M1 JAN02 (1)

1) (0.3) ↓8 (0.3) ↑6 (=-6)
Mom before = 0.3×8 = 2.4 Ns
Mom after = 0.3×-6 = -1.8 Ns
Impulse = 4.2 Ns

2) 1800 (4) 1200 (0) → 3000 (v)

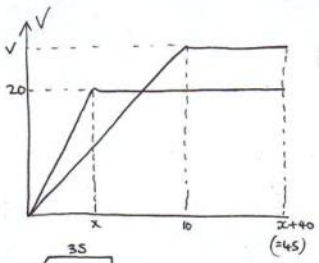
Total mom before = 1800×4 = 7200 Ns
Total mom after = 3000v

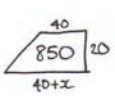
7200 = 3000v ⇒ v = 2.4 ms⁻¹

b) Momentum before R = 7200 Ns ⇒ Impulse = 7200
Momentum after R = 0
Impulse = force × time 7200 = Res × 8
Res = 900 N

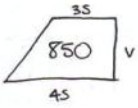
3) u=12 v=60 t=4
v=u+at ⇒ 60=12+4a ⇒ 4a=48 ⇒ a=12 ms⁻²
b) $S=\frac{(u+v)t}{2} \Rightarrow S=\frac{72\times4}{2}=144$ m
c) u=12 S=72 a=12
$v^2=u^2+2as \Rightarrow v^2=144+24\times72 \Rightarrow v=43.3$ ms⁻¹

(2)

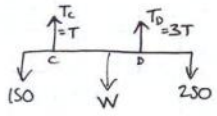
4) 

b) 

$\frac{(40+(40+x))}{2}\times20=85$
(80+x)10 = 850
80+x = 85
x = 5 sec

c) 

$\frac{(35+45)}{2}\times v=850$
80v = 1700 ⇒ v = 21.25 ms⁻¹

5) 

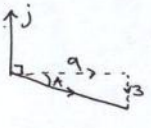
Rf ↑ = 0 ⇒ 4T = 400 + W
A↻ W×5 + 250×10 = T×1 + 3T×4
5W + 2500 = 22T

W = 4T − 400 ⇒ 5W = 20T − 2000
⇒ 20T − 2000 + 2500 = 22T
2T = 500 ⇒ T = 250 N

c) W = 4(250) − 400 = 600 N
d) weight acts at the middle of the girder.

(3)

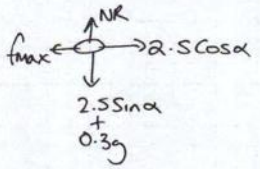
6) Rf = (6i+2j)+(3i−5j) = 9i−3j N

b) 

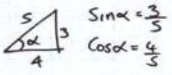
angle = 90+A
= 90 + $\tan^{-1}\left(\frac{3}{4}\right)$
= 108°

c) acc = $\frac{\text{change in vel}}{\text{time}}$ ⇒ Rf = ma.
(9i−3j) = 3a a = 3i−j ms⁻²

d) Vel = (Initial vel) + t(acc)
Vel = (−2i+j) + 2(3i−j) = 4i−j ms⁻¹
= $\sqrt{4^2+1^2}$ = 4.12 ms⁻¹

7) 

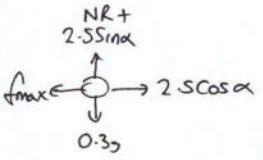
$\tan\alpha=\frac{3}{4}$



$\sin\alpha=\frac{3}{5}$
$\cos\alpha=\frac{4}{5}$

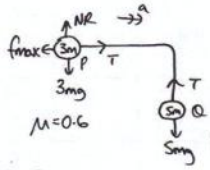
NR = 2.5×3/5 + 0.3g = 4.44 N
fmax = μNR ⇒ fmax = 4.44μ.
Rf = 0 ⇒ 2.5×4/5 = fmax ⇒ fmax = 2
= μ = 2/4.44 = 0.45

(4)

b) 

NR = 0.3g − 2.5×3/5
NR = 1.44
fmax = μNR = 0.6 S N

2.5 cos α = 2.5×4/5 = 2 N
So the ring will move since Rf = 1.3 S N

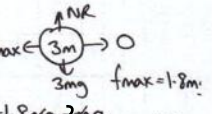
8) 

(P) T − fmax = 3ma
(Q) 5mg − T = 5ma +
5mg − fmax = 8ma.
5×9.8 − 1.8×9.8 = 8×a
3.2g = 8a
a = 3.2/8 g = 2/5 g m

(P) NR = 3mg
fmax = μNR = 1.8mg

c) T = 3ma + fmax
T = 3m×2/5 g + 1.8mg = 3mg N

d) u↓ = 0 v² = u² + 2as
a↓ = 2/5 g v² = 4/5 gh
s = h v = $\sqrt{\frac{4}{5}gh}$ ms⁻¹



u = $\sqrt{\frac{4}{5}gh}$ v = 0 a = [redacted] = −0.6g
−1.8×g = 3×a a = −0.6g
v² = u² + 2as ⇒ 0 = 4/5 gh − [redacted] 1.2gs
S = $\frac{\frac{4}{5}gh}{1.2g}$ = [redacted] 2h/3