Candidate forename		Candidate surname	

Centre number						Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

GCSE

A217/02

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A

Unit 3: Modules B6 C6 P6 (Higher Tier)

WEDNESDAY 20 JUNE 2012: Morning

DURATION: 40 minutes
plus your additional time allowance

MODIFIED ENLARGED

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

DC (NF/SW) 12MEP06061 62286/1
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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. HB pencil may be used for graphs and diagrams only.**
- **Answer ALL the questions.**
- **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).**

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.**
- **An enlarged Periodic Table is provided.**

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

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

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

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

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

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

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

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

ELECTRIC CIRCUITS

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

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

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

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

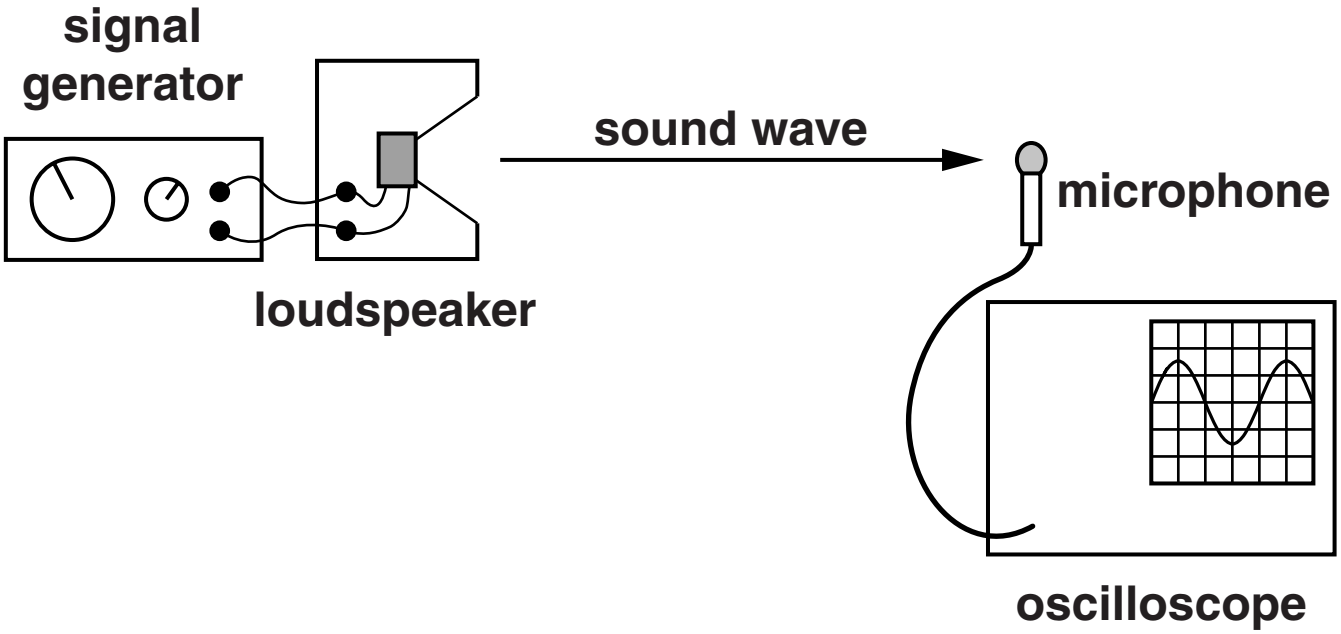
$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

THE WAVE MODEL OF RADIATION

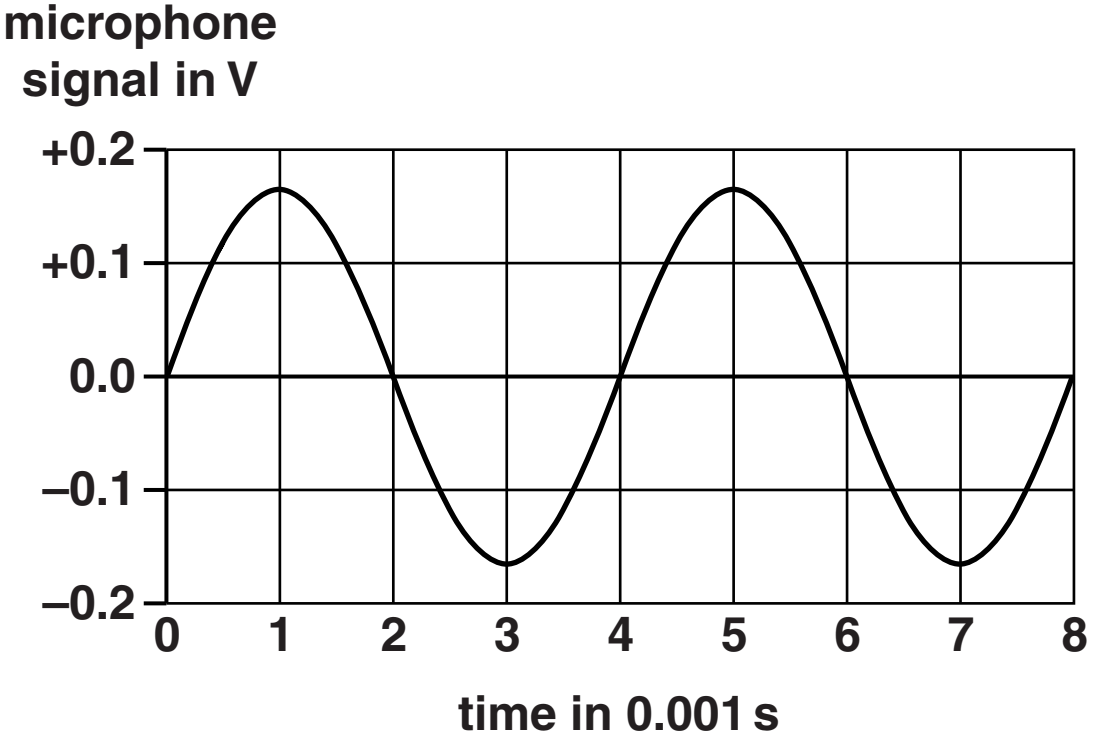
$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Answer ALL the questions.

1 Doris investigates sound waves with the apparatus below.



(a) The oscilloscope screen shows this voltage-time graph for the microphone signal.



(i) How should Doris calculate the frequency of the sound wave?

Put a (ring) around the correct calculation.

$$\frac{1}{8 \times 0.001}$$

$$\frac{1}{6 \times 0.001}$$

$$\frac{1}{4 \times 0.001}$$

$$\frac{1}{2 \times 0.001}$$

[1]

(ii) Doris alters the signal generator to increase the frequency of the sound wave.

Complete each sentence by putting a (ring) around the correct option in capitals.

The frequency of the sound increases.

The speed of the sound DECREASES / INCREASES / STAYS THE SAME.

So the wavelength of the wave

DECREASES / INCREASES / STAYS THE SAME.

[1]

(b) Doris knows that sound is a longitudinal wave.

Here are some statements about longitudinal waves moving FORWARDS through solid matter.

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

They carry matter with them as they pass through.	☐
They do not have any effect on the matter as they pass through.	☐
They make matter move from side to side as they pass through.	☐
They make matter move backwards and forwards as they pass through.	☐

[1]

(c) Complete the sentence about waves. Choose words from this list.

electromagnetic

empty space

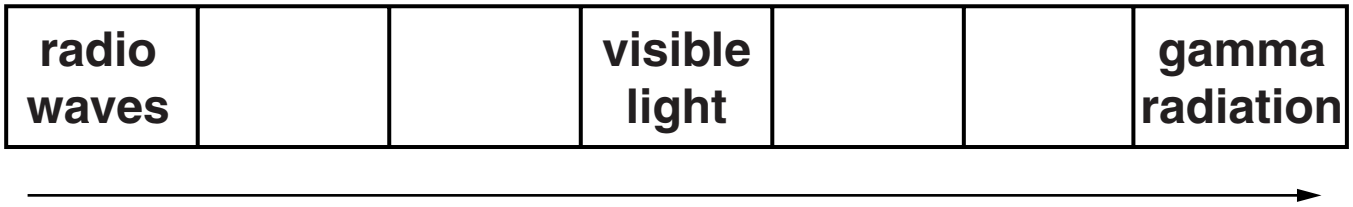
solids

sound

_____ waves cannot pass through _____ . **[1]**

[Total: 4]

2 Here is an incomplete diagram of the electromagnetic spectrum.



(a) What wave property always increases from left to right in the diagram?

answer _____ [1]

(b) Write MICROWAVES and INFRARED in the correct places on the diagram of the spectrum above. [1]

(c) The diagram shows a microwave oven with a rotating turntable.

In this microwave oven, the food will only cook evenly when the turntable rotates.

If the turntable does not rotate, some parts of the food cook much more than others.

Use ideas about INTERFERENCE to explain why the food needs to be rotated to cook evenly.

_____

_____

_____

_____

_____

_____

_____ **[3]**

[Total: 5]

3 Jack and Jill use two-way radios to communicate when they are apart.

(a) Jack speaks into his radio.

Complete the sentence with the correct technical term.

As Jack speaks, the radio waves emitted by the aerial are _____ . **[1]**

(b) Here are some possible reasons why radio waves might be used for communication.

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

Radio waves are not absorbed by air.	☐
Radio waves reflect off objects in their path.	☐
Radio waves diffract out of aerials in all directions.	☐
Radio waves are absorbed at the edge of the atmosphere.	☐

[1]

(c) The quality of the signal received by Jill gets worse as she moves away from Jack.

This is because the radios use ANALOGUE transmission.

Explain why the use of DIGITAL transmission could solve this problem.

_____

_____

_____

_____

_____

_____

_____ **[3]**

[Total: 5]

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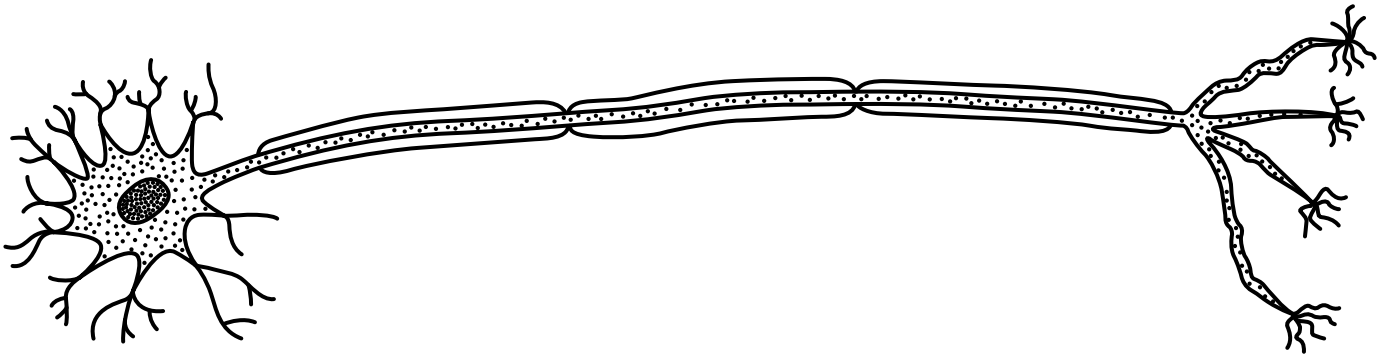
4 This is a diagram of a motor neuron involved in a reflex arc.



(a) Explain how this helps to produce rapid responses to changes in the environment.

Include ideas about the neuron and the reflex arc in your answer.

_____

_____

_____

_____

_____

_____ **[3]**

(b) The motor neuron can link to different cell types.

Put ticks (✓) in the boxes next to the TWO types of cell this motor neuron might send impulses to.

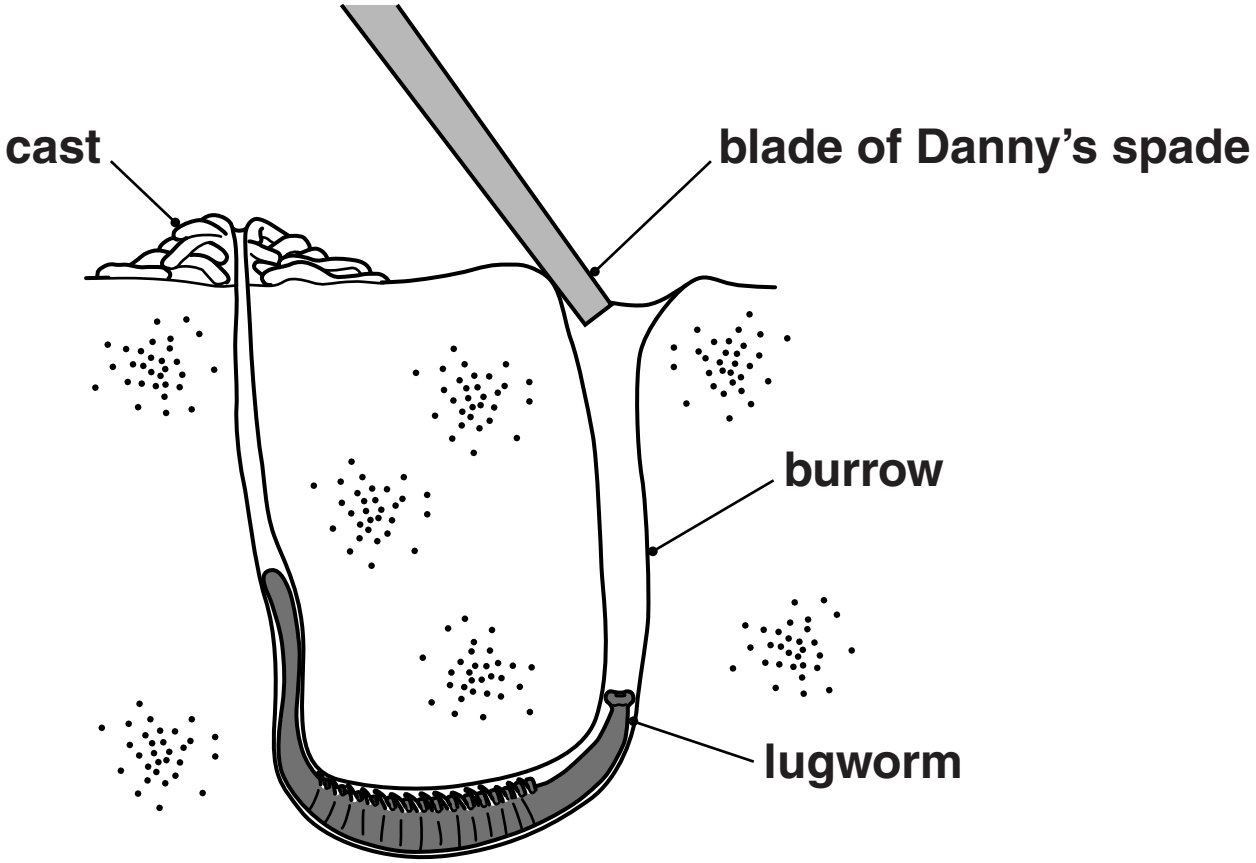
muscle cells	☐
skin cells	☐
retina cells	☐
hormone secreting cells	☐
cerebral cortex cells	☐

[1]

[Total: 4]

5 Danny is digging on the beach for lugworms.

Lugworms are simple animals that burrow in the sand and leave a worm cast above their burrows.



(a) When Danny digs, the worms go deeper into their burrows. This simple reflex helps the worm avoid danger.

What other ADVANTAGES does the lugworm have as a result of simple reflexes?

Put ticks (✓) in the boxes next to the TWO correct answers.

finding food	☐
growing	☐
communicating	☐
remembering	☐
reproducing	☐

[1]

(b) Danny is told a better way to dig for lugworms.

He scoops the whole burrow out of the sand with the lugworm in it.

Put a tick (✓) in the box next to the correct word to complete each sentence.

Danny's behaviour is adaptable to new situations because he

has a complex brain.	
uses only reflex actions.	
has specialised sense organs.	
has more body mass.	

Danny's brain forms new

neurons	
pathways	
muscles	
cells	

as he learns the new skill.

Danny's nervous system uses his

cerebral cortex	
peripheral system	
reflex arcs	
motor neurons	

to process what he is told.

[2]

(c) Next time Danny will be able to remember how to catch lugworms.

(i) Which type of verbal memory will he use?

_____ **[1]**

(ii) On his next seaside holiday Danny has a sudden recollection of being told how to catch lugworms.

Which statement could best explain why?

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

Danny has gained a reflex to hunt lugworms.	☐
Danny's brain links the smell of sea air with the memory.	☐
Danny's memory fades with time.	☐
Danny's hypothalamus stores the memory.	☐
Danny has acquired the skill at the right age.	☐

[1]

[Total: 5]

6 Amy is having her eyes examined by the doctor.

When the doctor shines a light in her eye, Amy's pupil contracts.

This is a reflex.

(a) Choose the correct events in this reflex from each pair in the list, and place these events in the right order.

The last one has been done for you.

A Chemicals reach the end of the sensory neuron.
B An impulse reaches the end of the sensory neuron.

C The motor neuron is stimulated.
D The motor neuron is suppressed.

E Receptor molecules bind with any chemicals diffusing in the synapse.
F Receptor molecules bind with specific chemicals diffusing in the synapse.

G Chemicals are attracted by the sensory neuron.
H Chemicals are released by the sensory neuron.

			C

[2]

(b) To see the retina of Amy's eye better, the doctor uses a drug to stop the reflex. This effect only lasts for a few hours.

Put a tick (✓) in the box next to the BEST explanation of how this drug stops the reflex action.

The drug increases the frequency of impulses in the sensory neuron.	☐
The drug blocks receptor sites at synapses.	☐
The drug makes the cells of the retina more sensitive to light.	☐
The drug stimulates the muscle cells in Amy's eye.	☐
The drug makes Amy's brain need different chemicals.	☐

[1]

(c) What happens in Amy's brain as a result of new experiences and interaction with the environment?

Put a tick (✓) in the boxes next to the two BEST explanations.

Amy's brain grows many new neurons.	☐
Amy was conditioned not to have the newborn reflexes.	☐
Amy's brain develops new receptors.	☐
Amy's brain forms new neuron pathways.	☐
Amy's brain relies on different chemicals as she learns.	☐
Amy's brain has some neuron pathways that are more likely to transmit impulses than other neuron pathways.	☐

[2]

[Total: 5]

7 Nick's water tank is blocked up with limescale.

He removes the limescale with concentrated hydrochloric acid.

(a) Limescale is calcium carbonate, $CaCO_3$. It reacts with hydrochloric acid, HCl, to make calcium chloride, $CaCl_2$, and water and carbon dioxide.

(i) One of the substances made is a salt. Which one?

_____ [1]

(ii) Complete and balance the equation for this reaction

$CaCO_3$ + _____ HCl = _____

+ _____ + _____ [2]

(b) When Nick descales his kettle he uses a different acid.

He knows that when you put any acid into water it always produces the same ion.

What is this ion?

_____ [1]

[Total: 4]

8 Mary studies the reaction between sulfuric acid and pieces of zinc.

The equation for the reaction is

$$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$$

(a) She wants to know how much zinc sulfate can be made in her reaction.

(i) Use information from the Periodic Table to calculate the relative formula mass of zinc sulfate.

Show your working.

relative formula mass = _____ [2]

(ii) What mass of zinc sulfate is made when 65 g of zinc reacts?

mass = _____ g [1]

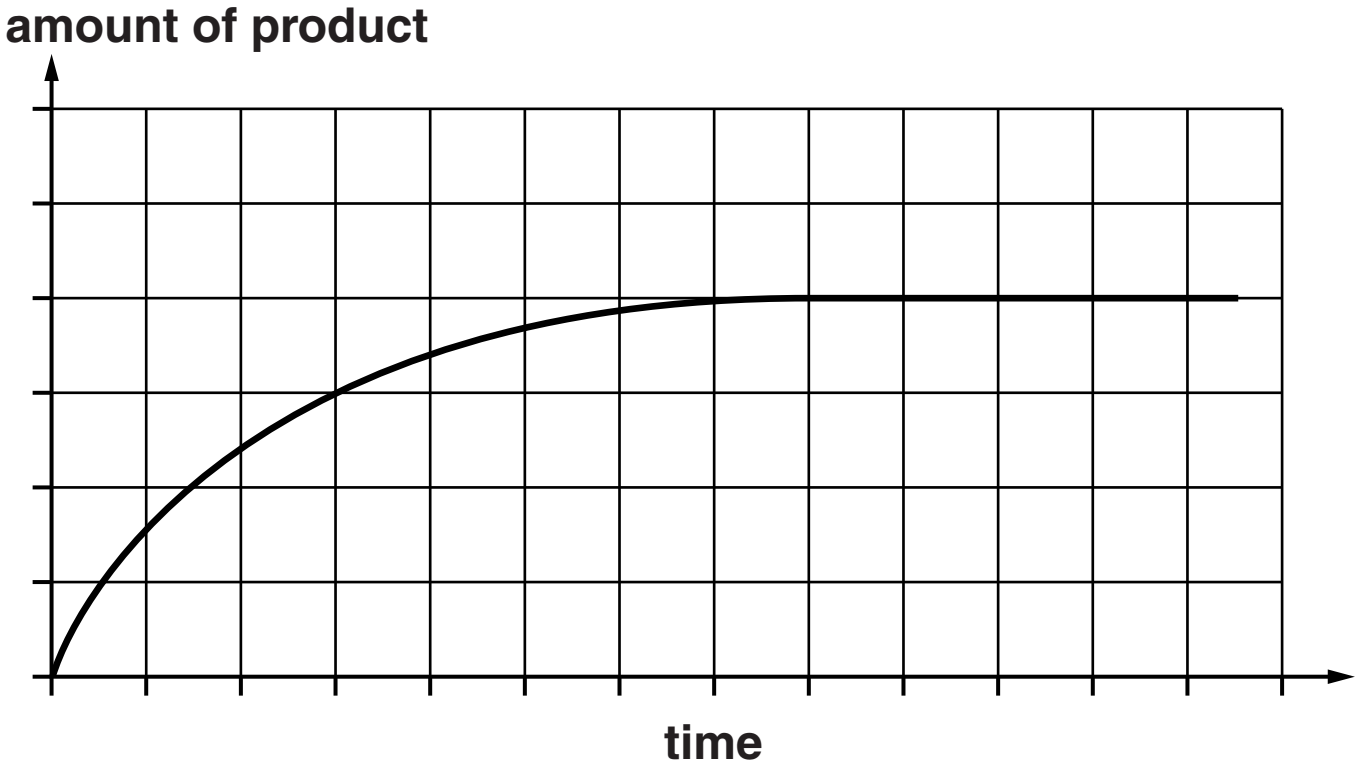
(b) When Mary uses more concentrated acid the reaction goes faster.

Draw ONE line to link the two statements which together provide the correct explanation for this.

MORE CONCENTRATED ACID HAS …	THIS LEADS TO …
… higher pH.	… more collisions.
… more surface area.	… bigger collisions.
… more volume.	… faster collisions.
… more acid particles in every cm^3.	… more collisions every second.

[2]

(c) Mary plots a graph of the progress of her reaction.



She does the experiment again.

The only difference is that this time she adds a catalyst.

On the graph draw a line to show the results of the experiment using the catalyst. [2]

(d) Mary did her experiment in a laboratory with small amounts of chemicals.

In industry, larger amounts are used and the rate of reaction has to be very carefully controlled.

Suggest why it is important to control the rate of reaction in an industrial process.

_____

_____

_____

_____ **[3]**

[Total: 10]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										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

**** 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.