

Candidate forename		Candidate surname	
-----------------------	--	----------------------	--

Centre number						Candidate number				
------------------	--	--	--	--	--	---------------------	--	--	--	--

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**A217/02**

**TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL SCIENCE A**

**Unit 3: Modules B6 C6 P6 (Higher Tier)**

**MONDAY 31 JANUARY 2011: Afternoon**

**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, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**
- **Answer ALL the questions.**

## **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 provided.**

**BLANK PAGE**

**QUESTION 1 STARTS ON PAGE 6**

# TWENTY FIRST CENTURY SCIENCE EQUATIONS

## USEFUL RELATIONSHIPS

### EXPLAINING MOTION

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

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

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

$$\begin{aligned} &\text{work done by a force} \\ &= \text{force} \times \text{distance moved in the direction of the force} \end{aligned}$$

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

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

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

## **ELECTRIC CIRCUITS**

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

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

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

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

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

## **THE WAVE MODEL OF RADIATION**

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

**Answer ALL the questions.**

**1 Isaac knows that light is made of waves.**

**(a) Draw a straight line to link the START of each sentence about light to its correct END.**

**START**

**END**

**The energy of a light wave ...**

**... decreases with increasing speed.**

**... is transferred by the transfer of matter.**

**The amplitude of a light wave ...**

**... is the maximum value of its disturbance.**

**... is transferred without the transfer of matter**

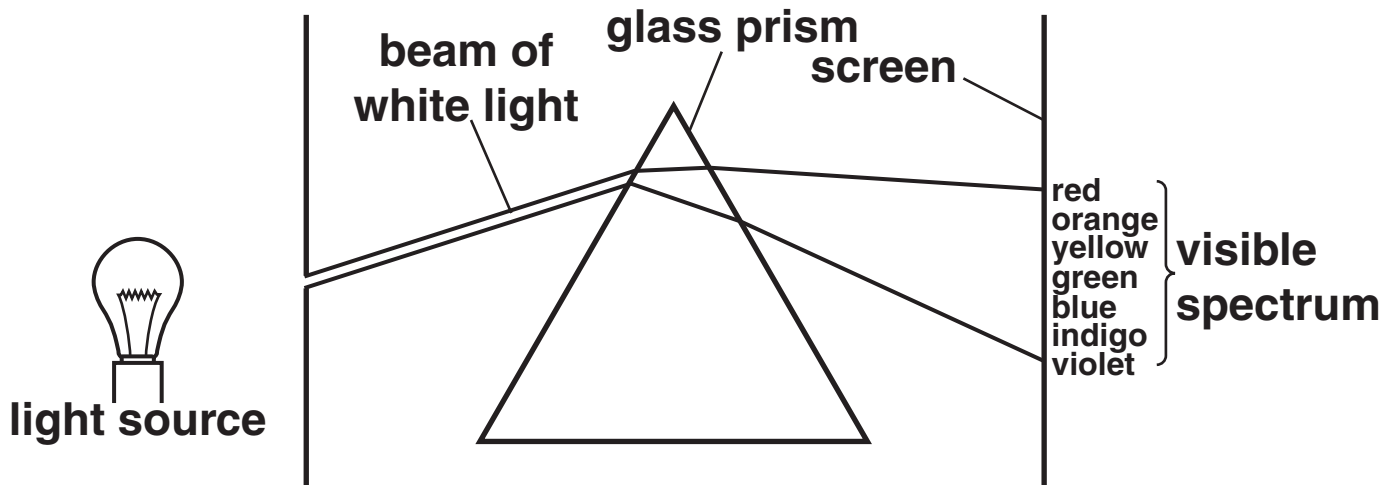
**The wavelength of a light wave ...**

**... is the distance from a crest to the next crest.**

**... is the distance from a crest to the next trough.**

**[2]**

(b) Isaac shines a beam of white light at a glass prism.



Isaac notices the spectrum of coloured light on the screen.

He uses the idea of photons to explain it.

Complete the sentences. Choose words from this list.

**ABSORBS    AMPLITUDE    DIFFRACTS    EMITS**

**REFLECTS    REFRACTS    SHAPE    WAVELENGTH**

The light source continually \_\_\_\_\_ a large number of different photons.

The prism \_\_\_\_\_ each photon by an amount that depends on its \_\_\_\_\_ .

The screen \_\_\_\_\_ these photons into

Isaac's eyes so that he can see their colour. [3]

**(c) Here are some possible equations for calculating the intensity of the light arriving at a point on the screen.**

**Which equation, A, B, C or D, is correct?**

**A intensity = photon energy  $\times$  photon rate**

**B intensity = photon power  $\times$  photon speed**

**C intensity = photon speed  $\times$  photon frequency**

**D intensity = photon amplitude  $\times$  photon wavelength**

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

**[Total: 6]**



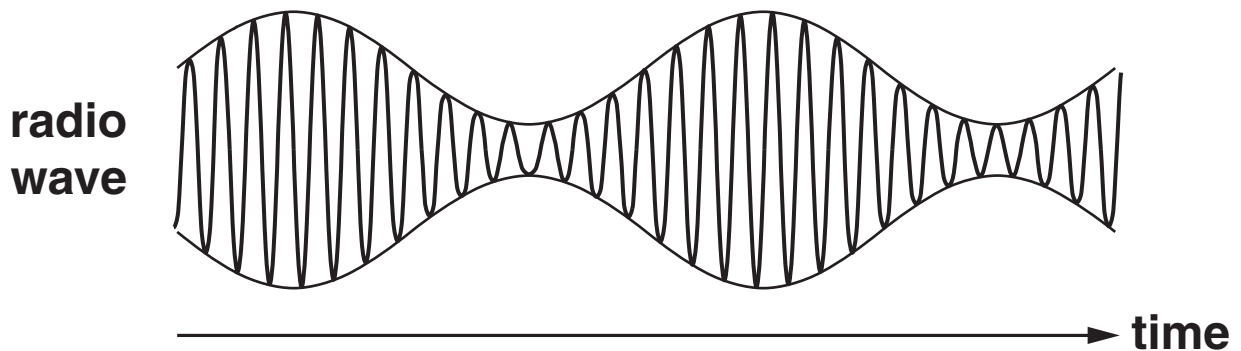
**BLANK PAGE**

**QUESTION 2 STARTS ON PAGE 10**

2 Paul uses a radio microphone to record a song.



(a) The microphone aerial emits an amplitude modulated radio wave.



Draw **IN THE SPACE BELOW** what a radio wave would look like if **FREQUENCY MODULATION** were used instead.

[1]

**(b) Paul is not pleased with the quality of sound from the radio microphone.**

**He decides to use a microphone that sends the sound by DIGITAL TRANSMISSION.**

**Explain how digital transmission improves the quality of the sound.**

---

---

---

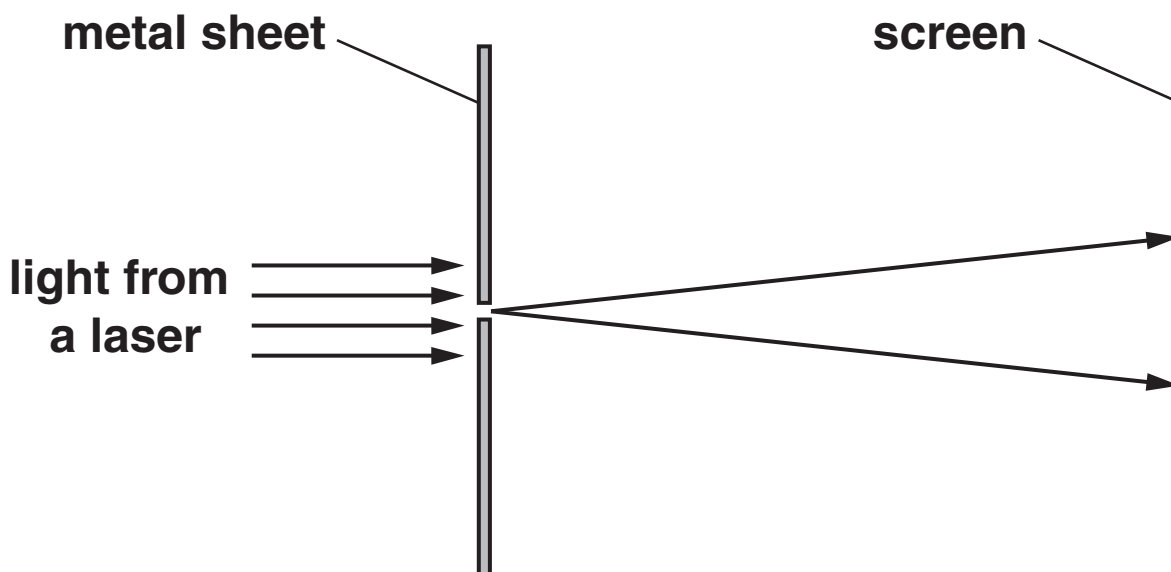
---

---

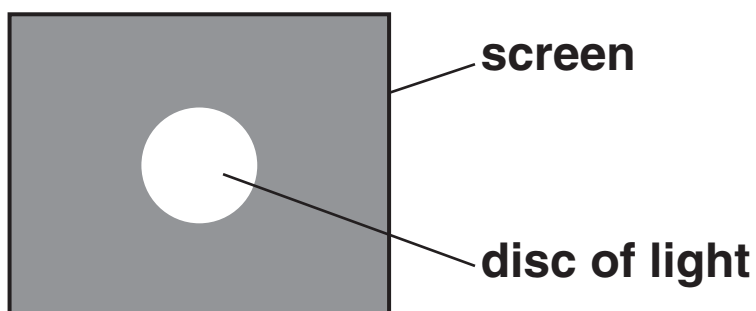
**[3]**

**[Total: 4]**

**3 Thomas passes light from a laser through a small hole in a metal sheet.**



**(a) Thomas sees a disc of light when he looks at the screen.**



**The disc is much larger than the hole.**

**Light that passes through the hole spreads out before it hits the screen.**

**(i) What is the name of this effect?**

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

**(ii) What does this observation suggest about light?**

**Put a tick (✓) in the box next to each of the TWO correct explanations.**

**Light has a wave nature.**

**Light is a longitudinal wave.**

**Light from the source has only one wavelength.**

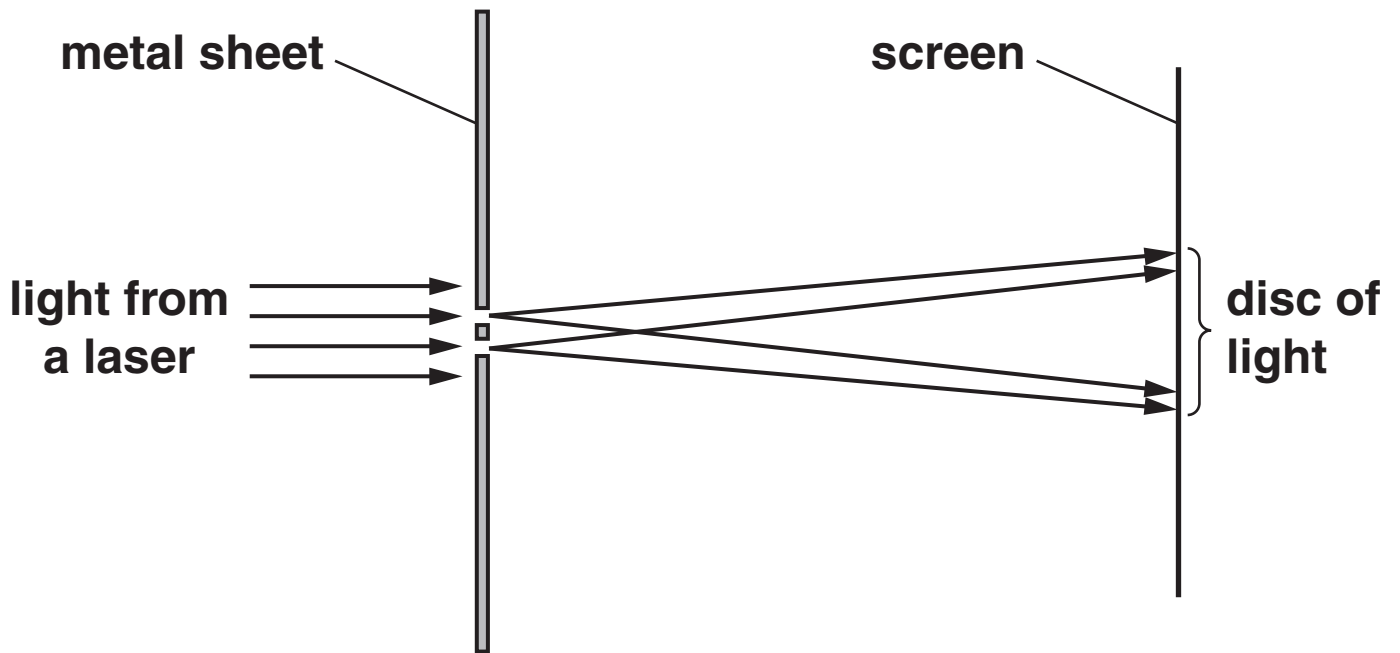
**The size of the hole is similar to the wavelength of the light.**

**Photons carry the energy of the light from the source to the screen.**

**The amplitude of the light is much smaller than the size of the pinhole.**

**[2]**

(b) Thomas makes a second hole in the metal sheet just above the first hole.



Thomas looks at the screen for an interference pattern.

Here are four possible patterns.



Which pattern, A, B, C or D, will Thomas see?

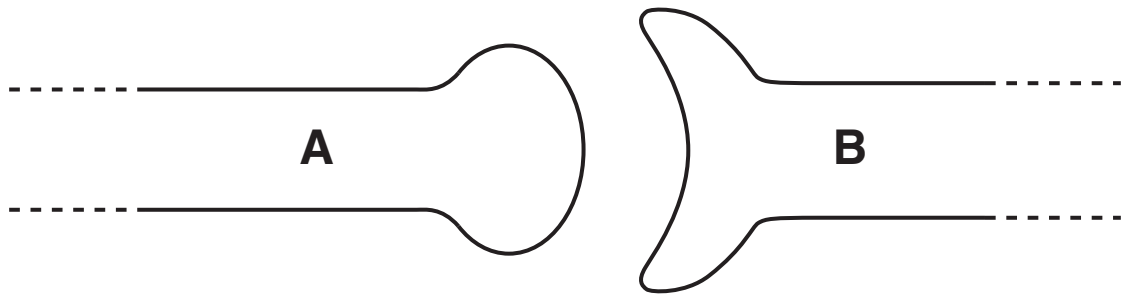
answer \_\_\_\_\_ [1]

[Total: 4]

**BLANK PAGE**

**QUESTION 4 STARTS ON PAGE 16**

**4 The diagram shows the synapse between neuron A and neuron B.**



**(a) Explain how the release of a chemical from neuron A can lead to an electrical impulse in neuron B.**

---

---

---

---

---

**[3]**



**(b) Serotonin is a chemical found in some synapses in the brain.**

**The drug Ecstasy alters the concentration of serotonin.**

**Draw ONE line to join the correct EFFECT OF ECSTASY with the correct CONSEQUENCE.**

**EFFECT OF ECSTASY**

**increases serotonin release from neuron A**

**reduces serotonin removal by neuron A**

**reduces serotonin release from neuron A**

**increases serotonin removal by neuron A**

**CONSEQUENCE**

**reduces serotonin concentration in synapse**

**reduces serotonin concentration in neuron B**

**increases serotonin concentration in synapse**

**increases serotonin concentration in neuron B**

**[2]**

**[Total: 5]**

**5 This question is about reflexes.**

**(a) Reflexes such as the knee jerk reflex help an animal to survive.**

**Give ANOTHER example of a reflex response and explain how it helps an animal's chances of survival.**

**reflex response** \_\_\_\_\_

\_\_\_\_\_

**how it helps survival** \_\_\_\_\_

\_\_\_\_\_

**[2]**

**(b) Barbara is being served dinner in the canteen.**

**She is handed a hot plate.**

**Her reflex is to drop it, but she does not.**

**Complete the sentences to explain why Barbara does not drop the plate.**

**Use words from this list. You may use each word once, more than once, or not at all.**

**INVOLUNTARY    MOTOR    SENSORY    VOLUNTARY**

**In a simple reflex arc the \_\_\_\_\_ neuron transmits impulses to the spinal cord. To modify this reflex, Barbara's brain transmits impulses through a neuron to the \_\_\_\_\_ neuron in the reflex arc.**

**This allows her response to be \_\_\_\_\_ .**  
**[2]**

**(c) A conditioned reflex has certain characteristics.**

**Put a tick (✓) in the box next to each of the TWO correct characteristics.**

**A secondary stimulus is associated with a primary stimulus.**

**A stimulus is not needed.**

**More than one secondary stimulus is used.**

**The final response has no direct connection to the stimulus.**

**It does not involve learning.**

**[1]**

**(d) Some brightly coloured caterpillars taste bitter.**

**Many birds will avoid eating all brightly coloured caterpillars after eating a few of them.**

**Complete the sentences to explain why. Use words from this list.**

**CONDITIONED**

**MODIFIED**

**PERIPHERAL**

**PRIMARY**

**SECONDARY**

**SIMPLE**

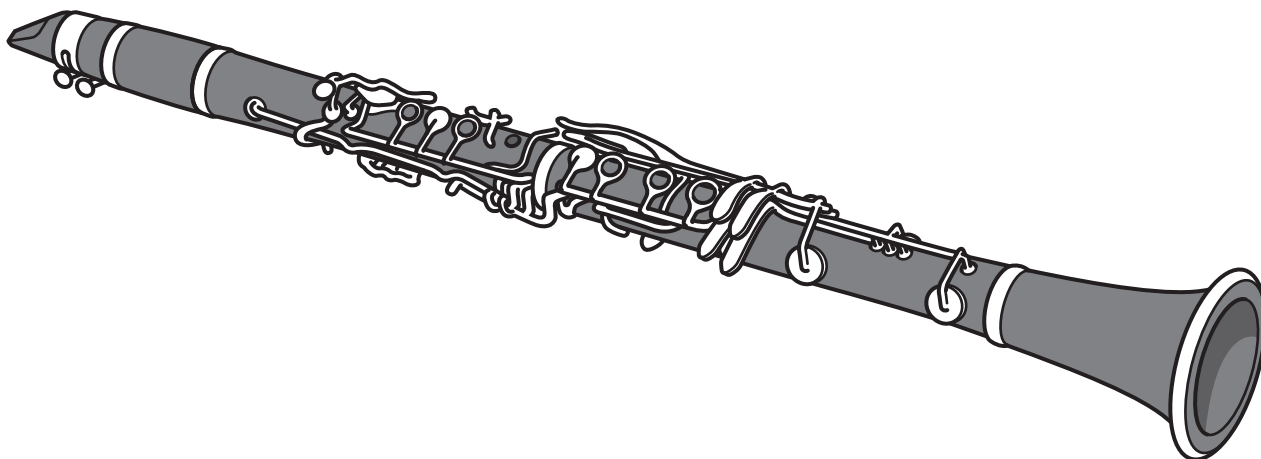
**The bitter taste is a \_\_\_\_\_ stimulus.**

**The bright colour is a \_\_\_\_\_  
stimulus.**

**This is a \_\_\_\_\_ reflex. [2]**

**[Total: 7]**

**6 Colin plays his clarinet in a school concert.**



**He has to practise playing to be able to perform.**

**Put ticks (✓) in the boxes next to the TWO statements that best explain what is happening in Colin's brain as he learns some new music.**

**Repetition causes neuron pathways to wear out.**

**New experiences cause new neuron pathways to form.**

**Repetition makes new pathways more likely to transmit impulses.**

**Repetition makes all new neurons more likely to transmit impulses.**

**New experiences cause neurons to make bigger electrical impulses.**

**[2]**

**[Total: 2]**

**BLANK PAGE**

**QUESTION 7 STARTS ON PAGE 24**

**7 Ann has some solid sodium hydroxide and she wants to know how pure it is.**

**She weighs out a sample and dissolves it in water to make an alkali solution.**

**(a) Ann carries out an accurate titration to find out how much acid reacts with  $25.0\text{ cm}^3$  of the alkali solution.**

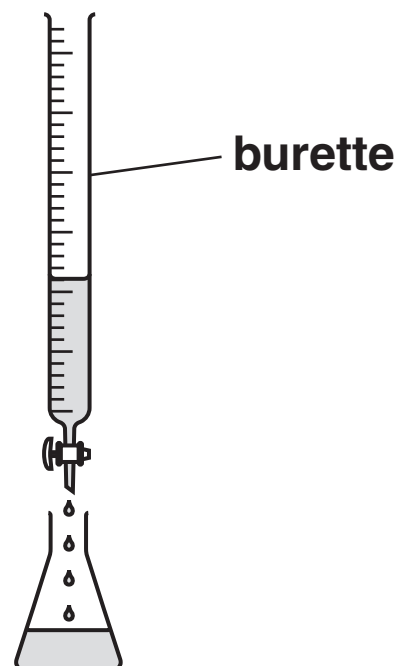
**She puts  $25.0\text{ cm}^3$  of the alkali solution into a conical flask.**

**She then adds a few drops of indicator solution.**

**She puts the acid into a burette.**

**Describe how Ann should carry out the rest of the titration.**

**Include any measurements that she should make.**



---

---

---

---

---

---

**[4]**



(b) Ann finds that her sodium hydroxide solution reacts with less acid than she expected.

Put a tick (✓) in the box next to the most likely reason for this.

Titration results always vary.

The acid contained impurities.

Not all the sodium hydroxide reacts.

The sodium hydroxide contained impurities.

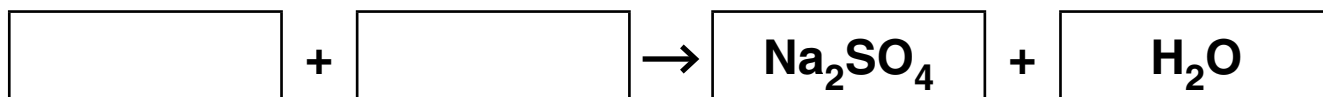
[1]

(c) Ann writes the equation for her reaction.

(i) The acid she used was sulfuric acid.

The alkali she used was sodium hydroxide.

Write the formula of each chemical in its box, then balance the whole equation.



[2]

(ii) The reaction between any acid and any alkali involves two ions.

Write the equation for this in the empty boxes.



[1]

[Total: 8]

8 Bernie buys stomach powder from his supermarket.



The powder contains magnesium carbonate and an acid.

(a) Put a **ring** around the acid that is most likely to be in the powder.

CITRIC ACID

ETHANOIC ACID

HYDROGEN CHLORIDE

SULFURIC ACID

[1]

(b) The statements below explain what happens as the powder is added to water.

Put the statements in the correct order. One has been done for you.

A A gas is produced.

B The acid dissolves.

C The carbonate reacts.

D Hydrogen ions spread through the water.

			A
--	--	--	---

[2]

(c) The magnesium carbonate reacts with hydrochloric acid in the stomach to form a salt.

Write down the name of the salt and its formula.

The symbols for the ions are  $Mg^{2+}$  and  $Cl^{-}$ .

name \_\_\_\_\_

formula \_\_\_\_\_

[2]

**(d) What other magnesium compound also reacts with acids?**

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

**magnesium chloride**

**magnesium oxide**

**magnesium sulfate**

**magnesium nitrate**

**[1]**

**[Total: 6]**

**END OF QUESTION PAPER**

**BLANK PAGE**

**BLANK PAGE**

## **Copyright Information**

**OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.**

**If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.**

**For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.**

**OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.**

# The Periodic Table of the Elements

	1	2	3	4	5	6	7	0										
	7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 P phosphorus 15	16 O oxygen 8	17 F fluorine 9	18 Ar argon 18								
	19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36
	37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
	55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium [209]	85 At astatine [210]	86 Rn radon [222]
	[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 hasium 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						

1	H	1
hydrogen		

**Key**

relative atomic mass  
atomic symbol  
name  
atomic (proton) number

\* 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.