OCR
Oxford Cambridge and RSA

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

Unit 1: Science fundamentals

Thursday 17 May 2018 – Afternoon

C340/1806

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**

Answer **all** the questions.

1 An atom of potassium has the symbol:

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

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

Protons ……..

Electrons ……

Neutrons ……

[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.

nuclear radius R = …….. m

[2]

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

.....

.....

.....

.....

.....

.....**[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.

.....

.....

.....**[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]

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

$NaNO_2$ + ... → HNO_2 + ...

[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.

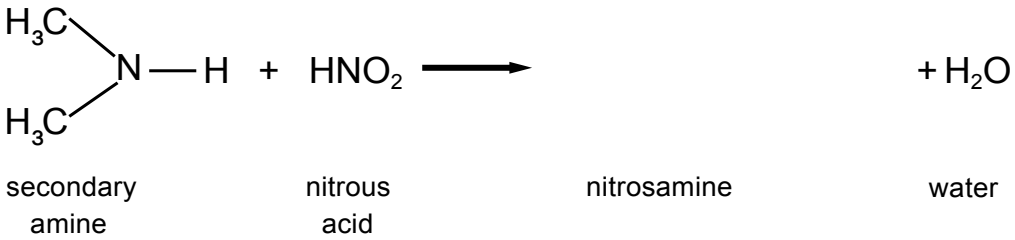


Fig. 2.1

[2]

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

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

1 .....

2 .....

3 .....

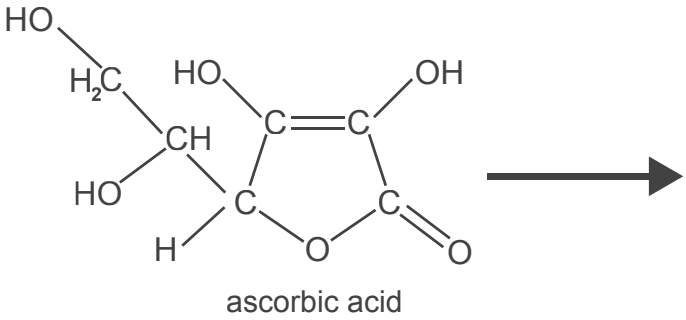
[3]

(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]

(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]

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.

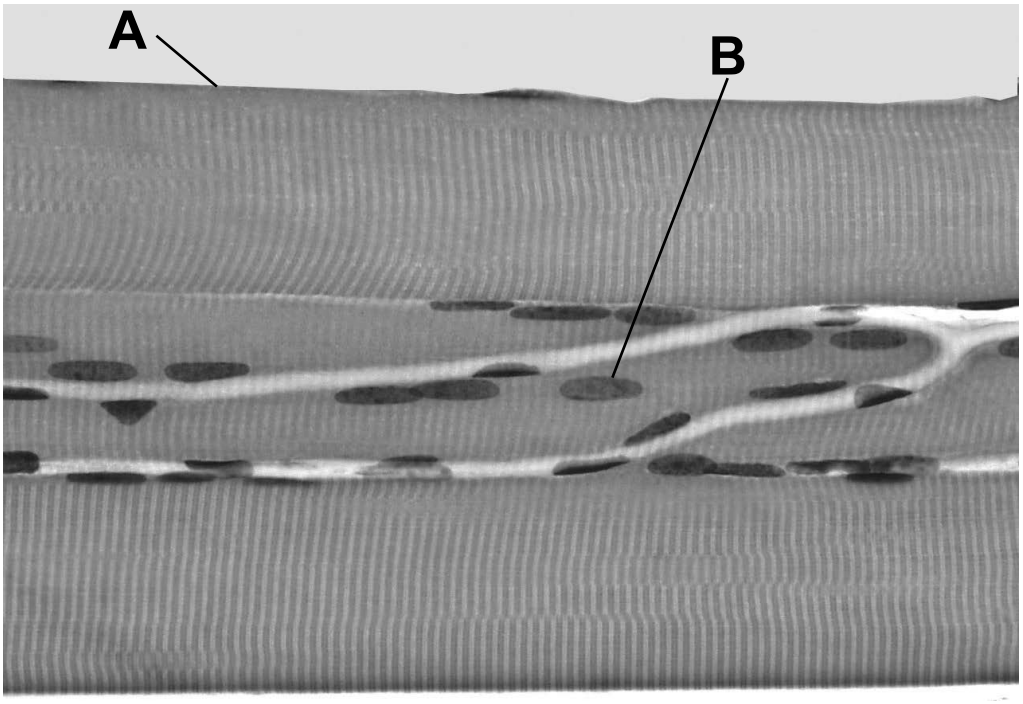


Fig. 3.1

(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.

A	Cell wall
	Chloroplast
	Cytoplasm
	Mitochondrion
B	Nucleus
	Plasma membrane

[2]

(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**

[2]

(iii) State the role of ribosomes in cells.

.....

.....**[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

.....

Why needed for muscle contraction.....

.....

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

(ii) Function of sarcoplasmic (endoplasmic) reticulum

.....

Why needed for muscle contraction.....

.....

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

(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.

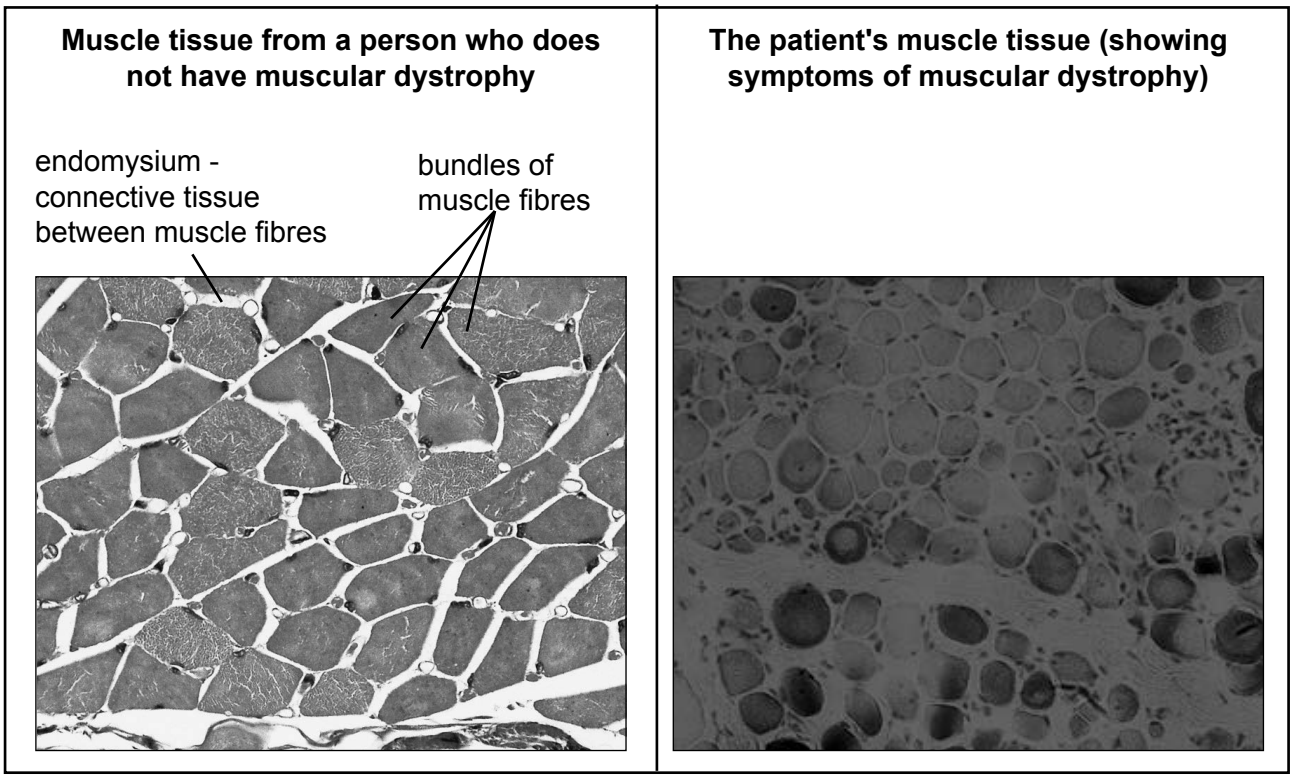


Fig. 3.2

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

.....

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

(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]

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

Tick (✓) **three** boxes.

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

[3]

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**.

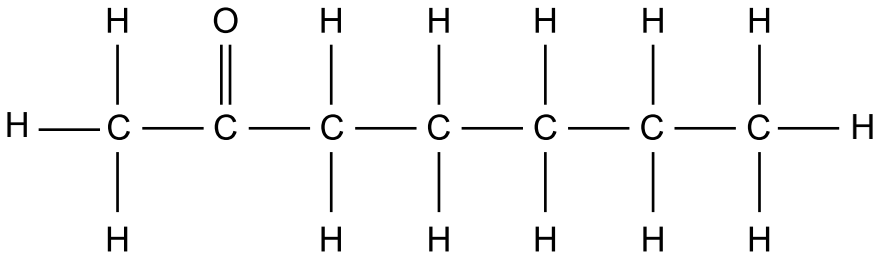


Fig. 4.1

(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 .....

2 .....

[2]

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

1 .....

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**

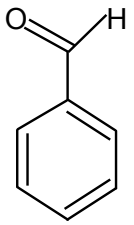
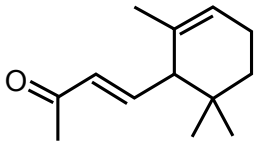
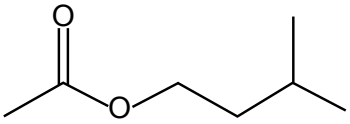
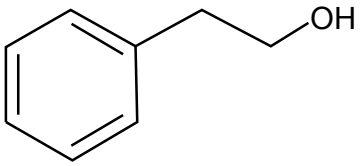
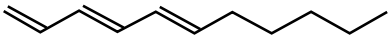
Name of compound	Structure of compound	Smell and flavour	Functional group(s)
benzaldehyde		The compound that gives flavour to almonds and marzipan	
ionone		Gives aromas and flavours of violets in beer and wine	
isoamyl acetate		Gives pear drop aroma in confectionary, wine and beer	
phenylethanol		Gives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

Table 4.1

[5]

(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**.

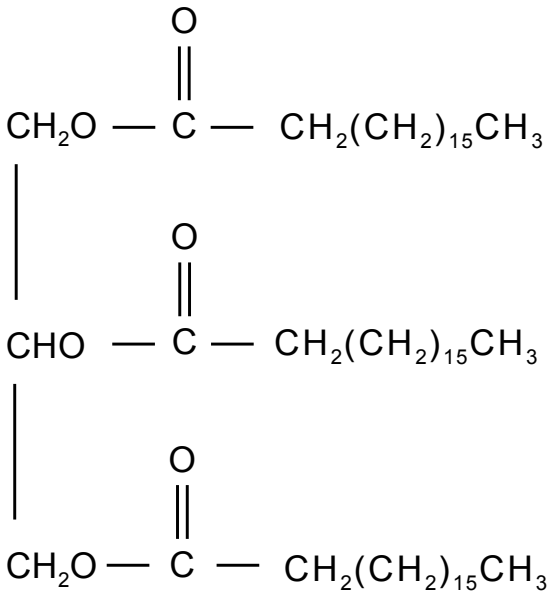


Fig. 4.2

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

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

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

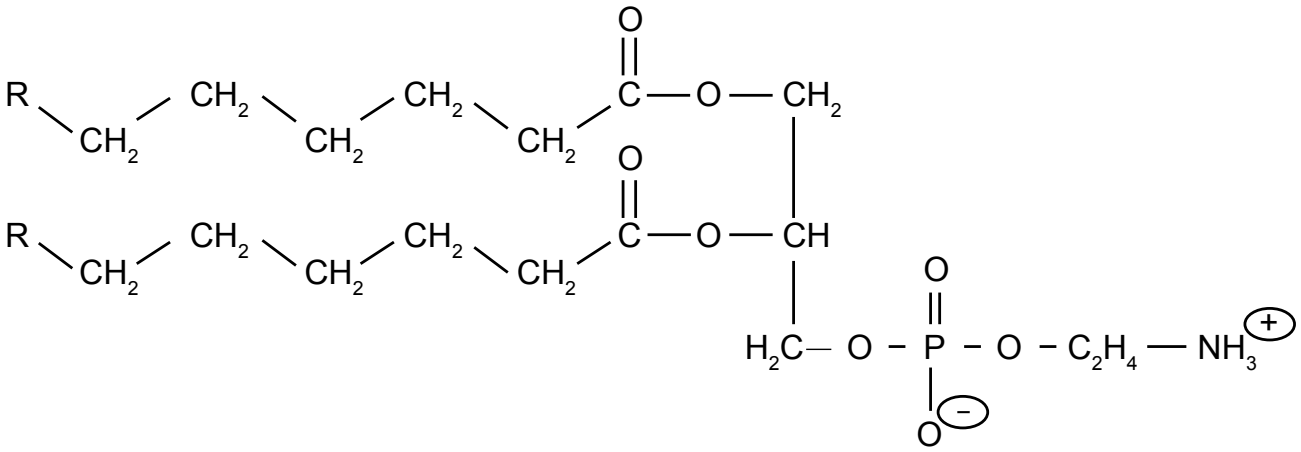


Fig. 4.3

What is the name of this type of lipid?

Tick (✓) **one** box.

Glycolipid ☐

Phospholipid ☐

Prenol lipid ☐

Sterol lipid ☐

[1]

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.	
Has a role in photosynthesis.	
Found at the active site of hydrogenase.	
Essential for osmotic balance in living cells.	
Has a role in oxygen transport.	

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 …….. .

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

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

Phosphates are an essential part of …….. and

……... .

[5]

(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**.

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.....

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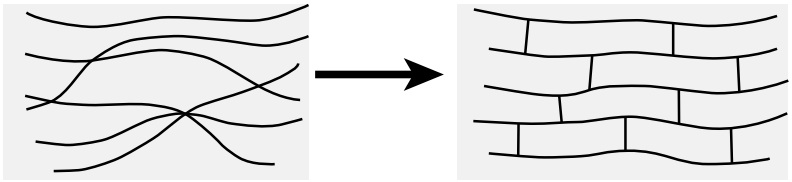
.....

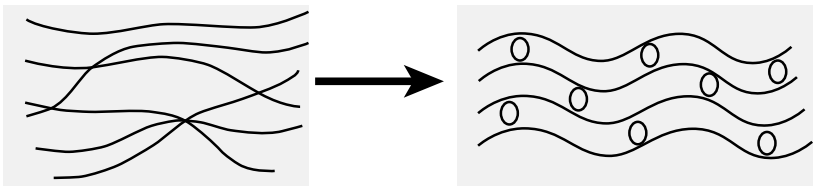
.....

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

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.

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

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

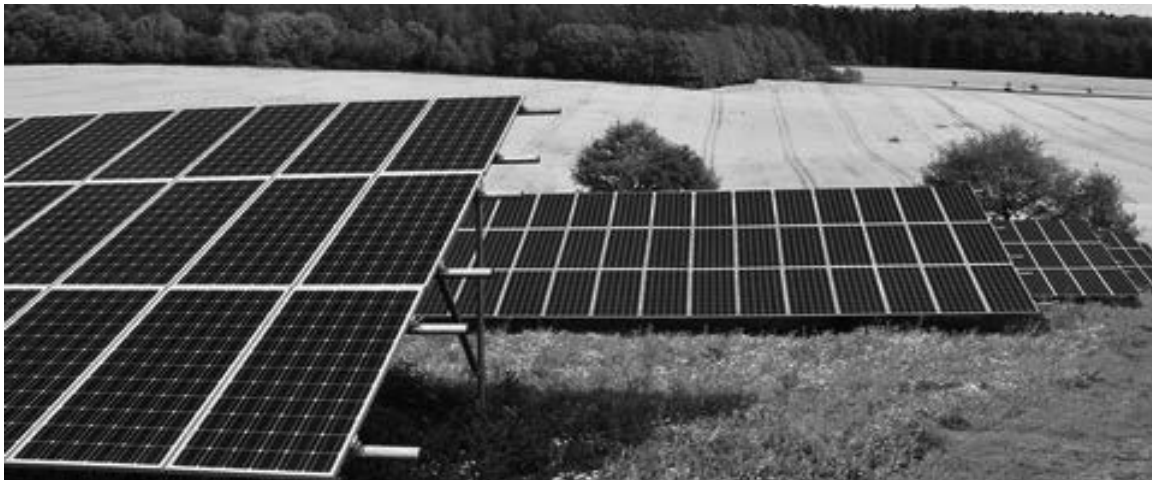

Fig. 7.1

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

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

power *P* = ...……..... units……

[3]

(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.

resistance *R* = ... Ω

[4]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s) – for example 1(c) or 2(b).

The Periodic Table of the Elements

Key
atomic number **Symbol** name relative atomic mass

(1) 1	(2) 2	3	4	5	6	7	8	9	10	11	12	(3) 13	(4) 14	(5) 15	(6) 16	(7) 17	(0) 18
1 **H** hydrogen 1.0																	2 **He** helium 4.0
3 **Li** lithium 6.9	4 **Be** beryllium 9.0											5 **B** boron 10.8	6 **C** carbon 12.0	7 **N** nitrogen 14.0	8 **O** oxygen 16.0	9 **F** fluorine 19.0	10 **Ne** neon 20.2
11 **Na** sodium 23.0	12 **Mg** magnesium 24.3											13 **Al** aluminium 27.0	14 **Si** silicon 28.1	15 **P** phosphorus 31.0	16 **S** sulfur 32.1	17 **Cl** chlorine 35.5	18 **Ar** argon 39.9
19 **K** potassium 39.1	20 **Ca** calcium 40.1	21 **Sc** scandium 45.0	22 **Ti** titanium 47.9	23 **V** vanadium 50.9	24 **Cr** chromium 52.0	25 **Mn** manganese 54.9	26 **Fe** iron 55.8	27 **Co** cobalt 58.9	28 **Ni** nickel 58.7	29 **Cu** copper 63.5	30 **Zn** zinc 65.4	31 **Ga** gallium 69.7	32 **Ge** germanium 72.6	33 **As** arsenic 74.9	34 **Se** selenium 79.0	35 **Br** bromine 79.9	36 **Kr** krypton 83.8
37 **Rb** rubidium 85.5	38 **Sr** strontium 87.6	39 **Y** yttrium 88.9	40 **Zr** zirconium 91.2	41 **Nb** niobium 92.9	42 **Mo** molybdenum 95.9	43 **Tc** technetium	44 **Ru** ruthenium 101.1	45 **Rh** rhodium 102.9	46 **Pd** palladium 106.4	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
55 **Cs** caesium 132.9	56 **Ba** barium 137.3	57–71 lanthanoids	72 **Hf** hafnium 178.5	73 **Ta** tantalum 180.9	74 **W** tungsten 183.8	75 **Re** rhenium 186.2	76 **Os** osmium 190.2	77 **Ir** iridium 192.2	78 **Pt** platinum 195.1	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
87 **Fr** francium	88 **Ra** radium	89–103 actinoids	104 **Rf** rutherfordium	105 **Db** dubnium	106 **Sg** seaborgium	107 **Bh** bohrium	108 **Hs** hassium	109 **Mt** meitnerium	110 **Ds** darmstadtium	111 **Rg** roentgenium	112 **Cn** copernicium		114 **Fl** flerovium		116 **Lv** livermorium		

57 **La** lanthanum 138.9	58 **Ce** cerium 140.1	59 **Pr** praseodymium 140.9	60 **Nd** neodymium 144.2	61 **Pm** promethium 144.9	62 **Sm** samarium 150.4	63 **Eu** europium 152.0	64 **Gd** gadolinium 157.2	65 **Tb** terbium 158.9	66 **Dy** dysprosium 162.5	67 **Ho** holmium 164.9	68 **Er** erbium 167.3	69 **Tm** thulium 168.9	70 **Yb** ytterbium 173.0	71 **Lu** lutetium 175.0
89 **Ac** actinium	90 **Th** thorium 232.0	91 **Pa** protactinium	92 **U** uranium 238.1	93 **Np** neptunium	94 **Pu** plutonium	95 **Am** americium	96 **Cm** curium	97 **Bk** berkelium	98 **Cf** californium	99 **Es** einsteinium	100 **Fm** fermium	101 **Md** mendelevium	102 **No** nobelium	103 **Lr** lawrencium