

^	Indicates where more is needed for a mark to be awarded (what is written is not wrong, but not enough). May also be used to annotate a response space that has been left completely blank.
SEEN	Indicates that a page has been seen.

Question	Answer	Marks
1(a)	similarity: both have magnitude	**B1**
	difference: distance is a scalar/does not have direction **or** displacement is a vector/has direction	**B1**
1(b)(i)	the measurements have a small range	**B1**
1(b)(ii)	the (average of the) measurements is not close to the true value	**B1**

Question	Answer	Marks
2(a)	a body continues at (rest or) constant velocity unless acted upon by a resultant force	**B1**
2(b)(i)	distance = [½ × (2.0 + 4.4) × 3.0] + [4.4 × 2.0]	**C1**
	= 9.6 + 8.8 = 18 m	**A1**
2(b)(ii)	$a = (v - u) / t$ **or** gradient **or** $\Delta v / (\Delta) t$	**C1**
	e.g. $a = (4.4 - 2.0) / 3.0 = 0.80$ m s^{-2}	**A1**
2(b)(iii)	**1.** force = 240 cos 28° **or** 240 sin 62° = 210 N	**A1**
	2. resultant force = 89 × 0.80 (= 71.2 N)	**C1**
	R = 210 – 71 = 140 N	**A1**
2(b)(iv)	$T \sin 45° = mg$	**C1**
	T = (89 × 9.81) / sin 45° = 1200 N	**A1**

Question	Answer	Marks
3(a)	for a body in (rotational) equilibrium	**B1**
	sum/total of clockwise moments about a point = sum/total of anticlockwise moments about the (same) point	**B1**
3(b)(i)	($W \times 0.45$) **or** (19×1.3) **or** ($W \times 1.85$) **or** (22×2.6)	**C1**
	($W \times 0.45$) + (19×1.3) + ($W \times 1.85$) = (22×2.6) so W = 14 N	**A1**
3(b)(ii)	magnitude = 19 + 14 + 14 – 22 = 25 N	**A1**
	direction: vertically upwards	**A1**
3(c)(i)	the extension is zero when the force is zero	**B1**
	graph is a straight line and (so) Hooke's law obeyed	**B1**
3(c)(ii)	$k = F / x$ **or** k = gradient	**C1**
	e.g. k = 60 / (1.00 – 0.25) k = 80 N m^{-1}	**A1**
3(c)(iii)	area shaded below graph line between L = 0.25 m and L = 0.75 m	**B1**

Question	Answer	Marks
4(a)(i)	frequency **or** period	**B1**
4(a)(ii)	amplitude	**B1**
4(b)	constant phase difference so coherent	**B1**
4(c)	120°	**B1**
4(d)	resultant displacement = 4.0 μm – 1.0 μm = 3.0 μm	**B1**
4(e)	$I \propto A^2$	**C1**
	intensity of Z = $(2^2 / 4^2)\ I$ = 0.25 I	**A1**
4(f)	$v = \lambda / T$ **or** $v = f\lambda$ **and** $f = 1 / T$	**C1**
	$330 = \lambda / 3.0 \times 10^{-3}$	**C1**
	λ = 0.99 m	**A1**

Question	Answer	Marks
5(a)	joule per coulomb	**B1**
5(b)(i)	$1 / R = 1 / R_1 + 1 / R_2$ $= 1 / 300 + 1 / 200$ $R = 75\ \Omega$	**A1**
5(b)(ii)	$R = 75 + 55$ $= 130\ \Omega$	**A1**
5(c)(i)	**1.** $P = I^2R$ **or** $P = VI$ **and** $V = IR$	**C1**
	$I = (0.20 / 55)^{0.5}$ $= 0.060$ A	**A1**
	2. $I = 0.060 / 4$ $= 0.015$ A	**A1**
5(c)(ii)	potential difference $= 130 \times 0.060$ $= 7.8$ V	**A1**
	or	
	potential difference $= (300 \times 0.015) + (55 \times 0.060)$ $= 7.8$ V (*other valid methods are also possible*)	**(A1)**

Question	Answer	Marks
6(a)	A: cross-sectional area	**B1**
	n: number density of free electrons	**B1**
6(b)	units of I: A **and** units of A: m^2 **and** units of v: $m\,s^{-1}$	**B1**
	units of e: $A / (m^2\,m^{-3}\,m\,s^{-1}) = A\,s$	**A1**
6(c)	ratio $= A_Q / A_P$	**C1**
	$= [\pi r^2] / [\pi(2r^2)]$ $= 0.25$	**A1**

Question	Answer	Marks
7(a)(i)	$E = V / d$ **or** $E = F / Q$	**C1**
	$F = (450 \times 1.60 \times 10^{-19}) / 6.0 \times 10^{-3}$	**C1**
	$= 1.2 \times 10^{-14}$ N	**A1**
	direction: vertically downwards	**B1**

Question	Answer	Marks
7(a)(ii)	work done = *Fs* **or** *Fd* **or** *EQd*	**C1**
	= (–)1.2 × 10^{-14} × 6.0 × 10^{-3} = (–)7.2 × 10^{-17} J	**A1**
	or	
	work done = *VQ*	**(C1)**
	= (–)450 × 1.60 × 10^{-19} = (–)7.2 × 10^{-17} J	**(A1)**
7(b)	$E = \frac{1}{2}mv^2$	**C1**
	3.4 × 10^{-16} = ½ × 9.11 × 10^{-31} × v^2 v = 2.7 × 10^{7} m s^{-1}	**A1**
7(c)(i)	$^{1}_{1}p$	**A1**
	$^{0}_{0}\nu_{(e)}$	**A1**
7(c)(ii)	**1.** hadrons	**B1**
	2. leptons	**B1**