Question	Answer	Marks
2(b)(iii)	total distance fallen = 0.280 + 0.080 = 0.360 $0.360 = ½ \times 9.81 \times t^2$ $t = 0.27$ s	C1
	time taken = 0.27 – 0.24 = 0.03 s	A1
	or	
	v = 9.81 × 0.239 **or** $(2 \times 9.81 \times 0.280)^{0.5}$ **or** (2 × 0.280) / 0.239 = 2.34 ($m s^{-1}$)	(C1)
	$0.080 = 2.34t + ½ \times 9.81 \times t^2$ solving quadratic equation gives $t = 0.03$ s *allow any correct method using equations of uniform accelerated motion*	(A1)
2(c)	(average) resultant force/acceleration/speed/velocity (of low-density ball) is less	B1
	(so) time interval is longer	B1

Question	Answer	Marks
3(a)	force on body A (by body B) is equal (in magnitude) to force on body B (by body A)	B1
	force on body A (by body B) is opposite (in direction) to force on body B (by body A)	B1
3(b)(i)	$m_X \times 5v$ **or** $(m_X + m_Y) \times v$	C1
	$m_X \times 5v = (m_X + m_Y) \times v$ (so) $m_Y / m_X = 4$	A1
3(b)(ii)	$(E =) \frac{1}{2}mv^2$	C1
	ratio $= [\frac{1}{2} \times (m_X + m_Y) \times v^2] / [\frac{1}{2} \times m_X \times (5v)^2]$	C1
	$= 0.2$	A1
3(b)(iii)	ratio = 1	A1
3(c)(i)	**1.** (magnitude of resultant force is) zero	B1
	2. (magnitude of resultant force is) constant	B1
	(direction of resultant force is) opposite to the momentum	B1
3(c)(ii)	horizontal line from (0 ms, 0 squares) ending at (20 ms, 0 squares)	B1
	straight line from (20 ms, 0 squares) ending at (40 ms, 4.0 squares [= 4.0 cm vertically])	B1
	horizontal line from (40 ms, 4.0 squares) ending at (60 ms, 4.0 squares)	B1

Question	Answer	Marks
4(a)(i)	(vertically) upwards/up	B1
4(a)(ii)	increases (with time/velocity/depth)	B1
4(b)(i)	for a body in (rotational) equilibrium	B1
	<u>sum/total</u> of clockwise moments about a point = <u>sum/total</u> of anticlockwise moments about the (same) point	B1
4(b)(ii)	$(F_B \times 5.0)$ **or** (380×2.5) **or** (750×1.6)	C1
	$(F_B \times 5.0) = (380 \times 2.5) + (750 \times 1.6)$ $F_B = 430$ N	A1
4(b)(iii)	taking moments about C: $(380 \times 2.5) = 750 \times (2.0 - x)$	C1
	$(2.0 - x) = 1.3$ $x = 0.7$ m	A1
	or	
	moments may be taken about other points, e.g. about D: $(380 \times 4.5) + (750 \times x) = 1130 \times 2.0$	**(C1)**
	$x = 0.7$ m	**(A1)**

Question	Answer	Marks
5(a)	distance moved by wavefront/energy during one cycle/oscillation/period (of source) **or** <u>minimum</u> distance between two wavefronts **or** distance between two <u>adjacent</u> wavefronts	**B1**
5(b)	(T =) 2.0×2.5 (= 5.0 ms) **or** $2.0 \times 2.5 \times 10^{-3}$ (= 5.0×10^{-3} s)	**C1**
	$f = 1 / (5.0 \times 10^{-3})$ = 200 Hz	**A1**
5(c)(i)	(path difference =) $8.0 + (20.8^2 - 8.0^2)^{0.5} - 20.8 = 6.4$ (m)	**A1**
5(c)(ii)	• <u>path difference</u> = 4λ • waves (meet at C) in phase • constructive interference (of waves) *any two points, one mark each*	**B2**
5(c)(iii)	$v = 200 \times 1.6$ = 320 (m s^{-1})	**C1**
	$\Delta t = 6.4 / 320$ **or** $27.2 / 320 - 20.8 / 320$ = 0.020 s	**A1**
5(c)(iv)	$3\lambda = 6.4$ $\lambda = 2.1$ m	**A1**

Question	Answer	Marks
6(a)	<u>sum of</u> current(s) into junction = <u>sum of</u> current(s) out of junction **or** (algebraic) sum of current(s) at a junction is zero	**B1**
6(b)(i)	$R = V / I$	**C1**
	$= 0.60 / 7.5 \times 10^{-3}$	**C1**
	$= 80\ \Omega$	**A1**
6(b)(ii)	resistance decreases	**B1**
6(c)(i)	$E = 0.60 + 0.30$ $= 0.90$ V	**A1**
6(c)(ii)	(I =) 9.3 – 7.5	**C1**
	$I = 1.8$ (mA) **or** 1.8×10^{-3} (A) $R = 0.90 / 1.8 \times 10^{-3}$ $= 500\ \Omega$	**A1**
	or	
	total resistance $= 0.90 / 9.3 \times 10^{-3} = 96.8$ (Ω) total resistance of diode and X $= 0.90 / 7.5 \times 10^{-3} = 120$ (Ω) $1 / 96.8 = 1 / R + 1 / 120$	**(C1)**
	$R = 500\ \Omega$	**(A1)**

Question	Answer	Marks
6(c)(iii)	$P = VI$ **or** I^2R **or** V^2 / R	C1
	$= 0.60 \times 7.5 \times 10^{-3}$ **or** $(7.5 \times 10^{-3})^2 \times 80$ **or** $0.60^2 / 80$ $= 4.5 \times 10^{-3}$ W	A1
6(c)(iv)	current = 2.5 mA	A1

Question	Answer	Marks
7(a)	number of protons = 92	A1
	number of neutrons = 142	A1
7(b)	5.6 MeV = $5.6 \times 1.60 \times 10^{-19} \times 10^{6}$ (= 8.96×10^{-13} J)	C1
	number = $0.15 / (5.6 \times 1.60 \times 10^{-13})$ = 1.7×10^{11}	A1
	or	
	0.15 W = $0.15 / (1.60 \times 10^{-19} \times 10^{6})$ (= 9.38×10^{11} MeV s^{-1})	(C1)
	number = $9.38 \times 10^{11} / 5.6$ = 1.7×10^{11}	(A1)