Question	Answer	Marks
2(b)(iii)	1 $(\Delta)E = mg(\Delta)h$ $= 85 \times 9.81 \times 3200$	**C1**
	$= 2.7 \times 10^6$ J	**A1**
	2 <u>In terms of energy</u>: work done = 2.7×10^6 J force $= 2.7 \times 10^6 / (47 \times 2.8 \times 60)$	**C1**
	$= 340$ N	**A1**
	<u>In terms of forces</u>: component of weight along path = force due to air resistance force $= 85 \times 9.81 \times \sin 24°$	**(C1)**
	$= 340$ N	**(A1)**
2(b)(iv)	$(\Delta)p = \rho g(\Delta)h$ $(92 - 63) \times 10^3 = \rho \times 9.81 \times 3200$	**C1**
	$\rho = 0.92$ kg m^{-3}	**A1**

Question	Answer	Marks
3(a)	$(m \times 3.0)$ or $(2.5 \times 9.6 \times \cos 60°)$	**C1**
	$(m \times 3.0) - (2.5 \times 9.6 \times \cos 60°) = 0$ so $m = 4.0$ (kg)	**A1**

Question	Answer	Marks
3(b)	$2.5 \times 9.6 \times \sin 60° = (4.0 + 2.5) \times V$	**C1**
	$V = 3.2\ \text{m s}^{-1}$	**A1**
	or use of momentum vector triangle: $(4.0 \times 3.0)^2 + [(4.0 + 2.5) \times V]^2 = (2.5 \times 9.6)^2$	**(C1)**
	$V = 3.2\ \text{m s}^{-1}$	**(A1)**
3(c)	$E = \frac{1}{2}mv^2$ difference in $E_K = \frac{1}{2} \times 2.5 \times (9.6)^2 - \frac{1}{2} \times 4.0 \times (3.0)^2$	**C1**
	$= 97\ \text{J}$	**A1**

Question	Answer	Marks
4(a)	force per unit positive charge	**B1**
4(b)(i)	1 $E = V / d$ or $E = \Delta V / \Delta d$ $d = 4.0 \times 10^3 / 5.0 \times 10^4$	**C1**
	$= 8.0 \times 10^{-2}\ \text{m}$	**A1**
	2 plates are (in) horizontal (plane) (above and below the rod)	**B1**
	top (plate) negative and bottom (plate) positive	**B1**
4(b)(ii)	magnitude $= 5.0 \times 10^4 \times 3 \times 1.6 \times 10^{-19}$ $= 2.4 \times 10^{-14}\ \text{N}$	**A1**
	direction is (vertically) downwards / down	**B1**

Question	Answer	Marks
4(b)(iii)	$6.2 \times 10^{-16} = 2.4 \times 10^{-14} \times 72 \times 10^{-3} \times \cos\theta$	C1
	$\theta = 69°$	A1

Question	Answer	Marks
5(a)(i)	(two) waves meet/overlap (at a point)	B1
	(resultant) displacement is sum of the displacement of each wave	B1
5(a)(ii)	constant phase difference (between the waves)	B1
5(b)	$I \propto A^2$ $3I / I = (A + 1.5)^2 / 1.5^2$	C1
	$A = 1.1$ cm	A1
5(c)(i)	$\lambda = ax / D$	C1
	e.g. $a = 680 \times 10^{-9} \times 2.0 / 4.0 \times 10^{-3}$	C1
	$a = 3.4 \times 10^{-4}$ m	A1
5(c)(ii)	straight line from positive value on x-axis and always below 'old' line	B1
	straight line with a smaller positive gradient than 'old' line	B1

Question	Answer	Marks
6(a)	e.m.f.: energy transferred from chemical to electrical (per unit charge)	B1
	p.d.: energy transferred from electrical to thermal (per unit charge)	B1

Question	Answer	Marks
6(b)(i)	1 I = 4.8 / 32 = 0.15 A	**A1**
	2 $P = EI$ or $P = VI$ or $P = I^2R$ or $P = V^2 / R$ = 6.0 × 0.15 or $0.15^2 \times 40$ or $6.0^2 / 40$	**C1**
	= 0.90 W	**A1**
	3 number = It / e = [0.15 × 25] / 1.6×10^{-19}	**C1**
	= 2.3×10^{19}	**A1**
	or Q = 0.15 × 25 (= 3.75) number = 3.75 / 1.6×10^{-19}	**(C1)**
	= 2.3×10^{19}	**(A1)**
	4 4.8 / 6.0 = 32 / (R_{XY} + 32) or 1.2 / 6.0 = R_{XY} / (R_{XY} + 32) or 4.8 / 1.2 = 32 / R_{XY}	**C1**
	R_{XY} = 8.0 Ω	**A1**
	Alternative methods:	
	R_{XY} = (6.0 – 4.8) / 0.15 or	**(C1)**
	= 8.0 Ω	**(A1)**
	or 6.0 = 0.15 (32 + R_{XY})	**(C1)**
	R_{XY} = 40 – 32 = 8.0 Ω	**(A1)**

Question	Answer	Marks
6(b)(i)	5 $1 / 8.0 = 1 / R_X + 1 / 24$	**C1**
	Rx = 12 Ω	**A1**
	Alternative method:	
	$I_Z = 4.8 / 32 = 0.15$ and $I_Y = 1.2 / 24 = 0.05$ $I_X = 0.15 – 0.05$ (= 0.10)	**(C1)**
	$R_X = 1.2 / 0.10 = 12\ \Omega$	**(A1)**
6(b)(ii)	total resistance decreases	**M1**
	(so voltmeter) reading increases	**A1**

Question	Answer	Marks
7(a)(i)	alpha, neutron and proton	**B1**
7(a)(ii)	neutron	**B1**
7(a)(iii)	beta plus or β^+	**B1**
7(b)	$\bar{d}$ has charge (+)⅓ e	**C1**
	(so) other quark has charge = e – ⅓ e = (+)⅔ e	**M1**
	other quark is an up / u	**A1**