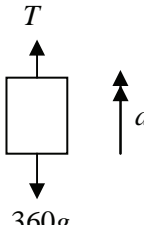


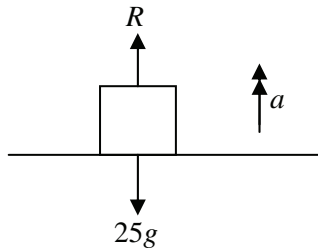
# M1

## Solutions and Mark Scheme

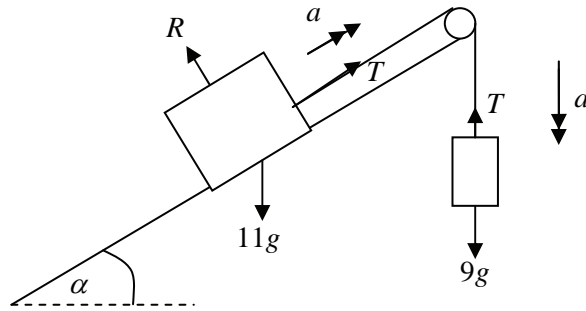
### Final Version

1. (a) Using  $v^2 = u^2 + 2as$  with  $u = 18.2$ ,  $a = (-)9.8$ ,  $v = 0$  o.e. M1  
 $0 = 18.2^2 + 2(-9.8)s$  A1  
 $s = \underline{16.9}$  (m) cao A1
- (b) Using  $s = ut + at^2$  with  $s = 0$ ,  $u = 18.2$ ,  $a = (-)9.8$  M1  
 $0 = 18.2t - 4.9t^2$  A1  
 $t = 0, \frac{26}{7}$   
 Ball returns to point A after  $\frac{26}{7}$  s. cao A1
- (c) Using  $v = u + at$  with  $u = 18.2$ ,  $t = 2.5$ ,  $a = (-)9.8$  M1  
 $v = 18.2 + (-9.8) \times 2.5$  A1  
 $= -6.3$   
 Ball is moving downwards with speed  $\underline{6.3}$  ms<sup>-1</sup>. A1

2. (a) (i)
- 
- Apply Newton's second law to lift dim. correct. M1  
 $T - 360g = 360a$  A1  
 When  $a = -3$ ,  $T = 360 \times 9.8 - 360 \times 3$   
 $= \underline{2448}$  (N) cao A1
- (ii)  $T = 360g = (3528 \text{ N})$  B1

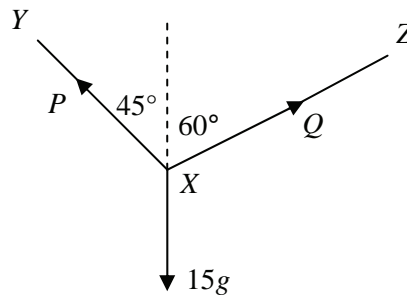
- (b)
- 
- N2L dim. correct M1  
 $R - 25g = 25a$  A1  
 $a = \frac{1}{25}(280 - 25 \times 9.8)$   
 $a = \underline{1.4}$  (ms<sup>-2</sup>) cao A1

3.



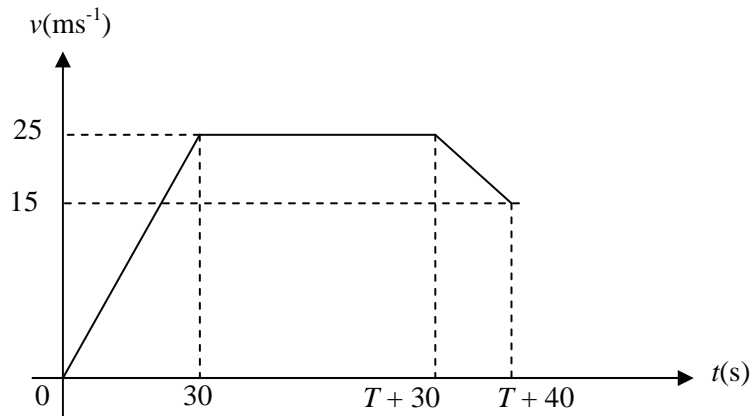
N2L applied to B.	dim. correct, all forces	M1
$9g - T = 9a$		A1
N2L applied to A.	dim. correct, all forces	M1
$T - 11g \sin \alpha = 11a$		A1
Attempt to eliminate one variable	dep. on both M's	m1
Adding $9g - 11g \sin \alpha = 20a$		
$a = \underline{2.254} \text{ (ms}^{-2}\text{)}$	cao	A1
$T = \underline{67.914} \text{ (N)}$	cao	A1

4.



Resolve vertically	attempt at equation with $P, Q$ resolved	M1
$P \cos 45^\circ + Q \cos 60^\circ = 15g$		A1
$\frac{P}{\sqrt{2}} + \frac{1}{2}Q = 15g$		
Resolve horizontally	attempt at equation with $P, Q$ resolved	M1
$P \cos 45^\circ - Q \cos 30^\circ = 0$		A1
$\frac{P}{\sqrt{2}} - \frac{Q\sqrt{3}}{2} = 0$		
Attempt to eliminate one variable		m1
Subtract		
$Q \left( \frac{1}{2} + \frac{\sqrt{3}}{2} \right) = 15g$		
$Q = \underline{107.6} \text{ (N)}$	cao	A1
$P = \underline{131.8} \text{ (N)}$	cao	A1

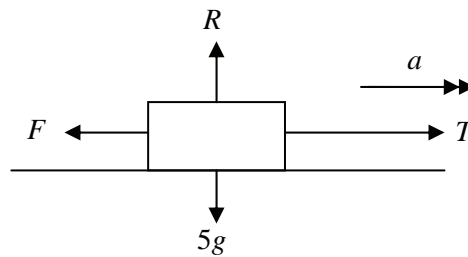
5. (a)



Line segment (0,0) to (30, 25) B1  
 Line segment (30, 25) to ((T + 30), 25) B1  
 Line segment ((T + 30), 25) to ((T + 40), 15) time interval required B1  
 Correct labelling + 2 previous B marks gained. B1

(b) An attempt at area under graph = 8000 o.e. M1  
 Any correct distance B1  
 $0.5 \times 25 \times 30 + 25 T + 0.5 (25 + 15) \times 10 = 8000$  A1  
 $375 + 25T + 200 = 8000$   
 $T = \underline{297} \text{ s}$  cao A1  
 Total time =  $297 + 30 + 10$   
 $= \underline{337} \text{ s}$  ft A1

6.

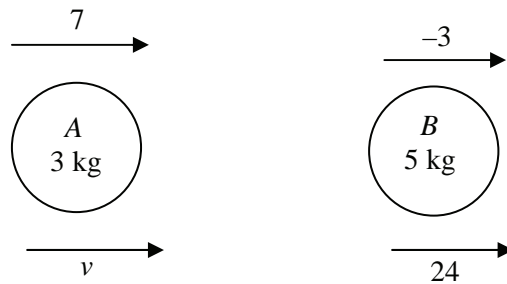


(a)  $R = 5g$  B1  
 Limiting friction =  $5g \times 0.6$  B1  
 $= 3g = 29.4 \text{ N}$

N2L applied to particle dim correct, all forces M1  
 $40 - 29.4 = 5a$  ft friction A1  
 $a = \underline{2.12} \text{ ms}^{-2}$  cao A1

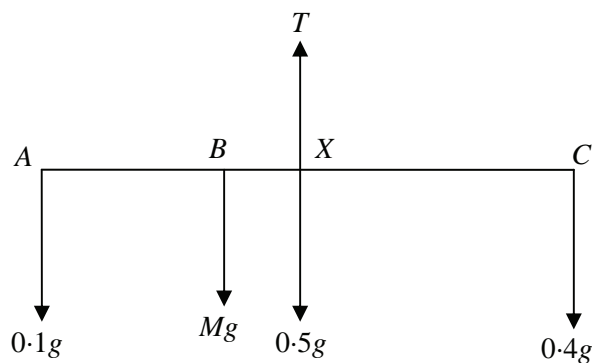
(b) Particle will not start moving. B1  
 Since  $T = 20 \text{ N}$ ,  $T$  is smaller than limiting friction. So friction will be equal to  $T$ . Since resultant is 0, there is no motion. E1

7.



- (a) Conservation of momentum                      attempted                      M1  
 $3v + 5 \times 2.4 = 7 \times 3 - 3 \times 5$                       any correct form                      A1  
 $v = -2 \text{ (ms}^{-1}\text{)}$                       cao                      A1
- Restitution                      attempted                      M1  
 $2.4 - v = -e(-3-7)$                       any correct form                      A1  
 $e = \underline{0.44}$                       ft  $v$                       A1
- (b) Speed of  $B$  after collision with the wall =  $v'$   
 $v' = 0.6 \times (\pm)2.4$                       M1  
 $v' = (\pm)\underline{1.44} \text{ (ms}^{-1}\text{)}$                       cao                      A1

8.



- (a) Moments about  $X$  to obtain equation.                      M1  
 At least one correct moment                      B1  
 $0.1g \times 10 + Mg \times 2 = 0.4g \times 10$                       any correct equation                      A1  
 $M = \underline{1.5} \text{ (kg)}$                       cao                      A1
- (b) Resolve vertically                      M1  
 $T = (0.1 + 1.5 + 0.5 + 0.4)g$                       ft  $M$                       A1  
 $T = \underline{24.5} \text{ (N)}$                       ft  $M$                       A1

9.	(a)		Area	from AC	from AB	
		<i>ABC</i>	36	4	2	B1
		<i>PQRS</i>	4	3	3	B1
		Lamina	32	$x$	$y$	B1

Moments about AC M1

$$32x + 4 \times 3 = 36 \times 4 \quad \text{ft} \quad \text{A1}$$

$$x = \frac{33}{8} = \underline{4.125 \text{ cm}} \quad \text{cao} \quad \text{A1}$$

Moments about AB M1

$$32y + 4 \times 3 = 36 \times 2 \quad \text{ft} \quad \text{A1}$$

$$y = \frac{15}{8} = \underline{1.875 \text{ cm}} \quad \text{cao} \quad \text{A1}$$

(b)	Mass	$x$	$y$
	10	4	0
	5	3	8
	2	-5	6
	3	-1	2

Moments about y-axis (or x-axis) M1

$$20x = 10 \times 4 + 5 \times 3 + 2 \times (-5) + 3 \times (-1) \quad \text{A1}$$

$$x = \underline{2.1} \quad \text{cao} \quad \text{A1}$$

Moments about x-axis

$$20y = 10 \times 0 + 5 \times 8 + 2 \times 6 + 3 \times 2 \quad \text{A1}$$

$$y = \underline{2.9} \quad \text{cao} \quad \text{A1}$$