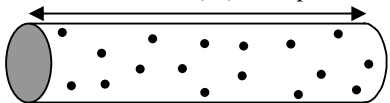


**PH1 Mark Scheme – January 2011**

Question		Marking details	Marks Available	
1	(a)	(i) [Rate of] flow of charge / $I = \frac{Q}{t}$ or $\frac{dQ}{dt}$ <u>with <math>Q</math> defined</u>	1	
		(ii) $C s^{-1}$	1	
	(b)	(i) $x = y + z$	1	
		(ii) charge	1	
	(c)	(i) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ or $R = \frac{R_1 R_2}{R_1 + R_2}$ of by impl. (1) $R_{  } = 30 \Omega$ (1); $R_{Total} = 40 \Omega$ (1) [no e.c.f.]	3	
		(ii) [Current $x =$ ] 0.15 A e.c.f. [Accept equiv., e.g. $\frac{6}{40}$ , but not 0.2A without working]	1	
		(iii) $V_1 = 0.15 \times 10$ [= 1.5 V] (1) [e.c.f.] $V_2 = 6 - 1.5$ [= 4.5 V] [or $30 \times 0.15 = 4.5$ V] (1) [e.c.f.]	2	
		(iv) $y = \frac{4.5}{120}$ [= 0.038 A] (1) $z = 0.15 - 0.038$ e.c.f. [= 0.11 A] $\left[ \text{or } \frac{4.5}{40} \right]$ [= 0.11 A] (1) [Accept solutions based upon ratios, e.g. $y = \frac{0.15}{4} \dots$ ]	2 <b>[12]</b>	
	2.	(a)	(i) $R = \frac{1.6}{15 \times 10^{-3}}$ (reading from graph, accept $14 \times 10^{-3}$ ) $R = 107 \Omega$ [answers in range 107 – 114 $\Omega$ ]	2
			(ii) [Very] high [accept infinite]	1
		(b)	(i) $V$ not proportion to $I$ / not a straight line [through the origin] [“Not through origin” insufficient on its own]	1
			(ii) Bulb / thermistor [Not wire or superconductor, but accept superconducting device, e.g. superconducting electromagnet coil]	1
(c)		$R = \frac{V}{I}$ (1); $R = \frac{10.4(1)}{15 \times 10^{-3}} = 693 \Omega$ (1) <b>Alt 1:</b> $10.4 = \frac{R}{R + 107} \times 12$ [or equiv.] (1) manipulation e.g. $10.4R + 112.8 = 12(1)$ ; $R = 696 \Omega$ (1) <b>Alt 2:</b> $R_T = \frac{V}{I}$ or $\frac{12}{1.5 \times 10^{-3}}$ (1) = 800 $\Omega$ (1); $R 800 - 107 = 693 \Omega$ (1)	3 <b>[8]</b>	

Question		Marking details	Marks Available					
3	(a)	<p style="text-align: center;"><math>l</math> or <math>(vt)</math> [accept <math>v</math> if stated dist travelled in 1 s]</p> <p>(1) </p> <p>[NB free electrons not required to be labelled]</p> <p>Number of free electrons = <math>nAvt</math> [or <math>nAl</math>] (1)                      Total change = <math>nAvte</math> [or <math>nAle</math>] (1)  <math>I = \frac{nAvte}{t}</math> with cancelling shown [or <math>\frac{nAle}{t}</math>, where <math>\frac{l}{t} = v</math> shown] (1)</p>	4					
	(b)	$2.0 = 1.0 \times 10^{29} \times 1.7 \times 10^{-6} v \times 1.6 \times 10^{-19}$ (1) [substitution] $v = 7.4 \times 10^{-5} \text{ m s}^{-1}$ ((unit))(1)	2					
	(c)	collisions [accept obstructions](1) between <u>free electrons and copper atoms / ions / lattice</u> (1) [accept: delocalised / moving / conducting electrons]	2					
	(d)	$R = \frac{P}{I^2}$ [or $P = I^2R$ ] (1); $R = \frac{0.1}{4}$ [=0.025 $\Omega$ ] (1) $\rho = \frac{0.025[\text{e.c.f.}] \times 1.7 \times 10^{-6}}{2.5}$ (1) [manipulation i.e. $\rho = \frac{RA}{l}$ or with figures ] $\rho = 1.7 \times 10^{-8} \Omega \text{ m.}$ (1)	4					
	(e)	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">cross-sectional area</td> <td>smaller (1)</td> </tr> <tr> <td><math>n</math></td> <td>the same (1)</td> </tr> <tr> <td>resistivity</td> <td>the same (1)</td> </tr> </table>	cross-sectional area	smaller (1)	$n$	the same (1)	resistivity	the same (1)
cross-sectional area	smaller (1)							
$n$	the same (1)							
resistivity	the same (1)							
<b>[15]</b>								
4.	(a)	(i)	To overcome the frictional / drag force or because the applied force is insufficient.	1				
		(ii)	$\frac{1}{\text{gradient}}$ attempted (1); Correct substitution, e.g. $\frac{3.0 - 0.5}{3.0}$ (1) $m = 0.8(3) \text{ kg}$ ((unit)) (1)	3				
	(b)	(i)	A = contact force of surface on body [accept <u>normal</u> reaction](1) B = gravitational force of Earth on body (1) [accept: weight / $mg$ ]	2				
		(ii)	<u>Gravitation force of body (mass)</u> (1) on Earth (1)	2				
<b>[8]</b>								

Question		Marking details	Marks Available	
5.	(i)	$[\pi \times 22^2](1)$ [accept $\pi r^2$ ] $\times 14$ (1) [=21 287 m <sup>3</sup> s <sup>-1</sup> ] [21 287 → 1 mark]	2	
	(ii)	mass every second = $1.2 \times 21000$ [or as calculated in (i)] [= 25 200] kg s <sup>-1</sup>	1	
	(iii)	Initial $E_{k1} = \frac{1}{2} \times 25\,200 \times 14^2$ (1) e.c.f. from (ii) Final $E_{k2} = \frac{1}{2} \times 25\,200 \times 14^2$ (1) e.c.f. from (ii) $\Delta E_k = 945 \times 10^3$ J s <sup>-1</sup> (1) e.c.f. from $E_{k1}$ and $E_{k2}$ NB. "Solutions" based upon $\frac{1}{2} m \times (14 - 11)^2 \rightarrow 0$	3	
	(iv)	Useful power available = $614\,250$ J s <sup>-1</sup> (1) e.c.f. from (iii) $N_{\text{turbines}} = \frac{1000 \times 10^6}{614250}$ [=1628] (1)	2	
			<b>[8]</b>	
6	(a)	Velocity = $\frac{\text{Displacement}}{\text{time}}$ / displacement per unit time / rate of change of displacement [but <b>not</b> per unit time] / $\frac{ds}{dt}$ with $s$ defined]	1	
	(b)	(i)	$v + 1$ [or equiv]	1
		(ii)	$t = \frac{s}{v}$ used [or by impl.](1) → $t = \frac{12(1)}{15}$ [= 8 s]	2
		(iii)	$v + 1 = \frac{28}{8}$ (1) [allow e.c.f. from (i) only on $v - 1$ or $1 - v$ ] manipulation (1) $v = 2.5$ m s <sup>-1</sup> (1) <b>Alt 1:</b> Distance moved by Stacey in 8 s = 8 m ✓ Distance moved by walkway in 8 s = 28 - 8 = 20 m ✓ Speed of walkway = $\frac{20}{8} = 2.5$ m s <sup>-1</sup> ✓ <b>Alt 2:</b> Velocity of Stacey on walkway = $\frac{28}{8} = 3.5$ m s <sup>-1</sup> ✓ Velocity of walkway = 3.5 - 1.0 ✓ = 2.5 m s <sup>-1</sup> ✓	3
	(iv)	5.0 m s <sup>-1</sup> e.c.f. from (iii), i.e. ans = 2.5 + (iii)	1	
			<b>[8]</b>	

Question		Marking details	Marks Available
7.	(a)	Use of $\cos 70^\circ$ (1) $2T \cos 70^\circ = 800$ (1) [ $\rightarrow T = 1170$ N] [Accept mysterious division by 2 (b.o.d.)]	2
	(b)	(i) Area under graph attempted or $\frac{1}{2}Fx$ or $\frac{1}{2}kx^2$ (1) 240 J (1)	2
		(ii) Initial energy stored in bow converted entirely to $E_k$ of arrow (1) $240$ e.c.f. = $\frac{1}{2}50 \times 10^{-3}v^2$ (1) [subst] manipulation leading to $v = 98 \text{ m s}^{-1}$ shown. (1) [Final mark not available if incorrect $E_k$ used]	3
	(c)	(i) $x = ut + \frac{1}{2}at^2$ (1); $u = 0$ (1) $t = 0.55$ s [accept 0.6 s] (1)	2
		(ii) $D = V_H t$ [or by imp.] (1) e.c.f. of $t$ $D = 98$ [or 100] $\times 0.55$ [or 0.6] [e.c.f.] $\therefore D = 54$ m (1)	3
		(iii) $v_{\text{vertical}} = u + at$ <b>and</b> $u = 0$ (1) [or equiv or by impl.] $v_v = 5.4 \text{ m s}^{-1}$ (1) $v_{\text{resultant}} = \sqrt{5.4^2 + 98.0^2}$ (1) or $v^2 = 5.4^2 + 98.0^2$ $v_{\text{resultant}} = 98.1 \text{ m s}^{-1}$ (1) Angle to horizontal [clearly identified] = $\sin^{-1} \frac{5.4}{98.1} = 3^\circ$ (1) [Or equivalent correct application of other trig function]	5
	(d)	Greater [initial] force [or equiv.] required to pull the Turkish bow string [through a given distance] (1) [or more work / energy needed] Greater area under the Turkish bow curve (1) [leading to] more [elastic] potential energy stored (1). Arrows will leave Turkish bow with a greater speed / velocity (1) [Accept converse arguments]. [Alt to 2 <sup>nd</sup> marking point: linking to 1 <sup>st</sup> marking point .... because gradient of graph greater for Turkish bow]	4
			<b>[21]</b>