GCE MARKING SCHEME

SUMMER 2016

Mathematics – M1
0980/01

INTRODUCTION

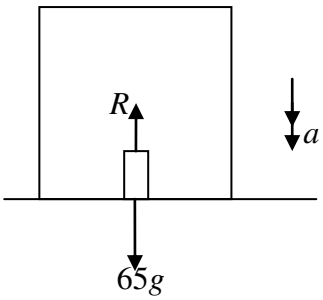
This marking scheme was used by WJEC for the Summer 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCE Mathematics - M1

Summer 2016 Mark Scheme

Q	Solution	Mark	Notes
1.			
	N2L applied man	M1	*R* and 65g opposing. dim correct
	$65g - R = 65a$	A1	
	1st stage, $a = 3.2$ $R = 65(9.8 - 3.2)$ $R = \underline{429}$ (N)	A1	cao
	2nd stage, $a = 0$ $R = 65 \times 9.8$ $R = \underline{637}$ (N)	B1	cao
	3rd stage, $a = -2.4$ $R = 65(9.8 + 2.4)$ $R = \underline{793}$ (N)	A1	cao

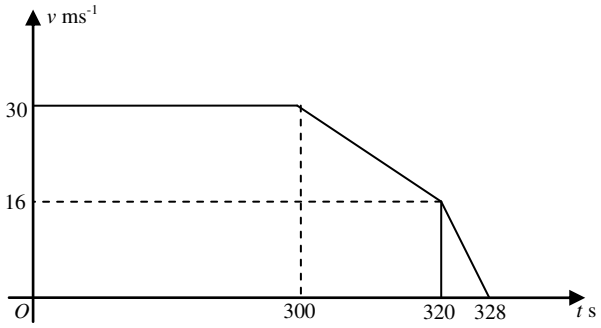
Q	Solution	Mark	Notes
2(a)	Apply N2L to B	M1	dim correct, all forces $5g$ and T opposing
	$5g - T = 5a$	A1	
	Apply N2L to A	M1	dim correct, all forces T and $2g$ opposing
	$T - 2g = 2a$	A1	
	Adding $5g - 2g = 7a$	m1	one variable eliminated, Dep on both M's
	$a = \underline{4.2\ \text{ms}^{-2}}$	A1	cao
	$T = \underline{28\ \text{N}}$	A1	cao
2(b)	Upwards positive		
(i)	Using $v = u + at$, u=0. a=(±)4.2,t=2	M1	cand's a
	$v = 0 + 4.2\times2$		
	$v = \underline{8.4\ (\text{ms}^{-1})}$	A1	ft a
(ii)	$s=ut+0.5at^2$, s=(±)18.9,u=(±)8.4,a=(±)9.8	M1	cand's v, one sign error
	$-18.9 = 8.4t + 0.5 \times -9.8 \times t^2$	A1	ft v
	$7t^2 - 12t - 27 = 0$	m1	recognition of quadratic and attempt to solve
	$(7t + 9)(t - 3) = 0$		
	$t = \underline{3\ (\text{s})}$	A1	cao

Q	Solution	Mark	Notes
3(a)	$I = 3 \times 4$ $= \underline{12 \text{ (Ns)}}$	B1	
3(b)	Conservation of momentum	M1	attempted, equation, dim correct.
	$3\times4 + 11\times0 = 3v_A + 11v_B$ $3v_A + 11\,v_B = 12$	A1	correct equation
	Restitution	M1	one sign error only
	$v_B - v_A = -\frac{1}{4}(0-4)$ $v_B - v_A = 1$	A1	correct equation, any form
	$3v_A + 11\,v_B = 12$ $-3v_A + 3v_B = 3$		
	Adding $14v_B = 15$	m1	
	$v_B = \underline{\frac{15}{14} \text{ (ms}^{-1}\text{)}}$	A1	cao
	$v_A = \underline{\frac{1}{14} \text{ (ms}^{-1}\text{)}}$	A1	cao
3(c)	$\frac{6}{7} = e \times \frac{15}{14}$ $e = \frac{6}{7} \times \frac{14}{15}$	M1	correct equation, any form
	$e = \frac{4}{5} = \underline{0.8}$	A1	ft v_B if $> \frac{6}{7}$

Note: Accept g throughout conservation of momentum equation, whether crossed off or not.

Q	Solution	Mark	Notes

4(a)



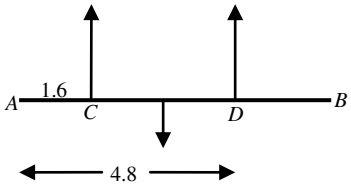
B1	(0, 30) to (300, 30)	
B1	(300, 30) to (320, 16)	
B1	(320, 16) to (328,0)	
B1	shape, units, labels	

4(b)	Total distance = area under graph	M1	attempted
	$D = 300\times30 + 0.5\times(30+16)\times20 + 0.5\times16\times8$	B1	one correct area, ft graph
		A1	all correct, ft graph if shape correct.
	$D = 9000 + 460 + 64$		
	$D = \underline{9524 \text{ (m)}}$	A1	cao

Q	Solution	Mark	Notes
5	Resolve in one direction	M1	obtain comp of resultant
	$X = 8\cos30° + 7\cos45°$		
	$\quad - 15\cos60° - 12\cos50°$	A1	
	$X = -3.3355$		
	Resolve in perpendicular direction	M1	obtain comp of resultant
	$Y = 8\cos60° - 7\cos45°$		
	$\quad - 15\cos30° + 12\cos40°$	A1	
	$Y = -4.7476$		
	$\text{Resultant}^2 = 3.3355^2 + 4.7476^2$	m1	dep on both M's
	Resultant = <u>5.8N</u>	A1	cao
	$\text{Acceleration} = \frac{5 \cdot 8021777}{4}$		
	Acceleration = <u>1.45 (ms^{-2})</u>	A1	ft Resultant. Accept 1.5.

Q	Solution	Mark	Notes

6.



Take moments about C	M1	dim correct moment equ.
$8g \times 1.4 = T_D \times 3.2$	B1	Any correct moment
	A1	correct equation
$T_D = \underline{3.5g\ (\text{N})} = \underline{34.3\ (\text{N})}$	A1	cao

Resolve vertically	M1	oe
$T_C + T_D = 8g = 78.4$	A1	
$T_C = \underline{4.5g\ (\text{N})} = \underline{44.1\ (\text{N})}$	A1	cao

Note:
Simultaneous equations

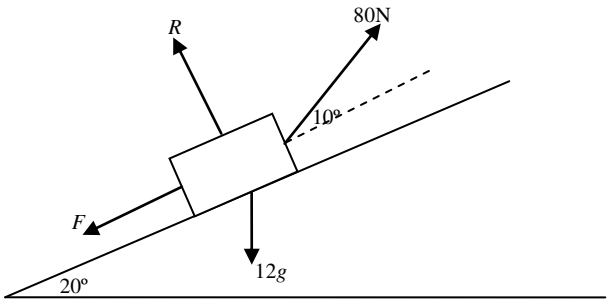
First moment equation	M1 B1 A1
Second moment equation or resolution equation	M1 A1 (B1 if not previously awarded)
Answers	A1 A1

Equal tension

Moments about C/D	4 marks available
Moments about anywhere else	2 marks available.

Q	Solution	Mark	Notes

7



7(a)	Resolve perpendicular to plane	M1	dim correct equation All forces No more than 1 sign error
	$R + 80 \sin 10^\circ = 12g \cos 20^\circ$	A1	
	$R = 96.616$		
	$F = \mu R = 0.2 \times 96.616$	M1	ft R (any correct form)
	$F = \underline{19.323 \text{ (N)}}$	A1	cao
7(b)	Resolve parallel to plane	M1	dim correct equation All forces Allow sin/cos errors Friction subtracted from tension
	$80 \cos 10^\circ - F - 12g \sin 20^\circ = 12a$	A2	-1 each error, (ft F)
	$a = \underline{1.6 \text{ (ms}^{-2})}$	A1	cao

Note (for both parts)

If no g with 12,	M0	(possibly M1 for μR)
If 80 not resolved	M0	
If g with 80	M0	

Q	Solution	Mark	Notes
8	Use of $s = ut + 0.5at^2$ with s=460, t=20	M1	
	$460 = 20u + 0.5 \times a \times 400$	A1	
	$u + 10a = 23$		
	Use of $v = u + at$ with t=6, v=17	M1	
	$17 = u + 6a$	A1	
	$u + 6a = 17$		
	attempt to solve simultaneously	m1	one variable remains
	$4a = 6$		
	$a = \underline{1.5}$	A1	cao
	$u = \underline{8}$	A1	cao

Note:

3 or more equations	
First correct equation	M1 A1
All subsequent equations, eg 2 if 3 unknowns, 3 if 4 unknowns	M1 A1
All variables except one eliminated	m1
Correct answers	A1 A1

Q	Solution				Mark	Notes
9.		Area	AC	AB		
	ABC	54	4	3	B1	
	Circle	4π	4	3	B1	
	D	12π	6	4.5	B1	
	Lamina	$(54+8\pi)$	x	y	B1	expressions for areas, oe
	Moments about AC				M1	consistent areas and moments
	$54\times4 + 12\pi\times6 = (54+8\pi)x + 4\pi\times4$				A1	signs correct. Ft table if at least one B1 for c of m gained.
	$x = \underline{4.95}$ (cm)				A1	cao
	Moments about AB				M1	consistent areas and moments
	$54\times3 + 12\pi\times4.5 = (54+8\pi)y + 4\pi\times3$				A1	signs correct. Ft table if at least one B1 for c of m gained.
	$y = \underline{3.71}$ (cm)				A1	cao
	Alternative solution					
		Area	AC	AB		
	ABC-Circle	$54-4\pi$	4	3	B1 B1	
	D	12π	6	4.5	B1	
	Lamina	$(54+8\pi)$	x	y	B1	expressions for areas, oe
	Moments about AC				M1	consistent areas and moments
	$(54-4\pi)\times4 + 12\pi\times6 = (54+8\pi)x$				A1	signs correct. Ft table if at least one B1 for c of m gained.
	$x = \underline{4.95}$ (cm)				A1	cao
	Moments about AB				M1	consistent areas and moments
	$(54-4\pi)\times3 + 12\pi\times4.5 = (54+8\pi)y$				A1	signs correct. Ft table if at least one B1 for c of m gained.
	$y = \underline{3.71}$ (cm)				A1	cao