


1)

Question		Answer	Marks	Guidance
(a)	(i)	Arrow (labelled F) directed towards centre of circle	B1	Allow: arrow drawn parallel to the string
	(ii)	Resultant force (F) acts at 90° to motion / velocity of bung so no work done is done by F (hence no change in speed)	B1 B1	Allow: No component of F acts in the direction of motion (B1) hence there is no acceleration <u>in the direction of motion</u> (AW) (B1)
(b)	(i)	Student <u>tries to</u> rotate bung at <u>constant</u> radius / <u>tries to</u> keep reference mark at end of tube (AW) Force F is calculated using $F = Mg$. where M is mass of slotted masses Measure time t for n revolutions of the bung (hence calculate T for 1 revolution). Measure radius r when <u>stationary</u> Calculate v using $2\pi r n / t$ (or $2\pi r / T$).	B1 B1 B1 B1	Not: bald 'constant radius' Not: $F = \text{weight}$ Not: 'take time for 1 revolution'
	(ii)	1 Straight line of positive gradient <u>passing through the origin</u> 2 $F = \frac{m}{r} v^2$ hence gradient = $\frac{m}{r}$ Mass = <u>gradient</u> (of graph) x radius (of orbit)	B1 B1 B1	Cannot award this mark if graph is curved Can score this mark if graph is curved
Total			11	

2)

Question	Expected Answers	Marks	Additional guidance
2 a i	$(v = 2\pi r/t) t = 2\pi 60/0.26 = \mathbf{1450}$ s	B1	Correct answer is 1449.96 hence allow 1.4×10^3 Do not allow a bare 1.5×10^3
	ii (ii) correct substitution into $F = mv^2/r$: eg $F = (9.7 \times 10^3 \times 0.26^2)/60$ $F = \mathbf{10.9}$ N	C1 A1	Allow 11 N
b i	THREE correct arrows at A, B and C all pointing towards the centre (judged by eye)	B1	Ignore starting point of arrow
	ii 1. Greatest reaction force is at C because it supports weight of sock AND provides the required upward resultant (centripetal) force (WTTE) 2. Least at A because sock's weight provides part of the required downward resultant (centripetal) force (WTTE)	M1 A1 B1	This is a mandatory M mark. The second mark cannot be gained unless this is scored. Any indication that candidates think that the centripetal force is a third force loses this second and possibly the next mark. They must make correct reference to the resultant force that provides the required centripetal force/acceleration. Allow answers using the equation $F = mv^2/r$ such as $N_c - mg$ (at C) = centripetal force OR mv^2/r OR $mg + N_A$ (at A) = centripetal force OR mv^2/r
Total		7	

3)

Question	Answer	Mark	Guidance
(a) (i)	 <p>Correct direction and labelling for W and T</p>	B1	Both forces must be correct to score this mark.
(a) (ii)	<p>Straight line for F</p> <p>Correct direction not horizontal or vertical</p>	B1	Allow: Freehand sketch of F must lie between 15° and 75° to the horizontal to score this mark.
(b) (i)	$a = T / m$ $a = 28 \times 10^3 / 6200 (= 4.516)$ $v^2 = u^2 + 2as$ $56^2 = 0 + 2 \times 4.516s$ (any subject) $s = 350$ (m)	C1 C1 A1	Must substitute to score this mark. Answer to 3 sf = 347 (m). Allow: max 2 marks if v is not squared but correct formula was quoted. [Expect $s = 6.2$ (m)] Allow: $Fs = \frac{1}{2} mv^2$ [C1] $28 \times 10^3 s = \frac{1}{2} \times 6200 \times 56^2$ [C1] (any subject) $s = 350$ (m) [A1] Allow: $Ft = mv$ $t = 12.4$ (s) [C1] $s = \frac{1}{2} vt = \frac{1}{2} \times 56 \times 12.4$ [C1] $s = 350$ (m) [A1]
(ii)	Air resistance/drag/friction acts on aircraft <u>decreasing</u> either the net forward force or the acceleration $Fs = \Delta KE$ so reduced force must act over a longer distance to produce enough kinetic energy for take-off OR $v^2 = (u^2) + 2as$ so reduced acceleration means longer distance to reach take-off speed.	M1 A1	Not: 'slowing the aircraft down'. Allow word equation. Note: This mark cannot be given if the previous (M1) mark has not been scored.
(c) (i)	$L \cos 35^\circ = 6200 \times 9.81$ $L = \frac{6200 \times 9.81}{\cos 35^\circ}$ OR $L = 7.42 \times 10^4$ $L = 7.4 \times 10^4$ (N)	M1 A0	Allow: Use of 9.8 Note: There is no mark for the answer as it is given in the question. Marks in 'Show' questions are for the working.
Question	Answer	Mark	Guidance
(ii)	$L \sin 35^\circ = mv^2 / r$ $r = \frac{6200 \times 86^2}{7.4 \times 10^4 \sin 35^\circ}$ $r = 1100$ (m)	C1 C1 A1	Possible ecf from (c)(i). Correct answer to 3 sf = 1.08×10^3 (m). Allow: 1 mark for using $\cos 35^\circ$ instead of $\sin 35^\circ$. Expect gives an answer of 760 (m). Allow: 2 marks for correct working using $v = 56$ (m s ⁻¹) Expect an answer of $r = 460$ (m). No marks for using $\tan 35^\circ$ or for omitting a trig function.
(d) (i)1	Indication at 'top' of circle (by eye)	B1	
(i)2	0 (N)	B1	
(ii)	P is not the resultant force OR Resultant force must be towards centre of circle so P must have a component acting vertically upwards, equal in magnitude to W (AW)	B1	Allow: (Horizontal) component of P provides centripetal acceleration and vertical component of P is equal to weight. (AW)
	Total	14	

For additional circular motion questions go to theonlinephysicstutor.com and look for question by topic.