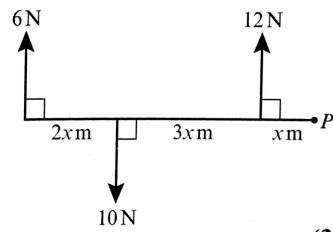4 The diagram shows a set of forces acting on a light rod. The resultant moment about P is 12.8 N m clockwise. Find the value of x.

6 N   12 N

2x m   3x m x m P

10 N

(3 marks)

Total Moment $= 12.8 N$ clockwise

$\therefore \quad 6 \times 6x + 12 \times x - 10 \times 4x = 12.8$

$36x + 12x - 40x = 12.8$

$8x = 12.8$

$x = \dfrac{12.8}{8}$

$x = 1.6$

5 A cruise ship is tethered to a dock and is being moved by three tugs. The cruise ship is modelled as a rectangular lamina *PQRS* fixed at *P* under the action of three coplanar forces. *A* is the midpoint of *PS* and *B* is the midpoint of *RS*.

Determine the direction of the rotation of the cruise ship and the magnitude of the resultant moment about *P*. **(5 marks)**
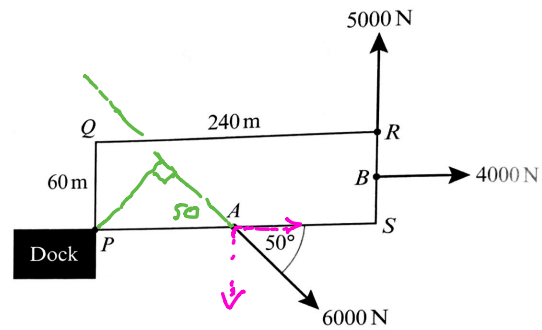
Taking anti-clockwise as positive

Resultant Moment $= 5000 \times 240 - 4000 \times 30 - 6000 \sin 50 \times 120$

$= 528,448 \, Nm$ anti-clockwise

6 The diagram shows a drawbridge inclined at an angle of θ to the horizontal, where $0 < \theta < 90°$. The drawbridge is modelled as a uniform rod of weight 8000 N. A horizontal force of magnitude 6000 N is applied at the top of the drawbridge. Given that the drawbridge is rising, prove that $\tan\theta > \frac{2}{3}$ **(5 marks)**
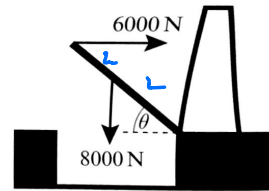
Hint The drawbridge is modelled as a uniform rod so its weight acts at its midpoint.

Rotating clockwise

∴ clockwise moment > ant-clockwise moment

Let rod be $2L$ long

$$6000 \times 2L\sin\theta > 8000 \times L\cos\theta$$

$$12000L\sin\theta > 8000L\cos\theta$$

$$\frac{\sin\theta}{\cos\theta} > \frac{8000L}{12000L}$$

$$\tan\theta > \frac{2}{3}$$