

GCE Examinations
Advanced Subsidiary / Advanced Level

Mechanics
Module M1

Paper F

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.



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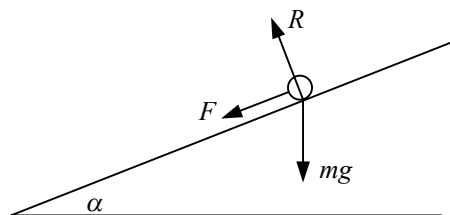
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M1 Paper F – Marking Guide

- | | | |
|----|---|---|
| 1. | <p>(a) resolve \uparrow: $R\cos 15 - 4g = 0$
 $R = \frac{4g}{\cos 15} = 40.6 \text{ N (3sf)}$</p> <p>(b) resolve $//$ to slope: $F\cos 15 - 4g\sin 15 = 0$
 $F = 4g\tan 15 = 10.5 \text{ N}$</p> | <p>M2
M1 A1</p> <p>M1
M1 A1 (7)</p> |
| | | |
| 2. | <p>(a) cons. of mom.: $2u = 0.03 (100)$
 $u = 1.5 \text{ ms}^{-1}$</p> <p>(b) $v^2 = u^2 + 2as$ so $0 = 6400 + 2a(0.02)$
 $a = -160000 \text{ ms}^{-2}$ so $F = 0.03 (-160000) = 4800 \text{ N (opp. dir}^n \text{ to bullet)}$</p> | <p>M2
A1</p> <p>M1 A1
M1 A1 (7)</p> |
| | | |
| 3. | <p>(a) moments about A (anticlockwise +ve) = $3(2) - 2(2)$
 $= 2 \text{ Nm (anticlockwise)}$</p> <p>(b) dist. of X from D is $2\sqrt{2}$ (by Pythagoras)
 moments about D: $X(2\sqrt{2}) = 5(2) + 3(2)$
 $X = \frac{8}{\sqrt{2}} = 4\sqrt{2}$</p> | <p>M2
A1</p> <p>M1
M1
M1 A1 (7)</p> |
| | | |
| 4. | <p style="text-align: center;"> T
 R
 R
 R
 $90g$
 $70g$ </p> | |
| | <p>(a) resolve \downarrow for man: $90g - R = 90(0.5)$ so $R = 837 \text{ N}$</p> <p>(b) resolve \downarrow for lift: $R + 70g - T = 70(0.5)$
 $837 + 686 - T = 35$ so $T = 1488 \text{ N}$</p> <p>(c) impulse = Δ mom. = $160(0 - 2) = 320 \text{ Ns}$</p> <p>(d) $Ft = 320$, so $F = \frac{320}{2} = 160 \text{ N}$</p> | <p>M2 A1</p> <p>M2 A1
A1</p> <p>M1 A1</p> <p>M1 A1 (11)</p> |
| | | |
| 5. | <p>(a) initially, A is at $6\mathbf{i}$ and travels $(-4T\mathbf{i} + T\mathbf{j}) \text{ km}$ in T hours
 T hours after midday, A is at $(6 - 4T)\mathbf{i} + T\mathbf{j} \text{ km}$
 initially B is at $3\mathbf{j}$ and travels $(4T\mathbf{i} - 3T\mathbf{j}) \text{ km}$ in T hours
 T hours after midday, B is at $4T\mathbf{i} + (3 - 3T)\mathbf{j} \text{ km}$</p> <p>(b) posⁿ. B rel. to A is $[4T - (6 - 4T)]\mathbf{i} + [(3 - 3T) - T]\mathbf{j}$
 i.e. $[(8T - 6)\mathbf{i} + (3 - 4T)\mathbf{j}] \text{ km}$</p> <p>(c) they will collide if coeffs. of \mathbf{i} and \mathbf{j} in part (b) are both zero
 $8T - 6 = 0$ and $3 - 4T = 0$ are both satisfied when $T = \frac{3}{4}$
 i.e. collision at 12:45 p.m.</p> | <p>M2
A1
M2
A1</p> <p>M1
A1</p> <p>M1
A1
A1 (11)</p> |

6. (a) $u = 0, s = 2200 - 240 = 1960, a = 9.8$ use $v^2 = u^2 + 2as$
 $v^2 = 0 + 2(9.8)(1960)$ so $v = 196 \text{ m s}^{-1}$ M2
M1 A1
- (b) $s = ut + \frac{1}{2} at^2$ M1
 $1960 = 0 + 4.9t^2 \Rightarrow t = 20 \text{ seconds}$ M1 A1
- (c) $140 - 20 = 120 \text{ seconds to travel } 240 \text{ m}$ M1
speed = 2 m s^{-1} A1
- (d) e.g. no air resistance;
velocity on opening parachute will not immediately reduce B2
e.g. if air resistance included, value in (a) would be much lower
and consequently value in (b) much higher B2 (13)

7.



- (a) $\sin \alpha = \frac{3}{5}$ (3,4,5 Pythag. triple) so $\cos \alpha = \frac{4}{5}$ B1
resolve perp. to plane: $R - mg \cos \alpha = 0$ so $R = \frac{4}{5} mg$ M1 A1
 $F = \mu R = \frac{1}{5} mg$ M1 A1
Resolve up the plane: $-F - mg \sin \alpha = ma$ M1
 $-\frac{1}{5} mg - \frac{3}{5} mg = ma$ so $a = -\frac{4}{5} g$ A1
i.e. $a = \frac{4}{5} g$ and is directed down the slope A1
- (b) $u = 20, v = 0, a = -\frac{4}{5} g$ use $v^2 = u^2 + 2as$ M1
 $0 = 400 - \frac{8}{5} gs \Rightarrow s = 25.51 \text{ m, i.e. } 4.49 \text{ m (nearest cm) from top}$ M2 A1
- (c) friction now acts up slope but R (and hence F) as in part (a) B1
 $mg \sin \alpha - F = ma \Rightarrow \frac{3}{5} mg - \frac{1}{5} mg = ma$ M2
 $a = \frac{2}{5} g$ A1
 $u = 0, s = 25.51, a = \frac{2}{5} g, s = ut + \frac{1}{2} at^2$ M1
 $25.51 = \frac{1}{5} gt^2$ i.e. $t = 3.61 \text{ seconds}$ M1 A1 (19)

Total (75)

