A level Applied Paper 3B Mechanics Practice Paper M11 MARK SCHEME

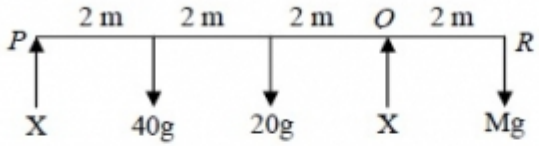
Question 1

Question Number	Scheme	Marks
(a)		B1 shape B1 figs (2)
(b)	$(\frac{1}{2}x4x5) + 60 \times 5$ $= 310$	M1 A1 A1 (3)
(c)	$\frac{(5+V)}{2} \times 20 = (400\text{-}310)$ $V = 4$	M1 A2 **ft** **DM**1 A1 (5)
(d)	$\frac{5-4}{20} = 0.05 \ \text{ms}^{-2}$	M1 A1 (2) **12**

Question 2

Question Number	Scheme	Marks
(a)	$0^2 = u^2 - 2\text{x}9.8\text{x}40$ $u = 28 \text{ m s}^{-1}$ ** GIVEN ANSWER	M1 A1 A1 (3)
(b)	$33.6 = 28t - \frac{1}{2}9.8t^2$ $4.9t^2 - 28t + 33.6 = 0$ $t = \dfrac{28 \pm \sqrt{28^2 - 4\text{x}4.9\text{x}33.6}}{9.8}$ $= 4$ s or (1.7 s or 1.71 s)	M1 A1 M1 A1 A1 (5) **8**

Question 3

Question Number	Scheme	Marks
(a)		
(i)	**EITHER** M(R), $8X + 2X = 40\text{g} \times 6 + 20\text{g} \times 4$	M1 A2
	solving for X, $X = 32\text{g} = 314$ or 310 N	M1 A1
(ii)	($\uparrow$) $X + X = 40\text{g} + 20\text{g} + M\text{g}$ (or another moments equation)	M1 A2
	solving for M, $M = 4$	M1 A1
(i)	**OR** M(P), $6X = 40\text{g} \times 2 + 20\text{g} \times 4 + M\text{g} \times 8$	M1 A2
	solving for X, $X = 32\text{g} = 314$ or 310 N	M1 A1
	($\uparrow$) $X + X = 40\text{g} + 20\text{g} + M\text{g}$ (or another moments equation)	M1 A2
(ii)	solving for M, $M = 4$	M1 A1 (10)
(b)	Masses concentrated at a point or weights act at a point	B1 (1) **11**

Question 4

Question Number	Scheme	Marks
	↗ $4\cos\alpha + F = W\sin\alpha$	M1 A1
	↖ $R = 4\sin\alpha + W\cos\alpha$	M1 A1
	$F = 0.5R$	B1
	$\cos\alpha = 0.8$ or $\sin\alpha = 0.6$	B1
	$R = 20N$ ** GIVEN ANSWER	M1 A1
	$W = 22N$	A1
		(9)
OR	→ $R\sin\alpha = 4 + F\cos\alpha$	M1 A1
	↑ $R\cos\alpha + F\sin\alpha = W$	M1 A1
	$F = 0.5R$	B1
	$\cos\alpha = 0.8$ or $\sin\alpha = 0.6$	B1
	$R = 20N$ ** GIVEN ANSWER	M1 A1
	$W = 22N$	A1
		(9)
		9

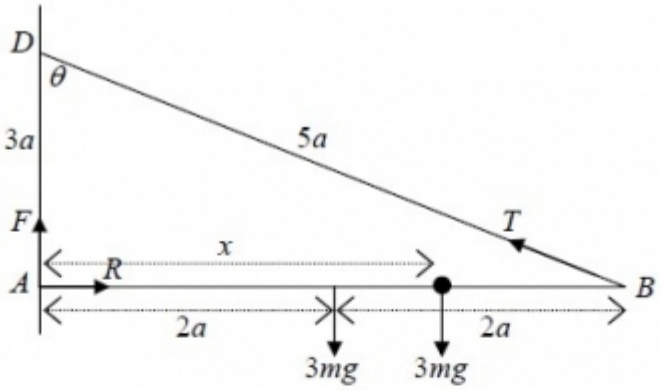
Question 5

Question Number	Scheme	Marks
(a)	$\tan\theta=\frac{3}{4}$; bearing is 37° **(nearest degree)**	M1; A1 (2)
(b)		
(i)	$\mathbf{p}=(\mathbf{i}+\mathbf{j})+t(2\mathbf{i}-3\mathbf{j})$	M1 A1
(ii)	$\mathbf{q}=(-2\mathbf{j})+t(3\mathbf{i}+4\mathbf{j})$	A1
(iii)	$\mathbf{PQ}=\mathbf{q}-\mathbf{p}=(-\mathbf{i}-3\mathbf{j})+t(\mathbf{i}+7\mathbf{j})$	M1 A1 (5)
(c)		
(i)	$-1+t=0$ $t=1$ or 3pm	M1 A1
(ii)	$-1+t=-(-3+7t)$ $t=\frac{1}{2}$ or 2.30 pm	M1 A1 (4)
		11

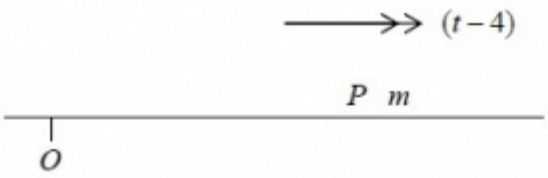
Question 6

Question Number	Scheme	Marks
(a)	$R = 0.3g\cos\alpha$ $= 0.24g = 2.35$ (3sf)=2.4 (2sf)	M1 A1 (2)
(b)	$mg - T = 1.4m$ $T - 0.3g\sin\alpha - F = 0.3$ x 1.4 $F = 0.5R$ Eliminating R and T $m = 0.4$	M1 A1 M1 A2 M1 **DM**1 A1 (8)
(c)	$v = 1.4$ x 0.5 $-0.3g\sin\alpha - F = 0.3a$ $a = -9.8$ $0 = 0.7 - 9.8t$ $t = 0.071$ s or 0.0714 s (1/14 A0)	B1 M1 A1 A1 M1 A1 (6) **16**

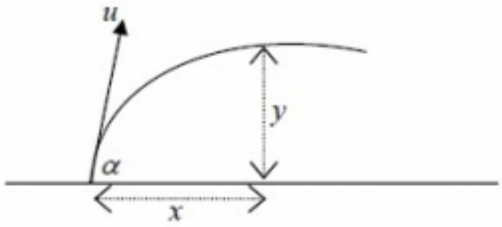
Question 7

Question Number	Scheme	Marks
(a)		
	M(A) $3mg \times 2a + 3mgx = T\cos\theta \times 4a$	M1 A2,1,0
	$= \frac{12}{5}aT$	
	$\frac{12}{5}aT = 6mga + 3mgx$	
	$T = \frac{25}{4}mg$ $\quad \frac{12}{5}a \times \frac{25}{4}mg = 6mga + 3mgx$	M1
	$15a = 6a + 3x$	
	$x = 3a$ **	A1
		(5)
(b)	R$(\rightarrow)$ $R = T\sin\theta$	M1
	$= \frac{25}{4}mg \times \frac{4}{5}$	A1
	$= 5mg$ **	A1
		(3)
(c)	R$(\uparrow)$ $F + \frac{25}{4}mg \times \frac{3}{5} = 3mg + 3mg$	M1 A2,1,0
	$F = 6mg - \frac{15}{4}mg = \frac{9}{4}mg$	
	$\mu = \frac{F}{R} = \frac{\frac{9}{4}mg}{5mg} = \frac{9}{20}$	DM1 A1
		(5)
		13

Question 8

Question Number	Scheme	Marks
(a)		
	$\frac{dv}{dt} = t - 4$	
	$v = \frac{1}{2}t^2 - 4t(+c)$	M1 A1
	$t = 0 \quad v = 6 \quad \Rightarrow c = 6$	M1
	$\therefore v = \frac{1}{2}t^2 - 4t + 6$	A1
		(4)
(b)	$v = 0 \quad 0 = t^2 - 8t + 12$	M1
	$(t-6)(t-2) = 0$	DM1
	$t = 6 \quad t = 2$	A1
		(3)
(c)	$x = \frac{t^3}{6} - 2t^2 + 6t + k$	M1 A1 ft
	$x_6 - x_2 = \frac{6^3}{6} - 2\times 6^2 + 6^2 + k$	DM1
	$-\left(\frac{2^3}{6} - 2\times 2^2 + 6\times 2 + k\right)$	
	$= -5\frac{1}{3}$	
	$\therefore$ Distance is $5\frac{1}{3}$ m	A1
		(4)
		11

Question 9

Question Number	Scheme	Marks
(a)		
	Horiz: $x = u\cos\alpha t$	B1
	Vert: $y = u\sin\alpha t - \frac{1}{2}gt^2$	M1
	$y = u\sin\alpha \times \frac{x}{u\cos\alpha} - \frac{1}{2}g \times \frac{x^2}{u^2\cos^2\alpha}$	DM1
	$y = x\tan\alpha - \frac{gx^2}{2u^2\cos^2\alpha}$ **	A1
		(4)
(b)	$y = -7$: $-7 = \tan 45x - \frac{gx^2}{2\times 7^2\cos^2 45}$	M1 A1
	$-7 = x - \frac{9.8x^2}{7^2}$	
	$-7 = x - \frac{x^2}{5}$	M1
	$x^2 - 5x - 35 = 0$	
	$x = \frac{5 \pm \sqrt{25 + 4\times 35}}{2}$	M1
	$x = 8.92$ or 8.9	A1
		(5)
(c)	Time to travel 8.922 m horizontally $= \frac{8.922}{7\cos 45} = 1.802...$s	M1
	$v = \frac{8.922}{1.402}$	M1 A1 ft
	$= 6.36$ or 6.4 $\left(\text{m s}^{-1}\right)$	A1
		(4)
		13