WJEC GCSE PHYSICS

PHYSICS



EXAM QUESTION PACK

UNIT P3 FOUNDATION TIER 0247 PAPERS

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0247/01

SCIENCE
FOUNDATION TIER
PHYSICS 3

A.M. WEDNESDAY, 30 January 2013

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**3**	
2.	**4**	
3.	**2**	
4.	**4**	
5.	**6**	
6.	**3**	
7.	**5**	
8.	**4**	
9.	**4**	
10.	**5**	
11.	**5**	
12.	**5**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.
A list of equations is printed on page 2. In calculations you should show all your working.

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EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

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

$$a = \frac{v - u}{t}$$

$$x = \frac{1}{2}(u + v)t$$

where u is the initial velocity
v is the final velocity
a is the acceleration
t is the time
x is the distance travelled

momentum = mass × velocity

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Answer **all** *questions.*

1. When an earthquake occurs, two types of seismic waves, P and S travel through the Earth. Tick (✓) the boxes that contain true facts about S waves. [3]

A transverse wave	
A longitudinal wave	
Can travel through solids	
Can travel through liquids	
Travel slower than P waves	
Travel faster than P waves	

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3

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2. Draw a labelled diagram of a $^{7}_{3}Li$ atom to show the number and arrangement (or position) of the protons, neutrons and electrons.

Use the following key for your diagram:

- ● proton
- ○ neutron
- × electron [4]

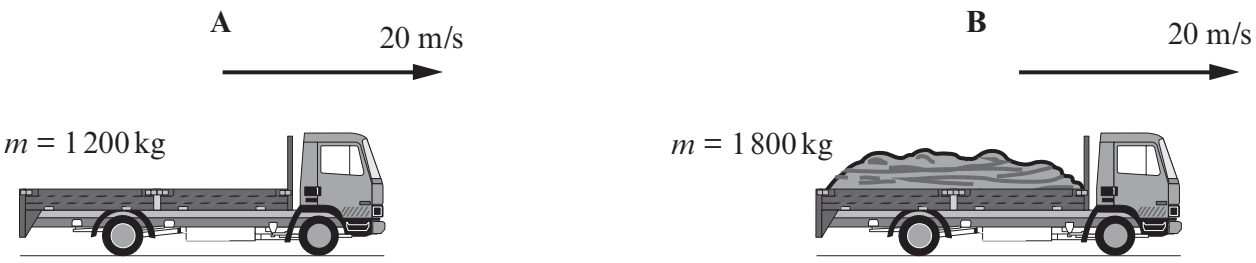
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3. The diagram gives information about two lorries, **A** and **B**, coming to rest under the action of the **same braking force**.



Use information from the diagram to:

(i) calculate the change in momentum of lorry **A** when it is brought to rest; [1]

momentum = mass × velocity

Change in momentum of **A** = ... kg m/s

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(ii) Give a reason why **B** will take longer than **A** to be brought to rest under the same braking force. [1]

.....

.....

2

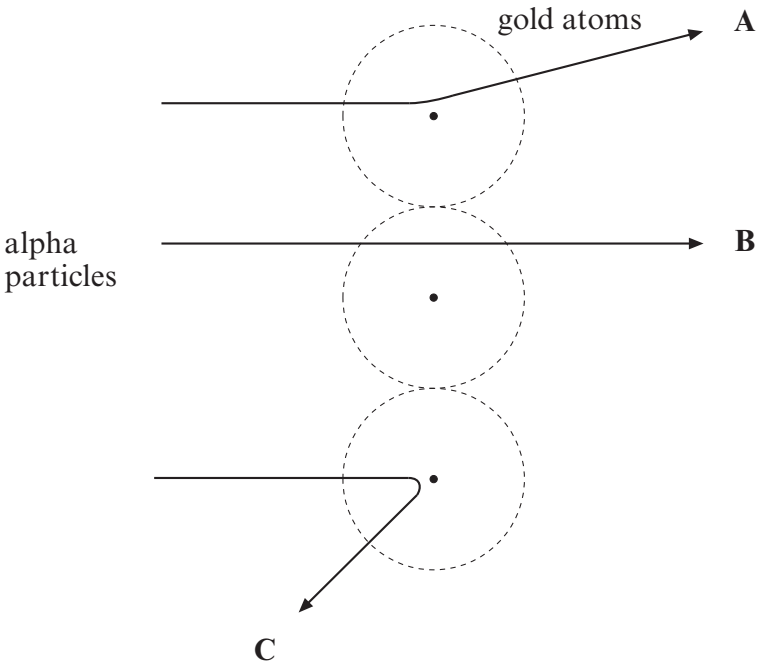
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4. In the Rutherford alpha particle scattering experiment, alpha particles were passed through thin gold foil.
The results showed that many alpha particles passed straight through (like alpha particle **B** in the diagram). Some alpha particles were deflected through small angles (like alpha particle **A**). Very few alpha particles were deflected by a large angle (like alpha particle **C**).



Complete the sentences below by using a word or phrase from the box. Each word or phrase may be used **once**, **more than once or not at all**. [4]

	orbit	neutron	solid	**A**
nucleus	proton	empty space	**B**	**C**

(i) The fact that most alpha particles follow path ..... shows that most of the atom is ..... .

(ii) The fact that a small number of alpha particles follow path ..... shows that a positive charge exists in the ..... .

4

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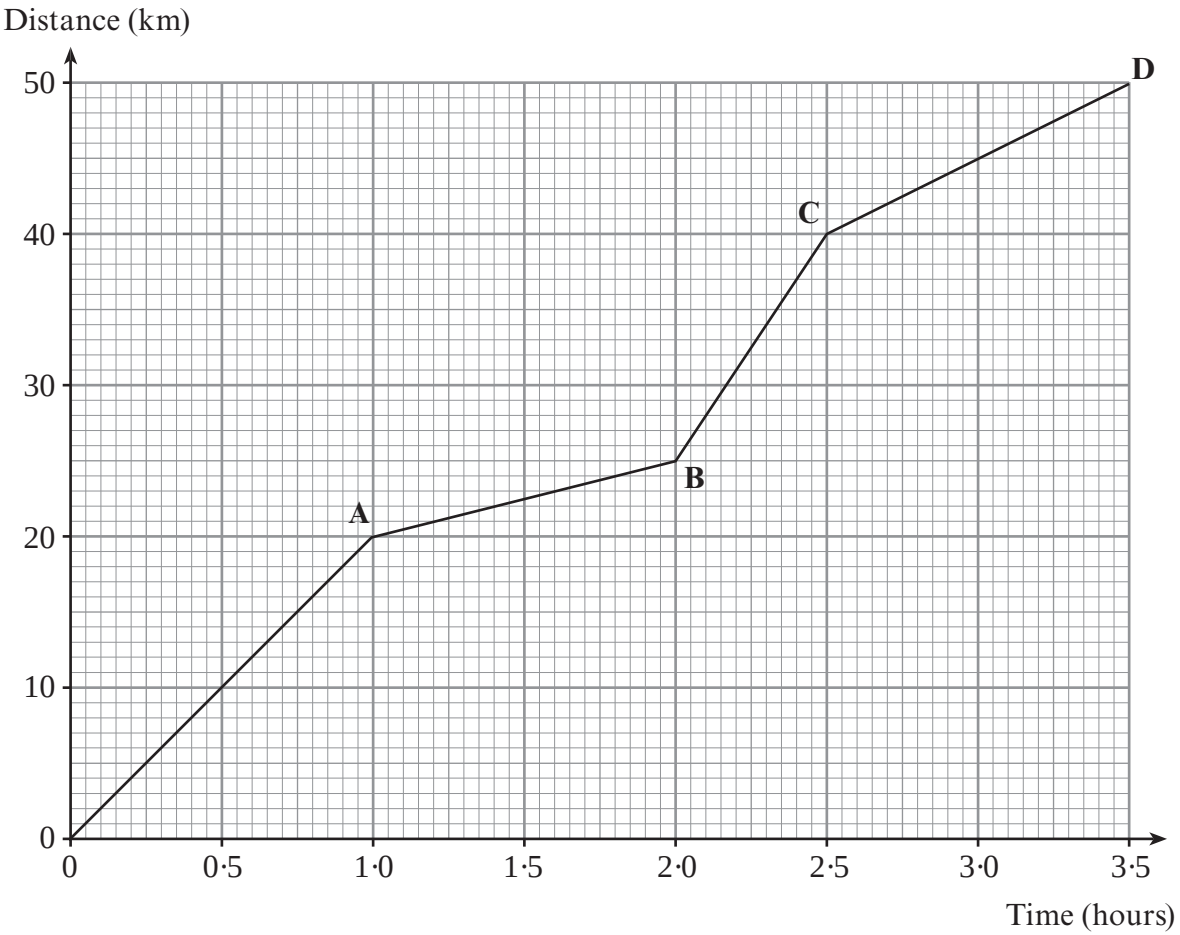
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5. A cyclist takes part in a 50 km race.
Part of the race requires the competitors to cycle **up a very steep mountain** and **down the other side**.
The graph shows the motion of the cyclist during the race.



(a) The speed of the cyclist is the gradient of the line.

(i) Over which region **OA**, **AB**, **BC**, **CD** did the cyclist travel at his greatest speed? [1]

.....

(ii) Give a reason for your answer to *(a)*(i). [1]

.....

(iii) Explain why point **B** is most likely to be the top of the mountain. [2]

.....

.....

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(b) Use the equation:

$$\text{mean speed} = \frac{\text{total distance}}{\text{time}}$$

to calculate the cyclist's mean speed for the race. [2]

Mean speed = ... km/h

6

6. *(a)* State **two** differences between nuclear fission and nuclear fusion. [2]

.....

.....

.....

.....

(b) Give **one** reason why it is difficult to achieve controlled nuclear fusion on Earth. [1]

.....

.....

3

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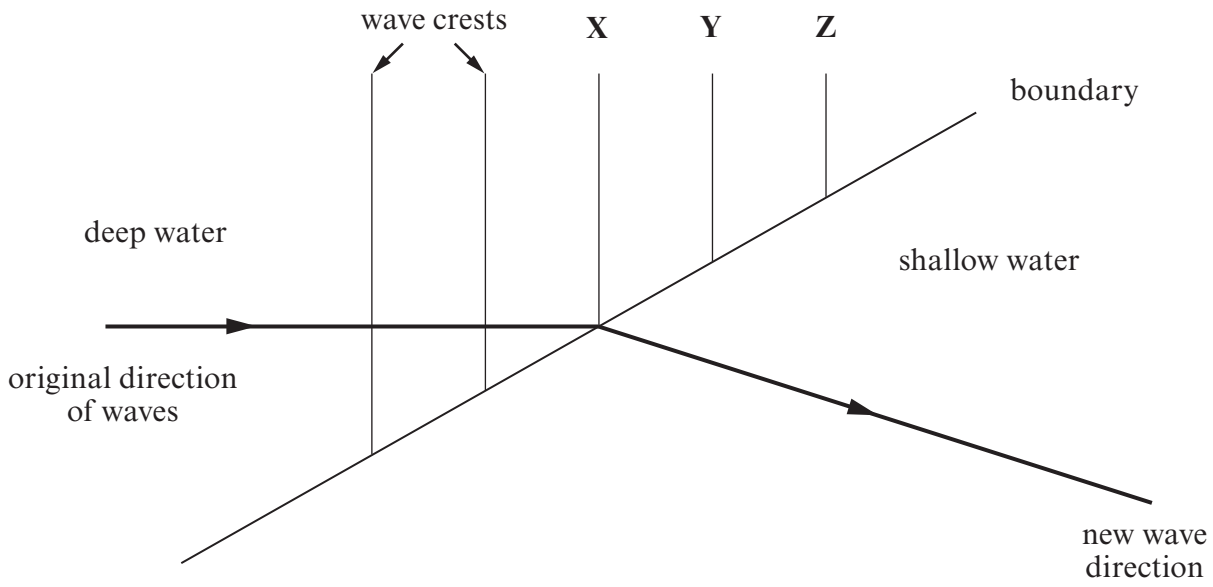
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7. The diagram below shows the crests of water waves in a ripple tank moving from deep to shallow water.



(a) **Complete the diagram** to show the crests of waves **X**, **Y** and **Z** in the shallow water. [2]

(b) As the wave moves into the shallow water the direction changes. What name is given to this change of direction? ..... [1]

(c) Complete the following sentences by underlining the correct word or phrase in the brackets.

(i) When the wave passes into shallow water the wavelength **(increases / decreases / stays the same)**.

(ii) When the wave passes into shallow water the speed of the wave **(increases / decreases / stays the same)**. [2]

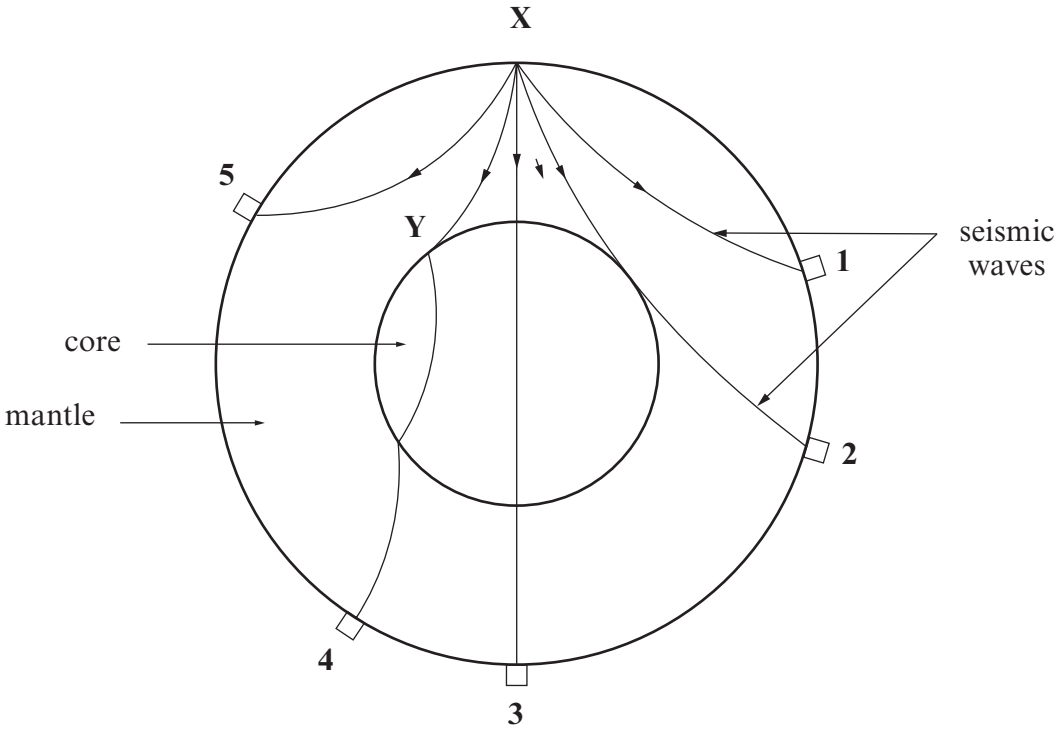
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8. The diagram below shows a cross-section of the Earth. An earthquake occurs at **X** and detectors **1**, **2**, **3**, **4** and **5** pick up seismic waves.



(a) (i) State which detectors pick up both P and S waves. .....

(ii) Explain why the P waves always arrive before the S waves at the detector.

.....

.....

(iii) Give a reason why detector **5** is likely to be the first to detect the earthquake.

.....

.....

[3]

(b) Give a reason why there is a change in direction of the seismic wave when it passes from the mantle to the core at **Y**. [1]

.....

.....

4

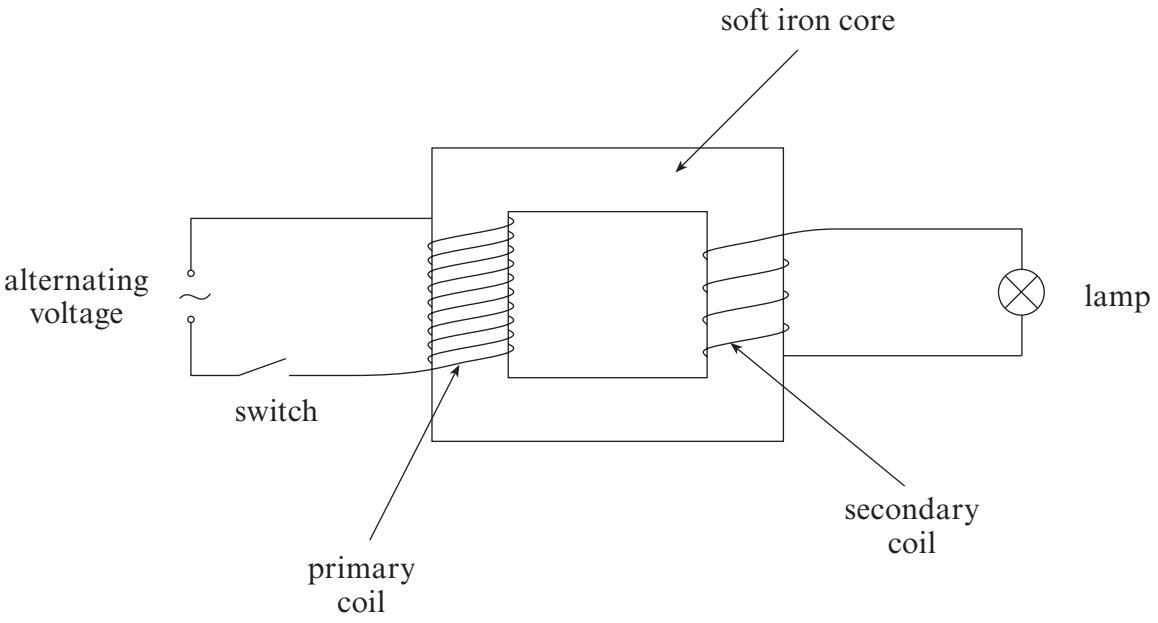
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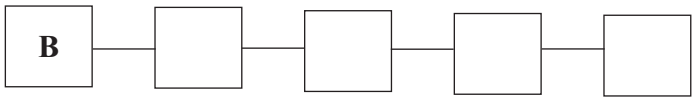
9. The diagram represents a transformer.
The lamp lights, when the switch is closed.



(a) The following sentences, **A** to **E**, describe how the transformer works.
The sentences are in the wrong order.

A	A changing magnetic field is also produced in the soft iron core.
B	When the primary circuit is switched on, an alternating current flows through the primary coil.
C	An alternating current is induced in the secondary coil and the lamp lights.
D	The changing field in the iron core links with the secondary coil.
E	A changing magnetic field is produced in the primary coil.

Arrange the sentences in the right order, starting with **B**.
Show your order in the boxes below. [3]



(b) How can you tell that the transformer shown in the diagram is a step-down transformer? [1]

.....

.....

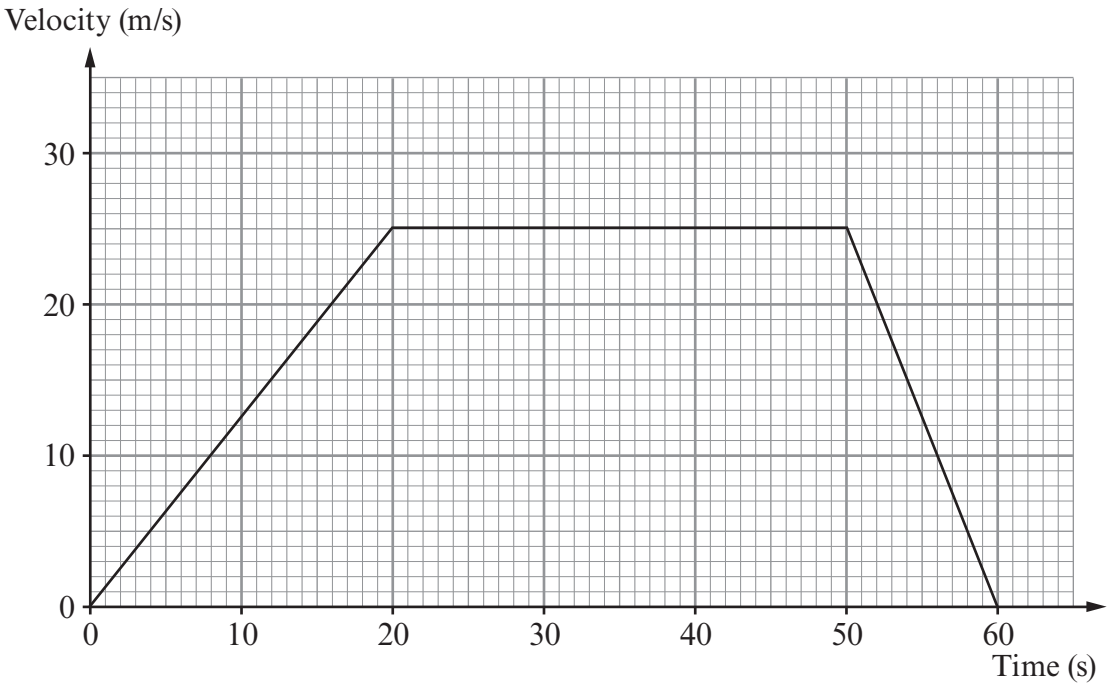
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10. The graph shows part of the motion of an underground train as it travels from one station to the next station.



(a) The acceleration/deceleration is the gradient of the appropriate line of a velocity-time graph. Calculate the deceleration of the train. [2]

Deceleration = ... m/s^2

(b) The distance travelled is the area under the line of a velocity-time graph. Calculate the distance travelled when the train was accelerating. [2]

Distance travelled = ... m

(c) State how the graph shows that the train travelled further in the last 30 s of its motion than in the first 30 s of its motion. [1]

.....

.....

5

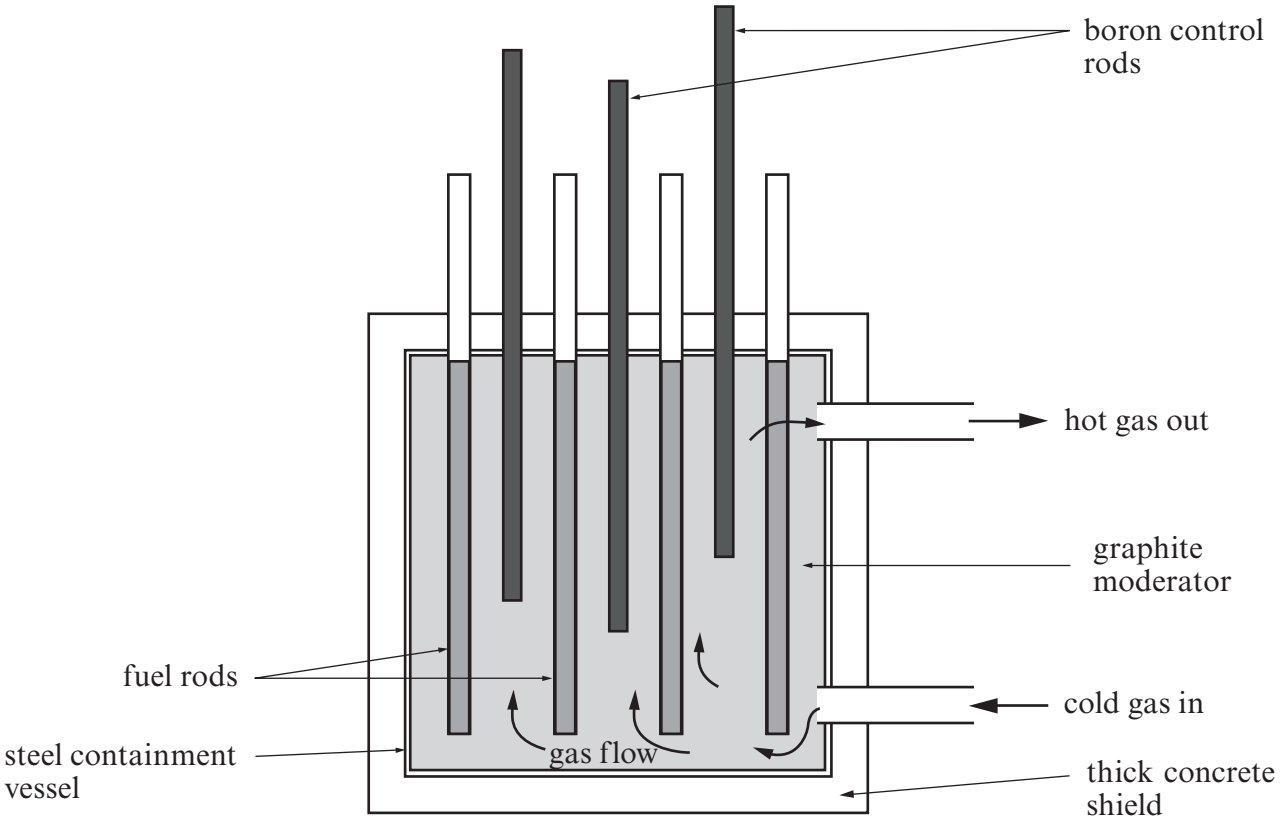
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11. Read the information in the passage and look carefully at the diagram before answering the questions that follow.

The diagram shows the important parts of the core of a gas-cooled nuclear reactor.



The fuel rods used in the core of a gas-cooled reactor are made of U-238 (Uranium-238) enriched with 3% of U-235 (Uranium-235). Only U-235 undergoes fission. Its atoms capture slow moving neutrons and split to produce two new radioactive nuclei and up to three new fast moving neutrons.

The fuel rods are surrounded by graphite which slows down the fast moving neutrons to allow more fission to take place.

Boron rods, which readily absorb neutrons, can be raised or lowered into the core and enable the rate of fission to be controlled.

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(a) (i) What causes U-235 to undergo fission?

.....

.....

(ii) Explain why graphite is important to the fission process.

.....

.....

.....

[3]

(b) Describe the effect that lowering the boron control rods into the core has on the output from the reactor. [2]

.....

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.....

.....

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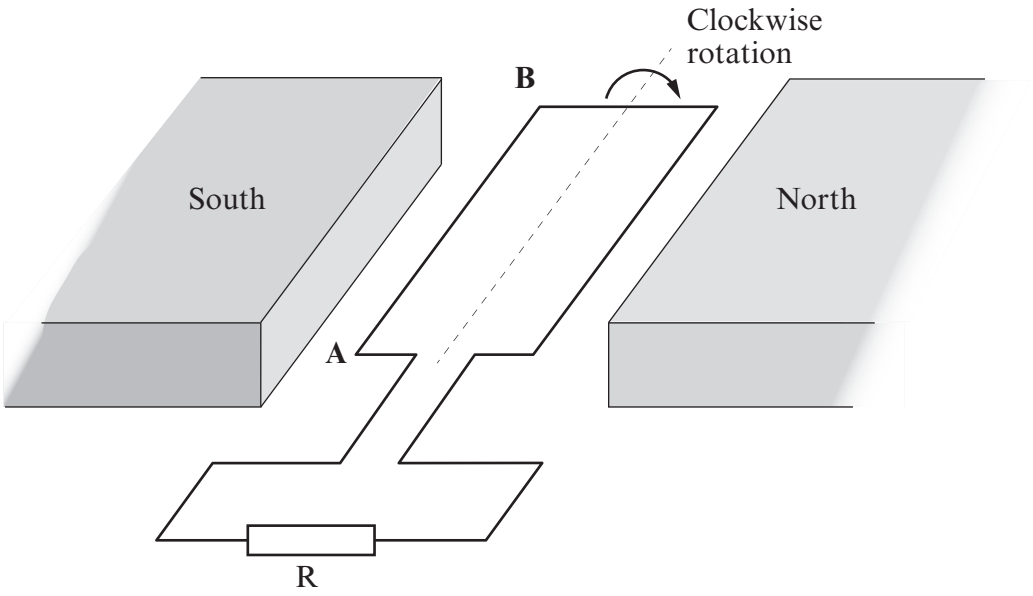
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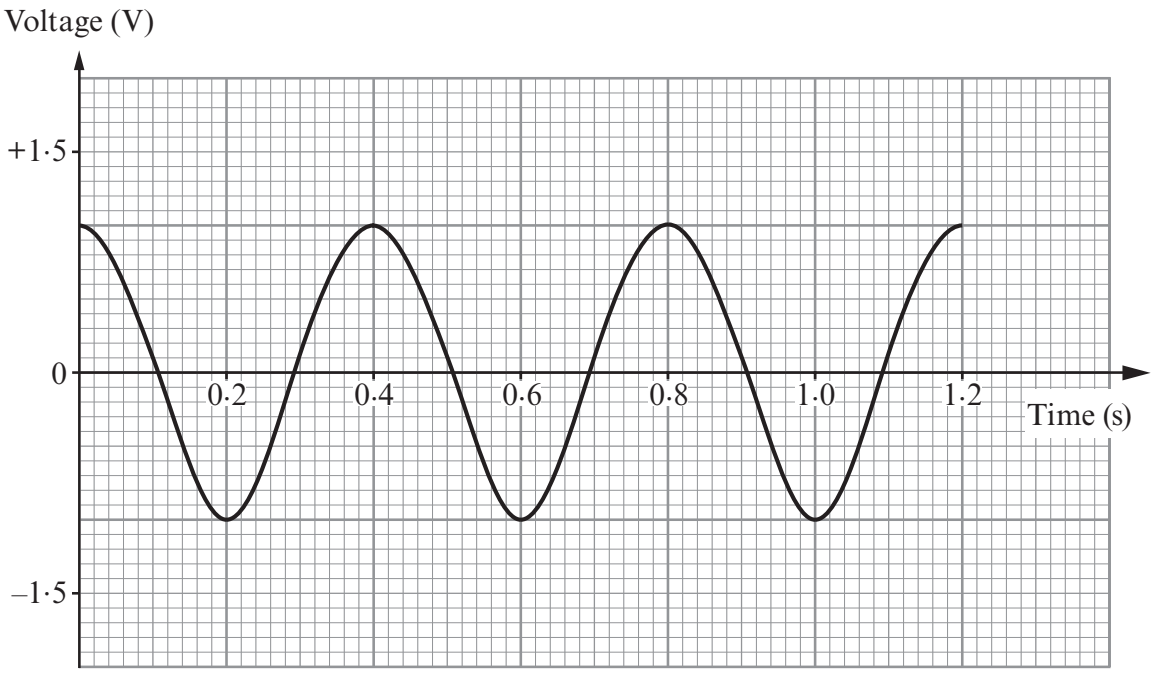
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12. The diagram shows a simple a.c. generator. It consists of a single coil which is rotated at constant speed in a magnetic field.



As the coil rotates, it 'cuts through' the magnetic field lines producing a voltage which drives an alternating current through the coil and the resistor R.

The graph below shows how this voltage varies with time.



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(a) Use the graph to find the time taken to make one complete rotation of the coil. [1]

Time = ... s

(b) Use Fleming's right hand rule to **mark on the diagram** the direction of the current through **AB** when the coil is moving through the position shown. [1]

(c) Complete the table below to state the effect, if any, the following separate changes would have on the output voltage. Parts of the table have been completed for you. [3]

Change	Effect on the maximum voltage	Effect on the time for one rotation of the coil
Increasing the strength of the magnetic poles and turning the coil at the same speed	Increased	No change
Turning the coil at a slower speed	.....	Increased
Increasing the number of coils and turning the coil at a faster speed	.....	.....

5

END OF PAPER

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GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

JANUARY 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE SCIENCE - PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Unit	Page
P1 - FOUNDATION TIER	1
P1 - HIGHER TIER	4
P2 - FOUNDATION TIER	7
P2 - HIGHER TIER	10
P3 - FOUNDATION TIER	13
P3 - HIGHER TIER	16

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GCSE Science - Physics (Legacy) - P3

Mark Scheme

FOUNDATION TIER

Question			Marking details	Marks Available
1.			A transverse wave (1) Can travel through solids (1) Travel slower than P waves (1) **Question total**	3 **[3]**
2.			Diagram with defined nucleus (1) containing 3 protons and 4 neutrons (1) 2 orbits (1) with 2, 1 electrons (1) **Question total**	4 **[4]**
3.		(i) (ii)	1 200 x 20 = 24 000 [kg m/s] Greater mass / more momentum **Question total**	1 1 **[2]**
4.		(i) (ii)	B (1) empty space (1) A / C (1) nucleus (1) **Question total**	4 **[4]**
5.	*(a)* *(b)*	(i) (ii) (iii)	BC Largest gradient / steepest line Speed changes (1) from low to high value (1) $\frac{50}{3.5}$ (1) = 14.28 [km/h] (1) **Question total**	1 1 2 2 **[6]**

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Question			Marking details	Marks Available
6.	*(a)*		Any (1) x 2: • Fusion is joining together of two atoms • Releases more energy • Produces no radioactive waste • Readily available source of atoms Fission statements acceptable alternatives	2
	(b)		Any (1) x 2: • The extremely high temperatures required. • Safe containment for the reaction.	1
			Question total	**[3]**
7.	*(a)*		3 waves drawn (1) perpendicular to wave direction (1)	2
	(b)		Refraction	1
	(c)	(i) (ii)	Decreases (1) Decreases (1)	2
			Question total	**[5]**
8.	*(a)*	(i) (ii) (iii)	1, 2 and 5 (1) Faster than S waves (1) Nearest to the earthquake (1)	3
	(b)		Change of medium / solid → liquid	1
			Question total	**[4]**
9.	*(a)*		E A D C 3 or 4 correct = 3 marks 2 correct = 2 marks 1 correct = 1 mark	3
	(b)		Less turns on secondary / more turns on primary	1
			Question total	**[4]**

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Question			Marking details	Marks Available
10.	*(a)*		$\frac{25}{10}$ (1) = 2.5 [m/s^2] (1)	2
	(b)		½ x 20 x 25 = 250 [m] (1) (substitution (1))	2
	(c)		Larger area for the last 30 s	1
			Question total	**[5]**
11.	*(a)*	(i) (ii)	Capture (1) of slow neutrons (1) Graphite slows (1) up neutrons to enable fission (1) **Award a maximum of 3 marks in total for *(a)*.**	3
	(b)		Reduces output (1) since more neutrons are absorbed / so less fission (1)	2
			Question total	**[5]**
12.	*(a)*		0.4 [s]	1
	(b)		B→A	1
	(c)		Decreased (1) Increased (1) Decreased (1)	3
			Question total	**[5]**
			Total Foundation paper	**50**

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HIGHER TIER

Question			Marking details	Marks Available
1.	*(a)*		$\frac{25}{10}$ (1) = 2.5 [m/s^2] (1)	2
	(b)		½ x 20 x 25 = 250 [m] (1) (substitution (1))	2
	(c)		Larger area for the last 30 s	1
			Question total	**[5]**
2.	*(a)*	(i) (ii)	Capture (1) of slow neutrons (1) Graphite slows (1) up neutrons to enable fission (1) **Award a maximum of 3 marks in total for *(a)*.**	3
	(b)		Reduces output (1) since more neutrons are absorbed / so less fission (1)	2
	(c)		To prevent escape of radiation – stray neutrons (1) Protection for workers / community / environment (1)	2
	(d)		*a* = 92 – 36 = 56 (1) *b* = 236 – 146 = 90 (1)	2
			Question total	**[9]**
3.	*(a)*		0.4 [s]	1
	(b)		B→A	1
	(c)		Decreased (1) Increased (1) Decreased (1)	3
	(d)		Any 2 x (1): • Radial fields • Multi-coils • Electromagnets rotate • Rotor & stator	2
			Question total	**[7]**

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Question			Marking details	Marks Available
4.	*(a)*		Transverse <u>vibrations</u> (1) at right angles to direction (1) / longitudinal <u>vibrations</u> (1) along direction (1)	2
	(b)		Any (1) x 5: Speed increases with depth in the mantle (1) Speed increases with depth in the core (1) No S waves in the core (1) Core must be a liquid (1) Abrupt change of speed shows boundary (1) Size of mantle (1) Size of core (1) P wave speed constant through solid inner core (1)	5
			Question total	**[7]**
5.	*(a)*	(i) (ii)	Alpha (1) Beta (1)	2
	(b)		230 – 90 = 140	1
	(c)		A	1
			Question total	**[4]**

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Question			Marking details	Marks Available
6.	*(a)*	(i)	Core has a changing field (1) which links with secondary coil (1)	
		(ii)	Fewer turns (1)	3
	(b)		No changing field with d.c.	1
	(c)		$\frac{V_1}{V_2} = \frac{N_1}{N_2}$	1
			$\frac{230}{V_2} = \frac{4600}{40}$ (1 for substitution) (1 for manipulation)	
			$V_2 = \frac{230}{115} = 2$ [V] (1)	3
			Question total	**[8]**
7.	*(a)*	(i)	$v^2 = u^2 + 2ax$ $240^2 = 2 \times a \times 0.6$ (1) $a = 48\,000$ [m/s^2] (1)	2
		(ii)	$x = \frac{1}{2}(u+v)t$ $0.6 = \frac{240}{2}t$ (1) $t = 0.005$ [s] (1)	2
	(b)		Momentum before = Momentum after $0.02x240 = 2v(1)$ $v = \frac{0.02x240}{2}$ $v = 2.4$ [m/s] (1)	2
	(c)	(i)	$KE = \frac{mv^2}{2}$ (1) $\frac{0.02x240^2}{2} = 576$ [J] (1)	2
		(ii)	Some lost as heat (1) Some lost doing work against bullet's penetration of target (1) Accept: change in shape of target	2
			Question total	**[10]**
			Total Higher Tier	**50**

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SCIENCE PHYSICS
FOUNDATION TIER
PHYSICS 3

A.M. THURSDAY, 24 May 2012

45 minutes

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Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**3**	
3.	**9**	
4.	**4**	
5.	**5**	
6.	**9**	
7.	**5**	
8.	**5**	
9.	**5**	
Total	**50**	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2 of the examination paper. In calculations you should show all your working.

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EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

$$a = \frac{v - u}{t}$$

$$x = \frac{1}{2}(u + v)t$$

where u is the initial velocity,
v is the final velocity,
a is the acceleration,
t is the time,
x is the distance travelled,

momentum = mass × velocity

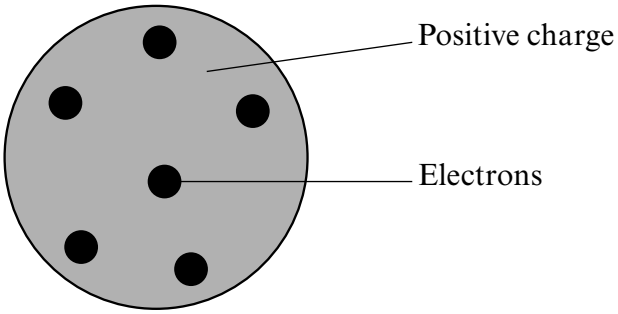
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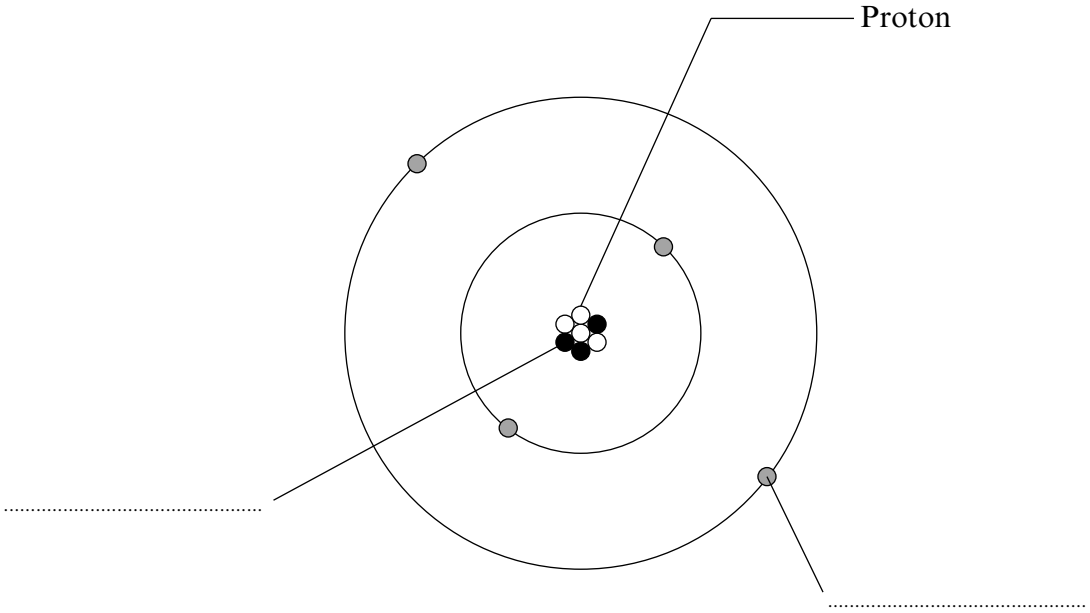
Answer **all** *questions*

1. J. J. Thomson thought that atoms were like a 'plum pudding'. His model is shown in the diagram below.



Plum pudding model

The current nuclear model is shown below.



(i) **Label** the diagram. [2]

(ii) Give **three** differences between Thomson's 'plum pudding' model and the nuclear model of the atom. [3]

1. .....

.....

2. .....

.....

3. .....

.....

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2. Ultrasound scans are used to produce images of unborn babies.



Complete the sentences below by underlining the correct word or number in brackets. [3]

(i) The minimum frequency for ultrasound is (200 / 2000 / 20 000) Hertz.

(ii) The image of the baby is produced by the (refraction / reflection / diffraction) of ultrasound.

(iii) Ultrasound is a (longitudinal / transverse / seismic) wave.

3

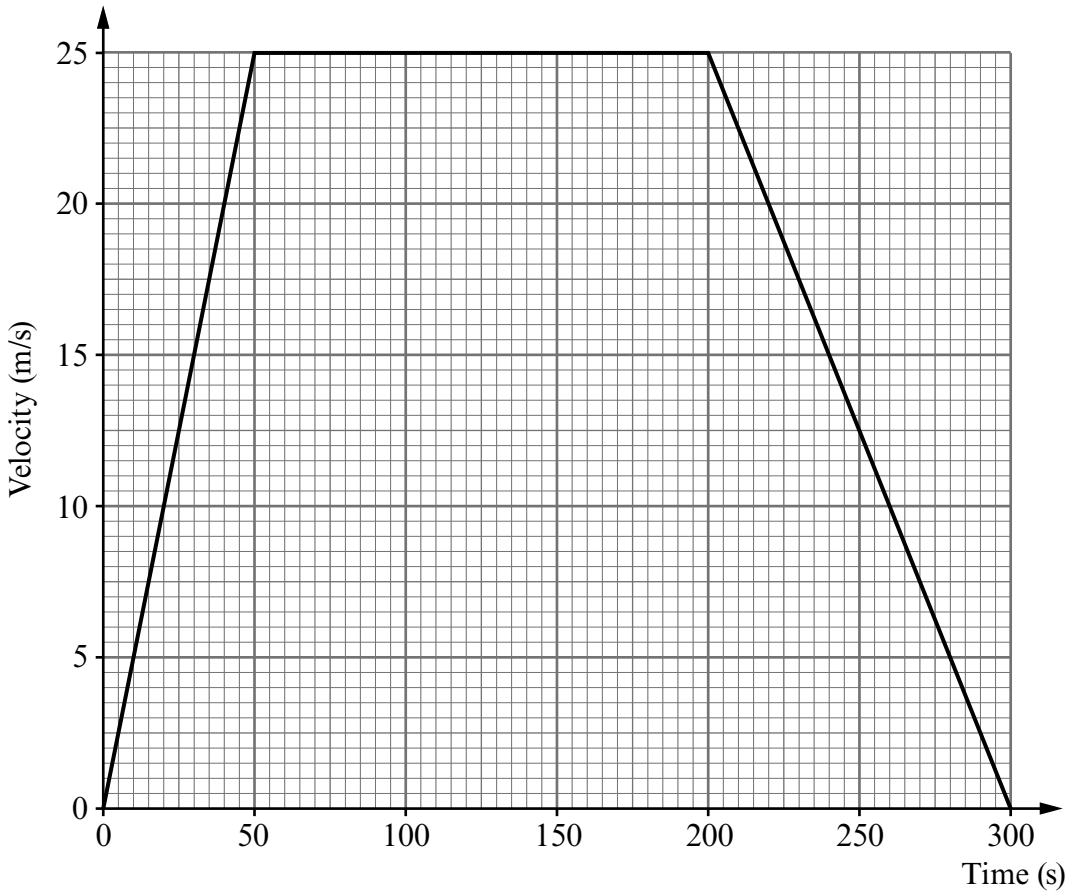
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3. The velocity-time graph shows part of the journey of a train.



(a) The gradient of the line gives the acceleration of the train. The area under the line gives the distance travelled by the train.

(i) Calculate the initial acceleration of the train. [2]

Acceleration = ... m/s^2

(ii) Calculate the distance travelled when the train was travelling at a constant velocity. [2]

Distance travelled = ... m

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(b) The train travelled a total distance of 5625 m.
Use the equation

$$\text{mean velocity} = \frac{\text{distance}}{\text{time}}$$

to calculate the mean velocity of the journey shown on the graph. [2]

Mean velocity = ... m/s

(c) The train has a mass of 30 000 kg.
Use the graph and the equation

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

to describe how the momentum of the train changes over the 300 s journey. [3]

.....

.....

.....

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9

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Turn over.

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4. The diagrams show the nuclei of four different atoms.

Key
○ proton
● neutron


nucleus **A**


nucleus **B**


nucleus **C**


nucleus **D**

(i) Complete the table to show the nucleus that matches with each symbol. [3]

Symbol	Nucleus
$^{4}_{2}He$	.....
$^{7}_{3}Li$	.....
$^{3}_{2}He$	.....
$^{1}_{1}H$	.....

(ii) Which **two** nuclei are isotopes? ..... [1]

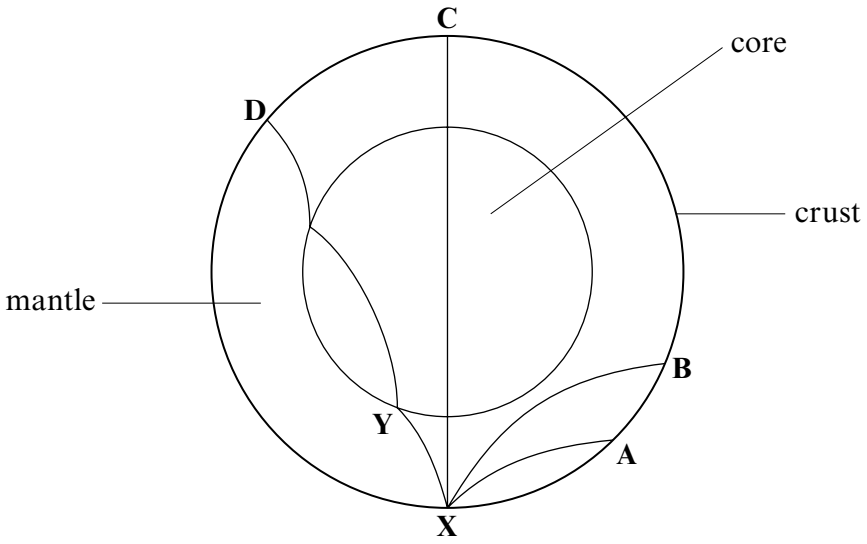
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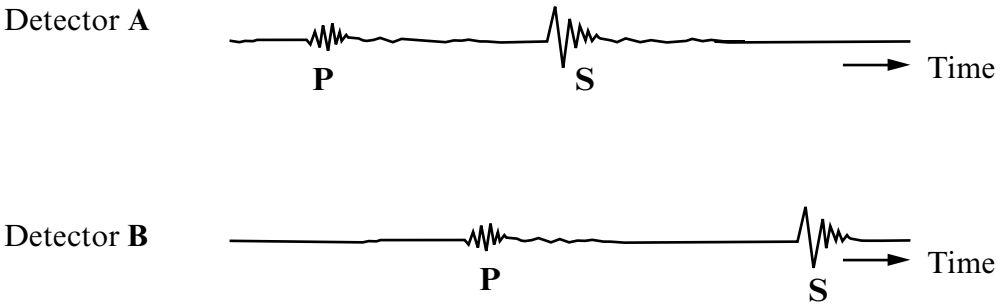
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5. The diagram shows the paths of seismic waves through the Earth.



Detectors at **A** and **B** record the signals shown below.



(i) Give **one** reason why **P** and **S** waves arrive at **A** at different times. [1]

.....

.....

(ii) State **two** other differences between **P** and **S** waves. [2]

1. .....

.....

2. .....

.....

(iii) Explain why the signal received at **C** will be different from the signals at **A** and **B**. [2]

.....

.....

.....

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6. *(a)* The table compares information about nuclear fusion and nuclear fission.

Nuclear Fission	Nuclear Fusion
Produces many highly radioactive particles.	Few radioactive particles are produced.
Fission is the splitting of a large atom into two or more smaller ones.	Fusion is the fusing of two or more lighter atoms into a larger one.
Slow speed neutrons are required.	High density, very high temperature environment is required.
Takes little energy to split two atoms in a fission reaction.	Extremely high energy is required to bring two or more nuclei close enough that nuclear forces overcome their electrostatic repulsion.
The energy released is 223 units per fission.	The energy released is 710 units per fusion.

Use the information in the table to answer the following questions.

(i) Give **two** advantages of producing energy from nuclear fusion. [2]

1. .....

.....

2. .....

.....

(ii) Explain why more energy is needed to start a nuclear fusion reaction. [2]

.....

.....

.....

.....

(iii) In nuclear fusion atoms are joined together to form a larger one. State how nuclear fission is different from this. [1]

.....

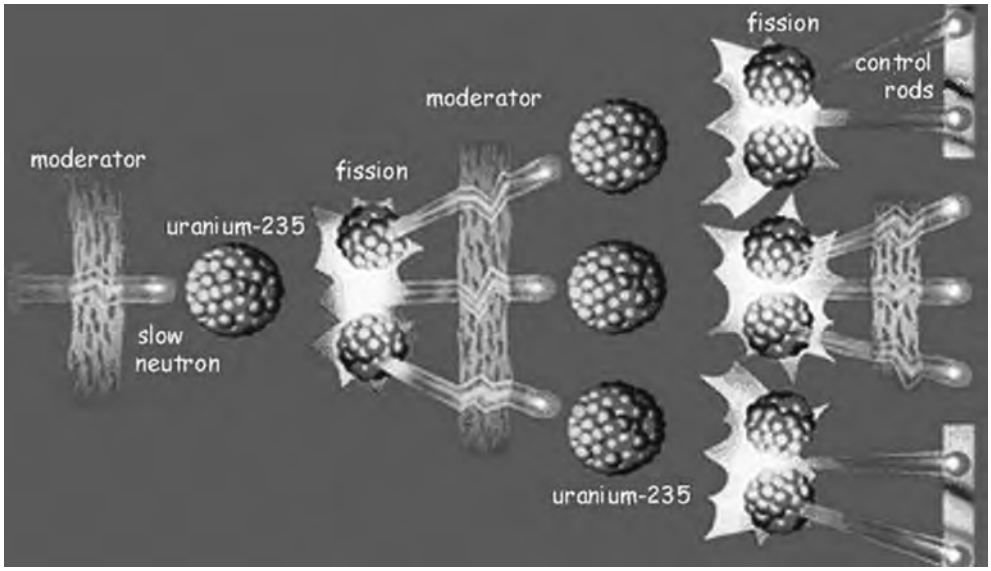
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(b) The diagram shows the fission reaction in a nuclear reactor.



(i) Explain the purpose of the moderator. [2]

.....

.....

.....

.....

(ii) Explain how an uncontrolled chain reaction is prevented. [2]

.....

.....

.....

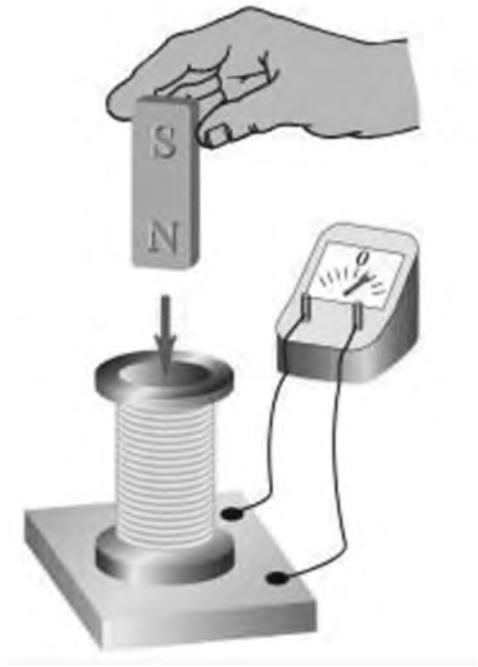
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7. *(a)* Electromagnetic induction is investigated using a magnet and a coil of wire.



When the North Pole of the magnet is pushed into the coil, the meter needle flicks to the right and returns to the middle.

Complete the following sentences. [2]

(i) When the North Pole is pulled back out of the coil, the meter needle .....

.....

.....

(ii) When the South Pole of the magnet is pushed into the same end of the coil, the meter needle .....

.....

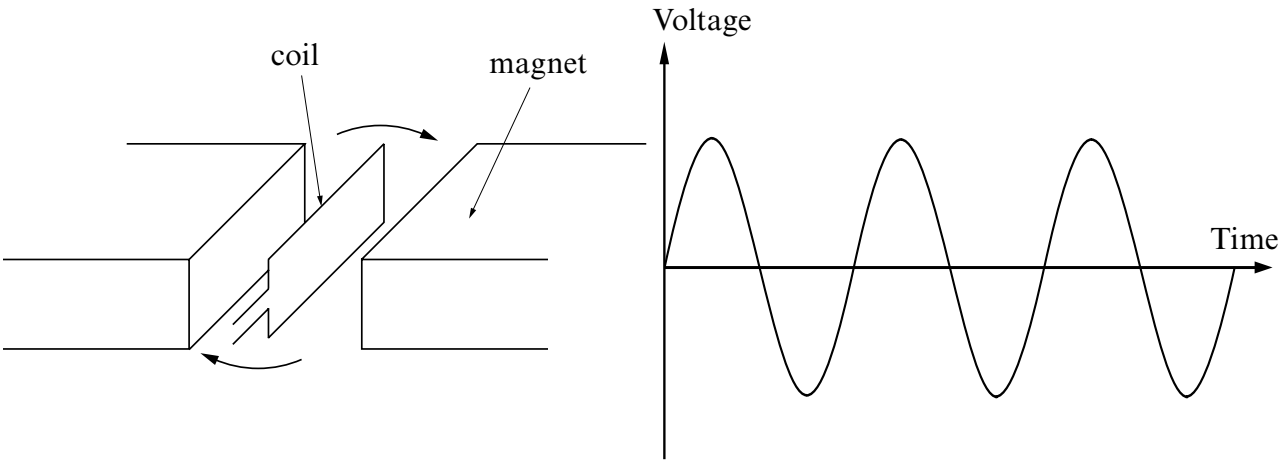
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(b) The diagrams show a simple electrical generator and the alternating voltage it produces by electromagnetic induction.



The table below gives changes that could be made to the generator.
For each case, complete the table to show whether the voltage and frequency produced **decreases**, **stays the same** or **increases**. [3]

Change to generator	Effect on voltage	Effect on frequency
More turns on the coil	.....	.....
Spinning the coil slower	.....	.....
Using stronger magnets	.....	.....

5

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8. *(a)* A slinky spring can be used to demonstrate the difference between longitudinal and transverse waves.

Transverse wave



Direction of travel

Longitudinal wave



Explain the difference between the two types of waves. [3]

Use the following phrases in your explanation.

at right angles *the vibrations* *are parallel to* *direction of travel*

.....

.....

.....

.....

.....

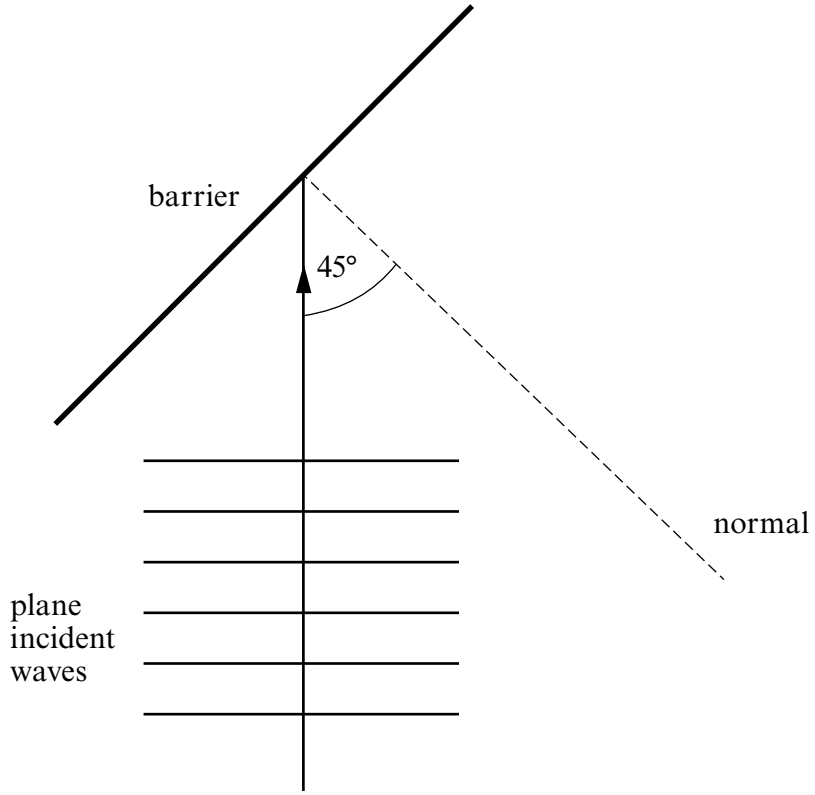
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(b) The diagram shows plane waves arriving at a barrier. Complete the diagram to show the path of the reflected waves. [2]



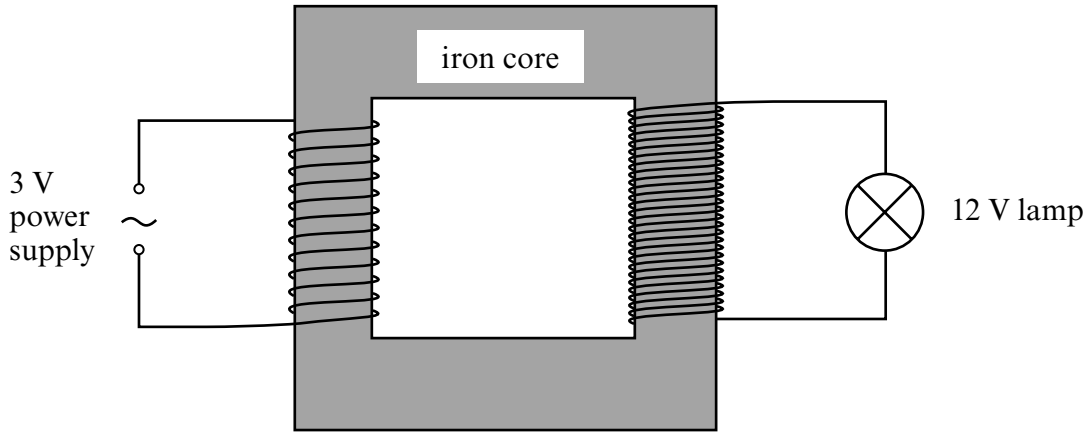
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9. The diagram shows a step-up transformer designed to light a 12 V lamp from a 3 V power supply.



(a) (i) How can you tell from the diagram that this is a step-up transformer? [1]

.....

.....

(ii) Describe the purpose of the iron core. [1]

.....

.....

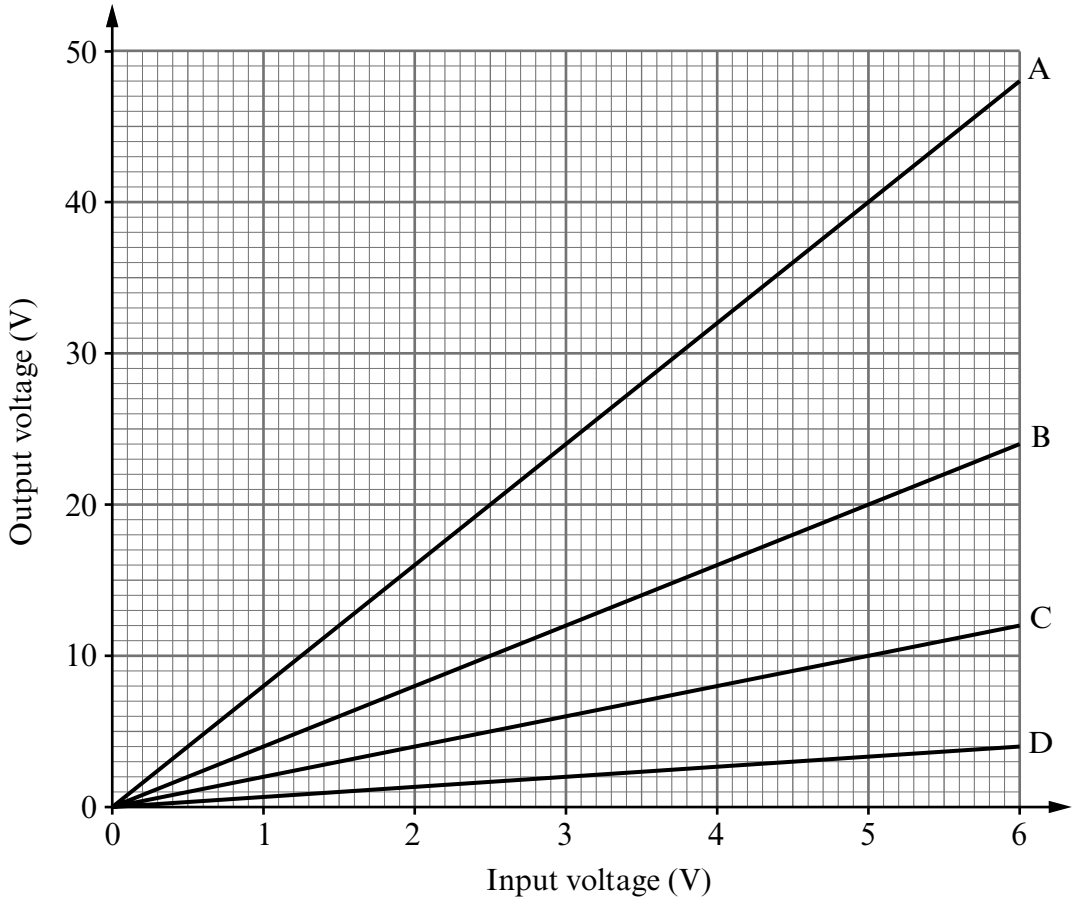
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(b) Four different transformers, A, B, C and D are investigated. For each transformer, the input voltage is changed and the output voltage measured each time. The results for each transformer are shown by the graphs.



Use the graphs to answer the following questions.

(i) Which transformer, A, B, C or D, would be used to light the 12 V lamp to normal brightness, from a 3 V supply? [1]

.....

(ii) Which transformer is a step-down transformer? ..... [1]
Give a reason for your answer. [1]

.....

.....

5

THERE ARE NO MORE QUESTIONS IN THE EXAMINATION.

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GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

SUMMER 2012

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE SCIENCE - PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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PHYSICS 3 (LEGACY)

FOUNDATION TIER

Question			Marking details	Marks Available
1.		(i) (ii)	Neutron (1) and electron (1) correctly labelled Thompson: solid (1), positive charge spread throughout atom (1), negative charges dotted throughout atom (1) no protons (1), no neutrons (1), no electron shells / orbits (1), no nucleus (1) OR alternative statements about nuclear atom e.g. mass concentrated in centre (1), mainly made up of empty space (1) Assume reference to "it" is referring to the Thomson model. **Question total**	2 3 **[5]**
2.		(i) (ii) (iii)	20 000 underlined (1) reflection (1) longitudinal (1) **Question total**	 3 **[3]**
3.	*(a)* *(b)* *(c)*	(i) (ii)	Gradient = $\frac{25}{50}$ (1), 0.5 [m/s^2] (1) Area = 25 x 150 (1), = 3750 [m] (1) Time of 300 s from graph (1), Subs $\frac{5625}{300}$ = 18.75 [m/s] (1) (accept 18.75 – 19) Correct description (momentum increases, becomes constant, and then decreases) (1) Constant momentum value calculated: 30 000 x 25 = 750 000 [kg m/s] (1), One correct reference to 0 i.e. either momentum increases from 0 **or** momentum decreases to 0. (1) **Question total**	2 2 2 3 **[9]**

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Question			Marking details	Marks Available
4.		(i)	In order downwards: C-D-B-A (3 all correct; 2 if 2/3 correct; 1 if 1 correct)	3
		(ii)	B & C or $^{4}_{2}He$ & $^{3}_{2}He$	1
			Question total	**[4]**
5.		(i)	P waves travel faster than S OR they travel at different speeds	1
		(ii)	P longitudinal S transverse(1)	
			P travel through liquids / S don't (1)	2
			P waves travel faster than S (only award if **not** referred to in (i))	
		(iii)	Signal will <u>only</u> have P waves, (1) since S waves can't pass through [liquid] core (1)	2
			Question total	**[5]**

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<table>
<tr><th colspan="3">Question</th><th>Marking details</th><th>Marks Available</th></tr>
<tr><td>6.</td><td>(a)</td><td>(i)</td><td>Few radioactive particles produced / doesn’t give off radiation (1)
greater energy released than fission / 710 units of energy released compared to 223 units (1)</td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Award any 2 marks out of 3:
To bring protons / nuclei / atoms close enough together, (1) nuclear forces overcome repulsion (1) high temperature needed (1)</td><td>2</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>[Large] atom splits [into 2 smaller atoms]</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>To slow the <u>neutrons</u> down,(1) so they are absorbed by the uranium atoms / so fission can occur (1)</td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Control / boron rods, (1) absorb [some] <u>neutrons</u> (1)</td><td>2</td></tr>
<tr><td></td><td></td><td></td><td>Question total</td><td>[9]</td></tr>
<tr><td>7.</td><td>(a)</td><td>(i)</td><td>Flicks to left [and returns to middle / zero] (1)</td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Flicks to left [and returns to middle / zero] (1)</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>1 mark for each correct row
<table>
<tr><th>Change to generator</th><th>Effect on voltage</th><th>Effect on frequency</th></tr>
<tr><td>More turns on the coil</td><td>increase</td><td>stays the same</td></tr>
<tr><td>Spinning the coil slower</td><td>decrease</td><td>decrease</td></tr>
<tr><td>Using stronger magnets</td><td>increase</td><td>stays the same</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td></td><td></td><td>Question total</td><td>[5]</td></tr>
</table>

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Question			Marking details	Marks Available
8.	*(a)*		In a transverse wave, the *vibrations (1)* are *at right angles* to the *direction of motion (1).* In a longitudinal wave, *the vibrations (1)* are *parallel to* the *direction of travel (1)*. (Maximum of 2 marks per statement) Only award a mark for vibrations once and it must be used in the correct context. Award a maximum of 3 marks in total.	3
	(b)		Correct angle of reflected ray (by eye) (1), wavefronts shown parallel and same wavelength drawn on reflected ray (by eye)(1)	2
			Question total	**[5]**
9.	*(a)*	(i)	More turns on output coil / larger voltage on output coil	1
		(ii)	Concentrates field [through coils] / makes the magnetic field stronger	1
	(b)	(i)	B	1
		(ii)	D,(1) output voltage less than input / decreases the voltage (1)	2
			Question total	**[5]**
			Total For Foundation Tier paper	**50**

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PHYSICS 3 (LEGACY)

HIGHER TIER

<table>
<tr><th colspan="3">Question</th><th>Marking details</th><th>Marks Available</th></tr>
<tr><td>1.</td><td>(a)</td><td>(i)</td><td>Reference to a magnetic field around the magnet (1) when magnet moves or the <u>magnetic field</u> changes / is cut [by the turns in the coil] (1) this induces / produces / creates a current/voltage (1)</td><td>3</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Flicks to left [and returns to middle / zero] (1)
Flicks to left [and returns to middle / zero] (1)</td><td>2</td></tr>
<tr><td></td><td>(b)</td><td></td><td>1 mark for each correct row
<table>
<tr><th>Change to generator</th><th>Effect on voltage</th><th>Effect on frequency</th></tr>
<tr><td>More turns on the coil</td><td>increase</td><td>stays the same</td></tr>
<tr><td>Spinning the coil slower</td><td>decrease</td><td>decrease</td></tr>
<tr><td>Using stronger magnets</td><td>increase</td><td>stays the same</td></tr>
</table>
Question total</td><td>3

[8]</td></tr>
<tr><td>2.</td><td>(a)</td><td></td><td>In a transverse wave, the vibrations (1) are at right angles to the direction of motion (1).
In a longitudinal wave, the vibrations (1) are parallel to the direction of travel (1). (Maximum of 2 marks per statement)
Only award a mark for vibrations once and it must be used in the correct context. Award a maximum of 3 marks in total.</td><td>3</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Correct angle of reflected ray (by eye) (1), wavefronts shown parallel and same wavelength drawn on reflected ray (by eye)(1)

Question total</td><td>2

[5]</td></tr>
<tr><td>3.</td><td>(a)</td><td>(i)
(ii)</td><td>More turns on output coil / larger voltage on output coil
Concentrates field [through coils] / makes the magnetic field stronger</td><td>1
1</td></tr>
<tr><td></td><td>(b)</td><td>(i)
(ii)
(iii)</td><td>B
D, (1) output voltage less than input / decreases the voltage (1)
Correct form of equation (1), appropriate pair of voltages from graph e.g. 3 & 12 (1) Subs (1), answer 200 (1)

Question total</td><td>1
2

4

[9]</td></tr>
<tr><td>4.</td><td>(a)</td><td>(i)
(ii)</td><td>Subs into gradient – time 20 and speed 20 (1), answer = 1 [m/s^2] (1)
Attempting a calculation of area (1), 3900 [m] (1)</td><td>2
2</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Addition of areas–3900 (ecf) + 3500 = 7400 (1), division by 400 (1),18.5 [m/s] (1)

Question total</td><td>3

[7]</td></tr>
</table>

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Question			Marking details	Marks Available
5.	*(a)*	(i)	[High] frequency sound above 20 000 Hz /too high a frequency to be heard	1
		(ii)	Award any 2 marks out of 3: Reflected / echo (1) when they hit a boundary between different media / densities / layers / parts of the baby (1) time taken for the reflections is used to create an image (1)	2
	(b)		Conversion of 6 MHz to 6 000 000 Hz, (1) manipulation, (1) answer = 0.00025 [m] (1) (Answer of 250 [m] = 2 marks)	3
			Question total	**[6]**
6.	*(a)*	(i)	[Total] momentum before [a collision] = [total] momentum after [collision] [provided no external forces act] **Don't** accept momentum stays the same or momentum is conserved	1
		(ii)	Calculation of initial momentum: 5 x 1200 = 6000 (1) [recognition that final momentum must also be 6000] momentum of Car A = 6000 -2400=3600 (1) velocity of car A = 6 [m/s] (1)	3
		(iii)	Change in momentum = 3600, divided by 0.2 = 18 000 [N]	1
		(iv)	Collision time / distance would increase,(1) therefore force decreases(1)	2
	(b)		Correct calculation of KE shown for either: 15 000 or 2400 (1) Correct answer = 12 600 [J] (1) OR 0.5 x 1200 (25-4) = 12 600 [J] (2 marks)	2
			Question total	**[9]**
7.	*(a)*		Requires very high temperature / pressure / lots of heat (1) For 2nd mark either: Because need to overcome the repulsion between [positive] nuclei / protons or difficult to contain.	2
	(b)	(i)	${}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} = {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$ (1 mark each for left and right hand side of equation) (Accept D and T or De and Tr) Correct word equation with numbers = 1 mark	2
		(ii)	3 protons in Li nucleus compared to 1 in H (1) 3 neutrons in Li nucleus compared to 2 in H (1) Correct comparison with no numbers included maximum of 1 mark Reference to electrons no marks	2
			Question total	**[6]**
			Total Higher Tier	**50**

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Candidate Name	Centre Number	Candidate Number
		0

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GCSE

247/01

SCIENCE PHYSICS
FOUNDATION TIER
PHYSICS 3

A.M. FRIDAY, 27 May 2011

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark awarded**
1.	**5**	
2.	**4**	
3.	**4**	
4.	**6**	
5.	**4**	
6.	**3**	
7.	**4**	
8.	**5**	
9.	**6**	
10.	**4**	
11.	**5**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2 of the examination paper. In calculations you should show all your working.

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EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

$$a = \frac{v - u}{t}$$

$$x = \frac{1}{2}(u + v)t$$

where u is the initial velocity,
v is the final velocity,
a is the acceleration,
t is the time,
x is the distance travelled,

momentum = mass × velocity

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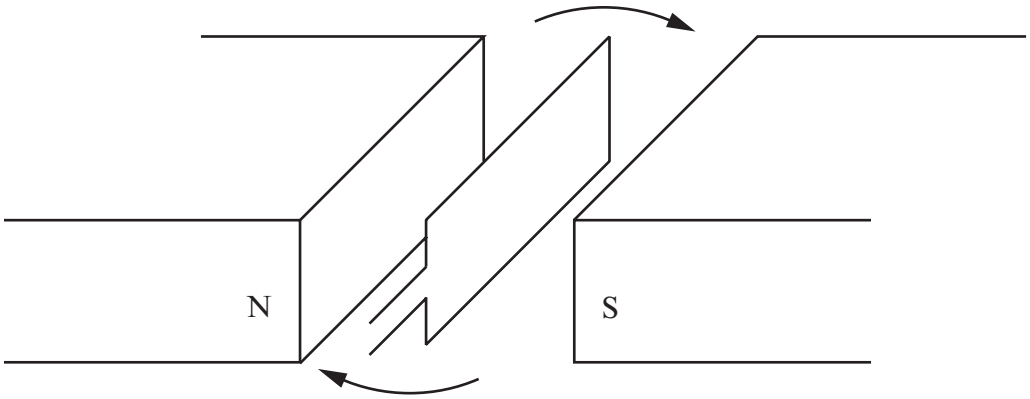
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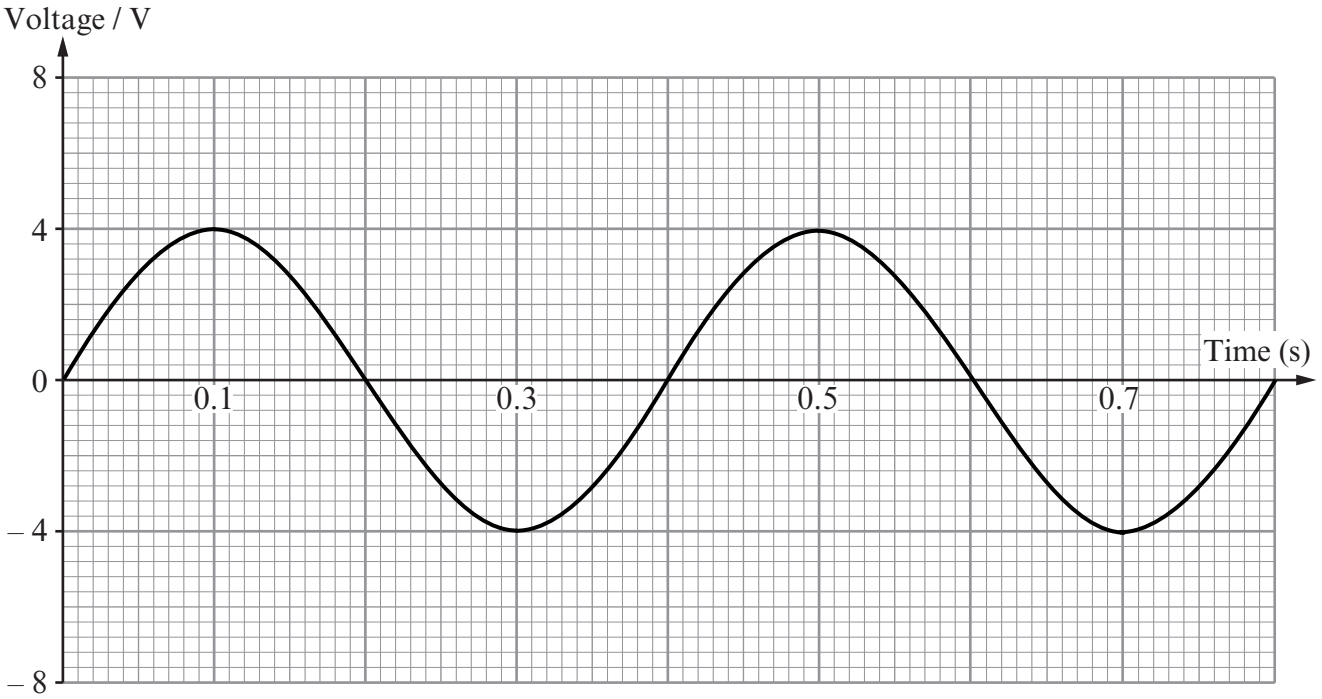
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Answer **all** *questions.*

1. The diagram shows a simple a.c. generator. It is a coil of wire which is made to rotate in a magnetic field.
As the coil rotates it cuts through the magnetic lines and a voltage is induced across the ends of the coil.



The graph shows how the output voltage varies with time as the coil makes two rotations from the vertical position shown in the diagram.



(a) (i) Use the graph to find the maximum voltage. Maximum voltage = ... V[1]

(ii) Use the graph to find the time for one rotation. Rotation time = ... s [1]

(iii) The frequency of the output voltage is the number of rotations made in one second.
Calculate the frequency of the output voltage.

Frequency = ... Hz [1]

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(b) The coil is rotated more quickly.
State what effect this has on

(i) the frequency of the output; .....

(ii) the size of the output voltage. .....

[2]

5

2. The four balanced equations below represent reactions that occur in nuclear physics.

A $^{235}_{92}U \longrightarrow {}^{231}_{90}Th + {}^{4}_{2}He$

B $^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{148}_{57}La + {}^{85}_{35}Br + {}^{1}_{0}n + {}^{1}_{0}n + {}^{1}_{0}n$

C $^{237}_{92}U \longrightarrow {}^{237}_{93}Np + {}^{0}_{-1}e$

D $^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n$

(i) Which reaction, **A**, **B**, **C** or **D**, represents a beta decay? .....

(ii) Which reaction, **A**, **B**, **C** or **D**, represents an alpha decay? .....

(iii) Which reaction, **A**, **B**, **C** or **D**, could lead to an uncontrolled chain reaction?

.....

(iv) Which reaction, **A**, **B**, **C** or **D**, requires massive temperature and pressure for it to take place?

.....

[4]

4

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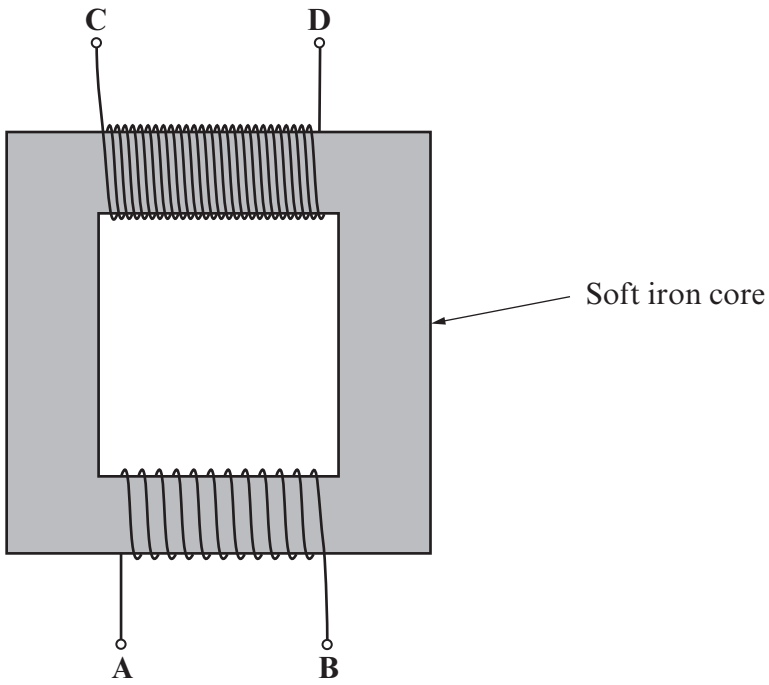
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3. *(a)* State how a step-up transformer differs from a step-down transformer. [1]

.....

.....

(b) The diagram below shows a transformer.



(i) It is used to change the mains voltage of 230 V to 10 V.
To which **two** terminals, **A**, **B**, **C** or **D**, should the mains voltage be connected? [1]

..... and .....

(ii) Give a reason why the coils are wound on a soft iron core. [1]

.....

.....

(iii) Explain why transformers will not work with direct currents. [1]

.....

.....

4

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4. *(a)* Waves are used to carry energy.
Some are described as **transverse waves** and others as **longitudinal waves**.
Explain how the vibrations producing transverse waves are different from those producing longitudinal waves. [2]

.....

.....

.....

(b) List **A** gives 4 energy-carrying waves.
List **B** describes the waves.

Draw one line from each wave in list **A** to its description in list **B**. [4]

List **A**	List **B**
Ultrasound waves in echo sounding	Transverse waves
γ radiation emitted by unstable nuclei	Longitudinal waves
Seismic waves from earthquakes	A mixture of transverse and longitudinal waves
Water waves in a ripple tank	

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6

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5. To take off from the deck of an aircraft carrier, a jet aircraft accelerates from rest along the deck at $32\,m/s^2$ for 2.5 seconds to attain its takeoff speed.



Use the equations

$$v = u + at, \text{ and}$$

$$x = \frac{u + v}{2} t$$

to calculate

(i) the takeoff speed, v,

$v =$ ..... m/s

(ii) the length of deck, x, required for the jet to take off.

$x =$ .....

[4]

4

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6. $^{14}_{6}C$ represents a neutral carbon atom.

Draw a labelled diagram of a $^{14}_{6}C$ atom to show the number and arrangement of the protons, neutrons and electrons. [3]

Key:

Proton ●

Neutron ○

Electron ×

3

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7. Read the passage carefully before answering the questions that follow.

> Echo sounding, using sonar, is widely used for mapping the sea bed and for tracking undersea objects.
> Sonar is high frequency (50 000 Hz plus) sound, known as ultrasound, which is not audible to humans (cannot be heard).
> Ultrasound has a short wavelength which allows it to be concentrated into a narrow beam which can penetrate to greater depth than audible sound waves. The short wavelengths also allow small details and small objects to be 'seen' and located.

(a) Give **two** reasons why ultrasound is preferred to audible sound for mapping the sea bed.

[2]

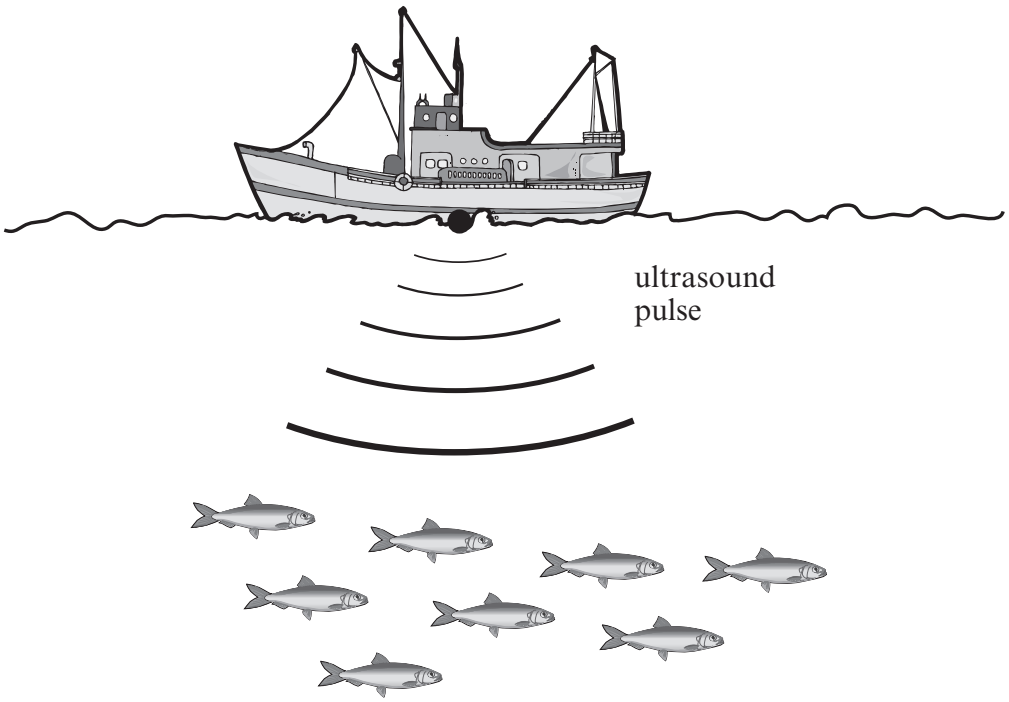
1. .....

.....

2. .....

.....

(b) A fishing boat, using sonar, sends out an ultrasound pulse into the water.



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Two echoes are received back, one later than the other.
Explain why. [2]

.....

.....

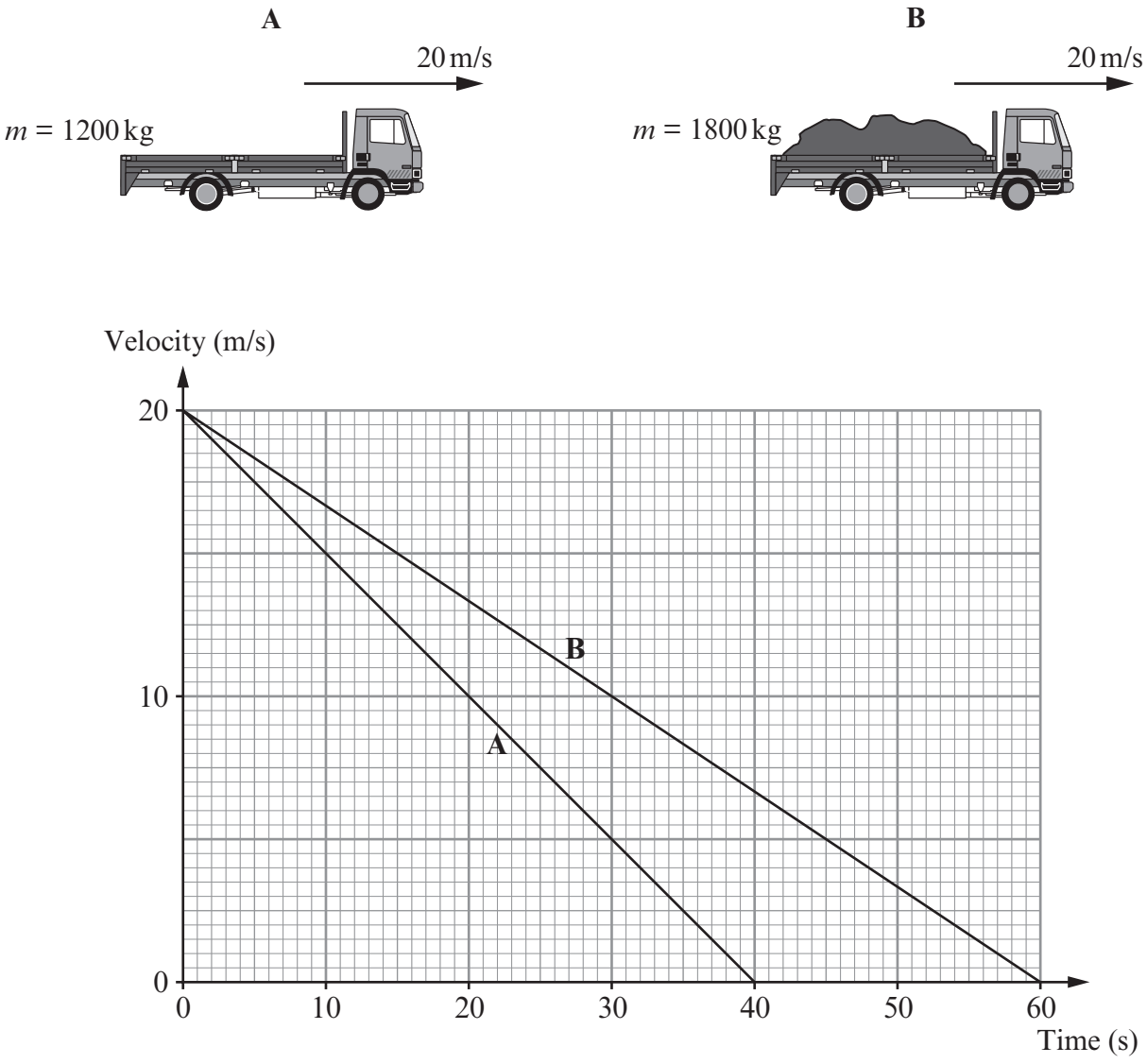
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8. The diagrams and graphs give information about two lorries, **A** and **B**, coming to rest under the action of the same braking force.



(a) Use information from the diagrams and graphs to:

(i) calculate the change in momentum of lorry **B**; [1]

momentum = mass × velocity

Change in momentum of **B** = ... kg m/s

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(ii) explain why **B** took longer than **A** to be brought to rest. [1]

.....

.....

(b) Acceleration is the gradient of a velocity-time graph.

(i) Calculate the deceleration of **A**. [2]

Deceleration of **A** = ... m/s^2

(ii) Explain how the graphs show that the deceleration of **B** is less than that of **A**. [1]

.....

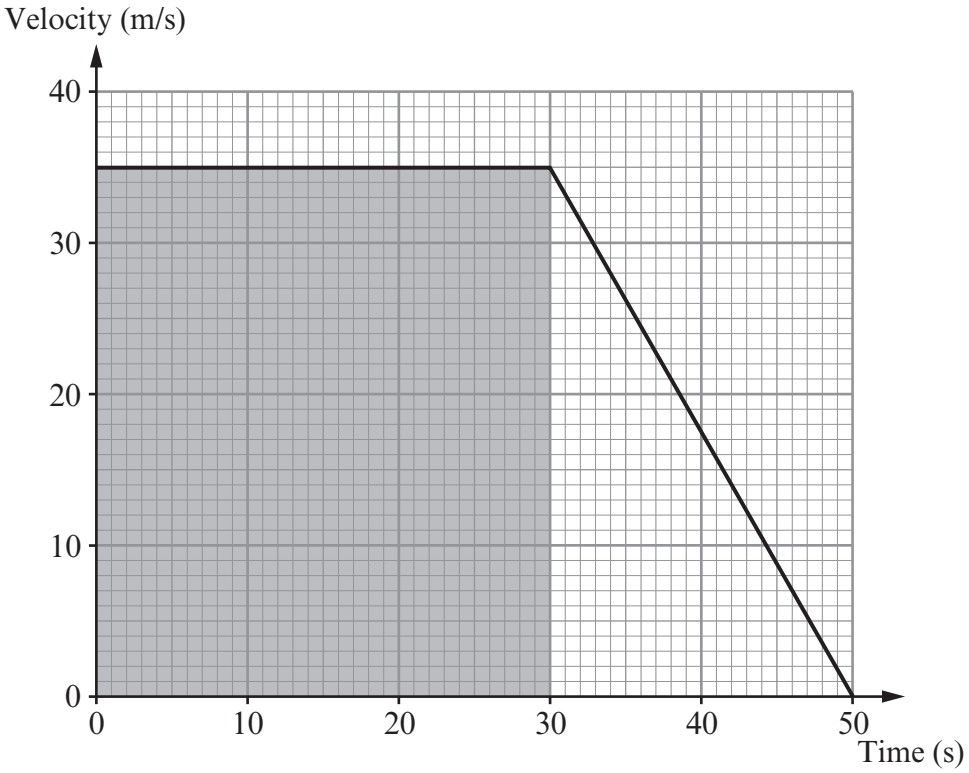
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9. The graph shows the motion of a motor cyclist along a straight road.



(a) Describe clearly what the shaded area represents. [2]

.....

.....

.....

(b) (i) Calculate the **total area** under the graph.

Area = ... m

(ii) Use the equation

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

to find the mean speed of the motor cyclist during the 50 s of the motion.

Mean speed = ... m/s
[4]

6

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10. Read the information carefully before answering the questions.

> In a nuclear reactor, uranium-235 undergoes fission by capturing a slow-moving neutron. Large amounts of energy are released together with a number of very fast-moving neutrons. Under certain conditions, the neutrons can keep the reaction going.
> The rate of fission can be controlled by raising or lowering boron rods, which readily absorb neutrons. The fuel rods are surrounded by graphite, which slows down the neutrons produced during fission.

(a) Explain how the boron rods are used to **increase** the rate of fission in the reactor. [2]

.....

.....

.....

.....

(b) (i) What causes uranium-235 to undergo fission? [1]

.....

.....

(ii) Explain why graphite is necessary to the fission process. [1]

.....

.....

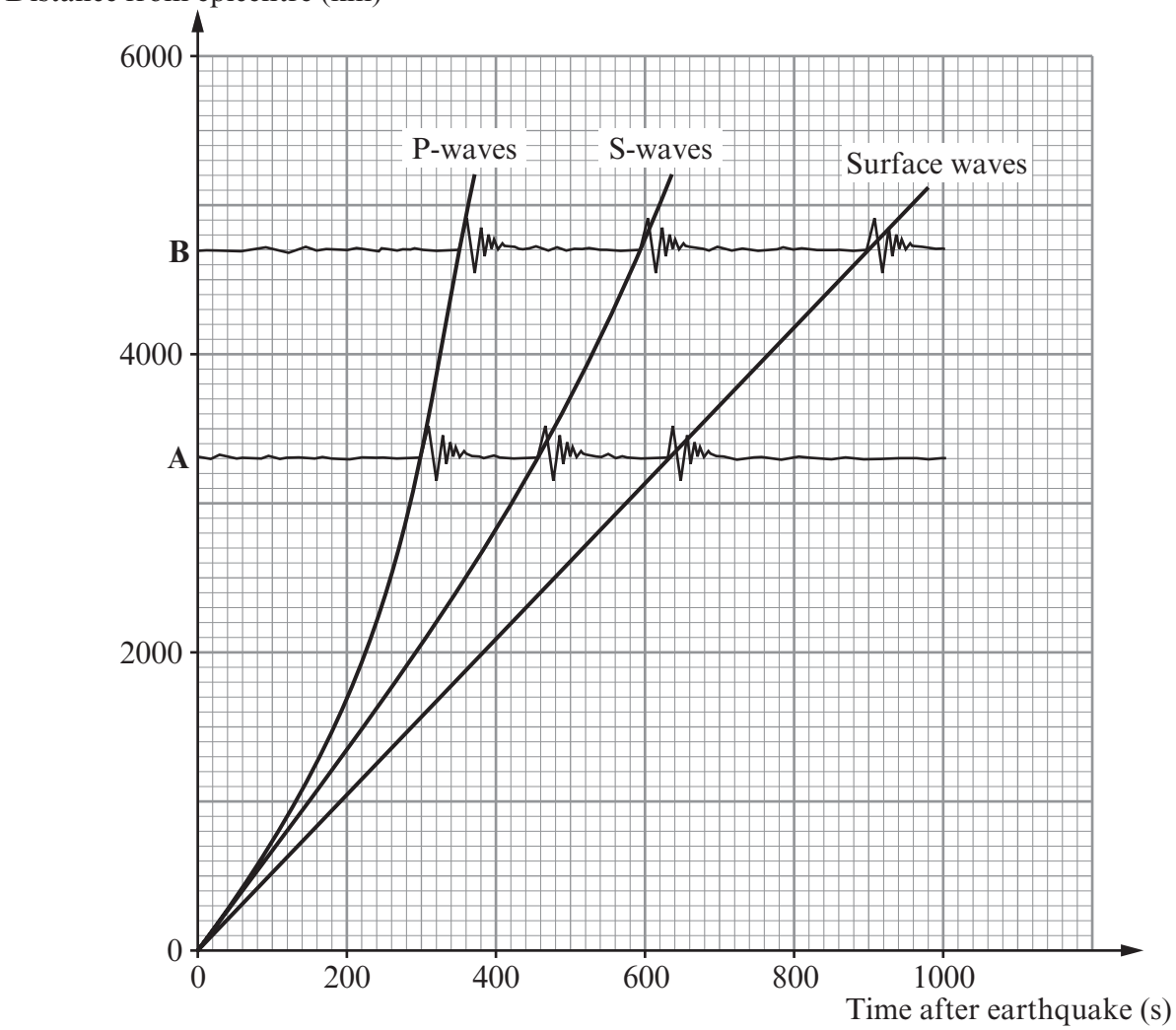
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Turn over.

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11. The graph shows how the **P**, **S** and **Surface waves** spread out from the epicentre of an earthquake.
A and **B** are seismic stations.



(a) (i) Use the graph to find the time delay between the arrival of the **P** and **S** waves at station **A**, [1]

Time delay = ... s

(ii) Explain why there is a time delay between the arrival of the **P** and **S** waves at station **A**. [1]

.....

.....

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(b) (i) Explain how the graphs show that the speed of the surface waves is constant. [1]

.....

.....

(ii) Explain why **P** and **S** waves change speed as they travel from the epicentre to stations **A** and **B**. [2]

.....

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.....

.....

5

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