GCE Examinations

Advanced Subsidiary / Advanced Level

Mechanics
Module M1

Paper E

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 E – Marking Guide

1. $^-5 + 2q + 1 = 0 \Rightarrow q = 2$ M1 A1
$4p + 3 + 1 = 0 \Rightarrow p = {}^-1$ M1 A1 **(4)**

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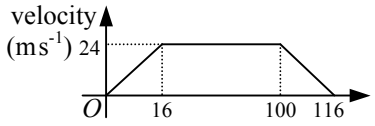
2. *(a)* $t = \frac{116-84}{2} = 16$ seconds M1 A1

(b)



B2

(c) dist. = area under graph = $\frac{1}{2}(116 + 84)(24) = 2400$ m M2 A1 **(7)**

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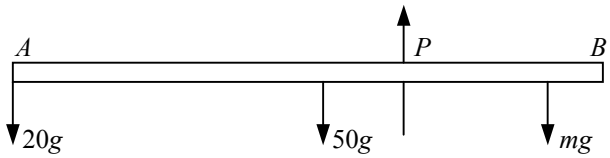
3. *(a)* resolve →: $6 + X\cos 45 - 18\sin 30 = 0$ M2
$6 + X\frac{\sqrt{2}}{2} - 9 = 0$ so $X = 3\sqrt{2}$ N M1 A1

(b) resolve ↑: $Y + X\cos 45 + 18\cos 30 - 20 = 0$ M2
$Y + (3\sqrt{2})\frac{\sqrt{2}}{2} + 18\frac{\sqrt{3}}{2} - 20 = 0$ M1
$Y = 20 - 9\sqrt{3} - 3 = 17 - 9\sqrt{3}$ A1 **(8)**

4.



(a) moments about P : $20g(3) + 50g(0.5) - mg(1.7) = 0$ M2
$1.7m = 60 + 25 = 85 \Rightarrow m = 50$ kg M1 A1

(b) moments about P : $(20 + x)g(3) + 50g(0.5) - 50g(2) = 0$ M1
$100 - 25 - 3(20 + x) = 0 \Rightarrow x = 5$ kg M1 A1

(c) weight acts at the middle of the plank B1 **(8)**

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5. *(a)* particle B1

(b) cons. of mom. (dir$^{n.}$ of bat +ve) $1.5(15\mathbf{i}) + 0.3(^-30\mathbf{i}) = 1.5(5\mathbf{i}) + 0.3(v\mathbf{i})$ M1 A1
$6\mathbf{i} = 0.3v\mathbf{i} \Rightarrow v = 20$ M1 A1

(c) $\boldsymbol{F}t = \Delta$mom. i.e. $\boldsymbol{F}(0.2) = 0.3(20\mathbf{i} - {}^-30\mathbf{i})$ M2
$\boldsymbol{F} = 75\mathbf{i}$ so $\boldsymbol{F}$ has magnitude 75 N A1 **(8)**

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6. *(a)*

$u = 10.5$, $v = 0$, $a = {}^{-}\text{g}$ use $v^2 = u^2 + 2as$ — M1

$0 = 110.25 - 19.6s \Rightarrow s = 5.625$ — M1 A1

ball starts from 0.6 m, so it reaches 6.225 m above ground level — A1

(b)

$s = 2 - 0.6 = 1.4$, $u = 10.5$, $a = {}^{-}\text{g}$, use $s = ut + \frac{1}{2}at^2$ — M1

$10.5t - 4.9t^2 > 1.4$ i.e. $7t^2 - 15t + 2 < 0$ — M1 A1

$(7t - 1)(t - 2) < 0$ leading to $\frac{1}{7} < t < 2$ — M1 A1

ball is above ground for $\frac{13}{7}$ (≈ 1.86) seconds — A1 **(10)**

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7. *(a)*

let acc$^{n.}$ be $k(2\mathbf{i} + \mathbf{j})$ so magnitude is $k\sqrt{(2^2 + 1^2)} = k\sqrt{5}$ — M2

$\Rightarrow k = 3$, so $\boldsymbol{a} = 6\mathbf{i} + 3\mathbf{j}$ — A1

using $v = u + at$, $\mathbf{v} = (1 - 5\mathbf{j}) + t(6\mathbf{i} + 3\mathbf{j})$ — M1

so $\mathbf{v} = [(6t + 1)\mathbf{i} + (3t - 5)\mathbf{j}]$ ms^{-1} — M1 A1

(b)

speed$^2 = (6t + 1)^2 + (3t - 5)^2 = 45t^2 - 18t + 26$ — M1 A1

by calculus or completing square, $t = \frac{1}{5}$ — M2 A1 **(11)**

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8. *(a)*

for A, resolve $\uparrow$: $R - 5Mg = 0 \Rightarrow R = 5Mg$ — M1

$F = \mu R$ so $F = \frac{3}{20}(5Mg) = \frac{3}{4}Mg$ — M1 A1

for A, resolve $\rightarrow$ $T - F = 5Ma$, $T - \frac{3}{4}Mg = 5Ma$ (1) — M1 A1

for B, resolve $\downarrow$ $3Mg - T = 3Ma$ (2) — M1

(1) + (2) gives $\frac{9}{4}Mg = 8Ma \Rightarrow a = \frac{9}{32}g$ ms^{-2} — M1 A1

(b)

$s = 1$, $u = 0$, $a = \frac{9}{32}g$, use $v^2 = u^2 + 2as$ — M1

$v^2 = \frac{9}{16}g \Rightarrow v = \frac{3}{4}\sqrt{g}$ (≈ 2.35 ms^{-1}) — M2 A1

(c)

after string goes slack, ${}^{-}F = 5Ma$ so $a = \frac{-\frac{3}{4}Mg}{5M} = \frac{-3}{20}g$ — M2 A1

$u^2 = \frac{9}{16}g$, $v = 0$, $a = {}^{-}\frac{3}{20}g$ use $v^2 = u^2 + 2as$ — M1

$0 = \frac{9}{16}g - \frac{3}{10}gs \Rightarrow s = 1.875$ m + 1 m before B hit the ground — M1 A1

$= 2.875$ so A is 0.125 m from pulley when it comes to rest — A1 **(19)**

Total **(75)**

Performance Record – M1 Paper E

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	8	Total
Topic(s)	**i**, **j**, forces	velocity – time graph	statics	moments	cons. of mom.	uniform accel.	**i**, **j**, accel.	connected bodies	
Marks	4	7	8	8	8	10	11	19	75
Student									