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 1 FEBRUARY 2010: 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 clearly in capital letters, your Centre Number and Candidate Number 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 <u>ALL</u> 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 <u>42</u>.

- A list of physics equations is printed on pages 4–5.

- A copy of the Periodic Table is provided.

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

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

momentum = mass × velocity

change of momentum
= resultant force × time for which it acts

work done by a force
= force × distance moved by the force

change in energy = work done

change in GPE = weight × vertical height difference

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

ELECTRIC CIRCUITS

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

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

energy transferred = power × time

power = potential difference × current
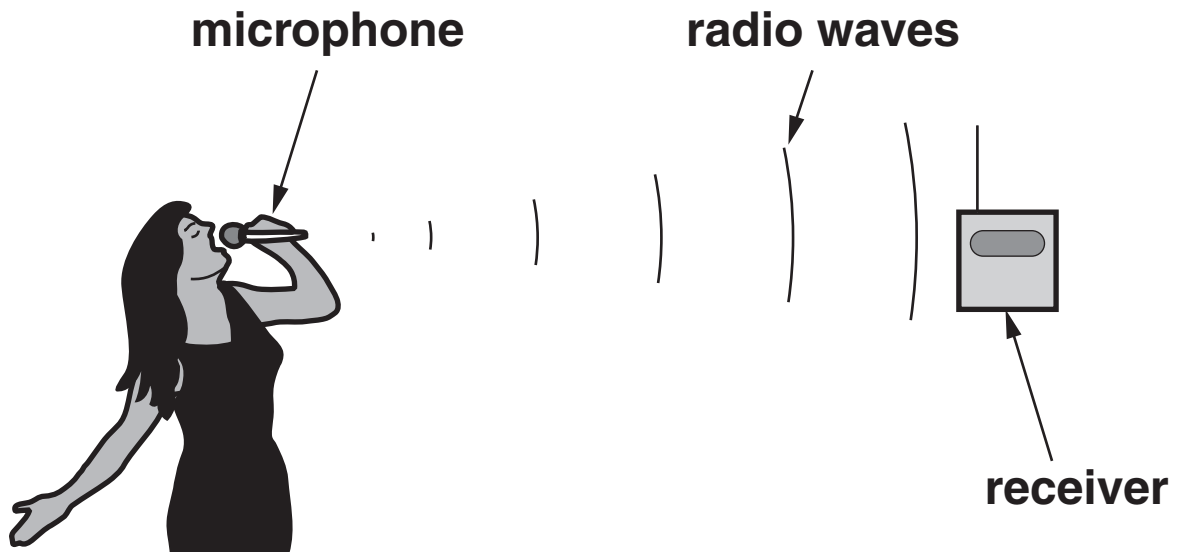
$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

THE WAVE MODEL OF RADIATION

wave speed = frequency × wavelength

Answer ALL the questions.

1   Sam uses a digital radio microphone when she sings karaoke.

microphone   radio waves

receiver

(a) Complete the sentences. Choose the **BEST** words from this list.

DECODES
MODULATES
OSCILLATES
RECEIVES
TRANSMITS

Sam sings into her radio microphone.

Her singing _____ the radio waves.

The aerial on her microphone

_____ the radio waves.

After the receiver picks up the radio waves, it

_____ them to produce a copy of

Sam's sound.

[2]

(b) The radio microphone uses digital coding instead of analogue coding.

This transmits Sam's sound with a higher quality.

Explain why digital coding gives a higher quality result than analogue coding.

_____

_____

_____ [3]
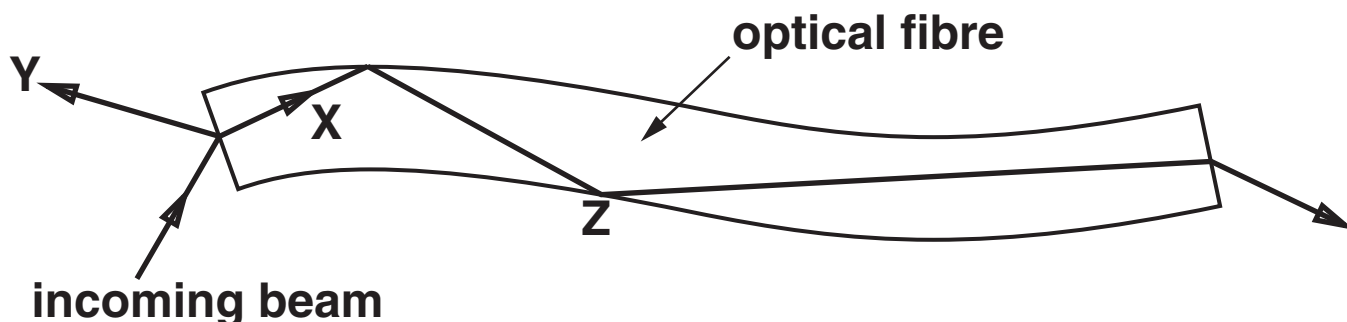
[Total: 5]

2   TV cable networks use optical fibres made of glass to carry digital signals.

(a) The diagram shows a beam of infrared light entering and leaving an optical fibre.

optical fibre

Y

X

Z

incoming beam

Complete the sentences. Choose words from this list.

ABSORBED

DIFFRACTED

REFLECTED

REFRACTED

At the start of the optical fibre the incoming beam splits.

One part of the beam goes to X, the other part goes to Y.

The part which goes to X is _____ .

The part which goes to Y is _____ .

[2]

(b) At point Z, the beam is <u>TOTALLY INTERNALLY REFLECTED</u>. Why does this happen?

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

Infrared light travels faster through glass than through air. ☐

None of the energy of the infrared light is absorbed by the glass. ☐

The angle of refraction of the emerging beam would be more than 90°. ☐

The glass has been coated with black plastic to absorb the infrared light. ☐

[1]

(c) Four friends discuss why infrared is used to carry TV signals through optical fibres.

It has the highest frequency of any wave.

ALAN

It travels a long way before becoming too weak to detect.

BESS

It can't be detected by human beings.

CARLOS

It heats up the fibre as it passes through.

DAVINA

Who has the correct reason why infrared light is used to carry TV information through optical fibres?

answer _____ [1]

[Total: 4]

3   Microwave ovens are used to heat food.

(a) When the oven is switched on it produces a beam of microwave photons.

Put ticks (✔) in the boxes next to the TWO correct ways of increasing the intensity of a beam.

The intensity of a beam can be increased by ...

... increasing the speed
of the photons. ☐

... decreasing the speed
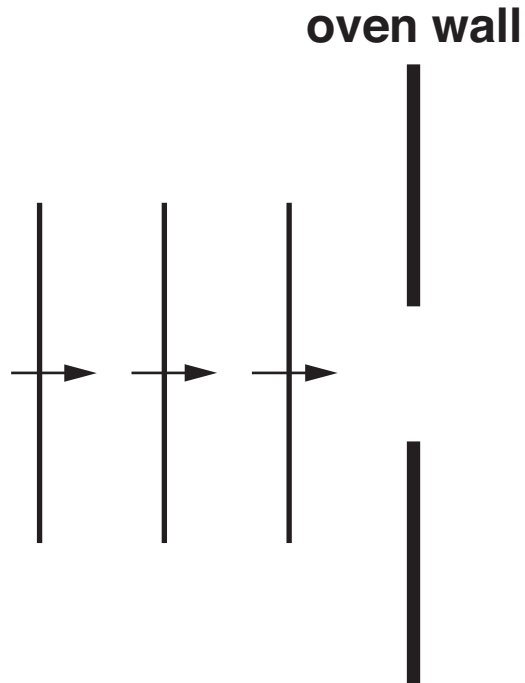of the photons. ☐

... decreasing the frequency
of the photons. ☐

... decreasing the wavelength
of the photons. ☐

... increasing the rate of
production of the photons. ☐

[2]

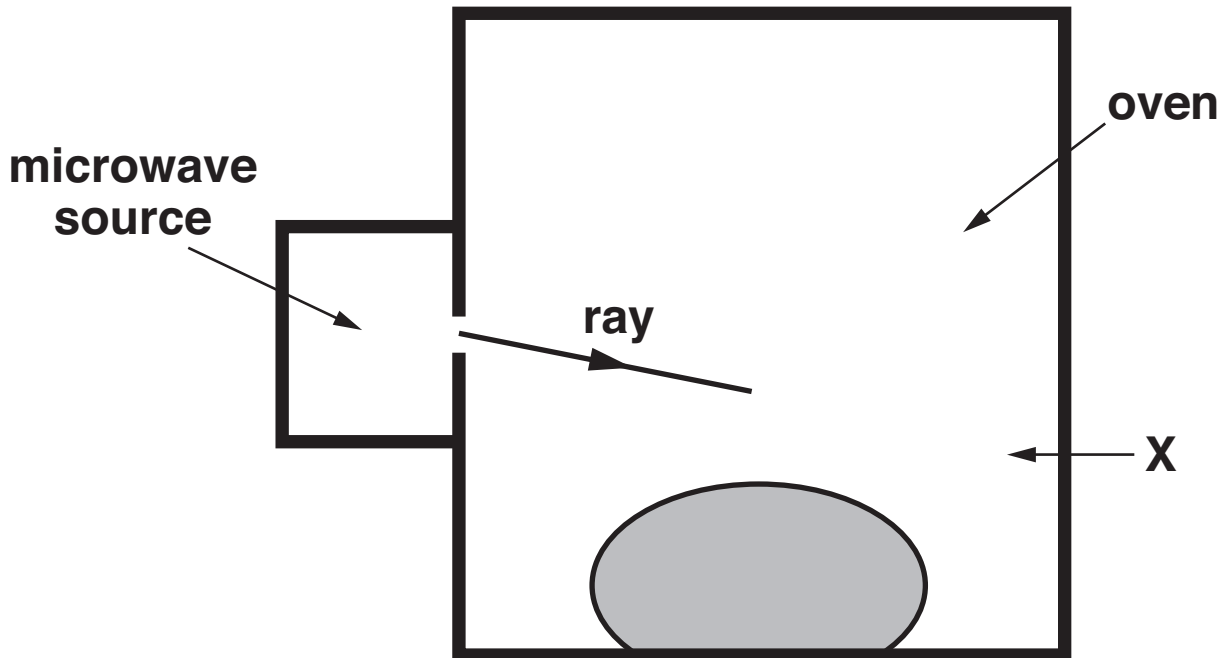**(b)** The microwaves **DIFFRACT** as they emerge from a small hole into the oven.

   (i) On the diagram draw three waves **AFTER** passing through the hole.

oven wall

[1]

(ii) The microwave rays reflect off the metal oven walls.

Complete the diagram to show the microwave ray reflecting off the wall at X.

[1]

(c) Complete the sentences.

Choose words from this list.

ABSORB   DIFFRACT   EMIT
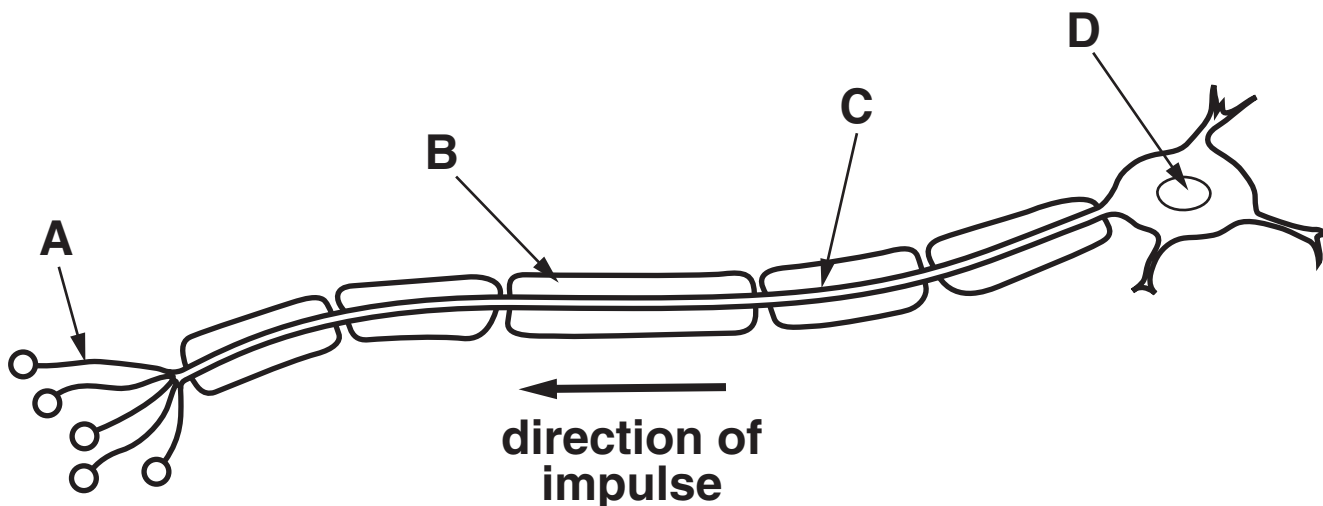
INTERFERE   REFLECT   REFRACT

The food is heated because water molecules in it

_____ the microwaves.

The heating is uneven because reflected

microwaves _____ with

microwaves which come directly from the source.

[1]

[Total: 5]

4 This question is about a motor neuron.

(a) (i) Which part of the diagram, A, B, C or D, shows the fatty sheath?

answer _____ [1]

(ii) The speed of the impulse along this neuron is 18 m/s.

What is the speed of the impulse likely to be in a different neuron that does not have a fatty sheath?

Put a (ring) around the correct speed.

2 m/s   18 m/s   30 m/s   75 m/s

[1]

(iii) Explain **ANOTHER** reason why neurons in organisms have a fatty sheath.

_____

_____

_____ **[2]**

(iv) The motor neuron might send the impulse to a muscle cell.

Name another **TYPE** of cell which might receive the impulse from a motor neuron.

answer _____ **[1]**

(b) Put a (ring) around the correct choice to complete each sentence.

Motor neurons are found in the
EXTERNAL / **PERIPHERAL** / **SENSORY**
nervous system.

Neurons release chemicals into the
SYNAPSE / **REFLEX ARC** / **SPINAL CORD**.

These chemicals move to the next cell by
ACTIVE TRANSPORT / **DIFFUSION** /
OSMOSIS.

A receptor on the membrane of a neuron binds to
SPECIFIC / **MANY** / **ALL** chemicals.

[2]
[Total: 7]

5 Hannah is walking on a woodland path when she stumbles into some stinging nettles.

She jumps away from them when they sting her.

(a) Complete the sentences. Choose words from this list.

LEARNED
MOTOR
MUSCLES
NERVES
REFLEX
SENSORY

This type of response is a _____ response.

The pain signal is carried by _____ neurons.

The effectors are _____ .

The signal to the effectors is carried by

_____ neurons.

[3]

(b) (i) Hannah's first response is to jump back.

She then realises that she has dropped her phone in the nettles.

Hannah reaches into the nettles to pick up the phone.

She knows the nettles will sting her.

Her brain makes it possible for her to <u>ADAPT HER BEHAVIOUR</u> in this way.

What is it about her brain that makes it possible to do this?

Put a tick (✔) in the box next to the <u>BEST</u> answer.

Her brain has many neurons. ☐

Her brain has many possible pathways between the neurons. ☐

Her brain is connected to her muscles. ☐

Her brain has a fixed number of neuron pathways. ☐

Her brain is in her central nervous system. ☐

[1]

(ii) This is an example of a modified reflex response.

This requires a change to the reflex arc.

Describe how Hannah's brain makes this change.

_____

_____ **[1]**

[Total: 5]

6   Some scientists study how people learn.

They test two groups of people.

Each group is given a short time to look at a set of numbers

Numbers shown to group <u>A</u>:
158   258   358   458   558   658

Numbers shown to group <u>B</u>:
558   185   358   685   258   458

Each person is then asked to repeat back what they can remember.

(a) Which part of their brain are they using to remember the numbers?

Put a (ring) around the correct answer.

<u>CEREBRAL CORTEX</u>

<u>HYPOTHALAMUS</u>

<u>PITUITARY</u>

<u>SPINAL CORD</u>   [1]

(b) Suggest a reason why group <u>A</u> was better at remembering the whole list.

_____

_____

_____ [1]

[Total: 2]

7   Geoff investigates how quickly copper carbonate reacts with hydrochloric acid.

(a) Suggest <u>THREE</u> ways in which Geoff could make the reaction go faster.

_____

_____

_____

_____

_____ [2]
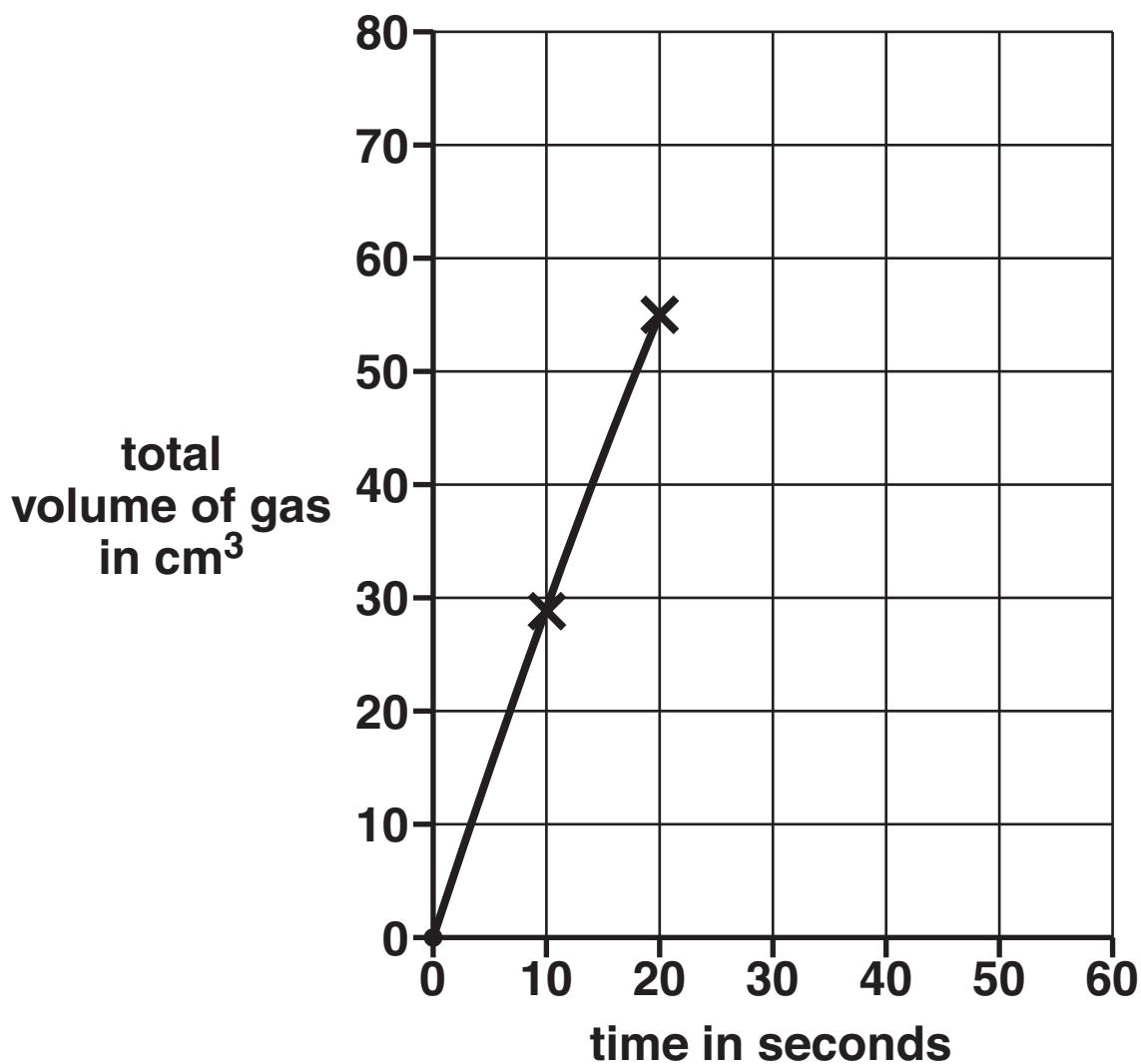
(b) Geoff measures the volume of carbon dioxide given off every ten seconds.

TIME IN SECONDS	TOTAL VOLUME OF GAS IN CM^3
0	0
10	29
20	55
30	66
40	72
50	74

(i) **Finish the graph of these results. The first three points have been done for you.**

[2]

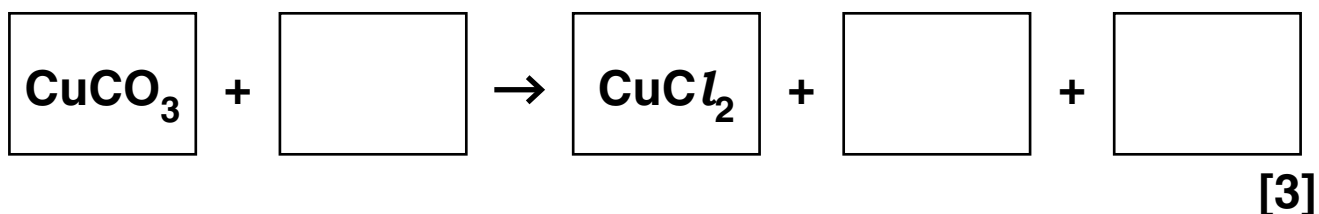**(ii)** **Why does the reaction gradually slow down?**

_____

_____ [1]

[Total: 5]

8 Geoff reacts copper carbonate with hydrochloric acid. He knows that this will produce a salt and two other products.

(a) Write the formula of each chemical in its box, then balance the equation

$$\boxed{CuCO_3} \; + \; \boxed{} \; \rightarrow \; \boxed{CuCl_2} \; + \; \boxed{} \; + \; \boxed{}$$

[3]

(b) What causes the acidic reactions of hydrochloric acid?

Put a ⬭ring around the correct answer.

<u>CHLORIDE IONS</u>

<u>HYDROGEN IONS</u>

<u>HYDROXIDE IONS</u>

<u>HYDROGEN CHLORIDE MOLECULES</u>

[1]

(c) Geoff produces some crystals of his salt, but they are not pure.

Here are six techniques used in purification.

Choose **FIVE** of these techniques and put them into a sequence to show how Geoff can produce pure, dry crystals from the impure crystals.

A crystallisation

B dissolving

C distillation

D drying

E evaporation

F filtration

[2]

(d) Geoff makes 10.3 g of crystals.

He knows that the theoretical yield for the reaction is 17.4 g.

What is the percentage yield for the reaction?

Put a (ring) around the correct answer.

0.59   1.7   59   170
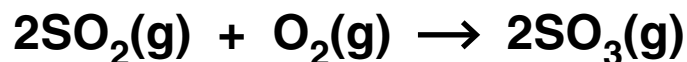
[1]

[Total: 7]

9 The chemical industry makes millions of tonnes of sulfuric acid every year.

The equation for one stage in the manufacture of sulfuric acid is

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$

(a) This process uses a catalyst.

Draw one line from <u>COLUMN A</u> to <u>COLUMN B</u>, and one line from <u>COLUMN B</u> to <u>COLUMN C</u>, to show what a catalyst does.

COLUMN A	COLUMN B	COLUMN C
It speeds up the reaction …	… and takes part in the reaction …	… and is used up in the reaction.
or	or	or
It slows down the reaction …	… but does not take part in the reaction …	… and is not used up in the reaction.

[1]

(b) A catalyst affects the rate of a reaction.

What does '<u>RATE OF REACTION</u>' tell you?

Put a tick (✔) in the box next to the <u>BEST</u> answer.

the cost of producing a substance ☐

the amount of substance produced ☐

the amount of substance produced per second ☐

the amount of substance produced per gram of reactant ☐

[1]

[Total: 2]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
																	4 **He** helium 2
7 **Li** lithium 3	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	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
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	128 **Te** tellurium 52	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** 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	[209] **Po** polonium 84	[210] **At** astatine 85	[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

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1
H
hydrogen
1

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.