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9702 PHYSICS

9702/23 Paper 2 (AS Structured Questions), maximum raw mark 60

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1 **(a)** 150 or 1.5×10^2 Gm — A1 [1]

(b) distance = $2 \times (42.3 - 6.38) \times 10^6$ (= 7.184×10^7 m) — C1

(time =) $7.184 \times 10^7 / (3.0 \times 10^8) = 0.24$ (0.239) s — A1 [2]

(c) units of pressure P: $\text{kg m s}^{-2} / \text{m}^2 = \text{kg m}^{-1} \text{s}^{-2}$ — M1

units of density ρ: kg m^{-3} and speed v: m s^{-1} — M1

simplification for units of C: $C = v^2 \rho / P$ units: $(\text{m}^2 \text{s}^{-2} \text{kg m}^{-3}) / \text{kg m}^{-1} \text{s}^{-2}$ and cancelling to give no units for C — A1 [3]

(d) energy and power *(both underlined and no others)* — A1 [1]

(e) **(i)** vector triangle of correct orientation — M1

three arrows for the velocities in the correct directions — A1 [2]

(ii) length measured from scale diagram 5.2 ± 0.2 cm or components of boat speed determined parallel and perpendicular to river flow — C1

velocity = 2.6 m s^{-1} (allow ± 0.1 m s^{-1}) — A1 [2]

2 **(a)** constant rate of increase in velocity/acceleration from $t = 0$ to $t = 8$ s — B1

constant deceleration from $t = 8$ s to $t = 16$ s or constant rate of increase in velocity in the opposite direction from $t = 10$ s to $t = 16$ s — B1 [2]

(b) **(i)** area under lines to 10 s — C1

(displacement =) $(5.0 \times 8.0) / 2 + (5.0 \times 2.0) / 2 = 25$ m
or ½ $(10.0 \times 5.0) = 25$ m — A1 [2]

(ii) $a = (v - u) / t$ or gradient of line — C1

$= (-15.0 - 5.0) / 8.0$

$= (-) 2.5 \text{ m s}^{-2}$ — A1 [2]

(iii) KE = $\frac{1}{2} m v^2$ — C1

$= 0.5 \times 0.4 \times (15.0)^2 = 45$ J — A1 [2]

(c) (distance =) 25 (m) (= $ut + \frac{1}{2} a t^2$) = $0 + \frac{1}{2} \times 2.5 \times t^2$ — C1

(t = 4.5 (4.47) s therefore) time to return = 14.5 s — A1 [2]

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3	**(a)**	(power =) work done / time (taken) or rate of work done	A1	[1]
	(b) **(i)**	$F - R = ma$	C1	
		$F = 1500 \times 0.82 + 1200$	C1	
		$= 2400\ (2430)\,\text{N}$	A1	[3]
	(ii)	$P = Fv$	C1	
		$= (2430 \times 22) = 53\,000\ (53\,500)\ \text{W}$	A1	[2]
	(c)	(there is maximum power from car and) resistive force = force produced by car hence no acceleration **or** suggestion in terms of power produced by car and power wasted to overcome resistive force	B1	[1]
4	**(a)** **(i)**	diameter and extension: micrometer (screw gauge) or digital calipers	B1	
		length: tape measure or metre rule	B1	
		load: spring balance or Newton meter	B1	[3]
	(ii)	to reduce the effect of random errors **or** to plot a graph to check for zero error in measurement of extension **or** to see if limit of proportionality is exceeded	B1	[1]
	(b)	plot a graph of F against e and determine the gradient	B1	
		$E = (\text{gradient} \times l)/[\pi d^2/4]$	B1	[2]
5	**(a)**	$R = \rho l / A$	C1	
		$= (5.1 \times 10^{-7} \times 0.50) / \pi(0.18 \times 10^{-3})^2 = 2.5\ (2.51)\,\Omega$	M1	[2]
	(b) **(i)**	resistance of CD = 8 × resistance of AB = $20\,(\Omega)$	C1	
		circuit resistance = $[1/5.0 + 1/20]^{-1} = 4.0\,(\Omega)$	C1	
		current = $V/R = 6.0/4.0$	C1	
		$= 1.5\,\text{A}$	A1	[4]
	(ii)	power in AB = I^2R or power = V^2/R	C1	
		$= (1.2)^2 \times 2.5 = 3.6\,\text{W}$ or $= (3.0)^2/2.5 = 3.6\,\text{W}$	A1	[2]

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	(iii)	potential drop A to M = 1.25 × 1.2 = 1.5 V	M1		
		potential drop C to N = 3.0 V p.d. MN = 1.5 V	A1		[2]
6	**(a) (i)**	coherent: constant phase difference	B1		
		interference is the (overlapping of waves and the) sum of/addition of displacement of two waves	B1		[2]
	(ii)	wavelength = 3.2 m (allow ± 0.05 m)	M1		
		f (= v/λ = 240 / 3.2) = 75 Hz	A1		[2]
	(iii)	90° (allow ± 2°) or π/2 rad	A1		[1]
	(iv)	sketch has amplitude 3.0 ± 0.1 cm	M1		
		correct displacement values at previous peaks to produce correct shape	A1		[2]
	(b) (i)	$\lambda = ax/D$	C1		
		x = (546 × 10^{-9} × 0.85) / 0.13 × 10^{-3} (= 3.57 × 10^{-3} m)	C1		
		AB = 8.9 (8.93) × 10^{-3} m	A1		[3]
	(ii)	shorter wavelength for blue light so separation is less	B1		[1]
7	**(a) (i)**	(rate of decay) not affected by any external factors **or** changes in temperature and pressure etc.	B1		[1]
	(ii)	two protons and two neutrons	B1		[1]
	(b) (i)	(total) mass before decay/on left-hand side is greater than (total) mass on right-hand side/after the decay	M1		
		the difference in mass is released as kinetic energy of the products	A1		[2]
		(may also be some γ radiation) (to conserve mass-energy)			
	(ii)	(6.2 × 10^{6} × 1.6 × 10^{-19} =) 9.9(2) × 10^{-13} J	A1		[1]

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