OCR
RECOGNISING ACHIEVEMENT

GCE

Mathematics

Advanced Subsidiary GCE

Unit **4728:** Mechanics 1

Mark Scheme for January 2011

Oxford Cambridge and RSA Examinations

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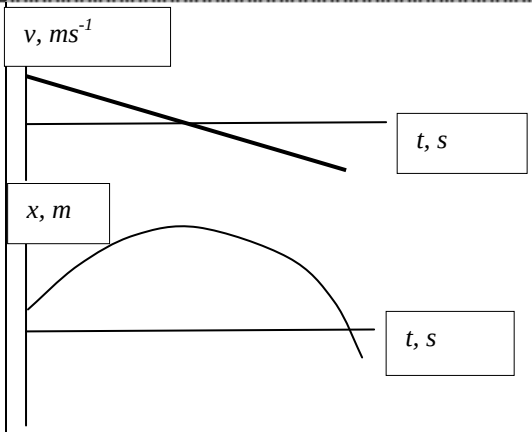
1 i	ΔMom P = 0.5(2.4 + 0.2) ΔMom P = +/-1.3 kgms^{-1}	M1 A1 [2]	+/- 0.5(2.4 ± 0.2)	MR P/Q +/-0.8(1.5+/-0.2) M1A0
ii	Momentum before = 0.5x2.4 – 0.8x1.5 0.5x2.4+/ – 0.8x1.5 = +/-(-0.5x0.2 +/- 0.8v) Speed = 0.125 ms^{-1} OR ΔMom Q =+/- (+/-0.8v – 0.8x1.5) 1.3 = +/-(0.8v – 0.8x1.5) Speed = 0.125 ms^{-1}	B1 M1 A1ft A1 [4] B1 M1 A1ft A1	+/-(0.5x2.4 – 0.8x1.5) Uses mom before = mom after Cv(Expression for before momentum) 1/8, +ve (not 0.13) Uses ΔMom P = ΔMom Q Cv(ans(i)) = +/-(+/-0.8v – 0.8x1.5) 1/8, +ve (not 0.13)	Cont MR 0.5x2.4-0.8x1.5 Uses mom before = mom after 0.5x2.4+/-0.8x1.5 = +/-(0.8x0.2+/-0.5v) 0.32 B1 M1A1A1 ft

2 i	10CorSα = 8 10cosα = 8 α = 36.9° OR 10CorSα = F 10sinα = 6 α = 36.9° OR tanθ = F/8 tanα = 6/8 α = 36.9°	M1 A1 A1 [3] M1 A1ft A1 M1 A1ft A1	Component of 10 = 8 Accept 37 36.8 and 37 from 36.7 Using value of F(ii) Using F(=6) from (ii) OR tanθ = 8/F, using value of F from (ii)	CorS is Cos or Sin (passim) Do not accept 36.7
ii	 F = 10sin36.9 F = 6 N OR F^2 +8^2 = 10^2 F = 6 N	M1 A1ft A1 [3] M1 A1 A1	F = 10CorSα Allow 10Cos53.1 Accept 6.01 (or from 10Cos53.1) or 6.0 Pythagoras, 3 squared terms	 anything rounding to 6.0 from correct working. Accept F^2 = 8^2+ 10^2

3 i	$v^2 = (+/-5)^2 + 2x9.8x2.5$ Speed (or v) = 8.6(0) ms^{-1} OR $0 = 5^2 – 2x9.8xs$ with $v^2 = (0) +2x9.8(s+2.5)$ $v^2 = 2x9.8x(2.5+1.28)$ Speed = 8.6(0) ms^{-1}	M1 A1 A1 [3] M1 A1 A1	Uses $v^2 = u^2 \pm 2gs$, u non-zero Accept √74 Do not accept -8.6(0) s = 1.2755... 19.8x3.7755.. Or rounds to 8.6	It is common to see the upwards and downwards motion treated separately. Both parts must be attempted for M1, and both parts must be attempted accurately with cvs for the A1
ii	8.6 = -5 + 9.8t Time = 1.39 s OR $9.8t^2 - 10t - 5 = 0$ Time = 1.39 s OR 2.5 = (8.6-5)t/2 Time = 1.39 s OR t = 5/9.8 + 8.6/9.8 Time = 1.39	M1 A1ft A1 [3] M1 A1 A1 M1 A1ft A1 M1 A1ft A1	Uses v(from (i)) = +/-5 +/- 9.8t Cv(8.60 from (i)) +/-2.5 = 5t +/- $gt^2/2$ 2.5 = +/- (5 - Speed from (i)) x t / 2 Cv(8.60 from (i)) Times to top and ground found and added Cv(8.60 from (i))	It is common to see the upwards and downwards motion treated separately. Both parts must be attempted for M1, and both parts must be attempted accurately with cvs for the A1
iii a) b)		B1 B1 B1 B1 [4]	Straight descending line to t axis Continues straight below t axis Inverted “parabolic” curve, starts anywhere on t=0 Ends below t = 0 level, need not be below t axis	Ignore values written on diagrams

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

5 ia	 s(P) = 4.9T + 0.5x 4.9T^2 y(Q) = (0) + 0.5x9.8T^2	M1 A1 A1 [3]	s=ut+0.5at^2 used along plane or vertically, with u = 4.9 or 0, and a = 4.9 or 9.8 appropriately Accept use of t or T Allow g in Y(Q)	
b	(m)x4.9 = (m)gsinθ θ = 30	M1* A1 [2]	Allow CorSθ	Sinθ =(0.5x9.8T^2)/(4.9T + 0.5x 4.9T^2) gets M1, but in ic. Beware circular argument.
c	y(Q)/s(P) = sinθ OR y(Q) = s(P) sinθ 0.5x9.8$(2/3)^2$ / (4.9x2/3 + 2.45$(2/3)^2$ = 0.5 OR 0.5x9.8T^2 / (4.9T + 2.45T^2) = sin30 T= 2/3 s AG	M1 D*M1 A1 [3]	Uses appropriate trigonometry to relate distances Verification needs explicit value of sin(cv(θib)) Ratio of distances considered using cv (30)	This may appear in b) 0.5x9.8$(2/3)^2$ = (4.9x2/3 + 2.45$(2/3)^2$ x 0.5 OR 0.5x9.8T^2 = (4.9T + 2.45T^2) x sin30
ii	v = 4.9 + 4.9x2/3 OR v = (0) + 9.8x2/3 v = 8.17 ms^{-1} w = 9.8x2/3 = 6.53 ms^{-1}	M1 A1 A1 [3]	Uses v = u + at, with appropriate u, a values once 8.2 6.5	

6 i	$x = \int t^2 - 9\ dt$ $x = t^3/3 - 9t\ (+c)$ Finds x(2) Displacement = 15⅓ m OR $x(2) = [t^3/3 - 9t]_0^2$ Displacement = 15⅓ m	M1* A1 D*M1 B1 [4] D*M1 B1	Uses integration of v(t) Award if +c omitted Allow + c or c omitted Accept 15.3, 46/3. Must be +ve Uses limits$[]_0^2$ on integrated x(t) Must be +ve	 Awarded if c omitted or assumed 0
ii	t=0 s=0 or s=46/3 hence x(0) or c= 0 or 46/3 Solves $t^2 - 9 = 0$ $t = (\pm)3$ $x(3) = 3^3/3 - 9x3\ (+ 15.3)$ x(3) = -18 (or -2.67) Dist = 18 m	B1* M1* A1 D*M1 M1 D*B1 [6]	Needs explanation, may be seen in part i May be implied Value of t when direction of motion changes Substitutes cv(t) >2 in integrated x(t) Evaluates c – 18 may be implied award if .. Accept 18(.0) [c=0 assumed]	B1* awarded if limits 0 and 3 used correctly Awarded if limits used correctly
iii	$a = d(t^2 - 9)/dt$ a = 2t 10 = 2t t = 5 $x(5)\ (= 5^3/3 - 9x5 + 15.3) = 12$ m OR $[t^3/3 - 9t]_2^5 = 12$ m	M1* A1 D*M1 A1 A1 [5] A1	Uses differentiation of v(t)	

7	Wt cmpts: // plane 0.6gsin30	B1	+/-2.94	
i	Perp plane 0.6gcos30	B1	+/-5.09(22.) = R	
		M1	N2L // plane, 2 force terms and ma (allow no g)	
	0.6gsin30 +/- X = 0.6x10	A1ft	Both weight cmpt and accn signs same	Accept Fr for X
	X = +/-3.06	A1	May be implied (Fr =0.6x10-0.6gsin30 used)	
	μ = 3.06 / 5.09(22..)	M1	Uses μ = Fr/R both terms same sign	Accept Fr = |X|
	μ = 0.601	A1	0.6	
	OR		[7]	
	3.06 = μ x 5.09(22..)	M1	Uses Fr = μR both terms same sign	Accept Fr = |X|
	μ = 0.601	A1	0.6	
ii	$C^2 = 3.06^2 + 5.09^2$	M1	Pythagoras with Fr and R, to find hypotenuse	
a)	C = 5.94 N	A1	Accept 5.9, 5.95 but not 6(.0)	
	$\tan\theta$ = 3.06/5.09(22..)	M1*	Or $\tan\theta = \mu$	
	Angle = (31) + 90	D*M1		
	Angle = 121°	A1	Not 120	
	OR		[5]	
	$\tan\varphi$ = 5.09(22..)/3.06	M1*	$\tan\varphi = 1/\mu$	
	Angle = 180 – (59)	D*M1		
	Angle = 121°	A1	Not 120	
b)	C (= 0.6x9.8) = 5.88 N	B1	5.9	No working needed as C is vertical
	Angle = 60°	B1		No working needed as C is vertical
		[2]		

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