Question	Answer	Marks
2(a)	(resultant) force proportional/equal to/is rate of change of momentum	**B1**
2(b)(i)	distance = area under graph **or** $s = ½ (u + v) t$ $= ½ \times (9 + 13) \times 10$ **or** $s = ut + ½at^2$ $= (9 \times 10) + (½ \times 0.40 \times 10^2)$ **or** $s = vt – ½at^2$ $= (13 \times 10) – (½ \times 0.40 \times 10^2)$ **or** $v^2 = u^2 + 2as$ $13^2 = 9^2 + (2 \times 0.40 \times s)$	**C1**
	distance = 110 m	**A1**

Question	Answer	Marks
2(b)(ii)	**1.** a = gradient **or** $a = (v - u) / t$ **or** $a = \Delta v / (\Delta)t$ e.g. $a = (14 - 9) / 12.5$ **or** $(13 - 9) / 10$	**C1**
	$a = 0.40\ \text{m s}^{-2}$	**A1**
	2. resultant force $= 850 \times 0.40$ $= 340\ \text{N}$	**A1**
	3. (F =) $510 + 440 + 340 = 1300$ (N)	**A1**
	4. $P = Fv$	**C1**
	$= 1300 \times 13$ $= 1.7 \times 10^4\ \text{W}$	**A1**
2(c)	$E = \sigma / \varepsilon$	**C1**
	$E = (F / A) / (\Delta L / L)$ **or** $E = FL / A\Delta L$	**C1**
	$\Delta L = (480 \times 0.48) / (3.0 \times 10^{-4} \times 2.2 \times 10^{11})$ $= 3.5 \times 10^{-6}\ \text{m}$	**A1**
2(d)	$f_o = f_s v / (v - v_s)$ $480 = f_s \times 340 / (340 - 14)$	**C1**
	$f_s = 460\ \text{Hz}$	**A1**

Question	Answer	Marks
3(a)	the point where (all) the weight (of the body) is taken to act	B1
3(b)(i)	vertical component = 54 sin 35° = 31 N	A1
3(b)(ii)	the (line of action of the) force (at B) passes through (point) A **or** the (line of action of the) force (at B) has zero (perpendicular) distance from (point) A	B1
3(b)(iii)	54 sin 35° × 0.68 **or** 54 cos 35° × 0.68 **or** W × 0.34	C1
	54 sin 35° × 0.68 + 54 cos 35° × 0.68 = W × 0.34 so W = 150 (N)	A1
3(b)(iv)	total vertical force = 150 – 31 = 120 N	A1
3(c)	$(\Delta)E = mg(\Delta)h$	C1
	$E = ½mv^2$	C1
	ratio = $(m \times 9.81 \times 4.8) / (½ \times m \times 9.2^2)$ **or** $(9.81 \times 4.8) / (½ \times 9.2^2)$	C1
	= 1.1	A1

Question	Answer	Marks
4(a)(i)	distance (in a specified direction of particle/point on wave) from the equilibrium position	**B1**
4(a)(ii)	the maximum distance (of particle/point on wave) from the equilibrium position **or** the maximum displacement (of particle/point on wave)	**B1**
4(b)	$I \propto A^2$	**C1**
	$I_R / I = (3.6 - 1.2)^2 / (1.2)^2$ resultant intensity = $4.0I$	**A1**
4(c)(i)	as wave(s) pass through the slit(s)	**B1**
	wave(s) spread (into geometric shadow)	**B1**
4(c)(ii)	$n\lambda = d \sin \theta$	**C1**
	$3\lambda = d \sin 90°$ **or** $3\lambda = d$	**C1**
	$d = 3 \times 630 \times 10^{-9}$ $= 1.9 \times 10^{-6}$ m	**A1**
4(c)(iii)	wavelength of blue light is shorter (than 540 nm/630 nm/wavelengths of original light)	**M1**
	(so) third order diffraction maximum is produced	**A1**

Question	Answer	Marks
5(a)	<u>sum of</u> e.m.f.(s) = <u>sum of</u> p.d.(s)	M1
	around a loop/around a closed circuit	A1
5(b)(i)	**1.** $1 / R = 1 / R_1 + 1 / R_2$ $1 / R = 1 / 90 + 1 / 18$	C1
	$R = 15\,\Omega$	A1
	2. $I = V / R$	C1
	$I = 4.8 / 15$ **or** $I = 4.8 / 90 + 4.8 / 18$ $I = 0.32$ A	A1
5(b)(ii)	$E = V + Ir$ **or** $E = I(R + r)$	C1
	$5.6 = 4.8 + 0.32\,r$ so $r = 2.5\,(\Omega)$ **or** $5.6 = 0.32 \times (15 + r)$ so $r = 2.5\,(\Omega)$	A1
5(b)(iii)	$P = EI$ **or** $P = VI$ **or** $P = I^2R$ **or** $P = V^2 / R$	C1
	ratio $= (0.32^2 \times 2.5) / (5.6 \times 0.32)$ **or** $0.256 / 1.792$	C1
	$= 0.14$	A1

Question	Answer	Marks
5(c)	$7.2 - 5.6 - 2.5I - 3.5I = 0$	**C1**
	$I = 0.27$ A	**A1**

Question	Answer	Marks
6(a)	path/direction in which a (free) <u>positive</u> charge will move	**B1**
6(b)	(lines) closer together in Y/further apart in X	**B1**
6(c)(i)	$a = Eq / m$ **or** $F = Eq$ **and** $F = ma$	**C1**
	ratio = (1e / 0.15 u) × (4 u / 2e) **or** 1 / 0.15 × 4 / 2	**C1**
	ratio = 13	**A1**
6(c)(ii)	down quark charge is –(1 / 3)e	**C1**
	– (1 / 3)e + q = –1e so q = –(2 / 3)e	**A1**
	(–(2 / 3)e is) anti-up / $\bar{u}$ (quark) (*allow charm or top antiquark*)	**B1**