

## HIGHER TIER

Question		Marking details	Mark	
1.	(a)	If no external / outside force acts (1) the <u>total</u> momentum remains constant /stays the same / is conserved <b>or</b> momentum before [collison/explosion] equals momentum after (1)	2	
	(b)	(i)	$15 \times 800 (1) = 12\,000 \text{ [kg m/s]} (1)$	2
		(ii)	Subs 12 000 or <b>ecf</b> (1) subs 1 600 kg (1) ans = 7.5 [m/s] (1)	3
		(iii)	16 000 [N] (1) to the left (1) Award 2 marks for -16 000 <b>or</b> equal and opposite force	2
	(c)	KE before collision = $\frac{1}{2} 800 \times 15^2 = 90\,000 \text{ [J]} (1)$ KE after collision = $\frac{1}{2} 1\,600 \times 7.5^2 = 45\,000 \text{ [J]} (1)$ <b>ecf from (b)(ii)</b> KE loss = 45 000 [J](1) <b>Award a maximum of 2 marks</b>	2	
	(d)	(i)	0	1
(ii)		equal and opposite momentum (1) so total momentum is zero (1) <b>Either mark can be awarded on its own but only award 2 marks if they are linked.</b> Award 1 mark only for momentum to the right cancels momentum to the left unless linked to 1 of the other marking points.	2	
<b>Question total</b>			<b>[14]</b>	

Question			Marking details	Mark
2.	(a)	(i)	Plots $\pm \frac{1}{2}$ small square division (2), curve (1)	3
		(ii)	As the volume increases, the pressure decreases (1) in a non-linear way / decreasing rate (1) (inversely proportional / as volume doubles the pressure is halved award both marks)	2
		(iii)	Around 67 000 ( <b>take the value that occurs from their line <math>\pm 500</math></b> )	1
	(b)	(i)	Indicative content:  As the volume increases, the molecules have further to travel between collisions with the container therefore they take a longer time to travel so the rate of change of momentum is reduced. This reduces the force from any one molecule when in collision with the walls. Since pressure = force / area, the decrease in the force gives a reason for a decrease in pressure / increase in area causes pressure.  <b>5 – 6 marks</b> 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.  <b>3 – 4 marks</b> 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.  <b>1 – 2 marks</b> 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.  <b>0 marks</b> The candidate does not make any attempt or give a relevant answer worthy of credit.	6
		(ii)	increased speed / faster / KE increases	1
			<b>Question total</b>	<b>[13]</b>
3.	(a)		Refraction (1). Passing from a less to a more dense medium or material / light slows down (1)	2
	(b)	(i)	point E	1
		(ii)	Award 2 x(1): strikes at an angle greater than the critical angle/ $42^\circ$ for glass (1) directed from a more to a less dense medium (1) angle of reflection is equal to the angle of incidence (1)	2
				<b>Question total</b>

Question			Marking details	Mark
4.	(a)		U	1
	(b)	(i)	coil A because it has the bigger voltage of the two [both points required for the mark] or it's a step-down transformer or A has less current	1
		(ii)	to set up a changing magnetic field [in the iron core] don't accept moving	1
		(iii)	to transfer / link the <u>field</u> into coil <u>B</u>	1
		(iv)	The <u>changing magnetic field</u> induces a voltage in coil B (cutting is neutral)	1
		(v)	$\frac{230}{12} = \frac{18400}{N_2}$ [1 sub] $N_2 = 18400 \times \frac{12}{230}$ $N_2 = 960$ (1)	2
<b>Question total</b>			<b>[7]</b>	
5.	(a)	(i)	[surface and] longitudinal / P waves [arrive between B and C]. (DO NOT ACCEPT "It is a shadow zone for S waves")	1
		(ii)	Surface waves / none [are detected between C and D]. (Accept it is in the shadow zones of S and P waves)	1
	(b)	Any 4 x (1): in the mantle stiffness increases with depth (1) so wave speed increases / refraction (1), solid mantle, liquid core (1) [entering the liquid core] the stiffness decreases / density increases (1) so the wave speed decreases / refracts the other way (1)	4	
<b>Question total</b>			<b>[6]</b>	
6.	(a)	(i)	$\frac{36 \pm 0.5(1)}{20(1)} = 1.8$	2
		(ii)	Take a very small interval of length (e.g. 5 cm) / draw a tangent and find its gradient	1
	(b)	Line below the one drawn from 60°C (1) down to, but never falling below room temp (1)	2	
	(c)	Presence of free electrons (1) which [transfer energy when they] <u>collide</u> (1) Award 1 mark only for moving particles which transfer energy by collisions.	2	
<b>Question total</b>			<b>[7]</b>	

Question		Marking details	Mark
7.	(a)	Using $E=mc^2$ , $4 \times 10^{26} = m \times (3 \times 10^8)^2$ (1) $m \sim 4.4 \times 10^9$ [kg] (1)	2
	(b)	<p>Indicative content:</p> <p>At the end of the main sequence, hydrogen is exhausted and the balance between gravity and radiation pressure fails. Initially, radiation pressure drops and the core contracts, density increases and the temperature increases allowing heavier elements to fuse. This is the red giant stage. Meanwhile the lighter elements continue fusing in a shell around the nucleus. Stars like the Sun never reach sufficient temperatures to create elements as heavy as iron. Eventually, the core will run out of helium fuel, and in order to maintain equilibrium, the core will contract again to initiate the last type of fusion – carbon.</p> <p><b>5 – 6 marks</b> 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><b>3 – 4 marks</b> 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><b>1 – 2 marks</b> 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><b>0 marks</b> The candidate does not make any attempt or give a relevant answer worthy of credit.</p> <p><b>Question total</b></p>	6
			<b>[8]</b>
<b>Higher tier paper total</b>			<b>[60]</b>