

GCE Examinations

Advanced Subsidiary / Advanced Level

Mechanics
Module M1

Paper K

MARKING GUIDE

This guide is intended to be as helpful as possible to teachers by providing concise solutions and indicating how marks should be awarded. There are obviously alternative methods that would also gain full marks.

Method marks (M) are awarded for knowing and using a method.

Accuracy marks (A) can only be awarded when a correct method has been used.

(B) marks are independent of method marks.



Written by Shaun Armstrong & Chris Huffer

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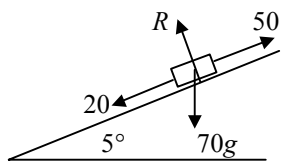
M1 Paper K – Marking Guide


1. (a) impulse = Δ mom = $800(0 - 15) = -12\,000 \therefore$ mag. = $12\,000$ Ns M1 A1
 (b) $Ft = 12\,000$, so $t = \frac{12000}{60000} = 0.2$ s M1 A1
 (c) use $v = u + at$ with $v = 0$, $u = 15$ $t = 0.2$ M1
 $0 = 15 + 0.2a \therefore a = -75$ so decel. = 75 ms^{-2} M1 A1 (7)

2. (a) moments about O (clockwise +ve): $90(1.2) + 70(1.2) - 80(1.2) - 60(1.2)$ M1
 $= 20(1.2) = 24$ Ns (clockwise) M1 A1
 (b) moments about O : $90(d) + 70(1.2) - 80(1.2) - 60(1) = 0$ M2 A1
 $90d = 72 \therefore d = 0.8$ m $\therefore x = 0.4$ m M1 A1 (8)

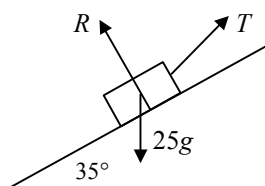
3. (a) $\mathbf{r} = 4t\mathbf{i}$ m A1
 $\mathbf{s} = (30\mathbf{i} - 60\mathbf{j}) + (-8t\mathbf{i} + 24t\mathbf{j})$ M1
 $(30 - 8t)\mathbf{i} + (24t - 60)\mathbf{j}$ m A1
 (b) they will collide if coeffs. of \mathbf{i} and \mathbf{j} in \mathbf{r} and \mathbf{s} are equal B1
 $4t = 30 - 8t$ and $24t - 60 = 0$ M1
 both are satisfied when $t = \frac{5}{2}$ so ball hits batsman M1 A1
 batsman is at $(4 \times 2.5)\mathbf{i} = 10\mathbf{i}$ A1
 (c) ball travelling fast \therefore air resistance significant B1
 ball will be affected by gravity \therefore not horizontal (may go over batsman) B1 (10)

4. (a) cons. of mom. $4m \times 2 - 3m \times 2 = 0 + 3mv$ M1
 $2m = 3mv$ so $v = \frac{2}{3} \text{ ms}^{-1}$ M1 A1
 (b) $R = mg$; $F = ma$ M1
 but $F = \mu R$; so $a = \frac{-\mu R}{m} = \frac{-\mu mg}{m} = -\mu g$ M1 A1
 use with $u = \frac{2}{3}$, $v = 0$, $s = 0.2$ M1
 $v^2 = u^2 + 2as$, $\therefore 0 = \frac{4}{9} - 0.4\mu g$ M1
 $\mu = \frac{10}{9g} = 0.113$ (3dp) M1 A1 (10)

5. (a) 
 resolve // to plane: $50 - 20 - 70g\sin 5^\circ = 70a$ M1 A1
 $a = -0.43$, \therefore decel. = 0.43 ms^{-2} (2dp) M1 A1
 (b) use of $s = ut + \frac{1}{2}at^2$ with $u = 3$ for $t = 4$ and $t = 5$ M1
 to give $s = 12 + 8a$ and $s = 15 + 12.5a$ M1 A1
 $\therefore 15 + 12.5a = 12 + 8a + 12$ M1
 $4.5a = 9 \therefore a = 2$ M1 A1
 use $v = u + at$ with $u = 3$, $a = 2$, $t = 5$ M1
 $v = 3 + 2 \times 5 = 13 \text{ ms}^{-1}$ A1 (12)

6. (a) eqn. of motion for A : $T = 5a$ (1) M1
 eqn. of motion for Q : $2g - T = 2a$ (2) M1
 (1) + (2) gives $2g = 7a$ i.e. $a = \frac{2g}{7}$ A1
 from (1), $T = 5a = \frac{10}{7}g$ N A1
 so force on pulley = $\sqrt{T^2 + T^2} = T\sqrt{2}$ M1
 $= \frac{10\sqrt{2}}{7}g$ N M1 A1
- 
- (b) $s = 0.3$, $u = 0$, $a = \frac{2}{7}g$ use $v^2 = u^2 + 2as$ M1
 $v^2 = \frac{6}{35}g$ i.e. $v = \sqrt{\frac{6}{35}g} = \sqrt{1.68} = 1.30 \text{ ms}^{-1}$ (3sf) M1 A1
- (c) B has 0.2 m left to fall B1
 for B : $u^2 = \frac{6}{35}g$, $s = 0.2$, $a = g$ use $v^2 = u^2 + 2as$ M1
 $v^2 = \frac{6}{35}g + 2g(0.2) \therefore v^2 = 5.6$; $v = 2.4 \text{ ms}^{-1}$ (1dp) M1 A1 (14)

7.



- (a) resolve // to plane: $T\cos 15 - 25g\sin 35 = 0$ M2
 so $T = 145.48 = 145 \text{ N}$ (3sf) A1
- (b) resolve perp. to plane: $R + T\sin 15 - 25g\cos 35 = 0$ M1 A1
 $R = 25g\cos 35 - 145.48 \times \sin 15 = 163.038 = 163 \text{ N}$ (3sf) M1 A1
- (c) resolve // to plane: $200\cos 15 - F - 25g\sin 35 = 0$ M2
 $F = 52.7 \text{ N}$ (3sf) down the slope A2
- (d) decrease B1
 e.g. perp. to plane, same force “down”, more from T “up” $\therefore R$ less B2 (14)

Total (75)

