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RECOGNISING ACHIEVEMENT

GCE

Mathematics

Advanced Subsidiary GCE **4728**

Mechanics 1

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
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1 i	t = 5/1.2 t = 4.17 s	M1 A1 [2]	5=1.2t or 0=5-1.2t 4 1/6 s, 4.166 or better, 4.16 recurring.
ii	s = $(-5)^2$/2x1.2 s = 10.4 m *OR (using(i))* s = 5x4.17 – 1.2x4.17^2/2 s = 10.4 m *OR (using(i))* s = (5 (+ 0))/2 x 4.17 s = 10.4 m	M1 A1 [2] M1 A1 M1 A1	s = 5^2/2x1.2 or 5^2 = 2x1.2s or 0 = 5^2 - 2x1.2s Accept 10 5/12, but not 10 Time must be > 0. Accept |t| from (i) Award if |-4.17| used.
iii	Fr = 3x1.2 R = 3x9.8 μ = (3x)1.2/(3x)9.8 μ = 0.122 *OR* R = 3x9.8 Mass x acceleration = +/- 3x1.2 +/-μ x29.4 = +/- 3x1.2 μ = 0.122	B1 B1 M1 A1 [4] B1 B1 M1 A1	Accept 3.6, +/- Accept 3g, +/- Ratio of 2 positive numerical force terms Not 0.12 Accept 3g, +/- Either both positive or both negative.

2 i	+/-(0.4x3 - 0.6x1.5) +/-(0.4x0.1 + 0.6v) (0.4x3 - 0.6x1.5) = +/-(0.4x0.1 + 0.6v) speed |v| = 0.433 ms^{-1} *OR* +/- (0.4x3 – 0.4x0.1) = +/- 1.16 (0.6v + 0.6x1.5) = 0.6v + 0.9 1.16 = +/-(0.6v + 0.9) speed |v| = 0.433 ms^{-1}	B1 B1 M1 A1 [4] B1 B1 M1 A1	+/- 0.3 Nb the terms have same signs Equating their total mom before & after Accept 13/30 or 0.43 recurring, but not 0.43 Momentum change of P Momentum change of Q Equating momentum changes 0.26/0.6 = v
ii	+/-(0.4x0.1 - 0.6v) (0.4x3 - 0.6x1.5) = +/-(0.6v - 0.4x0.1) v = 0.567 PQ = 0.1x3 +0.567x3 PQ = 2 m *OR* +/- 0.4x3 + 0.4x0.1 and +/- 0.6v + 0.6x1.5 1.24 = +/- 0.6v + 0.9 v = 0.567 etc	B1 M1 A1 M1 A1 [5] B1 M1 A1	Nb the terms have different signs Must use +/- same before momentum as in (i) May be implied, or in any format (0.1 + 0.567)x3 Accept 2.00(1), 2.0, 2.00 Both must be correct Equating change in momentum May be implied, or in any format

3 i	H = +/-(9 - 5cos60) H = 6.5 N AG	M1 A1 [2]	+/-(9 + 5cos120)
ii	V = +/-(12 - 5sin60) V = 7.67 N	M1 A1 [2]	+/-(12 + 5cos150) Accept 7.666 or better, or 7.6 recurring
iii	$R^2 = 6.5^2 + 7.67^2$ R = 10.1 N tan A = 6.5/7.67 or 7.67/6.5 A = 40(.3) or 49.7 Bearing = 320°	M1 A1 M1 A1 A1 [5]	Uses Pythagoras on forces V(ii) and 6.5 10.053.. Uses trigonometry in relevant triangle May be implied by final answer As this is not a final answer, exact accuracy is not an issue Or better

4 i	$3.2 - 0.2t^2 = 0$ $t = 4$ s	M1 A1 [2]	Puts 0 for v and attempts to solve QE Accept dual solution +/-4
ii	$a = -2x0.2t$ $a = -0.4x4$ $a = -1.6$ ms^{-2}	M1* D*M1 A1 [3]	Differentiates v Substitutes +ve t(i) in derivative of v Negative only
iii	$s= 3.2t - 0.2t^3/3$ (+c) $t = 0$, $s = 0$ so $c = 0$ $s(4) = 3.2x4 -0.2x4^3/3$ $s = 8.53$ m	M1* A1 B1 D*M1 A1 [5]	Integrates v, not multiplication by t Or correct use of limits 0 and 4 Accept without/loss of c 8 8/15 Accept with/without c

5 i	+/-3x20/2 30 m	M1 A1 [2]	Use area of <u>scalene</u> triangle(s). Not suvat. Accept -30
ii	$(t+4)x3/2 = 30$ or $3t/2 = 30 - 4x3$ $t = 16$ or $t = 12$ $T = 76$	M1 A1 A1 A1 [4]	Equates <u>scalene</u> trapezium area to distance (i) [(T-60)+4]x3/2 =30, award A2
iii	T(accn) = 3/0.4 (=7.5 s) decn = 3/([76-60] - 4 - 7.5) decn = (+/-) 2/3 ms^{-2} *OR* S(accn) = 3^2/(2x0.4) (= 11.25 m) decn = 3^2 / [2x(30 – 3x4 – 11.25)] decn = (+/-) 2/3 ms^{-2}	B1 M1 A1 [3] B1 M1 A1	 Or 3 = decn x ([76-60] - 4 - 7.5) (+/-) 0.667 or better - accept 0.6 recurring (+/-) 0.667 or better - accept 0.6 recurring

6 i a	T - 0.85g sin30 = 0.85a 0.55g - T = 0.55a a = 1.225/1.4 a = 0.875 T = 4.91	B1 B1 M1 A1 A1 [5]	Either equation correct Both eqns correct and consistent ‘a’ direction Solves 2 sim eqn 4.908 or better – has to be positive
b	F = 2Tcos30 F = 8.5(02..)	M1 A1ft [2]	Or Pythagoras or cosine rule cv(4.91)x√3
ii	$v^2 = 1.3^2 + 2x0.875x1.5$ (=4.315) $a = +/-g\sin30$ $0 = 4.315 -2x4.9s$ (s = 0.44…) S = 1.94	M1 A1ft B1 M1 A1 A1 [6]	Uses $v^2 = u^2 + 2a(1.5)$, u non-zero, a from (i) v = 2.077....(v^2 =1.69+3xcv(0.875)) a = +/-4.9 Uses $0^2 = u^2 +/-2as$, with a not g or (i), u not1.3 May be implied – need not be 3sf

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:

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
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