

Question	Answer	Marks
1(a)(i)	wavelength = 8.5×10^{-5} m	**A1**
1(a)(ii)	$f = v / \lambda$ **or** c / λ	**C1**
	$= 3.0 \times 10^{8} / 8.5 \times 10^{-5}$ $(= 3.5 \times 10^{12})$ $= 3.5$ THz	**A1**
1(a)(iii)	infrared	**B1**
1(b)	(implied) percentage uncertainty in I = 4% **or** (implied) fractional uncertainty in I = 0.04	**C1**
	percentage uncertainty in E = 5% + (4% × 2) = 13%	**A1**

Question	Answer	Marks
2(a)	point where (all) the weight (of the body)	**M1**
	is considered/seems to act	**A1**
2(b)(i)	horizontal component of force = 38 cos 60° **or** 38 sin 30° = 19 N	**A1**
2(b)(ii)	$(T \times 1.2)$ **or** (19×0.9) **or** 17	**C1**
	$(T \times 1.2) = (19 \times 0.9)$ $T = 14$ N	**A1**
2(b)(iii)	$F = 45 + 38 \sin 60°$ $= 78$ N	**A1**

Question	Answer	Marks
3(a)	$s = ½at^2$	**C1**
	$57 = ½ \times 9.81 \times t^2$ **and** $t = 3.4$ (s)	**A1**
3(b)	horizontal distance = 41×3.4 = 140 m	**A1**
3(c)	$(\text{displacement})^2 = 57^2 + 140^2$	**C1**
	displacement = $(57^2 + 140^2)^{0.5}$ = 150 m	**A1**
3(d)	straight line from the origin with positive gradient	**B1**
3(e)	$(1480 – m) \times 0.340 = m \times 41.0$	**C1**
	$m = 12.2$ kg	**A1**
	or	
	$m_c\, 0.34 = m_b\, 41$ **and** $m_c + m_b = 1480$	**(C1)**
	$m_c = (41 / 0.34)m_b$ $(41 / 0.34)m_b + m_b = 1480$ $m_b = 12.2$ kg	**(A1)**
3(f)	acceleration (of free fall) is unchanged/is not dependent on mass	**M1**
	(so) no change (to the graph)	**A1**

Question	Answer	Marks
4(a)	compression/extension is proportional to force (provided limit of proportionality is not exceeded)	**B1**
4(b)	(E) = ½Fx **or** ½kx^2 **or** area under graph	**C1**
	= ½ × 8 × 16 × 10^{-2} = 0.64 (J) **or** = ½ × 50 × (16 × 10^{-2})^2 = 0.64 (J)	**A1**
4(c)(i)	(E) = ½mv^2	**C1**
	0.64 = ½ × 0.076 × v^2 v = 4.1 m s^{-1}	**A1**
4(c)(ii)	(Δ)(E) = mg(Δ)h	**C1**
	= 0.076 × 9.81 × 0.24 (= 0.18 (J))	**C1**
	kinetic energy = 0.64 – 0.18 = 0.46 J	**A1**
4(c)(iii)	v = 4.1 m s^{-1}	**A1**
4(d)	W = Fs	**C1**
	d = 0.30 + (2π × 0.12) + 0.25 (= 1.3 m)	**C1**
	F = 0.23 / 1.3 = 0.18 N	**A1**

Question	Answer	Marks
5(a)(i)	$T = 2.0 \times 10^{-5} \times 6.0$ (= 1.2×10^{-4} s)	**C1**
	$f = 1 / (2.0 \times 10^{-5} \times 6.0)$ = 8300 Hz	**A1**
5(a)(ii)	new trace shows the same period	**B1**
	new trace shows amplitude of 10 small squares	**B1**
5(a)(iii)	(trace is a) vertical line	**B1**
5(b)(i)	$n\lambda = d \sin\theta$	**C1**
	$\lambda = (3.4 \times 10^{-6} \times \sin 16°) / 2$ = 4.7×10^{-7} m	**A1**
5(b)(ii)	$n = 3.4 \times 10^{-6}$ ($\times \sin 90°$) / 4.7×10^{-7} or 2 ($\times \sin 90°$) / sin 16° (= 7.2 or 7.3)	**C1**
	highest order = 7	**A1**

Question	Answer	Marks
6(a)	$\frac{\text{work (done) / energy (transferred from electrical to other forms)}}{\text{charge}}$	**B1**
6(b)	$R = \rho L / A$	**B1**
	$V = LA$ **and** (so) $R = \rho V / A^2$ (with ρ and V constant)	**B1**
6(c)	$E = IR + Ir$ **or** $E = I(R + r)$ **or** $E - Ir = IR$ **and** $R = (E / I) - r$	**A1**
6(d)(i)	$P = I^2R$ **or** $P = IV$ **or** $P = V^2 / R$	**C1**
	$R = 5.4\ (\Omega)$ **or** $V = 10.8\ (\text{V})$	**C1**
	$P = 2.0^2 \times 5.4$ $= 22\ \text{W}$	**A1**
6(d)(ii)	**1.** $r = 0.60\ \Omega$	**A1**
	2. E = gradient	**C1**
	= e.g. 5.4 / 0.45 $= 12\ \text{V}$	**A1**

Question	Answer	Marks
7(a)(i)	electric field strength = V / d	**B1**
7(a)(ii)	force = Vq / d	**B1**
7(a)(iii)	kinetic energy = Vq	**B1**
7(b)(i)	no change	**B1**
7(b)(ii)	no change	**B1**
7(c)(i)	nucleon number = 14 **and** proton number = 7	**A1**
7(c)(ii)	(electron) antineutrino	**B1**