

Surname	Centre Number	Candidate Number
Other Names		0



**GCSE**  
4503/02  
**PHYSICS**  
**PHYSICS 3**  
**HIGHER TIER**

P.M. MONDAY, 19 May 2014  
1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	12	
2.	6	
3.	11	
4.	11	
5.	8	
6.	12	
<b>Total</b>	<b>60</b>	

**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.

You are reminded that assessment will take into account the quality of written communication (QWC) used in your answers to questions **3(a)** and **6(c)**.

## Equations

$V_1$ = voltage on the primary coil $V_2$ = voltage on the secondary coil $N_1$ = number of turns on the primary coil $N_2$ = number of turns on the secondary coil	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$
power = voltage $\times$ current	$P = VI$
speed = $\frac{\text{distance}}{\text{time}}$	
$u$ = initial velocity $v$ = final velocity $t$ = time $a$ = acceleration $x$ = displacement	$v = u + at$ $v^2 = u^2 + 2ax$ $x = ut + \frac{1}{2}at^2$ $x = \frac{1}{2}(u + v)t$
momentum = mass $\times$ velocity	$p = mv$
kinetic energy = $\frac{\text{mass} \times \text{speed}^2}{2}$	$KE = \frac{1}{2}mv^2$
pressure = $\frac{\text{force}}{\text{area}}$	$p = \frac{F}{A}$
	$T / K = \theta / ^\circ C + 273$
$p$ = pressure $V$ = volume $T$ = kelvin temperature	$\frac{pV}{T} = \text{constant}$
density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
	$E = mc^2$

## SI multipliers

Prefix	Multiplier
p	$10^{-12}$
n	$10^{-9}$
$\mu$	$10^{-6}$
m	$10^{-3}$

Prefix	Multiplier
k	$10^3$
M	$10^6$
G	$10^9$
T	$10^{12}$

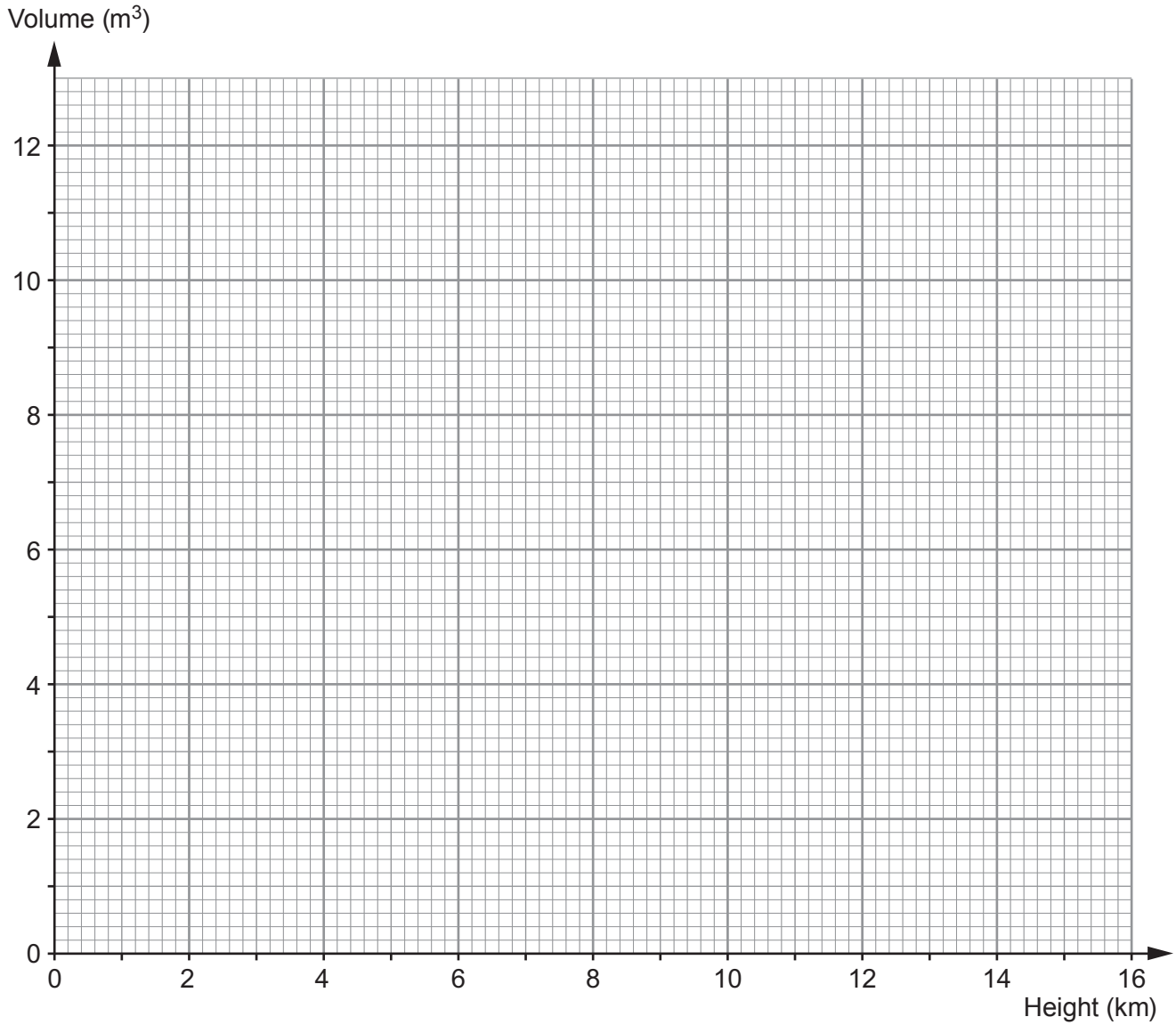
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Answer all questions.

1. A balloon is filled with  $2.0\text{m}^3$  of helium and released. The following table shows data for the balloon as it rises.

Height of balloon above the ground (km)	Volume of balloon ( $V$ ) ( $\text{m}^3$ )	Helium pressure ( $p$ ) ( $\text{kN/m}^2$ )	$pV$ ( $\text{kN m}$ )
0	2.0	100	200
2	2.4	80	.....
4	3.0	60	180
6	3.6	50	180
8	4.4	40	176
10	5.8	30	174
12	8.1	.....	162

- (a) (i) **Complete** the table. [2]
- (ii) Use the data in the table to plot a graph of **volume** against **height** of the balloon on the grid opposite. [3]



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(b) (i) Use your graph to describe how the **volume** of the balloon changes as the **height** increases. [2]

.....

.....

.....

(ii) Use the information in the table to give a reason why this volume change occurs. [1]

.....

.....

(iii) The balloon bursts when its volume reaches  $12\text{ m}^3$ . **Continue** your graph to estimate at what height this happens. [2]

height = ..... km

(c) The volume of the balloon is also affected by changes in temperature.

(i) State how a decrease in temperature affects the volume of the balloon.

[1]

.....

(ii) Give a reason for your answer in terms of molecules.

[1]

.....

.....

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2. The diagram shows the path of a signal through a glass fibre.



(a) State the name given to the change in direction of the signal: [2]

(i) at **A**; .....

(ii) at **B**. .....

(b) (i) Give a reason why the signal changes direction at **A**. [1]

.....  
 .....

(ii) State the **two** conditions needed for the signal to change direction at **B**. [2]

1. ....

2. ....

(c) **Add** a line to the diagram to show how the signal leaves the glass fibre at **C**. [1]

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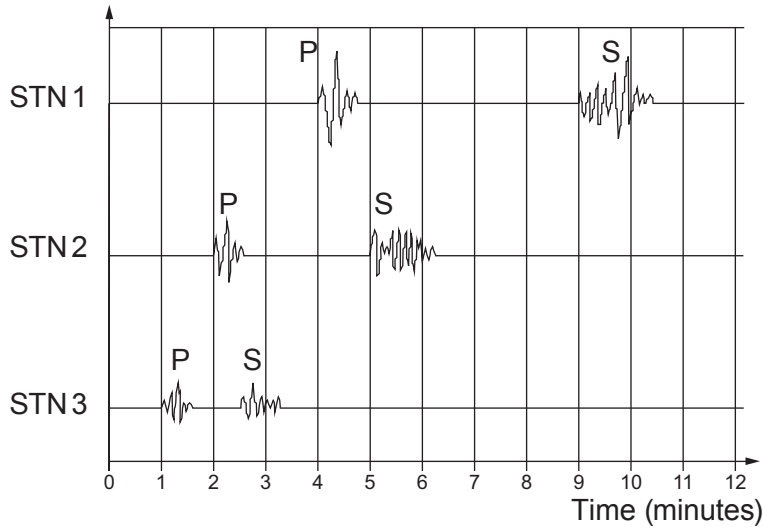
(b) By looking at the seismograms from different monitoring stations we can find out their distances from the epicentre of the earthquake. The signals arriving at 3 stations named as STN 1, STN 2 and STN 3 are shown below. (STN = station.)

(i) Use the information in the diagram and graph below to find the distance from the STN2 monitoring station to the epicentre of the earthquake, describing how you arrive at your answer. [2]

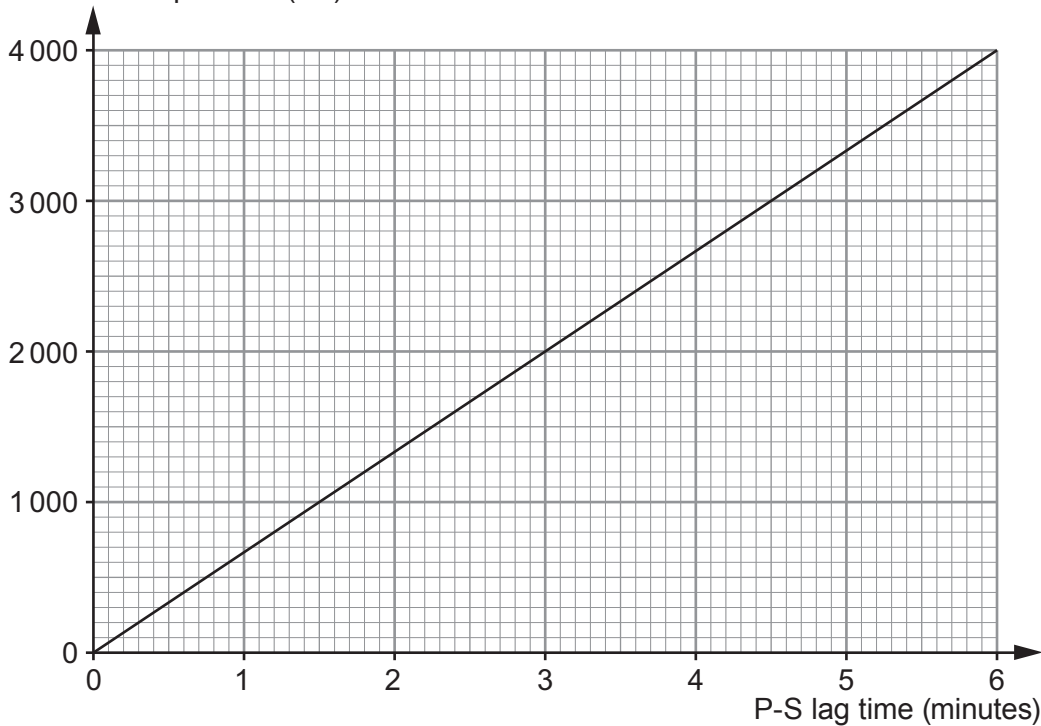
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STN2 distance from epicentre = ..... km

Plot of arrival of P and S waves at the three different monitoring stations



Distance from epicentre (km)



(ii) **Describe** how you would determine the position of the epicentre of the earthquake using your answer in (b)(i) and the information below. **Show** its position on the diagram below. [3]

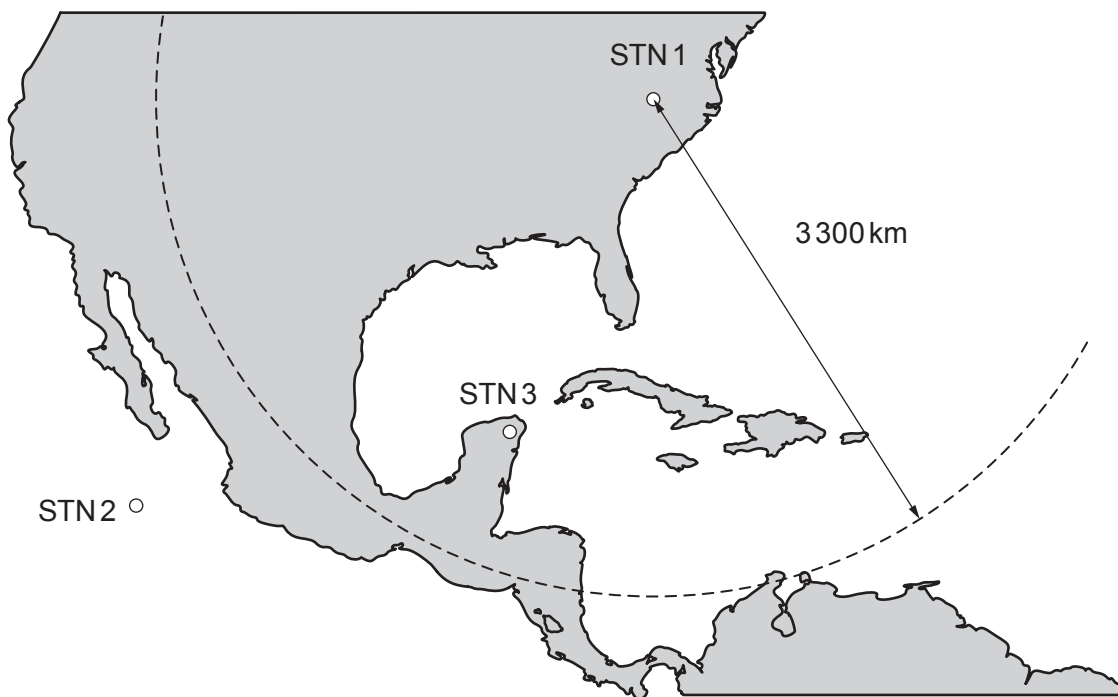
STN 1 distance from epicentre = 3 300 km

STN 3 distance from epicentre = 900 km

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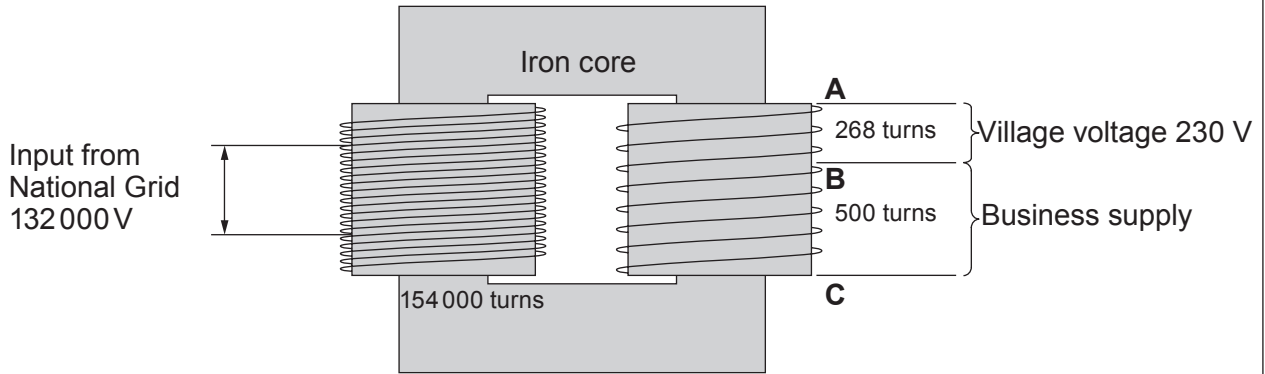
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Scale: 1 cm to 500 km

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4. A transformer supplies both a village and a business with electricity from the National Grid. The business and the village need electricity at different voltages so they are connected to different numbers of secondary turns on the iron core of the transformer.



- (a) Using an equation from page 2 and information from the diagram calculate the voltage supplied to the business. [3]

business supply voltage = ..... V

- (b) During a severe storm the connections from the transformer are altered by a falling tree. The **village is now connected to A and C.**

- (i) Explain what effect, if any, this would have on the voltage supplied to the village. [2]

.....

.....

.....

- (ii) State the effect, if any, you would expect this to have on the village. [1]

.....

- (iii) Explain what effect, if any, this would have on the business. [2]

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(c) Describe how a transformer works.

[3]

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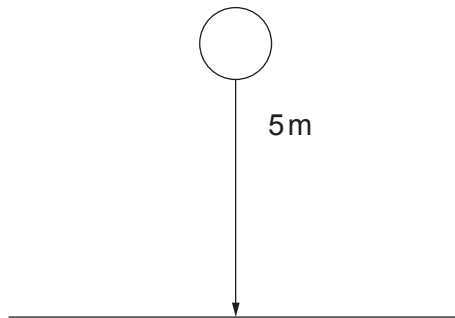
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5. A ball of mass 0.2 kg, initially at rest, is dropped from a height of 5 m.



Use equations from page 2 to answer the following questions.  
Assume acceleration due to gravity =  $10 \text{ m/s}^2$  and that air resistance is negligible.

- (i) Calculate the speed with which the ball hits the ground.

[3]

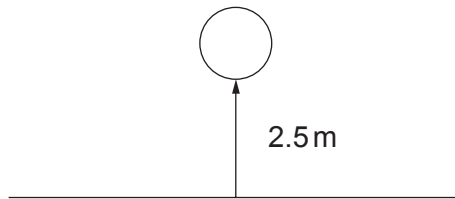
speed = ..... m/s

- (ii) As the ball rebounds it loses **half of its kinetic energy**. Calculate the rebound speed.

[2]

speed = ..... m/s

- (iii) The ball rebounds to a maximum height of 2.5 m. Calculate how long it takes to reach this height after it rebounds. [3]

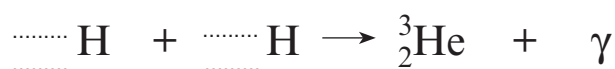


time = ..... s

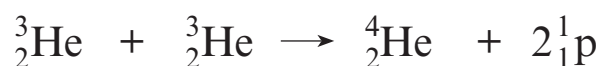
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6. (a) The Sun produces energy by nuclear fusion. One of the nuclear fusion reactions that takes place in the Sun is shown in the equation below. Complete the equation. [2]



- (b) Another nuclear fusion reaction in the Sun is shown below.



- (i) Use the information below to calculate the difference between the mass of the products and the reactants (i.e. the mass lost in the reaction in atomic mass units u). [2]

Nuclear mass of  $\begin{array}{c} 3 \\ 2 \end{array} \text{He} = 3.014932 \text{ u}$

Nuclear mass of  $\begin{array}{c} 4 \\ 2 \end{array} \text{He} = 4.00151 \text{ u}$

Mass of a proton = 1.00728 u

mass loss = ..... u

- (ii) Use an equation from page 2 and your answer to (i) to calculate the energy released in this reaction. [2]

$1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$

$c = 3 \times 10^8 \text{ m/s}$

energy released = ..... J





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