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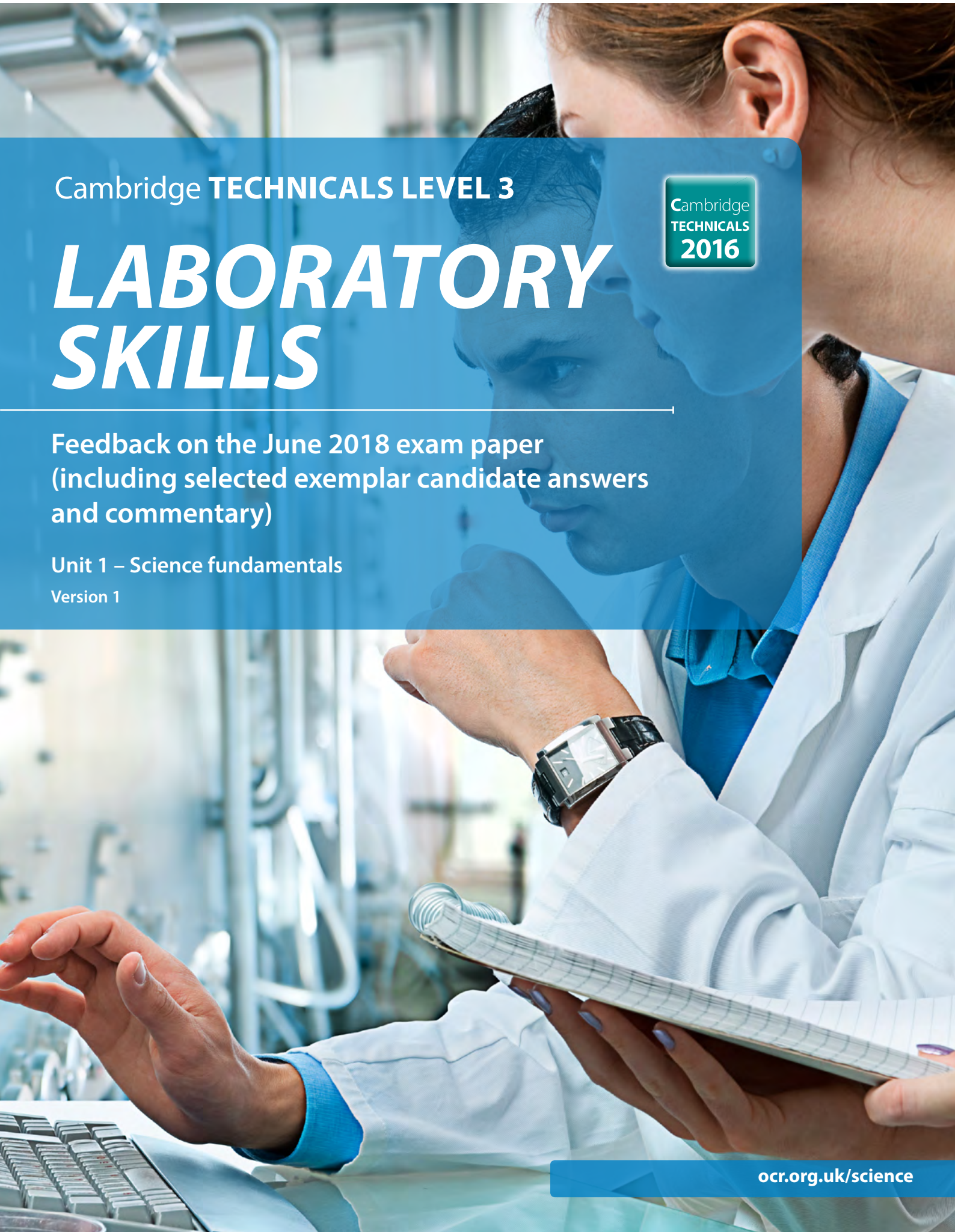


Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

LABORATORY SKILLS

Feedback on the June 2018 exam paper (including selected exemplar candidate answers and commentary)

Unit 1 – Science fundamentals

Version 1

CONTENTS

Introduction 3

General examiner comments on the paper 4

Questions 1(a), (b) and (c)(i) 5

Questions 1(c)(ii), (iii) and (d) 7

Exemplar candidate work 9

Question 2(a) 10

Question 2(b) and (c) 12

Exemplar candidate work 14

Question 3(a)(i) 16

Questions 3(a)(ii), (ii) and (b) 17

Question 3(c)(i) 19

Question 3(c)(ii) and (iii) 20

Questions 4(a)(i), (ii) and (iii) 21

Questions 4(a)(iv) and (b) 23

Question 4(c)(i) 25

Questions 4(c)(ii) 26

Question 5(a), (b) and (c) 27

Question 5(d) 29

Question 6 30

Question 7(a) 32

Question 7(b) 34

Exemplar candidate work 35

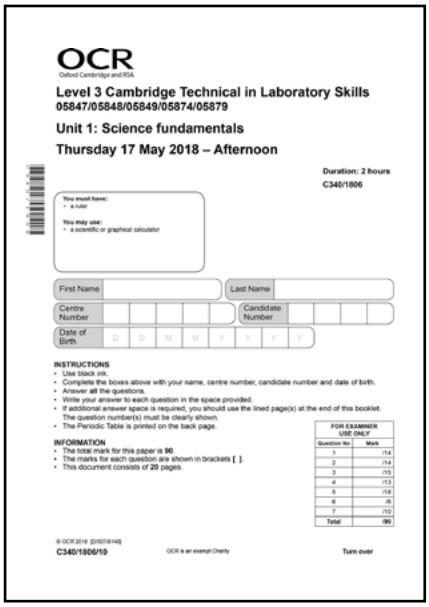
INTRODUCTION

This resource brings together the questions from the June 2018 examined unit (Unit 1), the marking guidance, the examiners comments and the exemplar answers into one place for easy reference.

We have also included exemplar candidate answers with commentary for Questions 1(c)(ii), 2(b)(i) and 7(b).

The marking guidance and the examiner's comments are taken from the Report to Centre for this question paper.

The Question Paper, Mark Scheme and the Report to Centre are available from:
https://interchange.ocr.org.uk/Modules/PastPapers/Pages/PastPapers.aspx?menuindex=97&menuid=250



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Level 3 Cambridge Technical in Laboratory Skills
05847/05848/05849/05874/05879

Unit 1: Science fundamentals
Thursday 17 May 2018 – Afternoon

Duration: 2 hours
C340/1806

You must have:
- a ruler

You may use:
- a scientific or graphical calculator

First Name | Last Name
Centre Number | Candidate Number
Date of Birth D D M M Y Y Y Y

INSTRUCTIONS
- Use black ink.
- Complete the boxes above with your name, centre number, candidate number and date of birth.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- If additional answer space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- The Periodic Table is printed on the back page.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **20** pages.

FOR EXAMINER USE ONLY

Question No	Mark
1	/14
2	/14
3	/15
4	/13
5	/18
6	/6
7	/10
Total	/90

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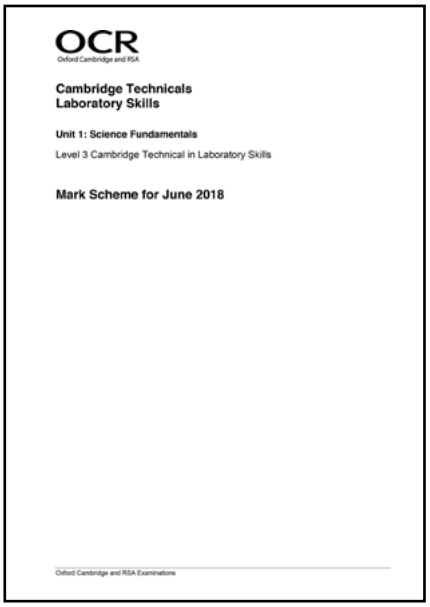
C340/1806/10 OCR is an exempt Charity **Turn over**



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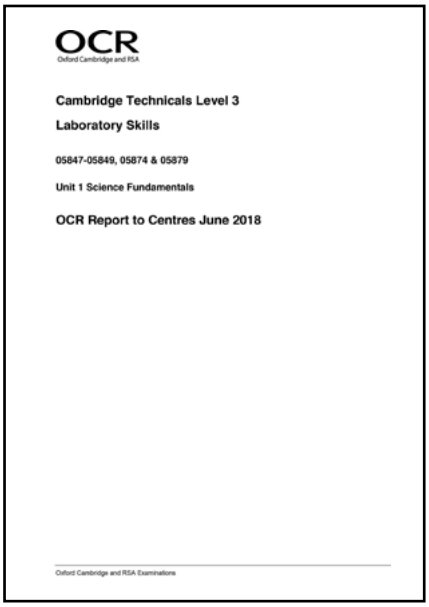
Cambridge Technicals
Laboratory Skills

Unit 1: Science Fundamentals

Level 3 Cambridge Technical in Laboratory Skills

Mark Scheme for June 2018

Oxford Cambridge and RSA Examinations



OCR
Oxford Cambridge and RSA

Cambridge Technicals Level 3
Laboratory Skills

05847-05849, 05874 & 05879

Unit 1 Science Fundamentals

OCR Report to Centres June 2018

Oxford Cambridge and RSA Examinations

GENERAL EXAMINER COMMENTS ON THE PAPER

The feedback provided by centres in respect of earlier papers was noted and considered in preparation for the current paper. The inclusion of more objective-style items enhanced the accessibility for candidates and enabled them to demonstrate their skills of factual recall and application of knowledge. In addition, candidates were well prepared for a wide range of themes/topics covered within the specification. The final question focussed on learning outcome (LO) 6 and the topic covered was clearly much more familiar to candidates. This was encouraging. However, as for earlier papers, a number of candidates struggled with items relating to cell and tissue structure and function. Many candidates were able to respond to all questions in the time available, and relatively few did not attempt to answer the questions. The additional page was rarely used by candidates.

Resources which might help address the examiner comments:

From the link below, you'll find 'The OCR guide to examinations' (along with many other skills guides)
http://www.ocr.org.uk/i-want-to/skills-guides/

Command verbs definitions
http://www.ocr.org.uk/Images/273311-command-verbs-definitions.pdf

Questions 1(a), (b) and (c)(i)

Answer **all** the questions.

1 An atom of potassium has the symbol:

$$^{39}_{19}K$$

(a) State the number of protons, electrons and neutrons in one atom of potassium.

Protons .... 19 .....

Electrons .. 19 .....

Neutrons ... 20 ..... **[3]**

(b) (i) Which **Group** in the Periodic Table does potassium belong to?

Put a (ring) around the correct answer.

(1) **3** **5** **7**

[1]

(ii) Which **Period** in the Periodic Table does potassium belong to?

Put a (ring) around the correct answer.

1 **2** **3** **(4)** **5** **6** **7**

[1]

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

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

A = nucleon number

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

(i) Calculate the nuclear radius of a potassium atom.

Show your working.

FIRST CHECK ANSWER ON ANSWER LINE
If answer = 4.24×10^{-15} (m) award 2 marks

$= 1.25 \times 10^{-15} \times 39^{1/3}$

$= 4.24 \times 10^{-15}$ (m)

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

Mark scheme guidance

Question 1(c):

ALLOW ecf 3.34×10^{-15} m (use of $19^{1/3}$).

OR 39 seen in working = 1 mark.

ALLOW 4.2 OR 4.239×10^{-15} = 2 marks.

Examiner comments

Question 1(a) – The majority of candidates were able to correctly identify the number of protons, electrons and neutrons for potassium. The most common error was the assumption that the neutron number was 39, rather than 20.

Question 1(b)(i)(ii) –Almost all candidates were able to select the correct group and period for potassium within the periodic table. No pattern was noted for alternative responses.

Question 1(c)(i) – Some candidates cope well with this item and successfully calculated the nuclear radius of a potassium atom. Some were unable to include 391/3 within their calculations.

Questions 1(c)(ii), (iii) and (d)

(ii) Explain, in terms of the forces between protons and neutrons, why the nucleus of the potassium atom does not fall apart.

Any two from:
- strong **nuclear** force
- **attraction** between protons and neutrons
- **greater** than repulsion of protons
- strong nuclear force is much greater (x 200 to 50) than repulsion force
- neutrons weaken the repulsive force between protons.

.....

.....

.....

.....

.....

.....[4]

(iii) The atomic radius of some atoms with similar properties is shown in **Table 1.1**.

Atom	Atomic radius (pm)
sodium	180
potassium	220
rubidium	235

Table 1.1

Suggest why the increase in atomic radius between potassium and rubidium is less than the increase between sodium and potassium.

- **greater** increase in protons
- **greater** attraction from nucleus to electrons

.....

.....

.....

.....[2]

(d) Two isotopes of sodium are:

$^{21}_{11}Na$ $^{22}_{11}Na$

Which statement about isotopes is correct?

Tick (✓) **one** box.

Isotopes have different charges. ☐

Isotopes have different numbers of electrons. ☐

Isotopes have different numbers of neutrons. ☑

Isotopes have different numbers of protons. ☐

[1]

Mark scheme guidance

Question 1(c)(ii):

ALLOW nucleon – nucleon interaction / residual strong force.

IGNORE ref. to force between protons and neutrons.

Question 1(c)(iii):

ALLOW 'atomic number' = 'protons'.

ALLOW 'force' = 'attraction'.

Question 1(d):

3rd box.

Examiner comments

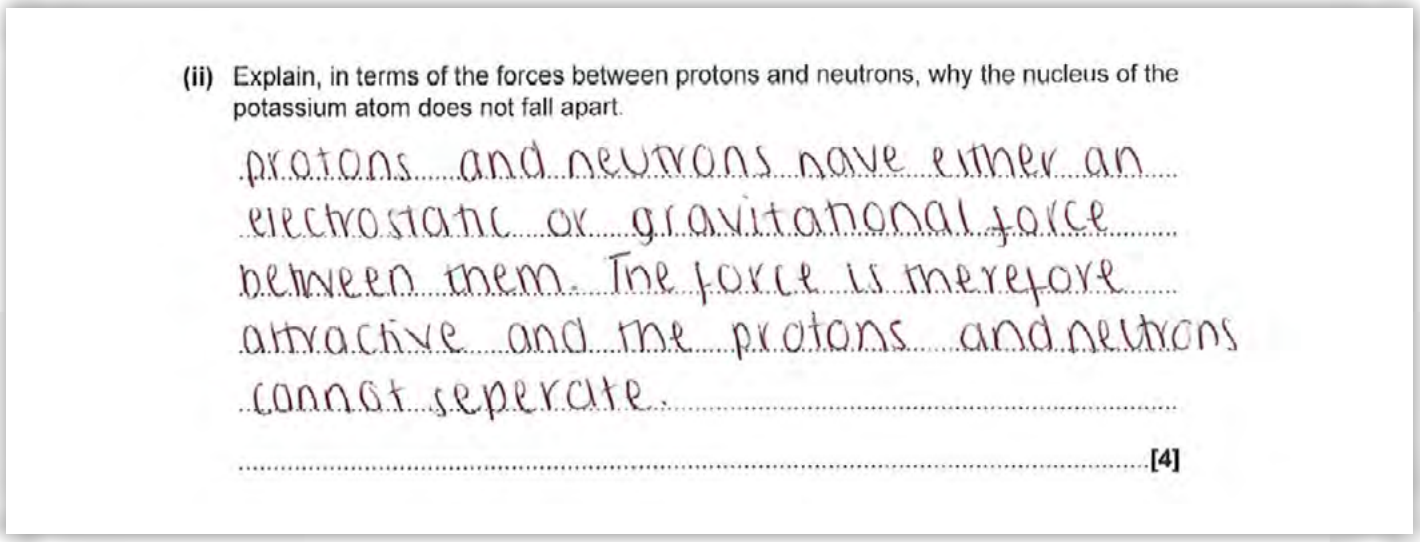
Question 1(c)(ii) – This item presented some difficulty for a number of candidates. It seemed that the features of strong nuclear force and the attraction between protons and neutrons were not fully appreciated. Some included references to gravitational forces out of context.

Question 1(c)(iii) – This item also was challenging for many candidates. The key features expected included the greater increase in proton numbers and the greater attraction from the nucleus to the electrons. Common responses referring to the numbers of electron shells failed to achieve the marking points.

Question 1(d) – The majority of candidates recognised that isotopes have different number of neutrons. No clear pattern of alternative responses was apparent.

Exemplar Candidate Work

Question 1(c)(ii) – Low level answer



(ii) Explain, in terms of the forces between protons and neutrons, why the nucleus of the potassium atom does not fall apart.

protons and neutrons have either an electrostatic or gravitational force between them. The force is therefore attractive and the protons and neutrons cannot seperate.

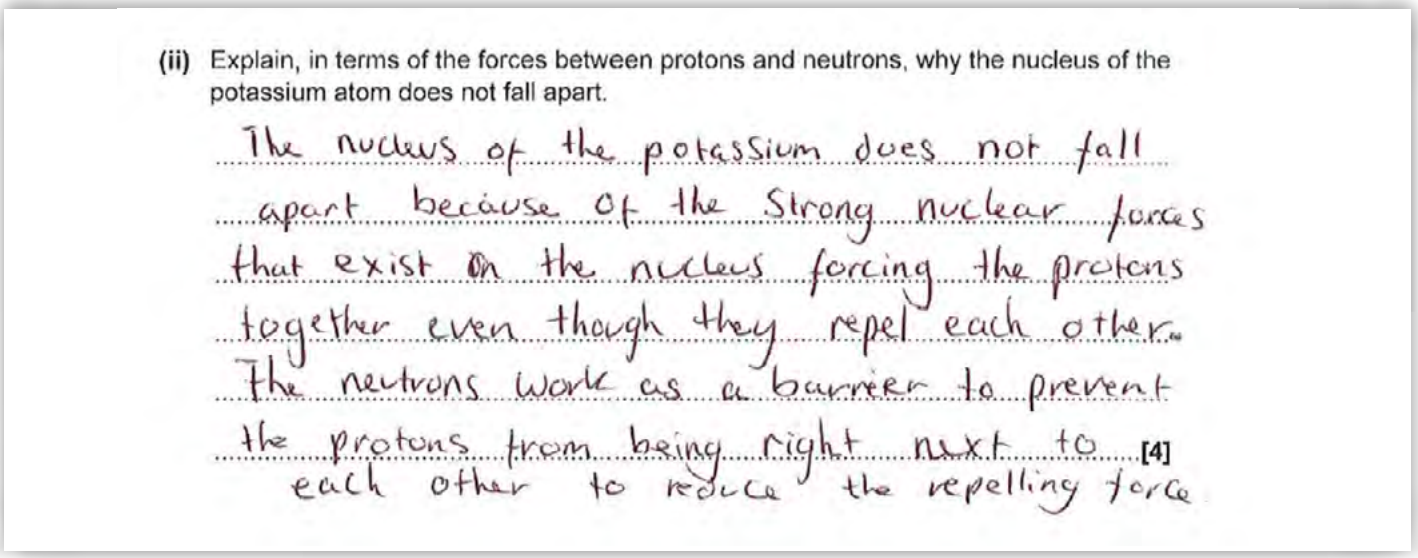
[4]

Commentary

This response referred to an attraction between protons and neutrons. This was correct but there was no reference to the strength of the nuclear force.

The response could have been further enhanced if it had stated that the attraction between the protons and neutrons was greater than the repulsion of the protons. An additional creditworthy point may have been awarded if it was further observed that neutrons weaken the repulsive force between the protons.

Question 1(c)(ii) – High level answer



(ii) Explain, in terms of the forces between protons and neutrons, why the nucleus of the potassium atom does not fall apart.

The nucleus of the potassium does not fall apart because of the strong nuclear forces that exist in the nucleus forcing the protons together even though they repel each other. The neutrons work as a barrier to prevent the protons from being right next to each other to reduce the repelling force [4]

Commentary

This response functioned at a much higher level because it clearly referred to a strong nuclear force, the repulsion of protons and the reduction of this repulsive force.

It may have been possible to achieve a full mark high level status with an additional reference to the attraction between protons and neutrons.

Question 2(a)

2 Chemicals, called amines, are important biologically and in the chemical industry.

(a) In foods nitrosamines are formed when nitrites react with amines in acidic conditions.

One source of nitrite is sodium nitrite which is used for preserving cooked meats.

(i) Sodium nitrite reacts with hydrochloric acid in the stomach to form nitrous acid, HNO_2 and sodium chloride.

Complete the symbol equation for the reaction between sodium nitrite and hydrochloric acid.

sodium nitrite + hydrochloric acid → nitrous acid + sodium chloride

$NaNO_2$ + reactants = HCl → HNO_2 + products = NaCl

[2]

(ii) When the nitrous acid reacts with a secondary amine a nitrosamine is formed.

The reaction between a secondary amine and nitrous acid is a substitution reaction.

Complete the reaction in **Fig. 2.1** to show the nitrosamine formed.

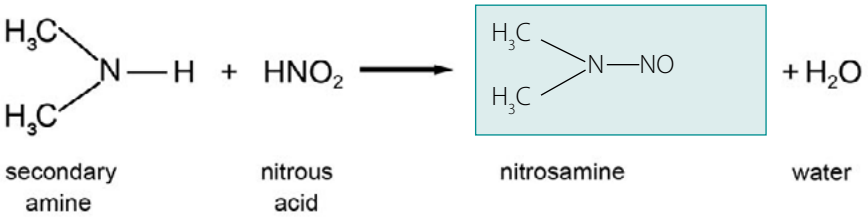


Fig. 2.1

[2]

(iii) Name **three** other types of chemical reactions.

Do **not include** oxidation or substitution in your answer.

1 ..... **Any three from:**
- reduction
- addition
- polymerisation
- radical
- displacement.

2 .....

3 .....

[3]

Mark scheme guidance

Question 2(a)(i):

DO NOT ALLOW incorrect case/words/numbers.

Question 2(a)(ii):

Correct formula = 2 marks

OR

ALLOW left side correct (incl. N) = 1 mark.

ALLOW right side correct (-NO) = 1 mark.

ALLOW -N=O $_{not}$ -N-O

Question 2(a)(iii):

ALLOW thermal decomposition.

IGNORE oxidation and substitution.

Examiner comments

Question 2(a)(i) – Candidates were familiar with the symbols for hydrochloric acid and sodium chloride. The addition of numbers, in an attempt to balance the equation, was not credited.

Question 2(a)(ii) – Most candidates correctly retained the left hand side of the nitrosamine structure but were unable to complete the –N-NO property.

Question 2(a)(iii) – This question was answers well by most candidates. Candidates were able to list options such as reduction, addition and polymerisation. Common errors included condensation.

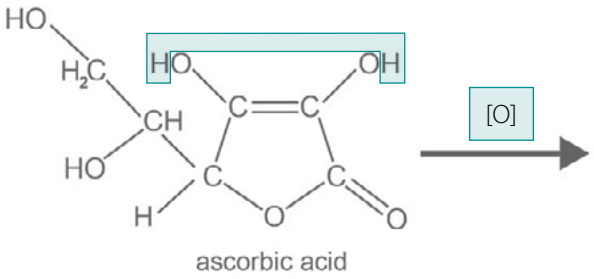
Questions 2(b) and (c)

(b) Other chemicals have been shown to protect humans against diseases and conditions. Ascorbic acid (vitamin C) is one of these chemicals.

In 2017, scientists discovered that skin creams containing ascorbic acid can protect the skin from damage by ozone, O_3.

When applied to the skin the ascorbic acid is oxidised.

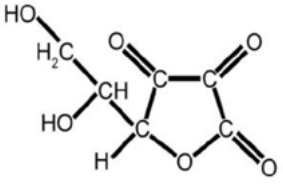
Complete the reaction in **Fig. 2.2** to show the oxidation of ascorbic acid.



ascorbic acid

Fig. 2.2

2 x O = C
1 x C-C



dehydroascorbic acid **[2]**

(c) The rate of reactions can be affected by a number of different factors.

(i) Four of these factors are listed below.

Draw a **line** to link each factor to its correct feature.

Factor	Feature
Solvent	Affects the chance of exposing one reactant to another.
Pressure	Acts as an organic catalyst.
Enzyme	Changes the space available for reactants to move.
Surface area	Changes the solubility and stability of reactants.

[3]

(ii) State **two** other factors known to affect the rate of reactions.

1 .....

2 .....

[2]

Any two from:
- physical state
- temperature
- light intensity
- light wavelength/frequency
- electromagnetic radiation
- concentration (of reactants)
- catalyst/enzyme.

ver

Mark scheme guidance

Question 2(b):

ALLOW removal of H from left and right HO = 1 mark max.

IGNORE any changes to other parts of molecule.

Question 2(c)(i):

4 correct lines = 3 marks.

2 or 3 correct lines = 2 marks.

1 correct line = 1 mark.

Question 2(c)(ii):

IGNORE unqualified 'light'.

IGNORE density.

ALLOW (inorganic) catalyst.

Examiner comments

Question 2(b) – Candidates struggled with this question with very few candidates successfully reconstructing the oxidation of ascorbic acid. The loss of the double bond between the carbon atoms and the removal of H ions generally were not considered. A wide range of incorrect, alternative responses was observed.

Question 2(c)(i) – Some candidates obtained full marks for recognising the features of the four factors listed, affecting the rate of reactions. However, many responses displayed correct links only for solvent and enzyme.

Question 2(c)(ii) – Candidates answered this question well. They readily listed two other factors known to affect the rate of reactions, ranging from temperature and light intensity to concentration and physical state.

Exemplar Candidate Work

Question 2(b) – Low level answer

(b) Other chemicals have been shown to protect humans against diseases and conditions. Ascorbic acid (vitamin C) is one of these chemicals.

In 2017, scientists discovered that skin creams containing ascorbic acid can protect the skin from damage by ozone, O_3.

When applied to the skin the ascorbic acid is oxidised.

Complete the reaction in **Fig. 2.2** to show the oxidation of ascorbic acid.

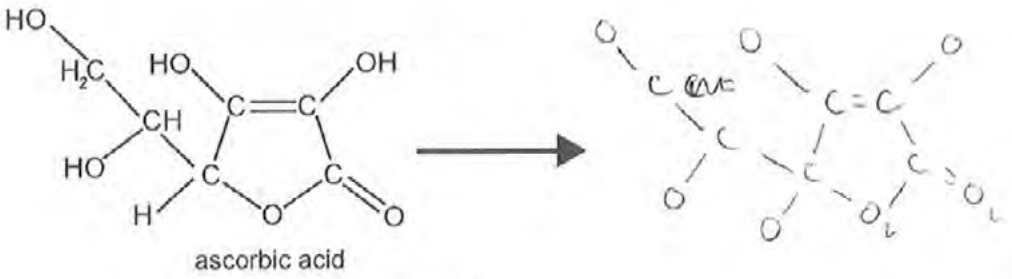


Fig. 2.2

[2]

Commentary

The focus of the expected response was limited to the presentation of carbons 2 and 3 in the oxidised ascorbic acid (dehydroascorbic acid). The change from a double bond between these two carbons (in ascorbic acid) to a single bond (in dehydroascorbic acid) was one of the features. In this response, the double bond was unfortunately retained. This prevented the candidate from achieving the marking point.

The second expected feature at carbons 2 and 3 was the loss of H from each of the two OH (shown in ascorbic acid), thereby displaying an O at each of the two carbons but with a double bond for each. In this response, the O atoms were drawn but with single bonds. This further prevented the candidate from achieving the marking point.

Clearly, a higher level answer would have shown one or both of the above features in the correct format.

Exemplar Candidate Work

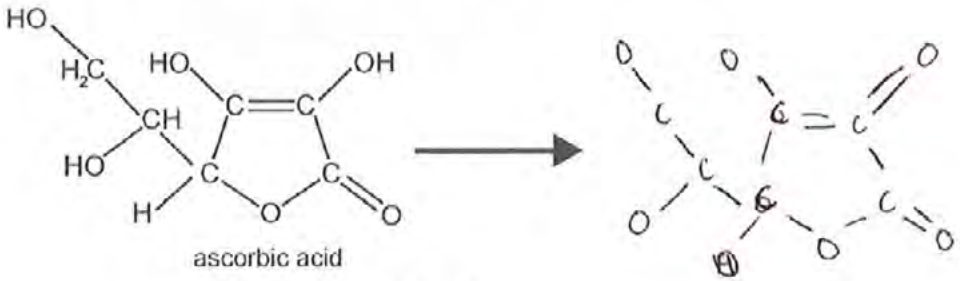
Question 2(b) – Medium level answer

(b) Other chemicals have been shown to protect humans against diseases and conditions. Ascorbic acid (vitamin C) is one of these chemicals.

In 2017, scientists discovered that skin creams containing ascorbic acid can protect the skin from damage by ozone, O_3. — sun light.

When applied to the skin the ascorbic acid is oxidised. - gain oxygen

Complete the reaction in **Fig. 2.2** to show the oxidation of ascorbic acid.



ascorbic acid

Fig. 2.2

[2]

Commentary

The candidate correctly drew a double bond, linking an O at carbon 2. The ideal response with reference to this marking point should have shown a double bond also linking an O at carbon 3. However, this incomplete feature was given the benefit of the doubt. Unfortunately, the expected single bond between carbons 2 and 3 was not shown. The response would have progressed onto a higher level if this second feature had been presented correctly.

Question 3(a)(i)

3 Striated muscle contains many muscle cells (or muscle fibres).

(a) The micrograph in **Fig. 3.1** is a longitudinal (lengthways) section of striated (skeletal) muscle as seen with the light microscope.

The micrograph shows part of different muscles fibres or cells.

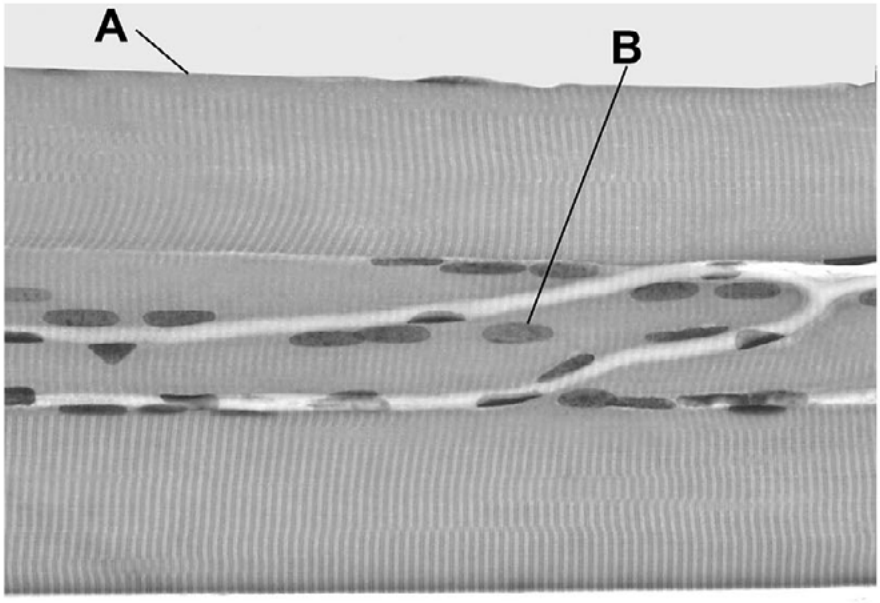
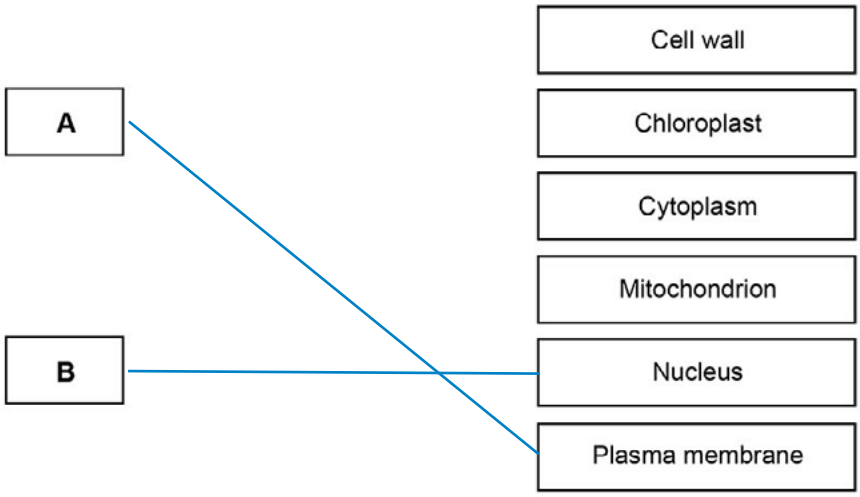


Fig. 3.1

(i) What are the names of the parts of the cells labelled **A** and **B** in **Fig. 3.1**?

Draw lines to join **A** and **B** to the correct name for the parts.



[2]

Examiner comments

The image shown in Fig.3.1 showed a number of nuclei. Muscle cells/fibres are multinucleate. Many candidates considered that these organelles were mitochondria. The identification of label A as the plasma membrane was demonstrated by most candidates. A few incorrectly identified this feature as the cell wall, which is not present in animal cells.

Questions 3(a)(ii),(iii) and (b)

(ii) **Fig. 3.1** does not show the details of other organelles in the muscle cells.

For example, the Golgi apparatus and lysosome are not visible.

Describe the **appearance** of a Golgi apparatus and a lysosome when seen in a cell.

Write a brief statement or draw a simple diagram in each of the boxes below.

Appearance of a **Golgi apparatus**	Appearance of a **lysosome**
Golgi apparatus – stacks of folded membranes (with vesicles pinching off)	**Lysosome** – simple and single-membrane vesicle/circular shape

[2]

(iii) State the role of ribosomes in cells.

Site of protein/polypeptide synthesis.

[1]

(b) Each muscle cell also contains many mitochondria and folded membranes called sarcoplasmic (endoplasmic) reticulum.

State the function of these **two** components and explain why this function is essential for muscle contraction.

(i) Function of mitochondria

Site of (aerobic) respiration/ATP/energy production/release.

Why needed for muscle contraction

Release **energy** needed (for contraction).

[2]

(ii) Function of sarcoplasmic (endoplasmic) reticulum

Storage/delivery of calcium ions/receive calcium ions from tissue fluid.

Why needed for muscle contraction

Calcium ions, dislodge the apparatus connecting the thick and thin filaments/ allow the thick and thin filaments to slide over each other.

[2]

Mark scheme guidance

Question 3(a)(ii):

ALLOW written statement OR diagram.

IGNORE organelle contents.

ALLOW 'like a vesicle'.

Question 3(a)(iii):

ALLOW correct descriptions of protein synthesis.

Question 3(b)(i):

DO NOT ALLOW anaerobic respiration.

AWTTE

IGNORE muscles becomes weak without mitochondria.

Question 3(b)(ii):

ALLOW calcium through.

AWWTE

Examiner comments

Question 3(a)(ii) – It was encouraging to see the successful attempts at drawing the Golgi apparatus and the lysosome. Most were able to recall that lysosomes are simple, spherical organelles but struggled to show the features of the Golgi body. No clear pattern of alternative responses was identified.

Question 3(a)(iii) – This question was answered well. Most candidates were aware that the ribosome is the site of protein synthesis. A few candidates incorrectly identified the process of respiration.

Question 3(b)(i) – Most candidates correctly identified the function of the mitochondrion as (cellular) respiration. Some referred to aerobic respiration and others to ATP production. References to the 'production of energy' negated this marking point. Many linked the correct response to the use of energy for the contraction of muscle cells.

Question 3(b)(ii) – This question on the topic of sarcoplasmic reticulum was not answered well. The role and context of this structure is linked to the movement/storage of calcium ions to enable the muscle cells to contract or, more specifically, to the sliding of muscle fibrils within the cells.

Question 3(c)(i)

(c) Doctors suspect that a patient may have muscle weakness due to muscular dystrophy.

A sample of the patient's muscle tissue is compared with muscle tissue from a person who does not have muscular dystrophy.

Fig. 3.2 shows cross sections of muscle fibres (cells) from the two tissue samples.

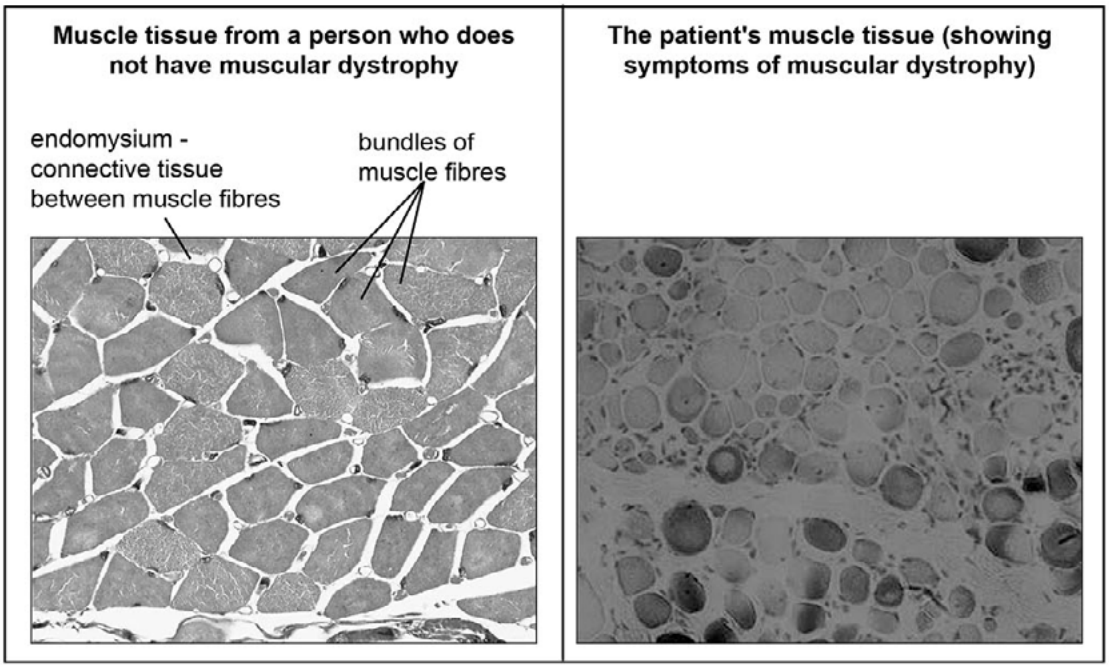


Fig. 3.2

(i) Suggest a function of the connective tissue between the bundles of muscle fibres (cells) shown in **Fig. 3.2**.

Any one from:
- hold/bind/stick bundles/fibres together
- packing tissue, OWTTE
- support/protection
- transmits forces involved in contraction and restoration to original shape.

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

Mark scheme guidance

ALLOW to enable bundles to slide over each other.

IGNORE to hold onto bone/tendons.

IGNORE shock absorption.

Examiner comments

Most candidates realised that the connective tissue binds the bundles of muscle fibres together and/or gives support. This feature was expressed in number of different ways but the key role was apparent.

Questions 3(c)(ii) and (iii)

(ii) Use **Fig. 3.2** to describe **two** differences between the patient's muscle tissue and the muscle tissue from a person who does not have muscular dystrophy.

1 .....

... .

... .

2 .....

... .

.....

[2]

Any two from:
- bundles occupy smaller area/bundles smaller
- bundles rounder/less polygonal
- increase in connective tissue/endomysium
- more bundles
- more/smaller blood vessels (TS)
- lower/reduced magnification (used)
- less-clear/darker/less contrast (any realistic qualitative description of image quality).

(iii) Give **three** components of connective tissue.

Tick (✓) **three** boxes.

Blood plasma	☐
Cell walls	☐
Chloroplasts	☐
Collagen	✓
Elastic fibres	✓
Gametes	☐
Matrix	✓

[3]

Mark scheme guidance

Question 3(c)(ii):

ALLOW visa versa responses.

ASSUME responses refer to the 'patient' unless qualified.

Examiner comments

Question 3(c)(ii) – For this question, it was pleasing to see candidates successfully comparing the features of the two images of normal and diseased muscle tissues. The image for diseased muscle was challenging to interpret but this did not affect the accreditation of relevant marking points. Most correct responses focussed on the shapes of muscle fibre bundles and the depth of connective tissue/endomysium.

Question 3(c)(iii) – Many candidates were able to recognise the components of connective tissue to include collagen, elastic fibres and matrix. Incorrect responses included blood plasma and gametes.

Questions 4(a)(i), (ii) and (iii)

4 Huw is a food chemist.

He works with existing and new food products.

Heptan-2-one is the main flavour compound in stilton cheese.

(a) Huw analyses **flavour** compounds in different types of food.

The structural formula of heptan-2-one is shown in **Fig. 4.1**.

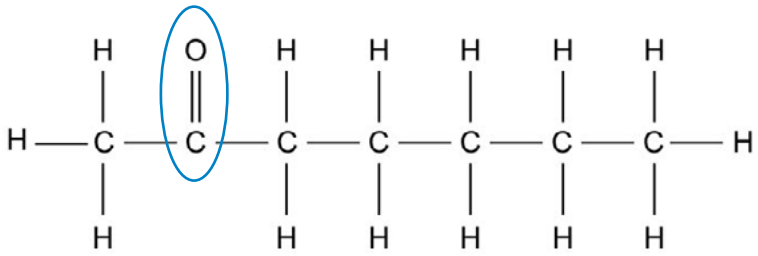


Fig. 4.1

(i) What **type** of compound is heptan-2-one?

Tick (✓) **one** box.

Alcohol	☐
Alkene	☐
Ester	☐
Ketone	☑

[1]

(ii) Draw a circle around the **functional group** in heptan-2-one in **Fig. 4.1**. **[1]**

(iii) Compounds such as heptan-2-one form isomers.

One type of isomer is an optical isomer.

Name **two** other forms of an isomer.

1 • structural
2 • geometric

[2]

Mark scheme guidance

Question 4(a)(ii):

ALLOW C = O plus adjacent C1 and C3.

ALLOW = O (without C highlighted).

Examiner comments

Question 4(a)(i) – Ketone was the correct response for the type of compound. This was identified by most candidates but a few incorrectly considered that the molecule was an ester.

Question 4(a)(ii) – The majority of candidates identified C=O as the functional group in heptan-2-one.

Question 4(a)(iii) – It was encouraging to note that most candidates recalled that two other forms of isomer are structural and geometric. A clear pattern of alternative responses could not be identified.

Questions 4(a)(iv) and (b)

(iv) State **two** features of isomers.

1 . *Any two from:*
- similar molecular formula
- different, chemical/physical **structure**/arrangement of atoms/side branches
- different spatial arrangement/asymmetric carbon atoms (e.g. Chiral).

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

(b) Huw also carries out analyses of chemical compounds that give foods their smell and flavour.

Complete **Table 4.1** by stating the functional group(s).

Choose the functional group(s) from the following list:

alcohol **aldehyde** **alkene** **alkyne** **carboxylic acid** **ester** **ketone**

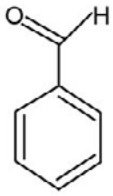
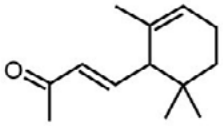
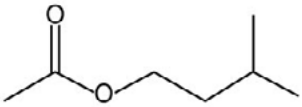
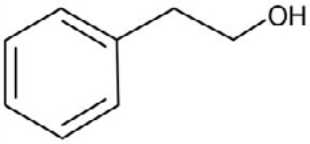
Name of compound	Structure of compound	Smell and flavour	Functional group(s)
benzaldehyde		The compound that gives flavour to almonds and marzipan	**aldehyde /alkene**
ionone		Gives aromas and flavours of violets in beer and wine	**ketone /alkene**
isoamyl acetate		Gives pear drop aroma in confectionary, wine and beer	**ester**
phenylethanol		Gives rose flavours to beer and wine, and used in rose-based perfumes	**alcohol**
1,3,5-undecatriene		A pepper-flavoured food additive added to meat products	**alkene**

Table 4.1 **[5]**

Mark scheme guidance

Question 4(a)(iv):

AWWTE

ALLOW same number **AND** type of atoms.

IGNORE references to geometric, optical, physical/chemical characteristics.

Question 4(b):

ALLOW only options from the list provided.

ALLOW either ketone or alkene as the functional group for ionone.

Examiner comments

Question 4(a)(iv) – Many candidates were aware that features of isomers included the similarity of molecular formulae with a different arrangement of atoms.

Question 4(b) – Table 4.1 enabled candidates to demonstrate their level of recall for functional groups. Most were successful and listed four or five of the groups. However, some considered that the ester (for isoamyl acetate) was a carboxylic acid.

Question 4(c)(i)

(c) Lipids are a natural component of many foods, and are added to other components to improve the feel of food in our mouths.

The **triglyceride** tristearin is shown in **Fig. 4.2**.

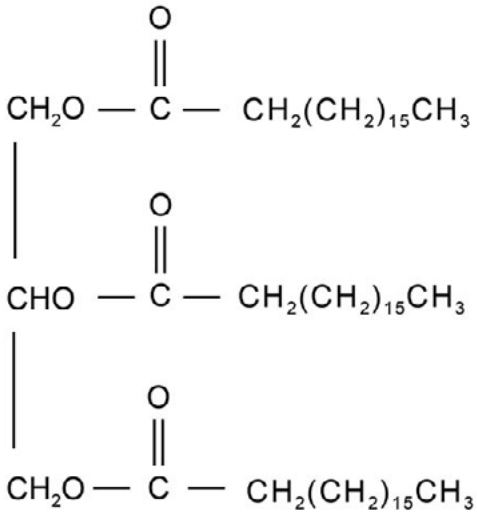


Fig. 4.2

(i) Name the type of **bond** formed between each fatty acid molecule and the glycerol molecule.

Ester/covalent .....**[1]**

Examiner comments

Many candidates struggled to recognise the ester bond in the triglyceride shown in Fig. 4.2. No clear pattern of alternative responses was identified.

Question 4(c)(ii)

(ii) An example of another type of lipid is shown in **Fig. 4.3**.

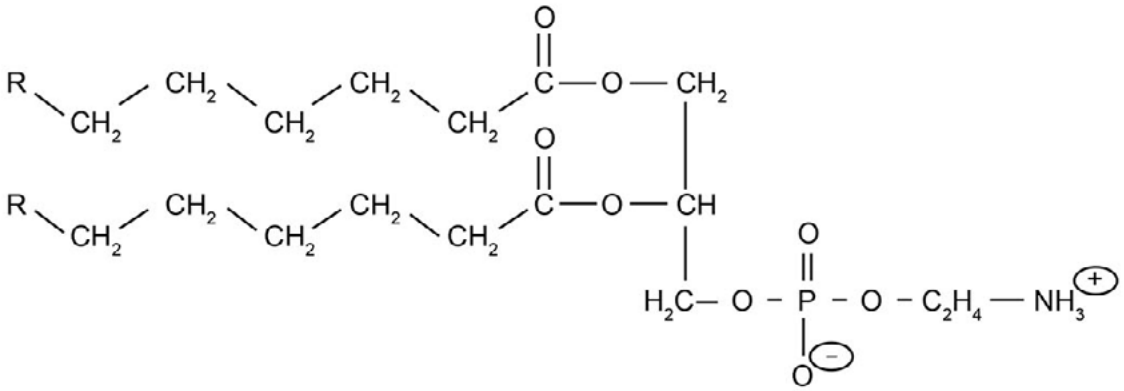


Fig. 4.3

What is the name of this type of lipid?

Tick (✓) **one** box.

Glycolipid	☐
Phospholipid	☑
Prenol lipid	☐
Sterol lipid	☐

[1]

Mark scheme guidance

2nd box.

Examiner comments

Most candidates named the molecule as a phospholipid but some ticked the sterol lipid option.

Questions 5(a), (b) and (c)

5 Metal ions have a number of biological functions.

(a) Complete **Table 5.1**.

Using the list below, write the **symbol** for each metal ion alongside their biological functions.

Ni^{2+} Cu^{2+} Mn^{2+} Ca^{2+} Na^{+}

Biological function	Metal ion (symbol)
Component of middle lamella between plant cells.	Ca^{2+}
Has a role in photosynthesis.	Mn^{2+}
Found at the active site of hydrogenase.	Ni^{2+}
Essential for osmotic balance in living cells.	Na^{+}
Has a role in oxygen transport.	Cu^{2+}

Table 5.1

[5]

(b) Other ions have important roles.

Place a tick (✓) in one box in each row to show if each statement is **true** or **false**.

	True	False
Platinum is a structural component of bone.		✓
Potassium has a role in creating nerve impulses.	✓	
Iron is a component of cytochromes in the electron transport chain.	✓	
Lithium is found in haemoglobin molecules.		✓

[4]

(c) Metals and metal ions can form inorganic compounds.

Inorganic compounds are important components of living systems.

Complete the sentences using words from the list.

Each word may be used once, more than once or not at all.

amino acids ammonium brain calcium carbohydrates DNA heart phospholipids liver

Peroxides are produced during the metabolism of .. amino acids ..... .

Peroxides must be broken down in the .. liver ..... .

Nitrates enter plants from the soil and are converted into .. ammonium ..... ions.

Phosphates are an essential part of .. DNA ..... and

phospholipids ..... .

[5]

Mark scheme guidance

Question 5(a):

IGNORE absence of/incorrect use of $^{2+}$ or $^{+}$.

Question 5(b):

MARK each row.

Question 5(c):

ALLOW DNA and phospholipids in **either order**.

Examiner comments

Question 5(a) – The biological functions of the metal ions listed in Table 5.1 are seen within the specification. Many candidates struggled with this question. A few obtained full marks but others were unable to make the correct links.

Question 5(b) – The objective format within the table enabled many candidates to draw the correct conclusions about the true or false statements. The candidates are familiar with this format.

Question 5(c) – Most sentences were completed successfully by many candidates in this question. However, some candidates incorrectly considered that peroxides are produced as a result of the metabolism of carbohydrates. The liver was correctly recalled as the site for the break down of peroxides.

Question 5(d)

(d) Metallic nickel (Ni), along with several nickel compounds are used in industry.

A number of studies have been carried out to find a possible link between nickel exposure and lung cancer.

Table 5.2 shows some of the data collected.

The data relate to workers 15 years or more after their first exposure to nickel.

Year first employed in a nickel refinery	Lung cancer	
	Number of deaths	Expected number of deaths
1902 – 1919	83	13.46
1920 – 1929	88	28.04
1930 – 1939	20	14.45
1940 – 1949	14	11.88
1953 – 1992	28	20.17

Table 5.2

Describe the link between exposure to nickel and lung cancer shown in **Table 5.2**.

Any four from:
- (actual) lung cancer deaths at higher levels than expected
- level quantified between actual and expected values (e.g. approx. 6.2×, 3.1×, 1.4×, 1.2×, 1.4×)
- declining trend/correlation cancer
- lung cancer **appears** to increase beyond 1953
- but rate is actually lower (due to 40 year period)
- one value for number of deaths for any one period
- greatest decline between 1920 – 1939 **OR** period 1920 – 1929 and period 1930 – 1939.

[4]

Mark scheme guidance

AWTTE

ALLOW any realistic, correct statement in relation to table of data.

ALLOW correct ref. to any one set of data.

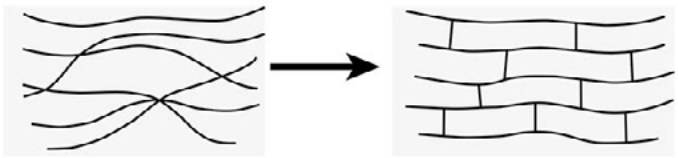
DO NOT ALLOW unqualified refs. to an increase.

Examiner comments

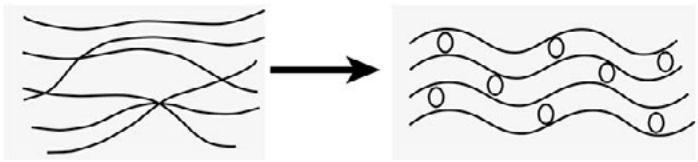
A wide range of descriptions was accredited for this open-response question. However, it was not possible to give marks for repeat statements for the same feature shown in Table 5.2. The downward trend was correctly noted by most. However, the 20 deaths linked to the period 1953 – 1992 was often incorrectly seen to be an increase but this was not the case because the period was much longer than others listed.

Question 6

6 **Fig. 6.1** shows **two** methods of changing the mechanical properties of a polymer.



method 1



method 2

Fig. 6.1

Identify both methods and explain how each method changes the mechanical properties of the polymer.

Valid points:

Method 1

- = crosslinking
- chemical bonds (introduced) between the molecular chains
- **decrease** ductility
- **increase** strength/stiffness/hardness
- **increase** in intermolecular forces
- **decreased** potential for chains to slide past each other
- gives **thermosetting** property.

Method 2

- = plasticising
- plasticising agents (introduced) between the molecular chains
- **increase** ductility
- **decrease** strength/stiffness/hardness
- **decrease** in intermolecular forces
- **increased** potential for chains to slide past each other
- gives **thermoplastic** property

[6]

Mark scheme guidance

[Level 3] Candidate shows a high level of understanding of the two methods and how they change the properties of the polymer.

(5 – 6 marks)

[Level 2] Candidate shows an understanding of the **both** methods and how they change the properties of the polymer.

(3 – 4 marks)

[Level 1] Candidate shows a basic understanding of the one **or** both methods and how they change the properties of the polymer, but with little or no explanation.

(1 – 2 marks)

[Level 0] Candidate includes **fewer than two** valid points.

(0 marks)

Examiner comments

Some candidates did very well with this free response (level of response) question and functioned at level 3, obtaining 5 or 6 marks out of 6. Others were more challenged with this topic and failed to compare the crosslinking shown in method 1 with the addition of plasticising agents shown in method 2. Some candidates were aware of the outcome of the two methods in relation to differences in strength but other features were not considered fully.

Question 7(a)

7 Solar panels contain many light-trapping solar cells.

They are designed to generate electricity and act as an alternative energy source.

Fig. 7.1 shows a collection of solar panels

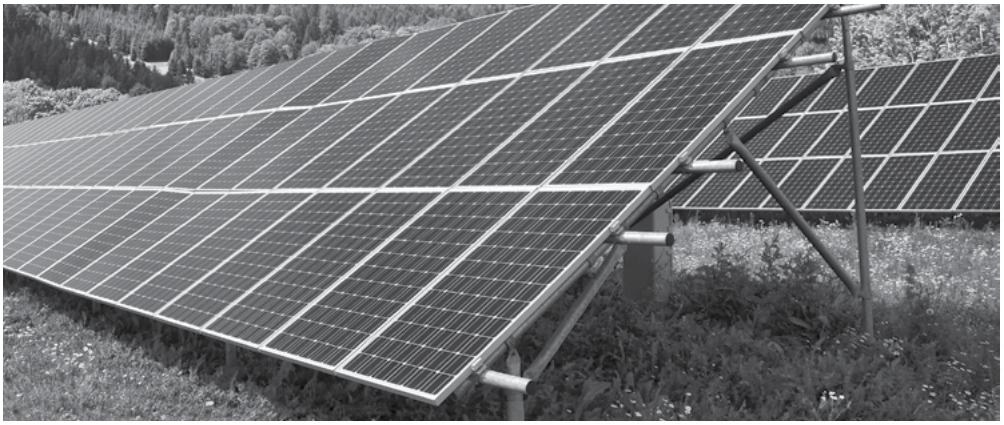


Fig. 7.1

The sunlight hitting each solar cell produces a potential difference of 3.6 V and a current of 0.04 A.

(a) (i) Calculate the charge *Q*, transferred by each solar cell in 7 minutes.

Use the equation: charge = current × time

FIRST CHECK ANSWER ON ANSWER LINE
If answer = 16.8 (C) award 3 marks
7 × 60
0.04 × 420
16.8 (C)

charge *Q* = ... C
[3]

(ii) Calculate the power *P*, produced by each solar cell and give the units.

Use the equation: power = potential difference × current

FIRST CHECK ANSWER ON ANSWER LINE
If answer = 0.144W OR 0.14J/S award 3 marks
3.6 × 0.04
0.144 **or** 0.14
W **or** J/S)

power *P* = ... units.....
[3]

Mark scheme guidance

Question 7(a)(i):

ALLOW 17.

ALLOW 0.28 (C) = **1 max**.

Examiner comments

Question 7(a)(i) – It was most encouraging to see that, with the appropriate scaffolding provided within this question, many candidates were able to successfully complete the calculation. The units were already provided so they was not an issue in this question No clear pattern of errors was identified.

Question 7(a)(ii) – Many candidates answered this question well. The provision of the equation enabled many candidates to achieve a correct value for power. However, some failed to obtain the mark for the units since they referred to joules (J) rather than joules per second.

Question 7(b)

(b) Each solar cell is then connected to a power supply for 3 minutes.

The potential difference of the power supply is 5.2 V. The current in the cell is 0.09 A.

Calculate the resistance *R*, of the solar cell.

Use the equation: potential difference = current × resistance

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

FIRST CHECK ANSWER ON ANSWER LINE
If answer = 57.78 (Ω) award 4 marks

Rearrange equation to give:
resistance = potential difference ÷ current
OR $R = \frac{V}{I}$

5.2 ÷ 0.09
57.78 (Ω)
two decimal places (only with correct value)

resistance *R* = ... Ω
[4]

Mark scheme guidance

ALLOW 57.8 or 58.0 or 57.77 **or** 57.777 for 3 marks.

ALLOW 5.2 ÷ 0.09 without rearranged equation.

= 2 marks

ALLOW 57.77 = 57.78

Examiner comments

Some candidates obtained full marks for this question. Others were able to rearrange the equation for the calculation but struggled to obtain the correct answer due to the inclusion of incorrect values. Others failed to express the answer to two decimal places.

Exemplar Candidate Work

Question 7(b) – Medium level answer

(b) Each solar cell is then connected to a power supply for 3 minutes.

The potential difference of the power supply is 5.2 V. The current in the cell is 0.09 A.

Calculate the resistance *R*, of the solar cell.

Use the equation: potential difference = current × resistance

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

potential difference ÷ current = resistance

5.2 ÷ 0.09 = 57.7

resistance *R* = 57.7 Ω

[4]

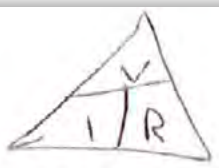
Commentary

The response correctly showed the reordering of the equation provided in the stem of the question. This enabled the candidate to determine the resistance R of the solar cell. The candidate then correctly inserted the values provided and stated that resistance = 5.2 ÷ 0.09. This was an encouraging start to the overall response. However, the candidate did not present the final value to two decimal places. In an attempt to simplify the value, the candidate incorrectly manipulated 57.7777 as 57.7.

This response could have been enhanced and achieved a much higher level if the manipulation of the final value culminated in two decimal places, as 57.78.

Exemplar Candidate Work

Question 7(b) – High level answer



(b) Each solar cell is then connected to a power supply for 3 minutes.

The potential difference of the power supply is 5.2 V. The current in the cell is 0.09 A.

Calculate the resistance *R*, of the solar cell.

Use the equation: potential difference = current × resistance

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

V = 5.2

I = 0.09

Resistance = potential difference / current

$R = \frac{5.2}{0.09} = 57.752$

resistance *R* = ... 57.7 ..... Ω **[4]**

Commentary

This response also correctly showed the reordering of the equation provided in the stem of the question. This was clearly presented in the space available for the working. The values were then correctly added so that R = 5.2 ÷ 0.09. This particular response functioned at a higher level because there was an attempt to show the recurring feature of 57.777. This enabled an additional marking point to be achieved.

The overall response could have progressed onto a full mark high level if the final value was presented as 57.78 (showing two decimal places, as requested) instead of the value given, 57.7.

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