

PH1 Mark Scheme – January 2010

Question		Marking details	Marks Available
1.	(a)	Flow of charge [acceptcharge/ions] or $\frac{[\Delta]Q}{[\Delta]t}$, if the symbols defined	1
	(b)	(i) Sum of areas of triangle and rectangle areas attempted [or reasonable attempt at area of trapezium] (1) $Q = 3.0 \text{ C ((unit))(1)}$	2
		(ii) No. of electrons = $\frac{3.0(\text{e.c.f.})}{1.6 \times 10^{-19} (1)} = 1.9 \times 10^{-19} (1)$ [1 st mark div by e]	2
		(iii) $I = 1.2(0) \text{ A (from graph) (1)}$; $v = \frac{I}{nAe}$ [manipulation shown – could be in following substitution – or by impl.](e.c.f. on I)(1) $= 3.75 \times 10^{-5} \text{ m s}^{-1}$ [accept $3.8 \times 10^{-5} \text{ m s}^{-1}$] (e.c.f. on I) (1)	3
			[8]
2.	(a)	<u>Free</u> [or equiv, e.g. conducting / moving / delocalised] electrons (1) collide / interact / hindered [by] (1) with atoms / ions of metal conductor / lattice [“particles” b.o.d.](1)	3
	(b)	(i) I. [0 – 2 V]: Resistance constant / changes by v. small amount II. [2 – 8 V]: Resistance increases	1 1
		(ii) Either $R_{\text{bulb}} = \frac{6.0}{0.8(1)} = 7.5 \Omega (1)$ Total resistance = $5 \Omega (1)$ [ecf] $\left[\text{Correct use of } \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \right]$ $I = 1.2 \text{ A (1) [ecf on } R]$	4
		Or $I \text{ through } 15\Omega = \frac{6.0}{15} (1) = 0.4 \text{ A (1)}$ $I \text{ through bulb} = 0.8 \text{ A (1)}$ $\therefore \text{Total current} = 1.2 \text{ A (1)}$	
		(iii) Subst in $P = I^2R$ [ecf on R and I] or in $P = \frac{V^2}{R}$ [ecf on R only] or $P = IV$ [ecf on I only] (1) $P = 7.2 \text{ W (1)}$	2
			[11]

Question		Marking details	Marks Available
3.	(a)	The electrical (potential) <u>energy transferred</u> [or <u>work done</u>] <i>per coulomb / unit charge passing through the cell</i> [<u>Underlined</u> (1); <i>italic</i> (1)]	2
	(b)	Voltmeter shown in parallel with cell [outside the dotted line – accept inside the line if outside the cell/i.r combination] [Accept equivalent, e.g. connected in parallel with resistor]	1
	(c)	All points correctly plotted (2) [-1 per mistake, min 0] Line correctly drawn [with extrapolation just to V axis] (1)	3
	(d)	(i) [e.m.f. =] 1.6 V	1
	(ii)	gradient attempted [or by impl.](1); $r = 0.33 \Omega / 0.3 \Omega / \frac{1}{3}\Omega$ (1)	2
			[10]
4.	(a)	(i) $\frac{\text{Total distance}}{\text{[Total] time}}$ [or equiv.] [Not rate of change of distance]	1
		(ii) Time for the whole journey = 3 h + 4 h = 7 h (1) [or 25 200 s] Mean speed = $\frac{480(1)}{7} \left[\frac{480000}{25200} \right] = 68.6 \text{ km h}^{-1}$ (1)[accept 69 – not 70]	3
	(b)	(i) Forward force labelled Driving / engine force and reverse force labelled Friction / drag / air resistance]	1
		(ii) Maximum at $t = 0$ (s) [accept: starts high at $t = 0$](1) Decreases (1) to zero [after 8 s] (1)	3
		(iii) $a = \frac{\Delta v(\text{from tangent})}{\Delta t (\text{from tangent})}$ (= 2.75 [accept 2.6 – 2.9] m s^{-1}) (1) $\Sigma F = ma / \Sigma F = 350 \times 2.75(\text{ecf})$ (1)= 962.5 [accept 910 – 1015] N (1)	3
	(c)	(i) Force \times distance (moved) (1) in the direction of the force (1) [or equivalent, e.g. component of force in the direction of motion \times distance moved, $Fd\cos\theta$ if symbols defined]	2
		(ii) Power $P = \frac{\text{work done}}{\text{time}}$ or $P = \frac{Fd}{t}$ (1) d/t <u>identified</u> with v (1) [by impl. if $F \times d / t$ used to define power]	2
		(iii) $F = \frac{40 \times 10^3}{18}$ [=2200 N]	1
	(d)	(i) Energy cannot be created or destroyed only changed from one form to another.	1
		(ii) Brake pads and wheel discs heat up (1) [accept k.e. \rightarrow heat energy] Reference to particles' gaining energy (1)	2
			[20]

Question		Marking details	Marks Available
5.	(a)	(i) Wire with rule positioned (1) and <u>labelled</u> moving pointer / jockey / croc clip (1) Either correctly positioned ohm-meter with no power supply or correctly position ammeter and voltmeter with power supply (1)	3
		(ii) [Different] length[s] of wire (1) Either measure V and I or measure / read R (1)	2
		(iii) Diameter of wire [not radius or csa by accept "thickness"] with micrometer / vernier calliper	1
		(iv) cross-sectional area fro πr^2 or $\pi(d/2)^2$ (1) graph of R against l [or mean value of R/l] (1) $\rho = \text{gradient} \times [\text{cs}]a$ [or mean value of $R/l \times \text{csa}$] (1) [NB $R = V/I$ given here can be used to credit 2 nd mark of (ii)] [NB Finding R for a measured length and [cs] area and then ρ calculated \rightarrow 1 only]	3
	(b)	(i) $R \propto l$ (1) $\therefore R$ <u>increases</u> as strain gauge gets longer (1) $R \propto 1/A$ (1) $\therefore R$ <u>increases</u> as the strain gauge gets thinner (1) [or $R = \frac{\rho l}{A}$ or $\rho = \frac{RA}{l}$ (1), A increases & l decreases (1) ρ doesn't change /constant (1) so resistance increases (1)]	4
		(ii) [csa =] $0.2 \times 10^{-3} \times 0.0012 \times 10^{-3}$ [or equiv.] (1) $\rho = 4.9 \times 10^{-7} \Omega \text{ m}$ ((unit)) (1) [ecf from csa calculation] [ecf on powers of 10 in both A and l]	2
		(iii) Either $1.6 = \frac{650}{650 + R} \times 6$ (1) Manipulation (1); $R = 1788 \Omega$ (1) Or $I = \frac{1.6}{650} (=2.46 \times 10^{-3} \text{ A})$ (1) $R = \frac{(6 - 1.6)(1)}{2.46 \times 10^{-3}} = 1788 \Omega$ (1)	3
			[18]

Question		Marking details	Marks Available	
6.	(a)	(i) Horizontal arrow [by eye] to right, close to A , labelled D . (1)	2	
		(ii) Vertically downwards arrow at A labelled F . (1)[NB if other force(s) labelled, s.i.f. $\rightarrow 0$]		
	(b)	(i) $U_H = \frac{4.50}{1.50} (= 3.0 \text{ m s}^{-1})$	1	
		(ii) Use of relevant equation, e.g. $v = u + at$ or $v^2 = u^2 + 2ax$ (1) [or by impl.] Correct subst e.g. $0 = u - 9.81 \times 0.75$ or $0 = u^2 - 2 \times 9.81 \times 2.75$ (1) [or by impl.] Answer $U = 7.3 / 7.35 / 7.4 \text{ m s}^{-1}$ (1)	3	
		(iii) $U = \sqrt{3.0^2 + 7.4^2}$ [or $U^2 = 3^2 + 7.4^2$] (1) [e.c.f. on both velocities] $= 7.9 - 8.0 \text{ m s}^{-1}$ (1)	2	
	(c)	(i) $E_{\text{total}} = mgh + \frac{1}{2}mv_H^2$ [or by impl.] [Accept $E_{\text{total}} = \text{P.E.} + \text{K.E.}$] (1) $= 6.0 \times 9.81 \times 2.75 + \frac{1}{2} \times 6.0 \times 3.0^2$ [e.c.f. on v_H] (1) [subst] $= 189 \text{ J}$ (1) [NB If only PE considered then 0]	3	
		(ii) Extreme points of trajectory both marked with a K .	1	
		(iii) $\frac{1}{2}mU^2 = 189$ (1) [e.c.f.] [accept $\text{KE} = 189 \text{ J}$ ecf] $U = 7.9 \text{ m s}^{-1}$ (1)	2	
				[14]