(No subject)

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Thu 14/05/2020 15:15

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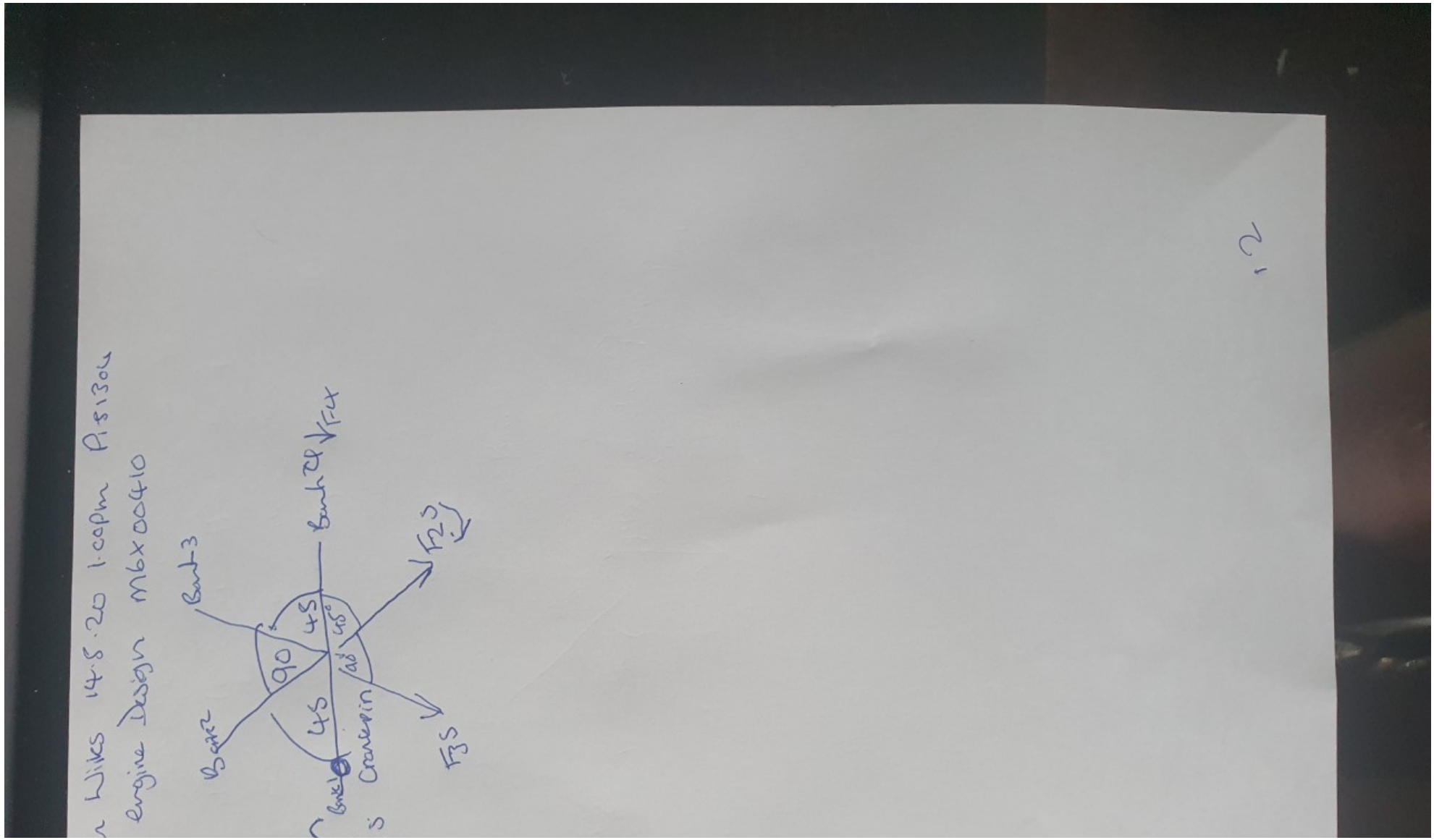

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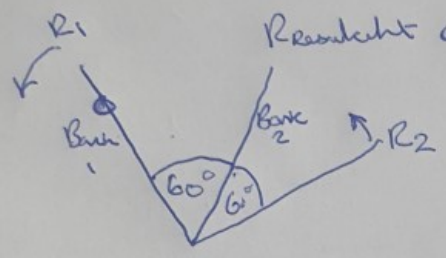
Engine design M6x00410



Resultant acting bank 2

$= R_2 = \frac{M_{Rec}}{2} R\omega^2$

$\text{tent} = \frac{M_{Rec}}{2} R\omega^2 \cos 60° + \frac{M_{Rec}}{2} R\omega^2 \cos 60°$

$= M_{Rec} R\omega^2 \cos 60°$

$\text{moment} = M_{Rec} R \cos 60°$

$= 0.36 \times 40 \times 0.5$

$= 7.2$ kg.mm

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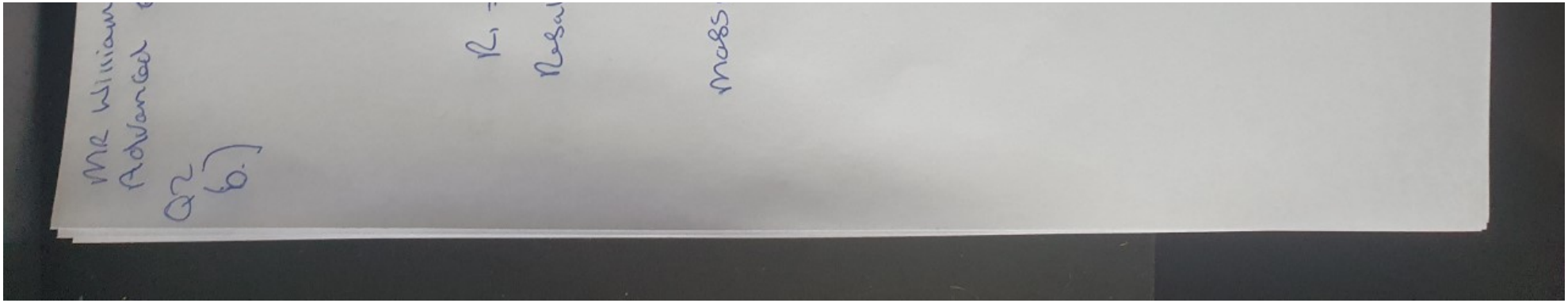
Q2
g)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6.)
R,
Resal
Mass

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c) First order Reverse mass moment

$\frac{M_{rec}}{2} \cdot R$ kg.mm its a twin

So $M_{Rec} \cdot R = 15.75$ kg.mm

d) Balance Shaft need to Rotate Counter Clockwise, Equal to engine Speed. use a Gear pair of equal diameter

e) To full balance make first order Reverse mass moment equal to:

$$M_{balance}\, y\, \omega^2 = \cancel{(2M_{Rot}} + \frac{M_{Rec}}{2} R\omega^2$$

in this case

$$y = \frac{M_{Rec} R}{M_{balance}}$$

$$y = \frac{15.75}{2.5}$$

$$y = 6.3\,mm$$

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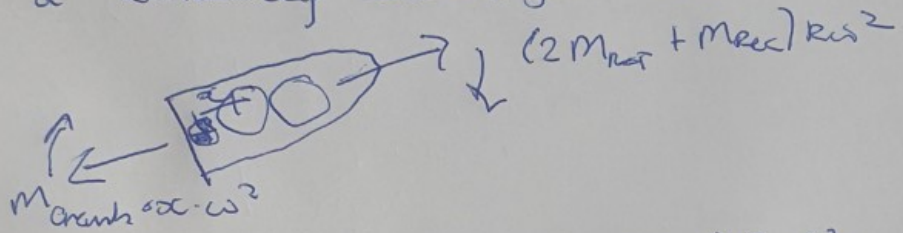
b.) An offset Centre of Gravity Crankshaft Creates a balancing Centrifugal force



So $M_{crank} \cdot x \cdot \omega^2 = (2M_{ROT} + M_{REC})R\omega^2$

$$x = \frac{(2M_{ROT} + M_{REC})R}{M_{crank}}$$

$$x = \frac{32.35}{5}$$

$$x = 7.47mm$$

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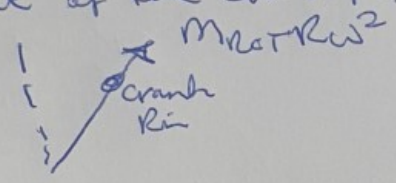
Q1a)

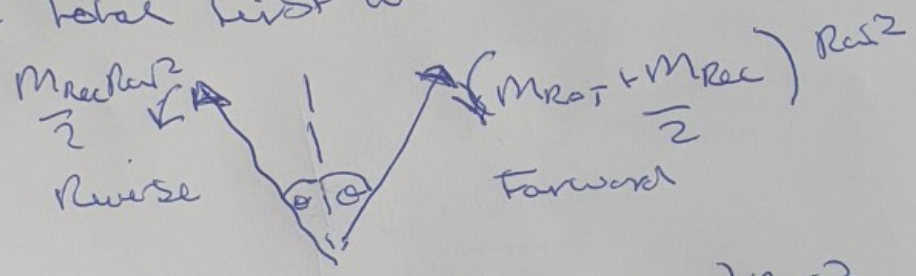
The rotating part of the Con-Rod also Create a Centrifugal force of magnitude

$M_{ROT} R\omega^2$

Along the direct of the Crank pin



So the total first order forces



So Firstand forward $= \left(M_{ROT} + \frac{M_{Rec}}{2}\right) R\omega^2$

In this case twin cylinder so

$= 2\left(M_{ROT} + \frac{M_{Rec}}{2}\right) R\omega^2$

$M_{ROT} = \frac{2}{3}$ ConRod mass + ~~Shell~~ Shells

$M_{Rec} =$ Piston mass $+ \frac{1}{3}$ ConRod

$\therefore$ Mass Moment forward $= (2M_{ROT} + M_{Rec}) R$

$= (2 \cdot 240 + 350)\, 45$

$2 \times 0.24 + 0.35)\, 45$

$= 37.35$ kg.mm

2

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Q2.

Piston mass = 240 Grams
Con-Rod mass = 360 Grams
Stroke = 80 mm
Con-Rod length = 140 mm

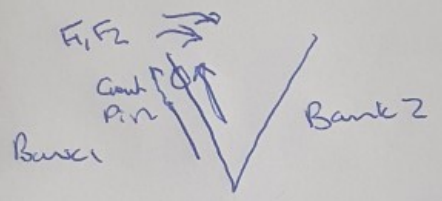
a)

$m_{REC} = 240 + \frac{1}{3} 360$

$= 360 \rightarrow 0.36 kg$

$m_{ROT} = \frac{2}{3} 360$

$= 240 \rightarrow 0.24 kg$



First order forces are along the same bank

$F_1 = F_2 = (m_{ROT} + \frac{m_{REC}}{2}) R\omega^2$

Resultant vector

$= 2(m_{ROT} + \frac{m_{REC}}{2}) R\omega^2$

Resultant mass moment

$= 2(m_{ROT} + \frac{m_{REC}}{2}) R$

$= 2(0.24 + \frac{0.36}{2}) 40$

$= 2(0.24 + 0.18) 40$

$= 2 \times 0.42 \times 40$

$= 33.6$ kg·mm

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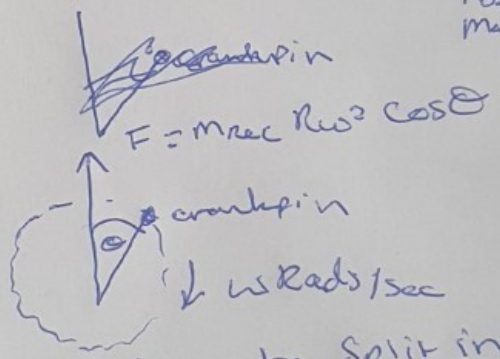
Q1)

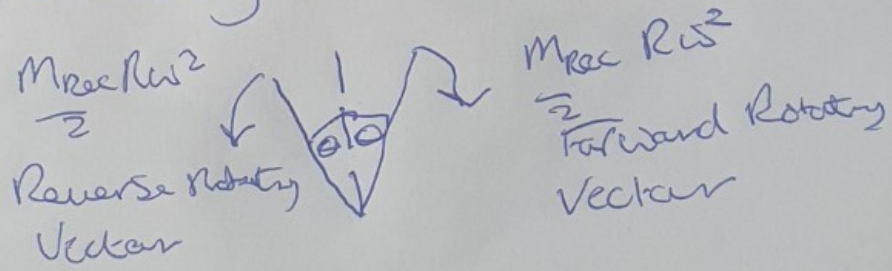
Piston mass = 240 Grams
Conrod mass = 330 Grams Inline twin
Big end Shell = 20 Grams
Stroke is = 90 mm
Crank mass = 5 kg
Con-Rod L = 140 mm

a) The Reciprocating mass Results in a first Order force along the Cylinder axis

m_{rec} = Piston Assembly mass + $\frac{1}{3}$ Conrod mass



The first order force can then be split into two Counter Rotating Constant applitude ~~force~~ Vectors since mathematically the same.



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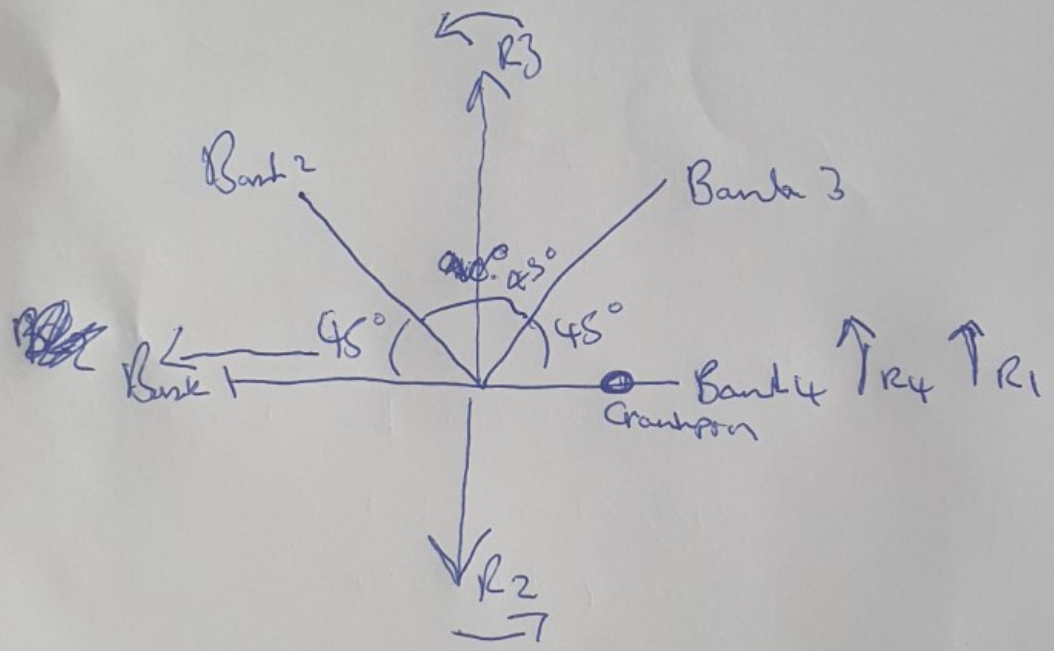
e) Balance the first order forward using a crank-shaft with offset C.G.
Balance the resultant reverse vector with a counter rotating balance shaft.



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h.

Mass moment of each balance shaft $= 2 \frac{1}{2} \frac{R}{L} M_{rec} R \omega^2$

$= \frac{R}{L} M_{rec} R \omega^2$

$= \frac{45}{140} 0.35 \cdot 45$

$= 5.0625$ kg.mm

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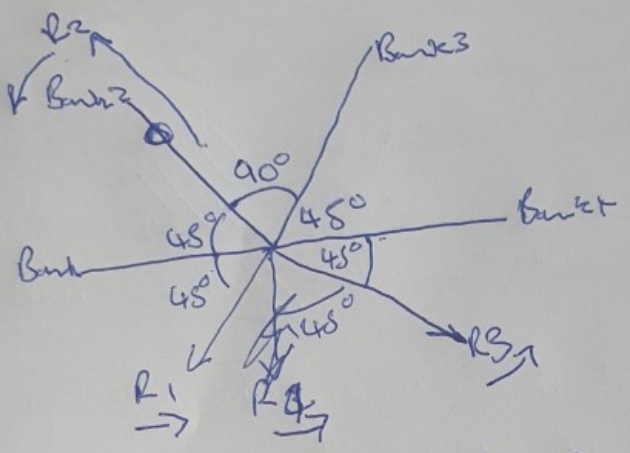
d)



Resultant vertical component down

$R_2 - R_3 + R_1 \sin 45° + R_4 \sin 90°$

$R - R + 0.7R + R$

$= 1.7R$ Down

Mass moment $= 1.7 \frac{M_{Rec}}{2} . R$

$= 1.7 \times 0.18 \times 40$

$= 12.24$ kg.mm

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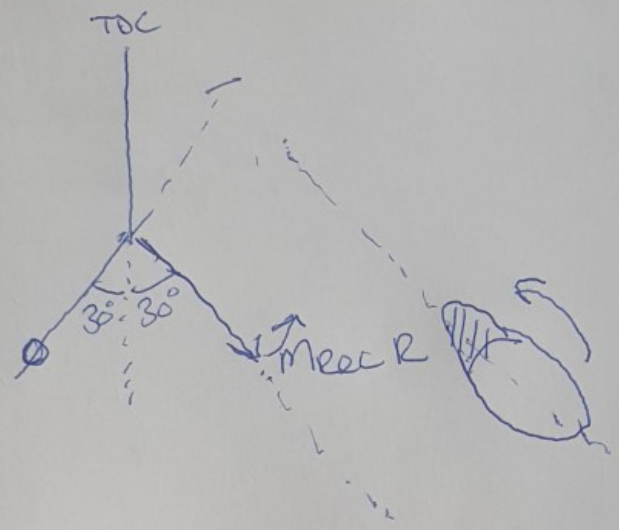
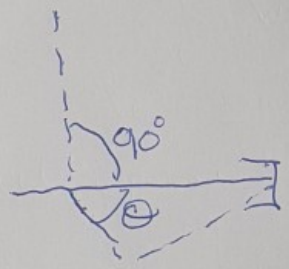
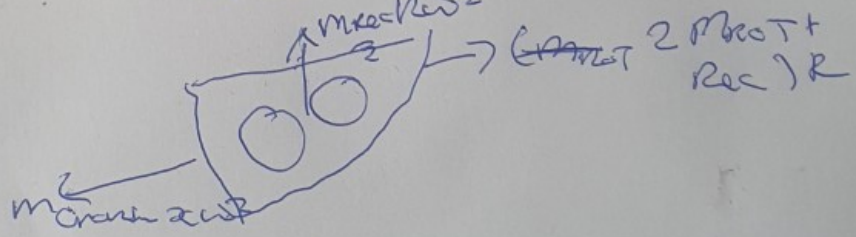


Engine is horizontal



If ~~underbalanced~~ $m_{Crank} \times \omega^2 = 2M_{ROT} R\omega^2$

make



To underbalance make

$m_{Crank} \times \omega^2 = (2M_{ROT} + M_{Rec})R$

$= 21.6$ kg.mm

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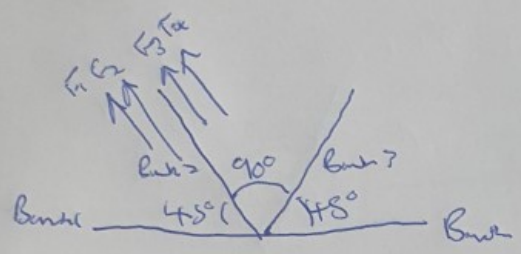
Q2 C.



First order vector is along Bank 2

mass moment $= 4\left(M_{ROT} + \frac{M_{rec}}{2}\right)R$

$= 4\,(0.24 + 0.18)\,40$

$= 4 \cdot 0.42 \cdot 40$

$= 67.2$ kg·mm

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