

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3440U20-1



FRIDAY, 10 MAY 2024 – MORNING

APPLIED SCIENCE (Single Award)
UNIT 2: Science to Support our Lifestyles

FOUNDATION TIER

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question 4(a) is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

A Periodic Table is printed on page 24.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	8	
3.	11	
4.	9	
5.	13	
6.	3	
7.	6	
8.	7	
9.	12	
Total	75	

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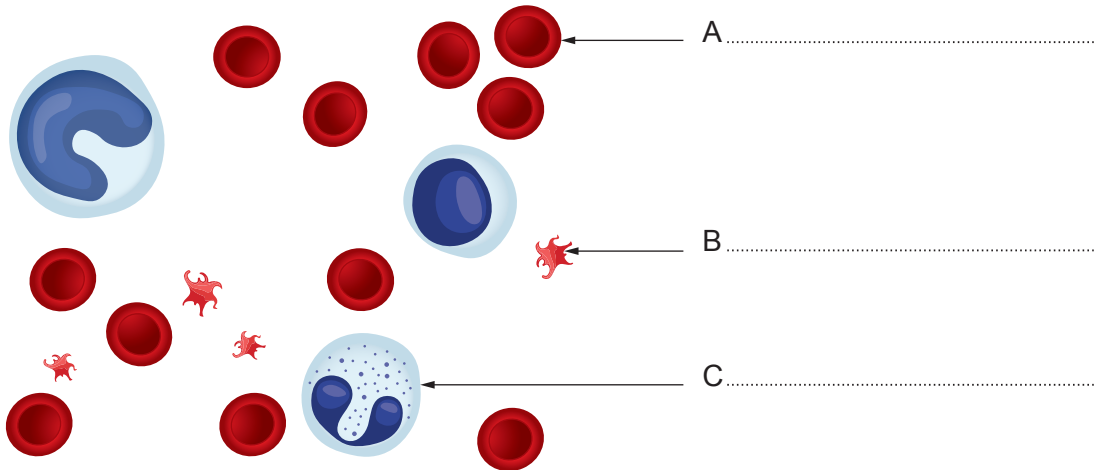
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Answer **all** questions.

1. The diagram below shows the parts of blood.



- (a) Label the diagram using words in the box below.

[3]

white blood cell

red blood cell

platelet

plasma

- (b) Draw a line to join the part of blood with its job.

[3]

Part of the blood

Job

red blood cell

clotting

white blood cell

carries oxygen

platelet

destroys bacteria

plasma

carries glucose



2. An ultrasound scan is used as an imaging technique in medicine.



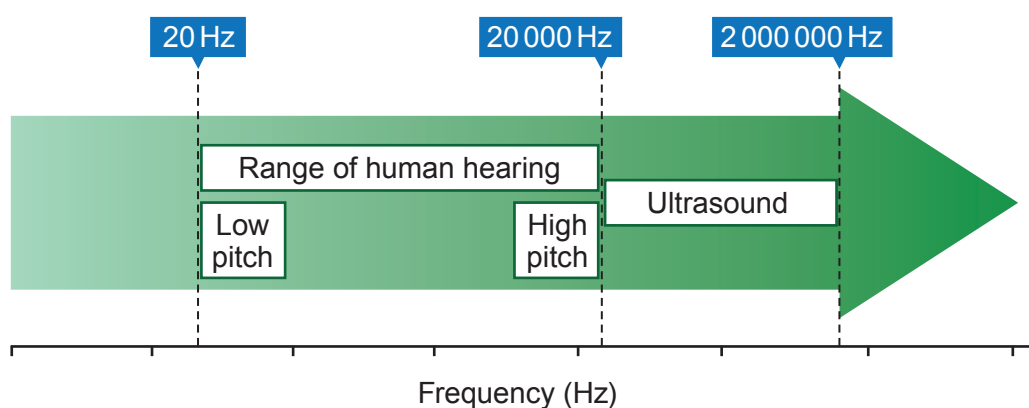
- (a) (i) Complete the following sentence by underlining the correct word in the brackets.

[1]

An ultrasound scan is produced using (**high** / **medium** / **low**) frequency sound waves to image the body.

- (ii) Use the information in the diagram below to suggest a **minimum value** for the frequency of an ultrasound wave.

[1]



frequency = Hz

- (iii) Tick (✓) **two** uses of ultrasound.

[2]

Treatment of cancer
Monitoring of a baby during pregnancy
Detecting heart problems
Diagnosing diabetes

☐
☐
☐
☐


- (b) (i) The images below show X-rays of bone fractures. Identify the correct type of fracture, by drawing a line between the image and the type of fracture. [2]



Broken
skin

compound fracture

greenstick fracture



simple fracture

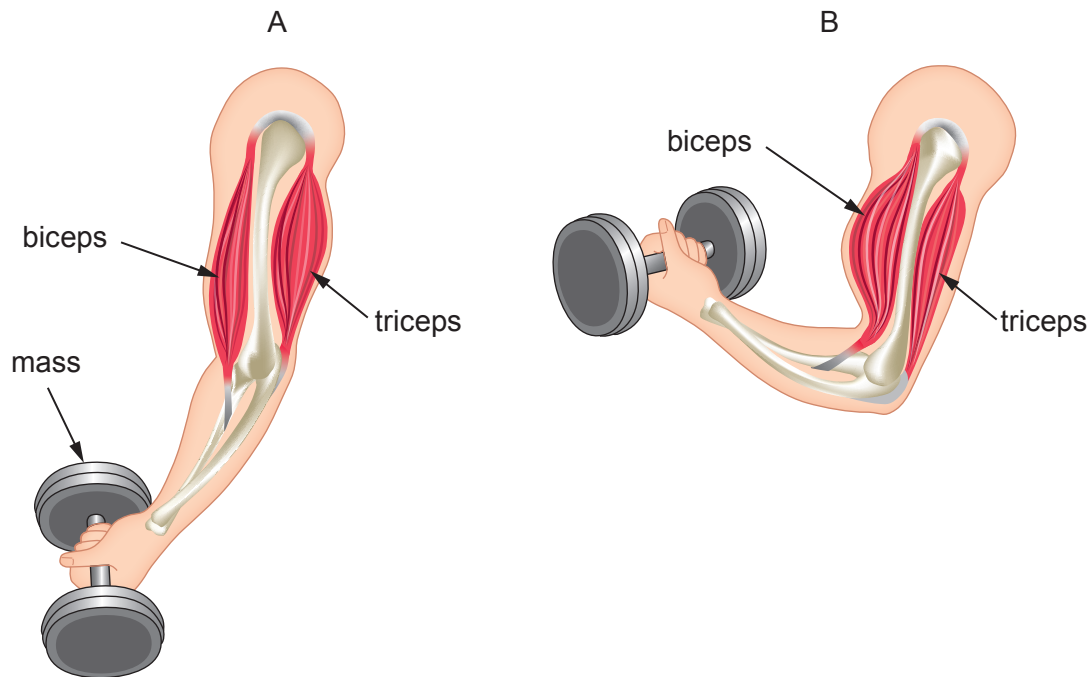
- (ii) State **two** methods, other than ultrasound and X-rays, of imaging the human body. [2]

1.

2.



3. Three fourteen-year-old boys from Bridgend are investigating how the strength of the muscles in both of their arms compare.



- (a) (i) Complete the following sentences by underlining the correct word in the brackets. [2]

The biceps and triceps muscles work in opposite directions and are called
(**antagonistic** / **diagnostic** / **ligaments**).

Muscles are joined to bones by (**cartilage** / **tendons** / **ligaments**).

- (ii) Describe how the pair of muscles in the arm work together to lift the mass. [2]

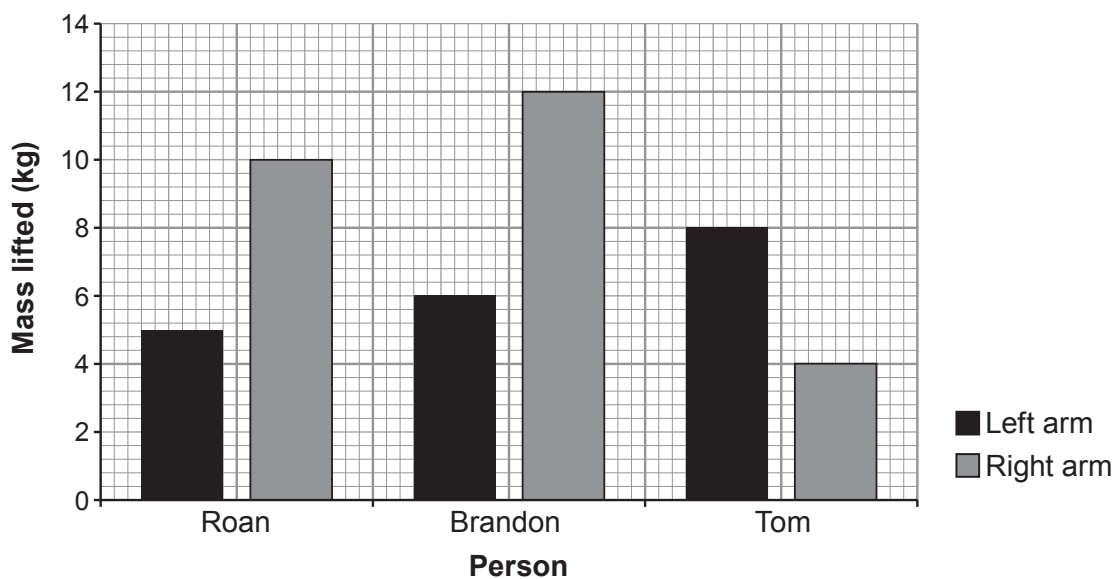
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(b) The results of the experiment are as follows.



Use the data in the graph to answer the questions below.

- (i) Calculate the difference between the mass lifted by Roan's right and left arms. [1]

difference = kg

- (ii) Andrew thinks that every right arm is twice as strong as a left arm. Use the data to explain whether or not this is true for all three boys. [3]

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- (iii) Brandon concluded that the relationship between the stronger and weaker arm is the same for all teenagers in Wales.
State **three** ways that a future investigation could improve the confidence in Brandon's conclusion. [3]

1.

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2.

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3.

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- The graph shows a journey with the following data points:
- | Time (minutes) | Distance from home (m) | Point |
|----------------|------------------------|-------|
| 0 | 0 | A |
| 1 | 400 | B |
| 3 | 800 | C |
| 4 | 800 | D |
| 8 | 0 | E |



- (b) Calculate the total distance that Osian ran.

[1]

total distance = m

- (c) Use the equation:

$$\text{mean speed (m/s)} = \frac{\text{total distance (m)}}{8 \text{ (mins)} \times 60}$$

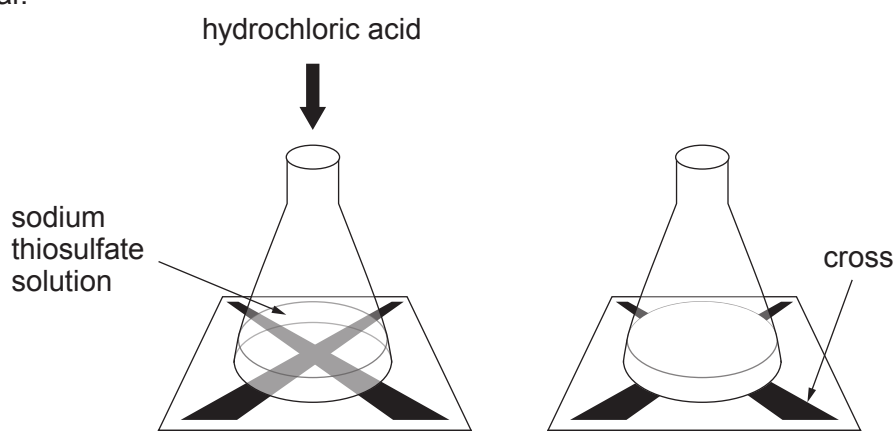
to calculate the mean speed for the run.

[2]

mean speed = m/s



5. Libby investigated the rate of a chemical reaction. She added hydrochloric acid to sodium thiosulfate solution and timed how long it took for a cross on a piece of white paper to disappear.



- (a) Complete the risk assessment below.

[1]

Hazard	Risk	Control measure
Dilute hydrochloric acid is an irritant	Transfer of acid from hands whilst pouring could cause damage to the eyes	

- (b) Libby obtained the results shown in the table below.

Concentration of hydrochloric acid (mol/dm ³)	Time taken for cross to disappear (s)			
	test 1	test 2	test 3	mean
0.5	48	50	52	50
1.0	53	34	32	33
1.5	22	24	23	23
2.0	15	17	19	17
2.5	12	10	11	11

- (i) **Circle** the anomalous result in the table.

[1]

- (ii) Show that the anomalous result was not used to calculate the mean.

[2]

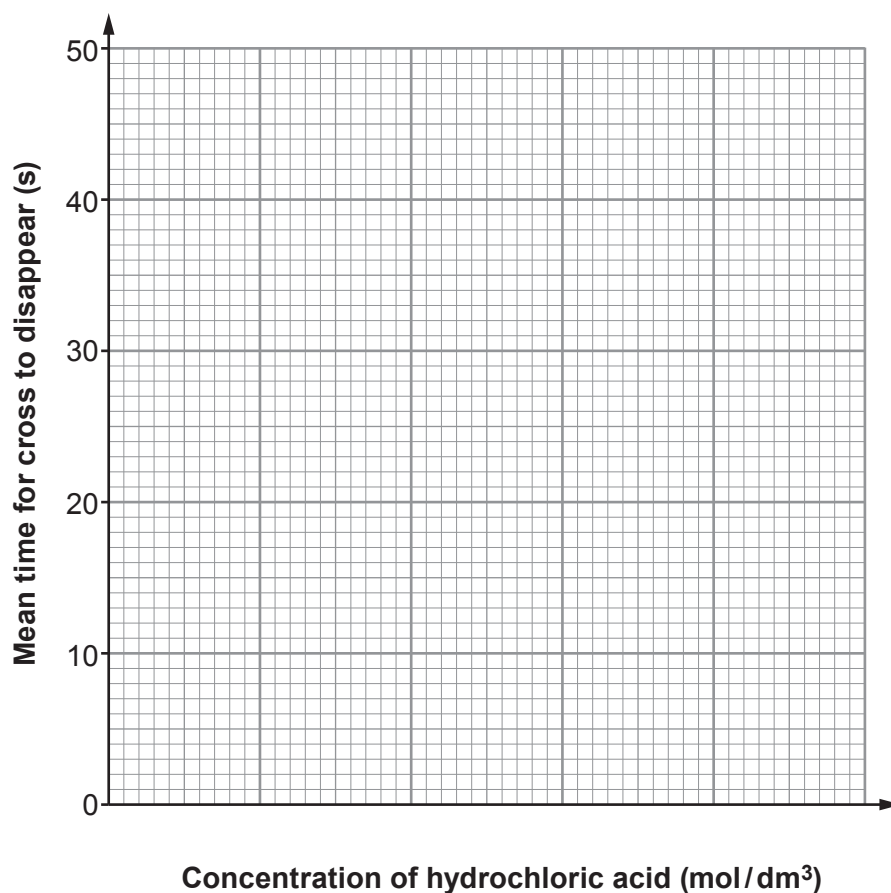
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- (iii) Add the scale to the x-axis and plot the data on the grid below. Draw a curve of best fit. [4]



- (iv) I. Use the graph to state how the mean time for the cross to disappear changes with the concentration of the acid. [1]

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- II. Explain your answer in terms of particles. [2]

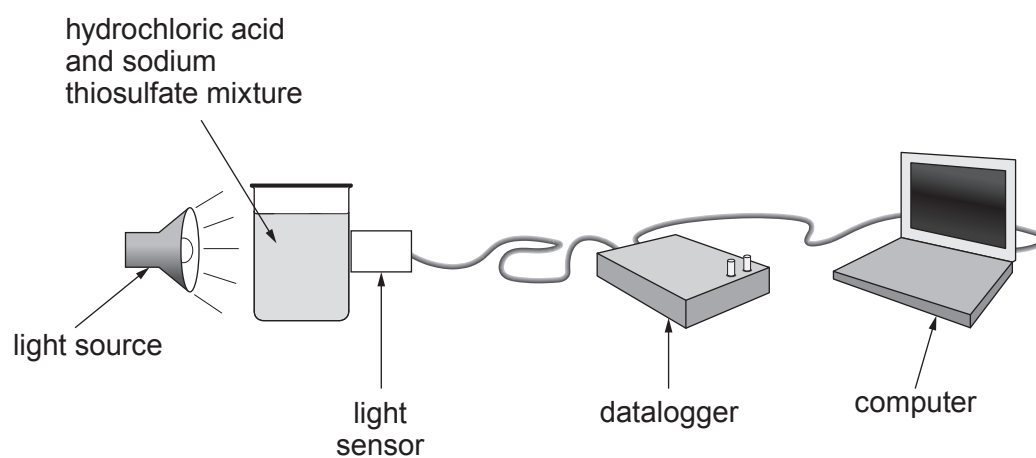
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- (c) Beth suggested that the experiment could be improved by using the apparatus shown below.



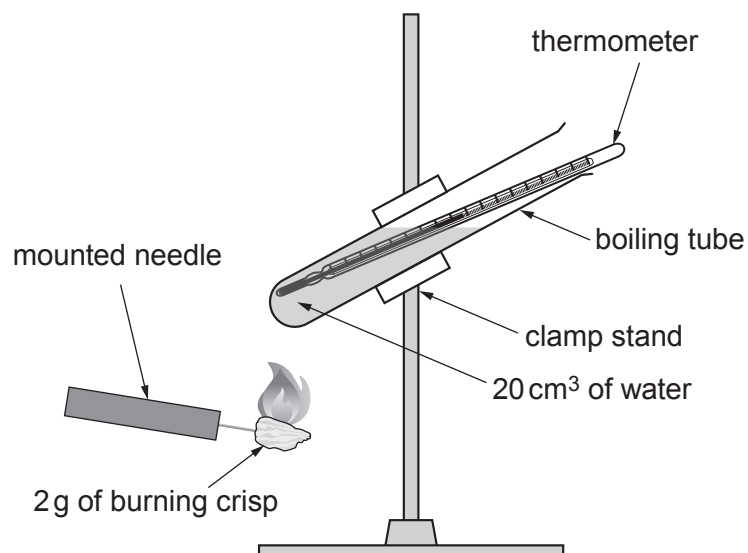
Suggest **two** ways in which the design of this apparatus improves the quality of the results obtained.

[2]

1.
2.



6. James and Llinos used the following apparatus to investigate the energy content of different crisps. They repeated the experiment three times for each type of crisp.



The results of the investigation are as follows.

Crisp	Temperature increase (°C)			
	trial 1	trial 2	trial 3	mean
A	38	36	35	36.3
B	20	17	18	18.3

- (a) James wants to reduce his energy intake. He thought that it would be better to eat crisp **B** than crisp **A**. Explain whether you agree with him. [2]

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- (b) Suggest how this investigation could be improved, to ensure that more of the energy from the crisp is transferred into the water. [1]

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7. Radioisotopes are used for a range of medical purposes.

The table below gives information about some radioisotopes of cobalt and iodine.

Radioisotope	Radiation emitted	Half-life
iodine-123	gamma	13 hours
iodine-129	beta	1.6 years
iodine-131	beta and gamma	8 days
cobalt-55	beta	17.3 hours
cobalt-60	beta and gamma	5.3 years

Use the data in the table to answer the following questions.

- (a) Calculate the fraction of iodine-131 remaining after 16 days. [2]

fraction remaining =

- (b) Brain tumours can be treated by external radiotherapy. This exposes patients to an **external** cobalt source of radiation to kill the cancerous tumour.

Explain why cobalt-60 is more suitable for treating brain tumours than cobalt-55. [2]

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- (c) The function of the thyroid gland can be checked using a radioactive **tracer** of iodine.

Explain why iodine-123 is a more suitable choice than iodine-129. [2]

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8. Sharon investigated the reaction between magnesium and hydrochloric acid. She added a different number of magnesium strips of the same length to five different boiling tubes. Each boiling tube contained 10 cm³ of hydrochloric acid. She recorded the temperature before adding the magnesium and after 5 minutes.

Her results are shown below.

Number of strips of magnesium	Temperature at the start (°C)	Temperature at the end (°C)
1	20.0	22.1
2	20.0	24.2
3	20.0	25.9
4	20.0	28.4
5	20.0	30.2

- (a) (i) State how Sharon could check the repeatability of her results. [1]

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- (ii) State how Sharon could check the reproducibility of her results. [1]

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- (b) Sharon thinks that the temperature change is proportional to the number of strips of magnesium. Explain whether you agree. [2]

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- (c) When hydrogen reacts with oxygen to form water, the temperature of the surroundings increases.

State this type of reaction, and explain this in terms of bond energies. [3]

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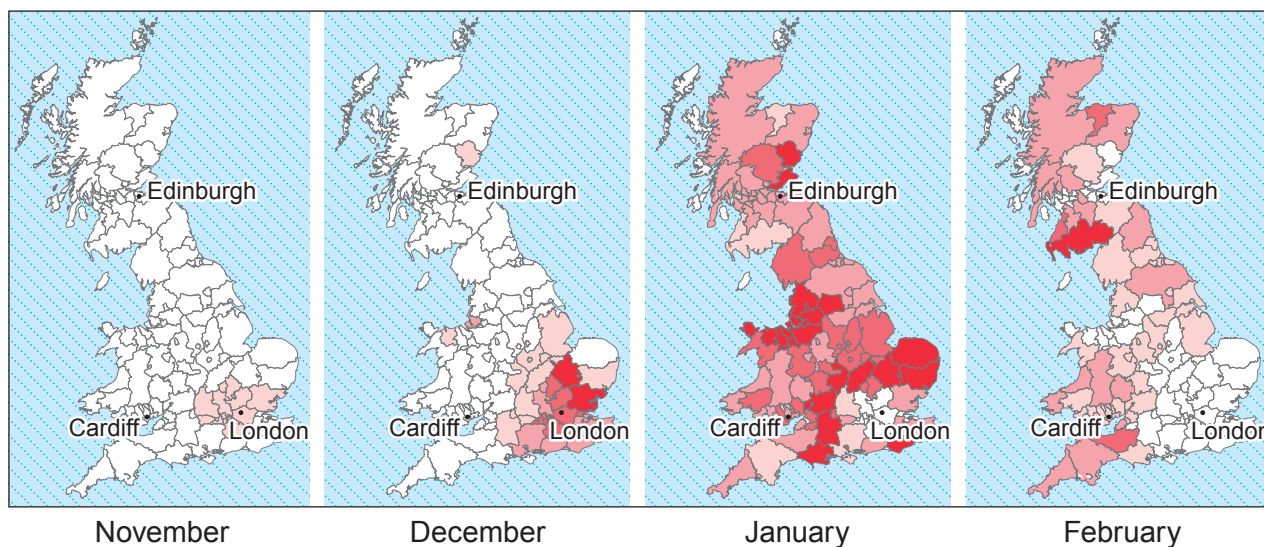
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9. Public Health England uses computers to model the potential spread of influenza (flu), in order to prepare suitable quantities of vaccines, in different counties of Great Britain.

The maps below show a potential flu outbreak over the winter months in different counties.



Key: Influenza cases per 100 000 population



- (a) State why Public Health England quotes the number of cases of flu per 100 000 of the population, for each county. [1]

- (b) Use the information in the diagram to answer the following questions.

- (i) It was expected that outbreaks of flu would start at the same time in major cities such as Cardiff, Edinburgh and London. Explain whether the data supports this. [2]



- (ii) Explain why flu spreads more rapidly in a city than in a rural area. [3]

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- (iii) Suggest in which month the vaccine should be given to the populations of Cardiff, Edinburgh and London. [2]

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- (c) A vaccine helps to prevent people from developing flu.

- (i) Explain how a vaccine works. [3]

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- (ii) State why it is still possible to contract flu after being vaccinated. [1]

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12



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THE PERIODIC TABLE

Group

1 2

3

4

5

6

7

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1 H Hydrogen 1 4 He Helium 2																	
7 Li Lithium 3	9 Be Beryllium 4																
23 Na Sodium 11	24 Mg Magnesium 12																
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

A_r	relative atomic mass
Symbol	
Name	
Z	atomic number