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GCE

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Mechanics M1 (6677)

Summer 2005

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Mark Scheme (Results)

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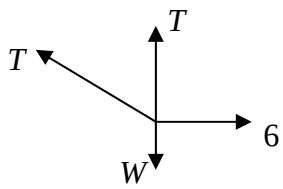
June 2005
6677 Mechanics M1
Mark Scheme

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)
2	8 → ○ ← ○ 2 (v →, w →) CLM: $0.6 \times 8 - 0.2 \times 2 = 0.6 \times v + 0.2 \times w$	M1 A1
	Using $w = 2v$ to form equn in v/w only	↓ M1
	Solve to get $v = \underline{4.4 \text{ m s}^{-1}}$	↓ M1 A1 (5)
	(b) Impulse on $B = 0.2(2 + 8.8)$	M1 A1√
	$= \underline{2.16 \text{ Ns}}$	A1 (3)
3	 (a) R(→) $T \cos \alpha = 6$	M1 A1
	$\rightarrow T = \underline{7.5 \text{ N}}$	A1 (3)
	(b) R(↑) $T + T \sin \alpha = W$	M1 A1
	Using same T's and solving	↓ M1
	$\rightarrow W = \underline{12 \text{ N}}$	A1 (4)

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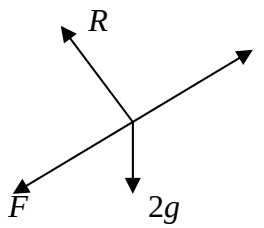
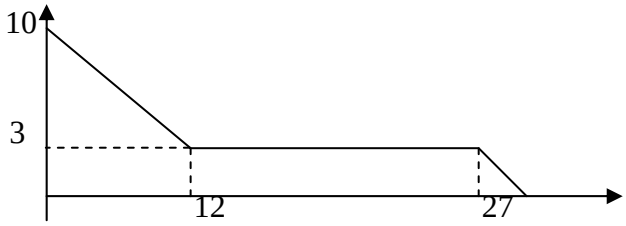
4	 (a) R (perp to plane): $R = 2g \cos 20$ $\approx$ 18.4 or 18 N (b) R (// to plane): $18 - 2g \sin 20 - F = 2a$ $F = 0.6\,R$ used Sub and solve: $a =$ 0.123 or 0.12 m s^{-2}	M1 A1 A1 (3) M1 A1 B1 ↓ M1 A1 (5)
5	(a)  Shape $0 < t < 12$ Shape $t > 12$ Figures (b) Distance in 1st 12 s = ½ x (10 + 3) x 12 *or* (3 x 12) + ½ x 3 x 7 = 78 m (c) **either** distance from $t = 12$ to $t = 27 = 15 \times 3 = 45$ $\therefore$ distance in last section = 135 – 45 = 12 m ½ x 3 x t = 12, $\Rightarrow t = 8$ s hence total time = 27 + 8 = 35 s **or** Distance remaining after 12 s = 135 – 78 = 57 m ½ x (15 + 15 + t) x 3 = 57 $\Rightarrow t = 8$ Hence total time = 27 + 8 = 35 s	B1 B1 B1 (3) M1 A1 (2) B1√ M1 A1√ A1 A1 (5) B1√ M1 A1√ A1 A1

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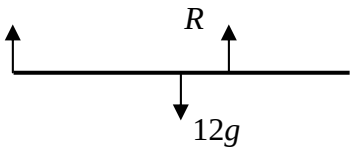
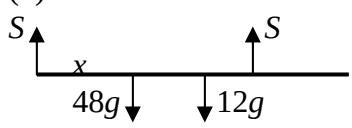
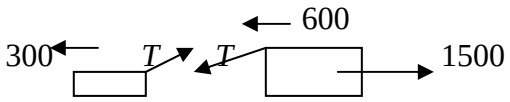
6	 (a) M(*A*): $12g \times 1.5 = R \times 2$	M1 A1
	$R = \underline{9g \text{ or } 88.2 \text{ N}}$	A1 (3)
	(b)  R(↑) $2S = 48g + 12g$	M1 A1
	$S = 30g$	
	M(*A*): $S \times 2 = 12g \times 1.5 + 48g \times x$	M1 A2,1,0 ↓↓
	Sub for *S* and solve for *x*: $x = \underline{7/8 \text{ or } 0.875 \text{ or }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

Question Number	Scheme	Marks
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 = $13.8 - 6 = 6.8$ 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)
	(e) Allow for friction on field (i.e. velocity of ball not constant) *or* allow for vertical component of motion of ball	M1 A1 ↓ M1 A1 ↓ M1 A1 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'.