

A level Applied Paper 3B Mechanics Practice Paper M8 **MARK SCHEME**

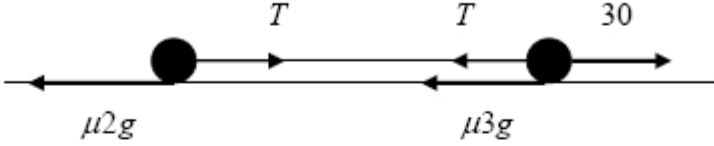
Question 1:

Question Number	Scheme	Marks
(a)	$v^2 = u^2 + 2as \Rightarrow 17.5^2 = u^2 + 2 \times 9.8 \times 10$ <p style="text-align: center;">Leading to $u = 10.5$</p>	M1 A1 A1 (3)
(b)	$v = u + at \Rightarrow 17.5 = -10.5 + 9.8T$ $T = 2\frac{6}{7} \text{ (s)}$	M1 A1 ft. M1 A1 (4)
		(7 marks)

Question 2:

Question Number	Scheme	Marks
(a)	<p style="text-align: right;">shape 25, 10, 30, 90</p>	B1 B1 (2)
(b)	$(b) \quad 30 \times 25 + \frac{1}{2}(25+10)t + 10(60-t) = 1410$ $7.5t = 60$ $t = 8 \text{ (s)}$ $a = \frac{25-10}{8} = 1.875 \text{ (ms}^{-2}\text{)} \quad 1\frac{7}{8}$	M1 <u>A1</u> A1 M1 A1 M1 A1 (7)
		(9 marks)

Question 3:

Question Number	Scheme	Marks
(a)	 $s = ut + \frac{1}{2}at^2 \Rightarrow 6 = \frac{1}{2}a \times 9$ $a = 1\frac{1}{3} \text{ (ms}^{-2}\text{)}$	<p>M1</p> <p>A1 (2)</p>
(b)	<p>N2L for system $30 - \mu 5g = 5a$ ft their a, accept symbol</p> $\mu = \frac{14}{3g} = \frac{10}{21}$ <p>or awrt 0.48</p>	<p>M1 A1ft</p> <p>M1 A1 (4)</p>
(c)	<p>N2L for P $T - \mu 2g = 2a$ ft their μ, their a, accept symbols</p> $T - \frac{14}{3g} \times 2g = 2 \times \frac{4}{3}$	<p>M1 A1 ft</p>
(d)	<p>Leading to $T = 12 \text{ (N)}$ awrt 12</p>	<p>M1 A1 (4)</p>
(e)	<p>The acceleration of P and Q (or the whole of the system) is the same.</p> $v = u + at \Rightarrow v = \frac{4}{3} \times 3 = 4$ <p>N2L (for system or either particle)</p> $-5\mu g = 5a$ <p>or equivalent</p> $a = -\mu g$ $v = u + at \Rightarrow 0 = 4 - \mu g t$ <p>Leading to $t = \frac{6}{7} \text{ (s)}$ accept 0.86, 0.857</p>	<p>B1 (1)</p> <p>B1 ft on a</p> <p>M1</p> <p>M1</p> <p>A1 (4)</p> <p>(15 marks)</p>

Question 4:

Question Number	Scheme	Marks
<p>(a)</p> <p style="text-align: center;"></p>	<p>$M(A) \quad 8g \times 0.8 + 12g \times 1.2 = X \times 2.4$</p> <p style="text-align: center;">$X \approx 85 \text{ (N)}$ accept $84.9, \frac{26g}{3}$</p>	<p>M1 A1</p> <p>DM1 A1 (4)</p>
	<p>(b)</p> <p style="text-align: center;"></p> <p>$R(\uparrow) \quad (X+10) + X = 8g + 12g$</p> <p style="text-align: center;">$(X = 93)$</p> <p>$M(A) \quad 8g \times 0.8 + 12g \times x = X \times 2.4$</p> <p style="text-align: center;">$x = 1.4 \text{ (m)}$ accept 1.36</p>	<p>M1 B1 A1</p> <p>M1 A1</p> <p>A1 (6)</p> <p>(10 marks)</p>

Question 5:

Question Number	Scheme	Marks
(a)		
	$R = 45 \cos 40^\circ + 4g \cos 30^\circ$	M1 A2, 1, 0
	$R \approx 68$	accept 68.4 M1 A1 (5)
(b)	Use of $F = \mu R$	M1
	$F + 4g \sin 30 = 45 \cos 50^\circ$	M1 A2, 1, 0
	Leading to $\mu \approx 0.14$	accept 0.136 M1 A1(6)
		(11 marks)

Question 6:

Question Number	Scheme	Marks
(a)		
	$(\uparrow) \quad 15 \sin 30^\circ = R \sin 50^\circ$	M1 A1
	$R \approx 9.79 \text{ (N)}$	M1 A1 (4)
(b)	$(\rightarrow) X - 15 \cos 30^\circ = R \cos 50^\circ$	ft their R M1 A2 ft
	$X \approx 19.3 \text{ (N)}$	M1 A1 (5)
		(9 marks)

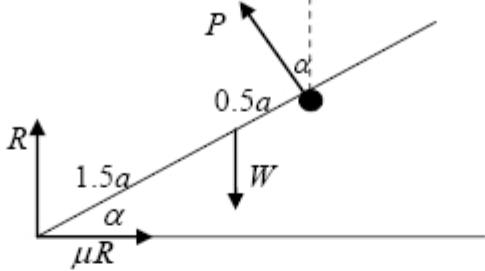
Question 7:

Question Number	Scheme	Marks
(a)	$\tan \theta = \frac{8}{6}$ $\theta \approx 53^\circ$	M1 A1 (2)
(b)	$\mathbf{F} = 0.4(6\mathbf{i} + 8\mathbf{j}) (= 2.4\mathbf{i} + 3.2\mathbf{j})$ $ \mathbf{F} = \sqrt{(2.4^2 + 3.2^2)} = 4$	M1 M1 A1 (3)
(c)	$\mathbf{v} = 9\mathbf{i} - 10\mathbf{j} + 5(6\mathbf{i} + 8\mathbf{j})$ $= 39\mathbf{i} + 30\mathbf{j} \text{ (ms}^{-1}\text{)}$	M1 A1 A1 (3)
		(8 marks)

Question 8:

Question Number	Scheme	Marks
(a)	N2L $(6t - 5)\mathbf{i} + (t^2 - 2t)\mathbf{j} = 0.5\mathbf{a}$	M1
	$\mathbf{a} = (12t - 10)\mathbf{i} + (2t^2 - 4t)\mathbf{j}$	A1
	$\mathbf{v} = (6t^2 - 10t)\mathbf{i} + \left(\frac{2}{3}t^3 - 2t^2\right)\mathbf{j} \quad (+C) \quad \text{ft their a}$	M1 A1ft+A1ft
	$\mathbf{v} = (6t^2 - 10t + 1)\mathbf{i} + \left(\frac{2}{3}t^3 - 2t^2 - 4\right)\mathbf{j}$	A1 (6)

Question 9:

Question Number	Scheme	Marks
(a)	 <p style="text-align: center;">$R(\uparrow) \quad R + P \cos \alpha = W$</p> <p style="text-align: center;">$M(A) \quad P \times 2a = W \times 1.5a \cos \alpha$</p> <p style="text-align: center;">$\left(P = \frac{3}{4} W \cos \alpha \right)$</p> <p style="text-align: center;">$R = W - P \cos \alpha = W - \frac{3}{4} W \cos^2 \alpha$</p> <p style="text-align: center;">$= \frac{1}{4} (4 - 3 \cos^2 \alpha) W \quad *$</p>	<p style="text-align: right;">M1 A1</p> <p style="text-align: right;">M1 A1</p> <p style="text-align: right;">DM1</p> <p style="text-align: right;">A1 (6)</p>
(b)	<p>Using $\cos \alpha = \frac{2}{3}$, $R = \frac{2}{3} W$</p> <p>$R(\rightarrow) \quad \mu R = P \sin \alpha$</p> <p>Leading to $\mu = \frac{3}{4} \sin \alpha$</p> <p>$\left(\sin \alpha = \sqrt{1 - \frac{4}{9}} = \frac{\sqrt{5}}{3} \right)$</p> <p style="text-align: center;">$\mu = \frac{\sqrt{5}}{4}$</p>	<p style="text-align: right;">B1</p> <p style="text-align: right;">M1 A1</p> <p style="text-align: right;">awrt 0.56</p> <p style="text-align: right;">M1 A1 (5)</p> <p style="text-align: right;">(11 marks)</p>

Question 10:

Question Number	Scheme		Marks
(a)	(↓)	$u_y = 25 \sin 30^\circ (=12.5)$ $12 = 12.5t + 4.9t^2$ Leading to $t = 0.743$, 0.74	B1 M1 A2, 1, 0 A1 (5)
(b)	(→)	$u_x = 25 \cos 30^\circ \left(= \frac{25\sqrt{3}}{2} \approx 21.65 \right)$ $OB = 25 \cos 30^\circ \times t (\approx 16.09458)$ $TB \approx 1.1$ (m)	B1 M1 A1ft A1 (4) awrt 1.09
(c)	(→)	$15 = u_x \times t \Rightarrow t = \frac{15}{u_x} (= \frac{2\sqrt{3}}{5} \approx 0.693 \text{ or } 0.69)$	M1 A1
	either	(↓) $v_y = 12.5 + 9.8t (\approx 19.2896)$ $V^2 = u_x^2 + v_y^2 (\approx 840.840)$ $V \approx 29$ (ms^{-1}) , 29.0	M1 M1 A1 (5)
			(14 marks)