

## A level Applied Paper 3B Mechanics Practice Paper J8 MARK SCHEME

### Question 1:

Question Number	Scheme	Marks
(a)	$27 = 0 + \frac{1}{2}a.3^2 \Rightarrow a = \underline{6}$	M1 A1 (2)
(b)	$v = 6 \times 3 = \underline{18 \text{ m s}^{-1}}$	M1 A1 ft. (2)
(c)	From $t = 3$ to $t = 5$ , $s = 18 \times 2 - \frac{1}{2} \times 9.8 \times 2^2$  Total ht. = $s + 27 = \underline{43.4 \text{ m. } 43 \text{ m}}$	M1 A1 ft.  M1 A1 (4)
		<b>8</b>

### Question 2:

Question Number	Scheme	Marks
(a)		B1 B1 B1 (3)
(b)	$\frac{1}{2}(15 + 5) \times t = 120$  $\Rightarrow t = 12 \rightarrow T = 12 + 16 + 22 = \underline{50 \text{ s}}$	M1 M1 A1 (3)
(c)	$120 + \frac{1}{2}(V + 5).16 + 22V = 1000$  Solve: $30V = 840 \Rightarrow V = \underline{28}$	M1 <u>B1</u> A1 DM1 A1 (5) <b>11</b>

**Question 3:**

Question Number	Scheme	Marks
(a)	$M(A): T \times 4 = 12g \times 2.5$ $T = \underline{7.5g \text{ or } 73.5 \text{ N}}$ $R(\uparrow) S + T = 12g$ $\Rightarrow S = \underline{4.5g \text{ or } 44.1 \text{ N}}$	M1 A1 A1  M1 A1 (5)
(b)	$M(A) V \times 4 = 16g \times y + 12g \times 2.5$ $V = \underline{4gy + 7.5g \text{ or } 39.2y + 73.5 \text{ N}}$	M1 A1 A1 (3)
(c)	$V \leq 98 \Rightarrow 39.2y + 73.5 \leq 98$ $\Rightarrow y \leq 0.625 = 5/8$ <p>Hence "load must be no more than 5/8 m from A" (o.e.)</p>	M1 DM1 A1 (3)
<b>11</b>		

**Question 4:**

Question Number	Scheme	Marks
(a)	$R (\parallel \text{ plane}): \quad 49 \cos \theta = 6g \sin 30$ $\Rightarrow \cos \theta = 3/5 \quad *$	M1 A1 A1 (3)
(b)	$R (\text{perp to plane}): \quad R = 6g \cos 30 + 49 \sin \theta$ $R \approx \underline{90.1 \text{ or } 90 \text{ N}}$	M1 A1 DM1 A1 (4)
(c)	$R (\parallel \text{ to plane}): \quad 49 \cos 30 - 6g \sin 30 = 6a$ $\Rightarrow a \approx \underline{2.17 \text{ or } 2.2 \text{ m s}^{-2}}$	M1 A2,1,0 A1 (4)
<b>11</b>		

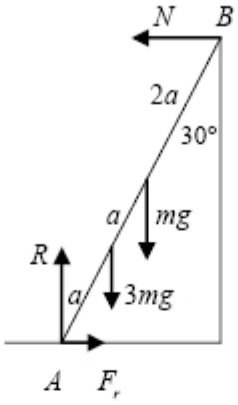
**Question 5:**

Question Number	Scheme	Marks
(a)	$B: \quad 2mg - T = 2m \times 4g/9$ $\Rightarrow T = \underline{10mg/9}$	M1 A1 A1 (3)
(b)	$A: \quad T - \mu mg = m \times 4g/9$ <p>Sub for <math>T</math> and solve: <math>\mu = 2/3</math> *</p>	M1 <u>B1</u> A1 DM1 A1 (5)
(c)	<p>When <math>B</math> hits: <math>v^2 = 2 \times 4g/9 \times h</math></p> <p>Deceleration of <math>A</math> after <math>B</math> hits: <math>ma = \mu mg \Rightarrow a = 2g/3</math></p> <p>Speed of <math>A</math> at <math>P</math>: <math>V^2 = 8gh/9 - 2 \times 2g/3 \times h/3</math></p> $\Rightarrow V = \frac{2}{3} \sqrt{(gh)}$	M1 A1 M1 A1 f.t. DM1 A1 (6)
(d)	Same tension on $A$ and $B$	B1 (1)
		<b>15</b>

**Question 6:**

Question Number	Scheme	Marks
(a)	Speed = $\sqrt{(5^2 + 8^2)} \approx \underline{9.43 \text{ m s}^{-1}}$	M1 A1 (2)
(b)	Forming $\arctan 8/5$ or $\arctan 5/8$ oe Bearing = $360 - \arctan 5/8$ or $270 + \arctan 8/5 = \underline{328}$	M1 DM1 A1 (3)
(c)	At $t = 3$ , p.v. of $P = (7 - 15)\mathbf{i} + (-10 + 24)\mathbf{j} = -8\mathbf{i} + 14\mathbf{j}$ Hence $-8\mathbf{i} + 14\mathbf{j} + 4(u\mathbf{i} + v\mathbf{j}) = \mathbf{0}$ $\Rightarrow \underline{u = 2, v = -3.5}$	M1 A1 M1 DM1 A1 (5)
(d)	p.v. of $P$ $t$ secs after changing course = $(-8\mathbf{i} + 14\mathbf{j}) + t(2\mathbf{i} - 3.5\mathbf{j})$ $= 7\mathbf{i} + \dots$ Hence total time = $\underline{10.5 \text{ s}}$	M1 DM1 A1 (3)
		<b>13</b>

**Question 7:**

Question Number	Scheme	Marks
	<p>(a)</p>  <p><math>\mathcal{M}(A) \quad N \times 4a \cos 30^\circ = 3mg \times a \sin 30^\circ + mg \times 2a \sin 30^\circ</math></p> <p><math>N = \frac{5}{4} mg \tan 30^\circ \quad (= \frac{5}{4\sqrt{3}} mg = 7.07 \dots m)</math></p> <p><math>\rightarrow F_r = N \quad , \quad \uparrow R = 4mg</math></p> <p>Using <math>F_r = \mu R</math></p> <p><math>\frac{5}{4\sqrt{3}} mg = \mu R \quad \text{for their } R</math></p> <p><math>\mu = \frac{5}{16\sqrt{3}} \quad \text{awrt } 0.18</math></p> <p>Alternative method:</p> <p><math>\mathcal{M}(B): mg \times 2a \sin 30 + 3mg \times 3a \sin 30 + F \times 4a \cos 30 = R \times 4a \sin 30</math></p> <p><math>11mga \sin 30 + F \times 4a \cos 30 = R \times 4a \sin 30</math></p> <p><math>\frac{11mg}{2} + F \frac{4\sqrt{3}}{2} = 2R</math></p> <p><math>\uparrow R = 4mg \quad ,</math></p> <p>Using <math>F_r = \mu R</math></p> <p><math>8\mu\sqrt{3} = \frac{5}{2}, \quad \mu = \frac{5}{16\sqrt{3}}</math></p>	<p>M1 A2(1,0)</p> <p>DM1 A1</p> <p>B1, B1</p> <p>B1</p> <p>M1</p> <p>A1 <b>(10)</b></p> <p><b>[10]</b></p> <p>M1A3(2,1,0)</p> <p>DM1A1</p> <p>B1</p> <p>B1</p> <p>M1 A1</p>

**Question 8:**

Question Number	Scheme	Marks
	(a) $\begin{array}{l} \rightarrow 30 = 2ut \\ \uparrow -47.5 = 5ut - 4.9t^2 \\ -47.5 = 75 - 4.9t^2 \\ t^2 = \frac{75 + 47.5}{4.9} (= 25) \\ t = 5 \quad * \end{array}$ <p style="text-align: right; margin-right: 100px;">eliminating <math>u</math> or <math>t</math></p> <p style="text-align: right; margin-right: 100px;">cso</p>	B1 M1 A1 DM1 DM1 A1 <b>(6)</b>
	(b) $30 = 2ut \Rightarrow 30 = 10u \Rightarrow u = 3$	M1 A1 <b>(2)</b>
	(c) $\begin{array}{l} \uparrow \dot{y} = 5u - 9.8t = -34 \\ \rightarrow \dot{x} = 2u = 6 \\ v^2 = 6^2 + (-34)^2 \\ v \approx 34.5 \text{ (ms}^{-1}\text{)} \end{array}$ <p style="text-align: right; margin-right: 100px;">M1 requires both <math>\dot{x}</math> and <math>\dot{y}</math></p> <p style="text-align: right; margin-right: 100px;">accept 35</p>	M1 A1 A1 DM1 A1 <b>(5)</b>
	<b>Alternative to (c)</b>	<b>[13]</b>
	$\frac{1}{2}mv_B^2 - \frac{1}{2}mv_A^2 = m \times g \times 47.5 \text{ with } v_A^2 = 6^2 + 15^2 = 261$ $v_B^2 = 261 + 2 \times 9.8 \times 47.5 (= 1192)$ $v_B \approx 34.5 \text{ (ms}^{-1}\text{)} \quad \text{accept 35}$ <p><b>BEWARE : Watch out for incorrect use of <math>v^2 = u^2 + 2as</math></b></p>	M1 A(2,1,0) DM1 A1 <b>(5)</b>



**Question 9:**

Question Number	Scheme	Marks
(a)	$\dot{\mathbf{p}} = (6t - 6)\mathbf{i} + (9t^2 - 4)\mathbf{j} \quad (\text{ms}^{-1})$	M1 A1 (2)
(b)	$9t^2 - 4 = 0$ $t = \frac{2}{3}$	M1 DM1 A1 (3)