OCR RECOGNISING ACHIEVEMENT

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A182/02**

PHYSICS A

Unit A182: Modules P4, P5, P6 (Higher Tier)

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)

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- 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

- Your quality of written communication is assessed in questions marked with a pencil (✐).
- A list of useful relationships is printed on page **2**.
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**6**	
2	**6**	
3	**2**	
4	**4**	
5	**2**	
6	**6**	
7	**3**	
8	**3**	
9	**2**	
10	**6**	
11	**6**	
12	**3**	
13	**3**	
14	**3**	
15	**5**	
TOTAL	**60**	

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful Relationships

The Earth in the Universe

distance = wave speed x time

wave speed = frequency x wavelength

Sustainable Energy

energy transferred = power x time

power = voltage x current

efficiency = $\dfrac{\text{energy usefully transferred}}{\text{total energy supplied}}$ x 100%

Explaining Motion

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

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

momentum = mass x velocity

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

work done by a force = force x distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight x vertical height difference

kinetic energy = $\dfrac{1}{2}$ x mass x [velocity]^2

Electric Circuits

power = voltage x current

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

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

Radioactive Materials

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

SPECIMEN

Answer **all** the questions.

1 This question is about different journeys made in a lorry.
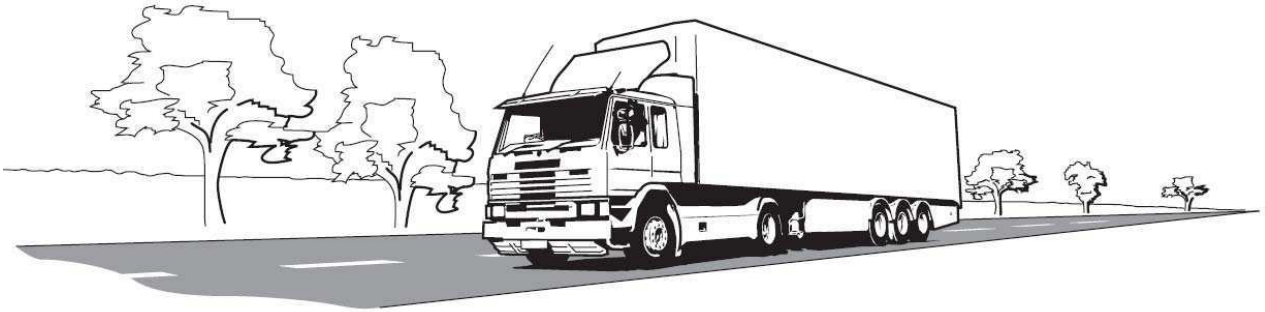
(a) The lorry is passing through a built up area where the speed limit is 14 m/s.

In 20 seconds, the lorry travels 250 metres.

(i) Calculate the speed of the lorry, and decide whether the lorry is within the speed limit.

speed = ... m/s

....

.... **[1]**

(ii) Here is the distance-time graph for 250 metre part of the journey.
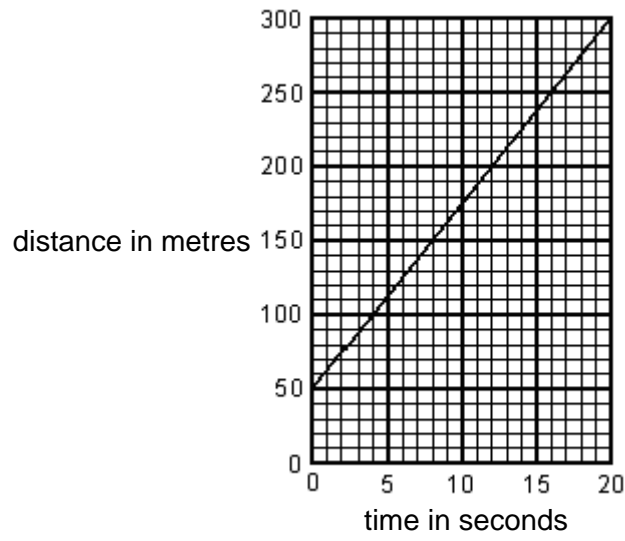
Explain how the graph increases your confidence in your decision about whether the lorry is within the speed limit.

....

....

.... **[2]**

(b) The lorry is fitted with a speed limiter.

This sets its maximum speed to 25 m/s.

The lorry is driven down a test track to test the speed limiter.

Here are six measurements, taken on two successive days.

day	trial number	measured speed
one	1	24.7 m/s
	2	25.2 m/s
	3	24.9 m/s
two	4	24.8 m/s
	5	24.2 m/s
	6	24.5 m/s

Day two was much colder than day one.

Did this make any difference to the results?

Use calculations to justify your answer.

....

....

.... **[3]**

[Total: 6]

2 Buzz is an astronaut.

He is in space far away from the Sun or any planets, repairing the outside of his spacecraft.

He uses small rocket boosters on his space pack to move about.

small rocket
boosters

Explain how the rockets move him from one end of the spacecraft to the other.

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

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.... **[6]**

[Total: 6]

3 This question is about car safety features.
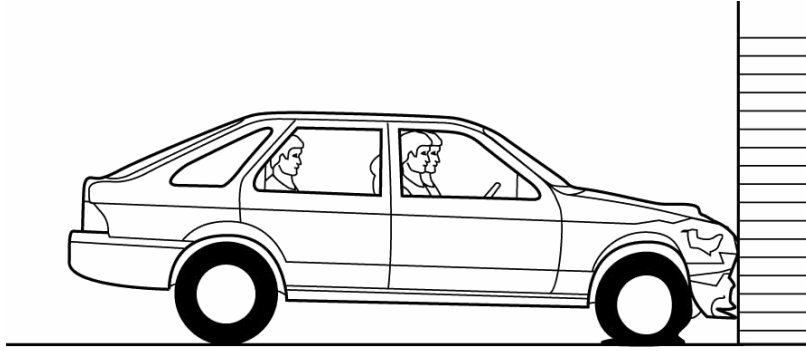
During safety tests a car of mass 1200 kg is crashed into a wall at a speed of 20 m/s.
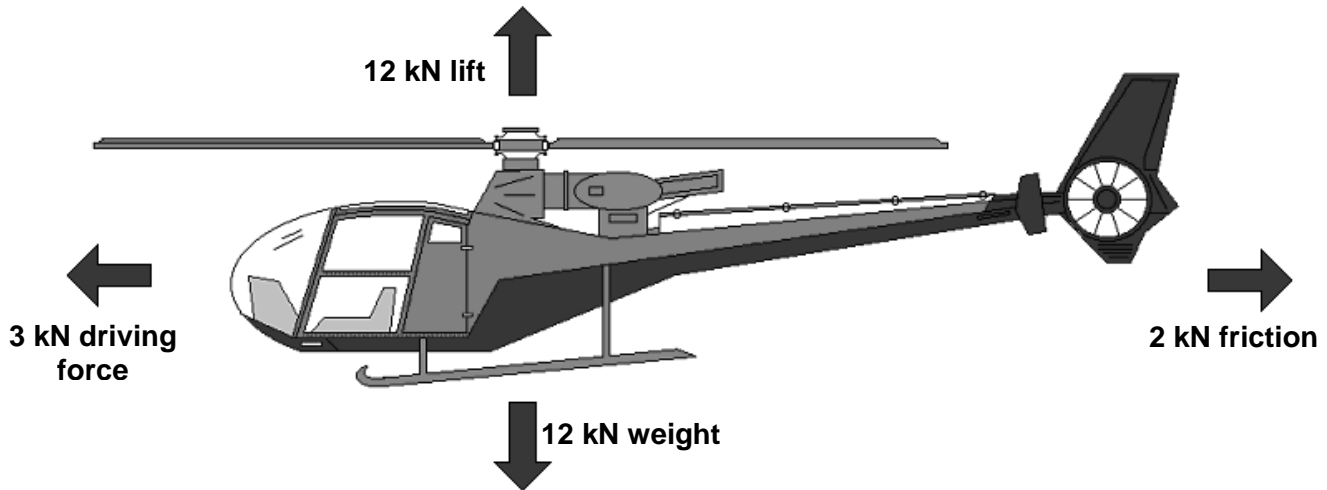
The collision stops the car.

This takes a time of 1.2 seconds.

Calculate the force exerted by the wall to stop the car.

force = ... N **[2]**

[Total: 2]

4   The diagram shows the forces acting on a helicopter in level flight.

12 kN lift

3 kN driving force

2 kN friction

12 kN weight

(a)   Describe the resultant force acting on the helicopter.

....

....**[2]**

(b)   Which of these quantities will be increasing for the helicopter?

Put rings around the **two** correct answers.

height

weight

momentum

kinetic energy

gravitational potential energy

[2]

[Total: 4]

5 Paul is a taxi driver in town.

I don't go fast enough to need a seat belt ... I can always use the steering wheel to stop me if I crash.

(a) How would a seatbelt help Paul if he had a crash?

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

A seatbelt increases the counterforce on him in a crash. ☐

A seatbelt transfers less energy to him as the car slows down. ☐

A seatbelt increases the time it takes for him to slow down in a crash. ☐

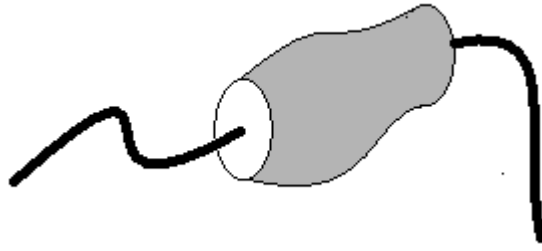A seatbelt reduces the amount of momentum he needs to lose in a crash. ☐

[1]

Turn over

(b) Paul's momentum is 900 kg m s^{-1} when he is travelling at 50 kph.

He slams on the brakes and stops the car in 3.0 s, moving a distance of 18 m.

Which is the correct distance-time graph for Paul as he stops?
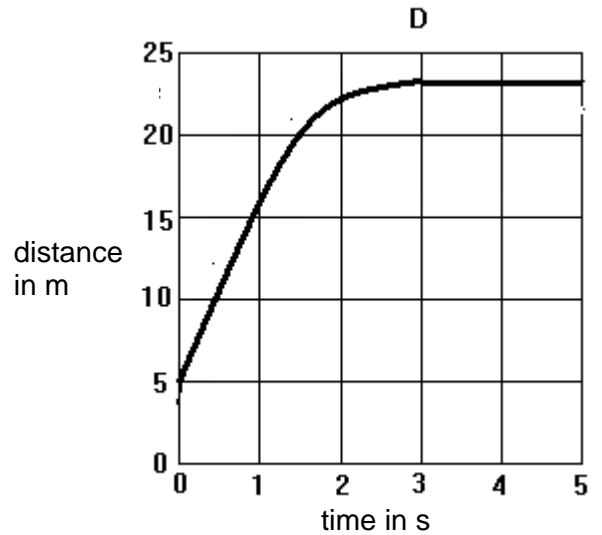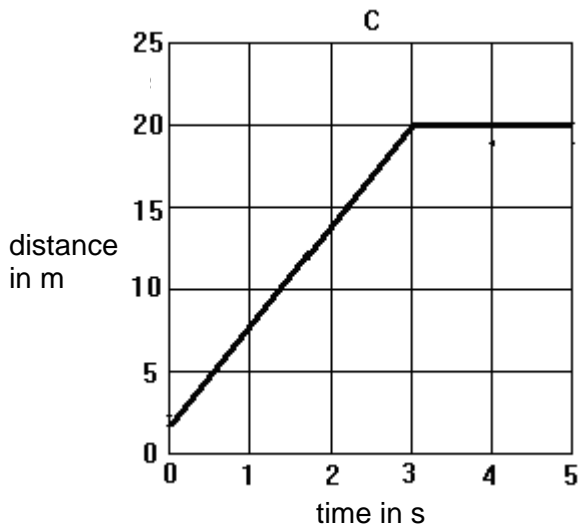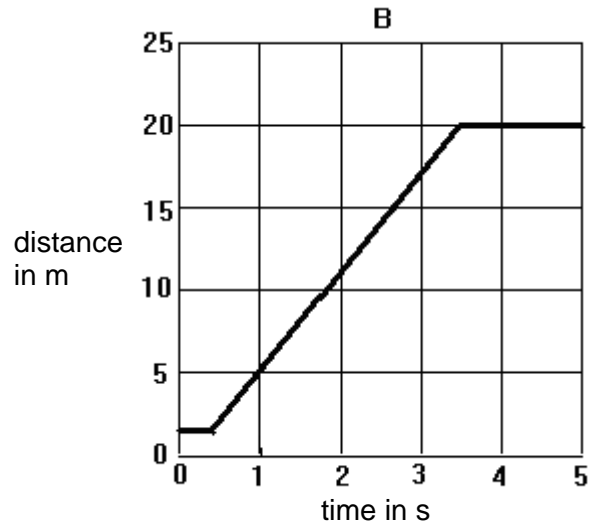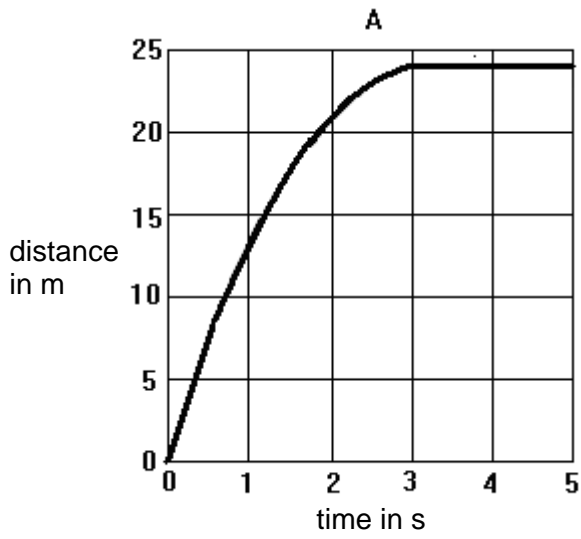
answer graph ....[1]

[Total: 2]

6 Jeff investigates a new component.

He connects it to three different batteries, measuring the current and voltage each time.

Here are his results.

voltage in volts	current in amps	resistance in ohms
2.8	0.70	
5.9	1.2	4.9
12	1.8	

(a) Complete the table by filling in the two missing values for resistance.

[1]

(b) Jeff says that any changes in the resistance are caused by changes in the current.

Explain whether Jeff's explanation is supported by the results.

....

....

....

....[2]

(c) Jeff decides to take some more measurements to test his idea.

He asks his colleagues for advice.

Alan

Repeat the experiment many times with the same batteries.

Bess

Repeat the experiment with a wider range of voltages.

Carlos

Do the experiment again with the component at a constant temperature.

Davina

Plot the results on a graph to find the outliers.

Who has the best advice?

answer ....[1]

(d) After making more measurements, Jeff decides that there is enough evidence to say that the resistance of the component depends on its current.

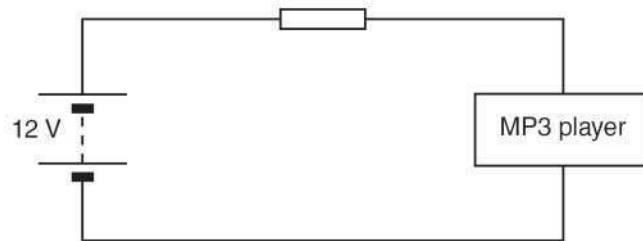Explain what he needs to do before publishing his theory.

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.... **[2]**

[Total: 6]

7 Jo likes to listen to her MP3 player.

She uses this circuit to connect her MP3 player to a 12 V battery.

(a) Here are some data about the MP3 player.

electrical property	value
operating power	0.45 W
working voltage	3.0 V
current	

Complete the table by filling in the empty box.

[2]

(b) The battery supplies a potential difference of 12 V for the circuit.

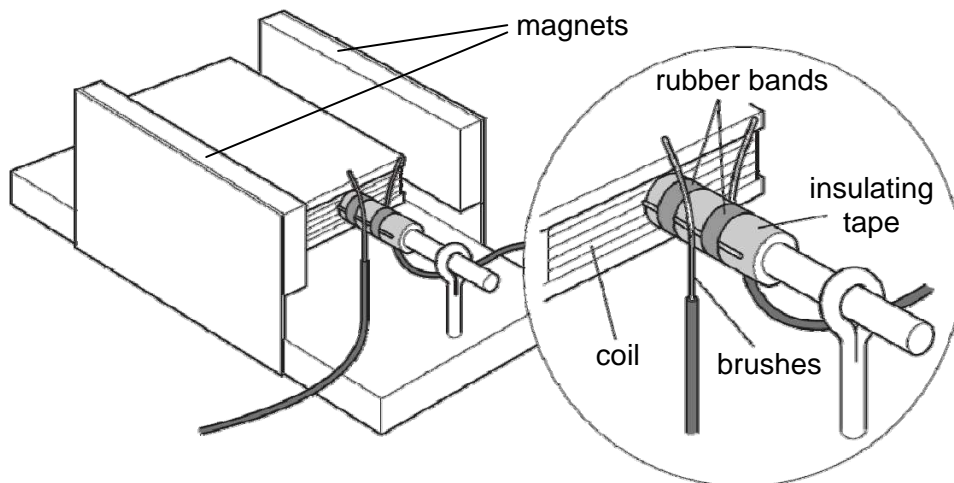The potential difference across the MP3 player is only 3 V.

What is the potential difference across the resistor?

potential difference = ………………………… **V**   [1]

[Total: 3]

8 Here is a diagram of a simple electric motor.

The motor is made of a coil of wire that is suspended between a pair of magnets.

The coil starts off in a horizontal position, as shown in the diagram.

The close-up shows the electrical contacts (labelled 'brushes').

When a potential difference is applied to the brushes, the coil rotates.

Select 3 statements from the list below, which when taken together, help to explain how this motor works.

A When the coil rotates it generates a potential difference.

B When the coil is connected to the brushes there will be a current flowing in the coil.

C The current in the coil exerts a force on the magnets which makes it move.

D A voltage will produce a current in the wire when there is a complete circuit.

E A current carrying conductor will always experience a force.

F The resistance of the wire in the coil reduces the current passing through it.

answer .... and .... and .... **[3]**

[Total: 3]

9 A generator is made using a magnet which spins near a coil of wire.

The generator produces a changing voltage.

(a) Which of the following words describes this process?

Put a (ring) around the correct answer.

deduction   **formation**   **induction**   **reduction**   **transformation**

[1]

(b) The graph shows how the voltage produced by the generator changes with time when the magnet spins at a particular speed.
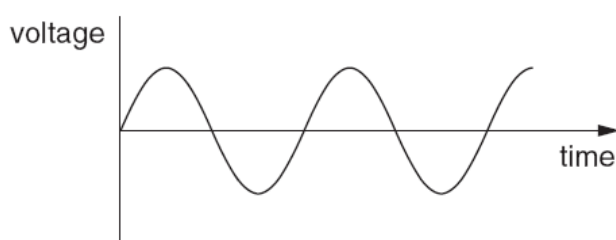
The following graphs all have the same scales as the graph above.
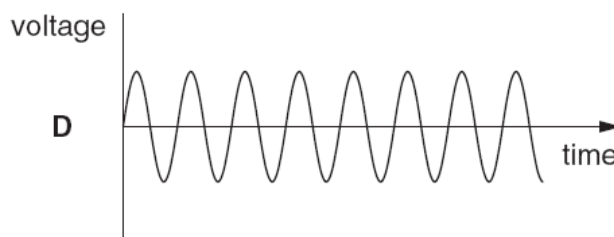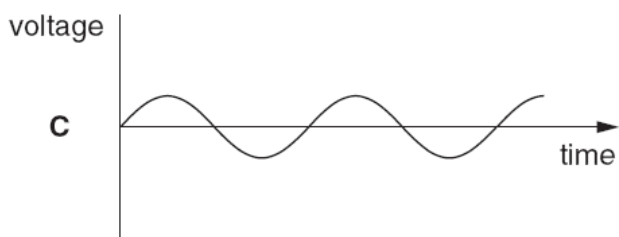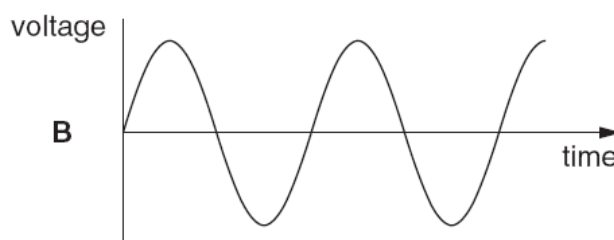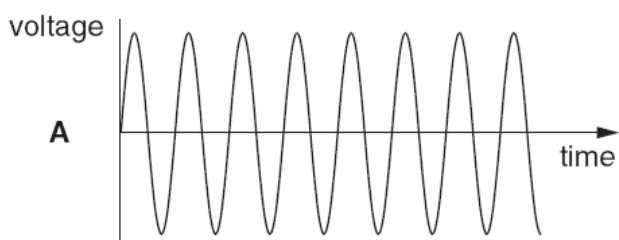
Which graph shows what happens when the magnet is spun round **faster**?

answer .... **[1]**

[Total: 2]

10 Bill assembles this circuit.
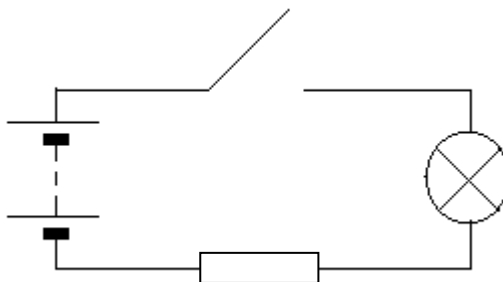
Explain why the lamp glows when Bill presses the switch.

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

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....**[6]**

[Total: 6]

11 A nuclear reactor produces radioactive materials for use in hospitals. The radioactive materials are used to treat patients.

Identify the different types of radioactive waste generated by the production and use of these radioactive materials and describe how the waste should be dealt with.

✎ *The quality of written communication will be assessed in your answer to this question.*

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.... **[6]**

[Total: 6]

12 Hospitals use a generator containing a radioactive substance called Mo – 99 to make an isotope called Tc – 99 m.

Mo – 99 has a half life of 66 hours.

Tc – 99 m has a half life of 6 hours.

The technician tests a sample from the generator to find out what it contains.

He measures its activity at seven different times.

Here are the results.

time of measurement	activity of sample in Bq
08:00 h	5624
10:00 h	4603
12:00 h	3740
14:00 h	3078
16:00 h	2598
18:00 h	2083
20:00 h	1757

What does the sample contain? Use the data from the table to justify your answer.

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....**[3]**

[Total: 3]

SPECIMEN

13 Read the newspaper article about a new treatment for breast cancer.

> **New treatment for breast cancer**
>
> The cancer is cut out by the surgeon. Then a radioactive rod is placed in the wound by the radiographer. Ionising radiation from the rod kills any cancer cells that the surgeon has missed. After a few hours the rod is removed and the wound is stitched up. No further treatment is needed.

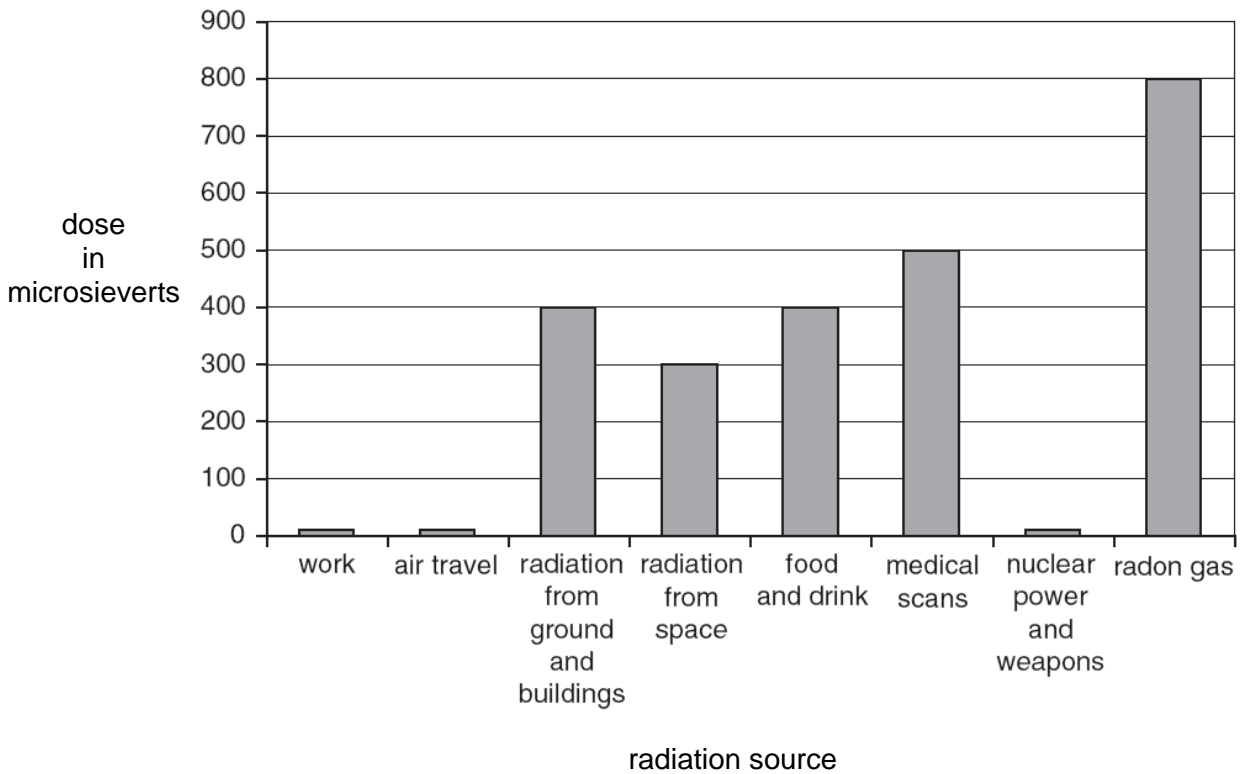Discuss the risks and benefits of the new treatment to **all** the people involved.

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....**[3]**

[Total: 3]

14 The bar chart shows the typical yearly radiation dose for a person in Britain from different sources.

(a) Radon gas provides the largest percentage of the total yearly dose of radiation.

What percentage of the total yearly dose comes from radon gas?

Write down your answer to the nearest whole number.

answer = …………… % **[1]**

(b) The total for all sources is 2430 microsieverts.

Which of the following statements are correct conclusions **from the bar chart**?

Put ticks (✓) in the boxes next to the **two** correct statements.

Not everyone will have medical scans. ☐

Radon gas provides more than half the total dose. ☐

The fraction of dose received from nuclear power stations is very small. ☐

The dose from radon gas will be different in different parts of Britain. ☐

The dose from food and drink is less than a quarter of the total dose. ☐

[2]

[Total: 3]

15 Read the article about nuclear power stations.

Nuclear power stations use uranium as a fuel.

Energy is released from the uranium by the process of nuclear fission.

Some people object to nuclear power stations because they produce radioactive waste.
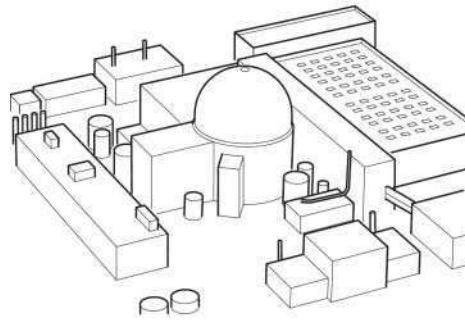
(a) The nuclear fission process needs to be controlled to release the energy safely.

The following statements describe this control process. They are in the wrong order.

A   Coolant is used to carry the heat energy away from the reactor.

B   More neutrons are released.

C   The uranium undergoes fission.

D   Neutrons in the reactor collide with uranium.

E   Some of these neutrons are absorbed by control rods.

Fill in the boxes to show the correct order. One has been done for you.

				A

[2]

(b) The process of nuclear fission can continue unaided once it has started.

Write the name for this type of reaction.

....[1]

(c) A nuclear power station has to release 4.5×10^7 J of energy to provide one person with their daily electricity needs. Use the formula $m = \dfrac{E}{c^2}$ to calculate the mass of fuel which must be lost to provide this energy.

$c = 3.0 \times 10^8$ m/s

mass of fuel lost =..................................... kg **[1]**

(d) The maximum annual risk of developing cancer from exposure to radiation for a worker in a nuclear reactor is 0.1%. This is approximately 40 times greater than the annual risk for a member of the public.

Why might this increased risk not be seen as a problem for the owners of the power station?

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

The owners are not required to consider the safety of their workers. ☐

The risk to a worker would still be very low. ☐

The owners supply their workers with protective clothing. ☐

The power stations are normally built far from major centres of population. ☐

[1]

[Total: 5]

[Paper Total: 60]

END OF QUESTION PAPER

23

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