Candidate Name	Centre Number	Candidate Number
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WJEC CBAC

GCSE

247/02

SCIENCE PHYSICS
HIGHER TIER
PHYSICS 3

P.M. WEDNESDAY, 11 June 2008

45 minutes

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

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

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.

EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

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

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

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

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

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

wave speed = frequency × wavelength

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

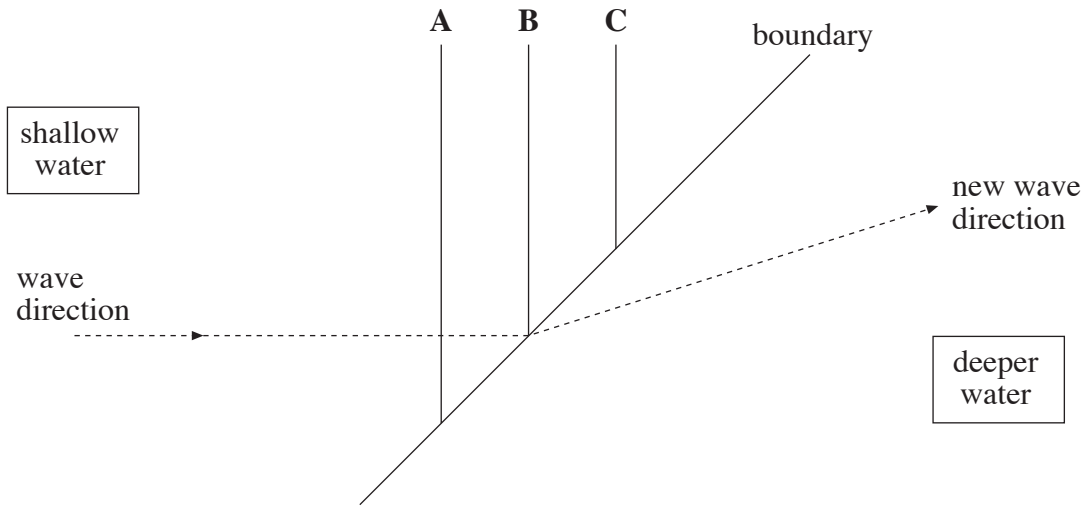
momentum = mass × velocity

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

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

*Answer **all** questions.*

1. The diagram shows the crests, **A**, **B** and **C**, of water waves travelling from shallow to deeper water. At the boundary, the waves change direction.



(a) **Complete the diagram** to show the crests of waves **A**, **B** and **C**, in the deeper water. [2]

(b) (i) Give a reason why the waves change direction at the boundary.

.....

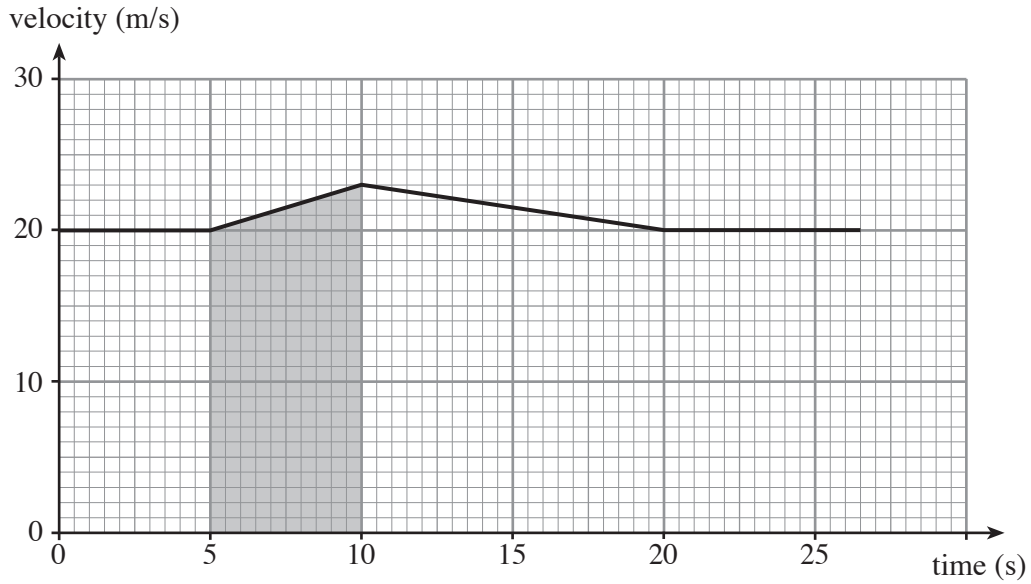
.....

(ii) State how the wavelength of the waves changes as they enter the deeper water.

..... [2]

4

2. A car overtakes a lorry. In doing so, the car accelerates and, after overtaking safely, returns to its original speed.
The graph represents the motion of the car when overtaking the lorry.



(a) Write down an equation, as it appears on page 2, and then use it, together with data from the graph, to calculate the acceleration of the car during overtaking.

Equation: .....

..... [1]

Calculation: [2]

Acceleration = ... m/s^2.

(b) Describe clearly what the shaded area of the graph represents. [2]

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(c) Write down an equation, as it appears on page 2, and then use it, together with data from the graph, to calculate the distance travelled between 10 s and 20 s

Equation: .....

..... [1]

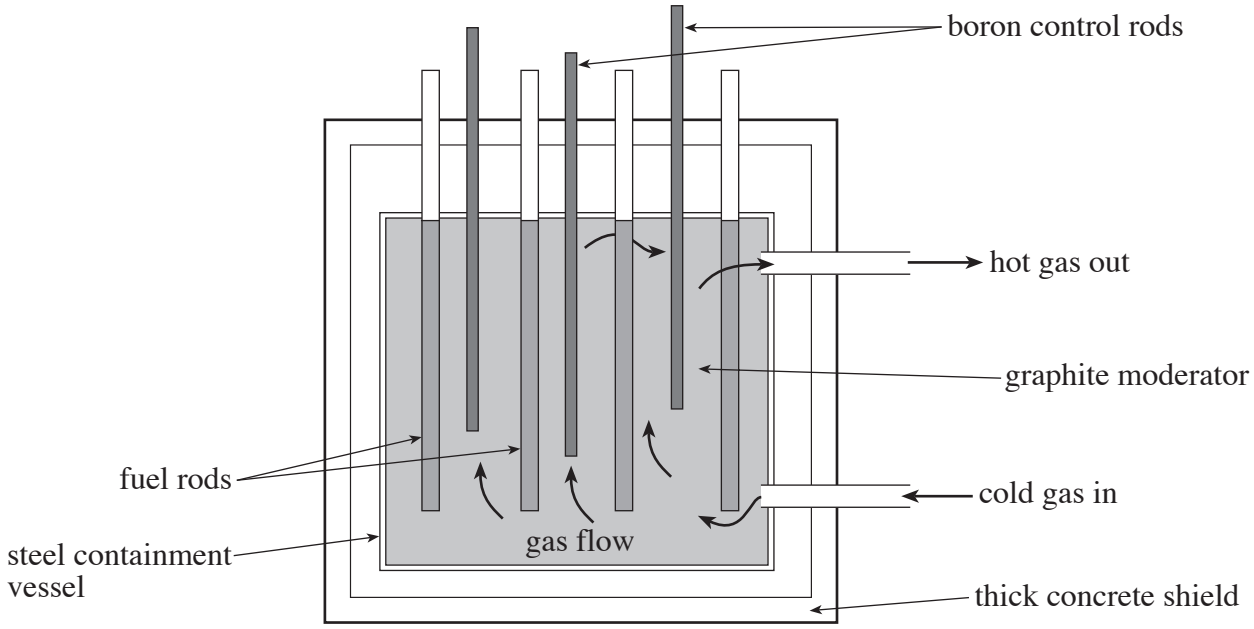
Calculation: [2]

Distance travelled = ... m.

8

3. 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.



In the reactor, energy is released by fission and is the result of a controlled chain reaction.

Fuel rods are made of U-238 (uranium 238) enriched with 3% of U-235. Only U-235 produces energy by fission. The U-235 nucleus captures a slow-moving neutron and splits to produce two new radioactive nuclei and up to three fast-moving extra neutrons plus energy.

The graphite moderator, surrounding the fuel rods, slows down the neutrons produced during fission. The extra neutrons, once slowed down, can produce more fission with other U-235 nuclei, which results in the release of even more energy and more neutrons.

The boron control rods readily absorb neutrons to reduce their number so that the chain reaction can be slowed or stopped. This prevents an uncontrolled chain reaction occurring.

Gas circulating the reactor carries away the heat energy produced to be used in electricity generation.

The whole core is encased in a steel-lined concrete shield to absorb stray neutrons and other radiation produced in the reactor.

(a) (i) Describe the process of fission as it occurs in a gas-cooled reactor. [2]

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(ii) Explain how the moderator helps the reaction. [2]

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(iii) Explain how and why the partial removal of the boron control rods would affect the energy production in the reactor. [2]

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(b) The reaction that takes place can be represented by the equation:

$$^{235}_{92}\mathbf{U} + {}^{1}_{0}\mathrm{n} \longrightarrow {}^{a}_{b}\mathbf{X} + {}^{90}_{36}\mathbf{Y} + {}^{1}_{0}\mathrm{n} + {}^{1}_{0}\mathrm{n} + {}^{1}_{0}\mathrm{n} + \text{Energy}$$

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

(i) What do the numbers 235 and 92 tell us about the particles in the U-235 nucleus? [2]

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.....

.....

(ii) Use the information in the equation to calculate:

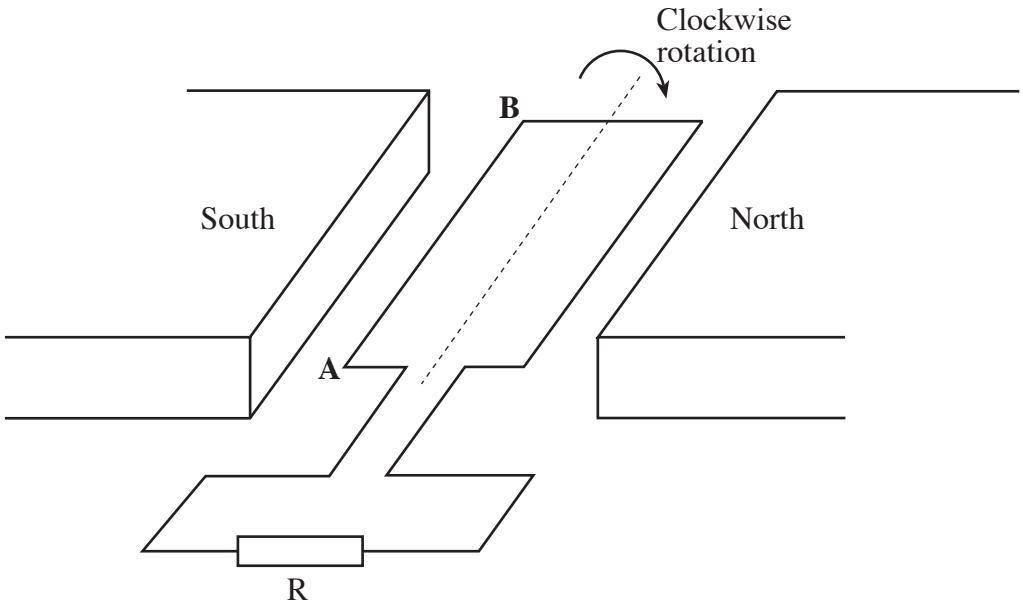
A. the mass number [nucleon number] of element **X**;

Mass number [nucleon number] = ...

B. the atomic number [proton number] of element **X**.

Atomic number [proton number] = ...
[2]

4. 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, an alternating voltage is produced which drives an alternating current through the coil and resistor R.

(a) (i) Explain why the current (and voltage) produced is a maximum when the coil moves through the position shown in the diagram. [2]

.....

.....

.....

.....

(ii) Use Fleming's Right Hand Rule to **mark on the diagram** the direction of the current through **AB** for the coil in the position shown. [1]

(b) (i) Describe **carefully** how the current through R changes as the coil is rotated through 180° from the position shown in the diagram. [2]

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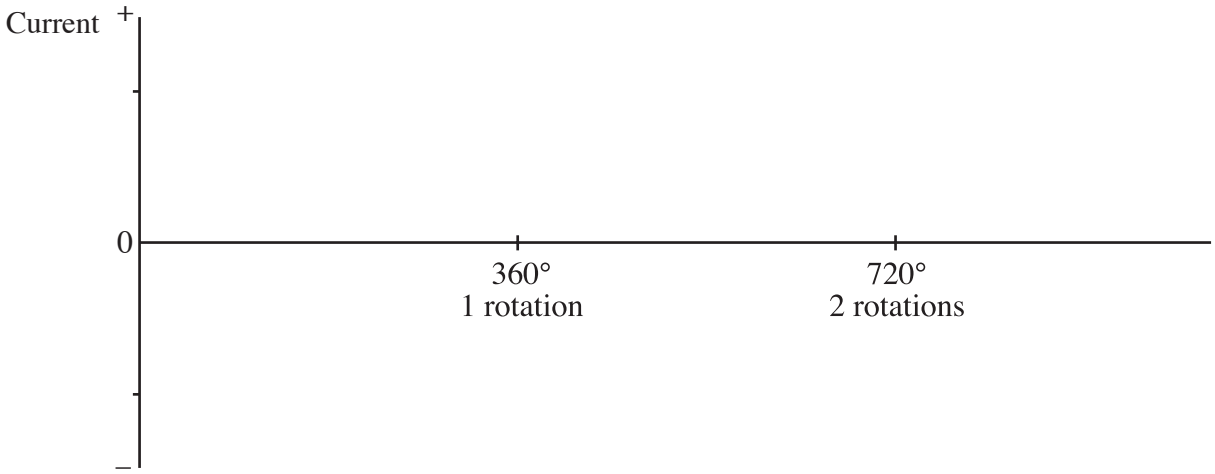
(ii) Hence sketch a graph on the axes below of how the current varies with the rotation of the coil from the position shown. [2]



(iii) Increasing the speed of rotation of the coil increases the size of the output current and voltage. State one other effect increasing the speed of rotation has on the output from the generator. [1]

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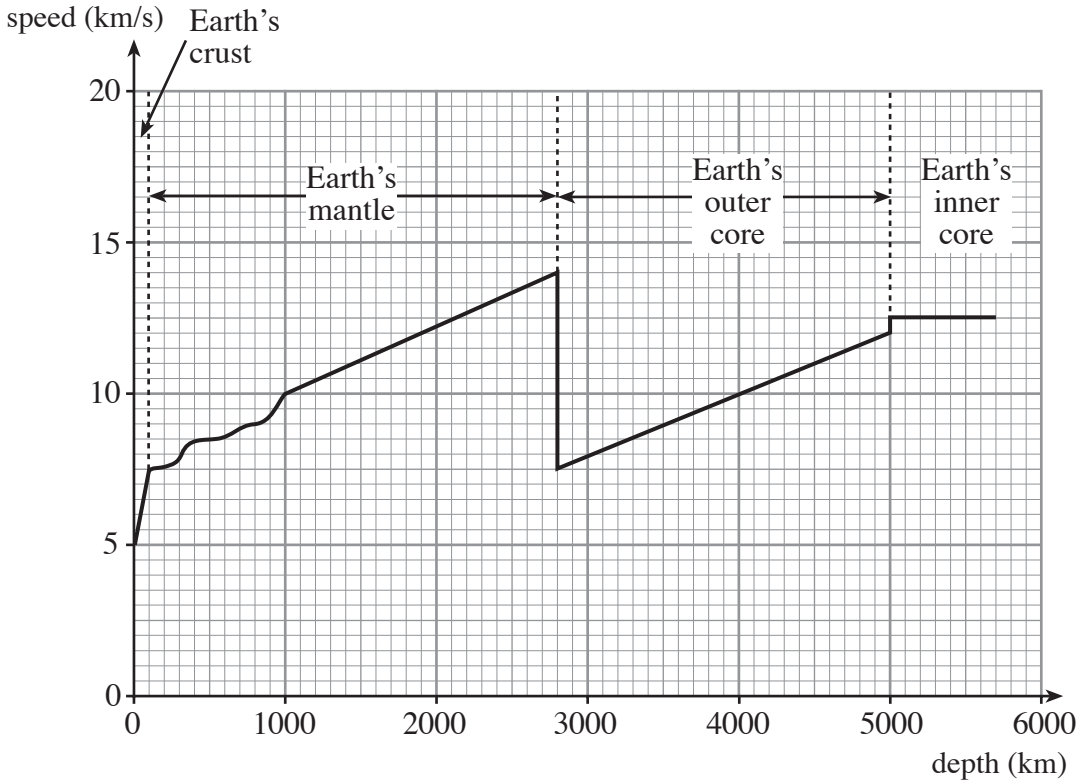
5. The graph shows how the speed of P waves (earthquake waves) changes with depth inside the Earth.



(a) (i) At what depth is the boundary between the mantle and the outer core?

..... km

(ii) **State how and explain why** the P-wave speed changes as it moves from the mantle to the outer core.

.....

.....

..... [3]

(b) Use the graph to

(i) calculate the thickness of the outer core; Thickness = ... km

(ii) estimate the average speed of P waves through the outer core.

Average speed = ... km/s
[2]

(c) Write down an equation as it appears on page 2 and then use it to calculate the time it would take a P wave to travel through the outer core from the boundary with the mantle to the boundary with the inner core.

Equation: .....

..... [1]

Calculation: [2]

Time = ... s

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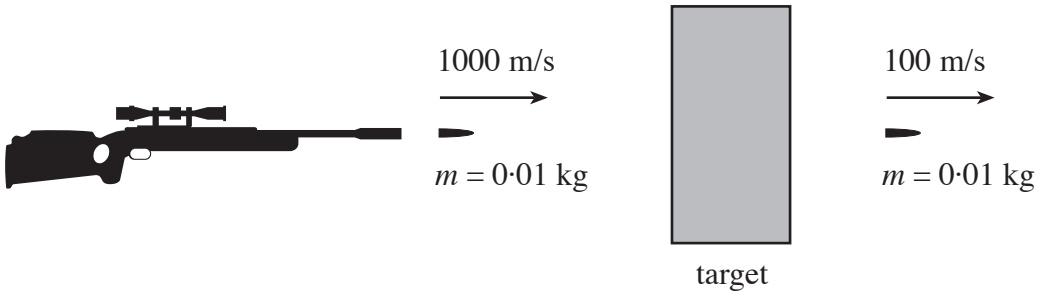
6. A gun fires a bullet of mass 0·01 kg, with a speed of 1000 m/s, at a target. The bullet passes through the target, emerging with a speed of 100 m/s.



(a) (i) Use the equation

momentum = mass × velocity

to calculate the change in momentum of the bullet passing through the target. [3]

Change of momentum = ... kg m/s

(ii) The bullet took 0·000 5 s to pass through the target.
Write down an equation as it appears on page 2 and then use it to calculate the average force exerted by the target on the bullet.

Equation: .....

..... [1]

Calculation: [2]

Average force = ... N

(b) (i) The gun has a mass of 1·25 kg. When the bullet is fired, the gun recoils with a velocity of 8 m/s.
Write down an equation as it appears on page 2 and then use it to calculate the **total** kinetic energy released when the bullet is fired from the gun.

Equation: .....

..... [1]

Calculation: [3]

Total kinetic energy = ... J

(ii) Explain why, when an explosion occurs, the smallest fragments travel the furthest and cause the most damage or injury. [2]

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