

**MECHANICS 1 (A) TEST PAPER 6 : ANSWERS AND MARK SCHEM**

1.  $F = 0.34 \text{ N}$  at dist.  $d$  from  $X$ , where  $0.34d = 0.2 \times 1.5 + 0.14 \times 2$  B1 M1 A1  
 $0.34d = 0.58$   $d = 1.71 \text{ m}$  or  $171 \text{ cm}$  A1 M1 A1 6
2. (a) At  $P$ ,  $v = 9 + 3.6t$  At  $Q$ ,  $v = 9 + 3.6t + 2t = 9 + 5.6t$  M1 A1  
 $9 + 5.6t = 16$   $5.6t = 7$   $t = 1.25$   $O$  to  $Q$  :  $2.5 \text{ s}$  M1 A1  
 (b)  $\frac{1}{2} \times 1.25 \times (9 + 13.5 + 13.5 + 16) = 32.5 \text{ m}$  M1 A1 A1 7
3. (a) Resolve :  $F \sin 60^\circ = T \sin 30^\circ$ ,  $F \cos 60^\circ + T \cos 30^\circ = 0.8g$  M1 A1 A1  
 Hence  $F\sqrt{3} = T$ ,  $F + T\sqrt{3} = 1.6g$   $4F = 1.6g$   $F = 3.92 \text{ N}$  M1 M1 A1  
 (b)  $T = 3.92\sqrt{3} = 6.79 \text{ N}$  M1 A1  
 (c) Modelled clay as a particle B1 9
4. (a) Momentum :  $7 \times 50 - 4y = 2.25(50 + y)$   $6.25y = 237.5$   $y = 38$  M1 A1 A1  
 Impulse =  $0.05(7 - 2.25) = 0.238 \text{ N s}$  M1 A1  
 (b) Momentum :  $7 \times 50 - 4y = -5 \times 50 + 5y$   $9y = 600$   $y = 66\frac{2}{3}$  M1 A1 A1  
 Impulse =  $0.05 \times 12 = 0.6 \text{ N s}$  M1 A1 10
5. (a)  $0 = 7^2 - 2a(4)$   $a = \frac{49}{8} \text{ ms}^{-2}$  M1 A1  
 (b) Acc down plane =  $g \sin 25^\circ + \mu g \cos 25^\circ = 9.8(\sin 25^\circ + \mu \cos 25^\circ)$  M1 A1  
 Hence  $\sin 25^\circ + \mu \cos 25^\circ = 0.625$   $\mu = 0.223$  M1 A1  
 (c) Now down plane, acc. =  $g \sin 25^\circ - \mu g \cos 25^\circ = 0.220g$  M1 A1  
 $v^2 = 0 + 2(4)(0.220g) = 17.27$   $v = 4.16 \text{ ms}^{-1}$  M1 A1  
 (d) Air resistance, which would make the answer smaller B1 B1 12
6. (a)  $\vec{AB} = -50\mathbf{i} + 120\mathbf{j}$ , which has magnitude 130 M1 A1  
 $\vec{v}_c = \frac{26}{130}(-50\mathbf{i} + 120\mathbf{j}) = (-\mathbf{i} + 2.4\mathbf{j}) \text{ ms}^{-1}$  M1 A1  
 (b)  $\vec{OB} = -20\mathbf{i} + 60\mathbf{j}$ , of magnitude  $\sqrt{4000} = 20\sqrt{10}$  M1 A1  
 $\vec{v}_D = \frac{k\sqrt{10}}{20\sqrt{10}}(-20\mathbf{i} + 60\mathbf{j}) = k(-\mathbf{i} + 3\mathbf{j}) \text{ ms}^{-1}$  M1 A1  
 (c) Posn. vectors at time  $t$  are  $(30 - t)\mathbf{i} + (2.4t - 60)\mathbf{j}$  and  $kt(-\mathbf{i} + 3\mathbf{j})$  B1 B1  
 When these are equal,  $30 - t = -kt$  and  $2.4t - 60 = 3kt$  M1  
 $-60 + 2.4t = -3(30 - t)$   $t = 50$   $k = 0.4$  A1 M1 A1 14
7. (a)  $4.5g - T = 4.5a$ ,  $T - 4g = 4a$  Add :  $0.5g = 8.5a$   $a = 0.576 \text{ ms}^{-2}$  M1 A1 A1 M1 A1  
 (b)  $v^2 = 2as = 2(0.576)(1.9) = 2.191$   $v = 1.48 \text{ ms}^{-1}$  M1 A1 A1  
 (c)  $P$  has risen  $1.9 \text{ m}$  and has speed  $1.48 \text{ ms}^{-1}$  B1  
 Under gravity  $P$  rises  $s \text{ m}$  where  $0 = 1.48^2 - 2(9.8)s$  M1 A1 A1  
 $s = 0.112 \text{ m} < 1.1 \text{ m}$ , so  $P$  does not hit the pulley M1 A1  
 (d) Momentum conserved :  $4(1.48) + 4.5(0) = 8.5v$   $v = 0.697 \text{ ms}^{-1}$  M1 A1 A1 17