OXFORD CAMBRIDGE AND RSA EXAMINATIONS

GCSE

A182/02

TWENTY FIRST CENTURY SCIENCE PHYSICS A

Modules P4 P5 P6 (Higher Tier)

FRIDAY 25 JANUARY 2013:
Afternoon

DURATION: 1 hour
plus your additional time allowance
MODIFIED ENLARGED 24pt

Candidate forename		Candidate surname	

Centre number					Candidate number				

**Candidates answer on the Question Paper.
A calculator may be used for this paper.**

OCR SUPPLIED MATERIALS:

Inserts A, B, C

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. HB pencil may be used for graphs and diagrams only.

- Answer <u>ALL</u> 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

- Your quality of written communication is assessed in questions marked with a pencil (✏).

- A list of useful relationships is printed on pages four and five.

- 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>60</u>.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

THE EARTH IN THE UNIVERSE

distance = wave speed × time

wave speed = frequency × wavelength

SUSTAINABLE ENERGY

energy transferred = power × time

power = voltage × current

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

EXPLAINING MOTION

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

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

momentum = mass × velocity

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

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

amount of energy transferred = work done

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

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

ELECTRIC CIRCUITS

power = voltage × current

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

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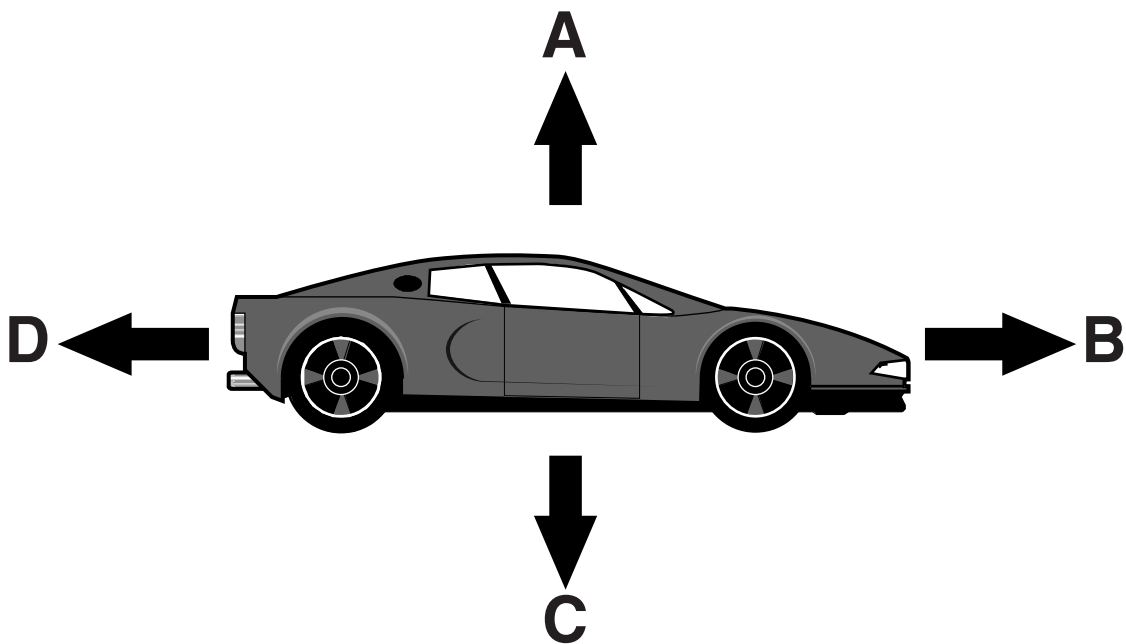
RADIOACTIVE MATERIALS

energy = mass × [speed of light in a vacuum]^2

Answer ALL the questions.

1   Racing car teams track the progress of cars to analyse their performance.

(a) Some of the forces on a car are shown below.

(i) Draw lines to match each ARROW to its FORCE and each FORCE with its DESCRIPTION.

ARROW	FORCE	DESCRIPTION
A	reaction force	push of the engine
B	driving force	force due to friction and air resistance
C	counter force	pull of gravity on the car
D	weight	force from the ground on the car

[2]

(ii) The team had force sensors on the car.

At one moment, the sensors measured the following forces:

A	B	C	D
6 400 N	18 000 N	6 400 N	11 500 N

Calculate the resultant force on the car, including its direction.

resultant force _____ N

direction _____

[2]

(b) The car is travelling at a steady velocity and then it suddenly accelerates for 2.0 s at a rate of 7.5 m/s^2.
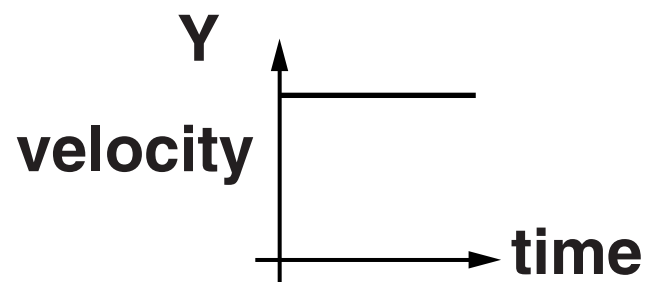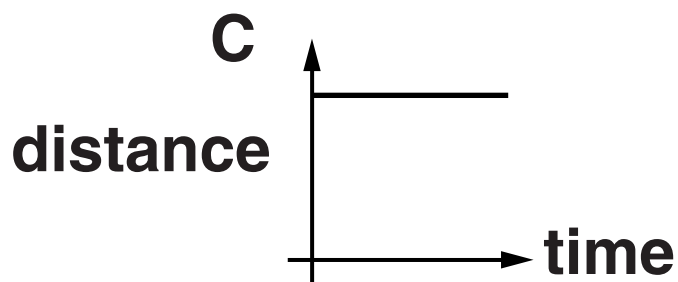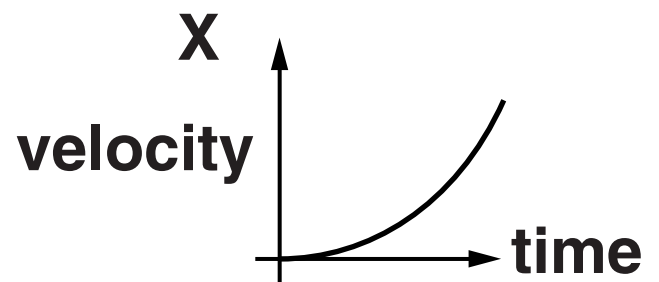
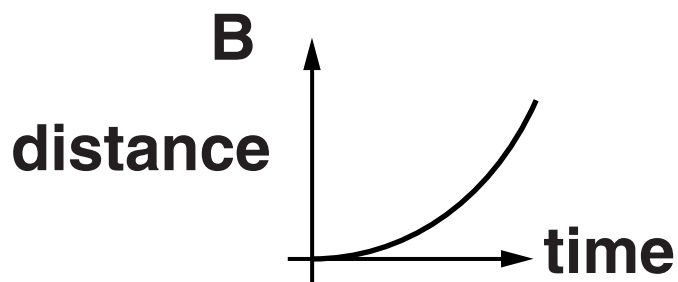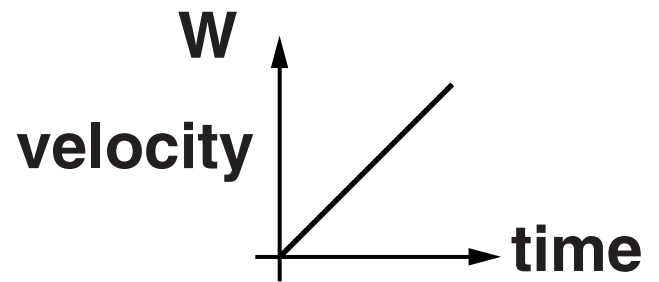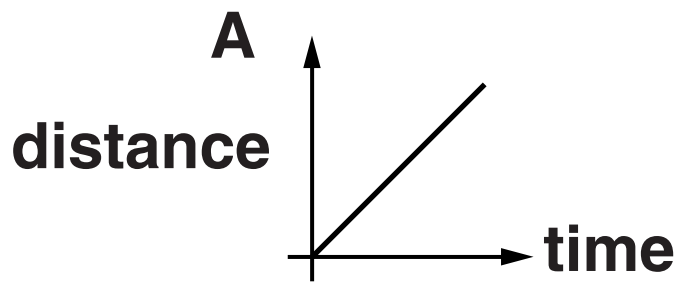It reaches a velocity of 40 m/s.

What velocity did the car start at?

Show your working.

velocity = _____ m/s

[2]

(c) Another car accelerates from rest.

Which distance-time graph, A, B or C, and velocity-time graph, W, X or Y, show the motion of the car as it accelerates at a constant rate?

A

distance

time

W

velocity

time

B

distance

time

X

velocity

time

C

distance

time

Y

velocity

time
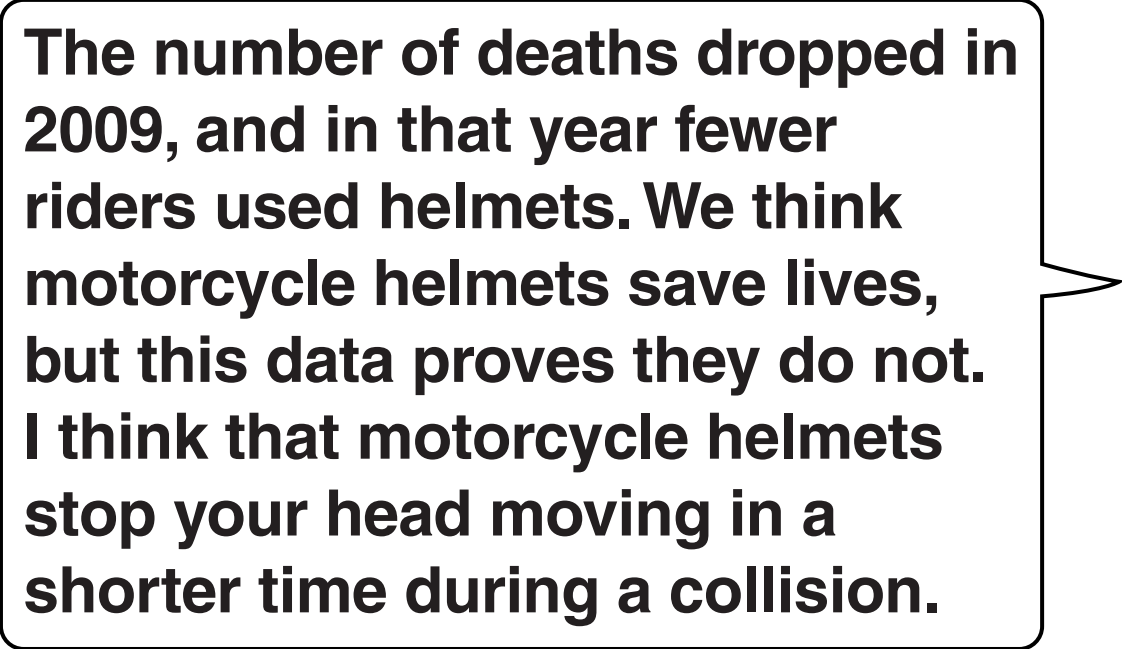
correct distance-time graph

_____

correct velocity-time graph

_____

[1]

[TOTAL: 7]

2 Look at the two graphs (Insert A and Insert B) showing motorcycle rider deaths and helmet use.
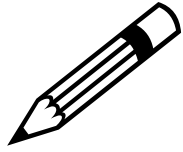
A politician looks at the graphs.

> The number of deaths dropped in 2009, and in that year fewer riders used helmets. We think motorcycle helmets save lives, but this data proves they do not. I think that motorcycle helmets stop your head moving in a shorter time during a collision.

The politician has misunderstood the ideas of correlation and cause, and does not understand how motorcycle helmets work.

Explain why he is WRONG, using the data and your knowledge of physics.

The quality of written communication will be assessed in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

[TOTAL: 6]

3 Hannah is doing an experiment with falling paper shapes.

(a) When Hannah lifts a paper circle, she does work on the paper.

Hannah lifts the paper circle 1.5 m from the floor and does a total of 0.03 J of work on it.

What is the weight of the paper circle?

weight = _____ N [1]

(b) Hannah holds the paper circle up high.

She then drops the paper.

Describe the transfer of energy as the paper circle falls.

_____

_____

_____

[2]

(c) (i) Hannah then squashes the paper circle into a ball, so the mass remains the same at 0.002 kg.

She then repeats her experiment, lifting the paper ball to the same height of 1.5 m above the floor, so the work done on the paper ball is still 0.03 J.

She finds that the paper ball drops FASTER.

Using ideas about energy, show that the maximum speed the paper ball could reach as it falls to the floor is 5.5 m/s.

Show your working clearly.

[2]

(ii) John suggests that the speed of the paper ball can be calculated using:

$$\text{speed (m/s)} = \frac{1.5 \text{ metres}}{\text{time taken to fall (seconds)}}$$

The value calculated in part (c)(i) is too large.

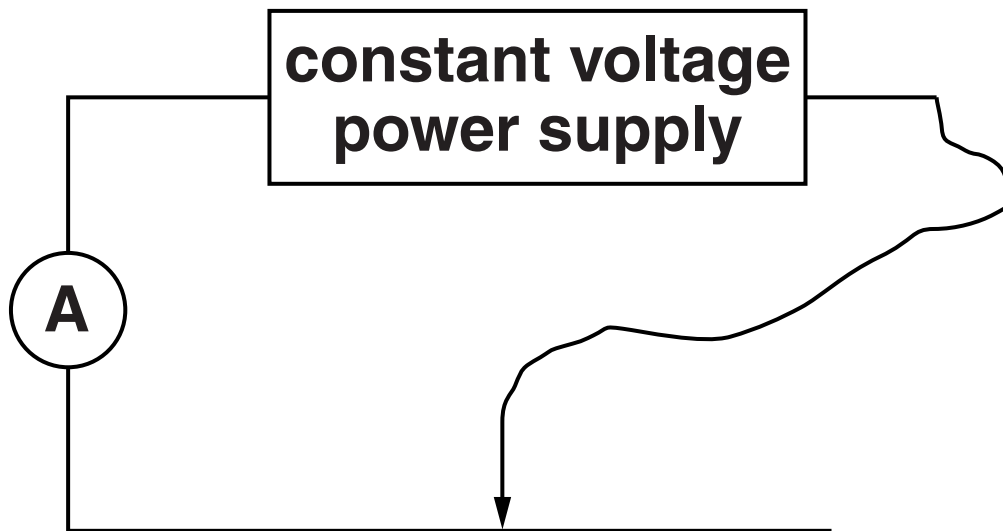John's calculated value is too small.

Explain why.

_____

_____

_____

_____

_____ [2]

[TOTAL: 7]

4 Diane investigates how the resistance of a wire changes with the length of wire.

She uses this circuit.
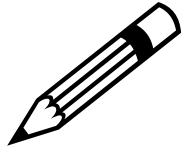
constant voltage power supply

A

Her results are on Insert C.

DIANE
I expected resistance to be proportional to length of wire. My graph does not show this. I noticed the wire got hot when it was short.

Discuss Diane's comments and explain the shape of her graph.

🖉 **The quality of written communication will be assessed in your answer.**

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

[TOTAL: 6]

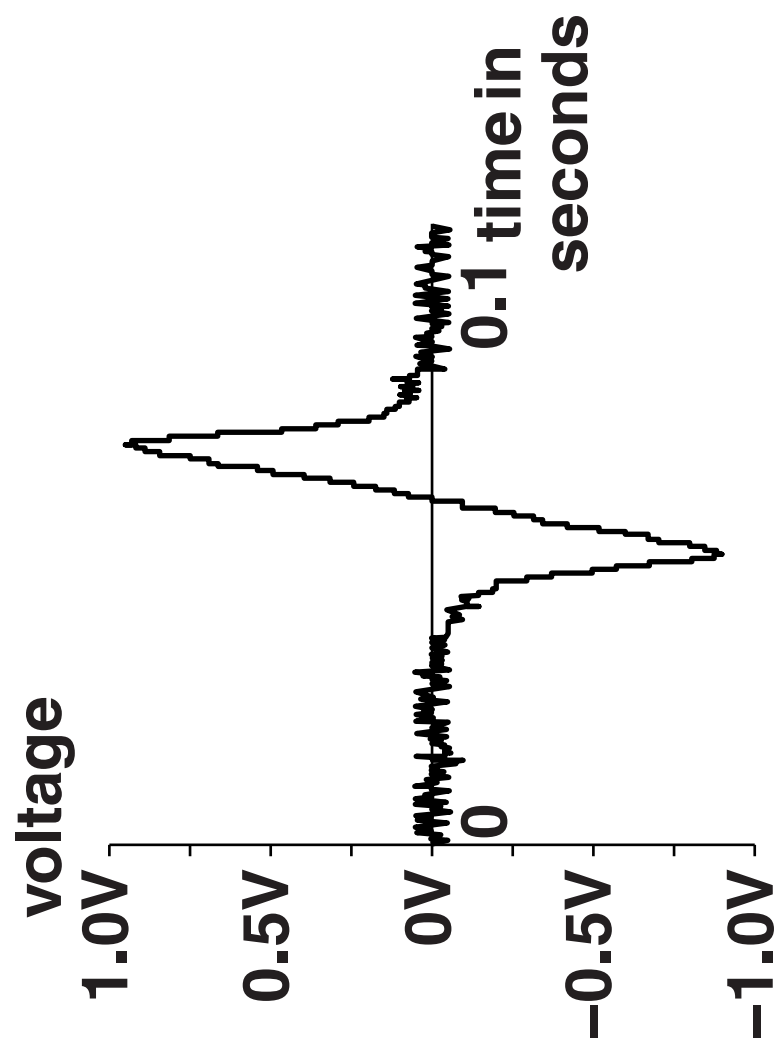**5** Ali does an experiment using a coil of wire and a magnet.
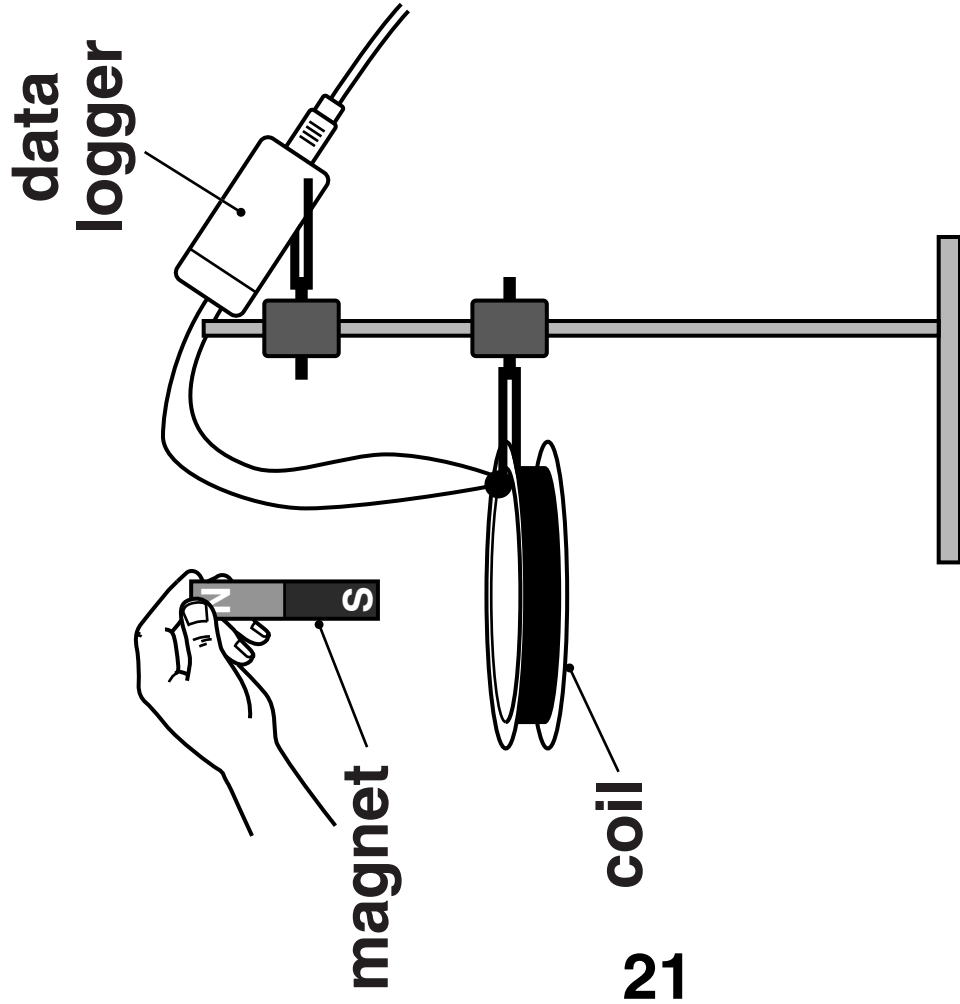
He connects the coil of wire to a data logger.

He then drops the magnet through the coil.

Ali displays the data as a graph showing how the voltage across the coil changes with time.

(a) Why is there a voltage across the coil?

_____

_____ [1]

voltage

1.0V

0.5V

0V

−0.5V

−1.0V

0.1 time in seconds

0

data logger

magnet

N   S

coil

21

(b) This effect described in part (a) is used in power stations to produce electricity.

Compare the electricity produced by a power station with the electricity produced in this experiment.

Use information from the graph.

_____

_____

_____

_____

_____ **[2]**

(c) The same effect is also used in transformers.

(i) What can transformers do?

Complete the sentence.

Draw **ONE** line to connect the correct **START** of the sentence to the correct **END** of the sentence.

START	END
Transformers can only increase the size …	**… of an alternating voltage.**
Transformers can only decrease the size …	**… of a direct voltage.**
Transformers can either increase or decrease the size …	**… of an alternating or direct voltage.**

[1]

(ii) The diagram below shows the basic construction of a transformer.

primary coil

secondary coil

iron core
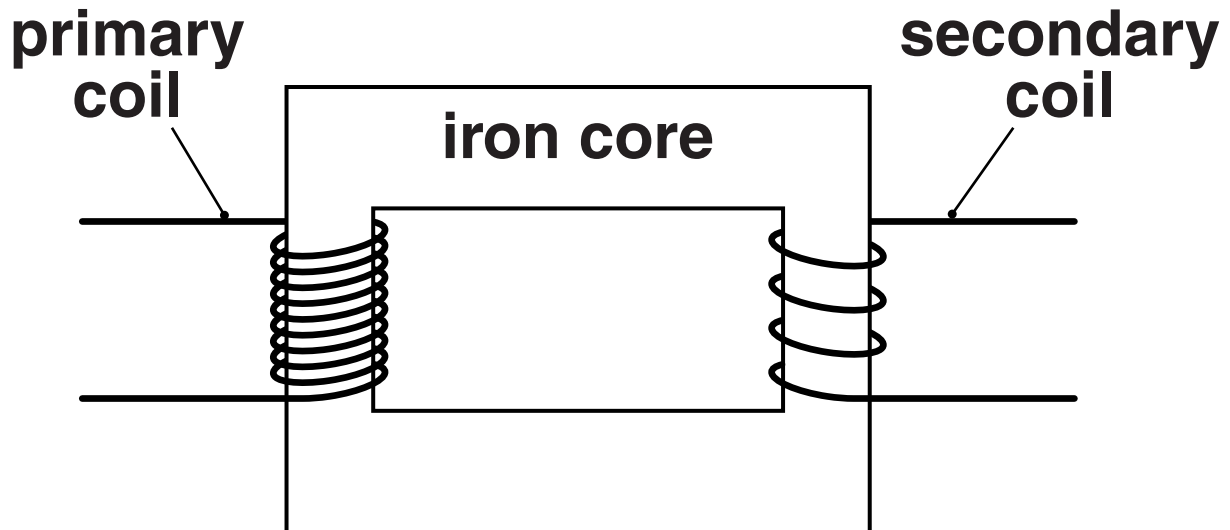
Complete the sentences opposite to describe how the transformer works.

Choose the correct letters from the list.

One of the letters will not be used.

P	changing voltage across the secondary coil
Q	changing current in the secondary coil
R	changing magnetic field in the core
S	constant magnetic field in the core
T	changing voltage across the primary coil
U	changing current in the primary coil

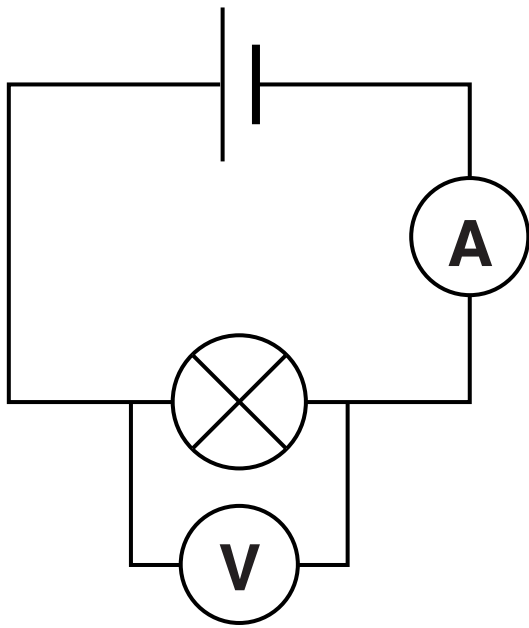A _____ causes a

_____ which causes a

_____ .

This will induce a

_____ which

causes a _____ .

[3]

[TOTAL: 7]

6 Jason sets up the following circuit.

(a) He measures the current and potential difference.

Draw a line from each QUANTITY to its best DESCRIPTION.

QUANTITY   DESCRIPTION

| the movement of electrons in the wires |

| current |

| the amount of energy transferred each second |

| the number of electrons in the wires |

| potential difference |

| the work done on the charge as it moves between two points |

| the total resistance of the circuit |

[2]

(b) Jason measured the voltage across the lamp to be 1.5V, and the current through it to be 0.5 A.

Draw a line from each QUANTITY to the correct VALUE.

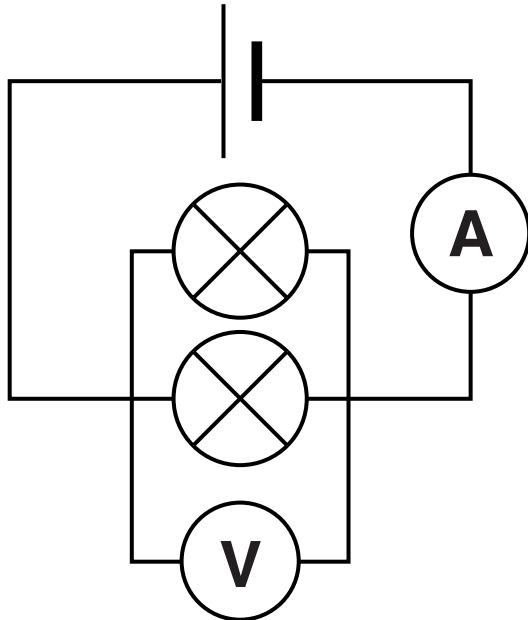| QUANTITY	VALUE
	0.33
power (W)	0.75
	1.00
resistance (Ω)	2.00
	3.00

[2]

(c) Jason adds another identical lamp to the circuit, in parallel with the first one.

State and explain what happens to the readings on the meters.

_____

_____

_____

_____ [3]

[TOTAL: 7]

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7 There are many arguments for and against nuclear power.

Some people are worried about the materials left over as waste from nuclear power stations.

(a) Three of the materials left over are caesium-134, technetium-99 and zirconium-93.

They have very different half-lives.

(i) What is meant by half-life?

_____

_____ [1]

(ii) The longer the half-life, the less active the radioactive isotope, for the same number of atoms.

Caesium-134 has a half-life of about 2 years.

Technetium-99 has a half-life of about 200 000 years.

Zirconium-93 has a half-life of about 1.5 million years.

Using this information, draw lines from each MATERIAL to its ACTIVITY and from each ACTIVITY to its TIME TAKEN TO BE CONSIDERED SAFE. Assume each material starts with the same number of atoms.

MATERIAL	ACTIVITY	TIME TAKEN TO BE CONSIDERED SAFE
caesium-134	least active	will take the shortest time to be considered safe
technetium-99	moderate activity	will take moderately long to be considered safe
zirconium-93	most active	will take the longest time to be considered safe

[2]

(iii) A scientist took a sample from a nuclear waste site and measured its activity.
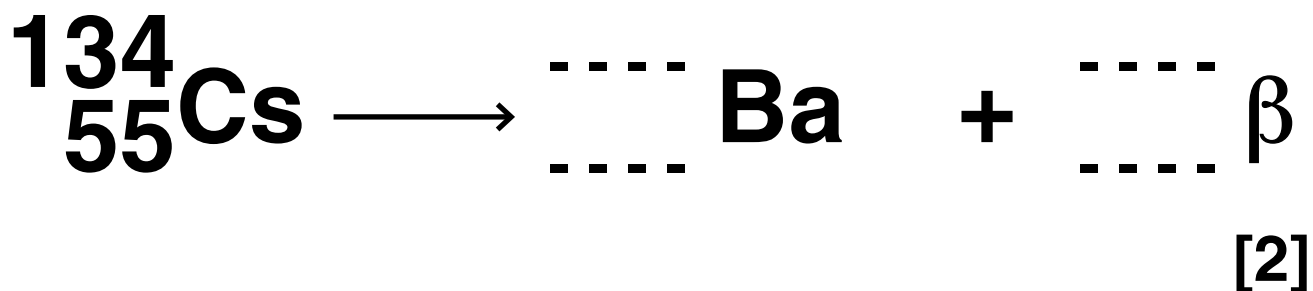
From his data, he generated this graph.

relative activity
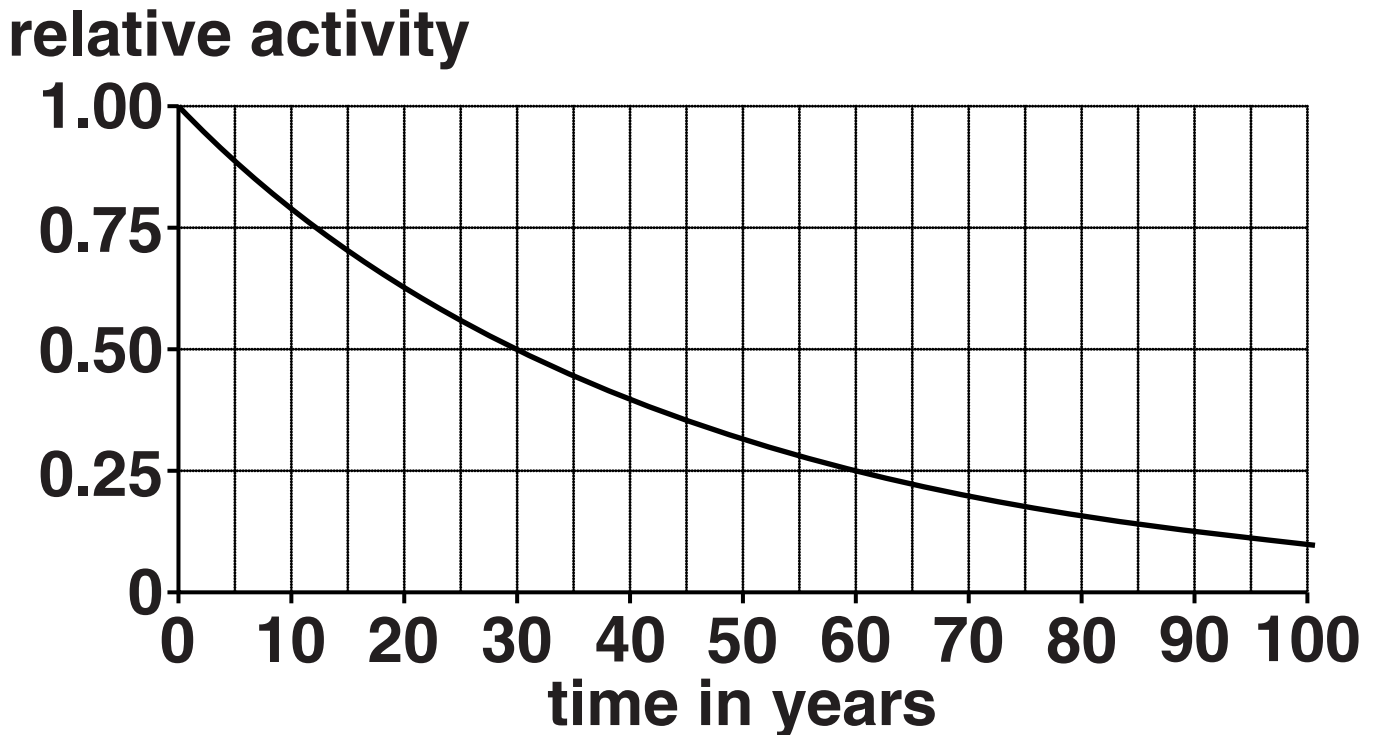
Use the graph to decide whether the sample could be one of the three isotopes given in part (ii), or a different isotope. Explain your decision.

_____

_____ [2]

(b) Caesium-134 decays by beta (β) decay.

Complete the nuclear equation for its decay.

$$^{134}_{55}\text{Cs} \longrightarrow \boxed{}\text{Ba} + \boxed{}\beta$$

[2]

(c) **Scientists are trying to decide how to store different samples of radioactive waste.**

Draw lines to link each PROPERTY to the related ISSUE and each ISSUE to the appropriate STORAGE SOLUTION (opposite).

PROPERTY	ISSUE	STORAGE SOLUTION
		most substances will shield this
emits alpha particles	highly penetrating	
		stored in containers under water
emits gamma rays	easily stopped	
		stored in lead or concrete
has a high activity	will be hot	
		must be stored securely for many years

[1]

37

(d) Radioactive sources are used in medicine.

Which of the following use radioactive sources?

Put ticks (✓) in the boxes next to each correct answer.

treating cancer ☐

sterilising surgical instruments ☐

using a tracer in the body ☐

using a vaccine ☐

using X-rays ☐

[1]

[TOTAL: 9]

8 Radon gas comes from the ground and emits alpha radiation.

The government has regulations about how buildings must be built.

Some of these regulations are about including protection against radon gas when a house is built.

(a) Why would radon gas in houses be dangerous to humans?

_____

_____

_____

_____

_____ [2]

(b) **The following chart shows the risk of cancer from exposure to different levels of radon gas.**

INDOOR RADON LEVEL	LIFETIME RISK OF CANCER
low	less than 1 in 200
medium	1 in 190
high	1 in 100

The building regulations insist that houses in high level radon areas have radon protection measures installed.

A politician proposes that people in areas with medium levels of indoor radon should also install the protection measures and that the government should pay for the change.

How would different groups of people be affected by this change?

_____

_____

_____

_____

_____ **[3]**

[TOTAL: 5]

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9 Zoe has a problem with her chest. Her doctor suggests that she has a series of CAT scans over a period of time.
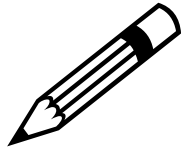
CAT scans do not use radioactive sources, but do produce ionising radiation.

Zoe researches CAT scans on the internet and finds the information shown on page 44.

RADIATION DOSE

dose received in a short period of time that causes symptoms of radiation poisoning — 0.4

lowest yearly dose clearly linked to increased cancer risk — 0.1

maximum yearly dose for hospital workers — 0.05

one chest CAT scan — 0.007

average yearly background dose — 0.004

dose in Sv
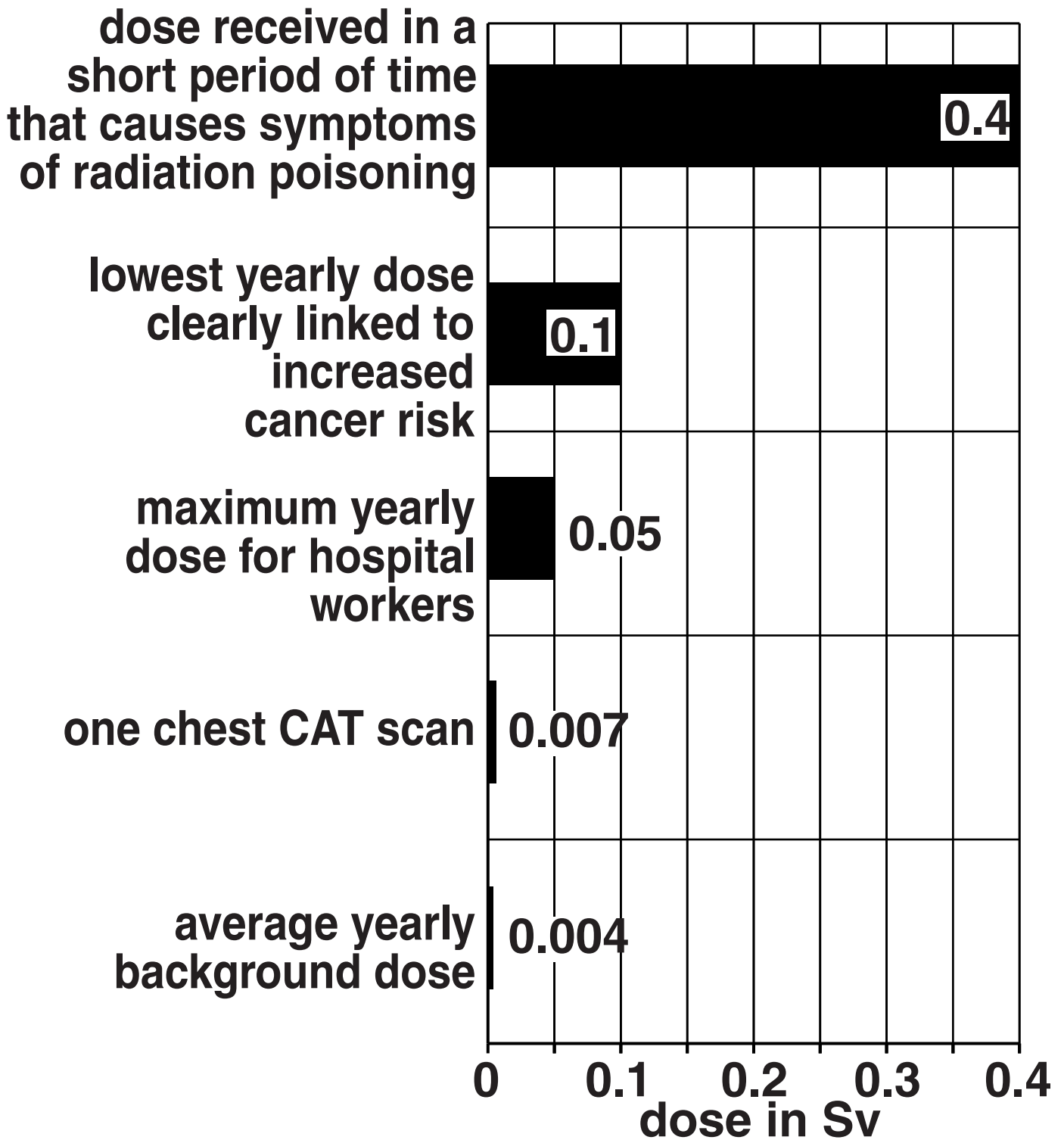
Use the data to help you discuss the issues that need to be thought about when Zoe makes a decision about whether or not to have the CAT scan.

🖊 **The quality of written communication will be assessed in your answer.**

_____

_____

_____

_____

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_____

_____

_____

_____ **[6]**

[TOTAL: 6]

END OF QUESTION PAPER

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