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| <b>Candidate<br/>Forename</b> |  | <b>Candidate<br/>Surname</b> |  |
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| <b>Centre<br/>Number</b> |  |  |  |  |  | <b>Candidate<br/>Number</b> |  |  |  |  |
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**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**A217/01**

**TWENTY FIRST CENTURY SCIENCE**

**ADDITIONAL SCIENCE A**

**UNIT 3: Modules B6 C6 P6  
(Foundation Tier)**

**FRIDAY 19 JUNE 2009: Morning**

**DURATION: 40 minutes**

**SUITABLE FOR VISUALLY IMPAIRED CANDIDATES**

**Candidates answer on the question paper**

**A calculator may be used for this paper**

**OCR SUPPLIED MATERIALS:**

**None**

**OTHER MATERIALS REQUIRED:**

**Pencil**

**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer ALL the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

## **INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 42.
- A list of physics equations is printed on pages 4 and 5.
- The Periodic Table is printed on page 35.

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# TWENTY FIRST CENTURY SCIENCE EQUATIONS

## USEFUL RELATIONSHIPS

### EXPLAINING MOTION

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved by the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

## ELECTRIC CIRCUITS

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

## THE WAVE MODEL OF RADIATION

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Answer ALL the questions.

1 Ben hurts his foot playing football. The hospital takes an X-ray image of his foot to see if any bones are broken.

(a) Ben asks his friends why X-rays can be used to make an image of his bones.

ALAN  
X-rays can pass through empty space.



BESS  
Bone absorbs more X-rays than muscle.



CARLO  
Muscle absorbs X-rays but bone does not.



DAVINA  
Nothing can stop X-rays.



**Who gives the BEST answer?**

**answer \_\_\_\_\_ [1]**

**(b) Ben knows that exposure to X-rays can be dangerous.**

**This is because X-ray photons carry a lot of energy and can damage cells.**

**Why do X-ray photons carry a lot of energy?**

**Put a tick (✓) in the box next to the correct reason.**

**X-rays are invisible.**

**X-rays have a high frequency.**

**X-rays can travel through a vacuum.**

**[1]**

(c) Here is an incomplete diagram of the electromagnetic spectrum.

Write X-RAY in the correct place.

|       |  |          |  |             |  |       |
|-------|--|----------|--|-------------|--|-------|
| radio |  | infrared |  | ultraviolet |  | gamma |
|-------|--|----------|--|-------------|--|-------|

[1]



(d) Complete the sentences. Choose words from the list.

AMPLITUDE

SOUND

SPEED

WAVELENGTH

Infrared and ultraviolet waves have the same  
\_\_\_\_\_ through empty space.

Infrared and ultraviolet waves must have a  
different \_\_\_\_\_ .

[2]

[Total: 5]

2 Jake is a security guard. He uses radio waves to communicate with his boss.

(a) The AMPLITUDE of the radio waves carries information about Jake's voice.  
Which other wave property can be used instead?

Put a ring around the answer.

FREQUENCY

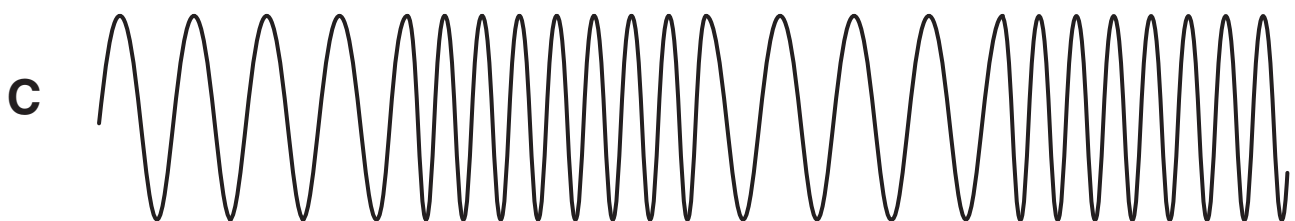
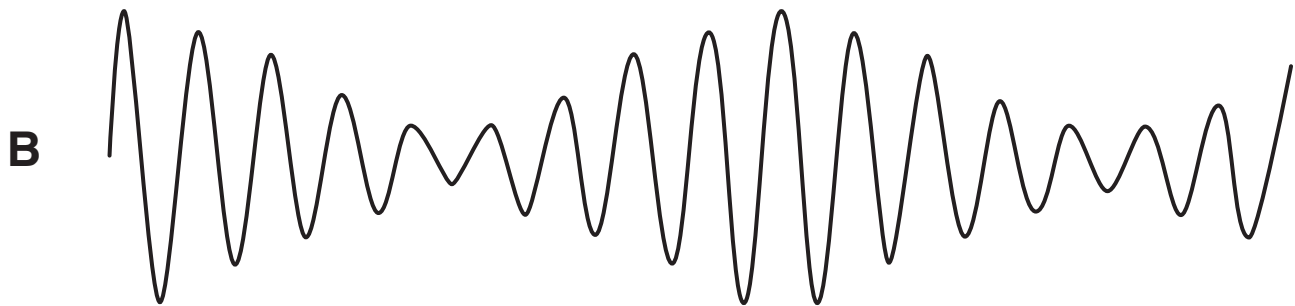
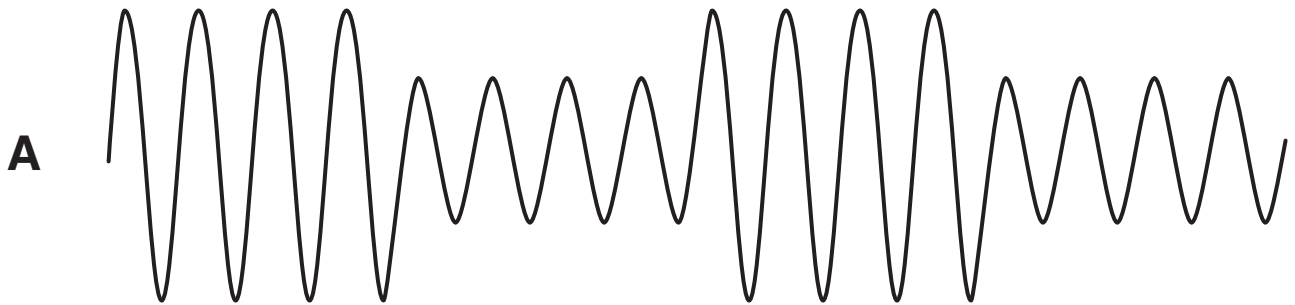
TRANSVERSE

SPEED

[1]

(b) The radio waves carry digital information.

Which of these wave patterns, A, B or C, shows DIGITAL information which has been AMPLITUDE MODULATED onto a wave?



wave pattern \_\_\_\_\_ [1]

(c) Put a ring around the correct word to complete the sentences.

Jake uses his radio to call his boss.

The waves travel away from the radio to the

RECEIVER    TRANSMITTER.

As the waves travel, their amplitude

DECREASES    INCREASES    STAYS THE SAME.

The quality of the radio waves gets worse as

INFORMATION    NOISE    is added to them.

[2]

(d) Radio waves are TRANSVERSE. What does this mean?

Put a tick (✓) in the box next to the correct description.

The disturbance of the wave is ...

... in the same direction as the wave energy flow.

... in the opposite direction to the wave energy flow.

... at right angles to the direction of the wave energy flow.

[1]

[Total: 5]

3 (a) Micky plays dominoes in a lesson about waves.

Each domino has a WORD at the top and a MEANING at the bottom.

Each word must be placed below its correct meaning, as shown below.

|          |                                            |           |
|----------|--------------------------------------------|-----------|
| <b>A</b> | <b><u>LONGITUDINAL</u></b>                 |           |
|          | number of waves per second from the source | — meaning |
| <b>B</b> | <b><u>FREQUENCY</u></b>                    | — word    |
|          | distance from one crest to the next        |           |
|          |                                            |           |
|          |                                            |           |
|          |                                            |           |

Here are the other three dominoes.

|                                    |                  |
|------------------------------------|------------------|
| <u>C</u>                           | <u>AMPLITUDE</u> |
| how far a wave goes<br>in a second |                  |

|                   |                   |
|-------------------|-------------------|
| <u>D</u>          | <u>WAVELENGTH</u> |
| height of a crest |                   |

|                                             |              |
|---------------------------------------------|--------------|
| <u>E</u>                                    | <u>SPEED</u> |
| energy flow parallel<br>to wave disturbance |              |

Write C, D or E in each blank domino on the page opposite, so that each word is below its correct meaning.

You may fill in the blank dominoes if it helps you work out the answers. [2]

**(b) Which one of these actions could change the speed of a wave?**

**Put a tick (✓) in the box next to the correct answer.**

**change the intensity of the wave**

**change the amplitude of the wave**

**change the frequency of the wave source**

**change the medium that the wave passes through**

**[1]**



(c) Alice talks to Micky about their work.

What do the sound waves transfer from Alice to Micky?

Put a ring around the correct answer.

ATOMS

ENERGY

RAYS

WAVELENGTHS

[1]

[Total: 4]

4 Animals such as woodlice respond to changes in their environment.

This process follows a series of steps.

(a) Complete the sentences to explain these steps.

Choose words from the list.

AN ACTION

AN EFFECTOR

A HORMONE

A MOTOR NEURON

A RECEPTOR

A SENSORY NEURON

A STIMULUS

A SYNAPSE

The change in the environment is \_\_\_\_\_.

The change is detected by \_\_\_\_\_.

Information is carried to the central nervous system by \_\_\_\_\_.

Information is carried from the central nervous system by \_\_\_\_\_.

The response is carried out by \_\_\_\_\_.

[4]

**(b) Woodlice move away from light.**

**Which of these sentences explains the reason for this response?**

**Put a tick (✓) in the box next to the BEST answer.**

**They prefer dry conditions.**

**They are afraid of the light.**

**Their food source is always in the dark.**

**Dark conditions are more favourable for their survival.**

**[1]**

**(c) Which of these terms describes the behaviour of simple animals such as woodlice?**

**Put a tick (✓) in the box next to the BEST answer.**

**a complex response**

**a simple reflex**

**a learned response**

**a learned reflex**

**[1]**

**[Total: 6]**

- 5 (a) Label the diagram, shown opposite, of a motor neuron.

Choose words from the list.

AXON

CHLOROPLAST

FATTY SHEATH

NUCLEUS

RIBOSOME

- (b) What happens when a motor neuron is stimulated?

Put a tick (✓) in the box next to the correct answer.

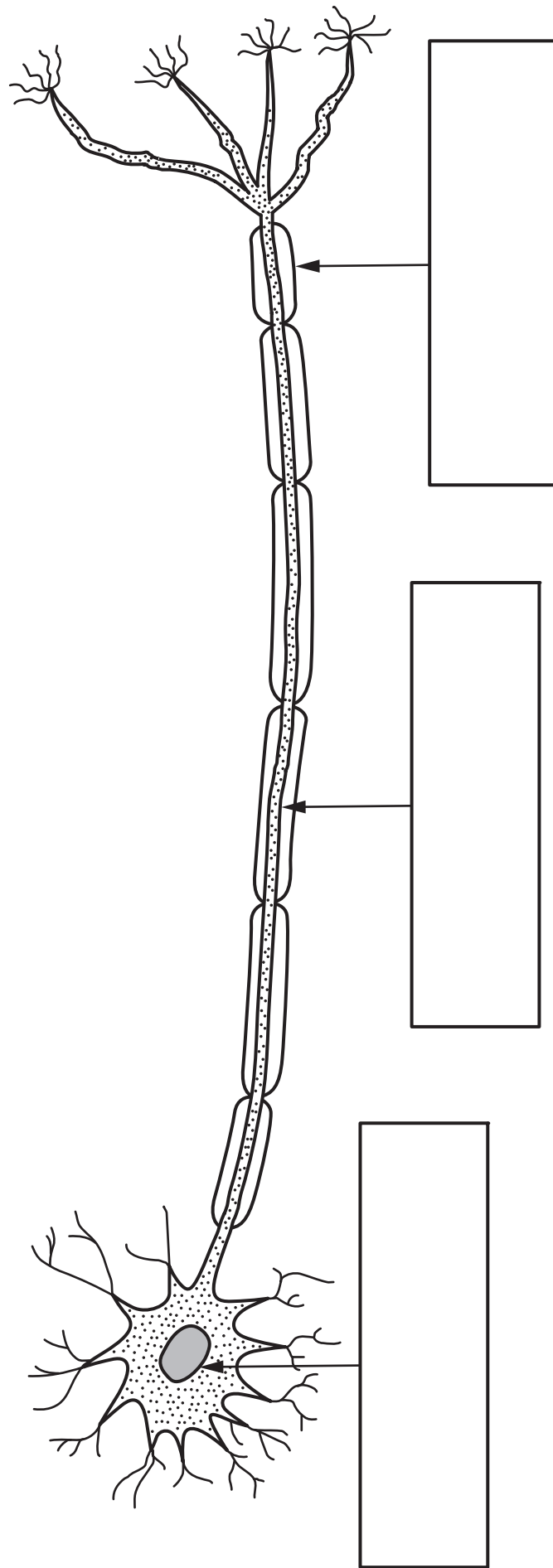
It gets shorter.

It moves to where it is needed.

It transmits an electrical impulse.

[1]

[Total: 4]



**6 Baby Sam is learning to crawl.**

**The brain is responsible for memory and for learning.**

**(a) Draw a straight line from each FUNCTION to its correct DESCRIPTION.**

**FUNCTION**

**DESCRIPTION**

|                 |                                                 |
|-----------------|-------------------------------------------------|
|                 | <b>the result of experience or repetition</b>   |
| <b>memory</b>   | <b>an involuntary response to a stimulus</b>    |
| <b>learning</b> | <b>the storage and retrieval of information</b> |
|                 | <b>a voluntary response to a stimulus</b>       |

**[2]**

**(b) Babies learn new skills as they develop.**

**The sentences explain how this happens.  
They are in the wrong order.**

**A If the experience is repeated the link becomes stronger.**

**B It is easier for impulses to pass along the link.**

**C When a baby tries something new, links between neurons are made in the brain.**

**D The response gets easier to make.**

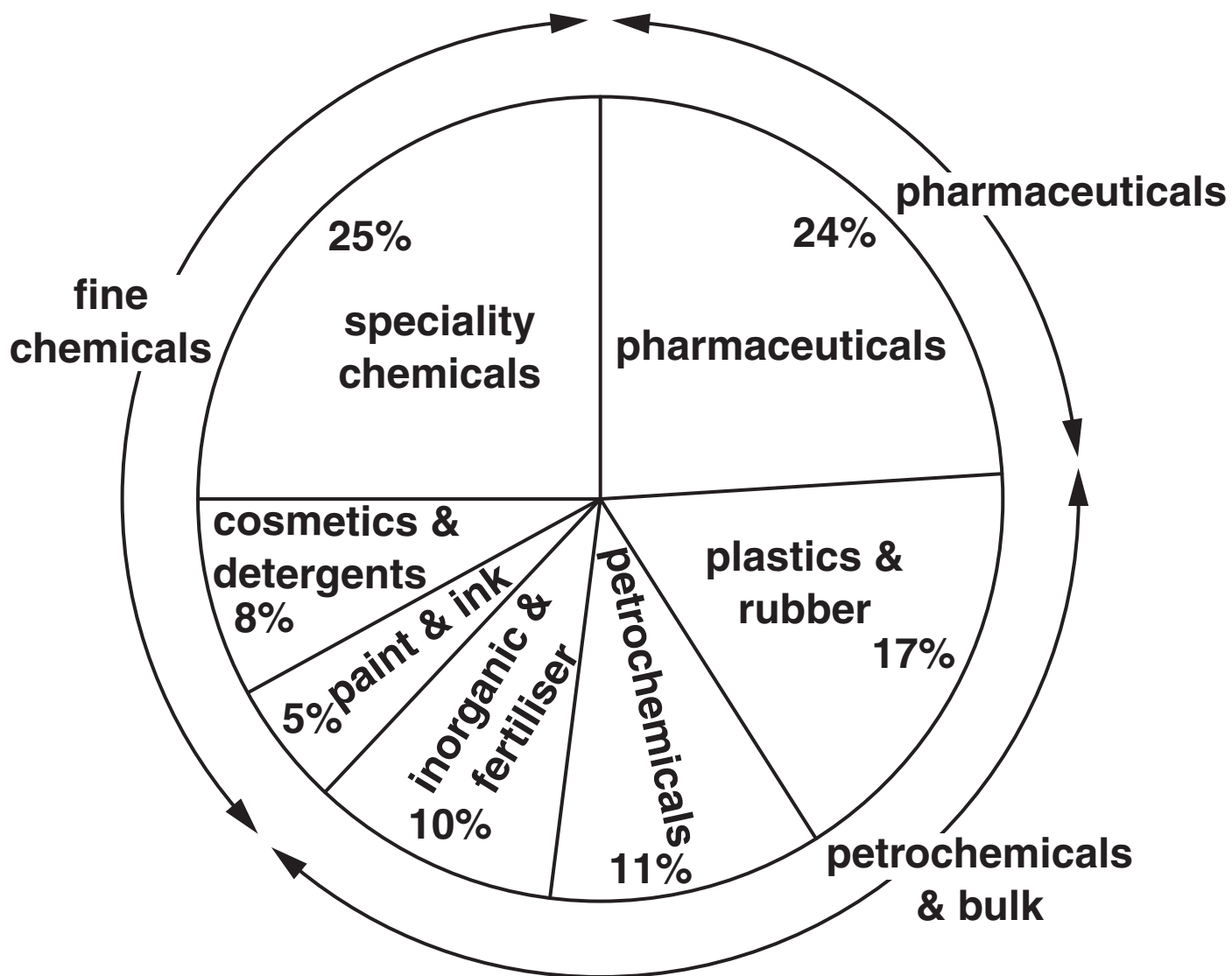
**Fill in the boxes to show the correct order. The first one has been done for you.**

|          |  |  |  |
|----------|--|--|--|
| <b>C</b> |  |  |  |
|----------|--|--|--|

**[2]**

**[Total: 4]**

7 The pie chart shows the EU chemical industry sales for 2003.





Mary combines these sectors to show the sales of the three main areas of the chemical industry.

(a) Complete the table to show the total size of the three main areas.

| <u>AREA</u>           | <u>TOTAL % SALES</u> |
|-----------------------|----------------------|
| pharmaceuticals       |                      |
| petrochemicals & bulk |                      |
| fine chemicals        |                      |

[2]

(b) The total sales of the industry are about 450 billion euros.

Using the information in the pie chart, put a **ring** around the total sales of the pharmaceuticals in billions of euros.

$$450 \times \frac{24}{100}$$

$$450 \times \frac{100}{24}$$

$$450 \times \frac{38}{100}$$

$$450 \times \frac{100}{38}$$

[1]

[Total: 3]

**8 Foods such as fruit taste pleasant because they contain small amounts of acid.**

**(a) Sometimes, extra acid is added to foods.**

**Acids which can be added to food are given E numbers.**

| <b><u>ACID</u></b>       | <b><u>E NUMBER</u></b> |
|--------------------------|------------------------|
| <b>ethanoic acid</b>     | <b>E260</b>            |
| <b>citric acid</b>       | <b>E330</b>            |
| <b>tartaric acid</b>     | <b>E334</b>            |
| <b>hydrogen chloride</b> | <b>E507</b>            |
| <b>sulfuric acid</b>     | <b>E513</b>            |

**Give one E number for an acid which is solid when pure.**

**answer** \_\_\_\_\_

**Give one E number for an acid which is a liquid when pure.**

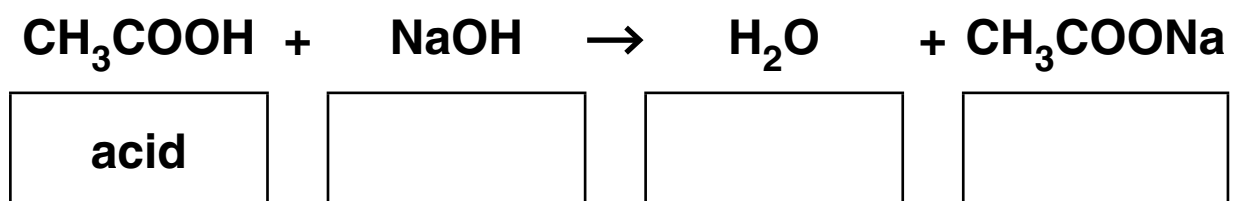
**answer** \_\_\_\_\_

Give one E number for an acid which is a gas when pure.

answer \_\_\_\_\_ [2]

(b) Acids in food show the normal reactions of an acid.

Write the labels ACID, ALKALI, SALT and WATER in the boxes. One has been done for you.

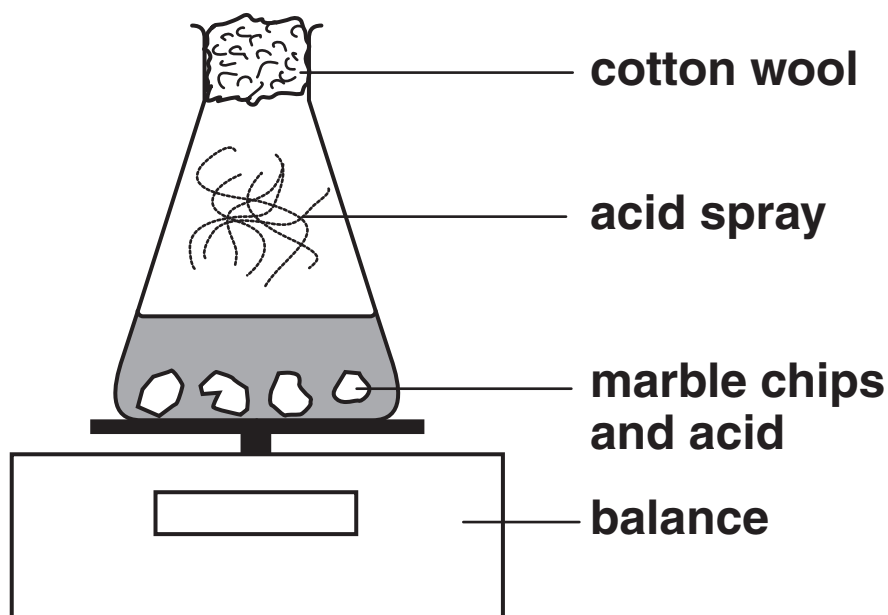


[1]

[Total: 3]

**9 Bobby reacts marble chips (calcium carbonate) with acid.**

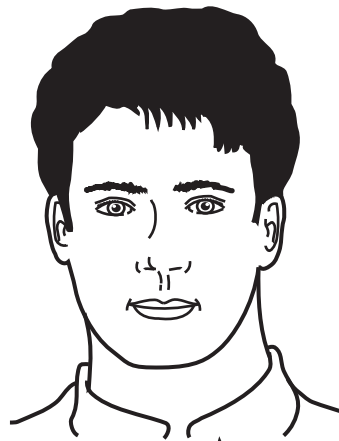
**He measures the change in mass as the acid reacts.**



(a) Why does he put cotton wool in the top of the flask?



**SU**  
To stop any air getting in.



**JIM**  
To stop any gas getting out.



**MIKE**  
To stop any marble chips getting out.



**KATE**  
To stop any spray from the bubbles getting out.

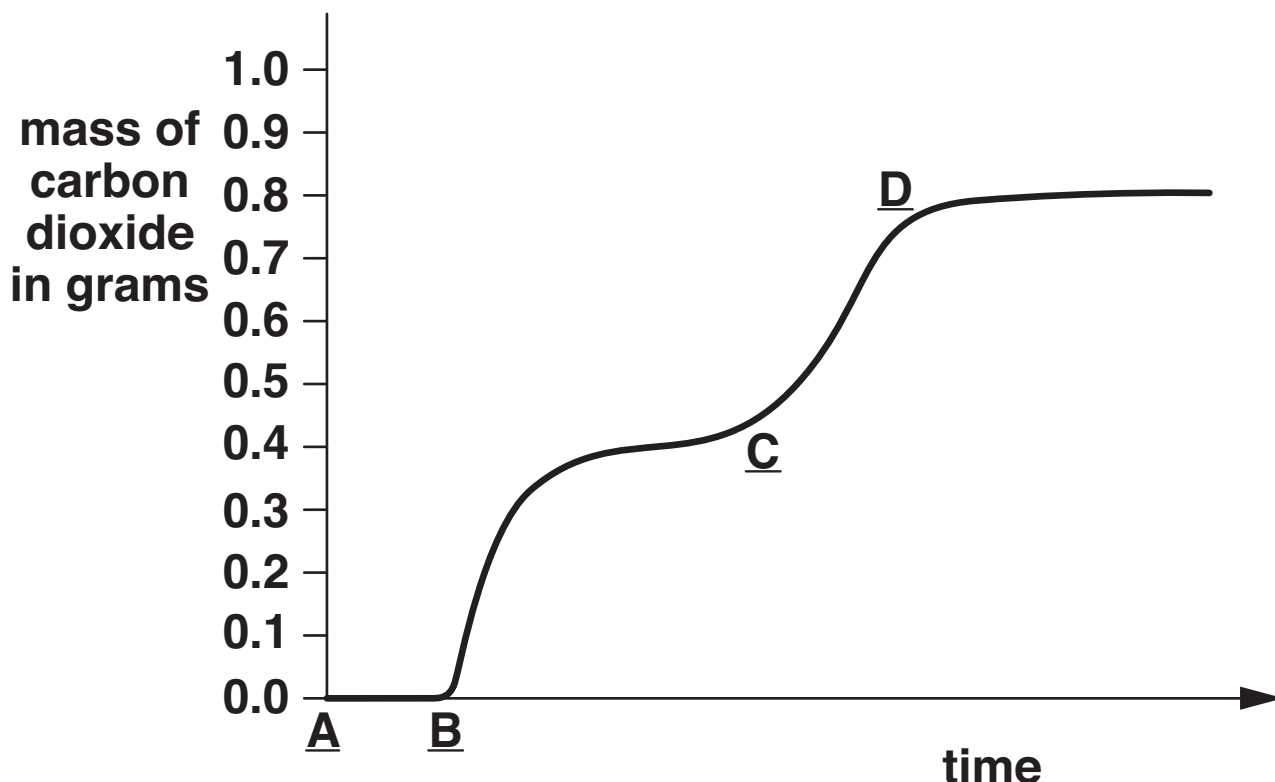


Who gives the **BEST** answer?

answer \_\_\_\_\_ [1]

(b) Bobby starts the reaction by adding some acid.

He adds extra acid part way through.



(i) Put a **ring** around the letter below that shows where he added the acid to START the reaction.

A                      B                      C                      D                      [1]

(ii) Put a **ring** around the letter below that shows where he added the extra acid.

A                      B                      C                      D                      [1]

(iii) Put a **ring** around the mass of carbon dioxide given off by the end of the experiment.

0.4 g              0.5 g              0.6 g              0.8 g              1.0 g              [1]

[Total: 4]

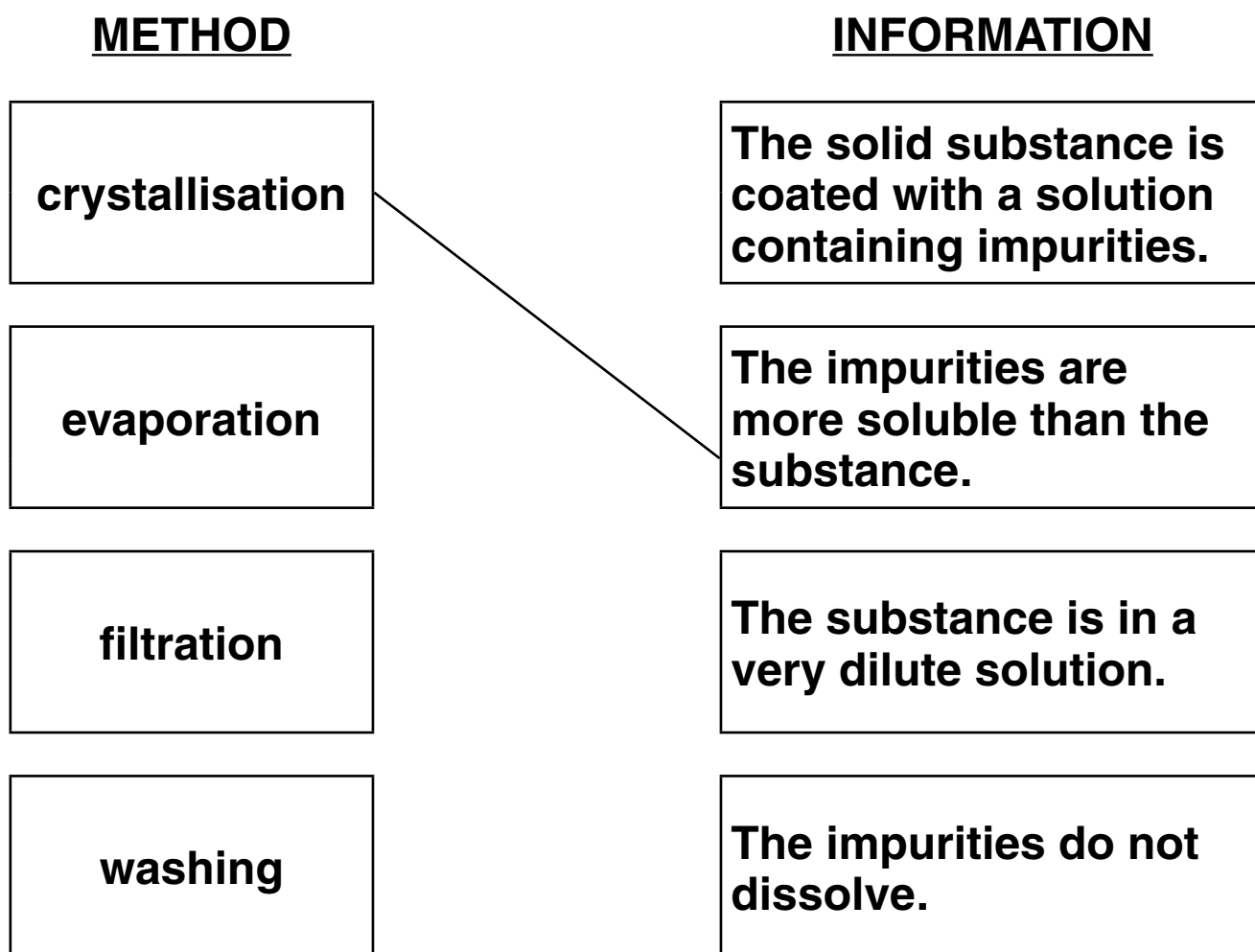
**10 Benzoic acid is added to foods as a preservative.**

**Benzoic acid forms solid crystals which must be purified before the acid is used.**

- (a) The table shows different methods of purifying chemicals, and information about when you would use each method.**

**Draw lines to link each METHOD to the correct piece of INFORMATION.**

**One has been done for you.**



**[2]**

(b) Terry does a titration to check the purity of some benzoic acid.

He wants to use an indicator which changes colour when the solution becomes slightly alkaline.

|          | <u>INDICATOR</u> | <u>pH RANGE FOR COLOUR CHANGE</u> |
|----------|------------------|-----------------------------------|
| <u>A</u> | gentian violet   | 0 to 2                            |
| <u>B</u> | methyl red       | 4 to 6                            |
| <u>C</u> | litmus           | 5 to 8                            |
| <u>D</u> | phenolphthalein  | 8 to 10                           |
| <u>E</u> | nitramine        | 11 to 13                          |

(i) Which indicator, A, B, C, D, or E, should he use?

answer \_\_\_\_\_ [1]



(ii) Terry does the titration five times.

He writes down his titration results.

| titration number                    | 1    | 2    | 3    | 4    | 5    |
|-------------------------------------|------|------|------|------|------|
| volume of alkali in cm <sup>3</sup> | 25.9 | 25.1 | 25.0 | 25.0 | 25.0 |

Put a tick (✓) in the box next to the result that he should use for his calculations.

25.0

25.1

25.2

25.9

[1]

[Total: 4]

**END OF QUESTION PAPER**

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# The Periodic Table of the Elements

|  |  | 1                                                                       |    | 2         |    |           |    |           |    |       |     |           |    |       |    | 3             |     | 4     |    | 5        |     | 6     |    | 7          |           | 0     |    |                        |         |       |    |           |            |       |    |            |        |       |      |              |          |       |    |             |       |                                                                                     |    |         |    |     |    |           |    |     |    |         |    |     |    |          |    |       |    |         |    |     |    |       |    |
|--|--|-------------------------------------------------------------------------|----|-----------|----|-----------|----|-----------|----|-------|-----|-----------|----|-------|----|---------------|-----|-------|----|----------|-----|-------|----|------------|-----------|-------|----|------------------------|---------|-------|----|-----------|------------|-------|----|------------|--------|-------|------|--------------|----------|-------|----|-------------|-------|-------------------------------------------------------------------------------------|----|---------|----|-----|----|-----------|----|-----|----|---------|----|-----|----|----------|----|-------|----|---------|----|-----|----|-------|----|
|  |  | 1<br>H<br>hydrogen<br>1                                                 |    |           |    |           |    |           |    |       |     |           |    |       |    |               |     |       |    |          |     |       |    |            |           |       |    | 4<br>He<br>helium<br>2 |         |       |    |           |            |       |    |            |        |       |      |              |          |       |    |             |       |                                                                                     |    |         |    |     |    |           |    |     |    |         |    |     |    |          |    |       |    |         |    |     |    |       |    |
|  |  | relative atomic mass<br>atomic symbol<br>name<br>atomic (proton) number |    | 9         | Be | beryllium | 4  |           |    |       |     |           |    |       |    |               |     |       |    |          |     |       | 11 | B          | boron     | 5     | 12 | C                      | carbon  | 6     | 14 | N         | nitrogen   | 7     | 16 | O          | oxygen | 8     | 19   | F            | fluorine | 9     | 20 | Ne          | neon  | 10                                                                                  |    |         |    |     |    |           |    |     |    |         |    |     |    |          |    |       |    |         |    |     |    |       |    |
|  |  | 23                                                                      | Na | sodium    | 11 | 24        | Mg | magnesium | 12 |       |     |           |    |       |    |               |     |       |    |          |     |       | 27 | Al         | aluminium | 13    | 28 | Si                     | silicon | 14    | 31 | P         | phosphorus | 15    | 32 | S          | sulfur | 16    | 35.5 | Cl           | chlorine | 17    | 40 | Ar          | argon | 18                                                                                  |    |         |    |     |    |           |    |     |    |         |    |     |    |          |    |       |    |         |    |     |    |       |    |
|  |  | 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    | 70                                                                                  | Ga | gallium | 31 | 73  | Ge | germanium | 32 | 75  | As | arsenic | 33 | 79  | Se | selenium | 34 | 84    | Kr | krypton | 36 |     |    |       |    |
|  |  | 85                                                                      | Rb | rubidium  | 37 | 88        | Sr | strontium | 38 | 89    | Y   | yttrium   | 39 | 91    | Zr | zirconium     | 40  | 93    | Nb | niobium  | 41  | 96    | Mo | molybdenum | 42        | [98]  | 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 | 127   | I  | iodine  | 53 | 131 | Xe | xenon | 54 |
|  |  | 133                                                                     | Cs | caesium   | 55 | 137       | Ba | barium    | 56 | 139   | La* | lanthanum | 57 | 178   | Hf | hafnium       | 72  | 181   | Ta | tantalum | 73  | 184   | W  | tungsten   | 74        | 186   | Re | rhodium                | 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 | Po | polonium | 84 | [222] | Rn | radon   | 86 |     |    |       |    |
|  |  | [223]                                                                   | Fr | francium  | 87 | [226]     | Ra | radium    | 88 | [227] | Ac* | actinium  | 89 | [261] | Rf | rutherfordium | 104 | [262] | Db | dubnium  | 105 | [266] | Sg | seaborgium | 106       | [264] | Bh | bohrium                | 107     | [277] | Hs | hassium   | 108        | [268] | Mt | meitnerium | 109    | [271] | Ds   | darmstadtium | 110      | [272] | Rg | roentgenium | 111   | Elements with atomic numbers 112-116 have been reported but not fully authenticated |    |         |    |     |    |           |    |     |    |         |    |     |    |          |    |       |    |         |    |     |    |       |    |

\* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.



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