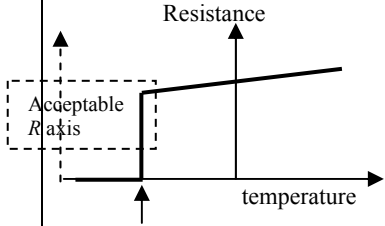
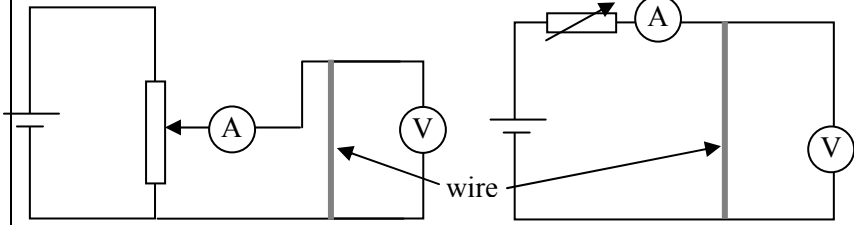


**PH1**

Question		Marking details	Marks Available									
1	(a)	(i) Vectors have magnitude and direction; scalars have only magnitude [Reference to vectors <b>and</b> scalars required for complete answer, e.g. vectors have direction and scalars do not is enough]	1									
		(ii) <table border="1" style="display: inline-table; vertical-align: middle;"> <thead> <tr> <th>Vector</th> <th>Scalar</th> </tr> </thead> <tbody> <tr> <td>velocity</td> <td>distance</td> </tr> <tr> <td>force</td> <td>time</td> </tr> <tr> <td></td> <td>temperature</td> </tr> <tr> <td></td> <td>density</td> </tr> </tbody> </table> <div style="display: inline-block; vertical-align: middle; margin-left: 20px;"> <p style="text-align: right;">All correct → 2 One incorrect → 1 Two or more incorrect → 0</p> </div>	Vector	Scalar	velocity	distance	force	time		temperature		density
	Vector	Scalar										
	velocity	distance										
force	time											
	temperature											
	density											
(b)	(i) $1600 \cos 25^\circ (1) = 1450 \text{ N} (1)$	2										
	(ii) Long (1) because greater component in the direction of motion (1) [NB Decrease angle only – not enough. 2 <sup>nd</sup> mark for reference to component either in direction of motion or perpendicular to it]	2										
<b>[7]</b>												
2.	(a)	No net / resultant force [accept ‘total’](1) No net / resultant moment (1) [1 mark max if ‘net’ or equiv missing]	2									
	(b)	(i) Downward vertical arrow indicated $\pm 1$ cm of centre of bar [halfway between 30 N and 25 N forces], labelled 20 N	1									
		(ii) $T_A \times 3(1) = 20 \times 1.5(1) + 40 \times 2.35 + 30 \times 1.75 + 25 \times 0.85(1)$ [Note: LHS →(1); RHS: moment of bar (1), all other moments (1)] $T_A = 65.9 \text{ N} (1)$	4									
		(iii) $115 \text{ N} (1) - 65.9 \text{ N} (\text{e.c.f.}) = 49.1 \text{ N} (1)$ [Accept solution based on taking moments about chain A or other equiv method]	2									
<b>[9]</b>												

Question		Marking details	Marks Available
3	(a)	A material which has zero [electrical] resistance [or equiv.]	1
	(b)	 <p>Resistance</p> <p>temperature</p> <p>Acceptable R axis</p> <p>Axes (1) Line (not nec straight above <math>T_C</math>)(1) Temperature at which resistance [of material] drops [suddenly] to zero [or label on graph] (1)</p>	3
	(c)	<p>No [accept little] heat [accept energy] lost / generated (1) [Accept – large current can be produced from zero /small pd] Any application, e.g. nuclear fusion / tokamaks, particle accelerators / LHC, MRI scanners / large motors or generators (1)</p>	2
<b>[6]</b>			
4.	(a)	 <p>wire</p> <p>Wire in functioning circuit with both meters correctly connected (1) Method of varying current / pd (1)</p>	2
	(b)	<p>(i) Resistance values / <math>\Omega</math>: 4.00, 4.00, 4.33, 4.75, 6.00 [all correct] 1</p> <p>(ii) Graph: Axes [scales, labels, units] (1), plots (1) line (1) [axes – no s.f. penalty; line – produced to R axis – accept extrapolation] 3</p>	
	(c)	<p>(i) <math>0 \rightarrow 0.2</math> A [‘at start’, ‘to begin with’] no change / constant (1) <math>0.2</math> A <math>\rightarrow 0.5</math> A [‘then’] <u>increasing</u> with current (1) 2</p> <p>(ii) <math>0 \rightarrow 0.2</math> A [e.c.f. from graph] 1</p> <p>(iii) Temperature wire not constant / increases [accept changes] [with current] 1</p>	
	(d)	<p>Current / ammeter reading would [rapidly rise from 0 then] decrease (1) and then stabilise (1) 2</p>	
<b>[12]</b>			

Question		Marking details	Marks Available
5.	(a)	<p><math>E</math> = total energy transferred [per unit charge passed] in the source (1)  <math>V</math> = energy [per unit charge passed] converted [accept 'lost'] in the internal resistance (1)            Correct use of "per unit charge" in definitions of both <math>E</math> and <math>V</math>. (1)</p>	3
	(b)	<p>(i) <math>Q = 0.22 \times 3600</math> [= 792 C] 1</p> <p>(ii) <math>E = \frac{4750}{792(\text{e.c.f.})}</math> [= 6.0 V] 1</p> <p>(iii) <math>V = \frac{4500}{792(\text{e.c.f.})}</math> (1) [= 5.7 V] 1            or <math>\left[ P = \frac{4500}{3600} = 1.25W. V = \frac{1.25}{0.22} = 5.7 \right]</math> V</p> <p>(iv) <math>r = 0.3 \text{ V}</math> [= ans (ii) – ans (iii) e.c.f.] 1</p> <p>(v) <math>0.32</math> (e.c.f.) = <math>0.22 r</math> (1) [or by impl]  <math>r = 1.45 \Omega</math> (1) [e.c.f. based upon (i) to (iv)] 2</p>	[9]
6	(a)	<p>Accept answers in range [-] 9.6 to [-] 10.0 [m/s<sup>2</sup>] [no unit or sign penalty] (1)            Acceleration <u>due to gravity</u> (1)</p>	2
	(b)	4.0 m s <sup>-1</sup> [accept 3.9 or 4] 1	
	(c)	<p>[Constant] deceleration from 4 m s<sup>-1</sup> to zero / rest in 0.4[1] s (1)            [Constant] accel from rest to - 4 m s<sup>-1</sup> from 0.4[1] s to 0.8[2] s (1)            [Momentarily] stationary [or at its max height] at 0.4[1] s (1)            [NB or equivalent wordings to the same effect]</p>	3
	(d)	<p>(i) Area shaded between graph and abscissa from 0.8[2] to 3.2 s 1</p> <p>(ii) Shaded area: <math>\frac{1}{2} \times 2.8 \times 2.7 - \frac{1}{2} \times 0.4 \times 4</math> (1) = 37 m (1)            [or <math>\frac{1}{2} (4 + 27) \times (3.2 - 0.8)</math> (1) = 37.2 m (1) or equiv. using equations of motion, eg. <math>x = ut + \frac{1}{2}at^2</math>] [37.5 ± 1.5✓] 2</p> <p>Directly beneath (1)  <u>Horizontal</u> speed constant (1) ...because .. <u>no horizontal</u> force[s]            acting on stone (1) [NB 'no' required; horizontal only needed once] 3</p>	[12]

Question		Marking details	Marks Available
7.	(a)	(i) Force $\times$ distance (1) moved in direction of force (1) [or equiv, eg component of force in direction of movement $\times$ distance moved, or $W = Fd \cos \theta$ (1) - explanation for 2 <sup>nd</sup> mark] [Work is done when a force moves its point of application $\rightarrow$ 1 only]	2
		(ii) $\text{kg m s}^{-2}$ (1) $\times$ m $\rightarrow$ $\text{kg m}^2 \text{ s}^{-2}$ (1)	2
	(b)	(i) $E_p \text{ lost} = 70 \times 9.81 \times 120 \sin 20^\circ$ (1) [or by impl.] $= 28\,000 \text{ J}$ [28148] (1) [Use of 10 for $g$ - 1 <sup>st</sup> mark lost]	2
		(ii) At A, $E_k = \frac{1}{2} \times 70 \times 6^2$ (1) [= 1260 J] At B, $E_k = \frac{1}{2} \times 70 \times 21^2$ (1) [=15435 J] $\Delta E_k = 14175 \text{ J}$ (1) [If $(21 - 6)^2$ calculated $\rightarrow$ 1 mark only]	3
	(c)	(i) Energy cannot be created or destroyed only changed from one form to another	1
		(ii) Energy is converted to [accept: lost as] internal energy heat / sound / ke of air (1) Detail: Molecules of air gain $E_k$ as skier moves / molecules of snow / skis gain $E_k$ / vibrational energy (1)	2
	(d)	<u>Use of <math>W = Fd</math></u> (1) [or by impl.] $28184 - 14175$ (1) (e.c.f. on both) $= F \times 120$ (1) [or by impl.] $F = 117 \text{ N}$ (1) [Accept answer based upon force components]	4

Question		Marking details	Marks Available
8	(a)	[A conductor is] a material through which charge / electrons [accept ions / holes] can flow / move <b>or</b> which contains free / delocalised electrons.	1
	(b)	(i) Volume = $2.0 \times 10^{-6} \times 2.0$ (1) [or by impl] mass = $8920 \times 4.0 \times 10^{-6}$ (1) [= 0.0357 kg] (( <b>unit</b> ))	2
		(ii) $\frac{0.0357(\text{e.c.f.})}{1.05 \times 10^{25}}$ (1) $\times 1.5$ (1) [= $5.1 \times 10^{23}$ electrons]	2
		(iii) $n = \frac{5.1 \times 10^{23}(\text{e.c.f.})}{4.0 \times 10^{-6}(\text{e.c.f.})}$ (1) [= $1.28 \times 10^{29} \text{ m}^{-3}$ ] $v = \frac{I}{nAe}$ [manipulation at any stage] (1) $v = \frac{1.2}{1.28 \times 10^{29} \times 2.0 \times 10^{-6} \times 1.6 \times 10^{-19}}$ (subst) (1) [e.c.f. on $n$ ] $v = 2.9 \times 10^{-5} \text{ m s}^{-1}$ (1) [NB use of $5.1 \times 10^{23}$ for $n \rightarrow 7.3(5) \text{ m s}^{-1}$ ]	4
		<b>[9]</b>	