OCR

Oxford Cambridge and RSA

F

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/04 Combined Science (Foundation Tier)

Monday 11 June 2018 – Morning
Time allowed: 1 hour 45 minutes

You must have:
- the Data Sheet (for GCSE Combined Science B (inserted))
- a ruler (cm/mm)

You may use:
- a scientific or graphical calculator
- an HB pencil

First name	
Last name	

Centre number					Candidate number				

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **75**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in the question marked with an asterisk (*).
- This document consists of **28** pages.

2

Answer **all** the questions.

1 Eve is making sodium chloride in the school laboratory.

(a) Eve makes the sodium chloride by reacting hydrochloric acid with sodium carbonate solution.

Complete the risk assessment in **Table 1.1** for the hydrochloric acid.

Source of hazard	Hazard	Risk	Safety precaution
Hydrochloric acid	⚠	Irritating to skin and eyes if spilt or splashed	....

Table 1.1

[1]

(b) Eve uses a **titration** to react the hydrochloric acid and sodium carbonate solution in the correct quantities.

(i) Which piece of apparatus, **A**, **B**, **C** or **D**, should she use to add the hydrochloric acid?

Put a (ring) around the correct answer.
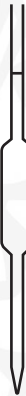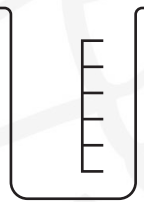
A	**B**	**C**	**D**

[1]

(ii) Eve adds a few drops of a chemical to a conical flask containing the sodium carbonate solution. The chemical added changes colour.

What is the name of this type of chemical?

.... [1]

(c) (i) Complete and balance the chemical equation for the reaction between sodium carbonate solution and hydrochloric acid.

sodium carbonate + hydrochloric acid → sodium chloride + carbon dioxide + water

Na_2CO_3 (aq) + 2 HCl (aq) → 2 .... (aq) + ... (g) + H_2O (l)

[2]

(ii) Which statement about the reaction between sodium carbonate solution and hydrochloric acid is correct?

Tick (✓) **one** box.

All the products are in the aqueous state. ☐

Sodium carbonate is neutralised during the reaction. ☐

All of the carbon dioxide produced dissolves in the reaction mixture. ☐

[1]

(d) Which process is used to produce **solid** sodium chloride from sodium chloride solution?

Tick (✓) **one** box.

Chromatography ☐

Crystallisation ☐

Filtration ☐

[1]

(e) Sodium chloride is more commonly known as salt.

In some countries, water contains high levels of salt. The salt has to be removed from the water so people are able to drink it.

Which process would separate pure water from the salt water?

Tick (✓) **one** box.

Chromatography ☐

Crystallisation ☐

Distillation ☐

Filtration ☐

[1]

(f) Sodium chloride (salt) is used to add flavour to food. Many people are concerned about the effects of high intakes of sodium on human health.

The graph in **Fig. 1.1** shows data from a study in 1995. It shows the relationship between intake of sodium and the rate of stomach cancer in different countries.
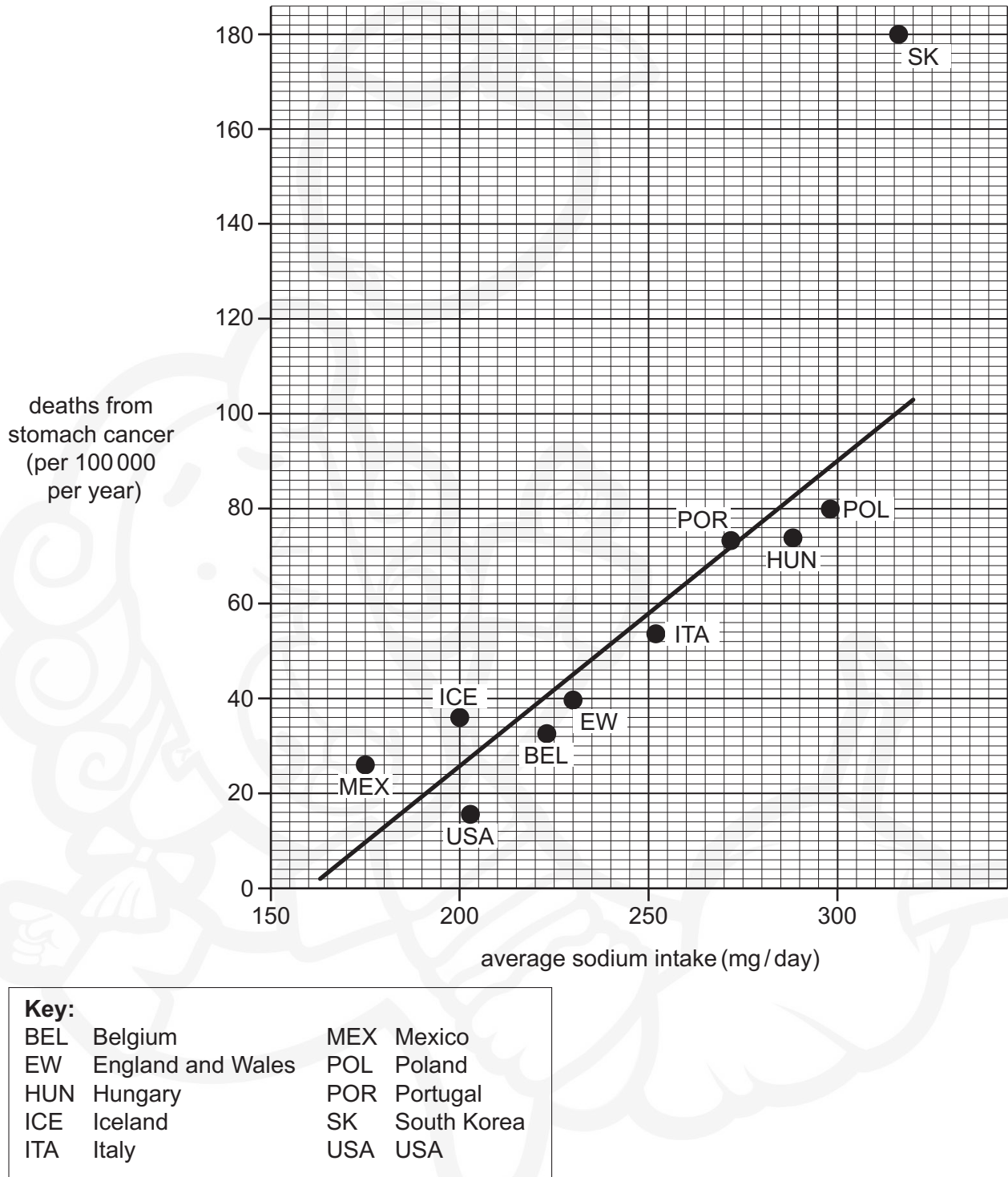

Key:

BEL	Belgium	MEX	Mexico
EW	England and Wales	POL	Poland
HUN	Hungary	POR	Portugal
ICE	Iceland	SK	South Korea
ITA	Italy	USA	USA

Fig. 1.1

5

(i) Describe the relationship between average sodium intake and deaths from stomach cancer.

....

....

.... **[1]**

(ii) Which statement about the graph in **Fig. 1.1** is correct?

Tick (✓) **one** box.

The death rate in England and Wales is 10 per 100 000 people per year. ☐

The study is too old for data to be reliable. ☐

The data point from Portugal is an outlier. ☐

The death rate in South Korea is higher than expected from the trend. ☐

[1]

(g) Some studies have suggested that a bacterium called *Helicobacter* is linked with stomach cancer.

One idea is that salt affects the growth of *Helicobacter*.

Suggest an experiment to test this idea.

....

....

....

.... **[2]**

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PLEASE DO NOT WRITE ON THIS PAGE

2 Amir is investigating electric circuits and magnetism.

(a) Amir sets up a solenoid.

(i) Describe how a solenoid can be made.

....

.... **[1]**

(ii) Amir connects the solenoid in a circuit. The circuit is shown in **Fig. 2.1**.

Amir closes the switch.

On the diagram in **Fig. 2.1**, draw:
- the direction of current flow through the solenoid
- the magnetic field lines and their direction
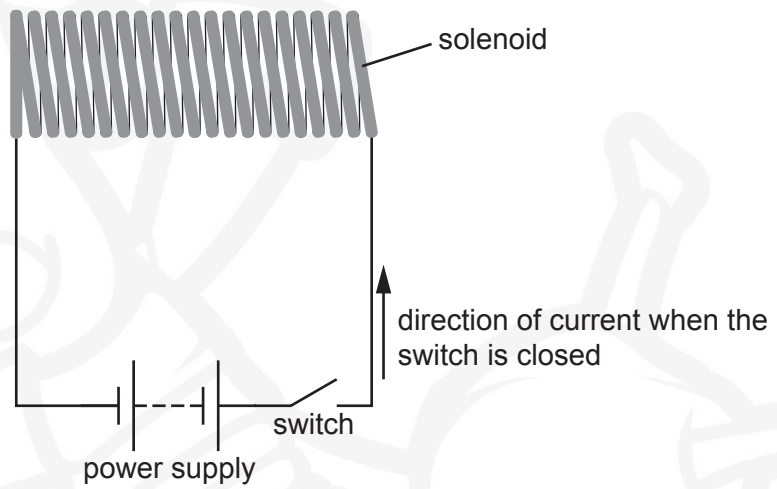- the poles of the magnetic field produced.

solenoid

direction of current when the switch is closed

switch

power supply

Fig. 2.1

[3]

(b) Amir places an iron core in the solenoid. The iron core becomes magnetised.

Amir uses the magnetised iron core to pick up paper clips. He counts the number of paper clips picked up.

He then repeats the experiment several times, each time changing the number of turns in the solenoid.

Amir's results are shown in **Table 2.1**.

Number of turns in the solenoid	Number of paper clips picked up by the iron core
10	5
20	10
30	14
40	19
50	25
60	31

Table 2.1

(i) Complete the graph in **Fig. 2.2** by plotting the results from **Table 2.1** and draw a line of best fit. Some have been plotted for you.
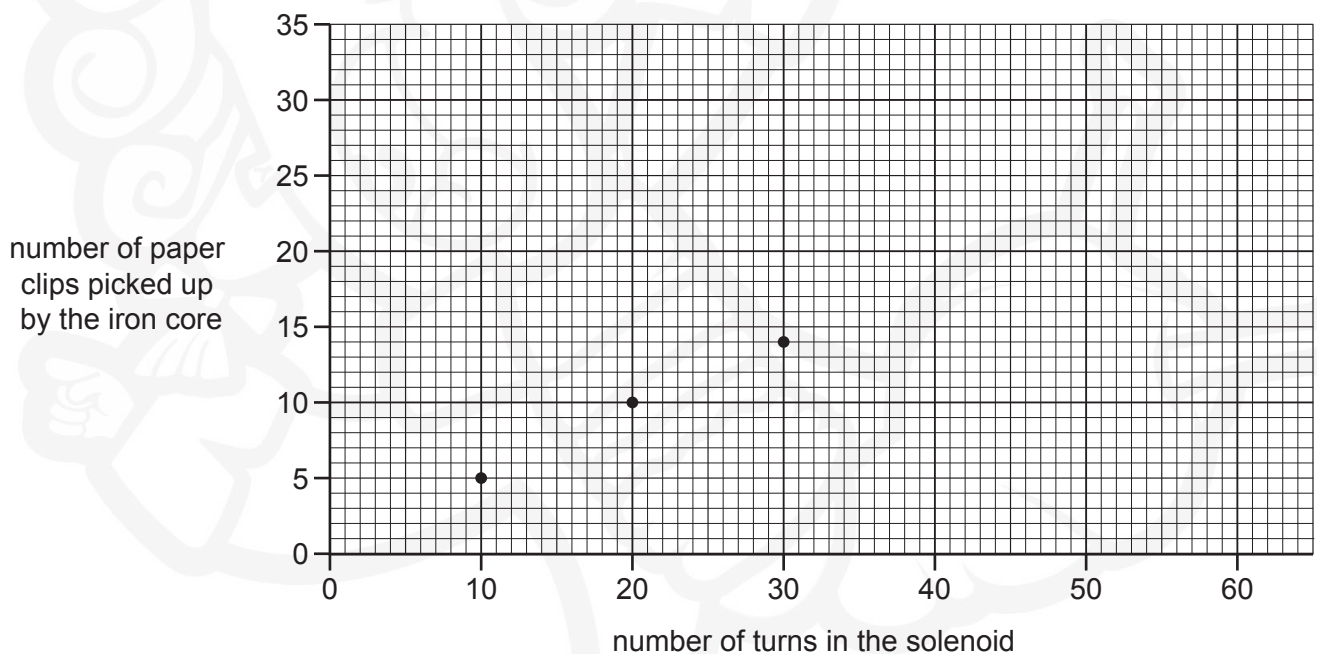

Fig. 2.2

[2]

9

    (ii) Describe the trend shown in the graph in **Fig. 2.2**.

      ....

      ....

      .... **[2]**

    (iii) State **one** other way to increase the strength of the magnetic field around the solenoid.

      .... **[1]**

(c) Electromagnets are often used in scrapyards.

    Which statement about electromagnets is correct?

    Tick (✓) **one** box.

    The electromagnets that lift waste use weak magnetic fields.   ☐

    Electromagnets are not permanent magnets.   ☐

    Electromagnets can be used to pick up all metal waste.   ☐

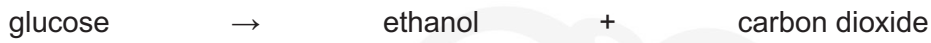   Electromagnets can work when the current is on or off.   ☐

      [1]

10

3   Nina is investigating alcohol (ethanol) production as a sample of beer is brewed.

Ethanol is produced by a chemical process called fermentation.

Fermentation can be represented by the following equation.

glucose   →   ethanol   +   carbon dioxide

(a) Nina measures the rate of the reaction by recording the volume of ethanol produced by $1\,dm^3$ of beer over a period of time.

Suggest **one** other method for recording the rate of this reaction.

....

.... **[1]**

(b) Nina plots the graph in **Fig. 3.1** to show the volume of ethanol produced over a period of time.
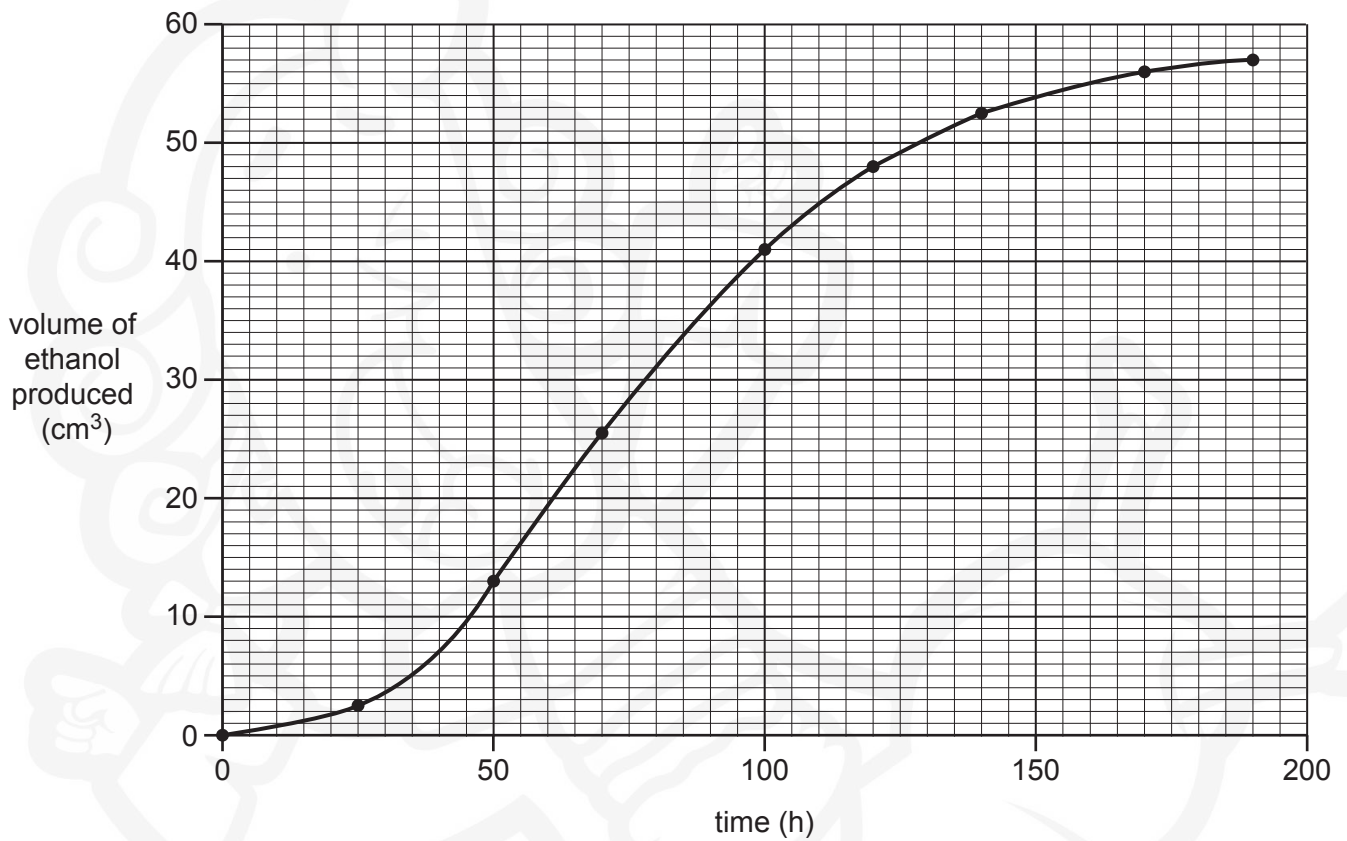
Fig. 3.1

11

(i) What volume of ethanol has been produced after 120 hours in **Fig. 3.1**?

Volume = ... cm^3 **[1]**

(ii) Calculate the rate of ethanol produced over the first 120 hours in **Fig. 3.1**.

Rate = ... cm^3/h **[3]**

(c) Some other students carry out investigations to determine the rate of this reaction at different temperatures.

The graph in **Fig. 3.2** shows how the rate of reaction changes over a range of temperatures.
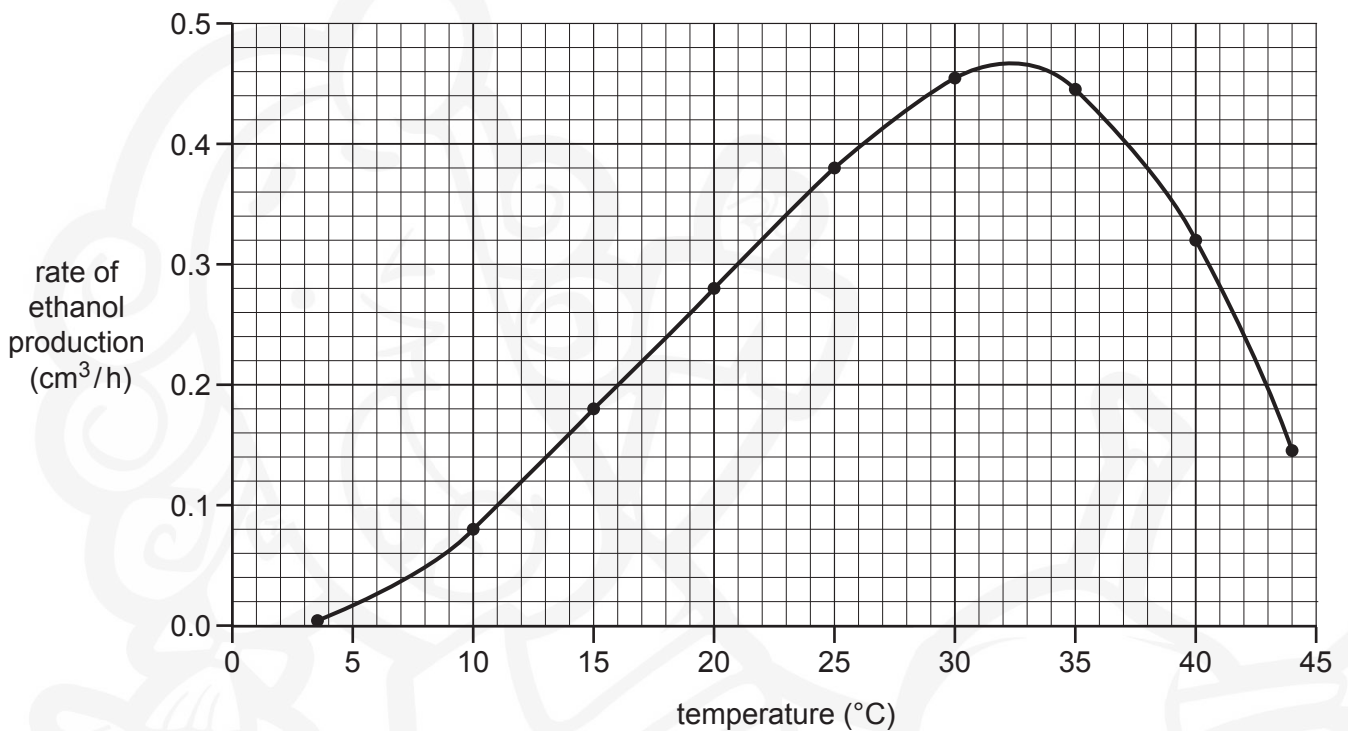
Fig. 3.2

(i) What was the temperature range of the investigation?

Temperature range = ... °C to .... °C **[1]**

(ii) Using information from **Fig. 3.2**, estimate the optimum temperature for fermentation.

Optimum temperature = ... °C **[1]**

Turn over

12

(iii) The students want to find a more accurate estimate of the optimum temperature for fermentation.

How could they do this?

Tick (✓) **two** boxes.

Carry out the experiment at higher temperatures. ☐

Measure the reaction rate at smaller temperature intervals. ☐

Brew a larger volume of beer. ☐

Brew the beer over a shorter period of time. ☐

Carry out the experiment again between 30 °C and 35 °C. ☐

[2]

(d) The ethanol concentration of beer can be found by measuring its density.

Describe how to measure the density of a liquid.

....

....

....

.... **[2]**

4 Alex and Beth are investigating reaction time.

(a) Alex drops a 30 cm ruler. Beth catches the ruler between her thumb and fingers, as shown in **Fig. 4.1**.

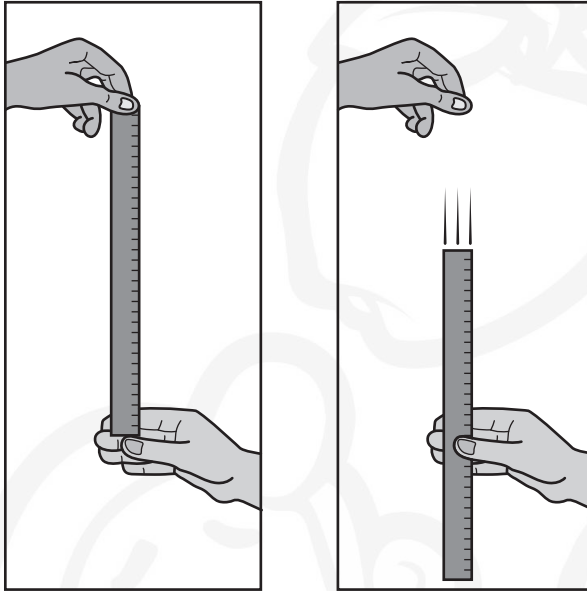The distance the ruler fell before being caught is recorded.

Fig. 4.1

(i) Suggest why the students work in pairs when carrying out the experiment.

....

.... **[1]**

(ii) Suggest **three** factors that need to be kept constant when carrying out the experiment.

1 ....

....

2 ....

....

3 ....

....

[3]

(iii) Suggest **one** factor that must be kept constant when making the measurements.

.... **[1]**

(b) The students' results are shown in **Table 4.1**.

Trial	Distance the ruler dropped before being caught (mm)
1	115
2	113
3	109
4	111
5	112
6	107
7	109
8	108
9	109
10	108

Table 4.1

(i) Calculate the mean distance the ruler dropped.

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

Mean distance = ... mm **[2]**

(ii) What was the median distance the ruler dropped?

Put a (ring) around the correct answer.

107 mm   109 mm   110 mm   110.5 mm   115 mm

[1]

(c) When the students' reaction times are measured, different parts of the nervous system are involved.

(i) Which sequence places the parts of the nervous system in the correct order?

Tick (✓) **one** box.

eye → sensory neuron → spinal cord → brain → spinal cord → motor neuron → muscle ☐

eye → sensory neuron → spinal cord → motor neuron → muscle ☐

eye → sensory neuron → brain → spinal cord → motor neuron → muscle ☐

eye → motor neuron → spinal cord → brain → spinal cord → sensory neuron → muscle ☐

[1]

(ii) How are nerve impulses transmitted between neurons?

Tick (✓) **one** box.

Neurons are physically connected ☐

Through the brain ☐

Through the spinal cord ☐

Across gaps called synapses ☐

[1]

(d) The students read an article about a study on the effects of alcohol on reaction time.

Scientists investigated the reaction times of two groups of adults.

The adults belonged to either a control group or an experimental group.

The different groups of adults were given a different drink, as shown in **Table 4.2**.

Ingredient used to make the drink	Volume of ingredient (cm³)	
	Control group	**Experimental group**
Orange drink (contains no alcohol)	240	200
Alcoholic drink	0	40

Table 4.2

(i) Suggest why orange drink was added to both groups' drinks.

....

.... **[1]**

(ii) Suggest why 240 cm³ of the drink was given in each experiment.

....

.... **[1]**

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(iii) The reaction times of the two groups were monitored using a computer.

Two connected lines of different length appear on the computer screen. The longer line could appear on the left or on the right.

The times when the lines appear is random. Whether the longer line is on the left or right is also random.
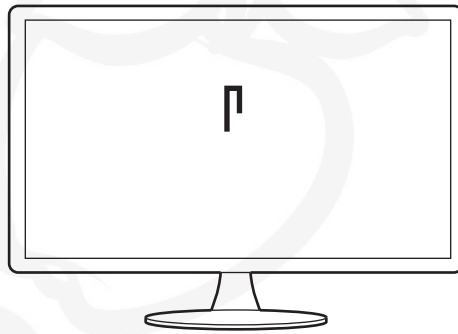
When the line is seen by those involved, they have to click a key for 'left' or 'right'.

The time taken for a response is measured by the computer.

Give **two** reasons why this method of measuring reaction times gives improved results when compared to using a ruler.

1 ....

 ....

2 ....

 ....

[2]

5 Plastics are important in our everyday lives. Plastics are made of polymers.

(a) Scientists have studied the environmental impact of plastics. They have looked at their production, use and disposal.

People do not always dispose of plastic waste carefully. This means that it can end up in the sea.

Table 5.1 shows the density of some polymers used to make plastics that pollute the sea.

Polymer	Density (kg/m^3)
LDPE	920
HDPE	960
Nylon	1120
Polyester	1040
PET	1041

Table 5.1

The density of seawater is approximately $1025 \, kg/m^3$.

The density of pure water is $1000 \, kg/m^3$.

(i) Which statement about the behaviour of polymers in seawater is correct?

Tick (✓) **one** box.

HDPE waste would float in seawater, but LDPE would sink. ☐

PET waste would eventually sink in seawater. ☐

Nylon is less dense than seawater. ☐

Polyester has a higher density than seawater, but is less dense than pure water. ☐
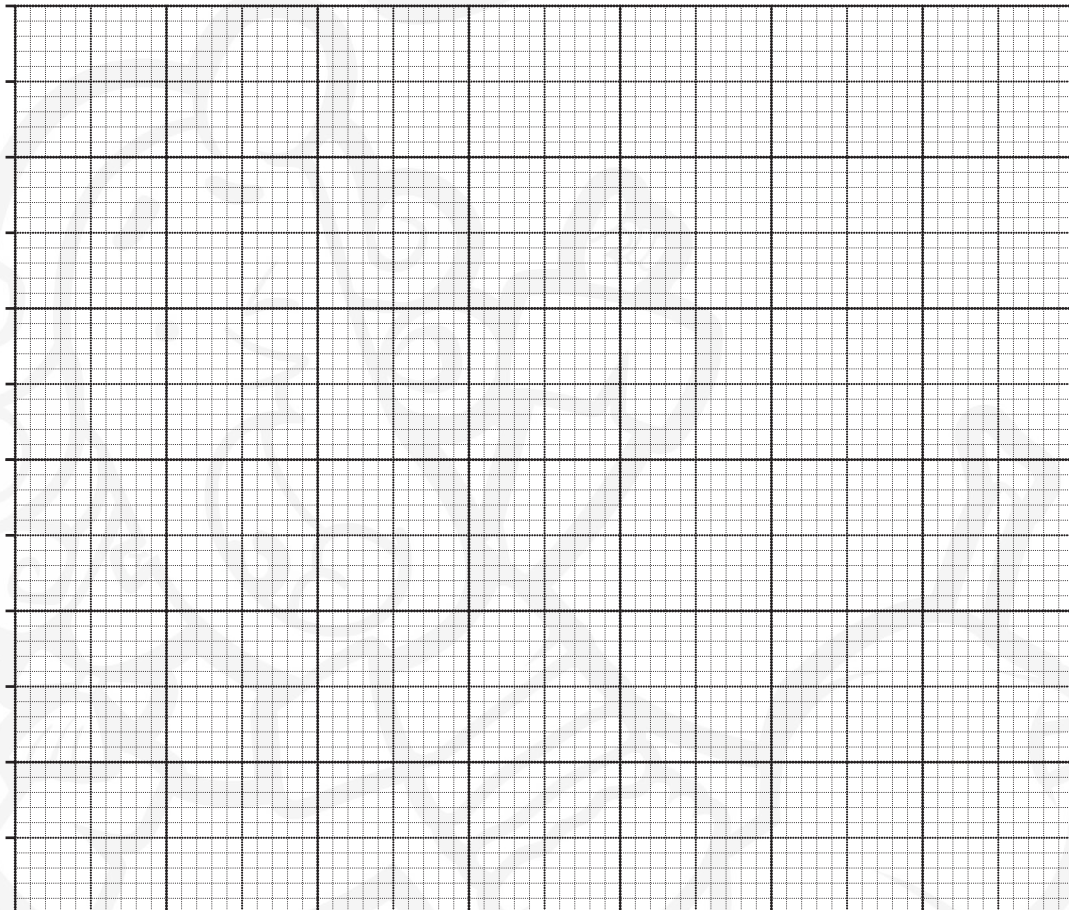
[1]

(ii) A study identified the types of plastic litter in samples of seawater.

Some of the results are shown in **Table 5.2**.

Type of plastic litter	Amount of plastic litter (%)
Beads	3
Fibres	57
Plastic fragments from larger pieces	34
Larger pieces of plastic (> 5 mm)	5

Table 5.2

Draw a bar chart of the data from **Table 5.2**.

[2]

19

(iii) The samples of plastic litter were analysed and the type of polymer was identified.

The main types of polymer found are shown in the pie chart.

Which **two** conclusions about the main types of polymer in the plastic waste are **true**?

Tick (✓) **two** boxes.

Polyethene forms about 5% of the waste. ☐

The proportions of acrylic and polyurethane are approximately the same. ☐

The proportion of polypropene is approximately double that of acrylic. ☐

Polypropene forms the smallest proportion of waste. ☐

Acrylic forms the largest proportion of waste. ☐

[2]

(b) PET is the main type of polymer used for manufacturing plastic drinks' bottles.

Describe **one** of the processes for recycling PET from drinks' bottles.

....

....

....

....

.... **[4]**

20

(c) PET was considered non-biodegradable.

In 2016, scientists in Japan discovered a type of bacterium living on the surface of waste PET bottles. The bacterium produces enzymes that break down the PET.

(i) The scientists think that the bacterium may be useful in the recycling of PET.

Suggest **two** ways in which the bacterium might improve recycling.

1 ....

2 ....

[2]

(ii) The bacterium is thought to have evolved from an existing species of bacterium.

The stages in its evolution are described below.

They are not in the correct order.

A   Some bacteria are able to produce enzymes to break down PET.

B   Mutations occur in some bacteria.

C   The altered gene spreads through the population.

D   Natural selection occurs.

Put the stages in the correct order.

Complete the table below.

[2]

6 Parkinson's disease is a condition that affects the nervous system. There is currently no cure for the disease.

(a) It is estimated that 145 000 people will have Parkinson's disease in 2018.

It is predicted that by 2025 the number of people with Parkinson's disease will rise by $\frac{1}{5}$.

Calculate how many more people will have Parkinson's disease in 2025 than in 2018.

Number of people = ... **[2]**

(b) Scientists have observed that smoking affects people's risk of developing the disease.

The scientists investigated three groups of patients with Parkinson's disease.

A total of 1808 patients were studied.

Smoking habit of group investigated	Number of patients with Parkinson's disease
Never smoked	909
Former smokers	750
Current smokers	149

Discuss the findings of the study.

....

....

....

.... **[2]**

(c) One hypothesis states that nicotine in cigarettes may protect against Parkinson's disease.

People use e-cigarettes because they may be a less harmful source of nicotine.

Pure nicotine is a liquid at room temperature.

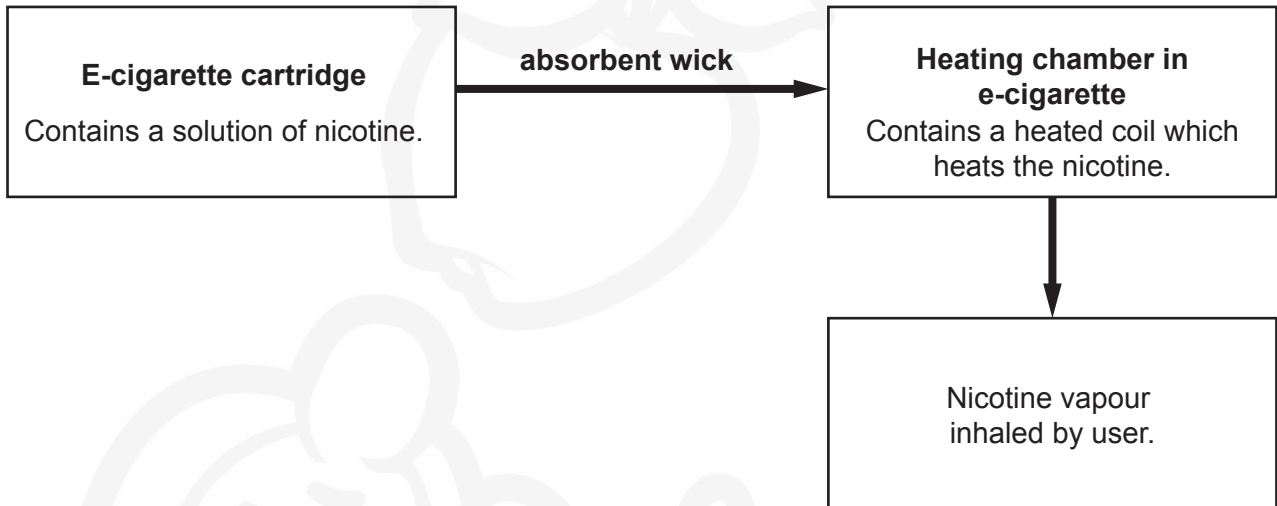**Fig. 6.1** is a simplified diagram showing how an e-cigarette works.

E-cigarette cartridge	absorbent wick →	Heating chamber in e-cigarette
Contains a solution of nicotine.		Contains a heated coil which heats the nicotine.

Nicotine vapour
inhaled by user.

Fig. 6.1

(i) Describe what happens to nicotine **particles** in the heating chamber in an e-cigarette.

....

....

.... **[2]**

(ii) Compare the changes that occur in an e-cigarette with those in a cigarette that burns tobacco.

....

....

.... **[1]**

(d) Some students are talking about using e-cigarettes to reduce the risk of Parkinson's disease.

Ali
Is it the nicotine that's involved in protection against Parkinson's disease, or some other factor?

Kai
Nicotine raises heart rate and blood pressure. It also increases the risk of cardiovascular disease.

Layla
Nicotine is very addictive and should be avoided, whether it's in tobacco cigarettes or e-cigarettes.

Sarah
Scientists have found that nicotine affects levels of a chemical transmitter molecule between neurons in the brain.

(i) Which student is discussing the idea of correlation and cause?

Tick (✓) **one** box.

Ali ☐

Kai ☐

Layla ☐

Sarah ☐

[1]

(ii) Which student has suggested a possible mechanism for the action of nicotine?

Tick (✓) **one** box.

Ali ☐

Kai ☐

Layla ☐

Sarah ☐

[1]

(e)* Food plants in the same family as tobacco also contain nicotine.

Scientists have studied how eating these foods affects the numbers of people with Parkinson's disease.

People with Parkinson's disease answered a questionnaire about their diet.

Scientists assessed the risk of developing Parkinson's disease in people that ate plant foods containing nicotine. The results are shown in **Table 6.1**.

Plant food in diet	Concentration of nicotine in the food (μg nicotine/kg food)	Risk of developing Parkinson's disease*
Foods containing no nicotine	0	1.00
Peppers	102	0.24
Potatoes	19	0.92
Tomatoes	44	0.58
Tomato juice	30	2.16

Table 6.1
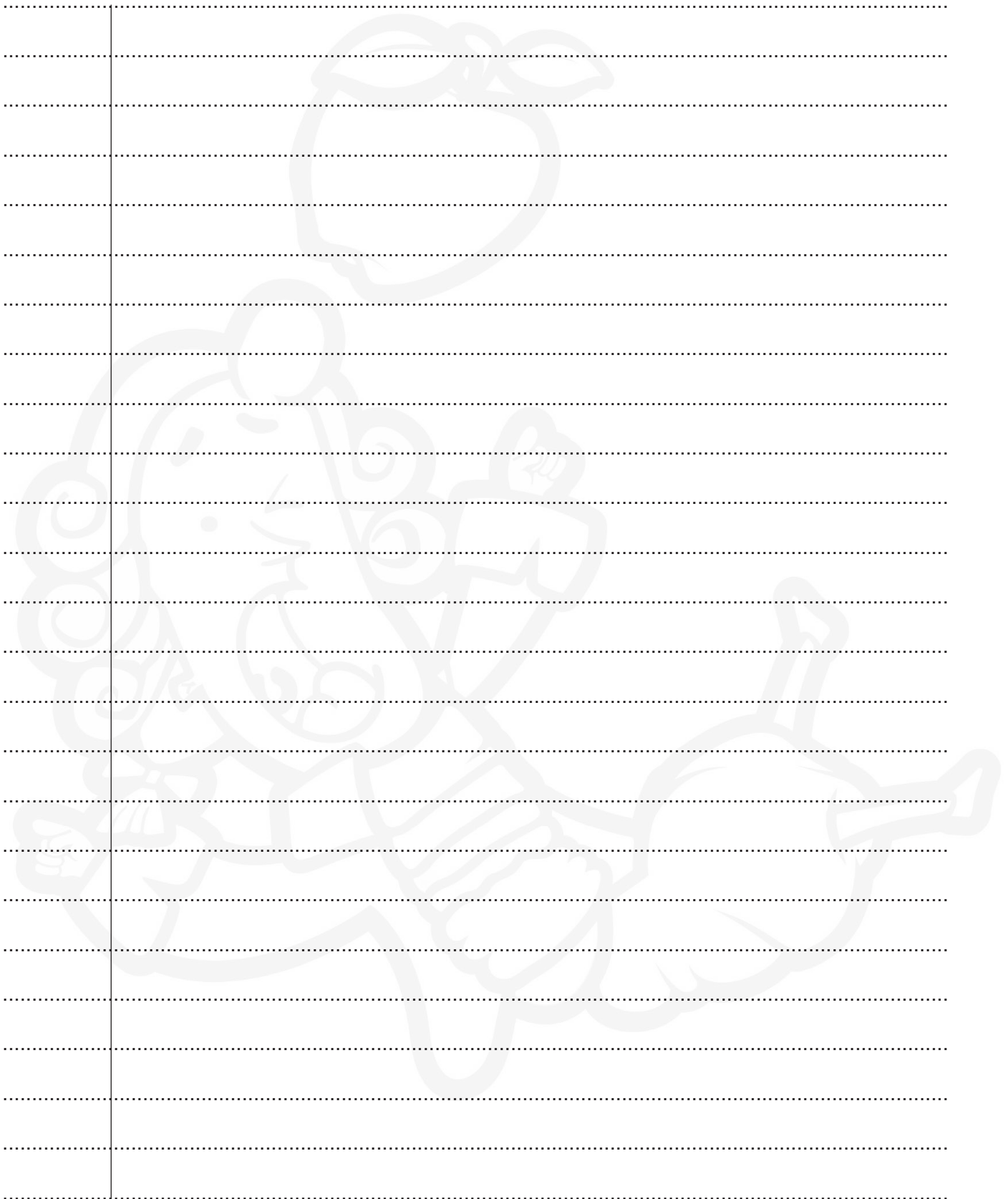
*This is the person's risk compared with patients who ate foods containing no nicotine.

For example:
- if the risk is 2.00, you are twice as likely to get the disease
- if the risk is 0.50, you are half as likely to get the disease.

Use the information to determine if there is a correlation between eating plant foods with different concentrations of nicotine and the risk of developing Parkinson's disease.

Use the data in **Table 6.1** to support your answer.

....

....

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.... **[6]**

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).

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