Edexcel GCE

Mathematics

Mechanics M1 6677

Summer 2005

Edexcel GCE
Mathematics

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.

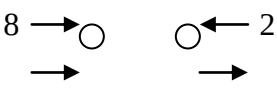
9. For methods of solution not in the mark scheme, allocate the available M and A marks in as closely equivalent a way as possible, and indicate this by the letters 'OS' (outside scheme) put alongside in the body of the script.

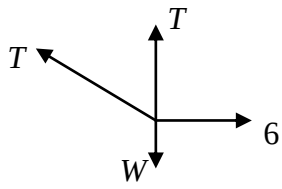
10. All A marks are 'correct answer only' (c.a.o.) unless shown, for example, as A1 f.t. to indicate that previous wrong working is to be followed through. In the body of the script the symbol $\surd$ should be used for correct f.t. and $\not\surd$ for incorrect f.t. After a misread, however, the subsequent A marks affected are treated as A f.t., but manifestly absurd answers should never be awarded A marks.

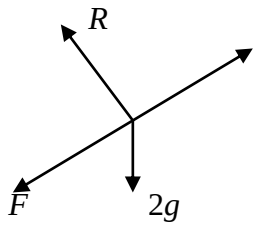
11. Ignore wrong working or incorrect statements following a correct answer.

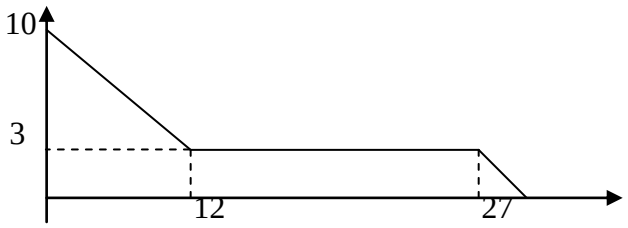
June 2005
6677 Mechanics M1
Mark Scheme

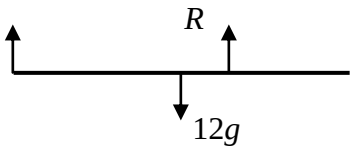
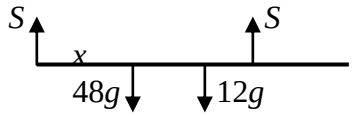
Question Number	Scheme	Marks
1	(a) '$v = u + at$': $74 = 2 + a \times 20 \Rightarrow a = \underline{3.6 \text{ m s}^{-2}}$	M1 A1 (2)
	(b) '$v^2 = u^2 + 2as$': $74^2 = 2^2 + 2 \times 3.6 \times AC$	
	or '$s = ut + \frac{1}{2}at^2$': $AC = 2 \times 20 + \frac{1}{2} \times 3.6 \times 20^2$	M1 A1√
	$\Rightarrow AC = 760$ m	A1
	Hence $BC = 1200 - 760 = \underline{440 \text{ m}}$	B1√ (4)

Question Number	Scheme	Marks
2	 CLM: $0.6 \times 8 - 0.2 \times 2 = 0.6 \times v + 0.2 \times w$ Using $w = 2v$ to form equn in v/w only Solve to get $v = \underline{4.4 \text{ m s}^{-1}}$	M1 A1 ↓ M1 ↓ M1 A1 (5)
	(b) Impulse on B = $0.2(2 + 8.8)$ = $\underline{2.16 \text{ Ns}}$	M1 A1√ A1 (3)

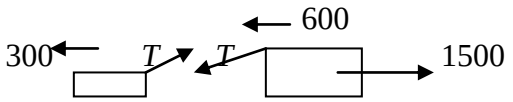
3	 (a) R($\rightarrow$) $T\cos\alpha = 6$ $\rightarrow T = \underline{7.5\text{ N}}$ (b) R($\uparrow$) $T + T\sin\alpha = W$ *Using* same T's and solving $\rightarrow W = \underline{12\text{ N}}$	M1 A1 A1 (3) M1 A1 $\downarrow$ M1 A1 (4)

4	 (a) R (perp to plane): $R = 2g \cos 20$ $\approx$ <u>18.4 or 18 N</u> (b) R (// to plane): $18 - 2g \sin 20 - F = 2a$ $F = 0.6\,R$ used Sub and solve: $a =$ <u>0.123 or 0.12 m s^{-2}</u>	M1 A1 A1 (3) M1 A1 B1 ↓ M1 A1 (5)

5	(a)  Shape $0 < t < 12$ Shape $t > 12$ Figures	B1 B1 B1 (3)
	(b) Distance in 1st 12 s = ½ x (10 + 3) x 12 *or* (3 x 12) + ½ x 3 x 7	M1
	= <u>78 m</u>	A1 (2)
	(c) **either** distance from $t = 12$ to $t = 27 = 15 \times 3 = 45$ $\therefore$ distance in last section = 135 – 45 = 12 m	B1√
	½ x 3 x t = 12,	M1 A1√
	$\Rightarrow t = 8$ s	A1
	hence total time = 27 + 8 = <u>35 s</u>	A1 (5)
	or Distance remaining after 12 s = 135 – 78 = 57 m	B1√
	½ x (15 + 15 + t) x 3 = 57	M1 A1√
	$\Rightarrow t = 8$	A1
	Hence total time = 27 + 8 = <u>35 s</u>	A1

6	 (a) M(*A*): $12g \times 1.5 = R \times 2$ $R = \underline{9g \text{ or } 88.2 \text{ N}}$ (b)  R(↑) $2S = 48g + 12g$ $S = 30g$ M(*A*): $S \times 2 = 12g \times 1.5 + 48g \times x$ Sub for *S* and solve for *x*: $x = \underline{7/8 \text{ or } 0.875 \text{ or } 0.88 \text{ m}}$	M1 A1 A1 (3) M1 A1 M1 A2,1,0 ↓↓ M1 A1 (7)

7

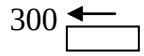


(a) Lorry + Car: $2500a = 1500 - 300 - 600$ M1 A1

$a = \underline{0.24 \text{ m s}^{-2}}$ A1 (3)

(b) Car: $T \cos 15 - 300 = 900a$ *OR* Lorry: $1500 - T \cos 15 - 600 = 1600a$ M1 A1 ↓↓

Sub and solve: $T \approx \underline{534 \text{ N}}$ M1 A1 (4)

(c)  Deceleration of car = 300/900 = 1/3 m s^{-1} M1 A1

Hence $6^2 = 2 \times 1/3 \times s \Rightarrow s = \underline{54 \text{ m}}$ M1 A1 (4)

(d) Vertical component of T now removed M1

Hence normal reaction is increased A1 cso (2)

8	(a) Speed of ball = $\sqrt{(5^2 + 8^2)}$ $\approx$ $\underline{9.43 \text{ m s}^{-1}}$	M1 A1 (2)
	(b) p.v. of ball = $(2\mathbf{i} + \mathbf{j}) + (5\mathbf{i} + 8\mathbf{j})t$	M1 A1 (2)
	(c) North of B when **i** components same, i.e. $2 + 5t = 10$ $t = \underline{1.6 \text{ s}}$	M1 A1 (2)
	(d) When $t = 1.6$, p.v. of ball = $10\mathbf{i} + 13.8\mathbf{j}$ (or **j** component = 13.8) Distance travelled by 2nd player = $13.8 - 7 = 6.8$ Speed = $6.8 \div 1.6 = \underline{4.25 \text{ m s}^{-1}}$ *or* $[(2 + 5t)\mathbf{i} +] (1 + 8t)\mathbf{j} = [10\mathbf{i} +] (7 + vt)\mathbf{j}$ (pv's or **j** components same) Using $t = 1.6$: $1 + 12.8 = 7 + 1.6v$ (equn in v only) $v = \underline{4.25 \text{ m s}^{-1}}$	M1 A1 ↓ M1 A1 ↓ M1 A1 (6) M1 A1 ↓ M1 A1 ↓ M1 A1
	(e) Allow for friction on field (i.e. velocity of ball not constant) *or* allow for vertical component of motion of ball	B1 (1)

(a) M1 Valid attempt at speed (square, add and squ. root cpts)

(b) M1 needs non-zero p.v. + (attempt at veloc vector) x t. Must be vector

(d) 2nd M1 – allow if finding displacement *vector* (e.g. if using wrong time)
3rd M1 for getting speed as a *scalar* (and final answer must be as a scalar). But if they get e.g. '4.25**j**', allow M1 A0

(e) Allow 'wind', 'spin', 'time for player to accelerate', size of ball
Do not allow on their own 'swerve', 'weight of ball'.