MECHANICS 2 (A) TEST PAPER 1 : ANSWERS AND MARK SCHEME

1.	(a) Deceleration $= \frac{5}{3}$ ms^{-2} Force $= 1200 \times \frac{5}{3} = 2000$ N	M1 A1	
	(b) K.E. lost $= 600(30^2 - 20^2) = 300\,000$ J	M1 A1	4
2.	(a) $AB = \int_0^5 v\,dt = [16t^2 - t^3]_0^5 = 400 - 125 = 275$ m	M1 A1 M1 A1	
	(b) $a = 32 - 6t$ $t = 3 : a = 32 - 18 = 14$ ms^{-2}	B1 M1 A1	7
3.	$P = Fv : 600 = 6F$ $F = 100$ N	M1 A1 A1	
	$100 = 96g \sin\alpha + R$ $R = 100 - 8g = 21{\cdot}6$ N	M1 A1 M1 A1	7
4.	(a) $\mathbf{v} = 2t\,\mathbf{i} + 2\mathbf{j}$ $t = 0 : \mathbf{v} = 2\mathbf{j}$, so speed $= 2$ ms^{-1}	M1 A1 A1	
	(b) $\mathbf{a} = 2\mathbf{i}$, so $\mathbf{a}$ is constant, with magnitude 2 ms^{-2}	M1 A1	
	(c) When $\lvert\mathbf{r}\rvert = 40$, $(t^2 - 2)^2 + (2t)^2 = 40^2$	M1 A1	
	$t^4 + 4 = 40^2$ $t = 6{\cdot}32$	M1 A1	
	(d) As t gets large, $\lvert\mathbf{r}\rvert$ increases, so only valid up to a certain time	B1	10
5.	(a) $600(25, 6) + 600(30, 27) = 1200(\bar{x}, \bar{y})$ $\bar{x} = 27{\cdot}5$, $\bar{y} = 16{\cdot}5$	M1 A1 M1 A1 A1	
	$\tan\theta = 16{\cdot}5 \div 27{\cdot}5 = 0{\cdot}6$ $\theta = 31°$	M1 A1 A1	
	(b) No : centre of mass depends only on area, not on density	B1 B1	10
6.	(a) Diagram showing weight, tension, normal reaction, friction	B2	
	(b) M(C) : $T(7a\cos\alpha) = 0{\cdot}8g(2a\cos\alpha)$ $T = 2(0{\cdot}8g) \div 7 = 2{\cdot}24$ N	M1 A1 M1 A1	
	(c) Resolve perp. to rod : $R + T\cos\alpha = 0{\cdot}8g\cos\alpha$	M1 A1	
	$R = 5{\cdot}6\cos 20° = 5{\cdot}26$ N	M1 A1	10
7.	(a) $(v_B - v_A)/(u - 4u) = -e$ $2u - v_A = 3eu$ $v_A = u(2 - 3e)$	M1 A1 A1	
	$v_A < 0$, so speed $= u(3e - 2)$	A1	
	(b) Since $v_A < 0$, $2 - 3e < 0$ $\frac{2}{3} < e \le 1$	M1 A1 A1	
	(c) $4mu + kmu = mv_A + kmv_B$ $v_A + 2ku = 4u + ku$	M1 A1	
	$v_A = u(4 - k)$, so $4 - k = 2 - 3e$ $k = 3e + 2$	M1 A1	
	$\frac{2}{3} < e \le 1$, so $4 < k \le 5$	M1 A1	13
8.	(a) $y = (u\sin\alpha)t - \frac{1}{2}gt^2 = 16t - 4{\cdot}9t^2$	M1 A1	
	When y is max., $16 - 9{\cdot}8t = 0$ $t = 1{\cdot}63$ $y = 13{\cdot}1$ m	M1 A1 A1	
	(b) When $y = 6$, $4{\cdot}9t^2 - 16t + 6 = 0$	B1	
	$t = (16 + \sqrt{138{\cdot}4})/9{\cdot}8 = 2{\cdot}83$ $x = (u\cos\alpha)t = 30t = 85{\cdot}0$ m	M1 A1 M1 A1 A1	
	(c) $\frac{1}{2}m(34^2) = mg(6) + \frac{1}{2}mv^2$ $v^2 = 1038$ $v = 32{\cdot}2$ ms^{-1}	M1 A1 A1	14