Topic X8 Mechanics (Pre-TT B) [52] MARKSCHEME

1.

4 i	2 – F = 0.8x0.2 F = Tcos10 T = 1.87 N OR 2 – Tcos10 = 0.8x0.2 T = 1.87 N	M1 M1 A1 [3] M1 M1 A1	N2L 2 force terms and ma (F = 1.84 N) F = TCorS10 1.8683.. N2L 2 force terms and ma TCorS10	m is the block mass, award if T not F
ii	R - 0.3x9.8 + TCorS10 = 0 R = 0.3x9.8 – 1.87sin10 R = 2.62 Tcos10 – Fr = 0.3x0.2 Fr = 1.78 μ = 1.78 / 2.62 OR 1.78 = 2.62 μ μ = 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-TCorS10 = 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)	$R = 0.5g\cos 40°$	B1		$R = 3.7536$
	$F = 0.6 \times 0.5g\cos 40°$	M1		For using $F = \mu R$
	Magnitude is 2.25N AG	A1	3	
(ii)		M1		For applying Newton's second law (either case) //slope, two forces
	$-/+0.5g\sin 40° - F = 0.5a$	A1		Either case
	(a) Acceleration is – $10.8ms^{-2}$	A1		Accept 10.8 from correct working (both forces have the same sign)
	(b) Acceleration is $1.79ms^{-2}$	A1	4	Accept -1.79 from correct working (the forces have opposite sign) Accept ! 1.8(0)
(iii)a)	$0 = 4 + (-10.8)T_1$	M1		Requires appropriate sign
	$T_1 = 0.370(3)$	A1		Accept 0.37
b)		M1		For complete method of finding distance from A to highest point using a(up) with appropriate sign
	$0 = 4^2 + 2(-10.8)s$ or $s = (0 + 4) \times 0.37/2$ or $s = 4(0.370) + ½ (-10.8)(0.370)^2$	A1 ft		ft a(up) and/or T_1 ($s = 0.7405$)
		M1		For method of finding time taken from highest point to A and not using a(up)
	$0.7405 = ½ (1.79)T_2^2$	A1ft		ft a(down) and cv(0.7405) ($T_2 = 0.908$ approx)
	$0.370 + 0.908$ $= 1.28s$	M1 A1	8	Using $T = T_1 + T_2$ with different values for T_1 ,T_2 3 significant figures cao

3.

7 i	Fr = 4 + 5sin60 Fr = 8.33 R = 12 - 5cos60 R = 9.5 μ = (4 + 5sin60)/(12 - 5cos60) μ = 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, Fr>4, R<12, both positive
ii	Upper block μ = 5sin60/(9-5cos60) (=4.3/6.5) μ = 0.666	 M1 A1 [2]	 (Component 5)/(9-component 5)
iii	Upper mass = 9/g (9/g)a = 5sin60 - 0.1(9 - 5cos60) a = 4.01 Lower mass Tractive force = 4 + 0.1(9-5cos60) (= 4.65) Max Friction = 0.877(3+(9-5cos60) (= 8.33) Tractive force < Max Friction a = 0 *OR for Lower Mass* ma = 4+0.1(9-5cos60)-0.877(3+9-5cos60) -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..) – 0.1x6.5 where friction = 0.1x(9-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
	$Wa\cos\alpha + 7W2a\cos\alpha = S\,2a\sin\alpha$	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
	$P_{MAX} = 3W + F$ or $P_{MIN} = 3W - F$	M1	3.4
	$P_{MAX} = 5W$ or $P_{MIN} = W$	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)