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# **GCE MARKING SCHEME**

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**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.

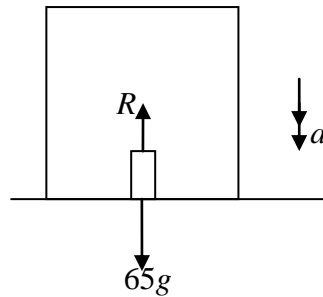
It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

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

1<sup>st</sup> stage,  $a = 3.2$   
 $R = 65(9.8 - 3.2)$   
 $R = \underline{429 \text{ (N)}}$

A1 cao

2<sup>nd</sup> stage,  $a = 0$   
 $R = 65 \times 9.8$   
 $R = \underline{637 \text{ (N)}}$

B1 cao

3<sup>rd</sup> stage,  $a = -2.4$   
 $R = 65(9.8 + 2.4)$   
 $R = \underline{793 \text{ (N)}}$

A1 cao

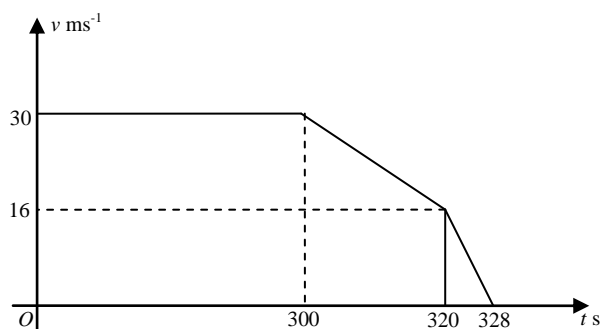
Q	Solution	Mark	Notes
2(a)	Apply N2L to B	M1	dim correct, all forces
	$5g - T = 5a$	A1	5g and T opposing
	Apply N2L to A	M1	dim correct, all forces
	$T - 2g = 2a$	A1	T and 2g opposing
	Adding		
	$5g - 2g = 7a$	m1	one variable eliminated, Dep on both M's
	$a = \underline{4.2 \text{ ms}^{-2}}$	A1	cao
	$T = \underline{28 \text{ N}}$	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)	<p>Conservation of momentum</p> $3 \times 4 + 11 \times 0 = 3v_A + 11v_B$ $3v_A + 11v_B = 12$ <p>Restitution</p> $v_B - v_A = -\frac{1}{4}(0 - 4)$ $v_B - v_A = 1$ $3v_A + 11v_B = 12$ $-3v_A + 3v_B = 3$ <p>Adding</p> $14v_B = 15$ $v_B = \frac{15}{14} \text{ (ms}^{-1}\text{)}$ $v_A = \frac{1}{14} \text{ (ms}^{-1}\text{)}$	M1 A1  M1 A1   m1  A1 A1	<p>attempted, equation, dim correct.</p> <p>correct equation</p> <p>one sign error only</p> <p>correct equation, any form</p> <p>cao</p> <p>cao</p>
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	<p>correct equation, any form</p> <p>ft <math>v_B</math> if <math>&gt; \frac{6}{7}</math></p>

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

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

$$D = 9000 + 460 + 64$$

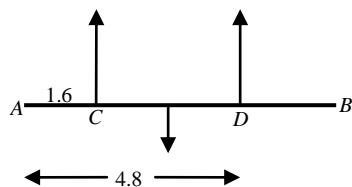
$$D = \underline{9524 \text{ (m)}}$$

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	M1	obtain comp of resultant
	$X = 8\cos 30^\circ + 7\cos 45^\circ$	A1	
	$- 15\cos 60^\circ - 12\cos 50^\circ$		
	$X = -3.3355$		
	Resolve in perpendicular direction	M1	obtain comp of resultant
	$Y = 8\cos 60^\circ - 7\cos 45^\circ$	A1	
$- 15\cos 30^\circ + 12\cos 40^\circ$			
$Y = -4.7476$			
Resultant <sup>2</sup> = $3.3355^2 + 4.7476^2$	m1	dep on both M's	
Resultant = <u>5.8N</u>	A1	cao	
Acceleration = $\frac{5 \cdot 8021777}{4}$			
Acceleration = <u>1.45 (ms<sup>-2</sup>)</u>	A1	ft Resultant. Accept 1.5.	

Q	Solution	Mark	Notes
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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

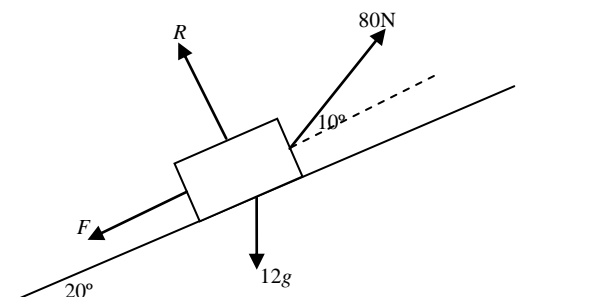
Equal tension

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



Q	Solution	Mark	Notes
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7



7(a)	Resolve perpendicular to plane	M1	dim correct equation All forces No more than 1 sign error
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$$R + 80 \sin 10^\circ = 12g \cos 20^\circ$$

$$R = 96.616$$

A1

$$F = \mu R = 0.2 \times 96.616$$

$$F = \underline{19.323 \text{ (N)}}$$

M1 ft  $R$  (any correct form)  
A1 cao

7(b)	Resolve parallel to plane	M1	dim correct equation All forces Allow sin/cos errors Friction subtracted from tension
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$$80 \cos 10^\circ - F - 12g \sin 20^\circ = 12a$$

$$a = \underline{1.6 \text{ (ms}^{-2}\text{)}}$$

A2 -1 each error, (ft  $F$ )  
A1 cao

Note (for both parts)

If no $g$ with 12,	M0 (possibly M1 for $\mu R$ )
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																				
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	$y = \underline{3.71 \text{ (cm)}}$	A1	cao																				

Alternative solution

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