

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

1. (a) Moments about  $P$ :  $4g + 8g = 2kg$        $k = 6$       M1 A1 A1  
 (b) Resolve vertically:  $R = 9g + kg$        $R = 15g = 147 \text{ N}$       M1 A1      5
2. (a) Cos. rule on force  $\Delta$ :  $R^2 = 16 + 36 - 48 \cos 140^\circ$        $R = 9.42 \text{ N}$       M1 A1 M1 A1  
 (b)  $\sin \theta / 6 = \sin 140^\circ / R$        $\sin \theta = 0.409$        $\theta = 24.2^\circ$       M1 A1      6
3. (a)  $7 = \frac{1}{2}gt^2$        $t^2 = 14 \div 9.8$        $t = 1.20 \text{ s}$       M1 A1  
 (b)  $v = gt = 11.7 \text{ ms}^{-1}$       (c)  $0 - 5.8566^2 = -2gh$        $h = 1.75 \text{ m}$       M1 A1; M1 A1 A1  
 Modelled stone as particle, ignored air resistance, etc.      B1 B1      9
4. (a)  $P$  has p.v.  $40\mathbf{i} + 80\mathbf{j}$ , so  $OP = \sqrt{8000} = 89.4 \text{ m}$       B1 M1 A1  
 (b) Speed from  $P$  to  $Q$  is  $3 \text{ ms}^{-1}$ , so time =  $25 \text{ s}$       M1 A1  
 (c)  $OQ = 40\mathbf{i} + 80\mathbf{j} + 25(2.4\mathbf{i} - 1.8\mathbf{j}) = 100\mathbf{i} + 35\mathbf{j}$       M1 A1 A1  
 (d)  $65(a\mathbf{i} + b\mathbf{j}) = 100\mathbf{i} + 35\mathbf{j}$        $a = \frac{20}{13}$ ,  $b = \frac{7}{13}$       M1 M1 A1 A1      12
5. (a)  $10\,000(u_A - 10) = 84\,000$        $u_A = 18.4 \text{ ms}^{-1}$       M1 A1 A1  
 $7\,000(u_B + 10) = 84\,000$        $u_B = 2 \text{ ms}^{-1}$       M1 A1 A1  
 (b) Resisting force =  $\mu R = 0.15 \times 17\,000g = 24\,990 \text{ N}$       M1 A1 A1  
 (c)  $v = u + at$ :  $0 = 10 - 0.15gt$        $t = 6.80 \text{ s}$       M1 A1 A1      12
6. (a)  $T - 0.2g = 0.4(1)$        $T = 0.4 + 0.2g = 2.36 \text{ N}$       M1 A1 A1  
 (b)  $Mg - T = 0.4M$        $9.4M = 2.36$        $M = 0.251$       M1 A1 A1  
 (c)  $0.5 = \frac{1}{2} \times 0.4t^2$        $t = 1.58 \text{ s}$       M1 A1 A1  
 (d)  $P$  has moved  $0.5 \text{ m}$  and has speed  $0.632 \text{ ms}^{-1}$  and acceleration  
 $-0.2g$ , so  $0^2 - 0.632^2 = 2(-0.2g)s$        $s = 0.102$       B1  
 Comes to rest  $0.75 - (0.5 + 0.102) = 0.148 \text{ m}$  from pulley      M1 A1      15
7. (a)      B3
- (b) Time for last section =  $240 \div \frac{1}{2}(40) = 12 \text{ s}$ , so total time =  $72 \text{ s}$       M1 A1  
 Total distance =  $\frac{1}{2}(50 + 72) \times 40 = 2440 \text{ m}$       M1 A1  
 Average speed =  $2440 \div 72 = 33.9 \text{ ms}^{-1}$       M1 A1
- (c) Put  $t = 5$ :  $k(5m - 25) = 4$       Put  $t = 10$ :  $k(10m - 100) = 0$       B1 B1  
 $k = \frac{4}{25}$ ,  $m = 10$       M1 A1 A1
- (d) When  $t = 2$ ,  $a = \frac{4}{25} \times 16 = 2.56 \text{ ms}^{-2}$       M1 A1      16