Topic X8 Mechanics (Post-TT B) [40] MARKSCHEME

1.

(i)		M1		For resolving forces vertically
	15 x 0.28 and 11x 0.8	A1		Allow use of □ = 16.3 and □ =53.1
	Y= 15x0.28 + 11x0.8 - 13	A1ft		Ft cv(15 x 0.28 and 11x 0.8)
	Component is zero AG	A1	4	SR 15sin□ + 11sin□ -13 = 0 gets M1A0A1ftA0
(ii)		M1		For resolving forces horizontally
	X = 15 x 0.96 – 11 x 0.6	A1		Allow use of □ = 16.3 and □ =53.1
	Magnitude is 7.8N	A1	3	Accept 7.79, -7.8
(iii)	Direction is that of the (+ve) x -axis	B1	1	Do not allow horizontal, 90° from vertical. Do not award if □ = 16.3 and □ =53.1 have been used.

2.

(i)	$F = 12\cos 15^\circ$	M1		Resolve horizontally (condone sin)
	Frictional component is 11.6 N	A1	[2]	Accept 12cos 15°
(ii)	$N + 12\sin 15^\circ = 2g$	M1		Resolve vert 3 forces (accept cos)
	Normal component is 16.5 N	A1	[2]	AG
(iii)	$11.591\ldots = \mu\ 16.494\ldots$	M1		For using cv $F = \mu$ cv N
	Coefficient is 0.7(0)	A1ft	[2]	Ft cv F to 2 sf. $\mu = 0.7027\ldots$
(iv)	$N = 2g$	B1		
	$F = 19.6 \times 0.7027\ldots$	M1		
		M1		For using Newton's second law
	$20 - 13.773\ldots = 2a$	A1ft		cv Tractive - cv Friction (e.g. from (i))
	Acceleration is 3.11 ms^{-2}	A1	[5]	Accept either 3.11 or 3.12 only
	MISREAD (omits "horizontal")	MR-1		All A and B marks now ft. Subtract "MR-1" <u>from initial B1 or final A1 (not A1ft in main scheme).</u>
	$N = 2g$ - 20sin15	B1ft		
	$F = 0.7027$ x 14.4	M1		Equals 14.42...
		M1		Equals 10.1....
	$20\cos 15 - 10.14 = 2a$	A1ft		For using Newton's second law
	Acceleration is 4.59 ms^{-2}	A1ft	[4]	cv Tractive - cv Friction Accept 4.59, 4.6(0)

3.

Uses correct forces to form a moment equation **(PI)**	AO1.1a	M1	Take moments about C: $Mg \times 0.8 = 0.7 \times 24$
Obtains correct value	AO1.1b	A1	$M = 21$
Total		**2**	

4.

6 ia	Perp = 10cos20 (= 9.3967 or 9.4) // = 10sin20 (= 3.4202)	B1 B1 [2]	Includes g, MR -1 in part (i). Accept –ve values.
b	μ = 10sin20/10cos20 = tan20 (= 3.42/9.4) μ = 0.364 (0.36397..) AG	M1 A1 [2]	Must use $\|F\| = \mu\|R\|$ Accept after inclusion of g twice
ii	*No misread, and resolving of 10 and T required* $R = 10\cos 20 + T\cos 45$ $F = T\cos 45 - 10\sin 20$ or $T\cos 45 = \mu R + 10\sin 20$ $T\cos 45 - 3.42 = 0.364(9.4 + T\cos 45)$ $0.707T - 3.42 = 3.42 + 0.257T$ $0.45T = 6.84$ T = 15.2 N (15.209..)	M1* A1 M1* A1 D*M1 A1 A1 [7]	3 term equation perp plane, 2 unknowns $9.4 + 0.707T$ (accept $9.4+.71T$) 3 term equation // plane, 2 unknowns $0.707T - 3.42$ (accept $0.71T - 3.4$) Substitutes for F and R in $F=0.364R$ *Award final A1 only for T = 149 N after using 10g for weight*

5.

(a)	Obtains correct horizontal component of the initial velocity	AO1.1b	B1	$2.5U = 40$ $U = 16$
	Forms equation to find vertical component of initial velocity	AO3.3	M1	$-10 = 2.5V - 0.5\times 9.81\times 2.5^2$
	Obtains correct vertical component of initial velocity	AO1.1b	A1	$V = 8.2625$
	Forms equation for vertical component of velocity at height 3 using 'their' derived values for U and V	AO3.4	M1	$v_y^2 = 8.2625^2 + 2\times(-9.81)\times 3$
	Obtains correct component of velocity	AO1.1b	A1	$v_y = 3.067\ldots$
	Correct final speed with units, correct for 'their' U and v_y FT applies only if both M1 marks have been awarded	AO3.2a	A1F	$v = \sqrt{16^2 + 3.067^2} = 16.3\,\text{m s}^{-1}$

(b)	States 'their' value of horizontal component of the initial velocity from part **(a)**	AO3.4	A1F	16 m s^{-1}
(c)	Explains that horizontal velocity has been assumed to be constant in their model and that this is not likely to be true, with valid reasoning	AO3.5b	E1	It was assumed that there were no resistance forces acting on the ball which is unlikely to be true in reality. The horizontal speed of the ball is likely to vary… air resistance would slow the ball down, wind might speed the ball up
	Total		**8**	