



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.

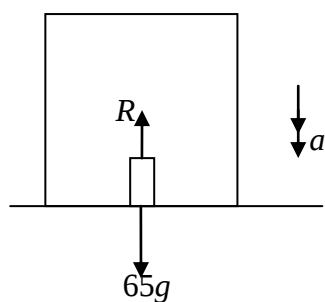
It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

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
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1.



N2L applied man

M1 R and $65g$ opposing.
dim correct

$$65g - R = 65a$$

A1

1st stage, $a = 3.2$

$$R = 65(9.8 - 3.2)$$

$$R = \underline{429 \text{ (N)}}$$

A1 cao

2nd stage, $a = 0$

$$R = 65 \times 9.8$$

$$R = \underline{637 \text{ (N)}}$$

B1 cao

3rd stage, $a = -2.4$

$$R = 65(9.8 + 2.4)$$

$$R = \underline{793 \text{ (N)}}$$

A1 cao

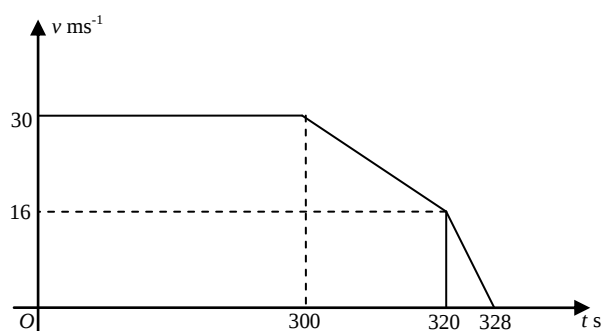
Q	Solution	Mark	Notes
2(a)	Apply N2L to B	M1	dim correct, all forces
	$5g - T = 5a$	A1	$5g$ and T opposing
	Apply N2L to A	M1	dim correct, all forces
	$T - 2g = 2a$	A1	T and $2g$ opposing
	Adding		
	$5g - 2g = 7a$	m1	one variable eliminated, Dep on both M's
	$a = \underline{4.2 \text{ ms}^{-2}}$	A1	cao
	$T = \underline{28 \text{ N}}$	A1	cao
2(b)	Upwards positive		
(i)	Using $v = u + at$, $u=0$. $a=(\pm)4.2, t=2$	M1	cand's a
	$v = 0 + 4.2 \times 2$		
	$v = \underline{8.4 \text{ (ms}^{-1}\text{)}}$	A1	ft a
(ii)	$s=ut+0.5at^2$, $s=(\pm)18.9, u=(\pm)8.4, a=(\pm)9.8$	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 $3 \times 4 + 11 \times 0 = 3v_A + 11v_B$ $3v_A + 11v_B = 12$ Restitution $v_B - v_A = -\frac{1}{4}(0 - 4)$ $v_B - v_A = 1$ $3v_A + 11v_B = 12$ $-3v_A + 3v_B = 3$ Adding $14v_B = 15$ $v_B = \frac{15}{14} \text{ (ms}^{-1}\text{)}$ $v_A = \frac{1}{14} \text{ (ms}^{-1}\text{)}$	M1 A1 M1 A1 m1 A1 A1	attempted, equation, dim correct. correct equation one sign error only correct equation, any form cao cao
3(c)	$\frac{6}{7} = e \times \frac{15}{14}$ $e = \frac{6}{7} \times \frac{14}{15}$ $e = \frac{4}{5} = \underline{0.8}$	M1 A1	correct equation, any form ft v_B if $> \frac{6}{7}$

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

Q	Solution	Mark	Notes
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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

$$D = 300 \times 30 + 0.5 \times (30 + 16) \times 20 + 0.5 \times 16 \times 8$$

$$D = 9000 + 460 + 64$$

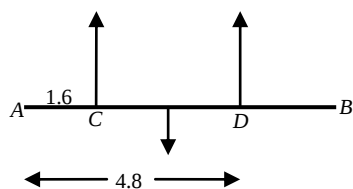
$$D = \underline{9524 \text{ (m)}}$$

M1	attempted
B1	one correct area, ft graph
A1	all correct, ft graph if shape correct.
A1	cao

Q	Solution	Mark	Notes
5	Resolve in one direction $X = 8\cos 30^\circ + 7\cos 45^\circ - 15\cos 60^\circ - 12\cos 50^\circ$ $X = -3.3355$	M1 A1	obtain comp of resultant
	Resolve in perpendicular direction $Y = 8\cos 60^\circ - 7\cos 45^\circ - 15\cos 30^\circ + 12\cos 40^\circ$ $Y = -4.7476$	M1 A1	obtain comp of resultant
	$\text{Resultant}^2 = 3.3355^2 + 4.7476^2$ $\text{Resultant} = \underline{5.8\text{N}}$	m1 A1	dep on both M's cao
	$\text{Acceleration} = \frac{5.8021777}{4}$ $\text{Acceleration} = \underline{1.45 \text{ (ms}^{-2}\text{)}}$	A1	ft Resultant. Accept 1.5.

Q	Solution	Mark	Notes
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6.



Take moments about C

$$8g \times 1.4 = T_D \times 3.2$$

$$T_D = \underline{3.5g \text{ (N)}} = \underline{34.3 \text{ (N)}}$$

M1 dim correct moment equ.

B1 Any correct moment

A1 correct equation

A1 cao

Resolve vertically

$$T_C + T_D = 8g = 78.4$$

$$T_C = \underline{4.5g \text{ (N)}} = \underline{44.1 \text{ (N)}}$$

M1 oe

A1

A1 cao

Note:

Simultaneous equations

First moment equation

Second moment equation or resolution equation

Answers

M1 B1 A1

M1 A1 (B1 if not previously awarded)

A1 A1

Equal tension

Moments about C/D

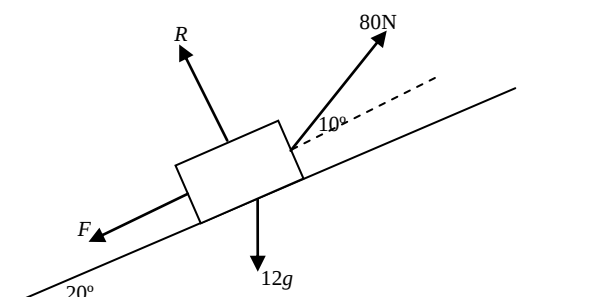
Moments about anywhere else

4 marks available

2 marks available.

Q	Solution	Mark	Notes
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7



7(a)	Resolve perpendicular to plane	M1	dim correct equation All forces No more than 1 sign error
	$R + 80 \sin 10^\circ = 12g \cos 20^\circ$ $R = 96.616$	A1	
	$F = \mu R = 0.2 \times 96.616$ $F = \underline{19.323 \text{ (N)}}$	M1 A1	ft R (any correct form) cao
7(b)	Resolve parallel to plane	M1	dim correct equation All forces Allow sin/cos errors Friction subtracted from tension
	$80 \cos 10^\circ - F - 12g \sin 20^\circ = 12a$ $a = \underline{1.6 \text{ (ms}^{-2}\text{)}}$	A2 A1	-1 each error, (ft F) 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 $s=460$, $t=20$ $460 = 20u + 0.5 \times a \times 400$ $u + 10a = 23$	M1 A1	
	Use of $v = u + at$ with $t=6$, $v=17$ $17 = u + 6a$ $u + 6a = 17$	M1 A1	
	attempt to solve simultaneously $4a = 6$ $a = \underline{1.5}$ $u = \underline{8}$	m1 A1 A1	one variable remains cao 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 <i>AC</i> <i>AB</i> <i>ABC</i> Circle <i>D</i> Lamina 54 4π 12π $(54+8\pi)$	4 4 6 x 3 3 4.5 y	B1 B1 B1 B1 expressions for areas, oe
	Moments about <i>AC</i>	M1	consistent areas and moments
	$54 \times 4 + 12\pi \times 6 = (54+8\pi)x + 4\pi \times 4$	A1	signs correct. Ft table if at least one B1 for c of m gained.
	$x = \underline{4.95 \text{ (cm)}}$	A1	cao
	Moments about <i>AB</i>	M1	consistent areas and moments
	$54 \times 3 + 12\pi \times 4.5 = (54+8\pi)y + 4\pi \times 3$	A1	signs correct. Ft table if at least one B1 for c of m gained.
	$y = \underline{3.71 \text{ (cm)}}$	A1	cao

Alternative solution

	Area <i>AC</i> <i>AB</i> <i>ABC</i>-Circle <i>D</i> Lamina $54-4\pi$ 12π $(54+8\pi)$	4 6 x 3 4.5 y	B1 B1 B1 B1 expressions for areas, oe
	Moments about <i>AC</i>	M1	consistent areas and moments
	$(54-4\pi) \times 4 + 12\pi \times 6 = (54+8\pi)x$	A1	signs correct. Ft table if at least one B1 for c of m gained.
	$x = \underline{4.95 \text{ (cm)}}$	A1	cao
	Moments about <i>AB</i>	M1	consistent areas and moments
	$(54-4\pi) \times 3 + 12\pi \times 4.5 = (54+8\pi)y$	A1	signs correct. Ft table if at least one B1 for c of m gained.
	$y = \underline{3.71 \text{ (cm)}}$	A1	cao