Mock Exam 1

PHYSICS **9702**

Paper 2 AS Level Structured Questions **1 hour 30 minutes**

MARK SCHEME

Maximum Mark: 68

Published

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1	(a)	sum of CW moments = sum of ACW moments	M1
		about the same point for (an object in rotational) equilibrium	A1
	(b)	moment = 0.3(0) × 0.29 cos 40° **or** 0.3(0) × 0.222	C1
		= 0.067 N m	A1
	(c)(i)	$k = F / x$ **or** k = gradient	C1
		e.g. $k = 21 / 10 \times 10^{-3}$ $k = 2100\ \text{N m}^{-1}$	A1
	(c)(ii)	$V_{(\text{sphere})} = \frac{4}{3} \times \pi \times (0.0480)^3$	C1
		$F = \rho g V$ (upthrust =) $1000 \times 9.81 \times (\frac{4}{3} \times \pi \times (0.048)^3) \times 0.26(0) = 1.18$ (N)	A1
	(c)(iii)	1.18 × 0.29 **or** 0.30 × 0.29 **or** F × 0.017	C1
		(1.18 × 0.29) = (0.30 × 0.29) + (F × 0.017) F = 15 N	A1
	(c)(iv)	$E_{(P)} = ½kx^2$ **or** $E_{(P)} = ½Fx$	C1
		$x = F / k = 15 / 2100$ **or** x determined from graph for F = 15.0 N $E_P = ½ \times 2100 \times (15 / 2100)^2$ **or** $E_P = ½ \times 15 \times (15 / 2100)$ E_P = 0.054 J	A1
	(d)	the sphere has gained gravitational potential energy	B1
2	2(a)	$F = \rho g V$ $0.071 = 1.2 \times 9.81 \times V$	C1
		($V = 6.03 \times 10^{-3}\ \text{m}^3$) $4/3 \times \pi \times r^3 = 6.03 \times 10^{-3}$ r = 0.11 m	A1
	2(b)	m = 0.053 / 9.81 (= 5.4×10^{-3} kg)	C1
		F = 0.071 – 0.053 (= 0.018 N)	C1
		a = (0.071 – 0.053) / (0.053 / 9.81) = 3.3 m s^{-2}	A1
	2(c)(i)	$v^2 = u^2 + 2as$ $3.6^2 = (-1.4)^2 + 2 \times 9.81 \times s$ **or** $3.6^2 = 1.4^2 + 2 \times 9.81 \times s$	C1
		s = 0.56 m	A1
	2(c)(ii)	single straight line from any positive non-zero value of v at t = 0 to any negative non-zero value of v at $t = T$	B1
		line starting at (0, 1.4) and ending at (T, –3.6)	B1

Question	Part	Answer	Marks
3	(a)	$E = ½mv^2$	C1
		$= ½ \times 0.25 \times 2.3^2$ $= 0.66$ J	A1
	(b)	$E = ½kx^2$ **or** $E = ½Fx$ **and** $F = kx$	C1
		$x = [(2 \times 0.66) / 420]^{0.5}$ $= 0.056$ m	A1
		or	
		$E = ½kx^2$	(C1)
		$½mv^2 = ½kx^2$ $x = (0.25 \times 2.3^2 / 420)^{0.5}$ $= 0.056$ m	(A1)
	(c)(i)	(p =) 0.25 × 2.3 **or** 0.25 × 1.5	C1
		change in momentum = 0.25 (2.3 + 1.5) = 0.95 N s	A1
	(c)(ii)	resultant force = 0.95 / 0.086 or 0.25 × (2.3 + 1.5) / 0.086 = 11 N	A1
	(d)	curved line from the origin with an increasing gradient	B1
4	(a)	wave(s) (travel along string and) reflect at fixed point / A / B / end	B1
		incident and reflected waves superpose / interfere **or** two waves travelling / with speed in opposite directions superpose / interfere	B1
	(b)	line has an approximate sinusoidal shape with maximum downward displacement at P and zero displacement at each node	B1
	(c)	$v = \lambda / T$ **or** $v = f\lambda$ **and** $f = 1 / T$	C1
		λ = 35 × 0.040 **or** 35 / 25 (= 1.4 m)	C1
		distance = 1.4 × 2.5 = 3.5 m	A1
	(d)	(number of periods / cycles) (= t / T) = 0.060 / 0.040 (= 1.5)	C1
		amplitude = 72 / 6 = 12 mm	A1
5	5(a)(i)	power = intensity × area	C1
		$= 1.3 \times 10^3 \times (\pi \times 0.055^2)$ = 12 W	A1
	5(a)(ii)	intensity = power / area $= 12 / (\pi \times 0.0015^2)$ $= 1.7 \times 10^6$ W m^{-2}	A1
	5(b)(i)	(λ =) v / f **or** c / f	C1
		(λ =) $3.0 \times 10^8 / 3.7 \times 10^{15} = 8.1 \times 10^{-8}$ (m)	A1
	5(b)(ii)	ultraviolet	A1

Question	Part	Answer	Marks
	5(b)(iii)	$d \sin\theta = n\lambda$ **or** $(1/N) \times \sin\theta = n\lambda$	C1
		$d = 1/2400 \times 10^3$ (m) $= 4.2 \times 10^{-7}$ (m) **or** $N = 2400 \times 10^3$ (m^{-1})	C1
		$n = 4.2 \times 10^{-7} \times \sin 90° / 8.1 \times 10^{-8}$ **or** $\sin 90° / 2400 \times 10^3 \times 8.1 \times 10^{-8}$ $n = 5.2$ or 5.1 **or** when $n = 5$, $\theta = 76.4°$ and when $n = 6$, $\sin\theta > 1$ (so) $n = 5$	B1
		number of maxima = $(2 \times 5) + 1$ $= 11$	A1
	5(b)(iv)	the wavelength has increased	M1
		(so) number of maxima decreases	A1
6	(a)	time for one oscillation/vibration/cycle **or** time between <u>adjacent</u> wavefronts (passing the same point) **or** <u>shortest</u> time between two wavefronts (passing the same point)	B1
	(b)	(when two or more) waves meet/overlap (at a point)	B1
		(resultant) displacement is sum of the individual displacements	B1
	(c)(i)	microwave(s)	B1
	(c)(ii)	$v = \lambda / T$ **or** $v = f\lambda$ **and** $f = 1/T$	C1
		$T = 0.040 / 3.00 \times 10^8$	C1
		$= 1.33 \times 10^{-10}$ (s) $= 1.33 \times 10^{-10} / 10^{-12}$ (ps) $= 130$ ps	A1
	(c)(iii)	$(1.380 - 1.240) / 0.040 = 3.5$ **or** $1.380 / 0.040 - 1.240 / 0.040 = 3.5$	A1
	(c)(iv)	phase difference = 1260° **or** 180°	A1
	(c)(v)	(always) zero	A1
	(c)(vi)	increase in distance between (adjacent intensity) maxima/minima	A1
7	(a)(i)	$R = V / I$	C1
		resistance = $(12 / 0.20) / 2$ **or** $6 / 0.20$ $= 30\,\Omega$	A1
	(a)(ii)	$I = 0.50 - 0.20$ $(= 0.30$ A$)$	C1
		$R + 28 = 12 / 0.30$ $(= 40\,\Omega)$ $R = 12\,\Omega$	A1

	(b)	p.d. across lamp = 0.20 × 30 (= 6.0 V)	C1
		p.d. across R = 0.30 × 12 (= 3.6 V)	C1
		V_{XY} = 6.0 – 3.6 = 2.4 V	A1
		or	
		p.d. across lamp = 0.20 × 30 (= 6.0 V)	(C1)
		p.d. across 28 Ω resistor = 0.30 × 28 (= 8.4 V)	(C1)
		V_{XY} = 8.4 – 6.0 = 2.4 V	(A1)
	(c)	$P = VI$ **or** $P = EI$ **or** $P = I^2R$ **or** $P = V^2/R$	C1
		ratio = (6.0 × 0.20) × 2 / (12 × 0.50) **or** 0.20 / 0.50 = 0.40	A1
	(d)	no change to V across lamps, so power in lamps unchanged **or** current in battery/total current increases (and e.m.f. the same) so power produced by battery increases	B1
		both the above statements and so the ratio decreases	B1
8	(a)	$^{14}_{7}X$	B1
		$^{0}_{-1}e^{-}$	B1
	(b)(i)	d → u + e^{-} + $\bar{\nu}$ **or** udd → uud + e^{-} + $\bar{\nu}$	B1
	(b)(ii)	–1 / 3 (e) = + 2 / 3 (e) – 1(e) (+ 0) **or** 2 / 3 (e) – 1 / 3 (e) – 1 / 3 (e) = 2 / 3 (e) + 2 / 3 (e) – 1 / 3 (e) – 1 (e) (+ 0)	B1
	(c)(i)	electrons / β-particles (emitted from the nucleus) have a (continuous) range of / different (kinetic) energies	B1
	(c)(ii)	the (emitted) neutrinos take varying amounts of the (same total) energy (released in the decay)	B1