GCE Examinations

Advanced Subsidiary / Advanced Level

Mechanics

Module M1

Paper A

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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M1 Paper A – Marking Guide

1. *(a)* cons. of mom: $2(7) + 0 = (2 + 1.5)v$ — M2
$v = 4$ ms^{-1} — A1

(b) impulse = Δ mom: i.e. for Q, $= 1.5(4 - 0) = 6$ Ns — M1 A1 **(5)**

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2. *(a)* speed of $B = \sqrt{[15^2 + (^-8)^2]} = 17$ ms^{-1} — M1 A1

(b) vel. of B rel. to $A = (15\mathbf{i} - 8\mathbf{j}) - (8\mathbf{i} - 3\mathbf{j})$ — M1
$= (7\mathbf{i} - 5\mathbf{j})$ ms^{-1} — A1

(c) req'd angle = $\tan^{-1}\frac{5}{7} = 35.5°$ to 1 dp — M1 A1 **(6)**

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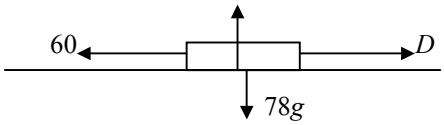
3. *(a)* take moments about B (as mass of dog unknown) — M1
let reaction at A and B equal R; $8R + 2R = 30g(4) + 80g(6)$ — M2 A1
$10R = 600g$ so $R = 60g$ (or 588 N) — A1

(b) resolve ↑: $R + R = 80g + 30g + Mg$ — M1
$120g = 110g + Mg$ — M1
$M = 10$ kg — A1

(c) no reaction at A; reaction at B greater (80g + 30g + weight of dog) — B2 **(10)**

4.



(a) acc$^n = \frac{10-0}{15} = \frac{2}{3}$ ms^{-2} — M1 A1

eqn. of motion is $D - 60 = 78 \times \frac{2}{3}$ — M1

$D = 112$ N — A1

(b) eqn. of motion is $112 - 60 - 78g\sin\alpha = 0$ (since no acc^n) — M1 A1

$\sin\alpha = \frac{52}{78g} = \frac{2}{3g}$ — M1

$\alpha = 3.901$ ∴ $\alpha = 4°$ (to nearest degree) — A1

(c) in *(a)* unlikely as increase in speed will cause increase in air resistance — B1
in *(b)* more reasonable as speed is constant — B1 **(10)**

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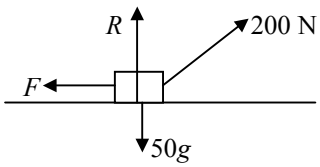
5. *(a)*



resolve ↑ : $R + 200\sin40° - 50g = 0$ ∴ $R = 50g - 200\sin40°$ — M1 A1

resolve → : $200\cos40° - F = 0$ ∴ $F = 200\cos40°$ — M1 A1

$F = \mu R$, so $\mu = \frac{200\cos 40°}{50g - 200\sin 40°} = 0.424$ (3sf) — M1 A1

(b) resolve ↑: $R + 200\sin30° - 50g = 0$ ∴ $R = 50g - 200\sin30° = 390$ — M1 A1

resolve → : $200\cos30° - \mu R = 50a$ — M1 A1

$50a = 100\sqrt{3} - 0.424(390)$ — M1

$a = 0.16$ ms^{-2} — A1 **(12)**

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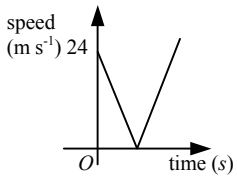
6. *(a)*



B3

(b) at max. height, $v = 0$; use $v^2 = u^2 + 2as$ with $a = {}^-9.8$, $u = 24$ — M1
$0 = 576 - 19.6s \quad \therefore s = 29.387\ldots$ — M1 A1
start value 2.5 m, so max. height = 31.89 m. (nearest cm) — A1

(c) use $v^2 = u^2 + 2as$ with $a = {}^-9.8$, $u = 24$ and $s = {}^-2.5$ (up is +ve) — M1
$v^2 = 576 + 49 = 625$ — M1 A1
so $v = \pm 25$ i.e. speed = 25 m s^{-1} downwards — A1

(d) use $v = u + at$ with $v = 25$, $u = {}^-24$ $a = 9.8$ (down is +ve) — M1
$25 = {}^-24 + 9.8\,t \quad \therefore t = 5$ — M1 A1 **(14)**

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7. *(a)* for X: $T - 3g\sin30° = 3a \quad \therefore T - \frac{3}{2}g = 3a$ (1) — M1 A1
for Y: $2g\cos30° - T = 2a \quad \therefore g\sqrt{3} - T = 2a$ (2) — M1 A1
(1) + (2) gives $g\sqrt{3} - \frac{3}{2}g = 5a$ — M1 A1
$a = \frac{g\sqrt{3}}{5} - \frac{3g}{10} \quad \therefore a = \frac{g}{10}(2\sqrt{3} - 3)$ — A1

(b) sub. a into (1) to get $T = 3a + \frac{3g}{2} = \frac{3g}{10}(2\sqrt{3} - 3) + \frac{3g}{2}$ — M1 A1
$T = 16.0645$ — A1
force on pulley = $\sqrt{(T^2 + T^2)} = T\sqrt{2}$ — M1
force on pulley = 22.7 N — A1
force acts at an angle 45° to each plane i.e. 15° to vertical — M1 A1

(c) initially, Y is at C and $CB = 4\sin30° = 2$ m — M1
use $v^2 = u^2 + 2as$ with $u = 0$, $s = 2$, $a = \frac{g}{10}(2\sqrt{3} - 3)$ — M1
$v^2 = 0 + \frac{4g}{10}(2\sqrt{3} - 3)$ so $v = 1.35$ m s^{-1} (2dp) — M1 A1 **(18)**

Total **(75)**

Performance Record – M1 Paper A

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	Total
Topic(s)	cons. of mom., impulse	**i**, **j** vectors, rel. vel.	moments	dynamics	statics incl. friction	uniform accel.	connected bodies	
Marks	5	6	10	10	12	14	18	75
Student								