Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/22**

Paper 2 AS Structured Questions **October/November 2016**

MARK SCHEME

Maximum Mark: 60

Published

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1	**(a)**	**(i)**	force / area (normal to the force)	B1	[1]
		(ii)	($p = F/A$ so) units: kg m s^{-2} / m^2 = kg m^{-1} s^{-2}	A1	[1]
			allow use of other correct equations: e.g. ($\Delta p = \rho g \Delta h$ so) kg m^{-3} m s^{-2} m = kg m^{-1} s^{-2} e.g. ($p = W/\Delta V$ so) kg m s^{-2} m / m^3 = kg m^{-1} s^{-2}		
	(b)		units for m: kg, t: s and ρ: kg m^{-3}	C1	
			units of C: kg / s (kg m^{-3} kg m^{-1} s^{-2})$^{1/2}$ *or* units of C^2: kg^2 / s^2 kg m^{-3} kg m^{-1} s^{-2}	C1	
			units of C: m^2	A1	[3]
2	**(a)**		$\Delta E = mg\Delta h$	C1	
			$= 0.030 \times 9.81 \times (-)0.31$		
			= (–)0.091 J	A1	[2]
	(b)		$E = ½mv^2$	C1	
			(initial) $E = ½ \times 0.030 \times 1.3^2$ (= 0.0254)	C1	
			$0.5 \times 0.030 \times v^2 = (0.5 \times 0.030 \times 1.3^2) + (0.030 \times 9.81 \times 0.31)$ so v = 2.8 m s^{-1} *or* $0.5 \times 0.030 \times v^2 = (0.0254) + (0.091)$ so v = 2.8 m s^{-1}	A1	[3]
	(c)	**(i)**	$0.096 = 0.030(v + 2.8)$	C1	
			v = 0.40 m s^{-1}	A1	[2]
		(ii)	$F = \Delta p/(\Delta)t$ *or* $F = ma$ $= 0.096/20 \times 10^{-3}$ *or* $0.030\,(0.40 + 2.8)/20 \times 10^{-3}$	C1	
			= 4.8 N	A1	[2]
	(d)		<u>kinetic</u> energy (of ball and wall) decreases/changes/not conserved, so inelastic *or* (relative) speed of approach (of ball and wall) not equal to/greater than (relative) speed of separation, so inelastic.	B1	[1]
	(e)		force = work done / distance moved = (0.091 – 0.076) / 0.60	C1	
			= 0.025 N	A1	[2]

3	**(a)**		resultant force (in any direction) is zero	B1	
			resultant moment/torque (about any point) is zero	B1	[2]
	(b)	**(i)**	force $= 33 \sin 52°$ *or* $33 \cos 38°$		
			$= 26\,\text{N}$	A1	[1]
		(ii)	26×0.30 *or* $W \times 0.20$ *or* 12×0.40	C1	
			$26 \times 0.30 = (W \times 0.20) + (12 \times 0.40)$	C1	
			$W = 15\,\text{N}$	A1	[3]
	(c)	**(i)**	$E = \Delta\sigma / \Delta\varepsilon$ *or* $E = \sigma / \varepsilon$	C1	
			$\Delta\sigma = 2.0 \times 10^{11} \times 7.5 \times 10^{-4}$		
			$= 1.5 \times 10^{8}\,\text{Pa}$	A1	[2]
		(ii)	$\Delta\sigma = \Delta F / A$ *or* $\sigma = F / A$	C1	
			$A = 78 / 1.5 \times 10^{8}$ $(= 5.2 \times 10^{-7}\,\text{m}^2)$	C1	
			$5.2 \times 10^{-7} = \pi d^{2} / 4$		
			$d = 8.1 \times 10^{-4}\,\text{m}$	A1	[3]
4	**(a)**		wave incident on/passes by or through an aperture/edge	B1	
			wave spreads (into geometrical shadow)	B1	[2]
	(b)	**(i)**	waves (from slits) overlap (at point X)	B1	
			path difference (from slits to X) is zero/ phase difference (between the two waves) is zero (so constructive interference gives bright fringe)	B1	[2]
		(ii)	difference in distances $= \lambda / 2 = 580 / 2$		
			$= 290\,\text{nm}$	A1	[1]
		(iii)	$\lambda = ax / D$	C1	
			$D = [0.41 \times 10^{-3} \times (2 \times 2.0 \times 10^{-3})] / 580 \times 10^{-9}$	C1	
			$= 2.8\,\text{m}$	A1	[3]
		(iv)	same separation/fringe width/number of fringes bright fringe(s)/central bright fringe/(fringe at) X less bright dark fringe(s)/(fringe at) Y/(fringe at) Z brighter contrast between fringes decreases		
			Any two of the above four points, 1 mark each	B2	[2]

5 **(a)** total/sum of electromotive forces or e.m.f.s
= total/sum of potential differences or p.d.s — M1
around a loop/(closed) circuit — A1 [2]

(b) **(i)** (current in battery =) current in A + current in B *or* $I_A + I_B$ — C1

(I =) 0.14 + 0.26 = 0.40 A — A1 [2]

(ii) $E = V + Ir$

6.8 = 6.0 + 0.40r *or* 6.8 = 0.40 (15 + r) — C1

$r = 2.0\ \Omega$ — A1 [2]

(iii) $R = V / I$ — C1

ratio (= R_A / R_B) = (6.0 / 0.14) / (6.0 / 0.26)
= 42.9 / 23.1 *or* 0.26 / 0.14

= 1.9 (1.86) — A1 [2]

(iv) **1.** $P = EI$ or VI *or* $P = I^2R$ *or* $P = V^2/R$ — C1

= 6.8 × 0.40 = $0.40^2 \times 17$ = $6.8^2 / 17$

= 2.7 W (2.72 W) — A1 [2]

2. output power = VI
= 6.0 × 0.40 (= 2.40 W) — C1

efficiency = (6.0 × 0.40) / (6.8 × 0.40) = 2.40 / 2.72
= 0.88 or 88% (*allow 0.89 or 89%*) — A1 [2]

6	**(a)** hadron not a fundamental particle/lepton is fundamental particle *or* hadron made of quarks/lepton not made of quarks *or* strong force/interaction acts on hadrons/does not act on leptons	B1	[1]
	(b) (i) ${}^{0}_{1}\text{e}^{(+)}$ or ${}^{0}_{1}\beta^{(+)}$	B1	
	${}^{0}_{0}\nu_{(\text{e})}$	B1	[2]
	(ii) weak (nuclear force / interaction)	B1	[1]
	(iii) • mass-energy • momentum • proton number • nucleon number • charge		
	Any three of the above quantities, 1 mark each	B3	[3]
	(c) (quark structure of proton is) up, up, down or uud	B1	
	up/u (quark charge) is (+)$\frac{2}{3}$(e), down/d (quark charge) is $-\frac{1}{3}$(e)	C1	
	$\frac{2}{3}e + \frac{2}{3}e - \frac{1}{3}e = (+)e$	A1	[3]