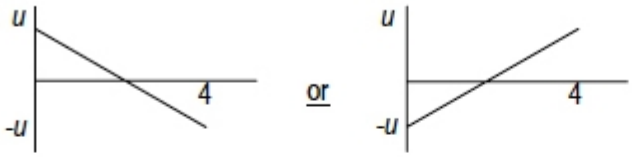
A level Applied Paper 3B Mechanics Practice Paper J9 MARK SCHEME

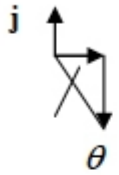
Question 1:

(a)		shape values	B1 B1 (2)
(b)	$19.6 = \frac{1}{2} \times 2 \times u$ $u = 19.6$		M1 A1 A1 (3) **[5]**

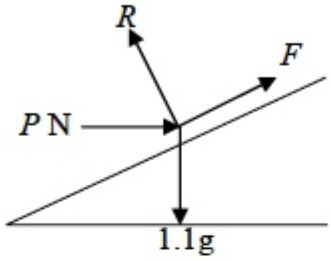
Question 2:

Question Number	Scheme	Marks
	$-6\mathbf{i} + \mathbf{j} = \mathbf{u} + 3(2\mathbf{i} - 5\mathbf{j})$ $\Rightarrow \mathbf{u} = -12\mathbf{i} + 16\mathbf{j}$ $\Rightarrow u = \sqrt{(-12)^2 + 16^2} = 20$	M1 A1 A1 cso M1 A1 **[5]**

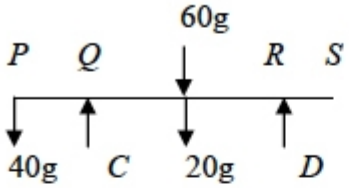
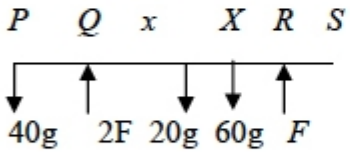
Question 3:

Question Number	Scheme	Marks
(a)	 $\tan\theta = \frac{2}{1} \Rightarrow \theta = 63.4^{\circ}$	M1 A1
	angle is 153.4°	A1 (3)
(b)	$(4+p)\mathbf{i} + (q-5)\mathbf{j}$	B1
	$(q-5) = -2(4+p)$	M1 A1
	$2p + q + 3 = 0$ *	A1 (4)
(c)	$q = 1 \Rightarrow p = -2$	B1
	$\Rightarrow \mathbf{R} = 2\mathbf{i} - 4\mathbf{j}$	M1
	$\Rightarrow \lvert\mathbf{R}\rvert = \sqrt{2^2 + (-4)^2} = \sqrt{20}$	M1 A1 f.t.
	$\sqrt{20} = m8\sqrt{5}$	M1 A1 f.t.
	$\Rightarrow m = \frac{1}{4}$	A1 cao (7)
		[14]

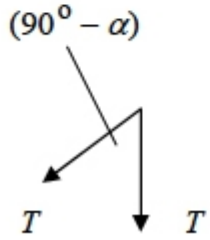
Question 4:

Question Number	Scheme	Marks
(a)		B2 -1 e.e.o.o. (labels not needed) (2)
(b)	$F = \frac{1}{2}R$ $(\uparrow),\ R\cos\alpha + F\sin\alpha = mg$ $R = \dfrac{1.1g}{(\cos\alpha + \frac{1}{2}\sin\alpha)} = 9.8\ \text{N}$ $(\rightarrow),\ P + \frac{1}{2}R\cos\alpha = R\sin\alpha$ $P = R(\sin\alpha - \frac{1}{2}\cos\alpha)$ $= 1.96$	B1 M1 A2 M1 A1 (6) M1 A2 M1 A1 (5) **[13]**

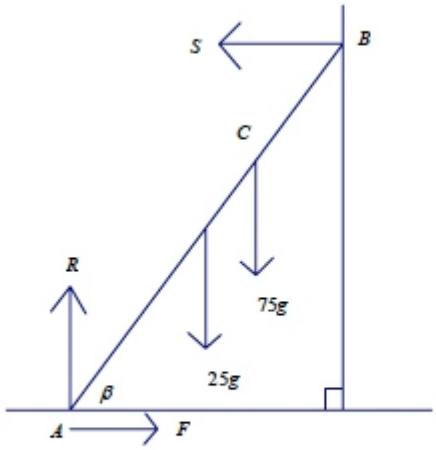
Question 5:

Question Number	Scheme	Marks
(a)		
	$C + D = 120g$	
	$M(Q),\ 80g.0.8 - 40g.0.4 = D.1.6$	M1 A1
	solving	M1 A1
	$C = 90g; D = 30g$	M1 A1 A1 (7)
(b)		
	$2F + F = 40g + 20g + 60g$	M1 A1
	$M(Q),\ 60gx + 20g.0.8 = 40g.0.4 + F.1.6$	
	solving	M1 A1
	$QX = x = \frac{16}{15}\ \text{m} = 1.07\text{m}$	M1 A1 (6) **[13]**

Question 6:

Question Number	Scheme	Marks
(a)	$T - 5g\sin\alpha = 5a$	M1 A1
	$15g - T = 15a$	M1 A1
	solving for a	M1
	$a = 0.6g$	A1
	solving for T	M1
	$T = 6g$	A1 (8)
(b)	For Q : $5g - N = 5a$	M1 A1
	$N = 2g$	A1 f.t. (3)
(c)		
	$F = 2T\cos(\frac{90^\circ - \alpha}{2})$	M1 A2
	$= 12g\cos 26.56..^\circ$	A1 f.t.
	$= 105$ N	A1 (5)
		[16]

Question 7:

(a)	 $R(\uparrow): R = 25g + 75g (= 100g)$ $F = \mu R \Rightarrow F = \frac{11}{25} \times 100g$ $= 44g\ (=431)$	B1 M1 A1 (3)
(b)	M(A): $25g \times 2\cos\beta + 75g \times 2.8\cos\beta$ $= S \times 4\sin\beta$ $R(\leftrightarrow): F = S$ $176g\sin\beta = 260g\cos\beta$ $\beta = 56(°)$	M1 A2,1,0 M1A1 A1 (6)
(c)	So that Reece's weight acts directly at the point C.	B1 **[10]**

Question 8:

(a)	$v = 10t - 2t^2$, $s = \int v dt$ $= 5t^2 - \frac{2t^3}{3} (+C)$ $t = 6 \Rightarrow s = 180 - 144 = \underline{36}$ (m)	M1 A1 A1 (3)
(b)	$\underline{s} = \int v\,dt = \underline{\frac{-432t^{-1}}{-1}} (+K) = \underline{\frac{432}{t}} (+K)$ t = 6, s = "36" $\Rightarrow 36 = \frac{432}{6} + K$ $\Rightarrow K = -36$ At $t = 10$, $s = \frac{432}{10} - 36 = \underline{7.2}$ (m)	<u>B1</u> M1* A1 d*M1 <u>A1</u> (5) **[8]**

Question 9:

Question Number	Scheme	Marks
(a)	Horizontal distance: $57.6 = p \times 3$ $p = 19.2$	M1 A1 (2)
(b)	Use $s = ut + \frac{1}{2}at^2$ for vertical displacement.	M1
	$-0.9 = q \times 3 - \frac{1}{2}g \times 3^2$	A1
	$-0.9 = 3q - \frac{9g}{2} = 3q - 44.1$	
	$q = \frac{43.2}{3} = 14.4$ *AG*	A1 cso (3)
(c)	initial speed $\sqrt{p^2 + 14.4^2}$ (with their p)	M1
	$= \sqrt{576} = \underline{24}$ (m s^{-1})	A1 cao (2)
(d)	$\tan\alpha = \frac{14.4}{p} (= \frac{3}{4})$ (with their p)	B1 (1)
(e)	When the ball is 4 m above ground:	
	$3.1 = ut + \frac{1}{2}at^2$ used	M1
	$3.1 = 14.4t - \frac{1}{2}gt^2$ o.e $(4.9t^2 - 14.4t + 3.1 = 0)$	A1
	$\Rightarrow t = \frac{14.4 \pm \sqrt{(14.4)^2 - 4(4.9)(3.1)}}{2(4.9)}$ seen or implied	M1
	$t = \frac{14.4 \pm \sqrt{146.6}}{9.8} = 0.023389\ldots$ or $2.70488\ldots$ awrt 0.23 and 2.7	A1
	duration = 2.70488... − 0.23389... = 2.47 or 2.5 (seconds)	M1 A1 (6)
or 6 (e)	M1A1M1 as above	
	$t = \frac{14.4 \pm \sqrt{146.6}}{9.8}$	A1
	Duration $2 \times \frac{\sqrt{146.6}}{9.8}$ o.e.	M1
	= 2.47 or 2.5 (seconds)	A1 (6)
(f)	Eg. : Variable 'g', Air resistance, Speed of wind, Swing of ball, The ball is not a particle.	B1 (1) **[15]**