

# EDEXCEL

190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject: **Mechanics**

Paper: **M1**

Question Number	Scheme	Marks
1	<p>Diagram showing two spheres. The left sphere has mass 1.5 kg and is moving to the right with speed 3. The right sphere has mass 2.5 kg and is moving to the left with speed 4. Below the spheres, the final velocities are indicated: the left sphere moves to the left with speed 2.5, and the right sphere moves to the right with speed <math>v</math>.</p> <p>(a) CLM: <math>1.5 \times 3 - 2.5 \times 4 = -1.5 \times 2.5 + 2.5 \times v</math></p> <p><math>\Rightarrow v = \underline{-0.7 \text{ m s}^{-1}}</math></p> <p>(b) Direction of Q unchanged</p> <p>(c) Impulse = <math>1.5 (3 + 2.5)</math></p> <p><math>= \underline{8.25 \text{ N s}}</math></p>	<p>M1 A1</p> <p>A1 (3)</p> <p>A1✓ (1)</p> <p>M1</p> <p>A1, A1 (3)</p>
	<p>(a) Accept <math>\pm 0.7</math> for final answer</p> <p>(b) Mark is an A mark, i.e. <math>\text{cao} = \text{cso}</math>, but allow <math>\checkmark</math> if clear from working/diagram</p> <p>(c) Allow M1 even if signs incorrect, but must be one mass <math>\times</math> difference/sum of two speeds the mass chosen.</p>	

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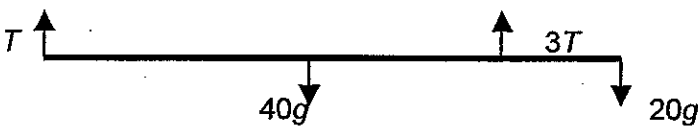
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2	 <p>(a) <math>R(\uparrow): T + 3T = 40g + 20g</math> <math>T = 15g</math>, so tension at C is <u>45g or 441 N or 440 N</u></p> <p>(b) <math>M(B) \quad 15g \times 3 + 45g \times d = 40g \times 1.5</math> Solve: <math>d = \underline{1/3 \text{ or } 0.33 \text{ or } 0.333 \text{ m}}</math></p>	<p>M1 A1 (2)</p> <p>M1 A2,1,0✓ M1 A1 (5)</p>
	<p>(a) Allow M1 for a potentially complete method to find <math>T</math> or <math>3T</math>.</p> <p>(b) Allow for moments about other points. Apply normal rules about extra/missing terms</p>	

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3	(a) Distance = $\frac{1}{2} \times 4 \times 9 + 16 \times 9$ or $\frac{1}{2} (20 + 16) \times 9$ $= \underline{162 \text{ m}}$	M1 A1 (2)
	(b) Distance over last 5 s = $\frac{1}{2}(9 + u) \times 5$ $162 + \frac{1}{2}(9 + u) \times 5 = 200$ $\Rightarrow u = \underline{6.2 \text{ m s}^{-1}}$	M1 M1 A1√ A1 (4)
	(c) $6.2 = 9 + 5a$ $a = (-) \underline{0.56 \text{ m s}^{-2}}$	M1 A1√ A1 (3)
<hr/>		
(a) M1 for valid attempt to find area (as triangle + rectangle, or as trapezium)		
(b) M1 for valid attempt to find area of the trap.  M1 for setting up equn appropriately; A1√ on '162' (only)		
(c) M1 for forming valid equation in $a$ only (but allow their ' $a$ ' as acceleration or deceleration) A1√ on 6.2 only.		

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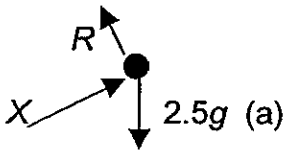
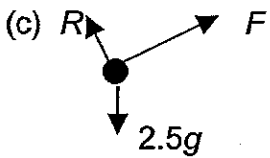
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4	 <p>(a) <math>R = 2.5g \cos 20</math>  <math>\approx \underline{23.0 \text{ or } 23 \text{ N}}</math></p> <p>(b) <math>X = 0.4 \times 23.0 + 2.5g \sin 20</math>  <math>\approx \underline{17.6 \text{ or } 18 \text{ N}}</math></p>  <p>(c) In equil. <math>F = 2.5g \sin 20 \approx 8.38 \text{ or } 8.4 \text{ N}</math>  <math>\mu R = 0.4 \times 2.5g \cos 20 \approx 9.21 \text{ or } 9.2 \text{ N}</math>  <math>8.4 &lt; 9.2</math> (comparison)          Since <math>F &lt; \mu R</math> remains in equilibrium (cso)</p>	<p>M1 A1 (2)</p> <p>M1 A2,1,0✓ A1 (4)</p> <p>B1 B1 M1 A1 (4)</p>

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5	(a) 's = ut + $\frac{1}{2}at^2$ ' for B: $0.4 = \frac{1}{2}a(0.5)^2$	M1 A1
	$a = \underline{3.2 \text{ m s}^{-2}}$	A1 (3)
	(b) N2L for B: $0.8g - T = 0.8 \times 3.2$	M1 A1✓
	$T = \underline{5.28 \text{ or } 5.3 \text{ N}}$	M1 A1 (4)
	(c) A: $F = \mu \times 0.5g$	B1
	N2L for A: $T - F = 0.5a$	M1 A1 ↓
	Sub and solve $\mu = \underline{0.75 \text{ or } 0.751}$	M1 A1 (5)
	(d) Same acceleration for A and B.	B1 (1)

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6	(a) $16^2 = 20^2 - 2 \times a \times 24 \Rightarrow a = \underline{3 \text{ m s}^{-2}}$	M1 A1 (2)
	(b) $v^2 = 20^2 - 2 \times 3 \times 30$ $v = \underline{\sqrt{220} \text{ or } 14.8 \text{ m s}^{-1}}$	M1 A1√ A1 (3)
	(c) $0.3 = m \times 3 \Rightarrow m = 0.1 \text{ kg } (*)$	M1 A1 (2)
	(d) $0.1(w + \sqrt{220}) = 2.4$ $w = 9.17$ $0 = 9.17 - 3 \times t$ $t \approx \underline{3.06 \text{ s}}$	M1 A1√ A1 ↓ M1 A1√ A1 (6)
	(d) If use 14.8 instead of $\sqrt{220}$ , this gives $w = 9.2$ and $t = 3.07$ : allow full marks from clear working.	

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7	<p>(a) <math>\mathbf{v}_P = \{(29\mathbf{i} + 34\mathbf{j}) - (20\mathbf{i} + 10\mathbf{j})\}/3 = \underline{(3\mathbf{i} + 8\mathbf{j}) \text{ m s}^{-1}}</math></p> <p>(b) <math>\mathbf{p} = (20\mathbf{i} + 10\mathbf{j}) + (3\mathbf{i} + 8\mathbf{j})t</math>  <math>\mathbf{q} = (14\mathbf{i} - 6\mathbf{j}) + 12t\mathbf{j}</math></p> <p>(c) <math>\mathbf{q} - \mathbf{p} = (-6 - 3t)\mathbf{i} + (-16\mathbf{i} + 4t)\mathbf{j}</math>  <math>d^2 = (-6 - 3t)^2 + (-16 + 4t)^2</math>  <math>= 36 + 36t + 9t^2 + 16t^2 - 128t + 256</math>  <math>= 25t^2 - 92t + 292</math> (*)</p> <p>(d) <math>25t^2 - 92t + 292 = 225</math>  <math>25t^2 - 92t + 67 = 0</math>  <math>(t - 1)(25t - 67) = 0</math>  <math>t = 67/25</math>  time <math>\approx</math> 161 mins, or 2 hrs 41 mins, or 2.41 am, or 0241</p>	<p>M1 A1 (2)</p> <p>M1 A1 M1 A1 (4)</p> <p>M1 A1 ↓ M1 ↓ M1 A1 (cso) (5)</p> <p>M1 A1 ↓ M1 A1 A1 (5)</p>
<p>(c) Allow for <math>\mathbf{q} - \mathbf{p}</math> or <math>\mathbf{p} - \mathbf{q}</math>. But signs must be consistent for A marks. Final A1 is cso for fully consistent working form PQ or QP.</p> <p>(d) 2<sup>nd</sup> M1 for valid method to solve quadratic.</p>		