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PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **October/November 2024**

MARK SCHEME

Maximum Mark: 60

Published

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Question	Answer	Marks
1(a)	a quantity with magnitude and direction	**B1**
1(b)(i)	SI base units of D: kg m s^{-2}	**C1**
	SI base units of r: m **and** v: m s^{-1}	**C1**
	base units of η: kg m s^{-2} / (m × m s^{-1}) = kg m^{-1} s^{-1}	**A1**
1(b)(ii)	$W = U + D$	**A1**
1(b)(iii)	U = 830 × 9.81 × 4.6 × $(10^{-2})^3$ (= 0.037 N)	**C1**
	W = 0.037 + 0.32 = 0.36 N	**A1**

Question	Answer	Marks
2(a)	product of mass and velocity	**B1**
2(b)	$F = m\Delta v / \Delta t$ $= 16 \times 0.60 / 1.1$	**C1**
	$= 8.7$ N	**A1**
2(c)	$x = ut + ½at^2$ $x = 0.60 \times 3.7 + ½ \times 0.85 \times 3.7^2$	**C1**
	or	
	$v = 0.60 + 0.85 \times 3.7$ (= 3.75 m s^{-1}) $x = 3.75 \times 3.7 – 0.5 \times 0.85 \times 3.7^2$ **or** $x = ½ \times (0.60 + 3.75) \times 3.7$ **or** $x = (3.75^2 – 0.60^2) / (2 \times 0.85)$	**(C1)**
	$x = 8.0$ m	**A1**
2(d)(i)	$F = W / s$	**C1**
	$= 250 / 18$ $= 14$ N	**A1**
2(d)(ii)	any line starting at distance = 0 and a positive non-zero value of kinetic energy	**B1**
	a straight line from distance = 0 to distance = x with positive gradient	**B1**
	a straight horizontal line at a non-zero value of kinetic energy starting at distance = x and ending at distance = x + 18 m that is continuous with the previous line	**B1**

Question	Answer	Marks
3(a)(i)	$E = \sigma / \varepsilon$ **or** E = gradient	**C1**
	E = e.g. $12 \times 10^7 / 0.0050$ $= 2.4 \times 10^{10}$ Pa	**A1**
3(a)(ii)	cross drawn at (1.0%, 24×10^7 Pa), labelled Q	**B1**
3(b)	resultant force (in any direction) is zero	**B1**
	resultant moment / torque (about any point) is zero	**B1**
3(c)(i)	(moment =) $33 \times 0.65 / 2$ **or** $1.5 \times (0.65 - 0.12)$ **or** $T \sin 50° \times (0.65 / 2)$	**C1**
	sum of clockwise moments = sum of anticlockwise moments $33 \times (0.65 / 2) + 1.5 \times (0.65 - 0.12) = T \sin 50° \times (0.65 / 2)$	**C1**
	tension = 46 N	**A1**
3(c)(ii)	$\sigma = F / A$	**C1**
	$\pi r^2 = 46 / (1.5 \times 10^7)$ $r = 9.9 \times 10^{-4}$ m	**A1**

Question	Answer	Marks
3(c)(iii)	elastic limit is not reached **or** (new) stress is less than (stress at) elastic limit **or** (new) strain is less than (strain at) elastic limit	**M1**
	(so the wire behaves) elastically	**A1**

Question	Answer	Marks
4(a)	longitudinal waves have oscillations parallel to the (direction of) transfer of energy	**B1**
	transverse waves have oscillations perpendicular to the (direction of) transfer of energy	**B1**
4(b)(i)	A marked at the open end of the pipe	**B1**
4(b)(ii)	$f = v / \lambda$	**C1**
	$\lambda = 4 \times 4.5 \times 10^{-2}$	**C1**
	$f = 340 / (4 \times 4.5 \times 10^{-2})$ $= 1900$ Hz	**A1**
4(b)(iii)	the node–antinode distance is longer **or** the wavelength (of the wave) is longer	**M1**
	(the speed of sound is constant so) the frequency (of the wave) is lower	**A1**

Question	Answer	Marks
5(a)	energy transferred per unit charge (from electrical to other forms)	**B1**
5(b)(i)	heater	**A1**
5(b)(ii)	(V =) 7.0 × 0.86 = 6.0 (V)	**A1**
5(b)(iii)	I = (230 – 6.0) / 170 (= 1.3 A)	**C1**
	I_1 = 7.0 – 1.3 = 5.7 A	**A1**
5(b)(iv)	V = 230 – 6.0 – (5.7 × 2.4)	**C1**
	= 210 V	**A1**
	or	
	R = ((230 – 6.0) / 5.7) – 2.4 (= 36.9 Ω)	**(C1)**
	V = 5.7 × 36.9 = 210 V	**(A1)**

Question	Answer	Marks
5(b)(v)	$P = IV$ **or** $P = I^2R$ **or** $P = V^2 / R$	**C1**
	$P = 5.7 \times 210$ **or** $P = 5.7^2 \times (210 / 5.7)$ **or** $P = 210^2 / (210 / 5.7)$ $P = 1200$ W	**A1**
5(b)(vi)	% efficiency = <u>useful</u> power out / (total) power in ($\times$ 100)	**C1**
	= 1200 / (230 $\times$ 7.0) ($\times$100) = 0.75 ($\times$ 100) = 75% or 74% (using 3 s.f. value from **(v)** gives 74%)	**A1**
5(b)(vii)	(current) decreases	**A1**

Question	Answer	Marks
6(a)	mass of α (particle) is <u>much</u> greater (than β^+ particle)	**B1**
	both particles are positively charged	**B1**
	(magnitude of) charge on α (particle) is twice the charge (on β^+ particle)	**B1**
6(b)(i)	cross labelled Q at (82, 212)	**B1**
6(b)(ii)	particles emitted are: • beta-minus (particle) / electron • (electron) antineutrino either particle named	**B1**
	both particles named and no incorrect particles named	**B1**
6(c)(i)	$212(u) \times 1.3 (\times 10^5) \sin 68°$ **or** $4(u) \times 150 (\times 10^5) \sin \theta$	**C1**
	$4(u) \times 150 (\times 10^5) \times \sin \theta = 212(u) \times 1.3 (\times 10^5) \times \sin 68°$	**C1**
	$\sin \theta = 0.426$ $\theta = 25°$	**A1**
6(c)(ii)	$E = \frac{1}{2}mv^2$	**C1**
	$= \frac{1}{2} \times 4 \text{ u} \times (150 \times 10^5)^2$ $= \frac{1}{2} \times 4 \times 1.66 \times 10^{-27} \times (150 \times 10^5)^2$ $= 7.5 \times 10^{-13}$ J	**A1**