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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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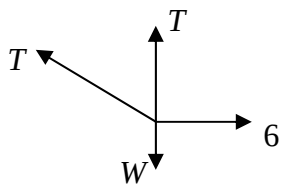
June 2005
6677 Mechanics M1
Mark Scheme

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 ↓ M1
	Using same T's and solving	
	$\rightarrow W = \underline{12 \text{ N}}$	A1 (4)

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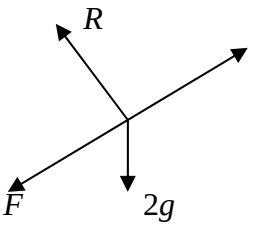
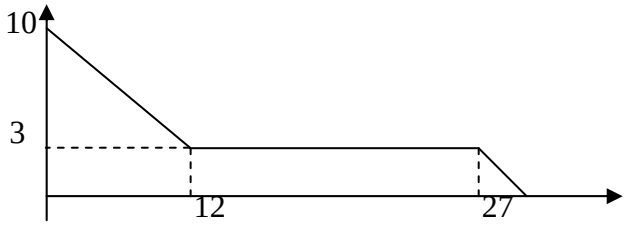
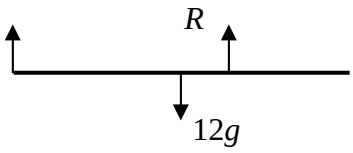
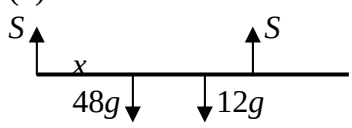
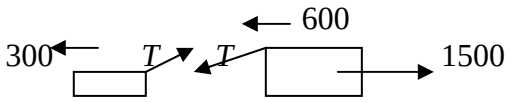
4		
	(a) R (perp to plane): $R = 2g \cos 20$	M1 A1
	$\approx$ 18.4 or 18 N	A1 (3)
	(b) R (// to plane): $18 - 2g \sin 20 - F = 2a$	M1 A1
	$F = 0.6\,R$ used	B1
	↓	
	Sub and solve: $a =$ 0.123 or 0.12 m s^{-2}	M1 A1 (5)
5	(a)  Shape $0 < t < 12$	B1
	Shape $t > 12$	B1
	Figures	B1 (3)
	(b) Distance in 1st 12 s = ½ x (10 + 3) x 12 *or* (3 x 12) + ½ x 3 x 7	M1
	= 78 m	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 = 35 s	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 = 35 s	A1

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