Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4503/02

PHYSICS

PHYSICS 3
HIGHER TIER

P.M. MONDAY, 19 May 2014

1 hour

Suitable for Modified Language Candidates

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

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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.
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 × 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 × velocity	$p = mv$
kinetic energy = $\frac{\text{mass} \times \text{speed}^2}{2}$	$KE = \frac{1}{2}mv^2$
pressure = $\frac{\text{force}}{\text{area}}$	$p = \frac{F}{A}$
	$T / \text{K} = \theta / °\text{C} + 273$
p = pressure V = volume T = kelvin temperature	$\frac{pV}{T}$ = constant
density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
	$E = mc^2$

SI multipliers

Prefix	Multiplier
p	10^{-12}
n	10^{-9}
μ	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 $2.0\,m^3$ 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) (m^3)	Helium pressure (p) (kN/m^2)	pV (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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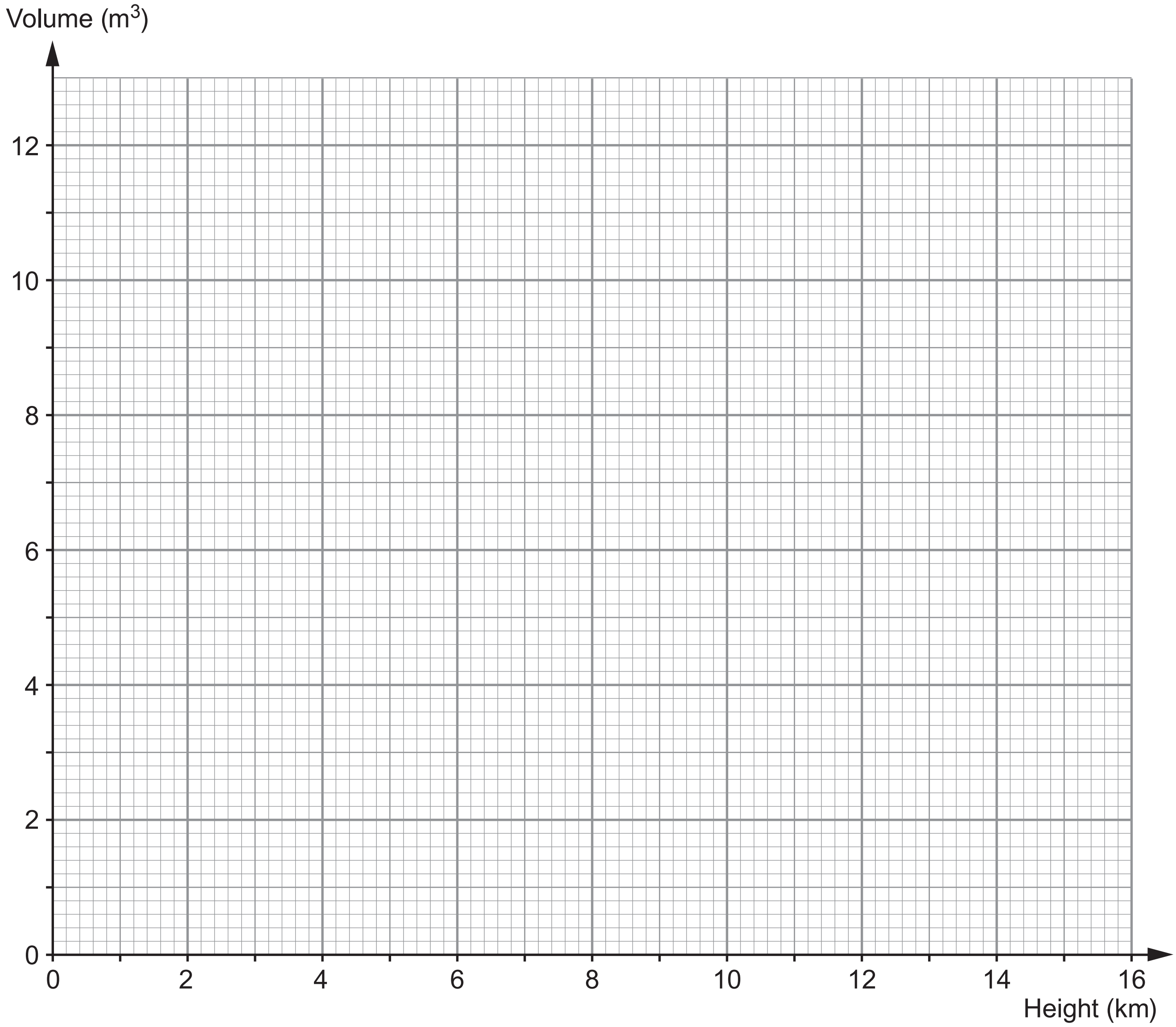

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(b) (i) Use your graph. How does the **volume** of the balloon change as the **height** increases? [2]

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(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 m^3. **Continue** your graph to estimate at what height this happens. [2]

height = ... km

Turn over.

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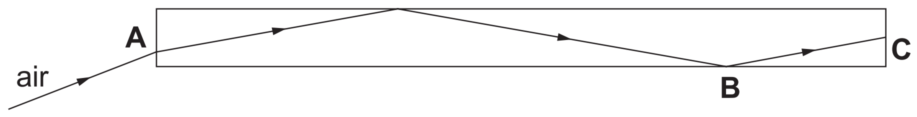
2. The diagram shows the path of a signal through a glass fibre.



(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]

6

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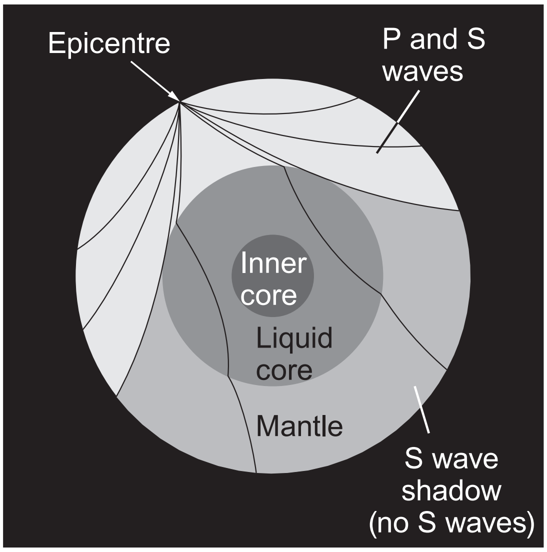
3. *(a)* Use the diagram below **and** your knowledge to compare the properties of seismic P waves, S waves and surface waves. [6 QWC]



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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.)

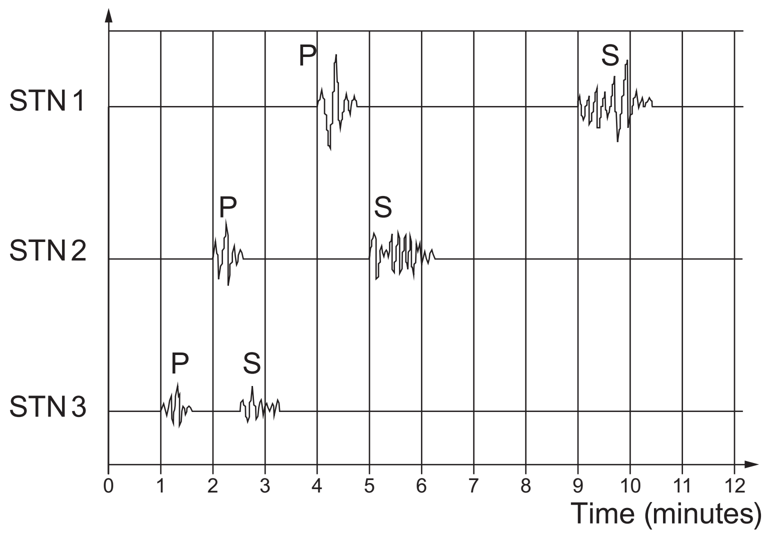
(i) Use the information in the diagram and graph below. Find the distance from the STN 2 monitoring station to the epicentre of the earthquake. Describe how you arrive at your answer. [2]

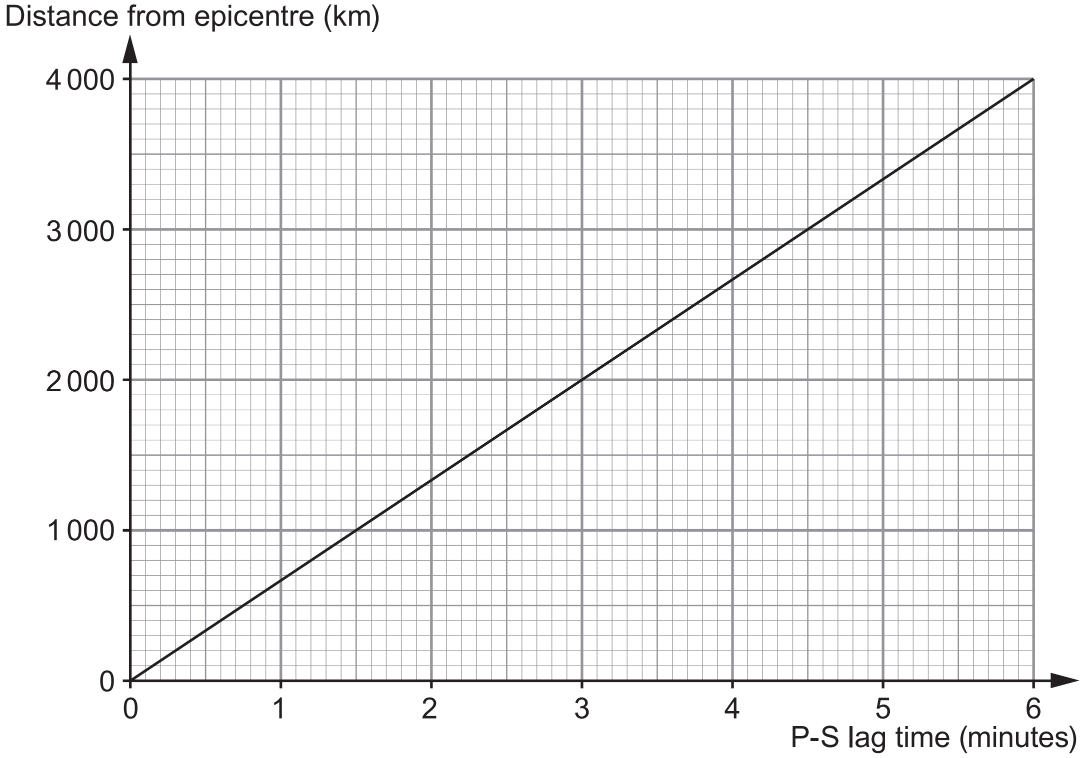
....

....

STN 2 distance from epicentre = ... km

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





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(ii) How would you determine (find out) the position of the epicentre of the earthquake? Use 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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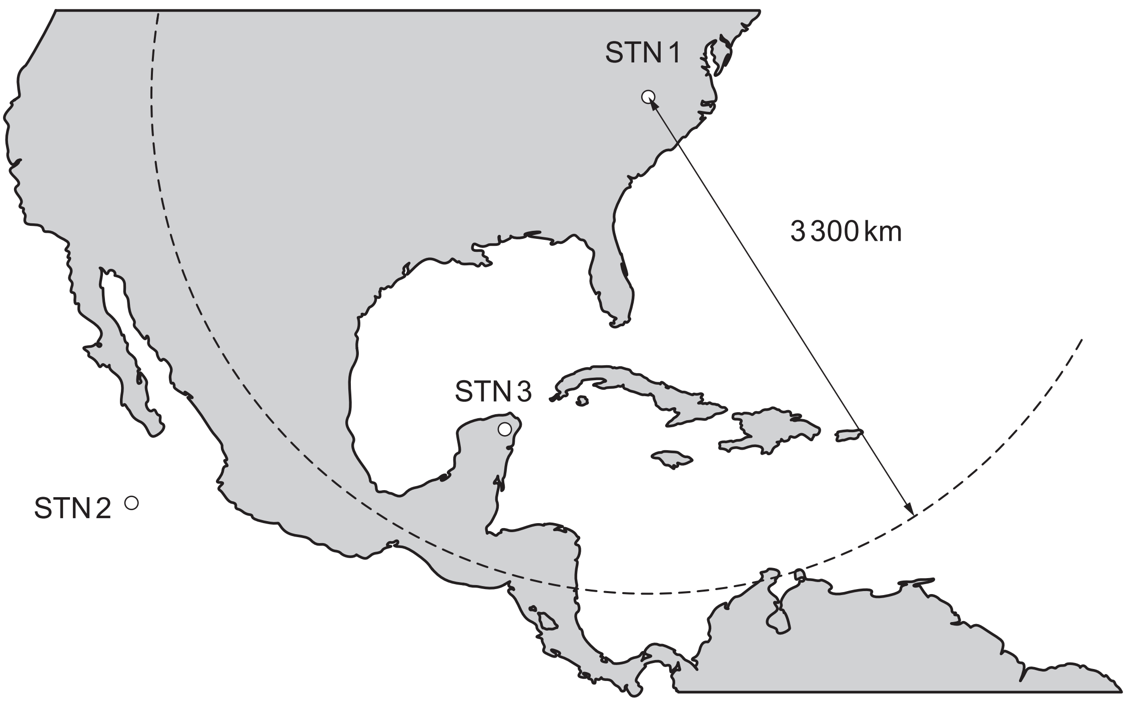

Scale: 1 cm to 500 km

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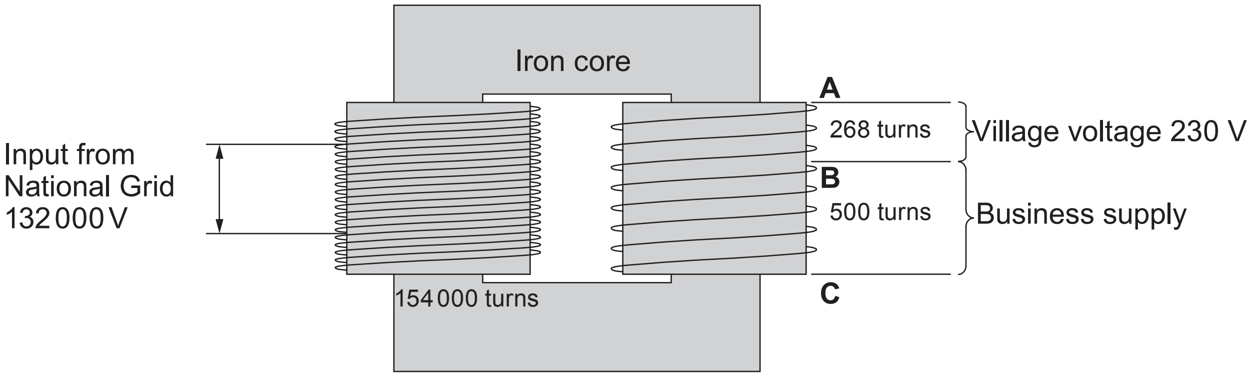
4. A transformer supplies both a village and a business with electricity from the National Grid. The business and the village need electricity at different voltages. They are connected to different numbers of secondary turns on the iron core of the transformer.



(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) What effect, if any, would you 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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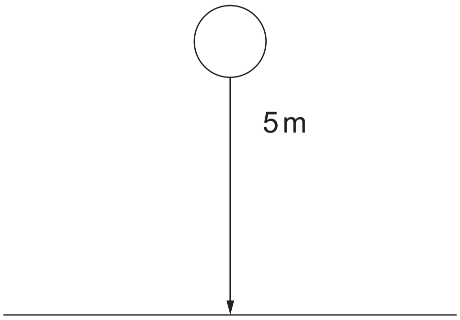
5. A ball of mass 0.2 kg, initially at rest, is dropped from a height of 5 m.



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

(i) Calculate the speed at which the ball hits the ground. [3]

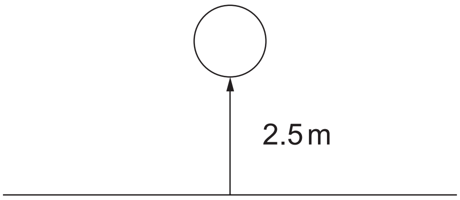
speed = ... m/s

(ii) As the ball rebounds it loses **half of its kinetic energy**. Calculate the rebound speed. [2]

speed = ... m/s

Examiner only

(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]

$$^{\cdots\cdots}_{\cdots\cdots}\mathrm{H} + ^{\cdots\cdots}_{\cdots\cdots}\mathrm{H} \longrightarrow {}^{3}_{2}\mathrm{He} + \gamma$$

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

$${}^{3}_{2}\mathrm{He} + {}^{3}_{2}\mathrm{He} \longrightarrow {}^{4}_{2}\mathrm{He} + 2\,{}^{1}_{1}\mathrm{p}$$

(i) Use the information below. 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 ${}^{3}_{2}\mathrm{He}$ = 3.014932 u
Nuclear mass of ${}^{4}_{2}\mathrm{He}$ = 4.00151 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 u = 1.66×10^{-27} kg
$c = 3 \times 10^{8}$ m/s

energy released = ... J

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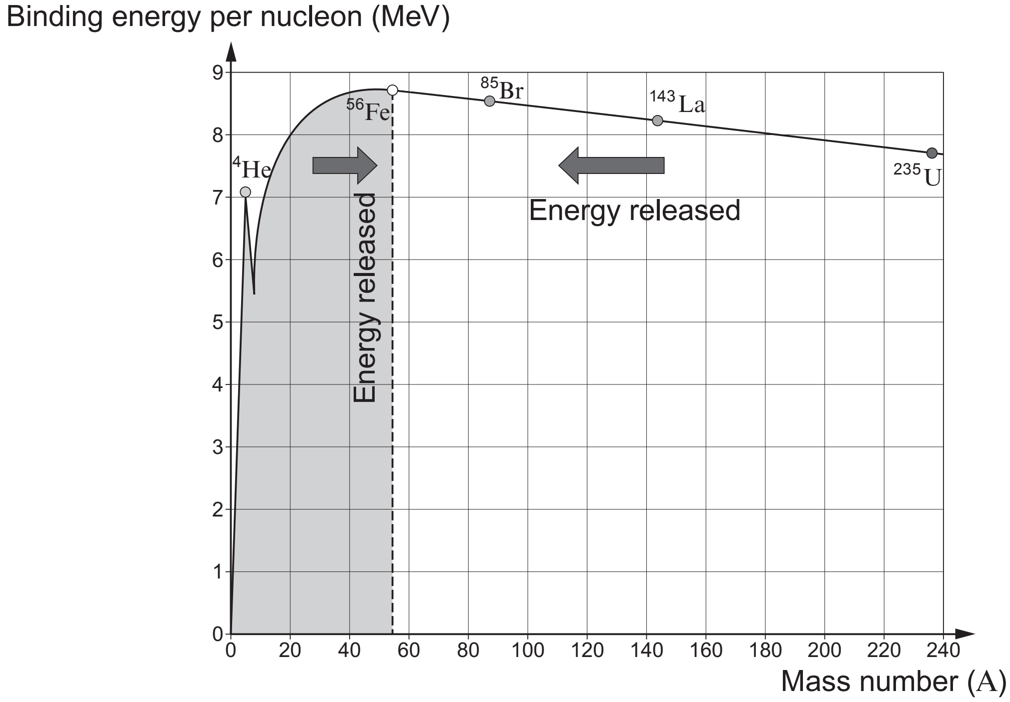
(c) Use the graph below to explain why energy is released in both nuclear fission **and** nuclear fusion. [6 QWC]



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