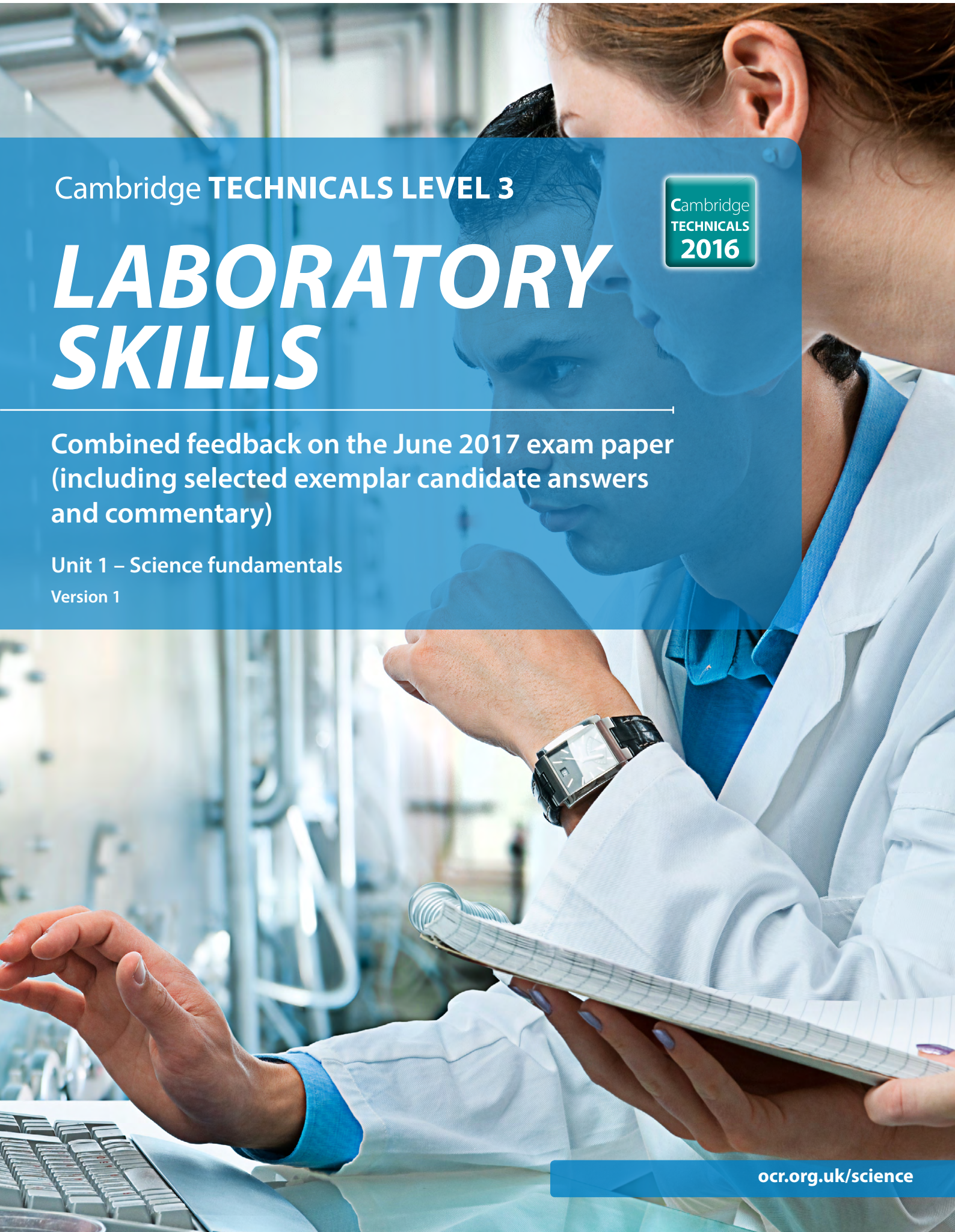
OCR
Oxford Cambridge and RSA



Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

# LABORATORY SKILLS

## Combined feedback on the June 2017 exam paper (including selected exemplar candidate answers and commentary)

### Unit 1 – Science fundamentals

Version 1

# CONTENTS

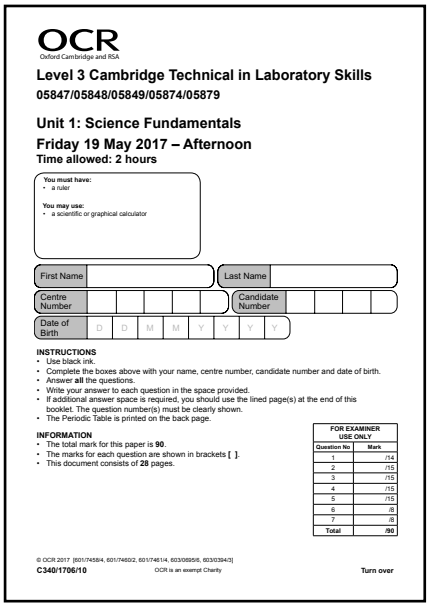
# INTRODUCTION

This resource brings together the questions from the June 2017 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 4a, 4b, 4c and 5c.

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



OCR
Oxford Cambridge and RSA

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

**Unit 1: Science Fundamentals**
**Friday 19 May 2017 – Afternoon**
**Time allowed: 2 hours**

**You must have:**
- a ruler

**You may use:**
- a scientific or graphical calculator

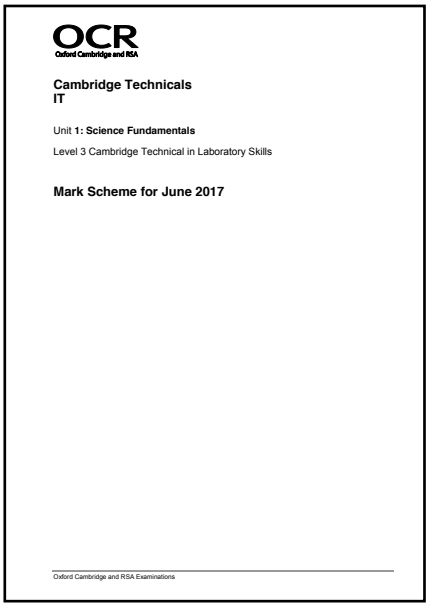
First Name | Last Name
Centre Number | Candidate Number
Date of Birth (D D M M Y Y Y Y)

**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 **28** pages.

| FOR EXAMINER USE ONLY | |
|---|---|
| Question No | Mark |
| 1 | /14 |
| 2 | /15 |
| 3 | /15 |
| 4 | /15 |
| 5 | /15 |
| 6 | /8 |
| 7 | /8 |
| Total | /90 |


C340/1706/10 OCR is an exempt Charity Turn over



OCR
Oxford Cambridge and RSA

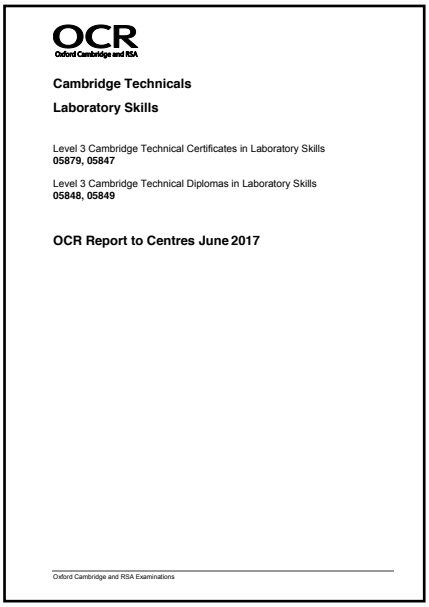
**Cambridge Technicals**
**IT**

Unit **1: Science Fundamentals**

Level 3 Cambridge Technical in Laboratory Skills

**Mark Scheme for June 2017**

Oxford Cambridge and RSA Examinations



OCR
Oxford Cambridge and RSA

**Cambridge Technicals**
**Laboratory Skills**

Level 3 Cambridge Technical Certificates in Laboratory Skills
**05879, 05847**

Level 3 Cambridge Technical Diplomas in Laboratory Skills
**05848, 05849**

**OCR Report to Centres June 2017**

Oxford Cambridge and RSA Examinations

# GENERAL EXAMINER COMMENTS ON THE PAPER

This paper was the first assessed for the new Cambridge Technical Level 3 (CT3) qualification in Laboratory Skills, Unit 1 (Science Fundamentals). It was clear that some candidates were sufficiently well-prepared for a range of topics covered within the specification and that the most able candidates were challenged by the use of a phase diagram to demonstrate the different states of water and were stretched by the final question based on an electric circuit. Some candidates did particularly well with items relating to cell and tissue structure and function, the impact of temperature on enzyme activity and the involvement of DNA and RNA in protein synthesis. Others struggled with a number of chemistry-related items. Although it was considered that the depth of knowledge required for one or two topics, including the roles of iron and calcium, was not overly challenging at this level of assessment, it was apparent that candidates were not sufficiently prepared. In general, the majority of candidates were able to respond the all questions in the time available, some using the additional pages in an appropriate manner.

**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)

Answer **all** the questions.

**1** **Fig. 1.1** shows the distribution of electrons of an oxygen atom in atomic orbitals.
This feature of the oxygen atom is known as its electron configuration.

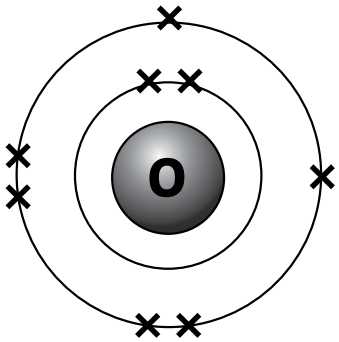



**Fig. 1.1**

**(a)** State the electron configuration of oxygen.

2,6; **[1]**

**(b)** State the proton number of oxygen.

8; **[1]**

**(c)** **(i)** The heaviest isotope of oxygen has 18 nucleons.
Determine the number of neutrons in oxygen-18.

10; **[1]**

**(ii)** Deduce the nuclear notation of oxygen-18.

$^{18}_{8}O$; **[1]**

# Question 1(d)

**(d)** Oxygen reacts with hydrogen to produce water.

**(i)** Write a **balanced** symbol equation for the reaction between oxygen and hydrogen.

$2H_2 + O_2 \Rightarrow 2H_2O$
Formula;
Balancing;

..**[2]**

**(ii)** State and explain the type of bonding found in a water molecule.

Covalent;
(Valence) electrons are shared;

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

**(iii)** Explain why, as a result of the bonding found in water, oxygen appears to have the electronic structure of neon.

Neon/noble gases have 8 electrons in **outer shell**;
Oxygen also has (6 + 2 =) 8 electrons in outer **shell**;

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

# Question 1(e)

**(e)** The atomic diameters of elements vary in the Periodic Table.

Some of these atomic diameters are shown in **Fig. 1.2**.

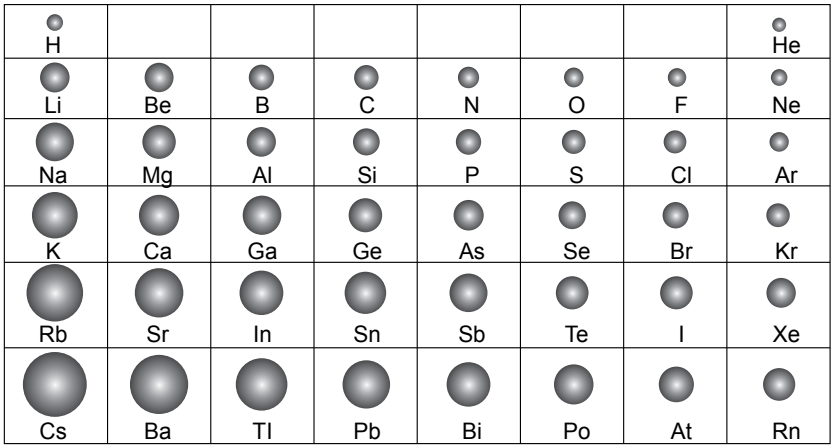



**Fig. 1.2**

**(i)** Describe the features shown in **Fig. 1.2**.

Atomic diameter decreases, as **group number** increase/along each row/left to right; .....
Atomic diameter increases, as **period** increases/down column/top to bottom/ down each group; .....

.....

.....

**[2]**

**(ii)** The atomic diameter of oxygen is 96 pm.

The atomic diameter of hydrogen is 106 pm.

The diameter of a hydroxide (OH) group is 220 pm.

Comment on the atomic diameter of the hydroxide molecule.

Explain your answer.

Hydroxide/it, 220 pm **diameter** is more than the sum of H and O diameters/202 pm/further 18pm; .....
Weaker **attraction** between the nuclei and the electrons; .....

.....

.....

**[2]**

## Mark scheme guidance

Question 1(a):

**DO NOT ALLOW** 26 (without ,) unless clear separate values

**IGNORE** [ ]

**ALLOW** $1S^2$ and $2S^2$ and $2P^2$.

Question 1(c)(ii):

**ALLOW** 18, 8 OR 18 and 8.

**ALLOW** $^{8}_{18}O$

Question 1(d)(i):

**ALLOW** for one mark: $2H + O \Rightarrow 2\ H_2O$

**DO NOT ALLOW** O or $O^2$ for formula.

**ALLOW** one error for reactants (if $H_2O$ is product).

e.g. $2H_2 + O$ = 1 mark max.

**ALLOW** $H_2 + ½\ O_2 \Rightarrow H_2O$ = 2 marks

**ALLOW** equal sign = ⇒

Question 1(d)(ii):

**IGNORE** references to sharing one electron only.

**ALLOW** both non-metals = 1 mark.

Question 1(d)(iii):

**ALLOW** both have full outer shells (= 2 marks).

**ALLOW** same number of electrons/10 electrons each = 1 mark.

Question 1(e)(i):

**MUST** refer to group number/period or columns/rows.

Question 1(e)(ii):

**ALLOW** diameter more/larger (hydroxide/it).

**ALLOW** between positive charges/protons and negative charges/electrons.

## Examiner comments

Question 1(a) – The majority of candidates were able to correctly state the electron configuration of oxygen. This was a most accessible question and no clear pattern of alternative responses was identified.

Question 1(b) – As for 1(a), the majority of candidates provided a correct response.

Question 1(c)(i) – Fewer candidates determined the number of neutrons in oxygen-18. Again, a clear pattern of alternative responses was not apparent.

Question 1(c)(ii) – It was surprising to note that relatively few candidates were able to deduce the nuclear notation of oxygen-18. The marking of this item was opened up to accept the numbers 18 and 8, even without the inclusion of O for oxygen.

Question 1(d)(i) – The symbol equation for the generation of water from a reaction between oxygen and hydrogen was expected to be relatively straightforward. However, only some candidates were able to correctly identify the formulae for the reactants and even fewer balanced the equation correctly.

Question 1(d)(ii) – Covalent bonding was identified by many candidates and some correctly noted that the electrons are shared. A number of candidates were allocated a mark for referring to their non-metal status.

Question 1(d)(iii) – Very few candidates explained that neon and oxygen have 8 electrons in their outer shells. However, many were awarded two marks for a reference to both having full outer shells.

Question 1(e)(i) – Although the stem of this question referred to the Periodic Table (provided at the rear of the paper), the instruction at (i) was based solely on the description of Fig. 1.2 (without further reference to the Periodic Table). As a result, most candidates did not present the anticipated description of group number and period. However, straightforward descriptions of rows and columns were accepted as valid marking points. Many candidates were therefore able to access the marks available.

Question 1(e)(ii)– Many candidates successfully expressed the difference between the two sets of data (comparing 220pm with 202pm). The explanation of a weaker attraction between the nuclei and electrons was not observed in most responses.

# Question 2(a)

**2** Scientists are currently researching the use of the pondweed *Spirogyra* to produce commercially important oils on a large scale.

The pondweed can be grown in large tanks, and the oils extracted mechanically using solvents.

The scientists are investigating how the addition of the enzyme papain might improve the extraction process.

Papain catalyses the breakdown of proteins, including those of the plasma membranes of the pondweed cells.

**(a)** Scientists have investigated the effect of the use of papain on oil extraction from pondweed at different temperatures.

The results of their research are shown in **Fig. 2.1**.

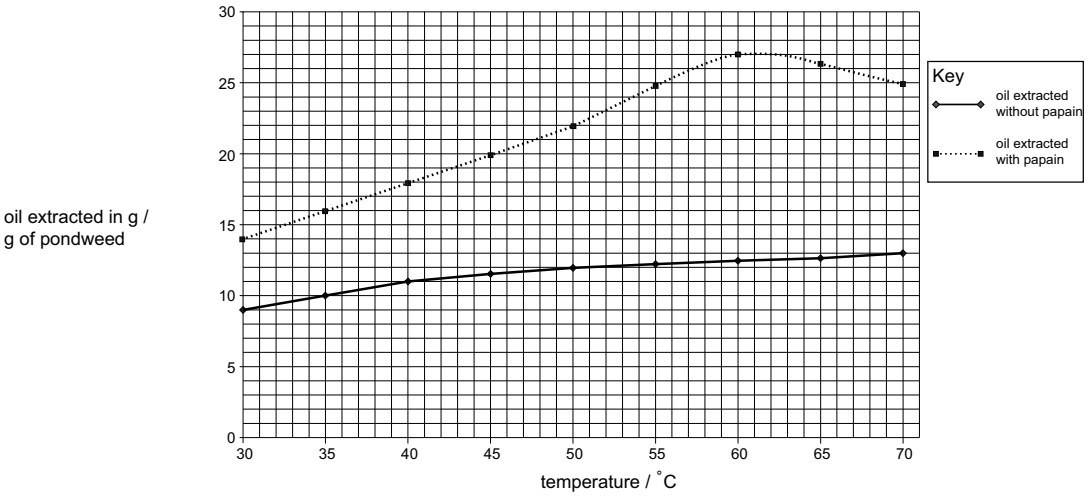



**Fig. 2.1**

# Questions 2(a)(i) and (ii)

**(i)** Describe the results in **Fig. 2.1**, showing the effects of temperature on **oil extraction** from the pondweed.

*Any four from:*
**General feature**
Increased temperature – increased oil extraction/positive correlation;
**Without papain**
From 9 – 13 g (oil per g of alga);
**With papain**
Increases more markedly (or wtte) as temperature increases;
From 14 – 27 g (oil per g of alga);
Reaches a peak of 27 g / 60 °C;
Reaches a peak before that of 'without papain';
Mass of oil extracted per g of alga decreases above 60°C;
Decreases from 27 – 25g (at 60°C);

**[4]**

**(ii)** Explain the effects of temperature on the enzyme, **papain,** activity.

*Any four from:*
Increase in **activity** with increasing temperature;
**Up to** approx. 60°C;
Molecules gain more **energy** (with increased temperature)/move faster/more excited;
Increase in successful **collisions** (between enzyme/papain and substrate/protein);
To form e**nzyme–substrate** complex;
**Optimum** activity reached at 60°C;
Decrease above 60°C is the result of (increasing) **denaturation** of the enzyme;
Resulting in change in **shape** of **active site**;
The substrate/protein **no longer fits** the active site;

**[4]**

# Question 2(b)

**(b)** The oil produced by the pondweed contains erucic acid.

Erucic acid is used in biodiesel production and in the production of 'environmentally-friendly' lubricating oils.

Some of the erucic acid produced is converted into behenic acid, silver behenate, and behenyl alcohol.

**Fig. 2.2** shows the relationship between two of these chemicals.

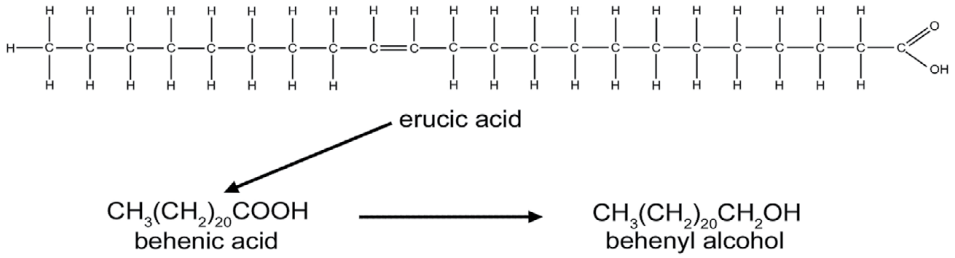



**Fig. 2.2**

For the following reactions, state the type of chemical reaction and describe the chemistry for how each of the products is synthesised.

**(i)** Behenic acid from erucic acid.

**Addition** (reaction);
*Any two from:*
Involving 2H/two hydrogen atoms (gained);
To carbon atoms 13 and 14;
Double bond removed/molecule becomes saturated;

..... [3]

**(ii)** Behenyl alcohol from behenic acid.

**Reduction** (reaction):
Addition of H/hydrogen atoms/COOH reduced;
One mark for correct equation but must show 4H;

$$\underset{\text{behenic acid}}{CH_3(CH_2)_{20}COOH} \xrightarrow{[4H]} \underset{\text{behenyl alcohol}}{CH_3(CH_2)_{20}CH_2OH}$$

..... [3]

**(iii)** Behenic acid is reacted with silver oxide to produce silver behenate.

State the type of reaction involved.

**Displacement** (reaction);

..... [1]

## Mark scheme guidance

Question 2(a)(i):

**IGNORE** references to **reasons** for increased oil extraction.

**MAX.** 3 marks if no reference to oil extraction without the addition of papain.

**DO NOT ALLOW** values without some units.

Question 2(a)(ii):

**ALLOW** oil extraction = BOD for indication of enzyme activity.

**ALLOW** best/ideal/peak = optimum.

**DO NOT ALLOW** enzymes broken down/killed.

Question 2(b)(i):

**ALLOW** reduction as an alternative to addition.

**ALLOW** hydrogenation.

Question 2(b)(ii):

**ALLOW** oxidation and reduction for first mark.

**ALLOW** answers related to specific reducing agent.

**ALLOW** $2H_2 = 4H$

**ALLOW** location of 2H2 on left side of arrow.

**ALLOW** equal sign = ⇒

## Examiner comments

Question 2(a)(i) – The expected description of Fig.2.1 was to include clear references to values shown at key points along the two curves, for both 'with' and 'without' the enzyme papain. A variety of responses were seen for this question. Some descriptions were excellent and provided a full response, including values for temperature and oil extracted. However, some responses described general features without reference to values and others confused the two sets of data. In some cases, only one curve was considered.

Question 2(a)(ii) – Some candidates provided very good explanations of the relationship between temperature and enzyme activity, with effective descriptions of collision rates, optimum activity and denaturation. It was unfortunate that some candidates provided an explanation within the descriptive account expected for 2(a)(i). This presented a problem for such candidates when they moved onto question 2(a)(ii). The relationship between temperature and enzyme activity did not appear to be well understood by many candidates, and yet this is a common feature of different GCSE Biology/Science specifications.

Question 2(b)(i)to (iii) – The relationship between the different molecules outlined in this question appeared to be challenging for a number of candidates. Some confidently referred correctly to the type of chemical reaction taking place for all three parts of the question but others failed to include the name of the reaction in their responses. However, the most common and correct response was for the displacement reaction at 1(b)(iii). Some candidates were able to articulate a response for the addition and reduction reactions to include a reference to the hydrogen atoms. The removal of the double bond during the addition reaction (benenic acid from erucic acid) was identified by a number of candidates.

# Question 3(a)(i) and (ii)

**3** A cell biologist is writing a textbook for medical students.

The textbook will include the structure and function of different types of tissue.

**(a)** The cell biologist first selects images of tissues as seen with the light microscope. A drawing of one of the images is shown in **Fig. 3.1**.

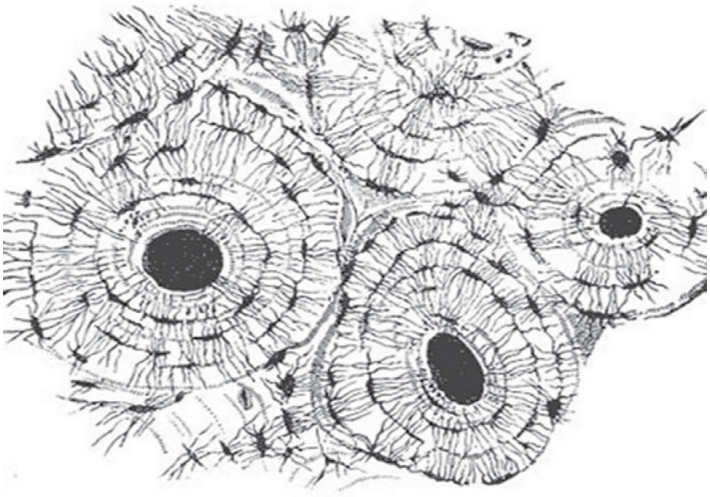


**Fig. 3.1**

**(i)** State the name of the tissue type shown in **Fig. 3.1**.

Bone/compact bone

**[1]**

**(ii)** Explain how the structure of the tissue in **Fig. 3.1** is related to its function.

*Any four from:*
Bone becomes **calcified/ossified**;
For **strength/support/protection**;
Contains **living** cells / is a living tissue/organ;
Bone tissue can **grow**;
Bone cells/osteocytes/osteoblasts in **layers**;

Mature bone cells/osteocytes confined to spaces (called lacunae);
Osteocytes/bone cells arranged in concentric rings called lamellae;
Osteocytes/bone cells connect by cytoplasmic extensions;
Osteocytes/bone cells deposit calcium (into the matrix);
Immature osteocytes/osteoblasts can reproduce to enable bones to grow;
Central Haversian canal contains blood vessels to provide nutrients/oxygen;
Canaliculi/small channels/Volkmann's canals radiate from Haversian system to connect cells/deliver blood/nutrients/oxygen;

**[4]**

# Questions 3(a)(iii) and (iv)

**(iii)** **Fig. 3.2** is a drawing of an electron micrograph of a cell from the same type of tissue.

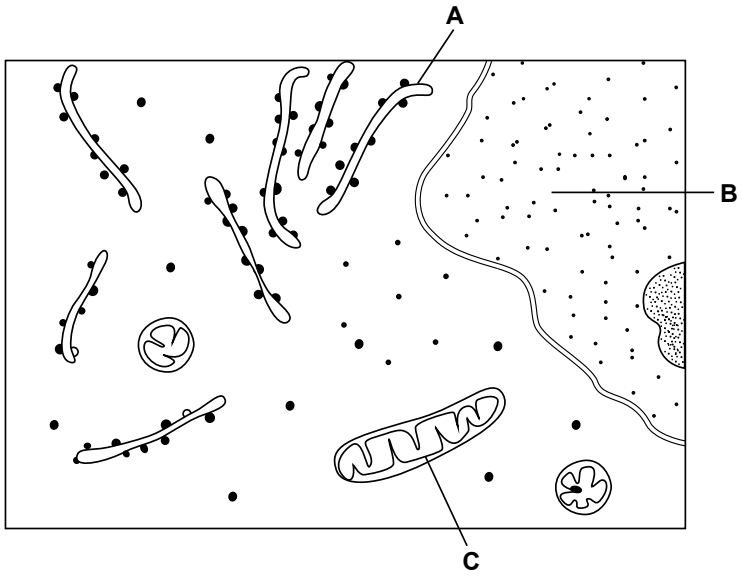



**Fig. 3.2**

Identify the cell components, **A**, **B** and **C**.

**A** Rough endoplasmic reticulum/RER/ribosomes

**B** Cytoplasm/nucleus

**C** Mitochondrion/crista **[3]**

**(iv)** Summarise the function of the structures **A** and **B**.

**A**

*Any two from:*
Involved in protein **synthesis**;
**Processing/packaging/storage** of protein;
**Transport** of proteins;
Forms **vesicles** to create Golgi apparatus/body

**B**

**If cytoplasm**
*Any two from:*
Site of (cellular) reactions;
Site of named reaction;
Provide cell shape;
Transport of materials (to and from organelles);
Supports/holds/contains organelles;
Cytoskeleton;
Storage of materials/molecules;

**If nucleus**
*Any two from:*
Contains DNA/genes/genome/chromosomes;
Site of DNA replication;
Controls protein synthesis

**[4]**

# Question 3(b)

**(b)** Connective tissue contains specialised cells called fibrocytes.

**Fig. 3.3** is an electron micrograph of a fibrocyte within a sample of connective tissue.

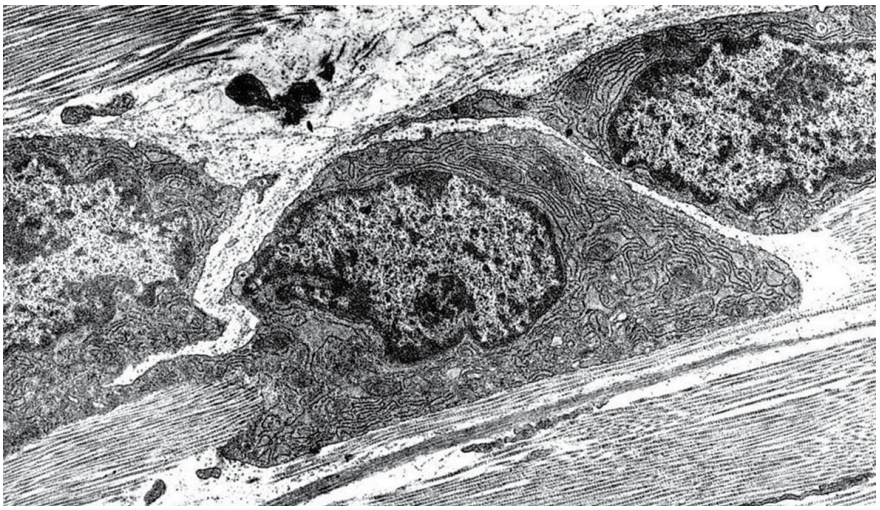


**Fig 3.3**

The function of fibrocytes is to produce the protein, collagen.

**(i)** State **one** feature of the cell that enables you to confirm that the fibrocyte produces large amounts of protein.

*Any one from:*
(Many/packed with) RER/ribosomes;
Nucleus is large/prominent;
Cell wrapped around (a bundle of) collagen;
(Many) mitochondria;

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

**(ii)** How is the structure of connective tissue related to its function?

*Any two from:*
Contains fibres/collagen;
Strength/support of connective tissue;
Holds organs in position / bone to bone / bone to muscle;
Contains elastin / elastic fibres;
Flexible/stretches/elastic;
Immature fibrocytes (fibroblasts) divide rapidly
Grows/repairs/heals/wtte;

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

## Mark scheme guidance

Question 3(a)(ii):

**IGNORE** references to gross anatomy of bones.

**ALLOW** Bone is compacted = ossified.

**ALLOW** correct reference to blood cell production.

Question 3(a)(iii):

**DO NOT ALLOW** plasma = B.

**ALLOW** mitochondria = C.

Question 3(a)(iv):

**ALLOW** proteins made = protein synthesis.

**ALLOW** keeps cell contents together/cell movement = cytoskeleton.

Question 3(b)(ii):

**ALLOW** holds tissues in place.

**DO NOT ALLOW** soft = flexible.

**DO NOT ALLOW** cells unqualified.

## Examiner comments

Question 3(a)(i) – Fig.3.1 was a clear TS image of bone. Some candidates were unable to identify this tissue type and referred to a range of tissues/organs including nervous tissue, testis and ovaries.

Question 3(a)(ii) – It was surprising to note that a number of candidates correctly provided functional characteristics of strength/support/protection, even without the correct tissue identified in 3(a)(i). For those who realised that Fig.3.1 was bone, they were able to progress further and explain the link between function and layering or compactness of the tissue. Red blood cell production was an acceptable answer, although evidence of this function was not provided in Fig.3.1.

Question 3(a)(iii) – Many candidates correctly labelled the three cell components in Fig.3.2. Some were somewhat puzzled by the features and included golgi body as structure A. Unfortunately, one or two candidates referred to chloroplasts for this cell taken from the same type of (animal) tissue displayed earlier in the question. Structure B was ideally identified as the nucleus (with nucleolus included) but the absence of nuclear pores in the nuclear envelope led many candidates to assume that B was the cytoplasm of an adjacent cell. This was a fully understandable response and was creditworthy.

Question 3(a)(iv) – A good functional summary for the ribosome/RER was frequently seen. The functions of the cytoplasm (or nucleus) were realistic but not fully described by many candidates. No clear pattern of alternative responses was apparent.

Question 3(b)(i) – The expected response was based on the large/prominent nucleus and the density of ribosomes/mitochondria. However, on this occasion a clear reference to such organelles was sufficient for the mark. It is understood that candidates would not necessarily be expected to appreciate detailed, distinguishing features for such a protein-synthesising cell.

Question 3(b)(ii) – This question was based on a general reference to connective tissue features. Many candidates correctly outlined the features of strength and flexibility and it was interesting to see the use of named examples including tendons and ligaments in the correct context.

# Question 4(a)

**4** 'Dipeptide 2' is sold as a skin-conditioning agent.

It is used in face creams aimed at reducing puffy eyes and dark circles under the eyes.

'Dipeptide 2' is a dipeptide comprised of the amino acids valine and tryptophan.

**(a)** The structural formulae of the two amino acids, valine and tryptophan, are shown in **Fig. 4.1**.

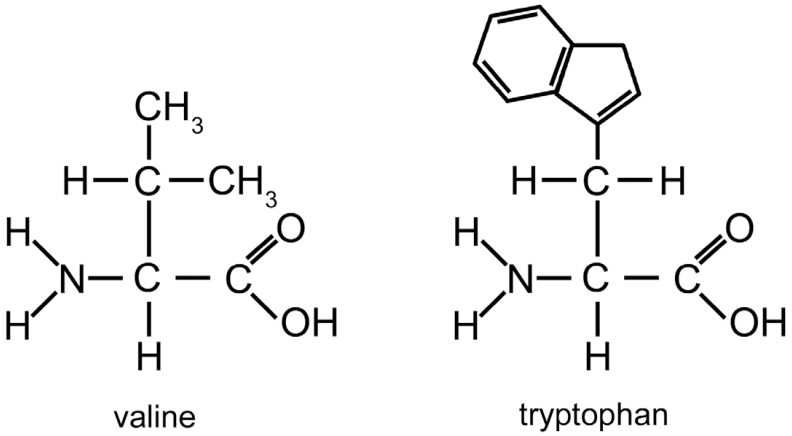
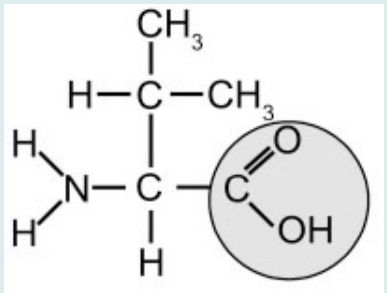



**Fig. 4.1**

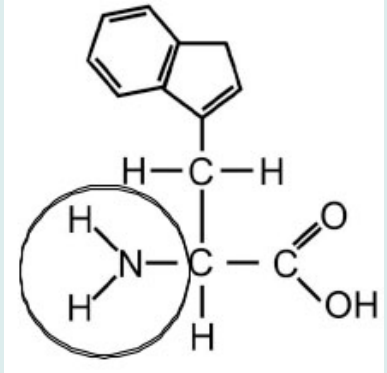
**(i)** On **Fig. 4.1** draw a circle around the functional group of **valine** that allows it to be described as an **acid**.

**[1]**



**(ii)** On **Fig. 4.1** draw a circle around the functional group of **tryptophan** that is related to the **amino** group description.

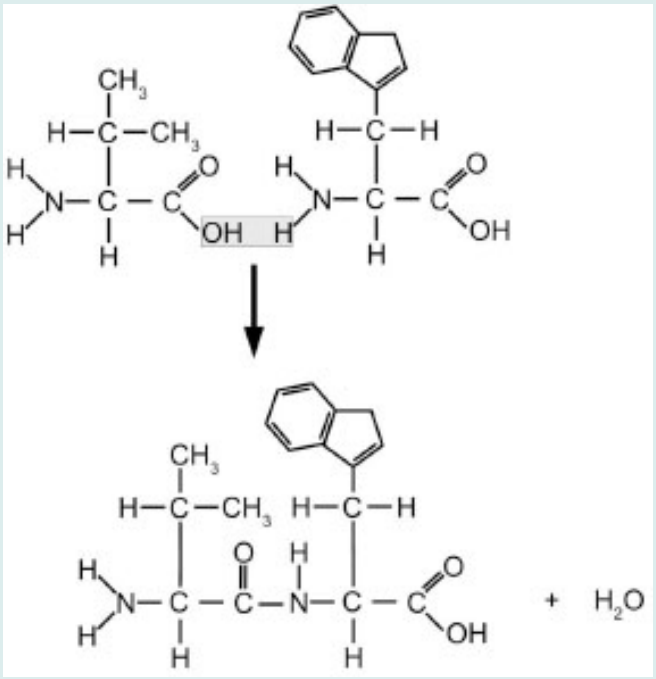
**[1]**



# Questions 4(b) and (c)

**(b)** In the space below, show the chemical reaction between the two amino acids valine and tryptophan to produce 'Dipeptide 2'.

Use the structural formulae of the amino acids to show this reaction.




**[3]**

**(c)** State the name of the bond formed between the two amino acids.

Peptide (bond);

.....

**[1]**

# Questions 4(d)(i), (ii) and (iii)

**(d)** The general formula of an amino acid is shown in **Fig. 4.2**.

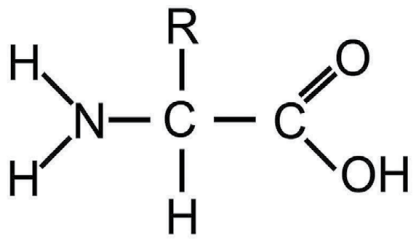



**Fig. 4.2**

The R-group varies from amino acid to amino acid.

**Table 4.1** shows some amino acids and their R-groups.

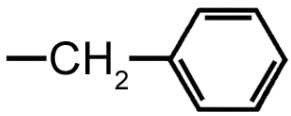
| Amino acid | R-group |
|---|---|
| Alanine | $-CH_3$ |
| Glycine | -H |
| Leucine | $-CH_3CH(CH_3)CH_3$ |
| Phenylalanine |  |
| Serine | $-CH_2OH$ |

**Table 4.1**

The R-groups can be used to identify the types of amino acids.

**(i)** Which of the amino acids in **Table 4.1** have hydrocarbon groups?

Alanine, leucine, phenylalanine; ..... **[1]**

**(ii)** Which amino acid in **Table 4.1** has a branched chain hydrocarbon group?

Leucine; ..... **[1]**

**(iii)** Which amino acid in **Table 4.1** has an aromatic hydrocarbon group?

Phenylalanine; ..... **[1]**

# Question 4(d)(iv), (v) and (e)

**(iv)** Which amino acid in **Table 4.1** has an alcohol group?

Serine; ..... **[1]**

**(v)** Which amino acid in **Table 4.1** does not have optical isomers?

Glycine; ..... **[1]**

**(e)** Amino acids are also used to make proteins (polypeptides).

Eukaryotic cells have the ability to make proteins.

Describe how DNA and RNA are used to make proteins in eukaryotic cells.

*Any two from (**transcription**):*
DNA in nucleus; DNA unzipped; .....
by enzyme (DNA helicase); .....
RNA polymerase also involved;
DNA/gene code/used/template for synthesis mRNA; .....
DNA contains, adenine, thymine, guanine and cytosine;
RNA contains uracil instead of thymine; .....
RNA single-stranded/DNA double-stranded/double helix;
By transcription; .....
mRNA synthesised in nucleus;
mRNA moves, into cytoplasm/to ribosomes/to RER; .....
mRNA attaches to ribosome;

*Any two from (**translation**):* .....
Protein synthesis at ribosomes/RER;
Ribosomal RNA/rRNA codes for synthesis of ribosomes; ..... **[4]**
Codons on mRNA carry information on the sequence of amino acids to be assembled;
Amino acid peptide bonds formed (on ribosome); Process is called translation;
Amino acid ferried to ribosome by transfer RNA/tRNA;
Process begun by initiation codon;
Second amino acid is ferried to/binds to ribosome by next transfer RNA molecule/tRNA;
Succession of amino acids/tRNAs brought in according the base sequence of mRNA/tRNA involved in decoding;
tRNA released to ferry in further amino acids.
Protein synthesis terminated by termination/stop codon;

## Mark scheme guidance

Question 4(a)(i):

The circle **MUST** be drawn on **valine**.

Question 4(a)(ii):

The circle **MUST** be drawn on **tryptophan**.

Question 4(b):

Two correct reactants = 1 mark

**ALLOW** correct dipeptide only = 2 marks if reactants not drawn.

**ALLOW** inclusion of $H_2O$ = 1 mark.

Question 4(c):

**ALLOW** covalent.

Question 4(d)(i):

All three required for 1 mark.

If **>3 amino acids** named = 0 marks

Question 4(e):

Reference to exons and introns, and pre-mRNA is not required.

**ALLOW** information = code.

## Examiner comments

Question 4(a)(i) and (ii) – It was anticipated that many candidates would be informed of (carboxylic) acid and amino groups for the amino acid molecule. However, a significant number of candidates were unable to complete this task correctly. A number circled the R groups of the two amino acids, whilst others circled part of the acid functional group for valine.

Question 4(b)– The majority of candidates were unable to redraw the two amino acids as reactants and to progress on to the formation of the dipeptide (showing the peptide bond). This was not anticipated. However, some correctly noted the generation of a molecule of water.

Question 4(c) – It was surprising that a number of candidates were not be able to identify the bond as peptide (or covalent). This GCSE Biology/Science topic appeared to be challenging for many.

Question 4(d)(i) to (v) – Many candidates did well with this series of linked questions, based on Table 4.1 The most common and correct responses were seen for the amino acid with an alcohol group (iv) and for the amino acid that does not have optical isomers (v). It was apparent that many were challenged by the combination of amino acids with hydrocarbon groups (i). Few candidates were able to achieve a mark for this particular feature.

Question 4(e) – The topic of protein synthesis, involving transcription and translation is well versed in GCSE Biology/Science specifications. Many candidates were able to recall some steps in either transcription or translation, but necessarily both. Some candidates provided excellent responses with a full account of DNA and RNA (both mRNA and tRNA) involvement. One common error included the link between the nucleic acids and amino acid 'formation/production'.

# Exemplar Candidate Work

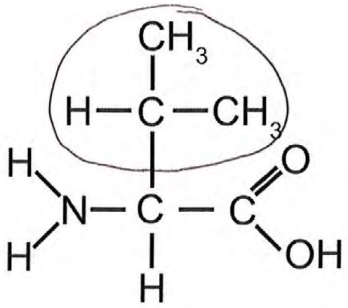
## Question 4a(i) – low level answer

**4** 'Dipeptide 2' is sold as a skin-conditioning agent.

It is used in face creams aimed at reducing puffy eyes and dark circles under the eyes.

'Dipeptide 2' is a dipeptide comprised of the amino acids valine and tryptophan.

**(a)** The structural formulae of the two amino acids, valine and tryptophan, are shown in **Fig. 4.1**.




valine

**Fig. 4.1**

**(i)** On **Fig. 4.1** draw a circle around the functional group of **valine** that allows it to be described as an **acid**.

**[1]**

### Commentary

The candidate provided a low level response (0 marks in this case) because they incorrectly circled the R-group on the valine in Fig.4.1. The response would have been improved and achieved the mark if the **carboxylic acid** (COOH) group had been circled on the **valine**.

# Exemplar Candidate Work

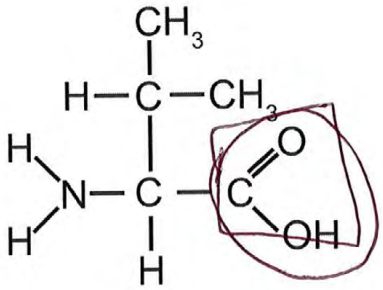
## Question 4a(i) – high level answer

**4** 'Dipeptide 2' is sold as a skin-conditioning agent.

It is used in face creams aimed at reducing puffy eyes and dark circles under the eyes.

'Dipeptide 2' is a dipeptide comprised of the amino acids valine and tryptophan.

**(a)** The structural formulae of the two amino acids, valine and tryptophan, are shown in **Fig. 4.1**.




valine

**Fig. 4.1**

**(i)** On **Fig. 4.1** draw a circle around the functional group of **valine** that allows it to be described as an **acid**.

**[1]**

### Commentary

The candidate has provided a high level answer because they have correctly circled the **carboxylic acid** (COOH) group on **valine**. Although the attempt to draw a square around this group was ignored when marked, the candidate should have drawn only a circle. The rubric/instructions were clear for this item.

# Exemplar Candidate Work

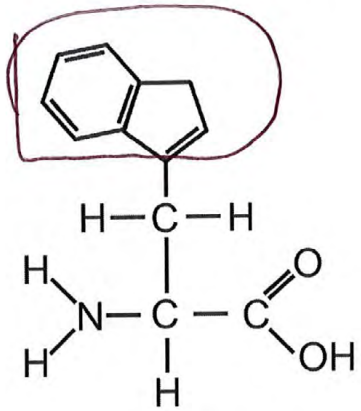
## Question 4a(ii) – low level answer

4 'Dipeptide 2' is sold as a skin-conditioning agent.

It is used in face creams aimed at reducing puffy eyes and dark circles under the eyes.

'Dipeptide 2' is a dipeptide comprised of the amino acids valine and tryptophan.

**(a)** The structural formulae of the two amino acids, valine and tryptophan, are shown in **Fig. 4.1**.




tryptophan

**Fig. 4.1**

**(ii)** On **Fig. 4.1** draw a circle around the functional group of **tryptophan** that is related to the **amino** group description.

**[1]**

### Commentary

The candidate provided a low level response (0 marks in this case) because they incorrectly circled the R-group on the tryptophan in Fig.4.1. The response would have been improved and achieved the mark if the **amine group** ($NH_2$) had been circled on the **tryptophan**.

# Exemplar Candidate Work

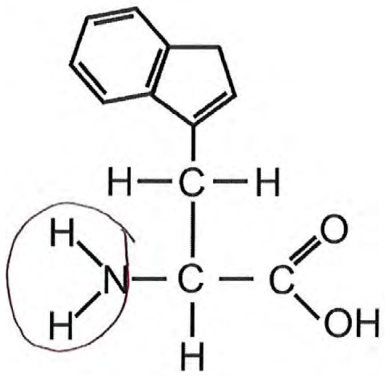
## Question 4a(ii) – high level answer

**4** 'Dipeptide 2' is sold as a skin-conditioning agent.

It is used in face creams aimed at reducing puffy eyes and dark circles under the eyes.

'Dipeptide 2' is a dipeptide comprised of the amino acids valine and tryptophan.

**(a)** The structural formulae of the two amino acids, valine and tryptophan, are shown in **Fig. 4.1**.




tryptophan

**Fig. 4.1**

**(ii)** On **Fig. 4.1** draw a circle around the functional group of **tryptophan** that is related to the **amino** group description.

**[1]**

### Commentary

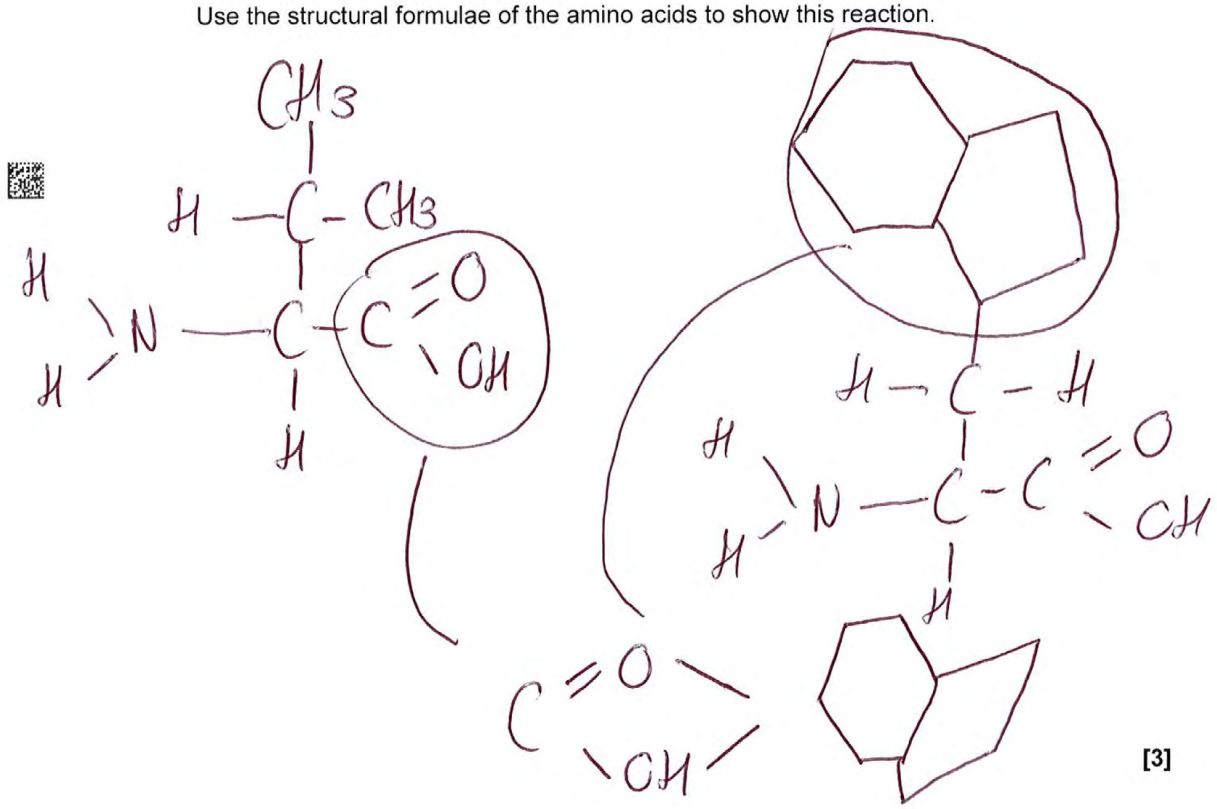
The candidate has provided a high level answer because they have correctly circled the **amine group** ($NH_2$) on **tryptophan**. The response was clear and the candidate had followed the rubric/instructions without any apparent problems.

# Exemplar Candidate Work

## Question 4(b) – low level answer

**(b)** In the space below, show the chemical reaction between the two amino acids valine and tryptophan to produce 'Dipeptide 2'.

Use the structural formulae of the amino acids to show this reaction.



**[3]**

### Commentary

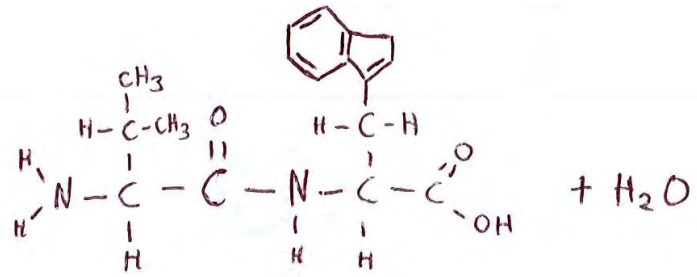
The candidate repeated the models for valine and tryptophan from Fig.4.1 but failed to construct the **peptide bond** or to show the molecule of **water** released due to the condensation reaction. The overall response was a low level answer, resulting in 0 marks. This could have become a medium answer if the candidate had not drawn lines linking fragmented parts of the molecule at the lower part of their response diagram. The correct redrawing of the two reactants would have enabled at least 1 mark to be awarded but the lines negated this mark.

# Exemplar Candidate Work

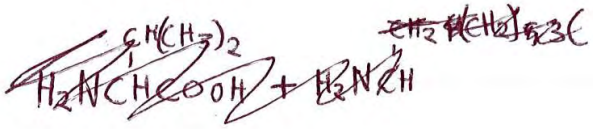
## Question 4(b) – high level answer

**(b)** In the space below, show the chemical reaction between the two amino acids valine and tryptophan to produce 'Dipeptide 2'.

Use the structural formulae of the amino acids to show this reaction.



$+ H_2O$



$C_5H_{11}NO_2 + C_{12}H_{13}NO_2 \longrightarrow C_{17}H_{22}N_2O_3 + H_2O$

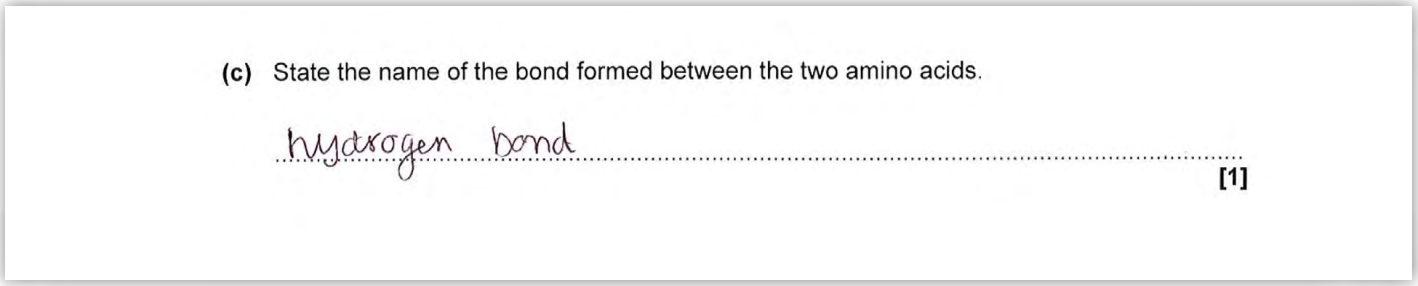
**[3]**

### Commentary

The candidate has provided a good response and obtained a high level mark. They have shown the two amino acid **residues**, based on the molecular models provided in Fig.4.1 and have made a realistic attempt to construct the **peptide bond** between the carboxylic and amine groups. The candidate has also shown the **water molecule** within the formula below the diagram. However, the response could have been even more secure if the H atom was in the correct position on the amine group at the peptide bond and if the water molecule had been included within the diagram

# Exemplar Candidate Work

## Question 4(c) – low level answer


(c) State the name of the bond formed between the two amino acids.

hydrogen bond

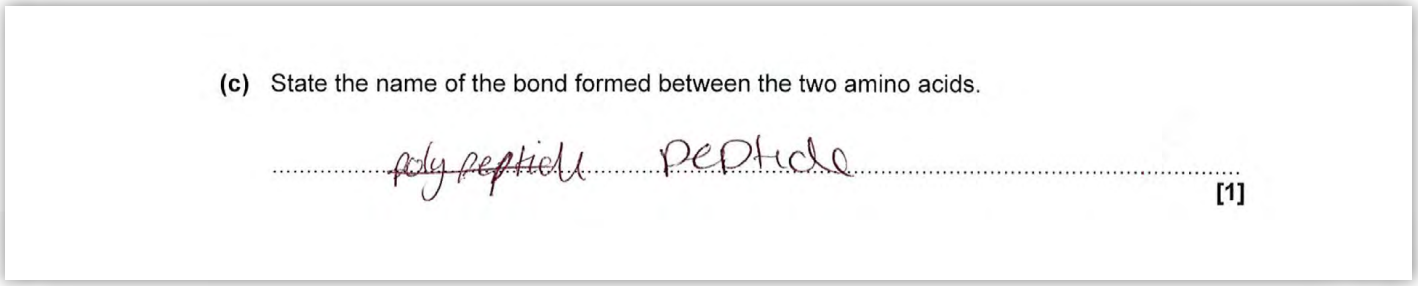
[1]

### Commentary

The candidate has attempted to provide an appropriate response and named a type of bond. However, in this case, the bond in the dipeptide molecule is a **peptide bond** and not the hydrogen bond named by the candidate. The response for this 1 mark item would have been improved with the provision of the correctly-named bond.

# Exemplar Candidate Work

## Question 4(c) – high level answer


(c) State the name of the bond formed between the two amino acids.

~~polypeptide~~ peptide

[1]

### Commentary

The candidate has provided the correct response for this 1 mark item. They successfully identified that the bond is known as the **peptide bond**. The response could have been more secure if an incorrect response had not been included on the answer line. However, in this case, the term 'polypeptide' had been clearly crossed out and was therefore ignored by the marker.

# Question 5(a)

**5** A consumer website lists the 'Top 20' ingredients found in bread.

**Table 5.1** shows the ingredients listed on the website.

| Ingredient | | Comments |
|---|---|---|
| Wheat flour | | |
| Salt | | |
| Water | | |
| Yeast | | |
| Glucose | | |
| B vitamins | Thiamine | |
| | Riboflavin | |
| | Niacin | |
| Vitamin C | | produces the optimum pH for yeast growth |
| Iron | | added as iron(II) sulfate |
| Calcium carbonate | | increases calcium levels in the diet |
| Soya oil | | improves bread texture and flavour |
| Calcium sulfate | | bread 'conditioner' |
| Calcium propionate (propanoate) | | mould inhibitor |
| E472e | | esters of mono- and diglycerides. |
| E920 | | a flour treatment agent.<br>the amino acid cysteine. |
| Soya lecithin | | a phospholipid that acts as an ingredient binder |
| Calcium phosphate | | raising agent and preservative |
| Sodium stearoyl lactylate | | emulsifier |
| Ammonium sulfate | | a source of nitrogen for the yeast |

**Table 5.1**

**(a)** List **five** ingredients in **Table 5.1** that are **inorganic** compounds.

*Any five from:*
salt;
water;
iron(II) sulphate;
calcium carbonate;
calcium sulphate;
calcium phosphate;
ammonium sulphate;

**[2]**

# Question 5(b)

**(b)** White bread has been fortified with calcium since 1943 to increase levels of the mineral calcium in our diet.

**(i)** Describe the role of calcium as a **structural** component in **humans**.

*Any two from:*
(Structural component of) **bone/teeth**;
**Strength/support** (for bone/teeth);
Pool of calcium for body;
Found as (mostly) calcium phosphate;
Ion transporters/carriers in cell membranes;

**[2]**

**(ii)** Describe how calcium is involved in muscle contraction.

*Any three from:*
**Stored** in endoplasmic/sarcoplasmic reticulum;
(Calcium ions) **flow/floods/diffuses** into cytoplasm/sarcoplasm;
**Dislodges/removes** barrier between actin and myosin/binds with molecule/complex;
Allowing actin and myosin to **slide** over each other/sliding filament theory;
Muscle cells **shorten**;
(Calcium ions) **pumped back** into endoplasmic/cytoplasmic reticulum;
Involved in generation of muscle action potential;
Myosin-binding sites on actin blocked by tropomyosin;
Calcium ions bind to troponin-tropomyosin causing conformational change;
Myosin can now interact with actin to cause actin- myosin cross-bridging/muscle contraction;
Calcium channels close as action potential passes;

**[3]**

**(iii)** Describe the role of calcium in **plants**.

*Any two from:*
Structural **support** (of plants/stems/roots/tissues/adjacent cells);
Gives **strength** (within plants/stems//roots/tissues);
Involved in plant **defence** mechanisms;
Structural roles in **cell wall** and cell membrane/calcium pectate holds adjoining cells together/maintenance of cell membranes;
Cell **signalling**/signal transduction;
**Regulator** of biochemical and physiological processes;

**[2]**

# Question 5(c)

**(c)** Iron is also a very important part of our diet.

It was originally added to bread to replace iron that was lost during the milling of flour.

100 g of bread can contribute up to around one third of our required dietary requirements.

Explain the biological functions of iron in the human body.

**Valid points:**

**Carriage of oxygen in haemolgolin**

- Involved with oxygen transport
- (Iron is) located in **haemoglobin**
- Involved in **red blood cell formation**/maturation
- Haemoglobin found in **red blood cells** (in blood plasma)
- Haemoglobin **transports oxygen** (in the blood)
- Forms **oxyhaemoglobin**
- Oxygen becomes **bound** to the haemoglobin
- (Oxygen/ferrous iron binding) is **reversible**
- Oxygen) binds to the iron-containing **porphyrin ring**.

**Carriage of oxygen in myoglobin**

- (Iron is) located in **myoglobin**
- Myoglobin found in **muscles**/muscle cells/fibres
- Myoglobin **stores/exchanges** oxygen in muscle
- Myoglobin **receives** oxygen from oxyhaemoglobin
- Mygolobin has **greater affinity/attraction** for oxygen.

**Component of cytochromes in electron transport chain**

- Iron is a component of **cytochrome**
- Cytochrome part of **electron transport/transfer chain**
- (Involved with) **ATP synthesis**
- Located inside **mitochondrion**
- Iron(II) (ferrous, $Fe^{2+}$) and iron(III), (ferric, $Fe^{3+}$) reversibly **oxidised/reduced**.

**[6]**

## Mark scheme guidance

Question 5(a):

4 or 5 correct responses = 2 marks.

2 or 3 correct responses = 1 mark.

0 or 1 correct response = 0 marks.

**If 6 or more responses – deduct 1** mark for each incorrect, additional response.

**MARK** as a **list** (remaining responses not considered).

Question 5(b)(i):

**ALLOW** component of mitochondria.

**IGNORE** unqualified reference to body.

Question 5(b)(iii):

**ACCEPT** inhibition/regulation of mould/fungus growth = defence mechanism.

**ALLOW** role in photosynthesis (details not needed).

Question 5(c):

**Level 0 (0 marks)**

Candidate response includes **no** valid points.

**Level 1 (1 – 2 marks)**

Candidate shows a basic understanding of the biological functions of iron in carriage of oxygen in haemoglobin **OR** in myoglobin **OR** as a component of cytochromes in electron transport chain with little or no explanation.

**Level 2 (3 – 4 marks)**

Candidate shows an understanding of the biological functions of iron in carriage of oxygen in haemoglobin **AND** in **EITHER** myoglobin **OR** as a component of cytochromes in electron transport chain with little explanation.

**Level 3 (5 – 6 marks)**

Candidate shows a good understanding of the biological functions of iron in carriage of oxygen in haemoglobin **AND** in myoglobin **AND** as a component of cytochromes in electron transport chain with an appropriate explanation.

## Examiner comments

Question 5(a) – A dichotomy of responses was observed for this question. A significant number of candidates were confident and capable of listing the five ingredients in Table 5.1 as inorganic compounds. They were able to list four or five correctly and obtain full marks. However, it was unfortunate that the remaining candidates were very challenged by the data and presented confusing responses including yeast and E-factors. It was not possible to identify a common error for this second group of candidates since the responses were diverse.

Question 5(b)(i) – The majority of candidates were able to respond to this question and obtain both accessible marking points. They noted that calcium was in bones (and teeth) and that its role involved strength/support.

Question 5(b)(ii) – The role of calcium in muscle contraction was not fully appreciated by the majority of candidates. A complex and detailed response was not anticipated. However, it was considered that the features of calcium storage within the tissue, its capacity to flood into muscle cells/fibres and to shorten muscles cells by removing/dislodging the barrier between the microfilaments (actin/myosin) would be achievable.

Question 5(b)(iii) – The role of calcium in plants is interesting since it also provides strength/support but via different means. It was expected that candidates would not necessarily appreciate the location of calcium between adjacent plant cell walls (in calcium pectate) but it was anticipated that the key features would be understood. Relatively few candidates successfully completed this question and yet some were able to achieve full marks. Some candidates also referred correctly to the additional role of calcium in photosynthesis (no details needed).

Question 5(c) – The biological function of iron in the human body appeared to be a challenging topic for some candidates. The responses varied greatly. Some candidates were capable of outlining the key functions of oxygen transport via haemoglobin within red blood cells. Such candidates progressed onto Level 2 marks (3 or 4) for this 'Level of Response' question. It was good to see that some candidates were also aware of the function of iron in myoglobin and as a component of electron transport chains. Detailed responses were not expected and the marking of this question therefore reflected the challenging nature for many candidates.

# Exemplar Candidate Work

## Question 5(c) – low level answer

**(c)** Iron is also a very important part of our diet.

It was originally added to bread to replace iron that was lost during the milling of flour.

100 g of bread can contribute up to around one third of our required dietary requirements.

Explain the biological functions of iron in the human body.

Iron has many important functions around the human body and mainly for the transportation of blood and oxygen around the body, with a lack of iron, People become anaemic as blood and nutrients can't be transported and cells have difficulty performing reactions as they require nutrients from to carry out reaction

[6]

### Commentary

The candidate showed little understanding of the biological functions of iron. The specification exemplar statements indicate that consideration of the role should include **haemoglobin**, **myoglobin** and as a component of **cytochromes** in the electron transport chain (in cellular respiration). The candidate indicated the role of iron in the transport of oxygen around the blood without reference to haemoglobin or red blood cells. This limited the response to level 1 (for this 'Level of Response' item) with only 1 mark awarded. A medium level response could have moved on to 2 or 3 marks if haemoglobin and/or myoglobin were named. The location of the two respiratory pigments, in the blood and muscle cells respectively, would have secured level 2 with up to 4 marks.

# Exemplar Candidate Work

## Question 5(c) – medium level answer

**(c)** Iron is also a very important part of our diet.

It was originally added to bread to replace iron that was lost during the milling of flour.

100 g of bread can contribute up to around one third of our required dietary requirements.

Explain the biological functions of iron in the human body.

Iron is found in haemoglobin in red blood cells, and it has a high affinity for oxygen, allowing it to bond with 3 molecules of oxygen and carry them around the body to parts that need oxygen.

**[6]**

### Commentary

The candidate provided a medium level answer. The overall response for this 'Level of Response' answer achieved level 2. The response included a number of valid points, indicating that the candidate showed an understanding of the biological functions of iron. They included the term **'haemoglobin'** and correctly linked this to red blood cells. The response was even more effective and unexpected at this point in the specification (exemplar statement) since a **high affinity** for oxygen was stated. The overall transport of oxygen, as part of the haemoglobin within the red blood cells, was also correctly included in the response. The response could have been allocated a higher score if the relevance of iron as a component of myoglobin and cytochromes (as part of the electron transport chain) had also been included.

High level answers would correspond to level 3 for this 'Level of Response' question, giving the potential for 5 or 6 marks. Ideally, responses at this level were expected to show a good understanding of the biological functions of iron in the transport of oxygen in **haemoglobin** (as an essential component of the molecule [via 4 haem groups], held within red blood cells and involved in their production), in **myoglobin** (as an essential component of the molecule [via 1 haem group], held within muscle cells and showing a greater affinity of oxygen than that of haemoglobin) and as a component of **cytochromes** in the **electron transport chain** (involved in ATP synthesis, located within mitochondria and in a reversibly oxidised/reduced state).

# Question 6(a)

**6** Andy is a student technician working in a laboratory.

He is being trained to interpret the data presented in phase diagrams.

**Fig. 6.1** is a phase diagram for water.

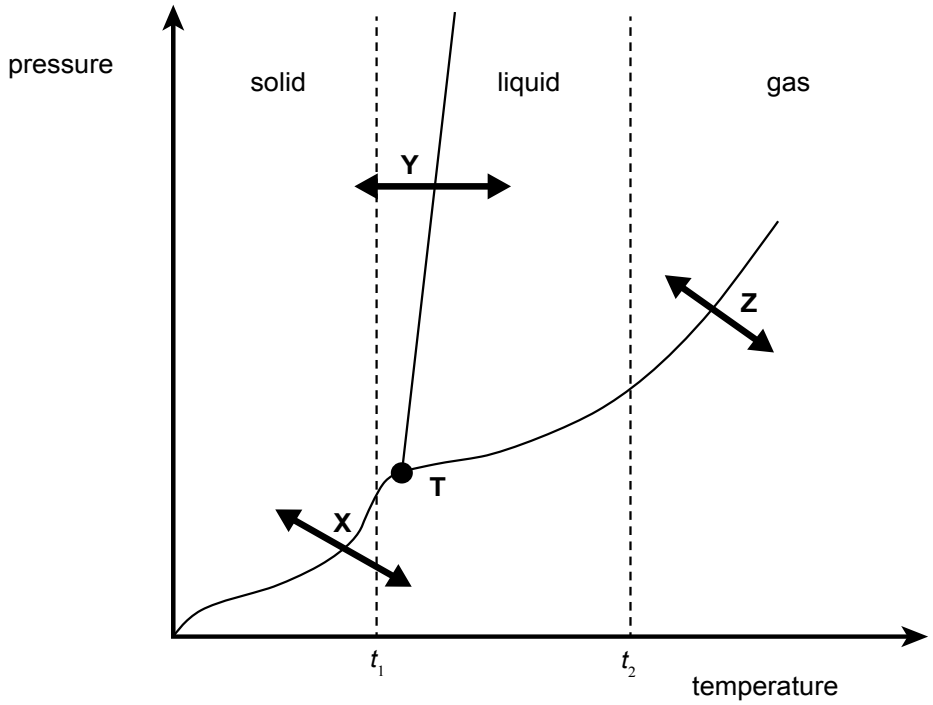



**Fig. 6.1**

Phase diagrams show the:

- impact of increasing pressures and temperatures on the phases of simple substances such as water
- lines of equilibrium or 'phase boundaries' between solid, liquid and gas
- changes of state (at X, Y and Z).

**(a)** Andy is asked to use the phase diagram to find out more about the properties of water.

**(i)** Use **Fig. 6.1** to describe point **T**.

T is a specific temperature and pressure .....

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

**(ii)** Deduce the physical state of water at point **T**.

Solid, liquid and gas; ....**[1]**

# Question 6(b)

**(b)** Describe the data presented in the phase diagram for water (**Fig. 6.1**).

**Valid points:**

**Stable phases and changes of state**

*Solid*

- Solid phase for water is **ice**
- (This requires) **lower temperatures**
- solid to gas is **sublimation** (at X)
- gas to solid is **deposition** (at X)
-

*Liquid*

- (This requires) **medium temperature AND medium pressure**
- solid to liquid is **melting** (at Y)
- liquid to solid is **freezing** (at Y)
-

*Gas*

- Gas phase for water is **steam**
- (This requires) **high temperatures AND low pressure**
- liquid to gas is **evaporation** (at Z)
- gas to liquid is **condensation** (at Z)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**[6]**

## Mark scheme guidance

Question 6(a):

**ALLOW** the temperature of water at a certain pressure/the pressure of water at a certain temperature.

Question 6(c):

**Level 0 (0 marks)**

Candidate response includes **no** valid points.

**Level 1 (1 – 2 marks)**

Candidate shows a basic understanding of the stable phases and changes of state **OR** temperatures of fixed points.

**Level 2 (3 – 4 marks)**

Candidate shows an understanding of the stable phases and changes of state **OR** temperatures of fixed points.

**Level 3 (5 – 6 marks)**

Candidate shows a good level of understanding of the stable phases and changes of state **AND** temperatures of fixed points.

Temperatures of fixed points:

- $t_1$ = 0°C/273K
- $t_2$ = 100°C/373K

**ALLOW** additional, correct valid point e.g. intermolecular forces.

## Examiner comments

Question 6(a) to (c) – A number of candidates were unable to complete this question successfully. The presentation of a phase diagram for water appeared to be unfamiliar. Candidates were frequently confused by the nature of T on the diagram (specific temperature and pressure) and were therefore unable to deduce the physical state of water at point T (solid, liquid and gas). Due to the position of T within the phase boundary of liquid, candidates assumed that it represented water as a liquid rather than an interface for all three states. It was encouraging to see that the overall description [6(c)] for some candidates included references to melting, freezing, evaporation and condensation, but such references were relatively rare. This appeared to be the most novel and challenging question for candidates and the allocation of marks for 6(c) was therefore as accessible as possible.

# Question 7(a)(i)

**7** Sara connects six identical lamps in parallel with a 12.0 V power supply.

Her circuit diagram is shown in **Fig. 7.1**.

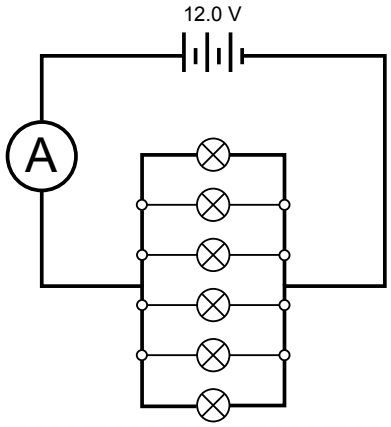



**Fig. 7.1**

She measures the current and then repeats the experiment by removing one lamp at a time.

Her results are shown in **Table 7.1**.

| Number of lamps in parallel | Current /A |
|---|---|
| 6 | 0.35 |
| 5 | 0.31 |
| 4 | 0.26 |
| 3 | 0.21 |
| 2 | 0.14 |
| 1 | 0.07 |

**Table 7.1**

**(a) (i)** Use **Table 7.1** to calculate the resistance $R_1$ of one lamp and the resistance $R_6$ of six lamps in parallel.

Show your working.

**For MP 1 and 2**
(R =) V/I / V = IR / 12.0 ÷ 0.07;
($R_1$ =) 171.4

$R_1$ = .....Ω

**For MP3**
(12 ÷ 0.35)
($R_6$ =) 34.3

$R_6$ = .....Ω **[3]**

# Questions 7(a)(ii), (iii) and (iv)

**(ii)** Use your answer $R_1$ and the formula for resistors in parallel, to determine the theoretical resistance $R_{6T}$ of six lamps in parallel.

Show your working.

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6}$$ **OR** $1 \div R_{6T}$

$= 6 \div 171.4$ **OR**

$R_{6T} = 171.4 \div 6$

$R_{6T} = 28.6$

$R_{6T}$ = .....Ω **[2]**

**(iii)** Explain why there is a difference between the actual resistance $R_6$ and the theoretical resistance $R_{6T}$.

Lamp resistance changes with **temperature**/the lamps are not ohmic resistors

.....

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

**(iv)** Sara concludes that:

**'The current in six lamps is less than I expected'.**

Use a calculation to justify Sara's conclusion.

Use of calculation e.g. 6 × current for one lamp/3 × current for 2 lamps etc;
Comparison with actual resistance/0.35

.....

.....

.....

**[2]**

## Mark scheme guidance

Question 7(a)(i):

**FIRST CHECK THE ANSWER.**

**If answer is $R_1$ = 171.4 award 2 marks**.

$R_1$ = 117.4 = 2 marks i.e. MP1 and MP2.

**ALLOW** 171 or 171.43/correct, unlimited decimal places (not limited via stem of question).

**ALLOW** 34 or 34.29/correct, unlimited decimal places (not limited via stem of question).

Question 7(a)(ii):

**FIRST CHECK THE ANSWER.**

**If answer is $R_{6T}$ = 28.6 award 2 marks**

**ALLOW** $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}$ ... etc

**ALLOW ecf** from answer to $R_1$.

**ALLOW 28.57**/correct, unlimited decimal places (not limited via stem of question).

**ALLOW 28.5** only if 171 for $R_1$ in 7(a)(i).

Question 7(a)(iii):

**ALLOW** heat = temperature.

Question 7(a)(iv):

**ALLOW** theoretical current/**I = V/R** = 12/28.5 = 0.42A

**ALLOW** correct reference to **Ohm's Law**/more resistance leads to reduced current = 1 max.

## Examiner comments

This final question of the paper also appeared to generate a dichotomy of responses. Some candidates were very confident and successfully completed the calculations for parts (i) and (ii). Other candidates were clearly challenged and struggled to use the data provided in Fig.7.1 and Table 7.1. It appeared that they were not familiar with circuit diagrams. An explanation for the difference between the actual resistance $R_6$ and the theoretical resistance $R_{6T}$ was stretching for the most able candidates. The topic was discriminatory for both candidate knowledge and application. The final question (iv) was successfully completed by a number of candidates, who were able to refer to Ohm's Law in the correct manner and to complete the necessary calculation to achieve the comparison required.

The small print

We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest



## Looking for a resource?

There is now a quick and easy search tool to help find **free** resources for your qualification:

www.ocr.org.uk/i-want-to/find-resources/

ocr.org.uk/science
OCR customer contact centre

**Vocational qualifications**
Telephone 02476 851509
Facsimile 02476 851633
Email vocational.qualifications@ocr.org.uk

OCR is part of Cambridge Assessment, a department of the University of Cambridge. *For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored.*



Cambridge Assessment

LLOYD'S REGISTER · LRQA
ISO 9001
UKAS MANAGEMENT SYSTEMS
001