

Edexcel GCE

Mechanics

Unit no. 6678/01

June 2006

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Mark Scheme
(Results)

General Instructions

1. The total number of marks for the paper is 75.
2. Method (M) marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
3. Accuracy (A) marks can only be awarded if the relevant method (M) marks have been earned.
4. (B) marks are independent of method marks.
5. Method marks should not be subdivided.
6. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected. Indicate this action by 'MR' in the body of the script (but see also note 10).
7. If a candidate makes more than one attempt at any question:
 - (a) If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
 - (b) If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.
8. Marks for each question, or part of a question, must appear in the right-hand margin and, in addition, total marks for each question, even where zero, must be ringed and appear in the right-hand margin and on the grid on the front of the answer book. It is important that a check is made to ensure that the totals in the right-hand margin of the ringed marks and of the unringed marks are equal. The total mark for the paper must be put on the top right-hand corner of the front cover of the answer book.
9. For methods of solution not in the mark scheme, allocate the available M and A marks in as closely equivalent a way as possible, and indicate this by the letters 'OS' (outside scheme) put alongside in the body of the script.
10. All A marks are 'correct answer only' (c.a.o.) unless shown, for example, as A1 f.t. to indicate that previous wrong working is to be followed through. In the body of the script the symbol \checkmark should be used for correct f.t. and for incorrect f.t. After a misread, however, the subsequent A marks affected are treated as A f.t., but manifestly absurd answers should never be awarded A marks.
11. Ignore wrong working or incorrect statements following a correct answer.

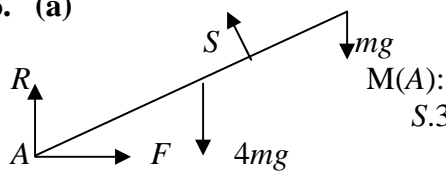
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Mark scheme

1. $a = 5 - 2t \Rightarrow v = 5t - t^2 + 6$ M1 A1, A1
 $v = 0 \Rightarrow t^2 - 5t - 6 = 0$ indep M1
 $(t - 6)(t + 1) = 0$ dep M1
 $t = \underline{6\text{ s}}$ A1
(6)
2. (a) $\frac{P}{24} = 600$ or $\frac{1000P}{24} = 600 \Rightarrow P = 14.4\text{ kW}$ M1 A1
(2)
- (b) $\frac{30000}{20} - 1200 \times 9.8 \times \sin \alpha - 600 = 1200a$ M1 A2,1,0
 $\Rightarrow a = \underline{0.4\text{ m s}^{-2}}$ A1
(4)
3. (a) $I = \pm 0.5(16\mathbf{i} + 20\mathbf{j} - (-30\mathbf{i}))$ M1
 $= \pm(23\mathbf{i} + 10\mathbf{j})$ indep M1
 $\text{magn} = \sqrt{(23^2 + 10^2)} \approx \underline{25.1\text{ N s}}$ indep M1 A1
(4)
- (b) $\mathbf{v} = 16\mathbf{i} + (20 - 10t)\mathbf{j}$ M1
 $t = 3 \Rightarrow \mathbf{v} = 16\mathbf{i} - 10\mathbf{j}$ indep M1
 $v = \sqrt{(16^2 + 10^2)} \approx \underline{18.9\text{ m s}^{-1}}$ indep M1 A1
(4)
4. (a) Total mass = $12m$ (used) M1
- (i) M(AB): $m.3a/2 + m.3a/2 + m.3a + 6m.3a + 2m.3a = 12m.x$ indep M1 A1
 $\Rightarrow x = \frac{5}{2}a$ A1
- (ii) M(AD): $m.a + m.a + m.2a + 6m.2a = 12m.y$ indep M1 A1
 $\Rightarrow y = \frac{4}{3}a$ A1
(7)
- (b) $\tan \alpha = \frac{2a - 4a/3}{5a/2}$ M1 A1 f.t.
 $\Rightarrow \alpha \approx \underline{14.9^\circ}$ A1 cao
(3)

5. (a) $x_A = 28t$ $x_B = 35 \cos \alpha t$ B1 B1
 Meet $\Rightarrow 28t = 35 \cos \alpha t \Rightarrow \cos \alpha = 28/35 = 4/5$ * M1 A1
 (4)

(b) $y_A = 73.5 - \frac{1}{2}gt^2$ $y_B = 21t - \frac{1}{2}gt^2$ B1 B1
 Meet $\Rightarrow 73.5 = 21t \Rightarrow t = \underline{3.5 \text{ s}}$ M1 A1
 (4)

6. (a)  $M(A):$
 $S \cdot 3a = 4mg \cdot 2a \cos \alpha + mg \cdot 4a \cos \alpha$ M1 A1
 $= \frac{48}{5}mga \Rightarrow S = \frac{16}{5}mg$ * A1
 (3)

(b) $R(\uparrow): R + S \cos \alpha = 5mg$ M1 A1
 $R(\rightarrow): F = S \sin \alpha$ M1 A1

$F \leq \mu R \Rightarrow \mu \geq \frac{48}{61}$ * dep on both previous M's M1 A1
 (6)

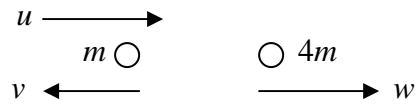
(c) Direction of S is perpendicular to plank
 or No friction at the peg B1
 (1)

7. (a) $R = 4g \cos \alpha = 16g/5 \Rightarrow F = 2/7 \times 16g/5$ M1 A1
 Work done = $F \times 2.5 = \underline{22.4 \text{ J}}$ or 22 J indep M1 A1
 (4)

(b) $\frac{1}{2} \times 4 \times u^2 = 22.4 + 4g \times 2.5 \times 3/5$ M1 A2,1,0 f.t.
 $\Rightarrow u \approx \underline{6.37 \text{ m s}^{-1}}$ or 6.4 ms^{-1} A1cao
 (4)

(c) $\frac{1}{2} \times 4 \times v^2 = \frac{1}{2} \times 4 \times u^2 - 44.8$ M1 A2,1,0 f.t.
 [OR $\frac{1}{2} \times 4 \times v^2 = 0 + 4g \times 2.5 \times 3/5 - 22.4$]
 $\Rightarrow v \approx \underline{4.27 \text{ m s}^{-1}}$ or 4.3 ms^{-1} A1
 (4)

8. (a)



$$mu = 4mw - mv \quad \text{M1 A1}$$

$$eu = w + v \quad \text{M1 A1}$$

$$\Rightarrow w = \left(\frac{1+e}{5}\right)u, \quad v = \left(\frac{4e-1}{5}\right)u \quad \text{indep M1 A1 A1}$$

(7)

(b) $w' = \left(\frac{4+4e}{25}\right)u \quad \text{B1 f.t.}$

Second collision $\Rightarrow w' > v$

$$\Rightarrow \frac{4+4e}{25} > \frac{4e-1}{5} \quad \text{M1}$$

$$\Rightarrow e < 9/16 \quad \text{dep M1 A1}$$

Also $v > 0 \Rightarrow e > 1/4$ Hence result (*) B1

(5)

(c)

$$\text{KE lost} = \frac{1}{2} mu^2 - \left[\frac{1}{2} \cdot 4m \left\{ \left(\frac{u}{5}\right)(1+e) \right\}^2 + \frac{1}{2} m \left\{ \left(\frac{u}{5}\right)(4e-1) \right\}^2 \right] \quad \text{M1 A1 f.t.}$$

$$= \frac{3}{10} mu^2$$

A1 cao

(3)