



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE



## General Certificate of Education

# Mathematics 6360

### *MM1B Mechanics 1B*

# Mark Scheme

## *2006 examination - June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

## Key To Mark Scheme And Abbreviations Used In Marking

|              |  |     |                            |
|--------------|--|-----|----------------------------|
| M            | mark is for method   |     |                            |
| m or dM      | mark is dependent on one or more M marks and is for method         |     |                            |
| A            | mark is dependent on M or m marks and is for accuracy              |     |                            |
| B            | mark is independent of M or m marks and is for method and accuracy |     |                            |
| E            | mark is for explanation  |     |                            |
| √ or ft or F | follow through from previous incorrect result                      | MC  | mis-copy                   |
| CAO          | correct answer only  | MR  | mis-read                   |
| CSO          | correct solution only  | RA  | required accuracy          |
| AWFW         | anything which falls within  | FW  | further work               |
| AWRT         | anything which rounds to   | ISW | ignore subsequent work     |
| ACF          | any correct form   | FIW | from incorrect work        |
| AG           | answer given   | BOD | given benefit of doubt     |
| SC           | special case   | WR  | work replaced by candidate |
| OE           | or equivalent  | FB  | formulae book              |
| A2,1         | 2 or 1 (or 0) accuracy marks                                       | NOS | not on scheme              |
| -x EE        | deduct x marks for each error                                      | G   | graph                      |
| NMS          | no method shown  | c   | candidate                  |
| PI           | possibly implied   | sf  | significant figure(s)      |
| SCA          | substantially correct approach                                     | dp  | decimal place(s)           |

### No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

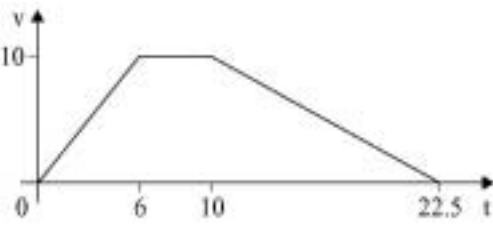
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

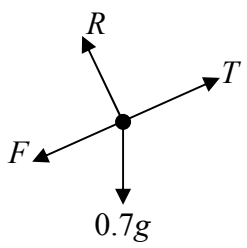
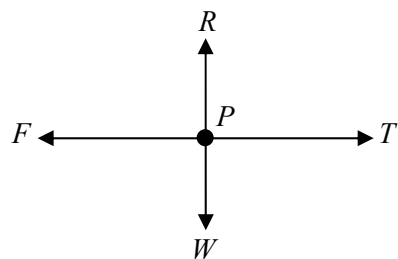
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

**Otherwise we require evidence of a correct method for any marks to be awarded.**

## MM1B

| Q                               | Solution   | Marks            | Total  | Comments   |
|---------------------------------|--|------------------|--|--|
| 1(a)                            | $s = 0 + \frac{1}{2} \times 9.8 \times 4^2$  | M1               | 3  | Full method<br>Correct subs, accept $\pm 9.8$<br>CAO (need positive)   |
|                                 | $s = 78.4$ metres  | A1               |  |  |
|                                 | (b) Average speed = $\frac{78.4}{4}$<br>= $19.6 \text{ ms}^{-1}$   | M1<br>A1F        |  |  |
| (c) Only force acting is weight | B1   | 1                | Acc resistance forces negligible or ignored, (not friction, or air friction) |  |
| <b>Total</b>                    |  |                  | <b>6</b>   |  |
| 2(a)                            | $P = 5 + 8 \cos 60^\circ$  | M1               | 3  | Both relevant forces, component of 8N attempted<br>All correct<br>CAO  |
|                                 | $P = 9$  | A1<br>A1         |  |  |
| (b)                             | $Q = 8 \cos 30^\circ$  | M1               | 2  | Component of 8N attempted<br>AWRT 6.93   |
|                                 | $Q = 6.93$ or $4\sqrt{3}$  | A1               |  |  |
| <b>Total</b>                    |  |                  | <b>5</b>   |  |
| 3(a)                            | $v = u + at$<br>$0 = 10 + (-0.8) \times t$   | M1               | 2  | Full method with $u, v$ used correctly<br>Accept $\pm 0.8$<br>CAO (correct subs and answer)  |
|                                 | $t = 12.5$ sec   | A1               |  |  |
| (b)                             |                           | B1<br>B1<br>B1   | 4  | } each line, straight and correct end points<br>SC: B1 for 3 lines giving correct shape but no values shown<br>SC: first error in labelling times loses B1, repeated errors no further penalty<br>axes labelled $v, t$ |
|                                 |  | B1               |  |  |
|                                 |  | B1               |  |  |
| (c)                             | distance = $\frac{1}{2} \times 10 \times (4 + 22.5)$<br>= 132.5 metres                                       | M1<br>A1F<br>A1F | 3  | Full correct method<br>Correct subs, FT graph if final $t = 12.5$<br>FT one slip, AWRT 133   |
|                                 | (d) Acceleration unlikely to:<br>change so abruptly or<br>be constant<br>or velocity unlikely to be constant | B1               | 1  |  |
| <b>Total</b>                    |  |                  | <b>10</b>  |  |

MM1B (cont)

| Q            | Solution  | Marks                | Total     | Comments   |
|--------------|---|----------------------|-----------|--|
| 4(a)         |                    | B1                   | 1         | Accept $W$ or $mg$ (or 6.86) for weight<br>Arrows and labels needed<br>(can replace $W$ with 2 correct components)   |
| (b)          | $R = 0.7g \cos 22^\circ$<br>$R = 6.36 \text{ N}$  | M1<br>A1<br>A1       | 3         | component of weight attempted<br>all correct, including signs<br>CAO   |
| (c)          | $F = 0.25 \times 6.36$<br>$F = 1.59 \text{ N}$  | M1<br>A1             | 2         | CAO  |
| (d)          | $5.6 - 0.7g \sin 22^\circ - 1.59 = 0.7a$<br>$a = 2.06 \text{ ms}^{-2}$                              | M1<br>A2<br>A1F      | 4         | 4 terms with weight component attempted<br>A marks -1 each error, accept $\pm 0.7a$<br>FT one error, accept $\pm$  |
| <b>Total</b> |   |                      | <b>10</b> |  |
| 5(a)(i)      |                   | B1                   | 1         | Accept $mg$ , $0.4g$ or $3.92$ for weight<br>Arrows and labels needed  |
| (ii)         | $F = 0.5 \times (0.4 \times 9.8)$<br>$F = 1.96 \text{ N}$   | M1<br>A1             | 2         | Need to see $0.4 \times 9.8$ or $3.92$ used  |
| (b)          | $T - 1.96 = 0.4a$<br>$0.3g - T = 0.3a$<br>$a = 1.4 \text{ ms}^{-2}$                                 | M1A1<br>M1A1<br>A1   | 5         | Consistent reversal of signs in both equations 4 marks; reversal of signs in one equation, M1 A1 M1 A0<br>Sign change needs justification (whole string: equation, $0.3g - 1.96 = 0.7a$ M1A1 $a = 1.4$ A1) max 3/5 |
| (c)          | $v = 1.4 \times 3$<br>$v = 4.2 \text{ ms}^{-2}$   | M1<br>A1             | 2         | Full method<br>CAO   |
| (d)          | <i>P</i> : Friction will cause speed to decrease<br><i>Q</i> : Gravity will cause speed to increase | M1<br>A1<br>M1<br>A1 | 4         | Accept decelerate or comes to rest<br>Accept accelerate  |
| <b>Total</b> |   |                      | <b>14</b> |  |

## MM1B (cont)

| Q            | Solution   | Marks           | Total     | Comments  |
|--------------|--|-----------------|-----------|---|
| 6(a)         | $\mathbf{d} = 3\mathbf{i} - 6\mathbf{j}$   | B1              | 3         | Accept $\pm\mathbf{d}$ or displacements of 3, 6 shown on a diagram<br>Or equivalent method for $t$<br>Accept ratio of vectors leading directly to $\pm 3$<br>CAO  |
|              | $3\mathbf{i} - 6\mathbf{j} = (\mathbf{i} - 2\mathbf{j})t$  | M1              |           |   |
|              | $t = 3$  | A1              |           |   |
| (b)(i)       | $\mathbf{r} = (\mathbf{i} - 2\mathbf{j}) \times 4 + \frac{1}{2} \times 2\mathbf{j} \times 16$        | M1              | 4         | Full method for vector expression giving change in position<br>For correct subs<br>(gives $4\mathbf{i} + 8\mathbf{j}$ )<br><br>FT slip provided obtain vector expression<br>( $\mathbf{u} = 0$ gives $6\mathbf{i} + 12\mathbf{j}$ ) |
|              | $+6\mathbf{i} - 4\mathbf{j}$<br>$= 10\mathbf{i} + 4\mathbf{j}$                                       | A1<br>M1<br>A1F |           |   |
|              | (ii) $A(3,2)$ $C(10,4)$<br>$\mathbf{d} = 7\mathbf{i} + 2\mathbf{j}$                                  | M1              |           |   |
|              | $ \mathbf{d}  = \sqrt{7^2 + 2^2}$<br>$AC = \sqrt{53} = 7.28$   | A1F             | 2         | FT $\mathbf{d}$ provided two non-zero components<br>Accept $\sqrt{53}$  |
| <b>Total</b> |  |                 | <b>9</b>  |   |
| 7(a)         | $57 = 24 \cos 40^\circ \times t$   | M1              | 3         | Component attempted and acceleration = 0<br>All correct<br>CAO  |
|              | $t = 3.10 \text{ sec}$   | A1<br>A1        |           |   |
|              | (b) $h = 24 \sin 40^\circ \times 3.1 - \frac{1}{2} \times 9.8 \times 3.1^2$<br>$h = 0.734 \text{ m}$ | M1<br>A1<br>A1F |           |   |
| (c)(i)       | horizontal, $u = 24 \cos 40^\circ = 18.39 \text{ ms}^{-1}$   | B1              | 5         | Seen anywhere in (c) accept 18.4<br>Component attempted & acceleration = 9.8<br>(Accept $-15.0$ )<br>Use of candidate's $u$ and new $v$ (when $t = 3.1$ )<br>FT use of candidate's $u$ and $v$ and new $v$ when $t = 3.1$           |
|              | vertical, $v = 24 \sin 40^\circ - 9.8 \times 3.1$  | M1              |           |   |
|              | $v = -14.95 \text{ ms}^{-1}$   | A1              |           |   |
|              | $V = \sqrt{(18.39)^2 + (-14.95)^2}$  | M1              |           |   |
|              | $V = 23.7 \text{ ms}^{-1}$   | A1F             |           |   |
| (ii)         | $\tan \theta = \frac{14.95}{18.39}$  | M1              | 2         | Use of candidate's $u$ and $v$<br>Accept inverted ratio<br><br>FT use of candidates $u$ and $v$ and $V$   |
|              | $\theta = 39.1^\circ$ or $39.2^\circ$<br>Also $140.8^\circ$ or $140.9^\circ$ } accept $\pm$          | A1F             |           |   |
| <b>Total</b> |  |                 | <b>13</b> |   |

## MM1B (cont)

| Q      | Solution   | Marks              | Total     | Comments  |
|--------|--|--------------------|-----------|---|
| 8(a)   | $m(5\mathbf{i} - 3\mathbf{j}) + 0.2(2\mathbf{i} + 3\mathbf{j})$  | M1<br>A1           | 2         | Momentum terms added<br>All correct   |
| (b)(i) | $(0.2 + m)(k\mathbf{i} + \mathbf{j})$<br>use of conservation of momentum<br><br>$-3m + 0.6 = 0.2 + m$<br>$m = 0.1$ | B1<br>M1<br><br>A1 | 3         | Seen or used to find $m$<br>Used with candidate's expressions in 2D equation or used to give one of the 1D equations below<br><br>Full verification accepted, CAO |
| (ii)   | $5m + 0.4 = 0.2k + mk$<br>substitute $m$<br>$k = 3$  | A1<br>m1<br>A1     | 3         |   |
|        | <b>Total</b>   |                    | <b>8</b>  |   |
|        | <b>TOTAL</b>   |                    | <b>75</b> |   |