

Topic X9 Mechanics (Pre-TT B) [52] MARKSCHEME

1.

4 i	$2 - F = 0.8x0.2$ $F = T\cos 10$ $T = 1.87 \text{ N}$ OR $2 - T\cos 10 = 0.8x0.2$ $T = 1.87 \text{ N}$	M1 M1 A1 [3] M1 M1 A1	N2L 2 force terms and ma ($F = 1.84 \text{ N}$) $F = T\cos 10$ 1.8683.. N2L 2 force terms and ma $T\cos 10$	m is the block mass, award if T not F
ii	$R - 0.3x9.8 + T\cos 10 = 0$ $R = 0.3x9.8 - 1.87\sin 10$ $R = 2.62$ $T\cos 10 - Fr = 0.3x0.2$ $Fr = 1.78$ $\mu = 1.78 / 2.62$ OR $1.78 = 2.62\mu$ $\mu = 0.68$	M1 A1ft A1ft M1 A1ft M1 A1 [7]	3 term equation, vertically $cv(T(i))$ 2.61(5..) seen or implied N2L 2 forces for P, component of T $cv(T(i))$ seen or implied both terms same sign	Treat as a mis-read $R - 0.8x9.8 - T\cos 10 = 0$ leading to $R = 8.16$ (i.e. works on block[2/3]) OR N2L 2 forces for P+Q: $2 - Fr = (0.8+0.3)x0.2$ R, Fr unequal to T From correct value of $T = 1.87$ only

2.

(i)	$R = 0.5g\cos 40^\circ$ $F = 0.6 \times 0.5g\cos 40^\circ$ Magnitude is 2.25N AG	B1 M1 A1	3	$R = 3.7536$ For using $F = \mu R$
(ii)	$-/+0.5g\sin 40^\circ - F = 0.5a$ (a) Acceleration is 10.8ms^{-2} (b) Acceleration is 1.79ms^{-2}	M1 A1 A1 A1	4	For applying Newton's second law (either case) //slope, two forces Either case Accept 10.8 from correct working (both forces have the same sign) Accept -1.79 from correct working (the forces have opposite sign) Accept ! 1.8(0)
(iii)a)	$0 = 4 + (-10.8)T_1$ $T_1 = 0.370(3)$	M1 A1		Requires appropriate sign Accept 0.37
b)	$0 = 4^2 + 2(-10.8)s$ or $s = (0 + 4) \times 0.37/2$ or $s = 4(0.370) + \frac{1}{2}(-10.8)(0.370)^2$	M1 A1 ft		For complete method of finding distance from A to highest point using a(up) with appropriate sign ft a(up) and/or T_1 ($s = 0.7405$)
	$0.7405 = \frac{1}{2}(1.79)T_2^2$ $0.370 + 0.908$ $= 1.28s$	M1 A1ft M1 A1	8	For method of finding time taken from highest point to A and not using a(up) ft a(down) and $cv(0.7405)$ ($T_2 = 0.908$ approx) Using $T = T_1 + T_2$ with different values for T_1, T_2 3 significant figures cao

3.

7 i	$F_r = 4 + 5\sin 60$ $F_r = 8.33$ $R = 12 - 5\cos 60$ $R = 9.5$ $\mu = (4 + 5\sin 60)/(12 - 5\cos 60)$ $\mu = 0.877$	M1 A1 M1 A1 M1 A1 [6]	All 4 + component 5 ($4 + 4.333(01)$) May be implied +/- (All 12 – component 5 ($12 - 2.5$)) May be implied, +ve from correct work Friction/Reaction, $F_r > 4$, $R < 12$, both positive
ii	Upper block $\mu = 5\sin 60/(9 - 5\cos 60)$ (=4.3/6.5) $\mu = 0.666$	M1 A1 [2]	(Component 5)/(9-component 5)
iii	Upper mass = $9/g$ $(9/g)a = 5\sin 60 - 0.1(9 - 5\cos 60)$ $a = 4.01$ Lower mass Tractive force = $4 + 0.1(9 - 5\cos 60)$ (= 4.65) Max Friction = $0.877(3 + (9 - 5\cos 60))$ (= 8.33) Tractive force < Max Friction $a = 0$ <i>OR for Lower Mass</i> $ma = 4 + 0.1(9 - 5\cos 60) - 0.877(3 + 9 - 5\cos 60)$ -ve a caused by friction impossible, hence $a = 0$	B1 M1 A1 M1 A1 A1 [6] M1 A1 A1	0.918(36..) N2L $0.918(36..)a = 4.33(01..) - 0.1 \times 6.5$ where friction = $0.1 \times (9 - \text{component } 5)$ Compares TF (tractive force) and max friction N2L with 3 force terms:

4.

9(a)	Take moments about A (or any other complete method to produce an equation in S , W and α only)	M1	3.3
	$W \cos \alpha + 7W \cos \alpha = S 2 \sin \alpha$	A1 A1	1.1b 1.1b
	Use of $\tan \alpha = \frac{5}{2}$ to obtain S	M1	2.1
	$S = 3W$ *	A1*	2.2a
		(5)	
(b)	$R = 8W$	B1	3.4
	$F = \frac{1}{4} R (= 2W)$	M1	3.4
	$P_{\text{MAX}} = 3W + F$ or $P_{\text{MIN}} = 3W - F$	M1	3.4
	$P_{\text{MAX}} = 5W$ or $P_{\text{MIN}} = W$	A1	1.1b
	$W \leq P \leq 5W$	A1	2.5
	(5)		
(c)	$M(A)$ shows that the reaction on the ladder at B is unchanged	M1	2.4
	also R increases (resolving vertically)	M1	2.4
	which increases max F available	M1	2.4
		(3)	
(13 marks)			