the knowledge and skills required • had some understanding of the penultimate question with regards to the use of a phase diagram.	• Did not appear to have focused on the details available via the 'exemplification' section of the specification • did not seem to acquire a range of skills and knowledge as outlined in the specification • struggled with the topics of inorganic and organic chemistry, including the interpretation of the Periodic Table and use of correct symbols and terminology • did not interact with some items, but with no discernable pattern linked to individual questions • did not respond well to the scaffolding available via the rubric of the exam paper, including the completion of tables and concept line drawing • were challenged by the interpretation of data provided via a graph • struggled to demonstrate the knowledge and skills required to respond effectively to the penultimate question, in particular, with regards to the concept of a phase diagram.

Question 1 (a) (i)

1 There are four fundamental forces.

The forces are listed in the box below.

gravitational force
electromagnetic force
strong nuclear force
weak nuclear force

(a) Some of these forces are responsible for attraction or repulsion within the nucleus of an atom.

You should select from the forces in the box to complete **(a)(i)** to **(a)(iv)**.

The name of each force can be used once, more than once or not at all.

State which fundamental force is responsible for:

(i) the attraction between electrons and protons.

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

The majority of candidates correctly identified the electromagnetic force as the attraction between electrons and protons. No clear pattern of alternative responses was identified.

Question 1 (a) (ii)

(ii) keeping the nucleus stable.

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

Most candidates correctly selected the strong nuclear force as the force needed to keep the nucleus stable. The provision of the term 'nucleus' in the stem may have contributed to a more confident response to this item.

Question 1 (a) (iii)

(iii) radioactive decay.

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

Again, candidates often gained the mark for this item, correctly identifying the weak nuclear force as the force leading to radioactive decay. Some alternative responses were seen but no clear pattern was noted.

Question 1 (a) (iv)

(iv) the repulsion between protons.

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

Some candidates may have been reluctant to repeat one of the terms in the list provided [having used electromagnetic force as their choice for Q1(a)(i)]. In this case, the electromagnetic force is responsible for the repulsion between protons. A number of candidates incorrectly chose gravitational force as their response.

Misconception

Future candidates may benefit from further support to avoid any misconceptions about electromagnetic and gravitational forces.

Question 1 (b) (i)

(b) An isotope of radon has the nuclear notation

$^{222}_{86}Rn$

In radioactive decay, the identity of this isotope of radon changes to an isotope of polonium with the loss of 4 atomic mass units.

(i) Use the Periodic Table on the back page to identify the atomic number of polonium.

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

Almost all candidates correctly identified the atomic number of polonium as **84**. No clear pattern of alternative responses was noted.

Question 1 (b) (ii)

(ii) Complete the nuclear notation of the isotope of polonium formed.

.....
Po
.....

[1]

Many candidates identified the nuclear notation of the isotope (formed for polonium). They correctly recorded both **218** and **84** in their response. Some candidates selected 84 correctly, but this was not the case for 218. The full notation was required for the mark.

Question 1 (b) (iii)

(iii) State **one** difference between different isotopes of polonium.

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

The most frequently used, correct response was the difference in the number of neutrons. However, some candidates did refer correctly to the different mass number.

Question 1 (b) (iv)

(iv) The nuclear radius of an atom, R, can be approximated using the formula:

$$R = r_0 A^{\frac{1}{3}}$$

where A is the nucleon number

$r_0 = 1.25 \times 10^{-15}$ m

Calculate the nuclear radius of the isotope Ra-222.

Show your working.

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

Although a number of candidates obtained full marks for this calculation, others struggled to use the values and equation provided to complete the task. Some candidates did not provide the power of 10^{-15} and were allocated a maximum of 1 mark. No common error was noted for this calculation.

Question 1 (c) (i)

(c) Polonium is classed as a metal.

(i) Use the Periodic Table on the back page to identify the group number of polonium.

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

Almost all candidates were capable of using the Periodic Table to identify the group number of polonium as either 6 or 16. Most selected 16.

Question 1 (c) (ii)

(ii) Polonium reacts with hydrogen to form a compound with the formula PoH_2.

Suggest why it is difficult to predict the type of bonding present in PoH_2.

.....

.....

.....

.....

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

Many candidates correctly observed that polonium is a metal. However, this was a challenging item for many candidates. Some correctly described the option of ionic bonding but tended to struggle to articulate the reasoning for covalent bonding.

OCR support

It is recommended that the comparison between ionic and covalent bonding is reinforced with candidates via simple, diagrammatic models wherever possible.

Question 1 (c) (iii)

(iii) Tellurium is in the same group in the Periodic Table as polonium. It has a relative atomic mass of 127.6.

Explain why the relative atomic mass of tellurium is not a whole number.

.....

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

Many candidates appreciated that atomic mass is the mean/average of the isotopic masses. Some also correctly noted that Tellurium has more than one isotope. Those candidates describing Tellurium as 'an isotope', without further explanation, were unable to obtain the marking point.

Question 2 (a) (i)

2 A chemistry student is investigating the redox reaction between chlorine and sodium iodide.

(a) A Cl_2 molecule is formed when two Cl atoms join together to form a covalent bond.

(i) The atomic number of Cl is 17.

Give the electron configuration of a Cl atom.

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

The majority of candidates correctly recorded 2, 8, 7 as the electron configuration. Other alternative responses did not reveal a trend or a particular misconception. However, the '1s2 2s2 2p6 3s2 3p5' was accepted as a realistic configuration.

Question 2 (a) (ii)

(ii) Draw a dot-and-cross diagram to show the bonding in a Cl_2 molecule and label the covalent bond.

Show the outer shells only.

[2]

A variety of responses were observed for this dot-and-cross diagram. Many candidates correctly showed the three pairs of dots and crosses on each outer shell but did not locate the remaining dot-and-cross in the point of overlap. The majority of candidates tended not to obtain the mark for a label of the covalent bond. This reinforces the need for candidates to carefully read the stem/instruction of an item.

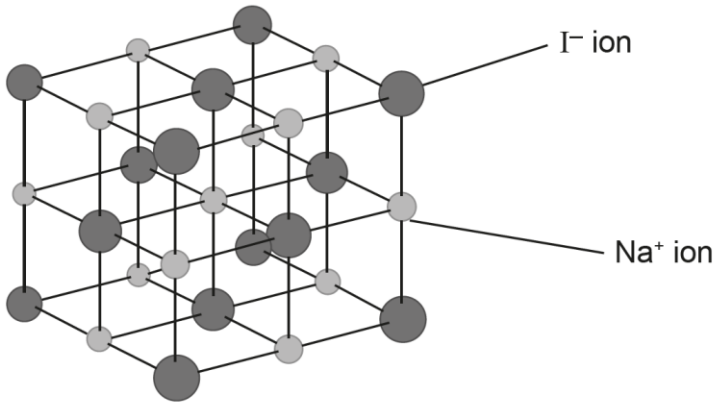
Assessment for learning

It is proposed that candidates are given the opportunity to study past paper questions, supported by teacher feedback, to reinforce the need to follow the rubric and read instructions with care.

Question 2 (b)

(b) Sodium iodide, NaI, is an ionic solid with a high melting point.

A model of the structure of NaI is shown below.



Use the model to explain why sodium iodide has a high melting point.

.....

.....

.....

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

Many candidates identified that the bonds in the model are strong (and hard to break). Fewer candidates also described the nature of the ionic bonding with respect to oppositely charged ions.

Question 2 (c) (i)

(c) When chlorine reacts with sodium iodide, chlorine molecules (Cl_2) react with iodide ions (I^-) to form iodine molecules and chloride ions.

(i) The reaction is normally carried out with water as the solvent.

Describe the colour change the student sees when they add aqueous sodium iodide NaI(aq) to chlorine water, Cl_2(aq).

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

Very few candidates correctly identified the colour change to red/brown/orange. Many referred to blue or white/cloudy. No apparent, common misconception was noted.

Question 2 (c) (ii)

(ii) Complete and balance the ionic equation for this reaction.

$Cl_2(aq)$ + …….. ⟶ $I_2(aq)$ + …….. **[1]**

Few candidates obtained the mark for this item. It was important for candidates to clearly show the charges involved.

Assessment for learning

It is considered that some form of assessment for learning, short internal tests, are used to help candidates to practice the skill of balancing equations.

Question 2 (c) (iii)

(iii) The reaction is a redox reaction.

State whether chlorine is oxidised or reduced and explain your answer.

.....

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

Having correctly identified that the reaction is 'reduced', candidates were expected to explain this in terms of gaining electrons. Some candidates were challenged by this item and opted, incorrectly, for 'oxidised' and linked this to either gaining or losing electrons.

Assessment for learning

The process of electron gain/loss in relation to redox reactions could be reinforced via simple models.

Question 2 (d)

(d) The student repeats the experiment in **2(c)** using solid sodium iodide in place of aqueous sodium iodide.

Explain in terms of particles why the reaction would be slower in **2(d)** than in **2(c)**.

.....

.....

.....

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

Some candidates continued to focus on the model provided in Q2(b) and incorrectly referred to bonding or gave a general description of particles being 'tightly packed'. This prevented them from obtaining full marks for Q2(d). However, many candidates noted that the particles were less free to move. Some continued with this approach and linked this to less frequent collisions. Relatively few candidates described the significance of the surface area.

Question 3 (a) (i)

3 (a) Photosynthesis takes place in the chloroplast of a plant cell.

Fig. 3.1 shows a labelled diagram of a chloroplast.

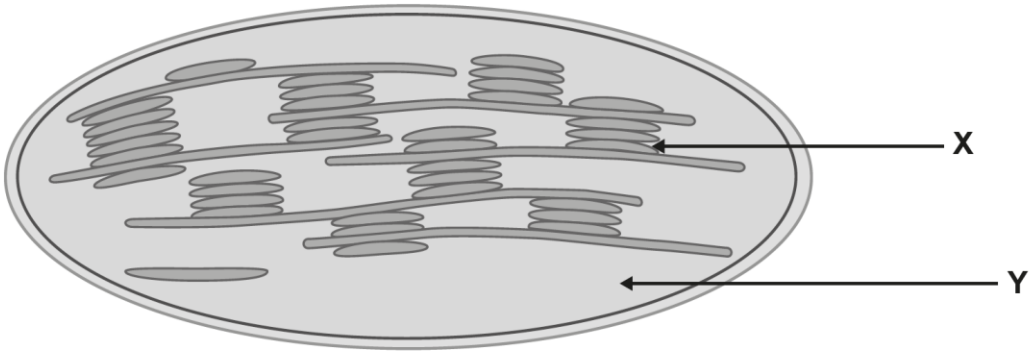


Fig. 3.1

(i) Draw a **straight line** to link each **Label** to the name of the **Structure**.

Label	Structure
	Cristae
X	Cytoplasm
Y	Cilia
	Stroma
	Thylakoid

[2]

Most candidates correctly used the standard format expected for this type of objective item. They drew a clear line from each of label X and label Y to their selected structure. Many candidates were challenged by this item. Some appeared to incorrectly interpret the model in **Fig.3.1** as a cell and assumed that label Y was pointing to cytoplasm. This was a misconception because the model was an organelle, and the watery material is stroma. Few candidates successfully identified X as a thylakoid.

OCR support

The OCR specification for Unit 1 (Learning Outcome [LO] 3.2) outlines the features of both the chloroplast and mitochondrion. It is suggested that this is used as a basis, along with the use of simple models, to clarify any misconception between these two organelles.

Question 3 (a) (ii)

(ii) Plant cells also contain mitochondria.

Mitochondria perform a biological process which differs from photosynthesis.

Identify the process and state **two** ways in which this process differs from photosynthesis.

Process .....

1 .....

.....

2 .....

.....

[3]

The majority of candidates were confident with this topic. Most candidates identified the process as 'respiration' and provided acceptable differences between respiration and photosynthesis. Some candidates struggled and gave incorrect statements about the 'production of energy'. Many candidates were clear about the need for sunlight in photosynthesis and the relevant exchange of gases. No clear pattern of alternative responses was observed.

OCR support

It is suggested that the exemplification statements in the Unit 1 specification (LO 3.2) for the structures of the mitochondrion and chloroplast are linked with the processes of (cellular) respiration and photosynthesis. The details of the two processes (e.g., glycolysis/Krebs' cycle of respiration, and e.g., light-dependent and light-independent/Calvin cycle stages of photosynthesis) are not required.

Question 3 (b) (i)

(b) A biology student is studying photosynthesis.

The student carries out an experiment to investigate the effect of light intensity on the rate of photosynthesis of an aquatic plant in water.

They set up the apparatus shown in **Fig. 3.2**.

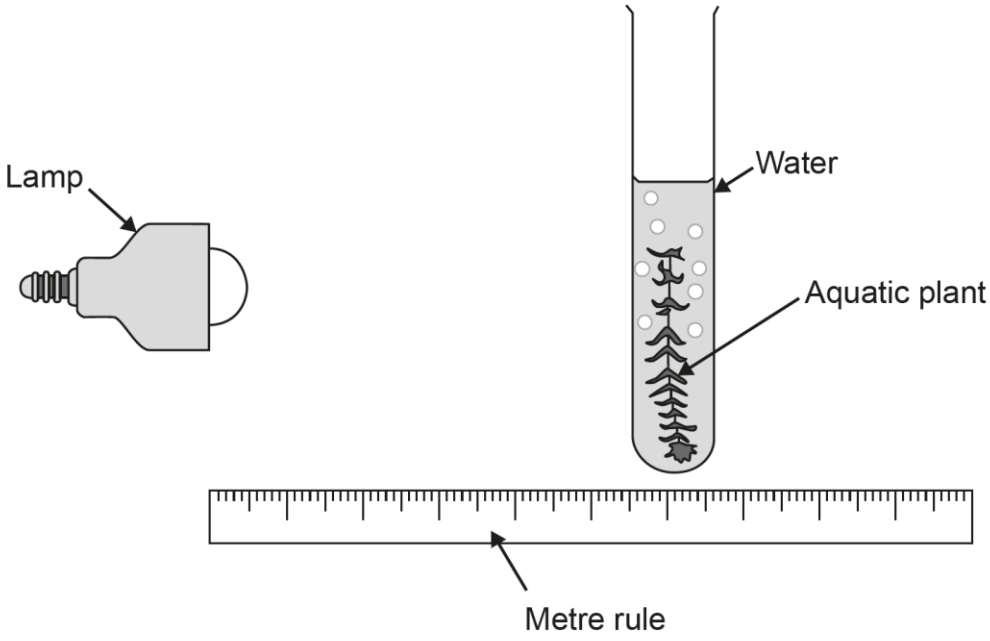


Fig. 3.2

- A light source is supplied by a lamp which is placed 0.1 m away from the test tube containing the aquatic plant.
- The student counts the number of bubbles produced in 1 minute. This is a measure of the rate of photosynthesis.
- The student repeats the experiment with the lamp placed at increasing distances from the aquatic plant.

The results of the experiment are shown in the table below.

Distance/metres	Rate (bubbles per minute)
0.1	49
0.2	49
0.3	49
0.4	36
0.5	25
0.6	
0.7	9
0.8	4
0.9	1
1.0	0

(i) Identify the gas found in the bubbles produced by the aquatic plant.

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

Most candidates correctly observed that oxygen is the gas released. However, the incorrect, alternative response of carbon dioxide was seen for a number of candidates. A few candidates were challenged by this topic and referred to hydrogen release.

Question 3 (b) (ii)

(ii) Predict the rate of photosynthesis when the lamp is 0.6 m away from the plant.

Write your answer in the blank space in the table.

[1]

Most candidates were capable of using the data provided in the table to estimate the rate of photosynthesis as 16 or 17, either response was acceptable. Very few candidates made an error with this item.

Question 3 (b) (iii)

(iii) Use the data shown in the table to describe the effect of light intensity on the rate of photosynthesis.

.....

.....

.....

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

Many candidates did well with this item and obtained 2 out of 3 marks. The third marking point was somewhat challenging. It focused on the details revealed by the data in relation to the rate of photosynthesis at light distances of 0.1 – 0.3 metres or from 0.3 metres onwards. It was clear that many candidates were sufficiently skilled to outline the relationship, using the method outlined and the table of results. It was insufficient to refer solely to the number of bubbles released for this item. Candidates were expected to draw a conclusion about the distance of the lamp/light source and the intensity of light.

Question 4 (a)

4 Tissues are a group of specialised cells which work together to provide a specific function.

(a) One type of tissue found in humans contains a collection of cells and fibres held in a gelatinous matrix.

Identify this type of tissue.

Put a tick (✓) in the correct box.

Ciliated epethelial	☐
Connective	☐
Nerve	☐
Squamous epethelial	☐

[1]

Many candidates correctly selected 'connective' as the tissue with a collection of cells and fibres held in a gelatinous matrix. A number of candidates incorrectly chose 'ciliated epithelial' tissue. The other, incorrect, options were rarely selected.

OCR support

A brief comparison of the four tissues (plus two further tissues/organs) can be found in the specification for Unit 1 at LO 3.3. It is proposed that the construction of a flow diagram should resolve any misconception about tissue types.

Question 4 (b) (i)

(b) Muscle tissue has a range of functions in the human body.

This type of tissue is important for the movement of the skeleton and for blood flow along blood vessels.

- Muscle tissue contains bundles of myofibrils.
- Each myofibril is formed from protein filaments called actin and myosin.

(i) The action of the filaments is triggered by the release of an ion by the sarcoplasmic reticulum.

Identify the ion that is released.

Draw a (circle) around the correct ion.

Ca^{2+} **Fe^{2+}** **Mn^{2+}** **Ni^{2+}**

[1]

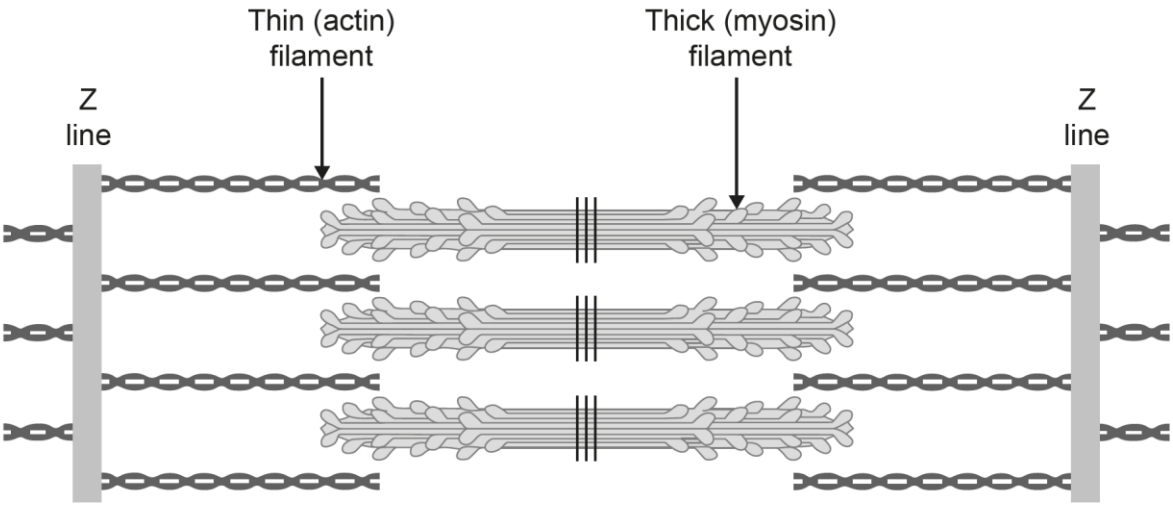
The majority of candidates identified the correct ion in this context i.e., calcium. An alternative response of iron was noted for some candidates.

Assessment for learning

This topic is based on factual recall and can be reinforced via an assessment for learning (AfL) exercise, supported with the use of past paper questions.

Question 4 (b) (ii)

(ii) The arrangement of the actin and myosin filaments in a **relaxed** muscle is shown below.



Explain how the action of the filaments in the figure can bring about muscle contraction and movement of the skeleton.

.....

.....

.....

.....

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

Many candidates were challenged by this item. They were unable to use the model to explain how the filaments relate to each other and the overall process of muscle contraction. Relatively few candidates referred to features of the sliding filament theory and struggled to explain the narrowing of the gap between the Z-lines.

Assessment for learning

It is suggested that the key features of the structure and function of the sarcomere are summarised via a series of teacher-generated models, based on the exemplification section for muscle tissue in the Unit 1 specification (LO 3.3). This video presentation may be a good model to use to demonstrate muscle contraction.

Question 4 (b) (iii)

(iii) Vasodilation is an important process involved in the regulation of body temperature.

Complete the sentences describing the process of vasodilation in the skin.

Use words or phrases from the list below.

contracts	**decreases**	**increases**	**less**
more	**no**	**relaxes**	**stays the same**

Nitric oxide is released into the smooth muscle tissue in the wall of blood vessels supplying blood to the capillaries in the skin.

As a result, the muscle tissue ……..…..... .

This allows ……..…..... blood to flow into the capillaries.

As a result, the temperature of the blood ……..…..... .

[3]

Candidates were expected to think carefully through the series of steps followed during the process of vasodilation. The topic is based on the key features of unstriated/smooth/involuntary muscle, in this case that found lining the walls of blood vessels e.g., arterioles. Many candidates coped well with the item and appreciated that the muscle tissue was relaxed and that more blood would flow into the capillaries. However, the concept that the temperature of the blood would decrease was misunderstood.

Question 5 (a)

5 **(a)** A protein is a long-chain molecule which is synthesised from amino acids.

Give the name of the bond formed when amino acids join together to form a protein molecule.

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

The bond formed between two amino acids is the peptide bond. Most candidates were correct in their response to this factual recall item. No clear pattern of alternative responses was recorded.

Question 5 (b)

(b) The amino acids in this molecule are joined together in a specific order.

The order of amino acids involves the activity of DNA and RNA molecules.

Identify the role of the DNA and RNA molecules.

Draw a **straight line** to link the name of each **Molecule** to its **Role**.

Molecule	Role
DNA	Brings the amino acids to the site of protein synthesis at the ribosome
Messenger RNA	Copies the genetic code and carries this to the ribosome
Transfer RNA	Holds the genetic code in the nucleus

[2]

Most candidates constructed a 'star shaped' collection of three lines, correctly linking each of the three molecules to their role. For those candidates achieving 1 out of 2 marks, they tended to be correct for the link between DNA and its role in holding the genetic code in the nucleus, but incorrect for the other two links.

Question 5 (c) (i)

(c) Vesicles are organelles which transport the proteins that have been made at the ribosomes.

One specific type of vesicle is a lysosome.

(i) Identify **two** structural features of a lysosome.

Put a tick (✓) in **two** boxes.

It has a membrane	☐
It has no membrane	☐
It has a star-like shape	☐
It has a spherical shape	☐
It has a rectangular shape	☐

[2]

Although the majority of candidates appreciated that the lysosome has a membrane and that it is spherical in shape, some understood the shape but considered that this organelle lacks a membrane.

Misconception

This misconception can be resolved by the construction of simple, diagrammatic models for each of the organelles listed in the specification for Unit 1 at LO 3.2, supported by an appropriate use of past paper questions. Placing the organelles in a generalised model of a cell is also helpful for this task.

Question 5 (c) (ii)

(ii) Identify the cell organelle that produces lysosomes.

Choose from the following list:

golgi apparatus	**plasma membrane**
rough endoplasmic reticulum	**smooth endoplasmic reticulum**

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

Many candidates correctly identified Golgi apparatus. There was, however, a tendency for candidates to incorrectly choose RER or SER as the production site of lysosomes.

Assessment for learning

It is advised that candidates are encouraged to construct a simple model of a cell, showing all relevant organelles involved in the production, processing, and packaging of proteins. This will help them to appreciate the difference between the vesicles produced by the SER and RER with the secretory vesicles and lysosomes produced by the Golgi apparatus.

Question 5 (c) (iii)

(iii) The type of protein that a lysosome contains is an enzyme.

Describe the specific functions of the enzyme contained within a lysosome.

.....

.....

.....

.....

.....

.....

.....

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

It was anticipated that candidates would focus on the 'specific' functions of the enzymes most commonly found in lysosomes. Such enzymes are digestive in nature, break down a range of organic compounds (including proteins), unwanted organelles and bacteria and even have the potential to destroy cells (autolysis). In general terms, this is outlined in the specification for Unit 1 at LO 3.2. However, it is understood that candidates are much more familiar with the 'general' features of enzymes e.g., active site and the 'lock and key' hypothesis. A general description of enzymes was credited with one mark.

Question 6 (a) (i)

6 Organic compounds can be classified according to which family they belong to.

Fig. 6.1 shows the first member of a family of hydrocarbons.

Fig. 6.1

(a) (i) State whether the hydrocarbon in **Fig. 6.1** is saturated or unsaturated.

Explain your answer.

.....

.....

.....

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

Many candidates did very well with this item. Having correctly stated that the hydrocarbon is unsaturated, candidates were expected to refer to the presence of the triple bond or to note that not all bonds are single. No clear pattern of alternative explanations was observed.

Question 6 (a) (ii)

(ii) Identify the type of hydrocarbon shown in **Fig. 6.1**.

Put a tick (✓) in the correct box.

Aldehyde ☐

Alkane ☐

Alkene ☐

Alkyne ☐

[1]

A number of candidates correctly identified 'alkyne' as the hydrocarbon shown in **Fig. 6.1**. However, it appeared that this item was challenging for many candidates. Not one of the three remaining options could be identified as a common, incorrect alternative response.

Question 6 (a) (iii)

(iii) Draw the structural formula of the second member in the family of hydrocarbons.

[1]

The key feature of this structural model was for candidates to locate the position of the triple bond. Many candidates were unable to complete this task correctly. Again, no clear pattern of alternative responses was identified.

Question 6 (b) (i)

(b) The compound in **Fig. 6.1** can be used as a monomer to make a polymer.

The skeletal formula of the polymer that is formed from the monomer is shown in **Fig. 6.2**, where *n* is the number of repeat units.

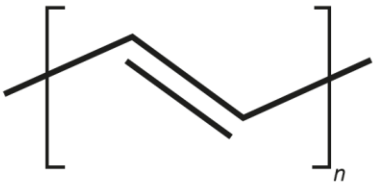


Fig. 6.2

(i) Identify the type of reaction taking place when the polymer shown in **Fig. 6.2** is formed.

Put a tick (✓) in the correct box.

Addition ☐

Condensation ☐

Substitution ☐

[1]

Many candidates correctly selected 'addition' as the type of reaction taking place. This appeared to be a relatively straightforward, factual recall item.

Question 6 (b) (ii)

(ii) Explain this reaction in terms of bond-breaking and bond-forming.

.....

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

Although some candidates seemed to have an understanding of the events taking place in this reaction, many were unable to articulate a clear response in relation to bond-breaking and bond-forming. The focus of the item was that of the triple bond-breaking in the monomer and forming another bond with an adjacent monomer during the formation of the polymer.

Question 6 (b) (iii)

(iii) The polymer shown in **Fig. 6.2** shows stereoisomerism.

Identify the type of stereoisomerism.

Draw a (circle) around the correct type.

geometric **optical** **structural**

[1]

Many candidates correctly selected 'geometric' as the type of stereoisomerism shown in the polymer. For those candidates who did not gain a mark, there was a tendency for them to incorrectly choose 'structural'.

Question 6 (b) (iv)

(iv) Explain how the section of the polymer shown in **Fig. 6.2** is able to exist as two stereoisomers.

.....

.....

.....

.....

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

This was a challenging question. Some candidates achieved 2 or 3 marks, but many were limited to 1 mark maximum. The correct response stemmed from the presence of a double bond in the polymer and that the polymer demonstrates a restriction of free rotation of the carbon atoms in the bond. Finally, it was expected that candidates would refer to the presence of two different atoms/groups on each carbon.

Question 6 (c) (i)

(c) A polymer that is formed from a different hydrocarbon monomer is shown in **Fig. 6.3**, where *n* is the number of repeat units.

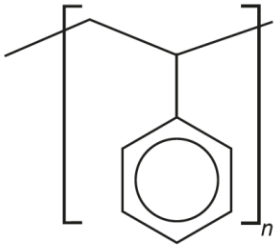


Fig. 6.3

(i) Identify the polymer shown in **Fig 6.3**.

Draw a (circle) around the correct name.

polyethene **polylactate** **polypropene** **polystyrene**

[1]

A list of polymers is provided in the specification for Unit 1 at LO 4.2. Relatively few candidates correctly selected 'polystyrene'. There was a tendency to incorrectly choose 'polythene'.

Assessment for learning

It is proposed that models of polymers listed in the specification are shared with candidates, reinforced by website sources, such as this one here.

Question 6 (c) (ii)

(ii) The compounds in **Figs 6.1**, **6.2** and **6.3** all have the same empirical formula.

Write down the empirical formula of these compounds.

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

Only some candidates identified 'CH' as the empirical formula for these compounds. There was a tendency to incorrectly quantify the numbers of atoms involved, using 2 or n.

Question 7 (a)

7 Lithium, sodium and potassium are metals in the same group of the Periodic Table.

They form ions that have important biological functions.

(a) Identify the charge on the ion that these metals form.

Put a tick (✓) in the correct box.

2− ☐

− ☐

+ ☐

2+ ☐

[1]

Many candidates correctly selected '+' as the charge of the ion of the metals lithium, sodium and potassium. Some, however, chose '2+' and thereby did not obtain the mark.

Question 7 (b)

(b) Identify the role that sodium and potassium ions have during nerve impulse transmission.

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

A number of candidates were challenged by this item and repeated the words from the stem e.g., the ions promote nerve impulse transmission. The role of these ions as charge carriers may not have been fully appreciated by some candidates but they were able to successfully describe the creation of the action potential or even their role at the synapse. The term 'charged carrier' and the creation of a 'potential difference' are included in the exemplification section of the specification for Unit 1 at LO 5.1.

Assessment for learning

It is suggested that the 'team' construction of a simple model of the axon membrane including the exchange of sodium and potassium, to create a potential difference, will be helpful for candidates to experience.

Question 7 (c)

(c) Sodium and potassium ions also create an isotonic balance between the cytoplasm and surrounding tissue fluid of cells.

This has an effect on the process of osmosis in the cell.

Explain what happens to a cell when the overall concentration of these ions in the surrounding tissue fluid decreases.

.....

.....

.....

.....

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

Candidates appear to be familiar with the process of osmosis. However, in the context of this item candidates were expected to consider isotonic imbalance, leading to the creation of a hypotonic environment in the tissue fluid and the corresponding influx of water (by osmosis), causing cells to expand or burst. This was challenging. However, some candidates did well and covered a number of the key features in their response. Many candidates were limited to 1 or 2 marks due to a misunderstanding of the direction of water flow. There was also a tendency for some to refer to the flow of ions by diffusion, without reference to osmosis.

Question 7 (d) (i)

(d) Two different lithium compounds that can be used to stabilise a person's mood are lithium carbonate and lithium citrate.

The mass of lithium in a compound can be found using the equation:

$$\text{mass of lithium (mg)} = \frac{\text{mass of compound (mg)} \times \text{number of ions of Li in formula} \times A_r \text{ of Li}}{M_r \text{ of compound}}$$

where A_r of Li = 6.9 and M_r = relative formula mass of a lithium compound.

Fig. 7.1

(i) Name **one** disorder that lithium compounds can be effective in treating.

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

This question was answered well by candidates, and they correctly referred to hypertension, dipolar disorder or depression. A number of candidates obtained the mark, but others incorrectly referred to cancer.

Question 7 (d) (ii)

(ii) A tablet contains 300 mg of lithium carbonate.

The formula of lithium carbonate is Li_2CO_3 and its M_r is 73.8.

Use the equation in **Fig. 7.1** to calculate the mass in mg of lithium that the tablet contains.

Give your answer to **3** significant figures.

Mass of lithium = ... mg **[2]**

This calculation appeared to be straightforward for many candidates. However, some were unable to correctly place the values provided into the equation in **Fig. 7.1**. Some candidates achieved the correct response but did not express it to 3 significant figures. This is an essential skill for candidates to appreciate.

Question 7 (d) (iii)

(iii) A syrup contains 466 mg of lithium citrate of which 46 mg is lithium.

The M_r of lithium citrate is 209.7.

Use the equation in **Fig. 7.1** to calculate the number of lithium ions in the formula of lithium citrate.

Number of lithium ions = ... **[2]**

Again, a number of candidates succeeded with this calculation. Some candidates presented the incorrect response but gained a mark for the correct presentation of the equation in the space provided. This is a useful reminder for candidates to be encouraged to use this space wherever possible.

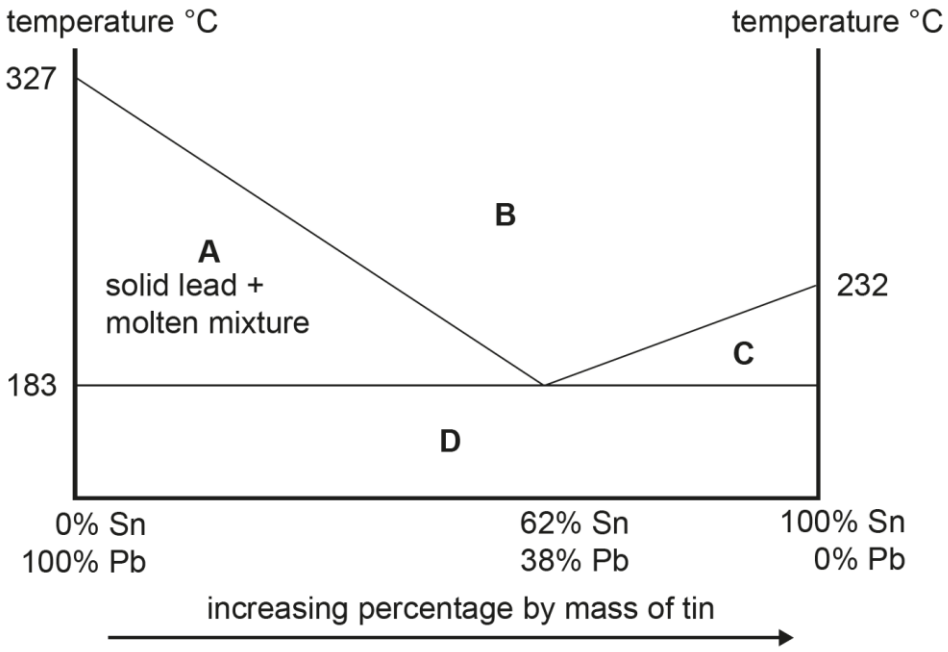
Question 8

8 Lead–tin solder is an alloy that is used to join metallic components in electronic circuits.

- When molten, solder is applied to the joint between the two surfaces; the metallic components do not melt because solder has a low melting point.
- As it cools down, the solder solidifies forming a strong bond between the two metallic surfaces.

The phase diagram below shows how the melting point of the alloy changes as the percentages of lead (Pb) and tin (Sn) change.

The phase diagram has four different regions (**A**, **B**, **C** and **D**) indicating the phases present a different temperatures. For example, in region **A**, solid lead (Pb) begins to separate out as the temperature decreases, but the mixture stays molten.



Use the phase diagram to deduce the melting points of lead and tin and describe the different phases present in regions **B**, **C** and **D**.

Explain why the composition of lead–tin solder is 62% tin (Sn) and 38% lead (Pb).

.....

.....

.....

.....

.....

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

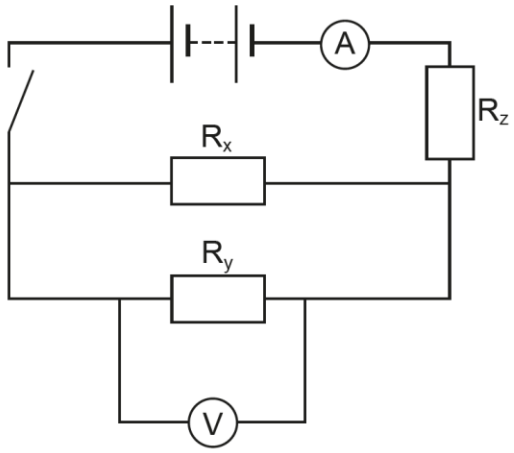
Candidates were generally limited to marks at Level 1 or Level 2. Within the structure of this free-response question (also known as a Level of Response or LoR item), these two Levels allowed candidates to obtain 1 or 2 marks, or 3 or 4 marks respectively. As in the previous series, relatively few candidates completed a response at Level 3, reflecting the challenging nature of this question. In this case, the expected response stemmed from an understanding of the concept of phase diagrams. The phase description for 'A' was provided within the model to give candidates an insight into what was expected. However, many struggled to provide a clear response and described the three remaining phases ('B' to 'D') with reference to changes in temperature along the line, rather than within each phase. Relatively few candidates were able to correctly deduce the melting points of lead and tin (at 327°C and 232°C). A response to this part of the question was often missing.

Assessment for learning

It is suggested that candidates are given the opportunity to reflect further on the construction and interpretation of phase diagrams, using a range of topics and models. One possible approach to the introduction of phase diagrams could be based on this guide.

Question 9 (a)

9 The circuit shown contains three resistors R_x, R_y and R_z.



Resistor R_x has a resistance of 22 Ω.
Resistor R_y has a resistance of 47 Ω.
Resistor R_z has a resistance of 10 Ω.

You will need to use the following equations to answer the questions below.

- Potential difference (V) = current (A) × resistance (Ω) (V = I × R)
- Charge (C) = current (A) × time (s) (Q = I × t)
- Power (W) = potential difference (V) × current (A) (P = V × I)
- Resistors in series $R_t = R_1 + R_2 + R_3$
- Resistors in parallel $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

(a) Calculate the combined resistance of the resistors in the circuit.

Combined resistance = ... Ω **[2]**

Although many candidates struggled to provide the correct value for the combined resistance of the resistors in the circuit, a number of candidates were allocated a mark for showing the addition of **10** for R_Z within their calculation. Again, this reinforces the need for candidates to include their calculations within the space provided. No clear pattern of alternative responses was identified.

Question 9 (b)

When the switch is closed the reading on the voltmeter is 12 V.

(b) Calculate the current in R_y.

Current in R_y = ... A **[2]**

A number of candidates were able to use the appropriate equation provided. Again, although many were unable to write the correct response, they included the equation with the correct values inserted. As a result, they obtained one of the marking points.

Question 9 (c) (i)

(c) Calculate:

(i) the current in R_x.

Current in R_x = ... A **[1]**

This was particularly challenging for a number of candidates. No clear error was identified in the context of alternative responses.

Question 9 (c) (ii)

(ii) the charge transferred in the ammeter in one minute.

Charge = ... C **[2]**

This was also challenging because the calculation involved two distinct steps. Some candidates were successful, but many were unable to respond in a coherent way.

Question 9 (d) (i)

(d) Calculate:

(i) the voltage across R_z.

Voltage across R_z = ... V **[1]**

Relatively few candidates were able to correctly determine the voltage across R_Z. The most confident candidates were, however, successful.

Question 9 (d) (ii)

(ii) the total power dissipated in the circuit.

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

Some candidates were capable of using the power equation provided at the start of this question and achieved 1 out of the 2 marks. In some cases, candidates correctly determined the total voltage.

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