



GCE MARKING SCHEME

SUMMER 2016

**Mathematics – M1
0980/01**

INTRODUCTION

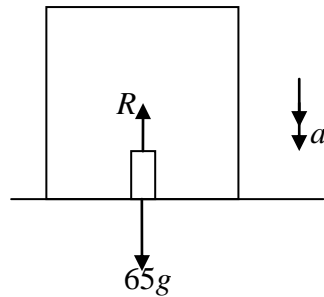
This marking scheme was used by WJEC for the Summer 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCE Mathematics - M1
Summer 2016 Mark Scheme

| Q | Solution | Mark | Notes |
|----|----------|------|-------|
| 1. | | | |



| | | |
|---|----|--|
| N2L applied man | M1 | R and $65g$ opposing. dim correct |
| $65g - R = 65a$ | A1 | |
| 1 st stage, $a = 3.2$ $R = 65(9.8 - 3.2)$ $R = \underline{429 \text{ (N)}}$ | A1 | cao |
| 2 nd stage, $a = 0$ $R = 65 \times 9.8$ $R = \underline{637 \text{ (N)}}$ | B1 | cao |
| 3 rd stage, $a = -2.4$ $R = 65(9.8 + 2.4)$ $R = \underline{793 \text{ (N)}}$ | A1 | cao |

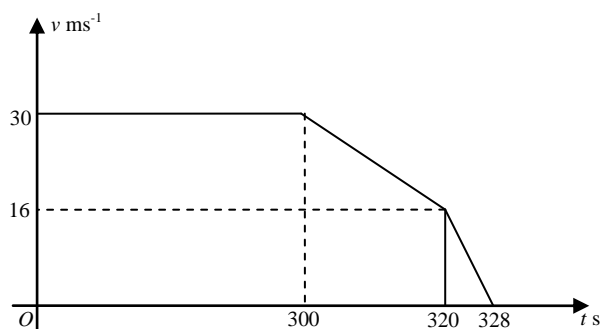
| Q | Solution | Mark | Notes |
|------|--|------|--|
| 2(a) | Apply N2L to <i>B</i> | M1 | dim correct, all forces |
| | $5g - T = 5a$ | A1 | $5g$ and T opposing |
| | Apply N2L to <i>A</i> | M1 | dim correct, all forces |
| | $T - 2g = 2a$ | A1 | T and $2g$ opposing |
| | Adding | | |
| | $5g - 2g = 7a$ | m1 | one variable eliminated, Dep on both M 's |
| | $a = \underline{4.2 \text{ ms}^{-2}}$ | A1 | cao |
| | $T = \underline{28 \text{ N}}$ | A1 | cao |
| 2(b) | Upwards positive | | |
| (i) | Using $v = u + at$, $u=0$. $a=(\pm)4.2, t=2$ | M1 | cand's a |
| | $v = 0 + 4.2 \times 2$ | | |
| | $v = \underline{8.4 \text{ (ms}^{-1}\text{)}}$ | A1 | ft a |
| (ii) | $s=ut+0.5at^2$, $s=(\pm)18.9, u=(\pm)8.4, a=(\pm)9.8$ | M1 | cand's v , one sign error |
| | $-18.9 = 8.4t + 0.5 \times -9.8 \times t^2$ | A1 | ft v |
| | $7t^2 - 12t - 27 = 0$ | m1 | recognition of quadratic and attempt to solve |
| | $(7t + 9)(t - 3) = 0$ | | |
| | $t = \underline{3 \text{ (s)}}$ | A1 | cao |

| Q | Solution | Mark | Notes |
|------|---|--|---|
| 3(a) | $I = 3 \times 4$ $= \underline{12 \text{ (Ns)}}$ | B1 | |
| 3(b) | <p>Conservation of momentum</p> $3 \times 4 + 11 \times 0 = 3v_A + 11v_B$ $3v_A + 11v_B = 12$ <p>Restitution</p> $v_B - v_A = -\frac{1}{4}(0 - 4)$ $v_B - v_A = 1$ $3v_A + 11v_B = 12$ $-3v_A + 3v_B = 3$ <p>Adding</p> $14v_B = 15$ $v_B = \frac{15}{14} \text{ (ms}^{-1}\text{)}$ $v_A = \frac{1}{14} \text{ (ms}^{-1}\text{)}$ | M1 A1 M1 A1 m1 A1 A1 | <p>attempted, equation, dim correct.</p> <p>correct equation</p> <p>one sign error only</p> <p>correct equation, any form</p> <p>cao</p> <p>cao</p> |
| 3(c) | $\frac{6}{7} = e \times \frac{15}{14}$ $e = \frac{6}{7} \times \frac{14}{15}$ $e = \frac{4}{5} = \underline{0.8}$ | M1 A1 | <p>correct equation, any form</p> <p>ft v_B if $> \frac{6}{7}$</p> |

Note: Accept g throughout conservation of momentum equation, whether crossed off or not.

| Q | Solution | Mark | Notes |
|---|----------|------|-------|
|---|----------|------|-------|

4(a)



| | |
|----|------------------------|
| B1 | (0, 30) to (300, 30) |
| B1 | (300, 30) to (320, 16) |
| B1 | (320, 16) to (328, 0) |
| B1 | shape, units, labels |

4(b) Total distance = area under graph

$$D = 300 \times 30 + 0.5 \times (30 + 16) \times 20 + 0.5 \times 16 \times 8$$

$$D = 9000 + 460 + 64$$

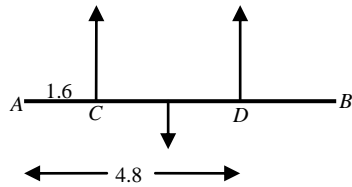
$$D = \underline{9524 \text{ (m)}}$$

| | |
|----|---|
| M1 | attempted |
| B1 | one correct area, ft graph |
| A1 | all correct, ft graph if shape correct. |
| A1 | cao |

| Q | Solution | Mark | Notes |
|--|---|---------------------------|--------------------------|
| 5 | Resolve in one direction | M1 | obtain comp of resultant |
| | $X = 8\cos 30^\circ + 7\cos 45^\circ$ | A1 | |
| | $\quad - 15\cos 60^\circ - 12\cos 50^\circ$ | | |
| | $X = -3.3355$ | | |
| | Resolve in perpendicular direction | M1 | obtain comp of resultant |
| | $Y = 8\cos 60^\circ - 7\cos 45^\circ$ | A1 | |
| $\quad - 15\cos 30^\circ + 12\cos 40^\circ$ | | | |
| $Y = -4.7476$ | | | |
| Resultant ² = $3.3355^2 + 4.7476^2$ | m1 | dep on both M's | |
| Resultant = <u>5.8N</u> | A1 | cao | |
| Acceleration = $\frac{5 \cdot 8021777}{4}$ | | | |
| Acceleration = <u>1.45 (ms⁻²)</u> | A1 | ft Resultant. Accept 1.5. | |

| Q | Solution | Mark | Notes |
|---|----------|------|-------|
|---|----------|------|-------|

6.



Take moments about C

$$8g \times 1.4 = T_D \times 3.2$$

$$T_D = \underline{3.5g \text{ (N)}} = \underline{34.3 \text{ (N)}}$$

| | |
|----|-------------------------|
| M1 | dim correct moment equ. |
| B1 | Any correct moment |
| A1 | correct equation |
| A1 | cao |

Resolve vertically

$$T_C + T_D = 8g = 78.4$$

$$T_C = \underline{4.5g \text{ (N)}} = \underline{44.1 \text{ (N)}}$$

| | |
|----|-----|
| M1 | oe |
| A1 | |
| A1 | cao |

Note:

Simultaneous equations

First moment equation

Second moment equation or resolution equation

Answers

| |
|--------------------------------------|
| M1 B1 A1 |
| M1 A1 (B1 if not previously awarded) |
| A1 A1 |

Equal tension

Moments about C/D

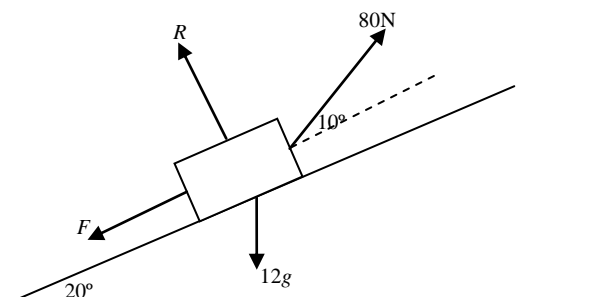
4 marks available

Moments about anywhere else

2 marks available.

| Q | Solution | Mark | Notes |
|---|----------|------|-------|
|---|----------|------|-------|

7



| | | | |
|------|--------------------------------|----|---|
| 7(a) | Resolve perpendicular to plane | M1 | dim correct equation All forces No more than 1 sign error |
|------|--------------------------------|----|---|

$$R + 80 \sin 10^\circ = 12g \cos 20^\circ$$

$$R = 96.616$$

A1

$$F = \mu R = 0.2 \times 96.616$$

$$F = \underline{19.323 \text{ (N)}}$$

M1 ft R (any correct form)
A1 cao

| | | | |
|------|---------------------------|----|--|
| 7(b) | Resolve parallel to plane | M1 | dim correct equation All forces Allow sin/cos errors Friction subtracted from tension |
|------|---------------------------|----|--|

$$80 \cos 10^\circ - F - 12g \sin 20^\circ = 12a$$

$$a = \underline{1.6 \text{ (ms}^{-2}\text{)}}$$

A2 -1 each error, (ft F)
A1 cao

Note (for both parts)

| | |
|-----------------------|-------------------------------|
| If no g with 12 , | M0 (possibly M1 for μR) |
| If 80 not resolved | M0 |
| If g with 80 | M0 |

| Q | Solution | Mark | Notes |
|---|---|------|----------------------|
| 8 | Use of $s = ut + 0.5at^2$ with $s=460$, $t=20$ | M1 | |
| | $460 = 20u + 0.5 \times a \times 400$ | A1 | |
| | $u + 10a = 23$ | | |
| | Use of $v = u + at$ with $t=6$, $v=17$ | M1 | |
| | $17 = u + 6a$ | A1 | |
| | $u + 6a = 17$ | | |
| | attempt to solve simultaneously | m1 | one variable remains |
| | $4a = 6$ | | |
| | $a = \underline{1.5}$ | A1 | cao |
| | $u = \underline{8}$ | A1 | cao |

Note:

| | | |
|---|--|-------|
| 3 or more equations | | |
| First correct equation | | M1 A1 |
| All subsequent equations, eg 2 if 3 unknowns, 3 if 4 unknowns | | M1 A1 |
| All variables except one eliminated | | m1 |
| Correct answers | | A1 A1 |

| Q | Solution | Mark | Notes | | | | | | | | | | | | | | | | | | | | |
|------------|---|------|---|----|----|------------|----|---|---|--------|--------|---|---|----------|---------|---|-----|--------|-------------|-----|-----|----------------------|---------------------------|
| 9. | <table border="0"> <thead> <tr> <th></th> <th>Area</th> <th>AC</th> <th>AB</th> </tr> </thead> <tbody> <tr> <td><i>ABC</i></td> <td>54</td> <td>4</td> <td>3</td> </tr> <tr> <td>Circle</td> <td>4π</td> <td>4</td> <td>3</td> </tr> <tr> <td><i>D</i></td> <td>12π</td> <td>6</td> <td>4.5</td> </tr> <tr> <td>Lamina</td> <td>$(54+8\pi)$</td> <td>x</td> <td>y</td> </tr> </tbody> </table> | | Area | AC | AB | <i>ABC</i> | 54 | 4 | 3 | Circle | 4π | 4 | 3 | <i>D</i> | 12π | 6 | 4.5 | Lamina | $(54+8\pi)$ | x | y | B1 B1 B1 B1 | expressions for areas, oe |
| | Area | AC | AB | | | | | | | | | | | | | | | | | | | | |
| <i>ABC</i> | 54 | 4 | 3 | | | | | | | | | | | | | | | | | | | | |
| Circle | 4π | 4 | 3 | | | | | | | | | | | | | | | | | | | | |
| <i>D</i> | 12π | 6 | 4.5 | | | | | | | | | | | | | | | | | | | | |
| Lamina | $(54+8\pi)$ | x | y | | | | | | | | | | | | | | | | | | | | |
| | Moments about <i>AC</i> | M1 | consistent areas and moments | | | | | | | | | | | | | | | | | | | | |
| | $54 \times 4 + 12\pi \times 6 = (54+8\pi)x + 4\pi \times 4$ | A1 | signs correct. Ft table if at least one B1 for c of m gained. | | | | | | | | | | | | | | | | | | | | |
| | $x = \underline{4.95 \text{ (cm)}}$ | A1 | cao | | | | | | | | | | | | | | | | | | | | |
| | Moments about <i>AB</i> | M1 | consistent areas and moments | | | | | | | | | | | | | | | | | | | | |
| | $54 \times 3 + 12\pi \times 4.5 = (54+8\pi)y + 4\pi \times 3$ | A1 | signs correct. Ft table if at least one B1 for c of m gained. | | | | | | | | | | | | | | | | | | | | |
| | $y = \underline{3.71 \text{ (cm)}}$ | A1 | cao | | | | | | | | | | | | | | | | | | | | |

Alternative solution

| | <table border="0"> <thead> <tr> <th></th> <th>Area</th> <th>AC</th> <th>AB</th> </tr> </thead> <tbody> <tr> <td><i>ABC</i>-Circle</td> <td>$54-4\pi$</td> <td>4</td> <td>3</td> </tr> <tr> <td><i>D</i></td> <td>12π</td> <td>6</td> <td>4.5</td> </tr> <tr> <td>Lamina</td> <td>$(54+8\pi)$</td> <td>x</td> <td>y</td> </tr> </tbody> </table> | | Area | AC | AB | <i>ABC</i> -Circle | $54-4\pi$ | 4 | 3 | <i>D</i> | 12π | 6 | 4.5 | Lamina | $(54+8\pi)$ | x | y | B1 B1 B1 B1 | expressions for areas, oe |
|--------------------|--|-----|---|----|----|--------------------|-----------|---|---|----------|---------|---|-----|--------|-------------|-----|-----|-------------------|---------------------------|
| | Area | AC | AB | | | | | | | | | | | | | | | | |
| <i>ABC</i> -Circle | $54-4\pi$ | 4 | 3 | | | | | | | | | | | | | | | | |
| <i>D</i> | 12π | 6 | 4.5 | | | | | | | | | | | | | | | | |
| Lamina | $(54+8\pi)$ | x | y | | | | | | | | | | | | | | | | |
| | Moments about <i>AC</i> | M1 | consistent areas and moments | | | | | | | | | | | | | | | | |
| | $(54-4\pi) \times 4 + 12\pi \times 6 = (54+8\pi)x$ | A1 | signs correct. Ft table if at least one B1 for c of m gained. | | | | | | | | | | | | | | | | |
| | $x = \underline{4.95 \text{ (cm)}}$ | A1 | cao | | | | | | | | | | | | | | | | |
| | Moments about <i>AB</i> | M1 | consistent areas and moments | | | | | | | | | | | | | | | | |
| | $(54-4\pi) \times 3 + 12\pi \times 4.5 = (54+8\pi)y$ | A1 | signs correct. Ft table if at least one B1 for c of m gained. | | | | | | | | | | | | | | | | |
| | $y = \underline{3.71 \text{ (cm)}}$ | A1 | cao | | | | | | | | | | | | | | | | |