WJEC
CBAC

GCE MARKING SCHEME

MATHEMATICS

AS/Advanced

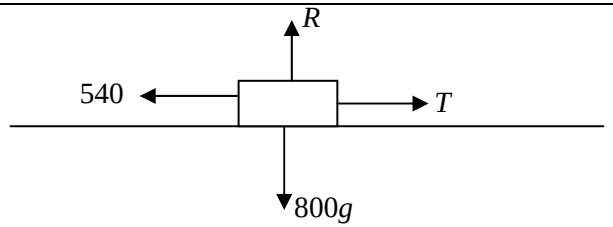
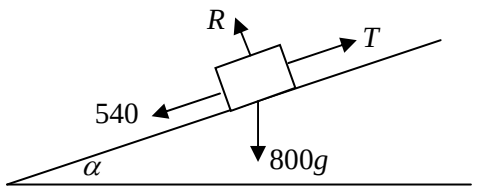
SUMMER 2011

M2

Question	Solution	Mark	Notes
1(a)	$a = \frac{dv}{dt}$ $a = 36\cos 3t + 16\sin 2t$	M1 A1A1	sin to cos, t retained one mark for each correct term
1(b)	$x = \int 12\sin 3t - 8\cos 2t \quad dt$ $x = -4\cos 3t - 4\sin 2t + (C)$ $t = 0, x = 0$ $0 = -4 + C$ $C = 4$	M1 A1A1 m1 A1	sin to cos, t retained one mark for each correct term use of initial conditions ft one error only

Question	Solution	Mark	Notes
2(a)	Speed $= v = r\omega$ $v = 0.6 \times 5$ $v = \underline{3\ (ms^{-1})}$	M1 A1	use of correct formula, oe
2(b)	tension in string $= m \times$ acceleration towards centre $T = mr\omega^2$ $T = 0.5 \times 0.6 \times 5^2$ $T = \underline{7.5\ (N)}$	M1 A1	use of formula ft v

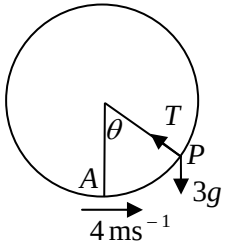
Question	Solution	Mark	Notes
3(a)	Attempt to differentiate v to find the acceleration $\mathbf{a} = 6\mathbf{j} + 12t^2\mathbf{k}$ $\mathbf{F} = 12\mathbf{j} + 24t^2\mathbf{k}$	M1 A1 A1	powers of t decreased once. vector ft **a**
3(b)	When t = 1, $\mathbf{v} = 2\mathbf{i} + 6\mathbf{j} + 4\mathbf{k}$ and $\mathbf{F} = 12\mathbf{j} + 24\mathbf{k}$ $\mathbf{F.v} = (2 \times 0) + (6 \times 12) + (4 \times 24)$ $\mathbf{F.v} = \underline{168}$ Units: watts	M1 M1 A1 B1	use ot t=1 in **v,F** or **v.F** correct method for dot product ft **F, v**

Question	Solution	Mark	Notes
4(a)			
	Constant speed $a = 0$	M1	si
	$T = 540$	A1	
	Power $P = T \times 60$	M1	any equivalent statement,T horizontal
	Power = <u>32400 (W)</u> = <u>32.4 (kW)</u>	A1	
4(b)			
	$T = 32.4 \times 1000 \div 15 = (2160)$	M1	use of P/v
	N2L	M1	dim correct 4 terms
	$T - F - 800g\sin\alpha = 800a$	A2	-1 mark for each error
	$a =$ <u>1.4125 (ms^{-2})</u>	A1	cao, allow+/-

Question	Solution	Mark	Notes
5(a)	Hooke's Law $T = \frac{80\times 0\cdot 4}{1\cdot 6}$	M1	use of correct formula with at least 2 correct values
	T = <u>20 (N)</u>	A1	
5(b)	Using ceiling as zero potential energy		
	Initial energy = $-4 \times 9.8 \times 0.5$	M1	any correct use of potential energy
	= -19.6 (J)	A1	correct value of PE, h=0.5/2/1.5
	Energy when string is 2m = $-4 \times 9.8 \times 2 + 0.5 \times 4v^2 + \frac{1}{2}\times 80 \times \frac{0\cdot 4^2}{1\cdot 6}$	M1	Use of EE formula with 80, 1.6
		A1	correct EE
		B1	correct KE
	$2v^2 - 74.4 = -19.6$	M1	Energy equation with 3 types
	v = <u>5.23 (ms^{-1})</u>	A1	Correct equation, any form
		A1	accept answers rounding to 5.23 cao
	<u>Alternative</u>		
	$\frac{1}{2}\times 4\times v^2 + \frac{80\times 0\cdot 4^2}{2\times 1\cdot 6} = 4\times 9.8\times 1.5$	B1	KE
		M1A1	EE
		M1A1	PE
	$2v^2 + 4 = 58.8$	M1A1	correct equation
	$v^2 = 27.4$		
	v = <u>5.23 (ms^{-1})</u>	A1	cao

Question	Solution	Mark	Notes
6(a)	Initial vertical velocity = $6.5\sin\alpha$ = (2.5)	B1	si
	Using $s = ut + 0.5 \times 9.8 \times t^2$ with s = -100, u = 2.5, a = -9.8	M1	allow +ve values, ft 2.5(c)
	$-100 = 2.5t - 4.9t^2$	A1	
	$4.9t^2 - 2.5t - 100 = 0$	m1	attempt to solve by quadratic formula
	t = <u>4.78 (s)</u>	A1	accept unrounded values, cao
6(b)	Initial horizontal velocity = $6.5\cos\alpha$ = (6)	B1	
	Required distance = 6×4.78		
	= <u>28.68</u>	B1	ft t and 2.5
6(c)	Using $v^2 = u^2 + 2as$ with u = 2.5, s = -100, a = -9.8	M1	oe. Accept +100,9.8. ft 6
	$v^2 = 2.5^2 + 2 \times (-9.8) \times (-100)$	A1	ft t if appropriate
	$v = \pm 44.34$	A1	ft t if appropriate
	Required speed = $\sqrt{6^2 + 44 \cdot 34^2}$	M1	
	= <u>44.7465</u>	A1	ft candidate's velocities
	$\theta = \tan^{-1}\left(\frac{44 \cdot 34}{6}\right)$	M1	
	θ = <u>82.29°</u>	A1	Accept 7.71, 8 or 82. ft candidate's velocities. Accept –ve values

Question	Solution	Mark	Notes
7.	$\boldsymbol{v}_A = 2\mathbf{i} - 6\mathbf{j} + 9\mathbf{k}$ $\lvert v_A \rvert = \sqrt{2^2 + 6^2 + 9^2}$ $= \underline{11}$	B1 M1 A1	si cao
7(b)	AB = $(5 + 3t - 2 - 2t)\mathbf{i} + (-8 - 6t - 3 + 6t)\mathbf{j} + (10 + 7t - 1 - 9t)\mathbf{k}$ AB = $(3 + t)\mathbf{i} + (-11)\mathbf{j} + (9 - 2t)\mathbf{k}$	M1 A1	allow BA
	$AB^2 = (3 + t)^2 + (-11)^2 + (9 - 2t)^2$ $AB^2 = 5t^2 - 30t + 211$	M1 A1	correct intermediate step
	$\frac{dAB^2}{dt} = 2(3 + t) + 2(9 - 2t)(-2)$ $= 6 + 2t - 36 + 8t$ $= 10t - 30$	M1	attempt to diff or complete sq
	When closest $\frac{dAB^2}{dt} = 0$ $10t = 30$ $t = \underline{3}$	M1 A1	or $5(t-3)^2 + k$ cao

Question	Solution	Mark	Notes
8.			
8(a)	Conservation of energy $0.5 \times 3 \times 4^2 = 0.5mv^2 + mg \times 0.4(1 - \cos\theta)$ $48 = 3v^2 + 6 \times 9.8 \times 0.4(1 - \cos\theta)$ $3v^2 = 48 - 23.52 + 23.52\cos\theta$ $v^2 = 8.16 + 7.84\cos\theta$	M1 A1A1 A1	 Ke correct, PE with correct h correct equation
8(b)	$T - mg\cos\theta = mv^2/r$ $T - 3 \times 9.8\cos\theta = 3(8.16 + 7.84\cos\theta)/0.4$ $T = 29.4\cos\theta + 61.2 + 58.8\cos\theta$ $T = 61.2 + 88.2\cos\theta$	M1A1 m1 A1	 cao
8(c)	Consider T when $\theta = 180°$ $T = 61.2 - 88.2 < 0$ Therefore P does not describe complete circles	M1 A1 A1	 ft T = a + bcosθ
8(d)	Consider v^2 when $\theta = 180°$ $v^2 = 8.16 - 7.84 > 0$. Therefore P does describe complete circles	M1 A1	 cao