

GCSE Science - Physics 3

Mark Scheme - Summer 2014

HIGHER TIER

Question			Marking details	Mark	
1.	(a)	(i)	192 (1) 20 (1)	2	
		(ii)	Correct points plotted – allow $\pm \frac{1}{2}$ small square division on volume axis (2) -1 for each error. Curve of best fit up to (12,8) (1) allow $\pm \frac{1}{2}$ small square division (1) don't allow wispy, wobbly, thick or point to point lines	3	
	(b)	(i)	Volume increases as height increases (1) description of curved relationship e.g. increases at an increasing rate or gradient increases (1) Don't accept non-uniformly / non-linearly / non-proportional	2	
		(ii)	[Air] pressure is decreasing	1	
		(iii)	Best fit line extrapolated (put tick on graph) (1) Answer consistent with graph (1)	2	
	(c)	(i)	[The balloon's volume would] decrease (treat reference to pressure as neutral)	1	
		(ii)	As the helium molecules are moving more slowly or have less [kinetic] energy / taking longer between collisions / less force applied in each collision / less collisions <u>per second</u> Don't accept closer together	1	
	Question total			[12]	
	2.	(a)	(i)	Refraction	1
			(ii)	<u>Total internal reflection / TIR</u>	1
(b)		(i)	Change of speed [at boundary] / change of density Don't accept speeds up or lower density	1	
		(ii)	Hits the edge at an angle <u>greater than the critical angle or greater than 42°</u> (accept between $41^\circ - 45^\circ$) (1) must be travelling [from more dense] to less dense medium (1)	2	
(c)		Emergent straight line should be drawn steeper (put tick or cross on the diagram)	1		
Question total			[6]		

Question		Marking details	Mark
3.	(a)	<p>Indicative content:</p> <p>A surface seismic wave travels across the surface of the Earth as opposed to through it. Surface waves usually have larger amplitudes and longer wavelengths than body waves, and they travel more slowly than body waves do. A P wave is a seismic body wave [that shakes the ground back and forth in the same direction and the opposite direction to the direction the wave is moving]/longitudinal wave. An S wave is a seismic body wave [that shakes the ground back and forth perpendicular to the direction the wave is moving]/transverse wave. S waves do not travel through fluids, [so do not exist in Earth's outer core [or molten rock (magma)]. S waves travel slower than P waves in a solid and, therefore, arrive after the P wave.</p> <p>5 – 6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3 – 4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p>	6

Question		Marking details	Mark
	(b) (i)	Describe use of trace to find time delay of 3 mins (1) Accept $5 - 2 = 3$ mins STN2 distance from epicentre = 2 000 [km] (1) ecf from their lag time e.g. lag time of 2.5 mins (0) distance 1 650 [km] (1) If no description present or indications on the diagrams only award 1 mark maximum.	2
	(ii)	To locate the earthquake candidate stated “draw arcs of the appropriate (scaled) radius from the monitoring stations” or shown calculations that generate answers of 1.8 cm and 4.0 cm (ecf) or these arcs shown on the diagram (1) and locate the epicentre where the three circles intersect or point of intersection shown on the diagram (1). Reasonable attempt at finding epicentre with 2 (rough) arcs drawn or scale lines that cross circle given. (1) N.B. Point only indicated award 1 mark only 1 arc shown for STN3 and point indicated award 2 marks only	3
		Question total	[11]
4.	(a)	Correct substitution into $\frac{V_1}{V_2} = \frac{N_1}{N_2} \rightarrow \frac{132\,000}{V_2} = \frac{154\,000}{50}$ (1) Rearrangement i.e. $V_2 = \frac{132\,000 \times 50}{154\,000}$ (1) 429 [V] (1) accept 428 [V] or 430 [V] Alternative method: Substitution of 768 turns (1) Rearrangement to give 659 [V] (1) Subtraction of 230 [V] to give 429 [V] (1)	3
	(b) (i)	Increased voltage (1) Because of increased number of [secondary] turns (1) To award both marks both statements must be linked.	2
	(ii)	Failure of electrical equipment / Overheating of equipment / Fire / fuse blows ecf from (i)	1
	(iii)	No effect. (1) Because the ratio of primary to secondary turns for the business remains the same / still connected to B and C (1) Alternative: The businesses lose their supply / the voltage falls to 0 (1) because B joins to C (1). To award both marks both statements must be linked.	2
	(c)	Alternating input current or voltage (1) creates changing magnetic field (1) links (or cuts) with output coil / <u>induces</u> an [alternating] current / <u>induces</u> an [alternating] voltage (1)	3
		Question total	[11]

Question		Marking details	Mark
5.	(i)	Substitution into $v^2 = u^2 + 2ax$ (1) $u = 0$ (1) $v = 10$ m/s (1) Alternative method: t calculated first OR another alternative method: $PE = mgh = 0.2 \times 10 \times 5 = 10$ [J] (1) $\frac{1}{2}mv^2 = 10$ [J] (1) then $v = 10$ [m/s] (1)	3
	(ii)	Recognition that v^2 halves i.e. to 50 (1) Therefore new $v = \sqrt{50} = 7[.07]$ [m/s] (1) Alternative method: Initial KE = 10 [J] ecf so rebound KE = 5 [J] (1) Calculation of $v = 7[.07]$ [m/s] (1)	2
	(iii)	Substitution into $x = \frac{1}{2}(u+v)t$ (1) rearrange so $t = \frac{2.5}{3.5(\text{ecf})}$ (1) Answer = 0.7[1] s (1) Award same format of marks if $x = ut + \dots$ is used	3
		Question total	[8]

Question		Marking details	Mark
6.	(a)	${}^2_1\text{H}(1)$ ${}^1_1\text{H}(1)$	2
	(b)	(i) mass of reactants = $(2 \times 3.014932) = 6.029864$ [u] (1) mass of products = $4.00151 \text{ u} + (2 \times 1.00728) = 6.01607$ [u] (1) [mass difference = 0.013794 u] N.B. for 1 proton: mass of products = 5.00879 [u] and [mass difference = 1.021074 u]	2
		(ii) conversion to kg = 0.013794 (ecf) $\times 1.66 \times 10^{-27} = 2.29 \times 10^{-29}$ kg(1) energy calculation to give answer = 2.06×10^{-12} [J] (1) N.B. for 1 proton: conversion to kg = 1.69498×10^{-27} kg energy = 1.52548×10^{-10} [J]	2
	(c)	Indicative content: The relationship $E = mc^2$ states the equivalence of mass and energy. Binding energy is the energy equivalent of the mass difference between a whole nucleus and its individual constituent protons and neutrons. As the graph above shows, fusion of light nuclei into heavier nuclei causes an increase in binding energy per nucleon. The product is more stable. In fission heavy nuclei split into lighter nuclei with a higher binding energy per nucleon. The fragments are more stable. In a fusion/fission reaction, the mass difference is converted to energy. 5 – 6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3 – 4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.	6
		Question total	[12]
		Higher tier paper total	[60]