Edexcel
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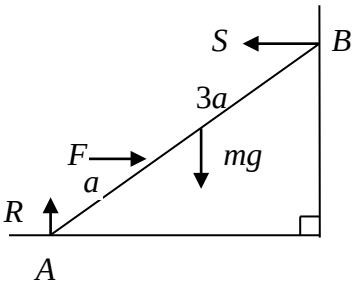
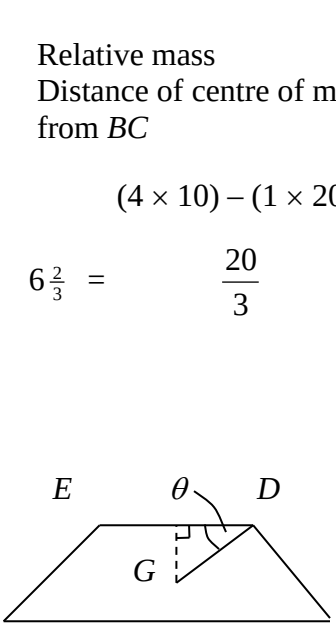
Mock Paper Mark Scheme

Advanced Subsidiary/Advanced GCE
General Certificate of Education

Subject **MECHANICS** Paper No. **Mock M2**

Question number	Scheme	Marks
1.	$v = \frac{1}{2}u$ KE loss $= \frac{1}{2}m(u^2 - (\frac{1}{2}u)^2)$ $= \frac{3mu^2}{8}$ $\therefore$ fraction of KE lost $= \frac{3mu^2}{8} \div \frac{1}{2}mu^2 = \frac{3}{4}$	B1 M1 A1 M1 A1 **(5)**
2.	 $R(\rightarrow)$, $F = S$ M (A) $mg\ 2a\cos\theta + F\ a\sin\theta = S \times 4a\sin\theta$ i.e. $2mg + 2F = 8S$ $F = \frac{1}{3}mg$	B1 M1 A2 M1 A1 **(6)**
3. (a)	 *ABC* *ADE* *BCDE* Relative mass 4 1 3 Distance of centre of mass from *BC* 10 20 $\bar{y}$ $(4 \times 10) - (1 \times 20) = 3\bar{y}$ $6\frac{2}{3} = \frac{20}{3} = \bar{y}$ (T)	B3 (–1 each error or omission) M1 A1 A1 (6)
(b)	$\tan\theta = \frac{15 - \bar{y}}{20}$ $= \frac{15 - \frac{20}{3}}{20} = \frac{5}{12}$ $\theta = 22.6°$ (1 d.p.)	M1 A1 A1 (3) **(9)**
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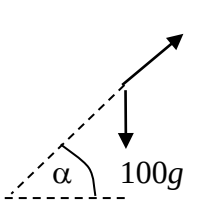
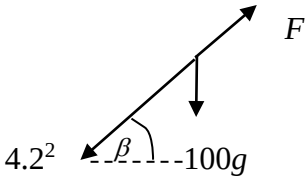
4. (*a*)		$R(\swarrow),\ 100g \times \frac{1}{20} = k \times \left(\frac{7}{2}\right)^2$ $\Rightarrow\ k = 4$ (T)	M1 A1 A1 (3)
(*b*)		$R(\nearrow),\ F - 100g \times \frac{1}{40} - 16 = 0$ $\Rightarrow\ F = 40.5$ N $P = 40.5 \times 2$ $= 81$ W	M1 A2 A1 M1 A1 (6) **(9)**
5. (*a*)	$u \rightarrow$ $\rightarrow \lambda u$ *S* (*m*) (*km*) *T* $\rightarrow$ $\rightarrow$ 0 v	$mu + km\lambda u = kmv$ $\frac{u}{k}(1 + k\lambda) = v$ $v = e(u - \lambda u) = eu(1 - \lambda)$ $\Rightarrow\ \frac{u}{k}(1 + k\lambda) = eu(1 - \lambda)$ $\Rightarrow \frac{(1+k\lambda)}{k(1-\lambda)} = e$ (T)	M1 A1 M1 A1 M1 A1 (6)
(*b*)	$\frac{1+k\lambda}{k(1-\lambda)} \le 1$	$\Rightarrow\ 1 + k\lambda \le k(1 - \lambda)$ $\Rightarrow\ \frac{1}{1-2\lambda} \le k$ since $0 < \lambda < \frac{1}{2}$, $k > 1$ (T)	M1 A1 A1 (3) **(9)**

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6. (*a*)	$\mathbf{v} = \int 2\mathbf{i} + 6t\mathbf{j}\ \mathrm{d}t = 2t\mathbf{i} + 3t^2\mathbf{j}$ (+ **c**)	M1 A1
	$\mathbf{c} = 2\mathbf{i} - 4\mathbf{j}$	A1 (3)
	$\mathbf{v} = (2t + 2)\mathbf{i} + (3t^2 - 4)\mathbf{j}$	
(*b*)	$t = 2$: $\mathbf{v} = 6\mathbf{i} + 8\mathbf{j}$	B1
	$3\mathbf{i} - 1.5\mathbf{j} = 0.5(\mathbf{v} - (6\mathbf{i} + 8\mathbf{j}))$	M1 A1
	$\Rightarrow \mathbf{v} = 12\mathbf{i} + 5\mathbf{j}$	A1
	$\Rightarrow \lvert\mathbf{v}\rvert = \sqrt{(12^2 + 5^2)} = 13$ m s^{-1}	M1 A1 (6) **(9)**
7. (*a*)	($\uparrow$): $-52.5 = 14t - \frac{1}{2} \times 9.8t^2$	M1 A2
	$7t^2 - 20t - 75 = 0$	
	$(7t + 15)(t - 5) = 0$	M1 A1 A1
	$t = 5$ (or $t = -\frac{15}{7}$)	M1
	($\rightarrow$): $S = 28 \cos 30° \times 5$	A1 (8)
	$= 70\sqrt{3} = 121$ m (3 s.f.)	
(*b*)	$v_{\text{horizontal}}$: $28 \cos 30° = 14\sqrt{3}$	B1
	v_{vertical}: $28 \sin 30° - 5g = -35$	M1 A1
	$\therefore$ speed $= \sqrt{((14\sqrt{3})^2 + 35^2)} = \sqrt{1813} = 42.6$ m s^{-1}	M1 A1 (5) **(13)**
OR	KE gain = PE loss	M1 A2
	$\frac{1}{2} m (v^2 - 28^2) = mg \times 52.5$	M1 A1 (5)
	$\Rightarrow v = \sqrt{1813} = 42.6$ m s^{-1}	

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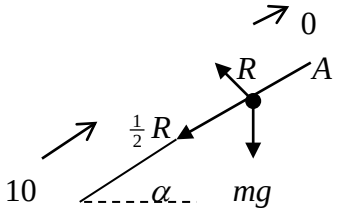
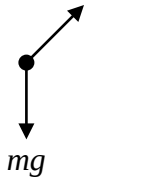
8. (*a*)	 R (↖), $R = mg\cos\alpha = \frac{4}{5}mg$	M1 A1
	$\frac{2}{5}mgd = \frac{1}{2}m \times 10^2 - mgd\sin\alpha$	M1 A3
	$OA = d = \frac{50}{g} = 5.10$ m (3 s.f.)	A1 (7)
(*b*)	At A,  component of weight down plane = $mg\sin\alpha = \frac{3mg}{5}$	B1
	limiting friction up = $\frac{2mg}{5}$	B1
	$\therefore$ slides down as $\frac{3mg}{5} > \frac{2mg}{5}$	M1 (3)
	Work done against friction = KE loss	
	$2 \times \frac{2mg}{5} \times \frac{50}{g} = \frac{1}{2}m(10^2 - v^2)$	M1 A3
	$v = \sqrt{20} = 4.47$ m s^{-1}	A1 (5) **(15)**