

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

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.

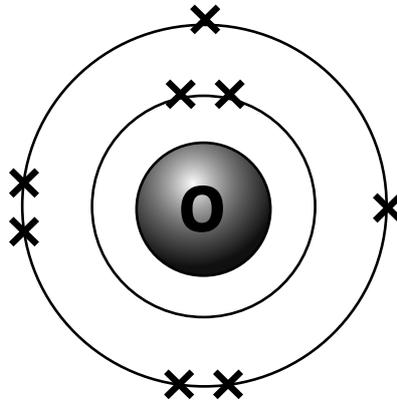


Fig. 1.1

- (a) State the electron configuration of oxygen.

.....

[1]

- (b) State the proton number of oxygen.

.....

[1]

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

.....

[1]

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

.....

[1]

(d) Oxygen reacts with hydrogen to produce water.

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

.....[2]

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

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

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

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.....[2]

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

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

 H							 He
 Li	 Be	 B	 C	 N	 O	 F	 Ne
 Na	 Mg	 Al	 Si	 P	 S	 Cl	 Ar
 K	 Ca	 Ga	 Ge	 As	 Se	 Br	 Kr
 Rb	 Sr	 In	 Sn	 Sb	 Te	 I	 Xe
 Cs	 Ba	 Tl	 Pb	 Bi	 Po	 At	 Rn

Fig. 1.2

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

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[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.

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[2]

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Turn over for the next question.

- 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**.

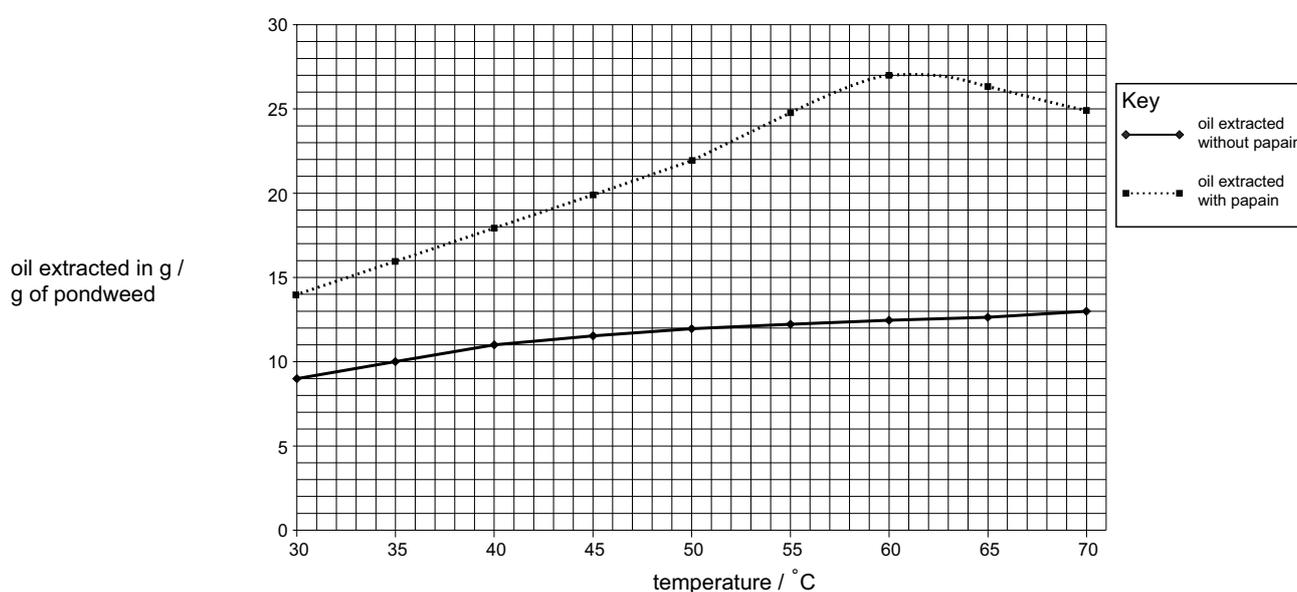


Fig. 2.1

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

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[4]

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

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[4]

(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.

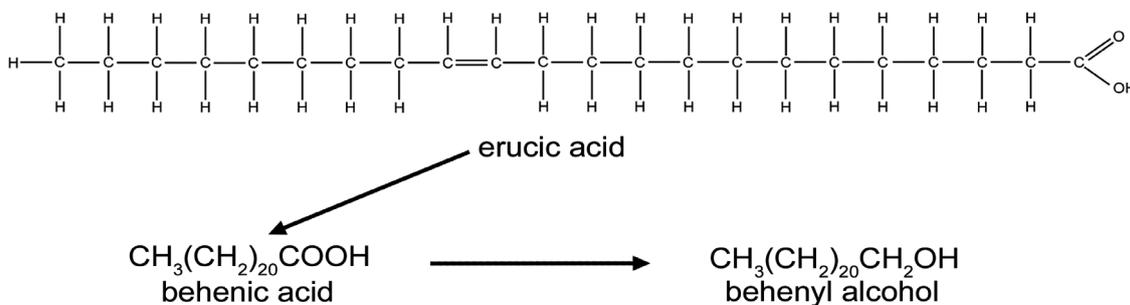


Fig. 2.2

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.

.....

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.....

[3]

(ii) Behenyl alcohol from behenic acid.

.....

.....

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[3]

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

State the type of reaction involved.

.....

[1]

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**.

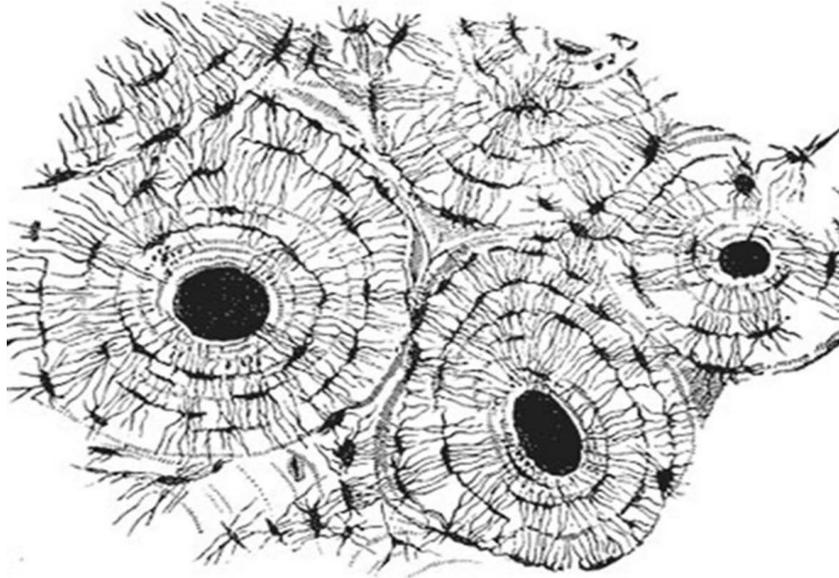


Fig. 3.1

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

..... [1]

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

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..... [4]

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

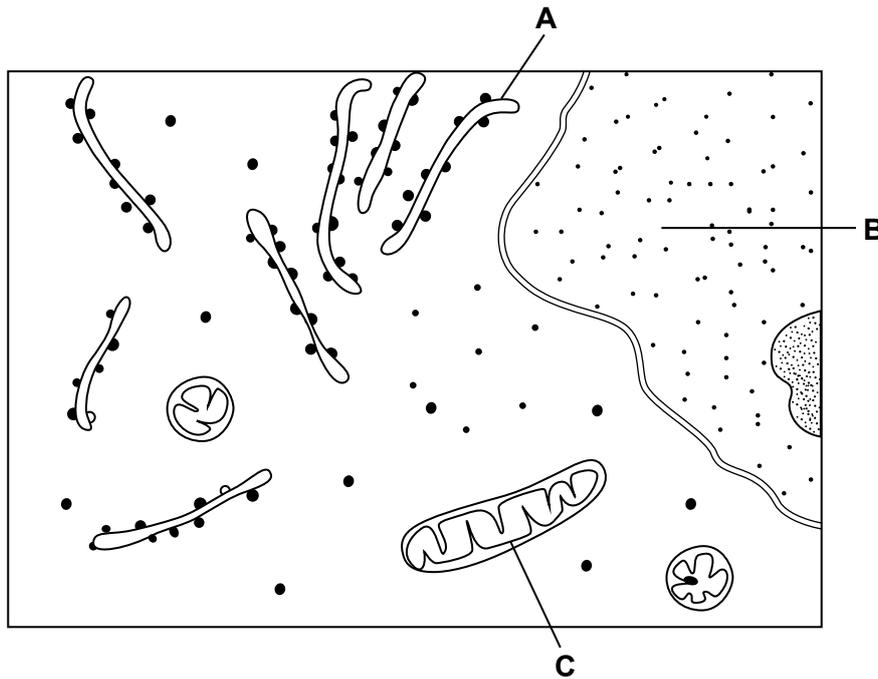


Fig. 3.2

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

A.....

B.....

C.....

[3]

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

A.....

.....

B.....

.....

[4]

(b) Connective tissue contains specialised cells called fibrocytes.

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

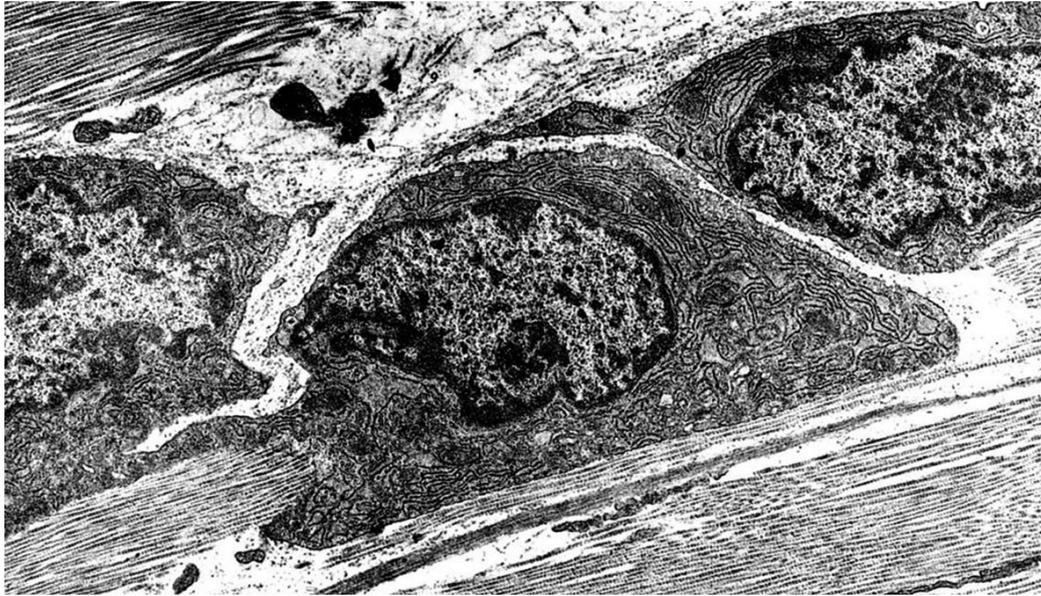


Fig 3.3

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.

..... [1]

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

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..... [2]

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.

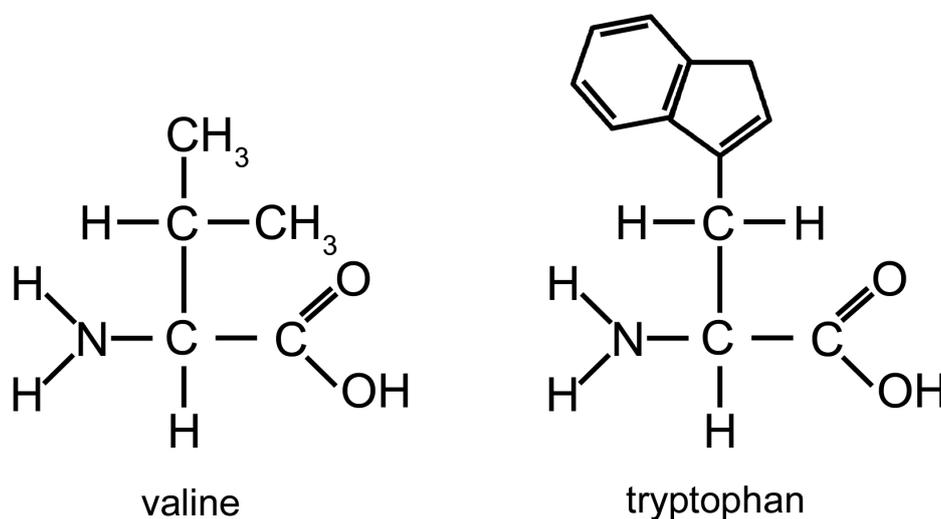


Fig. 4.1

(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]

- (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.

.....

[1]

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

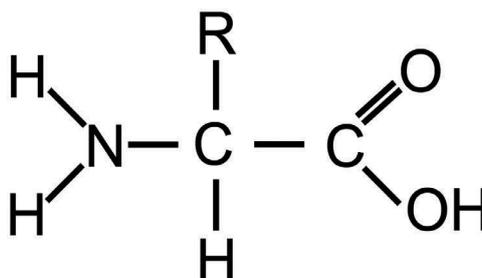


Fig. 4.2

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

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

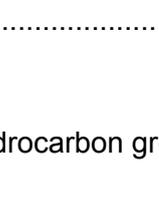
Amino acid	R-group
Alanine	-CH ₃
Glycine	-H
Leucine	-CH ₂ CH(CH ₃)CH ₃
Phenylalanine	-CH ₂ - 
Serine	-CH ₂ OH

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?

..... [1]

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

..... [1]

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

..... [1]

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

..... [1]

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

..... [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.

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..... [4]

- 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. 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.

.....

.....

.....

.....

[2]

(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**.

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.....
.....

[2]

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

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[3]

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

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.....

[2]

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Turn over for the next question.

- 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.

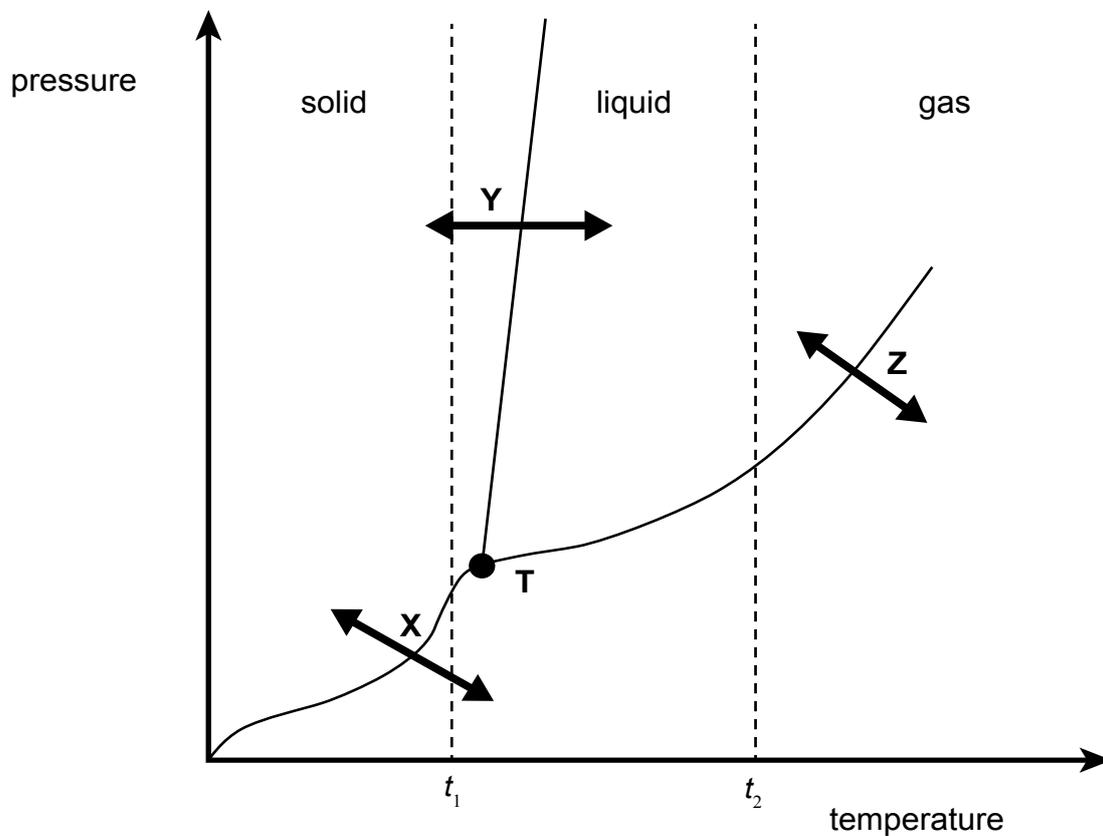


Fig. 6.1

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.

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

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

.....[1]

- 7 Sara connects six identical lamps in parallel with a 12.0V power supply. Her circuit diagram is shown in **Fig. 7.1**.

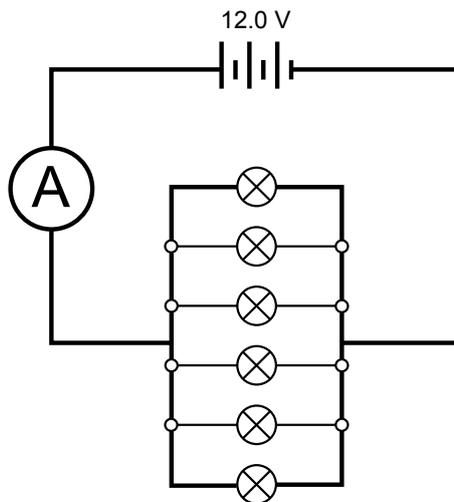


Fig. 7.1

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.

$$R_1 = \dots\dots\dots\Omega$$

$$R_6 = \dots\dots\dots\Omega \text{ [3]}$$

- (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.

$$R_{6T} = \dots\dots\dots\Omega \text{ [2]}$$

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

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

- (iv) Sara concludes that:

‘The current in six lamps is less than I expected’.

Use a calculation to justify Sara’s conclusion.

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large rectangular area with a solid vertical line on the left side and horizontal dotted lines across the page, providing space for writing answers.

A vertical solid line runs down the left side of the page. To its right, there are 25 horizontal dotted lines spaced evenly down the page, providing a template for writing.

A vertical solid line runs down the left side of the page. To its right, there are 25 horizontal dotted lines spaced evenly down the page, providing a template for handwriting practice.

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