

Topic X3 Mechanics AS (Post-TT B) [45] MARKSCHEME

1.

(i)	$WD = \frac{1}{2} \times 250 \times 150^2 - \frac{1}{2} \times 250 \times 100^2$	M1		
	1 560 000	A1		1 562 500
	$450\,000 = 1\,560\,000/t$	M1		
	3.47	A1	4	
(ii)	$F = 450\,000/120$	M1		
	3750	A1		
	$3750 = 250a$	M1		
	15 ms^{-2}	A1	4	8

2.

(i)	$T \cos \theta = 0.01 \times 9.8$	M1		resolving vertically	
	$8/10T = 0.01 \times 9.8$	A1		with $\cos \theta = 8/10$	
	$T = 0.1225\text{ N}$	A1	3	AG	
(ii)	$T + T \sin \theta = ma$	M1		resolving horizontally	
	use of $m r \omega^2$	M1			
	$\omega = 5.72\text{ rads}^{-1}$	A1	3		
(iii)	$K.E. = \frac{1}{2} \times 0.01 \times (r\omega)^2$	M1		$\frac{1}{2}mv^2$ with $v=r\omega$	
	$K.E. = 0.0588$	A1✓	2	✓0.0018 x their ω^2	8

3.

(i)a	100 J	B1	1		
b	7500 Nm	B1	1		
(ii)	$400 \cos \alpha \times 25 = 7500 + 100$	M1		sc N II gets M1A1 only. This M1 for total M ($a=0.08$)&A1 for α or 0.707 rads	
	✓ for $a + b$	A1✓			
	$\alpha = 40.5$	A1	3		5

4.

(i)	$F = 300/12$	M1			
	$R = 25$	A1	2		
(ii)	$P = 17.5 \times 12$ ($R_2 = 17.5$ & $F_2 = 17.5$)	M1		n.b. B1 only for 210 W without working	
	$P = 210\text{ W}$	A1	2		
(iii)	$500 = F \times 12$	M1			
	$F = 41.67$ or $500/12$ aef	A1			
	$41.67 - 25 - 75 \times 9.8 \sin 10^\circ = 75a$	M1			
		A1			
	0.0512 ms^{-2}	A1	5	or 0.051	
(iv)	$PE = 75 \times 9.8 \times 200 \sin 10^\circ$ (25530)	B1		OR $75 \times 9.8 \sin 10^\circ \cdot 120 = 75a$ (M1 + A1) $a = 0.102$ (A1) $v^2 = 169 + 2 \times 0.102 \times 200$ (M1) $v = 14.5$	
	$WD = 200 \times 120$ (24000)	B1			
	$\frac{1}{2} \cdot 75v^2 =$	M1			
	$\frac{1}{2} \cdot 75 \cdot 13^2 + 75 \times 9.8 \times 200 \sin 10^\circ - 200 \cdot 120$	A1			
	14.5 ms^{-1}	A1	5		14

5.

(i)	Loss in PE = $mg(0.5\sin\theta)$ $[\frac{1}{2}mv^2 - \frac{1}{2}m3^2 = mg(0.5\sin\theta)]$ $v^2 = 9 + 9.8\sin\theta$	B1 M1 A1 [3]	For using KE gain = PE loss (3 terms required) AG
(ii)	$a_r = 18 + 19.6\sin\theta$ $[ma_t = mg \cos\theta]$ $a_t = 9.8\cos\theta$	B1 M1 A1 [3]	Using $a_r = v^2/0.5$ For using Newton's second law tangentially
(iii)	$[T - mg \sin\theta = ma_r]$ $T - 1.96\sin\theta = 0.2(18 + 19.6\sin\theta)$ $T = 3.6 + 5.88\sin\theta$ $\theta = 3.8$	M1 A1 A1 B1 [4]	For using Newton's second law radially (3 terms required) AG