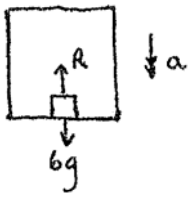
MATHEMATICS M1

1.

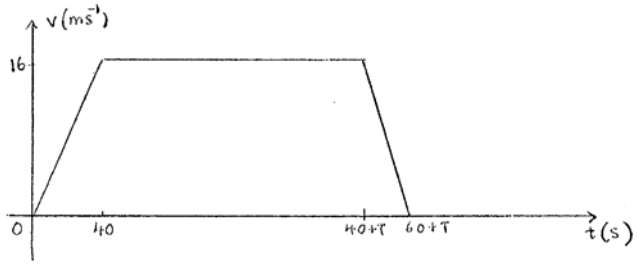


	N2L applied to object		M1
	$6g - R = 6a$	o.e.	A1
Accelerating $a = 3$	$R = 6g - 6 \times 3$		
	$= \underline{40{\cdot}8\text{N}}$	c.a.o.	A1
Constant speed $a = 0$	$R = 6g$		
	$= \underline{58{\cdot}8\text{N}}$		B1
Decelerating $a = -2$	$R = 6 + 6 \times 2$		
	$= \underline{70{\cdot}8\text{N}}$	c.a.o.	A1

2. *(a)* Use of $v = u + at$ with $u = 0$, $a = 0{\cdot}4$, $v = 1{\cdot}5$ M1

$$t = \frac{16}{0 \cdot 4} = \underline{40\text{s}}$$ A1

(b)



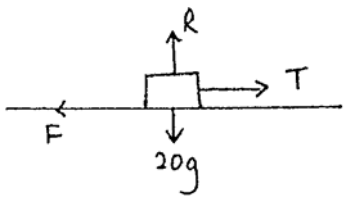
B1
B1
B1
B1

(c) $\frac{1}{2} \times 40 \times 16 + 16T + \frac{1}{2} \times 20 \times 16 = 2400$ M1, B1

$16T + 4800 = 2400$ f.t.(a) A1

$T = \underline{120s}$ c.ao. A1

3.



(a) $R = 20g$ B1

F = limiting friction $= \mu R$ used M1

$= 0{\cdot}3 \times 20g$

$= 58{\cdot}8\text{N}$

N2L dim. correct M1 A1

$T - F = 20a$

$a = \frac{65 - 58 \cdot 8}{20}$

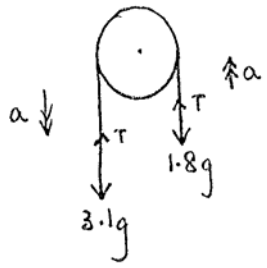
$= \underline{0{\cdot}31\ \text{ms}^{-2}}$ c.a.o. A1

(b) T < limiting friction

$\therefore$ F = T

$= 45\text{N}$ B1

4.



N2L applied to A and B M1

$3.1g - T = 3{\cdot}1a$ B1

N2L applied to B

$T - 1.8g = 1{\cdot}8a$ A1

Adding $3.1g = 1.8g = 4.9a$ m1

$a = \underline{2{\cdot}6\text{ms}^{-1}}$ c.a.o. A1

$T = 1{\cdot}8\,(2.6 + 9.8)$

$= \underline{22{\cdot}32\text{N}}$ c.a.o. A1

5. *(a)* Using $s = ut + \frac{1}{2}at^2$ with $s = 0$, $u = 22{\cdot}05$, $a = (\pm)\ 9{\cdot}8$ o.e. M1

$0 = 22{\cdot}05t - \frac{1}{2} \times 9{\cdot}8\ t^2$ A1

$t = \underline{4.5\text{s}}$ A1

$v = \underline{22{\cdot}05\text{ms}^{-1}}$ B1

(b) Using $v^2 = u^2 + 2as$ with $v = 0$, $u = 22{\cdot}05$, $a = (\pm)\ 9{\cdot}8$ o.e. M1

$0 = 22{\cdot}05^2 - 2 \times 9{\cdot}8s$ A1

$s = \underline{24{\cdot}8\ (0625)\text{m}}$ c.a.o. A1

(c) Using $v = u + at$ with $u = 22{\cdot}05$, $a = (\pm)\ 9{\cdot}8$, $t = 3$ o.e. M1

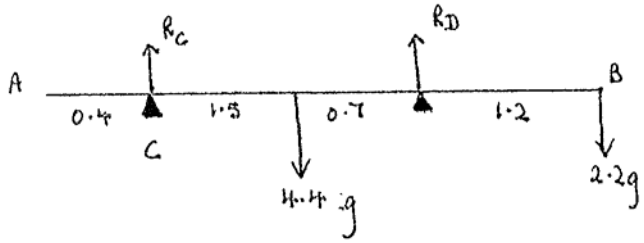
$v = 22{\cdot}05 - 9{\cdot}8 \times 3$ f.t. (a) if used A1

$v = -7{\cdot}35$

Speed $= \underline{7{\cdot}35\text{ms}^{-1}}$ A1

Direction is <u>downwards</u> B1

6.



Moments about C all forces dim. correct M1

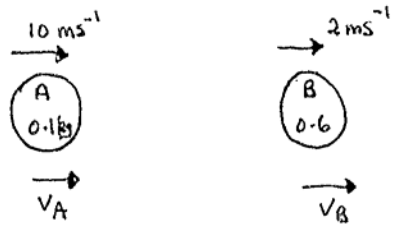
$4{\cdot}4g \times 1{\cdot}5 + 2{\cdot}2g \times 3{\cdot}4 = R_D \times 2{\cdot}2$ A2 B1

$R_D = \underline{62{\cdot}72\text{N}}$ $(6.4g)$ c.a.o. A1

Resolve ↑ $R_C + R_D = 4{\cdot}4g \times 2{\cdot}2g$ M1

$R_C = 0{\cdot}2g = \underline{1{\cdot}96\text{N}}$ f.t. R_D A1

7. *(a)*



Conservation of momentum		used	M1
$0{\cdot}1 \times 10 + 0{\cdot}6 \times 2 = 0{\cdot}1\ V_A + 0{\cdot}6\ V_B$ $V_A + 6V_B = 22$			A1
Restitution		used	M1
$V_B - V_A = -\frac{3}{4}\ (2 - 10)$ $-V_A + V_B = 6$			A1
Adding $7V_B = 28$		dep. on both Ms	M1
$V_B = \underline{4}$ ms^{-1}		c.a.o.	A1
$V_A = \underline{-2}$ ms^{-1}		c.a.o.	A1

(b) After B collide with wall, it is moving with speed V_B' towards A

$V_B' = \frac{1}{4} \times 4 = 1$ ms^{-1}	f.t.	B1
Since $\lvert V_B' \rvert = 1$ and $\lvert V_A' \rvert = 2$, B will not catch up with A		B1

(c)

$I = 0{\cdot}6\ (4 + 1)$		M1
$= 3$ NS	f.t. V_B, V_B'	A1

8. *(a)*

	Area	dist. from AB	dist. from AE	
ABDE	60	3	5	B1
BCD	18	4	12	B1 B1
Lamina	78	x	y	B1 (areas)

Moments about AB

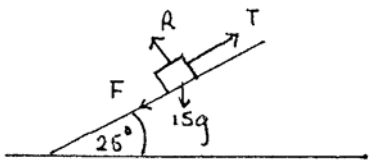
$60 \times 3 + 18 \times 4 = 78x$	f.t. cand's values	M1 A1
$x = \frac{43}{13}$	c.a.o.	A1

Moments about AE

$60 \times 5 + 18 \times 12 = 78\ xy$	f.t. cand's values	M1 A1
$y = \frac{86}{13}$	c.a.o.	A1

(b) $AX = \frac{43}{13}$ cm — f.t. x — B1

9. $\mu = 0{\cdot}4$



$\perp$ to plane	R	=	$15g \cos 25^\circ$		B1
Limiting friction	F	=	μR	used	M1
		=	$0{\cdot}4 \times 15g \cos 25^\circ$	si	M1
		=	53·2909 N		

Max T when body on point of moving up plane

	T	=	$15g \sin \alpha + F$	f.t. F	M1 A1
	T	=	115·42 N	c.a.o.	A1

Min T when body on point of moving down plane

	T	=	$15g \sin \alpha - F$	f.t. F	M1 A1
	T	=	8·83 N	c.a.o.	A1