Topic X8 Mechanics (Pre-TT A) [58] MARKSCHEME

1.

(i)	$0 = 50\sin25° \text{ t} - 4.9t^2$	M1		or 0=50sin25° - 9.8t &2t :2x2.16	
		A1			
	t = 4.31 s	A1	3		
(ii)	d = 50cos25° x 4.31	M1		or $u^2\sin(2x25°)/g$	
	195 m	A1√	2	√ 50cos25° x their t	5

2.

(i)(a)	$X = 2\times 8\cos30° - 5\sin40°$ Component is 10.6 N	M1 A1 A1 ft		For resolving 3 forces parallel to the x-axis ft for 4.17 from sin/cos mix only
(i)(b)	$Y = 5\cos40°$ Component is 3.83 N	B1 B1 ft	5	 ft for 3.21 from sin/cos mix only
(ii)	$R^2 = 10.64^2 + 3.83^2$ Magnitude is 11.3 N $\tan\theta = 3.83/10.64$ Direction is 19.8° anticlockwise from +ve x-axis	M1 A1 ft M1 A1 ft	4	For using $R^2 = X^2 + Y^2$ For using $\tan\theta = Y/X$

3.

(i)		$\mathbf{v} = 6t^2\mathbf{i} + (10t-4)\mathbf{j}$ $\mathbf{v} = 2.94\mathbf{i} + 3\mathbf{j}$ $90 - \tan^{-1}\left(\frac{2.94}{3}\right)$ $= 044°$	**B1** **M1** **A1** **[3]**	**1.1** **3.1a** **1.1**	At least one term reduces in power by 1 Substitution of $t = 0.7$, use $\tan^{-1}\left(\frac{y}{x}\right)$ and obtain $90 - 45.578 = 44.4°$ to give a 3 figure bearing	For a complete method to find a bearing
(ii)		$\mathbf{a} = 12\mathbf{i} + 10\mathbf{j}$ $\mathbf{a} = 8.4\mathbf{i} + 10\mathbf{j}$ Use $\mathbf{F} = m\mathbf{a}$ and use Pythagoras Obtain 1.57N	**M1** **A1** **M1** **A1FT** **[4]**	**1.1** **1.1** **3.3** **3.4**	Attempt differentiation of **v** Substitute $t = 0.7$ FT their **a** at $t = 0.7$	
(iii)		$6t^2 = 10t - 4$ $6t^2 - 10t + 4 = 0$ so $t = 1$ or $\frac{2}{3}$ E.g. **i** component always positive so both values are valid	**M1** **E1** **[2]**	**2.2a** **2.3**	Equate **i** and **j** components and solve FT their **v** from part (i) if it leads to a quadratic BC Must include comment on why equating components is sufficient in this case.	

4.

i		"...smooth ring...", "..no friction at ring.."	B1 [1]	If a variety of reasons is offered, "smooth ring" must be the last
ii		Tcosθ +5 = Tcos(90-θ) Tcosθ +5 = Tsinθ .....(a) Tsinθ + Tsin(90-θ) = 7 Tsinθ + Tcosθ = 7 ..... (b)	M1 A1 M1 A1 [4]	"Resolves horiz" equation, needs TCorSθ, 3 terms, 2 of which are T resolved "Resolves vert" equation, needs TCorSθ, 3 terms, 2 of which are T resolved {Allow candidates solving for (iii) to begin in (ii)}
iii		uses (b)+(a) and (b)-(a) for example Tsinθ = 6 or 2Tsinθ = 12, Tcosθ = 1 or 2Tcosθ = 2 $T^2 = 6^2 + 1^{(2)}$ T = 6.08 N Tanθ = 6(/1) θ = 80.5° *OR* (b) gives T=7/(sinθ+cosθ), subs in (a) for example 12cosθ = 2sinθ then mark as 6(iii) below for D*M1 A1 D*M1 A1	M1* A1 D*M1 A1 D*M1 A1 [6] M1* A1	Attempts to solve 2 equations in 2 unknowns Both terms have values correct Accept √37, 6.1 Uses a correct trig identity Accept 81°, 1.4 rad, 1.41 rad Attempts to solve 2 equations in 2 unknowns Correct two term equation in one variable

5.

8(a)	Use of $\mathbf{v} = \mathbf{u} + \mathbf{a}t$: $(10.5\mathbf{i} - 0.9\mathbf{j}) = 0.6\mathbf{j} + 15\mathbf{a}$	M1	3.1b
	$\mathbf{a} = (0.7\mathbf{i} - 0.1\mathbf{j})$ m s^{-2} Given answer	A1	1.1b
		(2)	
(b)	Use of $\mathbf{r} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$	M1	3.1b
	$\mathbf{r} = 0.6\mathbf{j}\,t + \frac{1}{2}(0.7\mathbf{i} - 0.1\mathbf{j})\,t^2$	A1	1.1b
		(2)	
(c)	Equating the **i** and **j** components of **r**	M1	3.1b
	$\frac{1}{2} \leftarrow 0.7\,t^2 = 0.6\,t - \frac{1}{2} \leftarrow 0.1\,t^2$	A1ft	1.1b
	$t = 1.5$	A1	1.1b
		(3)	
(d)	Use of $\mathbf{v} = \mathbf{u} + \mathbf{a}t$: $\mathbf{v} = 0.6\mathbf{j} + (0.7\mathbf{i} - 0.1\mathbf{j})\,t$	M1	3.1b
	Equating the **i** and **j** components of **v**	M1	3.1b
	$t = 0.75$	A1 ft	1.1b
		(3)	
			(10 marks)

6.

5(a)	Using the model and horizontal motion: $s = ut$	M1	3.3
	$12 = T \times 45\cos 10°$	A1	1.1b
	$T = 0.2707..$	A1	1.1b
	Using the model and vertical motion: $s = ut + \frac{1}{2}at^2$	M1	3.4
	$s = 45T\sin 10° + 4.9T^2$	A1	1.1b
	Correct strategy: sub for T and find s	M1	3.1b
	$d = 3.5 - 2.4752 - 1$	M1	3.1b
	$= 2.5$ (cm) (2 SF)	A1	2.2a
		(8)	
(b)	Using the model and vertical motion: $v = u + at$	M1	3.3
	$v = 45\sin 10° + 9.8T$	A1	1.1b
	Speed $= ((45\cos 10°)^2 + v^2)^{0.5}$	M1	3.1b
	46 (m s^{-1}) (2 SF)	A1	1.1b
		(4)	
(c)	Model does not take account of air resistance.	B1	3.5b
	Model does not take account of the size of the tennis ball	B1	3.5b
		(2)	