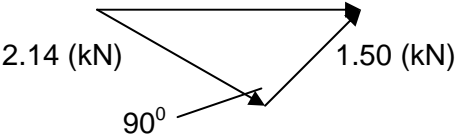


G481 Mechanics

Question		Expected Answers	Marks	Additional Guidance
1	(a)	Correct lines from: <ul style="list-style-type: none">• joule (J) to N m• watt (W) to J s^{-1}• newton (N) to kg m s^{-2}	B2	Note: 2 marks for all correct 1 mark for two correct 0 marks for none or one correct
	(b) (i)	weight in the range 200 to 1200 (N)	B1	
	(ii)	area in the range 0.01 to 0.08 (m^2)	B1	
	(iii)	pressure = (b)(i)/b(ii)	B1	Allow: 1 sf answer
		Total	5	



Question		Expected Answers	Marks	Additional Guidance
2	(a)	$W = mg$ weight = $1.50 \times 9.81 = 14.72$ (N) or 14.7 (N) or 15 (N)	B1	Allow: Use of 9.8 (m s^{-2}) Allow: Bald 15 (N); but not ' $1.50 \times 10 = 15(\text{N})$ '
	(b)	(i)	B1	Note: Must have reference to force
		(ii)	C1 C1 A1	Allow: 2 marks for 1.75/1.09' if answer from (iii) is used Allow: 2 sf answer Allow: 2 marks if 2.80 m is used; time = 2.27 (s)
		(iii)	C1 A1	Possible ecf Allow: 1.7 or 1.8 (m s^{-1})
		(iv)	C1 A1	Ignore sign for change in velocity Allow: 130 (m s^{-2}) ----- Special case: acceleration = $\frac{2.47 - 1.50}{0.030} = 32.3$ or 32 (m s^{-2}) scores 1 mark
		Total	9	

Question		Expected Answers	Marks	Additional Guidance
3	(a)	mass = $\underline{140 \times 3.0}$ (= 420 kg)	B1	Allow: $\frac{420}{3.0} = 140$ (reverse argument)
	(b) (i)	total mass = 500 + 560 + 420 (= 1480 kg) total weight = $1480 \times 9.8(1)$ / total weight = 14520 (N) net force = 1480×1.8 / net force = 2664 (N) tension = 14520 + 2664 tension = $1.7(2) \times 10^4$ (N)	C1 C1 C1 C1 A0	Note: Omitting one of the masses – can score maximum of 3 Omitting two masses – can score maximum of 2 Examples: 3 marks if mass of cable is omitted tension = 1908 + 10400 = 1.23×10^4 (N) 2 marks if mass of cable and people are omitted tension = 900 + 4905 = 5.8×10^3 (N) Note: 4 marks for 'tension = $(m(g + a) =) 1480 \times (9.81 + 1.8)$ '
	(ii)	stress = $\frac{1.72 \times 10^4}{3.8 \times 10^{-4}}$ / stress = $\frac{(b)(i)}{3.8 \times 10^{-4}}$ stress = $4.5(3) \times 10^7$ (Pa)	C1 A1	Possible ecf from (i) Note: A tension of 1.7×10^4 (N) gives an answer of $4.4(7) \times 10^7$ (Pa)
Total			7	

Question		Expected Answers	Marks	Additional Guidance
4	(a)	The mass (of the electron) increases as its speed approaches c / <u>speed of light</u> / $3 \times 10^8 \text{ m s}^{-1}$	M1 A1	Not: mass 'changes' / 'electron becomes heavier'
	(b) (i)	A line with correct arrow in the y direction has length of 14 to 16 'small squares' A line with correct arrow in the x direction has length of 24 to 26 'small squares'	B1 B1	Note: If correct arrows are not shown, then maximum mark is 1
	(ii)	component = $(8.0 \cos 31) = 6.86 \text{ (m s}^{-1})$ or $6.9 \text{ (m s}^{-1})$	B1	Allow: 6.85 as BOD
	(c) (i)	Correct vector triangle drawn  $(\text{resultant force})^2 = 2.14^2 + 1.50^2$ resultant force = 2.61 (kN)	B1 C1 A1	Note: Expect at least one 'label' on the sketch, eg: 2.14, 1.5, 90° The 'orientation' of the triangle is not important The directions of all three arrows are required Allow: 2 sf answer of 2.6 (kN) Allow a scale drawing; 2 marks if answer is within $\pm 0.1 \text{ kN}$ and 1 mark if $\pm 0.2 \text{ kN}$ Alternative for the C1 A1 marks: $1.50 \cos(55)$ or $2.14 \cos(35)$ C1 resultant force = $1.50 \cos(55) + 2.14 \cos(35)$ resultant force = 2.61 (kN) A1
	(ii)	2.6(1) (kN) (Constant velocity implies) zero <u>net</u> force / zero acceleration	B1 B1	Possible ecf Not: ' <i>resultant force = drag</i> ' since the first B1 assumes this
		Total	10	

Question		Expected Answers	Marks	Additional Guidance
5	(a)	Energy cannot be created or destroyed; it can only be transferred/transformed into other forms or The (total) energy of a system remains constant or (total) initial energy = (total) final energy (AW)	B1	Allow: 'Energy cannot be created / destroyed / lost'
	(b)	Any suitable example of something strained (eg: stretched elastic band)	B1	
	(c) (i)	$E_p = mgh$ <u>and</u> $E_k = \frac{1}{2}mv^2$ (Allow Δh for h)	B1	Not: $E_k = mgh$
	(ii)	$mgh = \frac{1}{2}mv^2$ $v^2 = 2gh$ or $v = \sqrt{2gh}$	B1 B1	
	(d) (i)	$m = \rho V$ $m = 1.0 \times 10^3 \times (1.2 \times 10^{-2} \times 2.0 \times 10^7)$ mass of water = 2.4×10^8 (kg)	C1 C1 A0	Allow any subject for the density equation
	(ii)	loss in potential energy = $2.4 \times 10^8 \times 9.81 \times 2.5 \times 10^3$ 30% of GPE = $0.3 \times 5.89 \times 10^{12}$ (= 1.77×10^{12}) power = $\frac{1.77 \times 10^{12}}{900}$ power = $1.9(63) \times 10^9$ (W) (≈ 2 GW)	C1 C1 C1 A0	Allow 1 mark for ' 5.89×10^{12} (J)' Allow 2 marks for ' 1.77×10^{12} (J)' Note: $\frac{5.89 \times 10^{12}}{900}$ (= 6.5 GW) scores 2 marks
	(iii)	Any correct suitable suggestion; eg: the energy supply is not constant/ cannot capture all the rain water / large area (for collection)	B1	Note: Do not allow reference to 'inefficiency' / 'cost'
Total			11	

Question		Expected Answers	Marks	Additional Guidance
6	(a)	The graph shows length and not extension of the spring / spring has original length (of 2.0 cm) (AW)	B1	Allow: 'length cannot be zero'
	(b)	Straight line (graph) / linear graph / force \propto <u>extension</u> / constant gradient (graph)	B1	Not 'force \propto <u>length</u> '
	(c)	force constant = $\frac{2.0}{0.04}$ force constant = 50 (N m ⁻¹)	C1 A1	Note: The mark is for any correct substitution Allow: 1 mark for 0.5 (N m ⁻¹) – 10 ⁿ error Allow 1 mark for $5/12 \times 10^{-2} = 41.7$ or $4/10 \times 10^{-2} = 40$ or $3/8 \times 10^{-2} = 37.5$ or $2/6 \times 10^{-2} = 33.3$ or $1/4 \times 10^{-2} = 25$
	(d)	work done = $\frac{1}{2}Fx$ or $\frac{1}{2}kx^2$ or 'area under graph' work done = $\frac{1}{2} \times 3.0 \times 0.06$ or $\frac{1}{2} \times 50 \times 0.06^2$ work done = 0.09 (J)	C1 A1	 Possible ecf Note: 1 sf answer is allowed
	(e)	Find the gradient / slope (of the tangent / graph) Maximum speed at 1.0s / 3.0s / 5.0s / steepest 'part' of graph / displacement = 0	B1 B1	 Allow: 2 marks for 'steepest / maximum gradient'
		Total	8	

Question		Expected Answers	Marks	Additional Guidance
7	(a)	(i)	B1	Allow: it has 'same force but thinner/smaller area' Not: Thin / small area
		(ii)	B1	Note: Need reference to force or stress removed Allow: '.. does not return to original size / shape / length when force / stress is removed'
	(b)	<p>Measurement:  Diameter Any <u>two</u> from:</p> <ul style="list-style-type: none"> • original / initial length (Not: final length) • extension / initial <u>and</u> final lengths • weight / mass <p>Equipment:  Micrometer / vernier (calliper) (for the diameter of the wire) Any <u>two</u> from:</p> <ul style="list-style-type: none"> • Ruler / (metre) rule / tape measure (for measuring the original length / extension) • Travelling microscope (for measuring extension) • Scales / balance (for measuring the mass & <i>mg</i> equation is used or for measuring weight) / Newtonmeter (for the weight of hanging masses) / 'known' weights used <p>Determining Young modulus:</p> <ul style="list-style-type: none"> • stress = force/(cross-sectional) area <u>and</u> strain = extension/original length • Young modulus = stress/strain / Young modulus is equal to the gradient from stress-strain graph (in the linear region) 	<p>B1</p> <p>B1 X 2</p> <p>B1</p> <p>B1 x 2</p> <p>B1</p> <p>B1</p>	<p>The term <i>diameter</i> to be included and spelled correctly to gain the mark</p> <p>The term <i>micrometer / vernier (calliper)</i> to be included and spelled correctly to the gain mark. (ALLOW: Micrometer is used to measure area / radius / thickness – as BOD)</p> <p>Allow: 'known masses & <i>mg</i> equation' but not 'known masses'</p> <p>Allow: stress = F/A <u>and</u> strain = x/L</p> <p>Special case for determining Young modulus: Gradient from force-extension graph is $\frac{EA}{L}$ B1 Young modulus = gradient $\times L/A$ B1</p>
Total			10	