WJEC GCSE PHYSICS

PHYSICS



EXAM QUESTION PACK

UNIT P3 HIGHER TIER 0247 PAPERS

STEMUP

These questions belong to WJEC, not to us.

The examination questions, mark schemes and examiner reports in this pack were written and published by WJEC. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with WJEC and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. WJEC has not endorsed, approved or been involved in the production of it. WJEC and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

WJEC publishes its past papers, mark schemes and examiner reports free of charge. Always check the current specification at wjec.co.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0247/02

SCIENCE
HIGHER TIER
PHYSICS 3

A.M. WEDNESDAY, 30 January 2013

45 minutes

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

0247
020001

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.

© WJEC CBAC Ltd.

STEMUP.CO.UK

EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

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

$v = u + at$

$v^2 = u^2 + 2ax$

$x = ut + \frac{1}{2}at^2$

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

where x = distance, u = initial velocity, v = final velocity, a = acceleration, t = time

$$\frac{V_1}{V_2} = \frac{N_1}{N_2}$$

where V_1 = voltage across the primary coil, V_2 = voltage across the secondary coil, N_1 = number of turns on the primary coil, N_2 = number of turns on the secondary coil

momentum = mass × velocity

kinetic energy $= \frac{mv^2}{2}$, where m = mass, v = velocity or speed

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

wave speed = wavelength × frequency

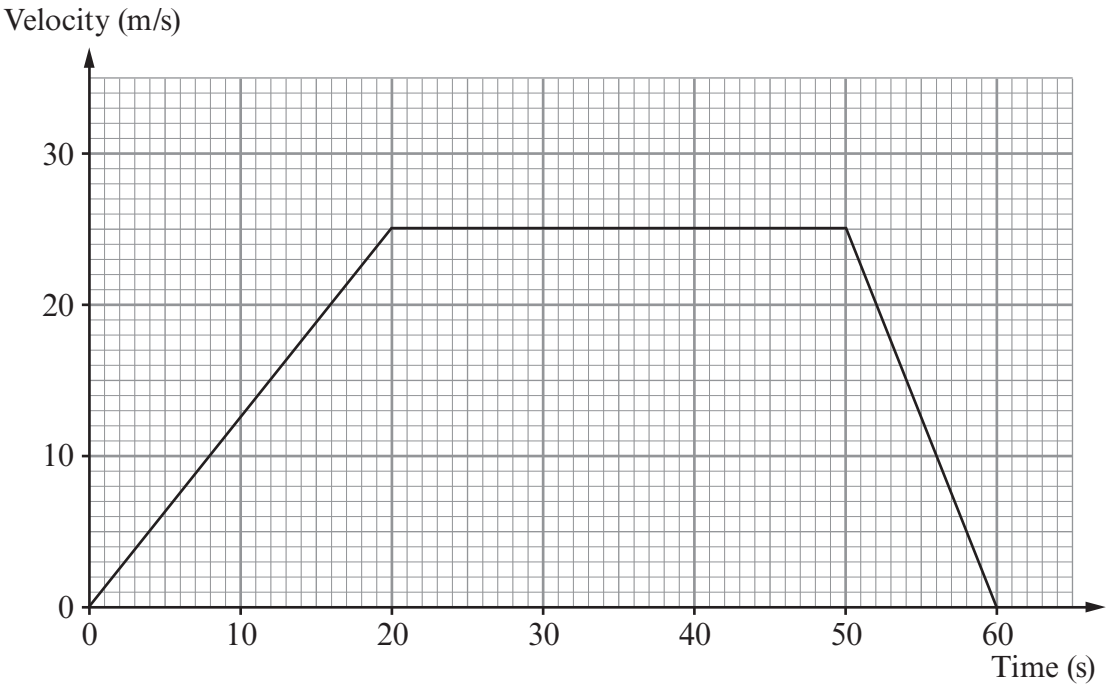
© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

Answer **all** *questions.*

1. 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

© WJEC CBAC Ltd.

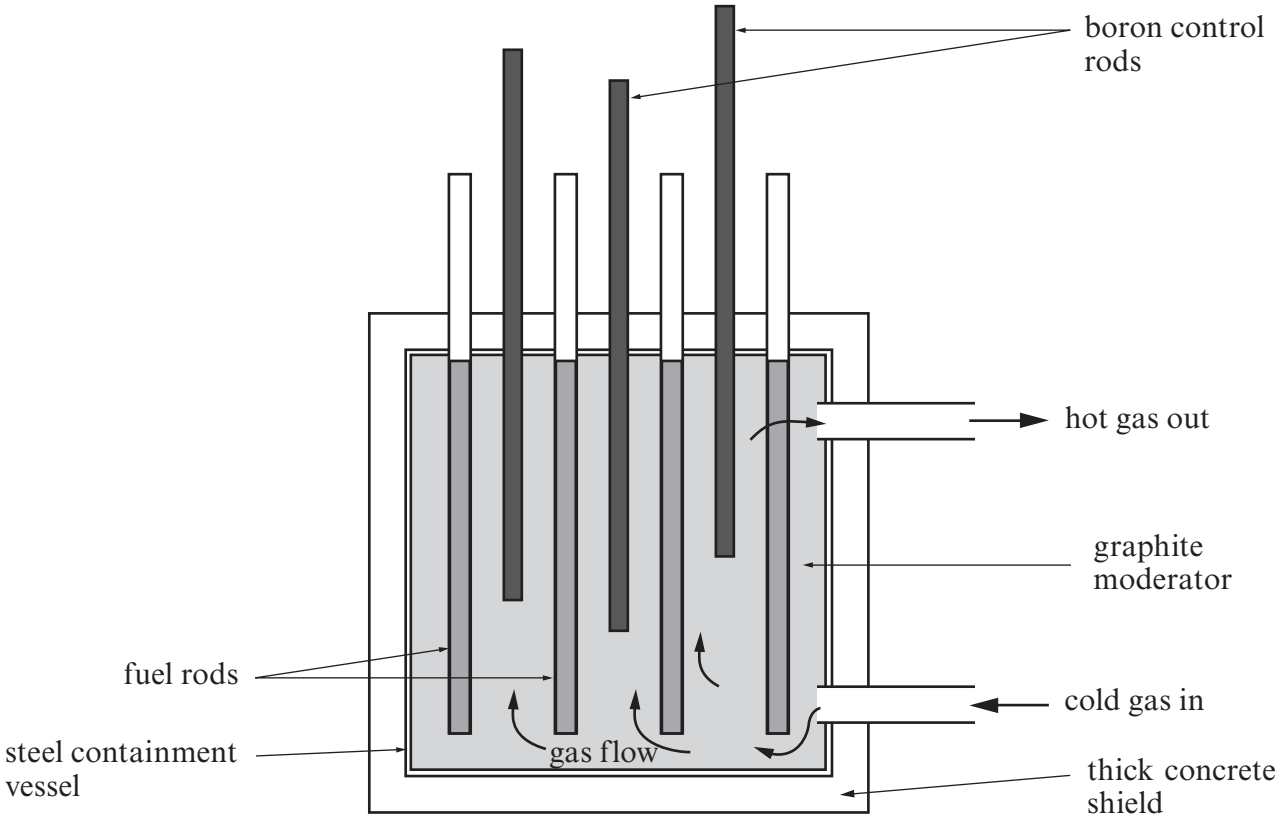
Turn over.

STEMUP.CO.UK

0247 020003

2. 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.

The energy produced is removed by the gas circulating the reactor and is used to generate electricity.

The whole core is encased in a steel lined concrete shield.

© WJEC CBAC Ltd

STEMUP.CO.UK

Examiner only

(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]

.....

.....

.....

.....

(c) Give **two** reasons why it is important for the core to be encased in a steel lined concrete shield. [2]

.....

.....

.....

(d) The reaction that takes place in the reactor can be represented by the following equation:

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} = {}^{143}_{a}\mathrm{X} + {}^{b}_{36}\mathrm{Y} + {}^{1}_{0}\mathrm{n} + {}^{1}_{0}\mathrm{n} + {}^{1}_{0}\mathrm{n} + \text{energy}$$

where $^{1}_{0}\mathrm{n}$ are neutrons and X and Y are radioactive elements.

Balance the equation by identifying the missing numbers *a* and *b*. [2]

a = ...

b = ...

0247 020005

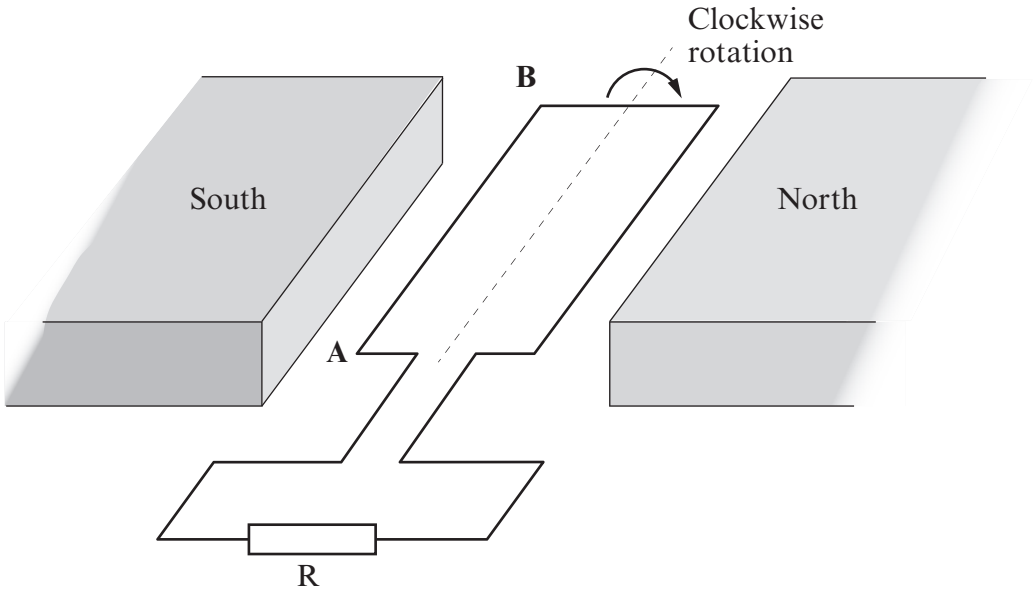
9

© WJEC CBAC Ltd.

STEMUP.CO.UK

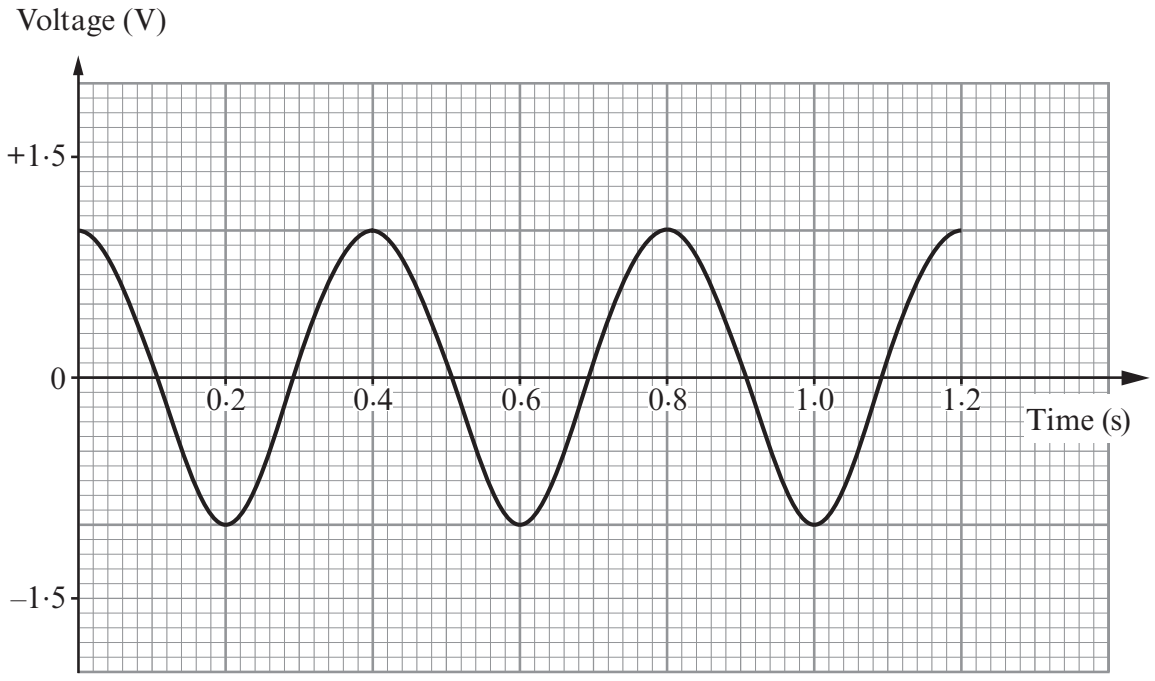
Examiner only

3. 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.



© WJEC CBAC Ltd

STEMUP.CO.UK

Examiner only

(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	.....	.....

(d) State **two** differences, apart from size, between industrial a.c. generators used in power stations and the simple a.c. generator shown in the diagram on the opposite page. [2]

.....

.....

.....

.....

7

0247 020007

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

4. P and S waves are seismic waves. P waves are longitudinal waves and S waves are transverse waves.

(a) Explain, in terms of particle movement, the difference between longitudinal and transverse waves. [2]

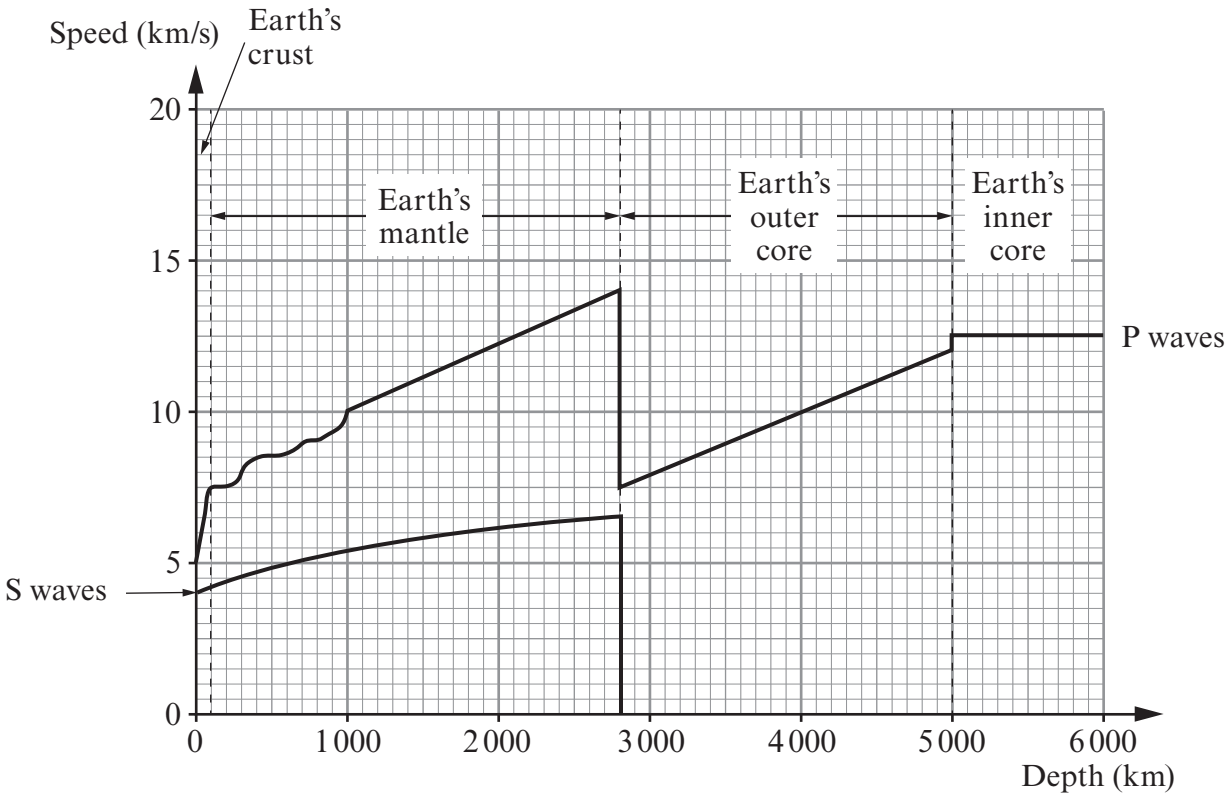
.....

.....

.....

.....

The graphs show how the speed of P and S waves change with depth inside the Earth.



© WJEC CBAC Ltd

STEMUP.CO.UK

Examiner only

(b) Explain how **evidence from the graphs** can be used to deduce the physical properties of the mantle and the core. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

7

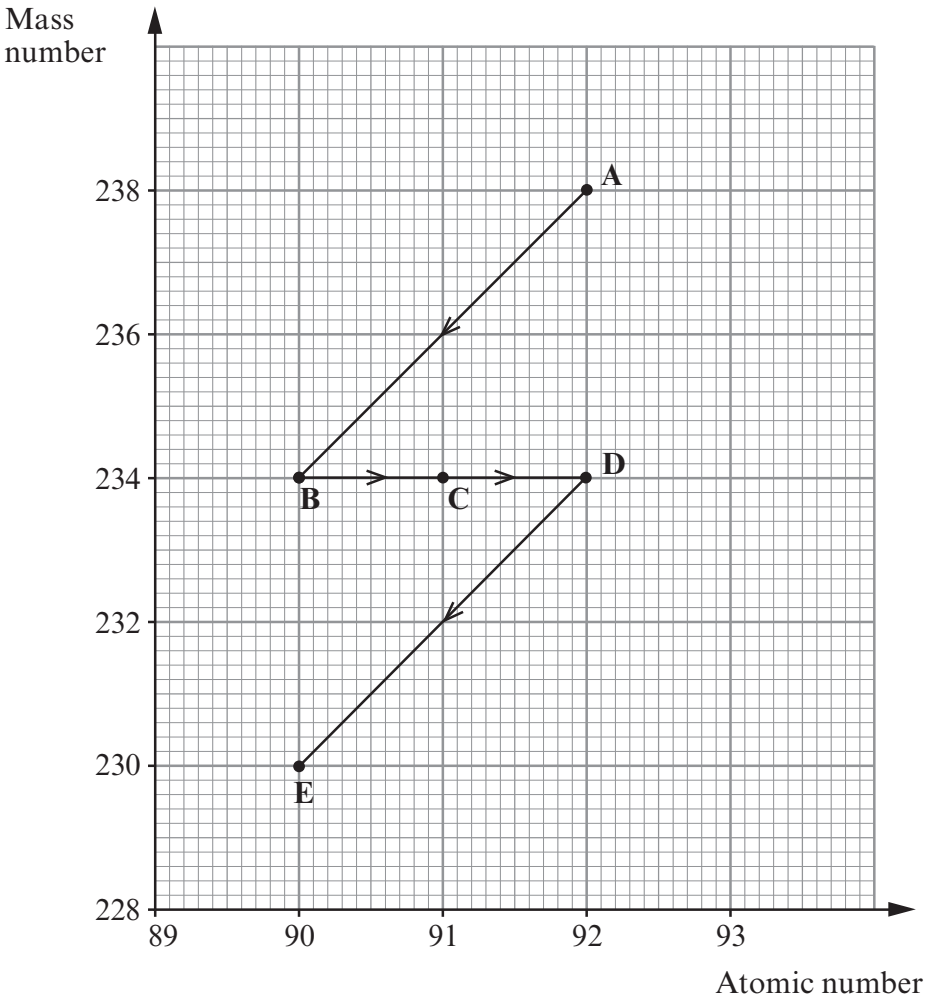
© WJEC CBAC Ltd.

Turn over.

STEMUP.CO.UK

Examiner only

5. The graph below represents a radioactive decay series in which nucleus **A** decays to nucleus **B**. Further decays eventually produce nucleus **E**.



(a) Name the radiation emitted in the change: [2]

(i) **A** to **B** .....

(ii) **C** to **D** .....

(b) Calculate the number of neutrons contained in nucleus **E**. ..... [1]

(c) Nucleus **D** is a uranium nucleus. State which *other* nucleus is an isotope of uranium.

..... [1]

4

© WJEC CBAC Ltd

STEMUP.CO.UK

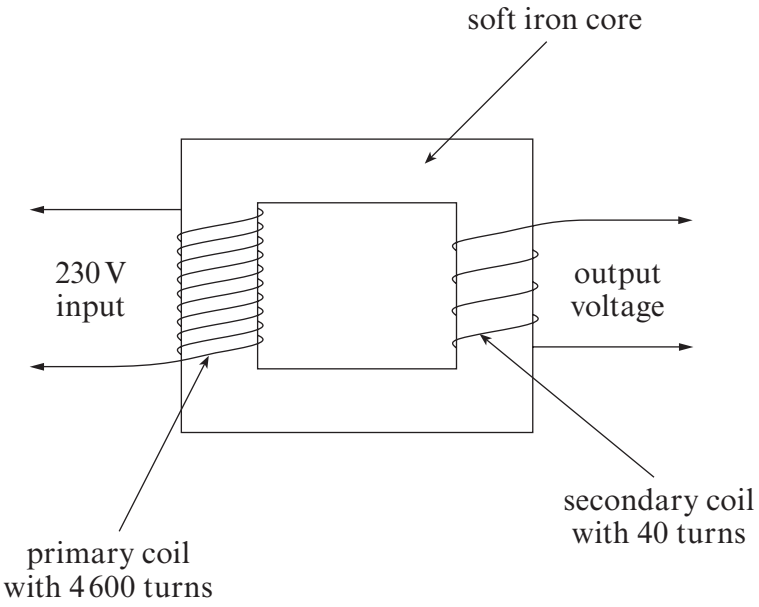
BLANK PAGE

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

6. The diagram shows the primary and secondary coils of a transformer, wound on a soft iron core.



When the input alternating voltage of 230 V is applied to the primary coil an output alternating voltage is produced in the secondary coil.

(a) (i) Explain what part the iron core plays in producing the output voltage.

.....

.....

.....

.....

(ii) Explain why the output voltage is less than the input voltage for this transformer.

.....

.....

.....

[3]

© WJEC CBAC Ltd

STEMUP.CO.UK

Examiner only

(b) Give a reason why the output voltage is zero when a d.c. voltage is applied to the primary coil. [1]

.....

.....

(c) Select an equation from page 2 and use it together with data shown on the diagram to calculate the output voltage.

Equation: ..... [1]

Calculation:

Output voltage = ... V
[3]

8

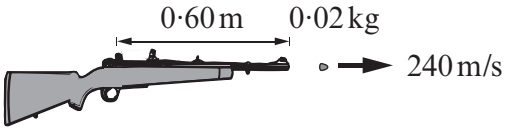
© WJEC CBAC Ltd.

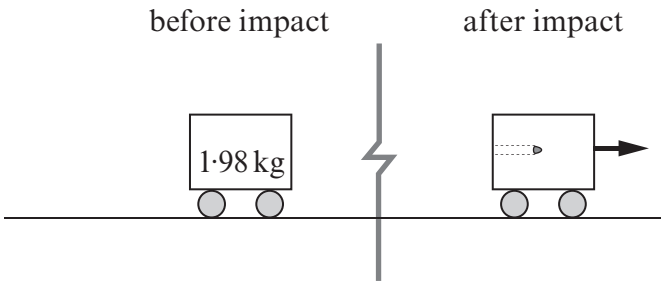
Turn over.

STEMUP.CO.UK

Examiner only

7. A bullet is fired from a rifle. It strikes a target mounted on wheels which then starts to move freely.





(a) Choose from these equations to answer the questions that follow.

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

$$v^2 = u^2 + 2ax$$

$$x = ut + \frac{1}{2}at^2$$

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

(i) Calculate the mean acceleration of the bullet during its travel along the 0·60 m barrel of the rifle. [2]

Acceleration = ... m/s^2

(ii) Calculate the time taken by the bullet to travel the length of the barrel. [2]

Time = ... s

© WJEC CBAC Ltd

STEMUP.CO.UK

Examiner only

(b) Use the equation: momentum = mass × velocity

together with the law of conservation of momentum to find the velocity of the target and bullet after impact. [2]

Velocity = ... m/s

(c) (i) Select an equation from page 2 to find the total kinetic energy before impact. [2]

Kinetic energy = ... J

(ii) Most often kinetic energy is lost on impact. Explain how you can account for the loss of energy. [2]

.....

.....

10

END OF PAPER

© WJEC CBAC Ltd.

STEMUP.CO.UK

GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

JANUARY 2013

© WJEC CBAC Ltd.

STEMUP.CO.UK

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

© WJEC CBAC Ltd.

STEMUP.CO.UK

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]**

© WJEC CBAC Ltd.

STEMUP.CO.UK

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]**

© WJEC CBAC Ltd.

STEMUP.CO.UK

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**

© WJEC CBAC Ltd.

STEMUP.CO.UK

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]**

© WJEC CBAC Ltd.

STEMUP.CO.UK

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]**

© WJEC CBAC Ltd.

STEMUP.CO.UK

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**

© WJEC CBAC Ltd.

STEMUP.CO.UK

Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0247/02

SCIENCE PHYSICS
HIGHER TIER
PHYSICS 3

A.M. THURSDAY, 24 May 2012

45 minutes

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

0247
020001

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.

© WJEC CBAC Ltd.

STEMUP.CO.UK

EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

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

$v = u + at$

$v^2 = u^2 + 2ax$

$x = ut + \frac{1}{2}at^2$

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

where x = distance, u = initial velocity, v = final velocity, a = acceleration, t = time

$$\frac{V_1}{V_2} = \frac{N_1}{N_2}$$

where V_1 = voltage across the primary, V_2 = voltage across the secondary, N_1 = number of primary turns, N_2 = number of secondary turns

momentum = mass × velocity

kinetic energy = $\frac{mv^2}{2}$, where m = mass, v = velocity or speed.

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

wave speed = wavelength × frequency

© WJEC CBAC Ltd.

STEMUP.CO.UK

BLANK PAGE

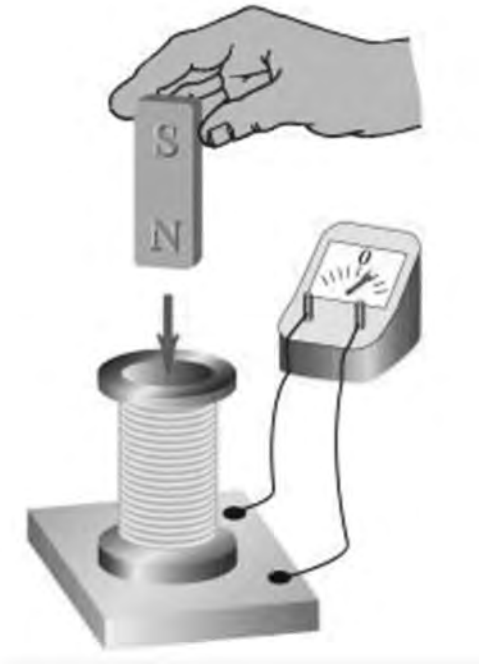
© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

Answer **all** *questions.*

1. *(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.

(i) Explain these observations. [3]

.....

.....

.....

.....

(ii) Complete the following sentences: [2]

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

.....

.....

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

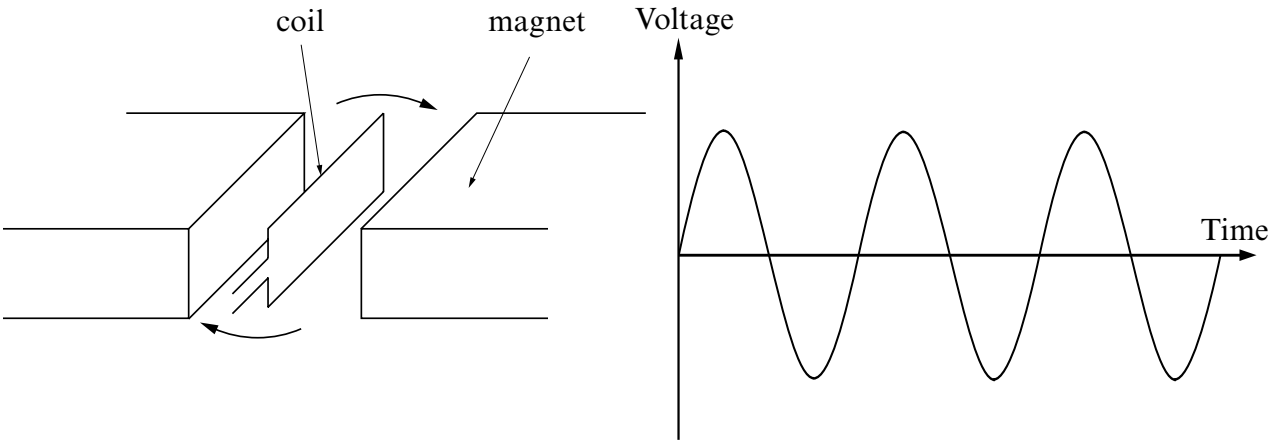
.....

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

(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	.....	.....

0247 020005

8

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

2. *(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*

.....

.....

.....

.....

.....

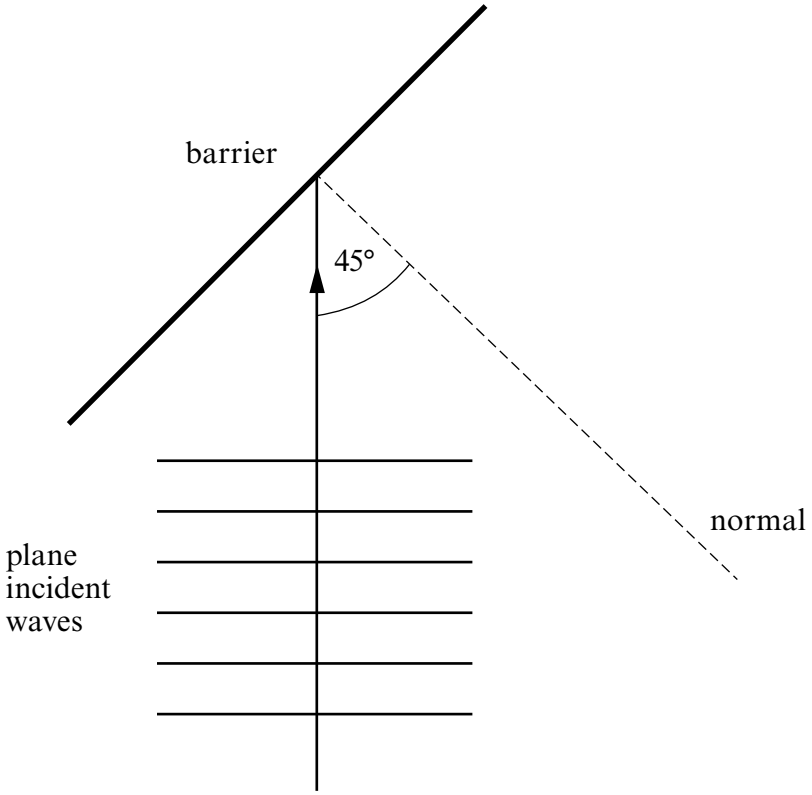
.....

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

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



0247
020007

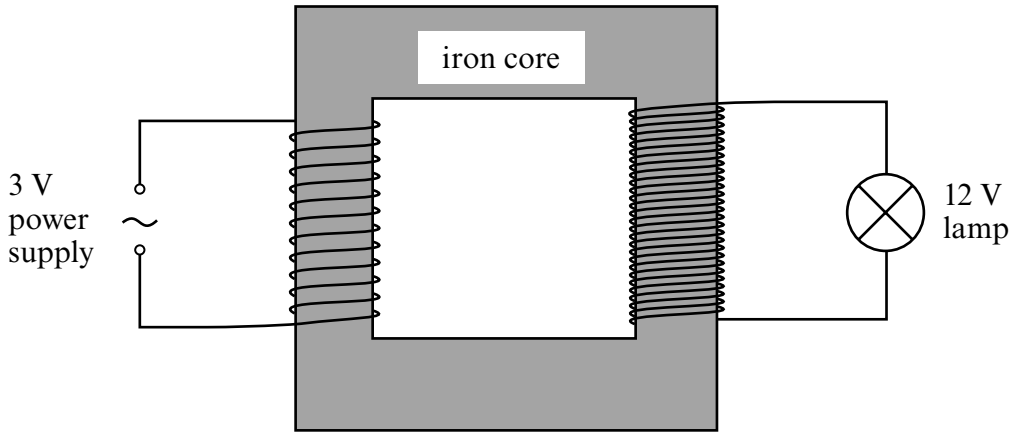
5

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

3. 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]

.....

.....

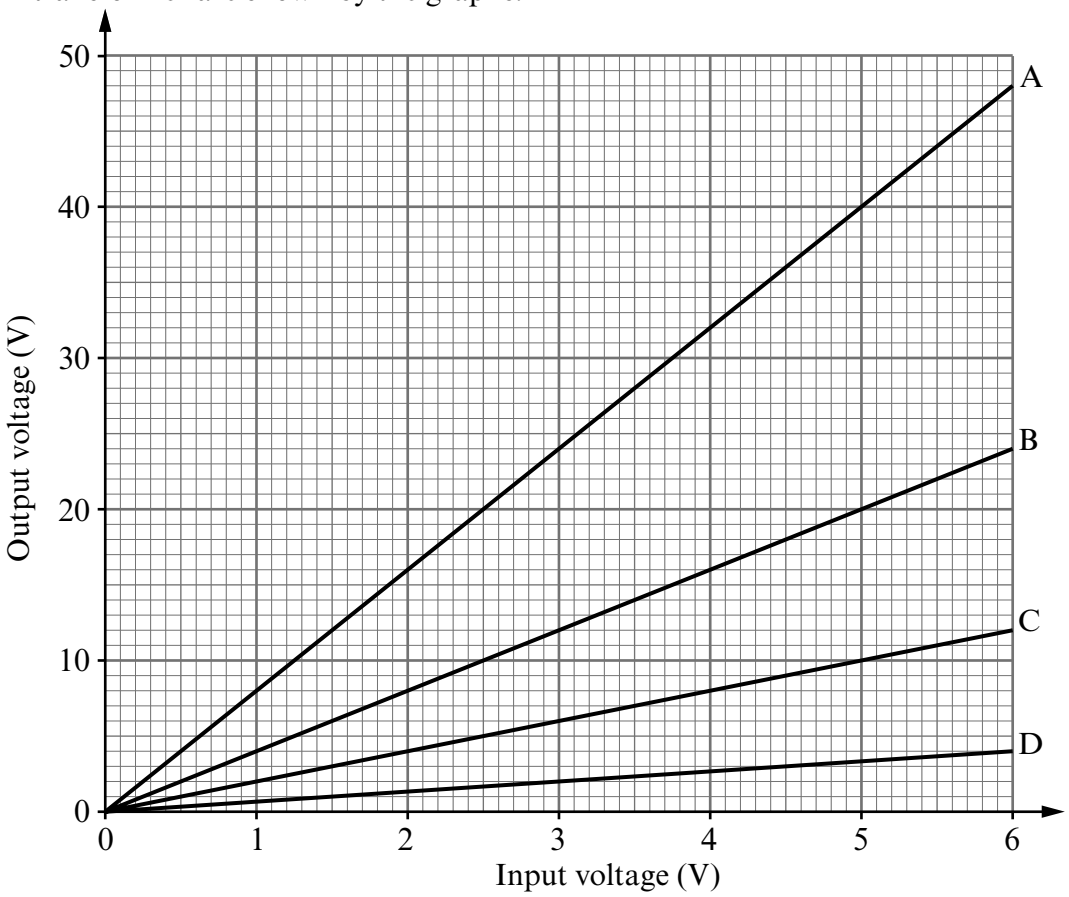
.....

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

(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]

.....

.....

(iii) Transformer B contains 50 turns on its primary coil.
Write down an equation from page 2 and use it to calculate the number of turns on its secondary coil.

Equation: ..... [1]

Calculation: [3]

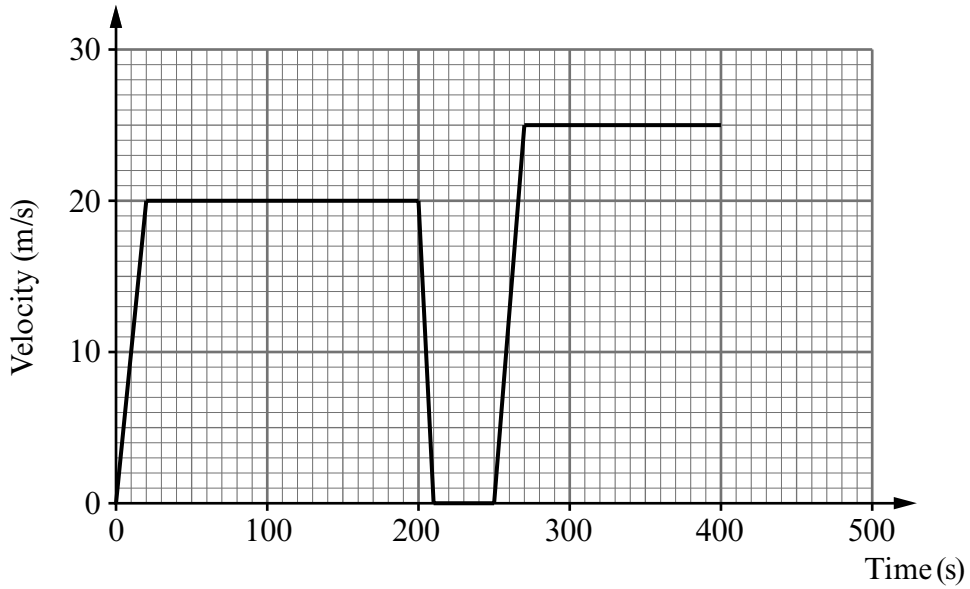
Number of turns on secondary coil = ...

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

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



(a) (i) Using information from page 2, calculate the initial acceleration of the train. [2]

Acceleration = ... m/s^2

(ii) Using information from page 2, calculate the distance travelled in the first 210 s. [2]

Distance travelled = ... m

(b) Between 250 s and 400 s the train travelled a distance of 3500 m.
Using an equation from page 2, calculate the mean speed between 0 and 400 s. [3]

Mean speed = ... m/s

7

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

5. The picture shows ultrasound being used for scanning an unborn baby.



(a) (i) What is ultrasound? [1]

.....

.....

.....

(ii) Explain how the ultrasound produces an image of the baby. [2]

.....

.....

.....

.....

(b) Narrow beams of ultrasound can be produced because they have much shorter wavelengths than normal sound. Ultrasound of frequency 6 MHz travels at a speed of 1500 m/s through the body.
Use the equation

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

to calculate the wavelength of the ultrasound waves. [3]

Wavelength = ... m

6

© WJEC CBAC Ltd.

Turn over.

STEMUP.CO.UK

Examiner only

6. The photograph shows a collision at traffic lights.



Car **A** was stationary when car **B**, travelling at 5 m/s went into the back of **A**. The collision caused car **B** to slow down to 2 m/s and car **A** to move forward. Car **A** had a mass of 600 kg and car **B** had a mass of 1200 kg.

(a) (i) State the law of conservation of momentum. [1]

.....

.....

.....

(ii) Use the equation

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

and the law of conservation of momentum to calculate the velocity with which car **A** moved off after the collision. [3]

Velocity = ... m/s

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

(iii) If the cars were in contact for 0.2 s, use the equation

$$\text{force} = \frac{\text{change of momentum}}{\text{time}}$$

to calculate the force exerted by car **B** on car **A**. [1]

Force = ... N

(iv) Explain how this force would be affected if both cars had been fitted with crumple zones. [2]

.....

.....

.....

.....

(b) Using an equation from page 2, calculate the kinetic energy lost by car **B** during the collision. [2]

KE lost = ... J

9

TURN OVER FOR QUESTION 7

© WJEC CBAC Ltd.

STEMUP.CO.UK

Examiner only

7. British scientists have drawn up plans to build the world's first nuclear fusion power station by 2030.

(a) Explain the difficulties that must be overcome in achieving nuclear fusion under controlled conditions. [2]

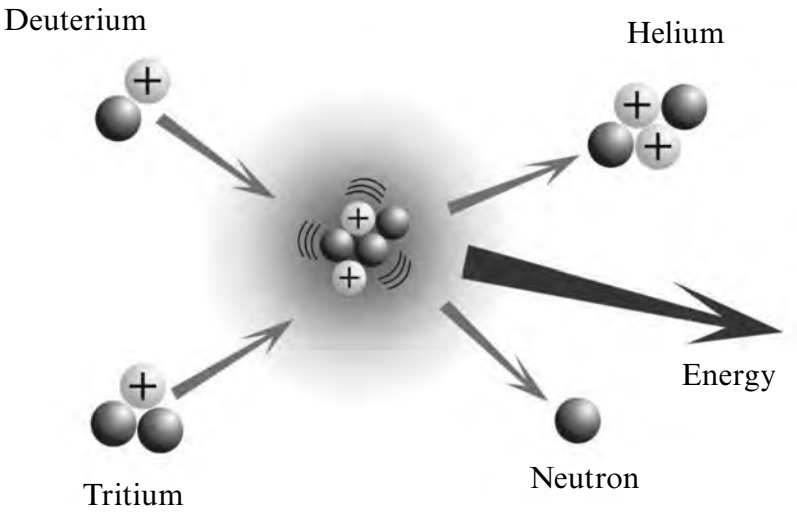
.....

.....

.....

.....

(b) The most promising fusion reaction is between two isotopes of hydrogen. These are deuterium and tritium. The reaction between the nuclei is shown in the diagram.



(i) Write down the nuclear equation for this reaction. [2]

..... + ... ⟶ ..... + ...

(ii) Tritium does not occur in nature. However tritium can be bred by bombarding $^{6}_{3}\mathrm{Li}$ with neutrons.

Compare the contents of a $^{6}_{3}\mathrm{Li}$ nucleus with those of a tritium nucleus. [2]

.....

.....

.....

.....

THERE ARE NO MORE QUESTIONS IN THE EXAMINATION.

6

© WJEC CBAC Ltd.

STEMUP.CO.UK

BLANK PAGE

© WJEC CBAC Ltd.

STEMUP.CO.UK

GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

SUMMER 2012

© WJEC CBAC Ltd.

STEMUP.CO.UK

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.

© WJEC CBAC Ltd.

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]**

© WJEC CBAC Ltd.

STEMUP.CO.UK

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]**

© WJEC CBAC Ltd.

STEMUP.CO.UK

<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>

© WJEC CBAC Ltd.

STEMUP.CO.UK

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**

© WJEC CBAC Ltd.

STEMUP.CO.UK

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>

© WJEC CBAC Ltd.

STEMUP.CO.UK

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**

© WJEC CBAC Ltd.

STEMUP.CO.UK

Candidate Name	Centre Number	Candidate Number
		0

WJEC CBAC

GCSE

247/02

SCIENCE PHYSICS
HIGHER TIER
PHYSICS 3

A.M. FRIDAY, 27 May 2011

45 minutes

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

0247 020001

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.

STEMUP.CO.UK

EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

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

$$v = u + at$$

$$v^2 = u^2 + 2ax$$

$$x = ut + \tfrac{1}{2}at^2$$

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

where x = distance
u = initial velocity
v = final velocity
a = acceleration
t = time

$$\frac{V_1}{V_2} = \frac{N_1}{N_2}$$

where V_1 = voltage across the primary
V_2 = voltage across the secondary
N_1 = number of primary turns
N_2 = number of secondary turns

momentum = mass × velocity

kinetic energy = $\frac{mv^2}{2}$, where m = mass,
v = velocity or speed.

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

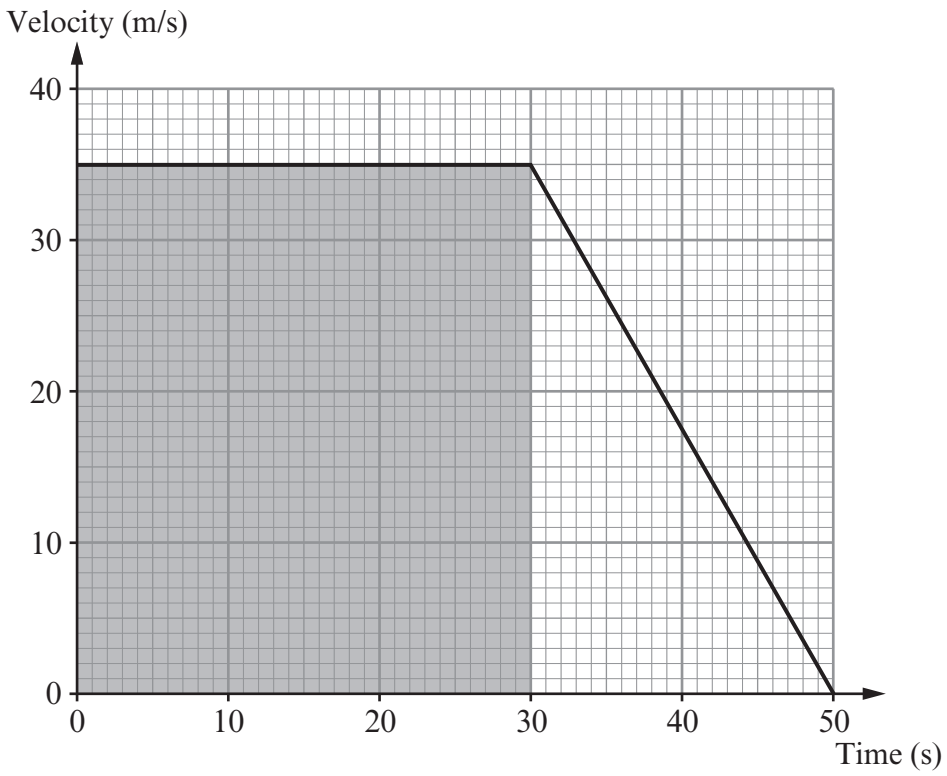
wave speed = wavelength × frequency

STEMUP.CO.UK

Examiner only

Answer **all** *questions.*

1. 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]

STEMUP.CO.UK

Examiner only

2. 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]

.....

.....

4

STEMUP.CO.UK

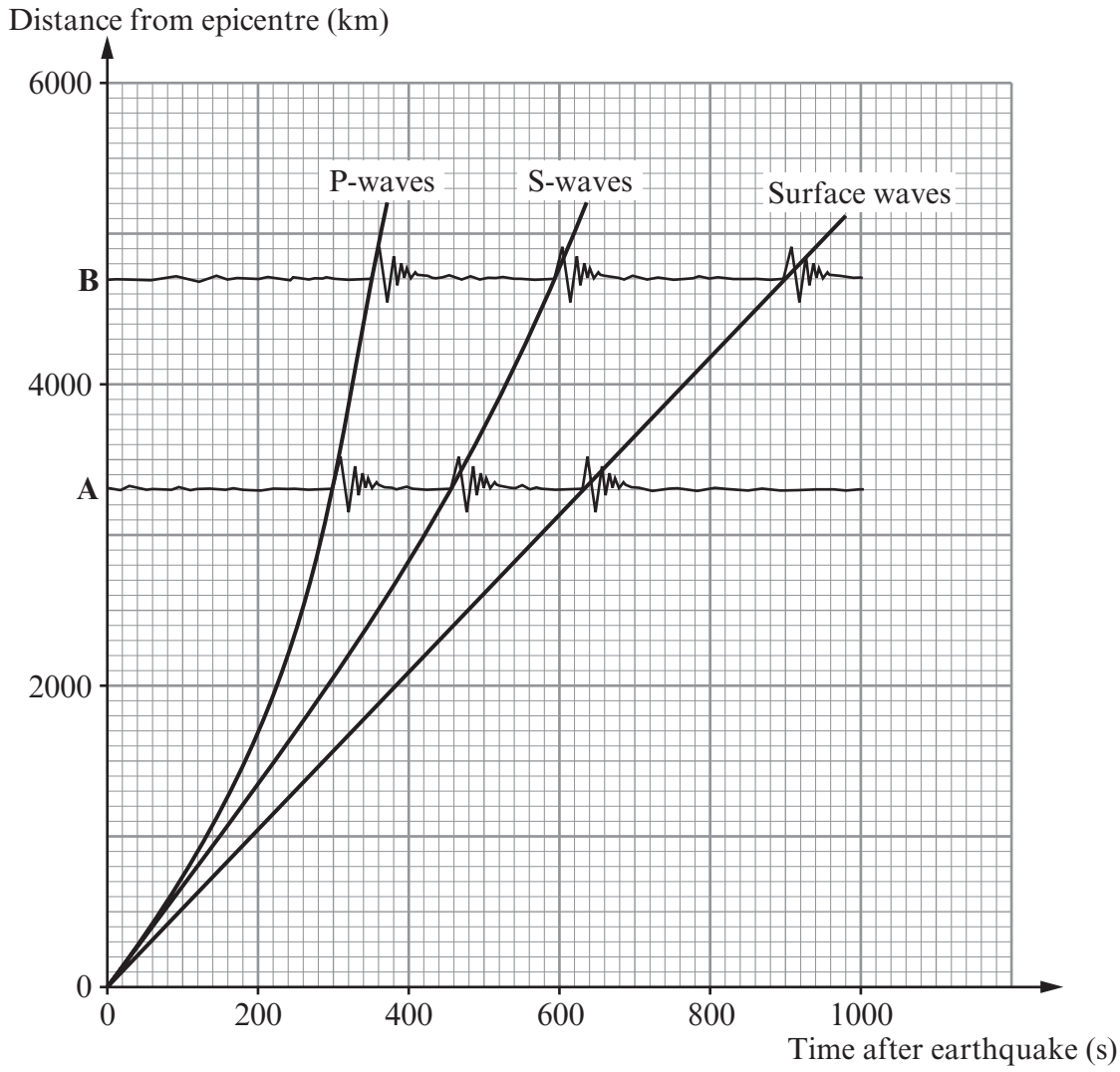
0247
020005

BLANK PAGE

STEMUP.CO.UK

Examiner only

3. 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]

.....

.....

STEMUP.CO.UK

Examiner only

(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]

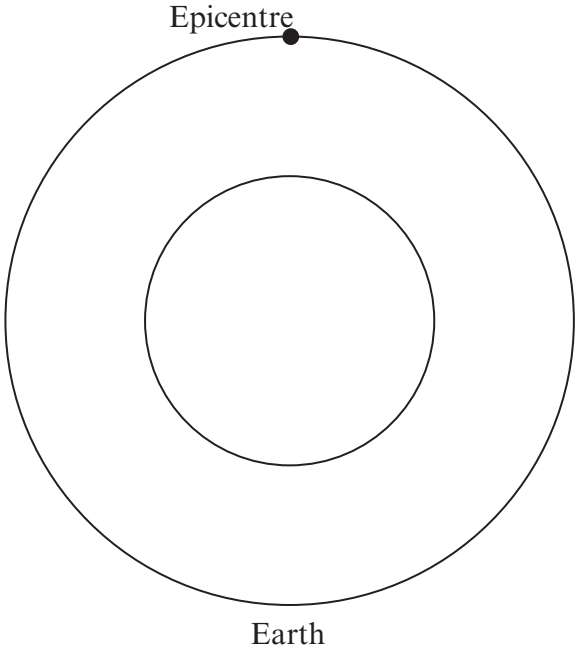
.....

.....

.....

.....

(c) Write a brief account of how the study of the paths of **P** and **S** waves through the Earth has enabled geophysicists to produce a model of the Earth's structure. [4]
[Credit will be given for adding appropriately to the diagram of the Earth to illustrate your answer.]



.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

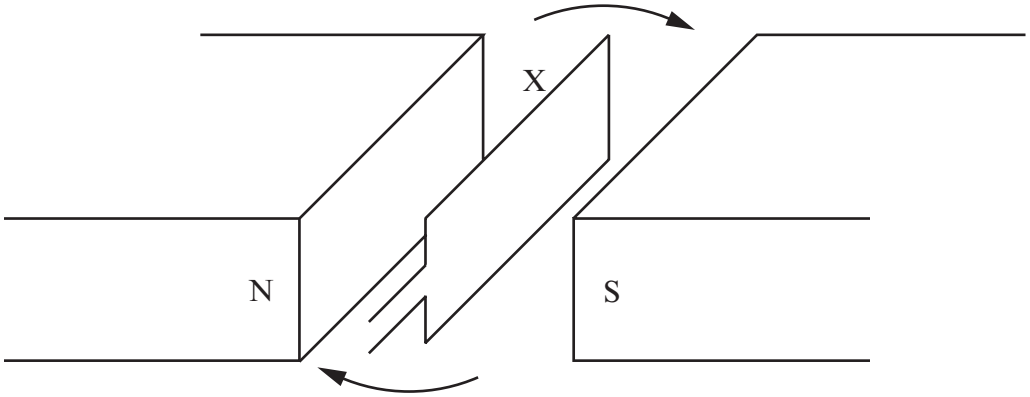
.....

0247
020007

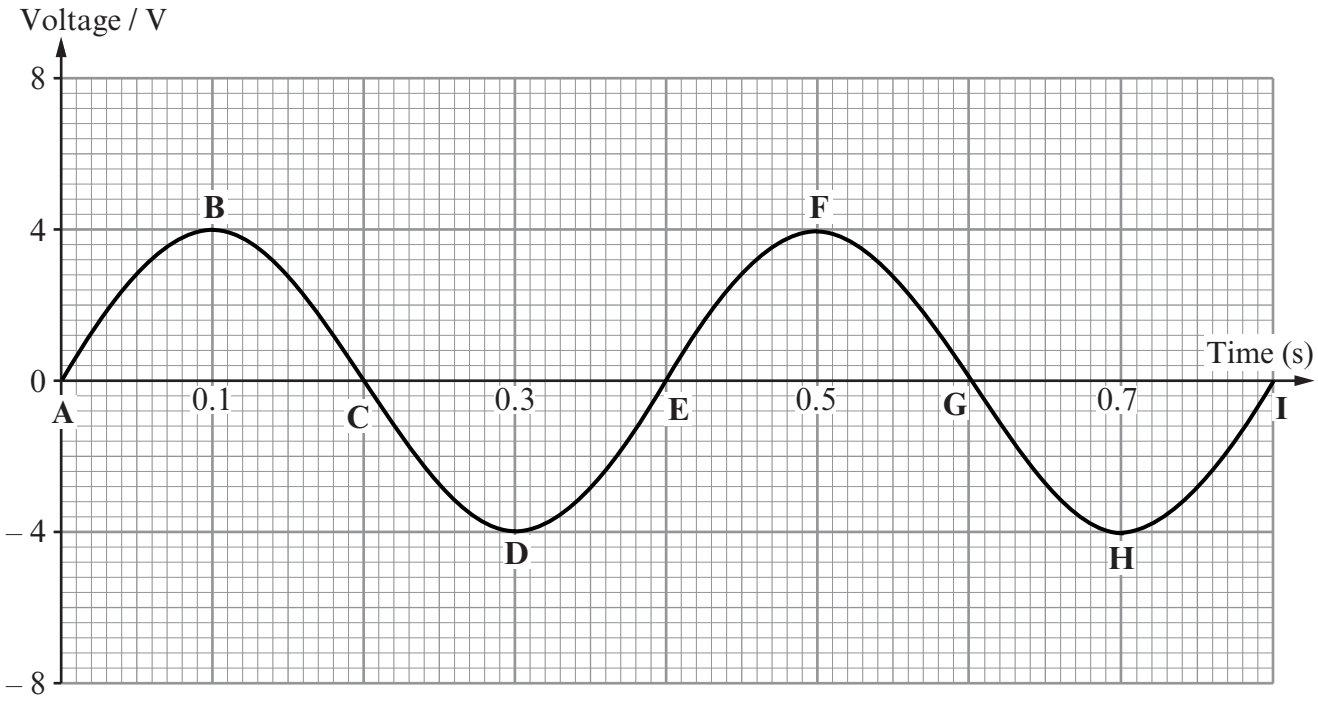
STEMUP.CO.UK

Examiner only

4. The diagram shows a simple a.c. generator. It is a coil of wire which is made to rotate clockwise at constant speed in a magnetic field.



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



(a) Explain why the output varies as the coil rotates. [3]

.....

.....

.....

.....

.....

.....

.....

STEMUP.CO.UK

Examiner only

(b) When wire X is in the position shown in the diagram the output voltage produced is shown by points **A**, **E**, and **I**.

(i) State **one** point of the voltage graph which gives the output voltage when the coil is horizontal with wire X near the South pole.

..... [1]

(ii) Describe the position of the coil and wire X that gives an output voltage that corresponds to point **G**. [1]

.....

.....

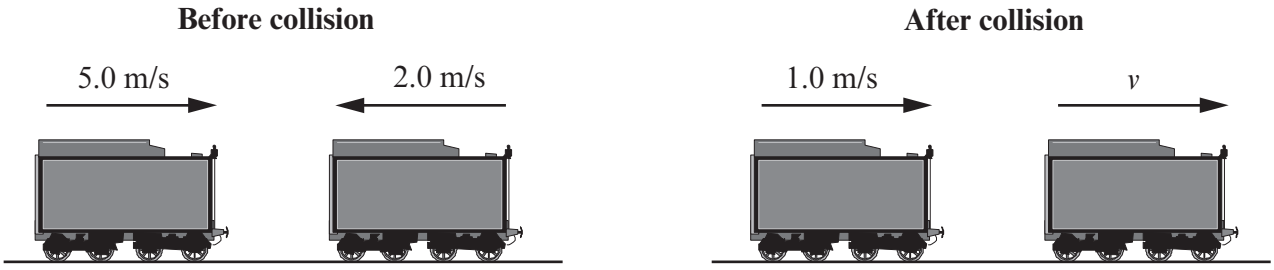
(c) **Draw a graph on the same grid** to show the output voltage produced when the speed of rotation of the coil is doubled. [3]

8

STEMUP.CO.UK

Examiner only

5. Two trucks, **A** and **B**, each of mass 5 000 kg, collide as shown in the diagrams.



(a) (i) The momentum of a body is given by

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

State the law of conservation of momentum and use it to calculate the velocity, v, of truck **B** after the collision. [3]

.....

.....

v = ... m/s

(ii) The duration of the collision is 0.4 s.
Use the equation

$$\text{Force} = \frac{\text{change of momentum}}{\text{time}}$$

to calculate the force exerted by truck **A** on truck **B** during the collision. [2]

Force = ... N

STEMUP.CO.UK

Examiner only

(b) (i) Calculate the kinetic energy lost by truck **A** during the collision. [1]

$$\text{Kinetic energy} = \frac{\text{mass} \times \text{velocity}^2}{2}$$

Kinetic energy lost = ... J

(ii) Explain what has happened to this lost kinetic energy. [2]

.....

.....

.....

.....

0247 020011

8

STEMUP.CO.UK

Examiner only

6. *(a)* The equation represents the decay of iodine-131 by β emission to Xenon-131.

$$^{131}_{53}\text{I} \longrightarrow {}^{131}_{54}\text{Xe} + {}^{0}_{-1}\beta$$

Compare the nuclei of I-131 and Xe-131 in terms of their charge, mass and their constituent particles. [3]

.....

.....

.....

.....

.....

.....

(b) The table shows a decay series for radon-222.

Element	Nuclear Symbol	Radioactive emission
Radon	$^{222}_{86}$Rn	α
Polonium	$^{218}_{84}$Po	α
Lead	.....$_{82}$Pb	β
Bismuth	^{214}.....Bi	.....
Polonium	.....$_{84}$Po	α
Lead	$^{210}_{82}$Pb	stable

(i) **Complete the table** by filling in the gaps. [4]

(ii) Two of the nuclei in the series are isotopes of Polonium.
Explain the meaning of the term *isotope*. [1]

.....

.....

8

STEMUP.CO.UK

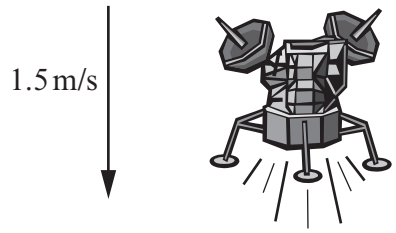
BLANK PAGE

QUESTION 7 IS ON PAGE 14

STEMUP.CO.UK

Examiner only

7. The diagram shows a lunar module descending at a constant speed of 1.5 m/s under the action of retrorockets.



surface of the moon

Three seconds before landing, the retrorockets are switched off and the lunar module falls to the surface with an acceleration of 1.6 m/s^2.

(a) Select an equation from page 2 and use it to show that the height of the lunar module above the surface when the retrorockets are switched off is 11.7 m.

Equation: .....

..... [1]

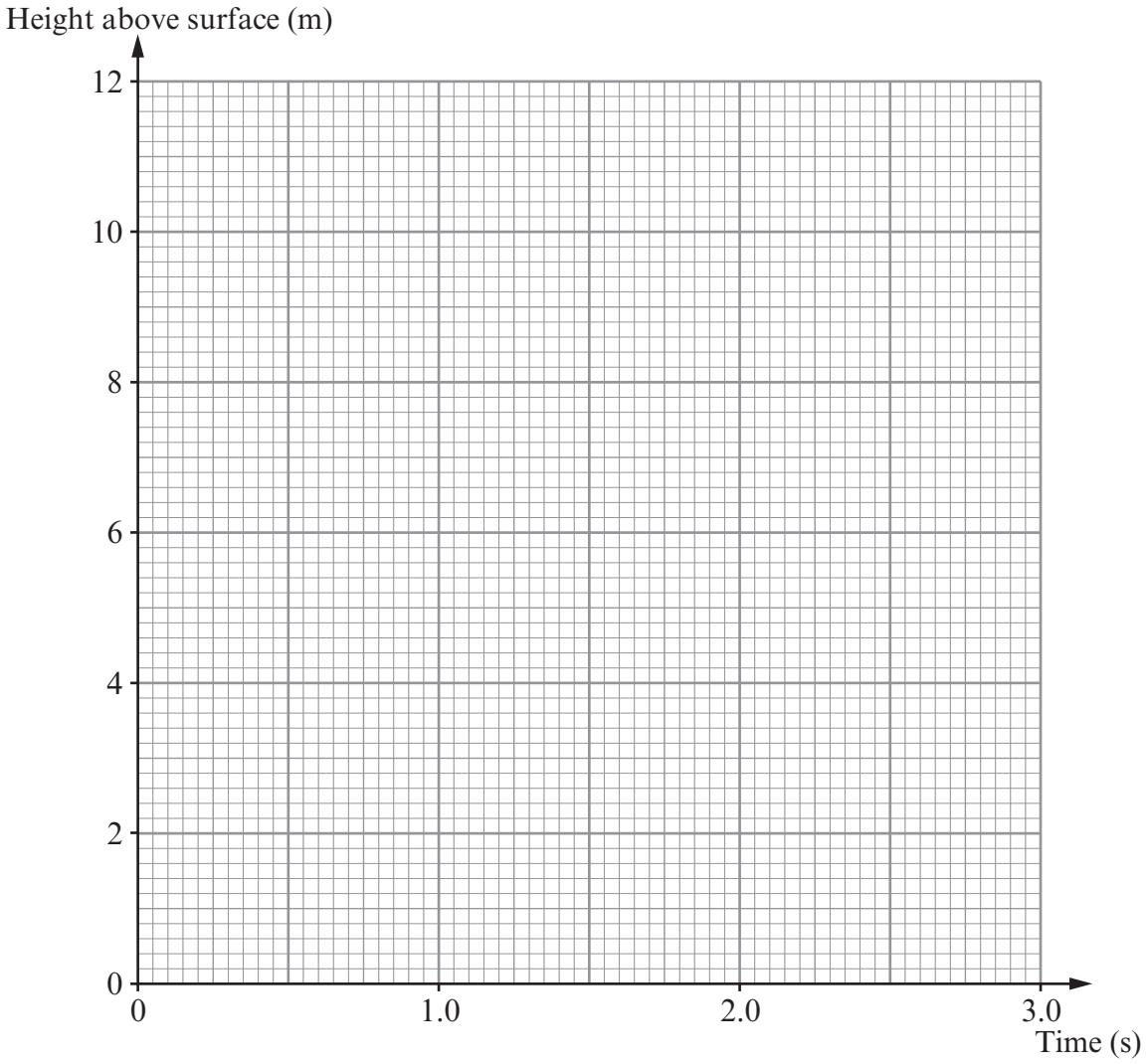
Calculation: [2]

(b) Complete the table and graph to show how the height of the lunar module changes in the last 3 seconds of its motion. [4]

Time after rockets switched off (s)	0.0	1.0	2.0	3.0
Distance moved by lunar module towards moon's surface (m)	0.0	.....	.....	11.7
Height above surface (m)	11.7	.....	.....	0.0

STEMUP.CO.UK

Examiner only



Space for working:

7

STEMUP.CO.UK