Q1

Mass of crate $m = 80\,kg$

The weight of the crate: $W = (80)(9.81\,m/s^2)$

$W = 784.8\,N$

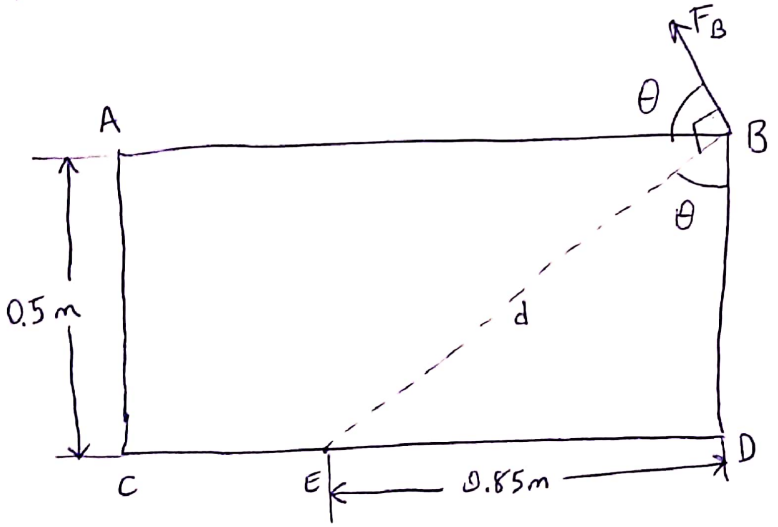
a.) Moment about point E, $M_E = -W(0.85 - 0.6)$

$M_E = -784.8 \times 0.25\,N\text{-}m$

$M_E = -196.2\,N\text{-}m$

the moment about the point E is $\boxed{M_E = 196.2\,N\text{-}m\,(CW)}$

b.) Let us draw a diagram to show the smallest force F_B



From figure $d = \sqrt{AC^2 + DE^2}$

$d = \sqrt{(0.85)^2 + (0.5m)^2}$

$d = 0.986\,m$

$\theta = \tan^{-1}\left(\frac{0.85}{0.5}\right)$

$\theta = 59.53^\circ$

Moment of point E, $-M_E = F_B \times d$

$196.2\,N.m = F_B\,(0.986m)$

$F_B = \frac{196.2\,N.m}{0.986m}$

$F_B = 198.98\,N$

the smallest force applied at B is $\boxed{F_B = 198.98\,N}$

(92) Write the equation of the position vector for the line DG,

$\vec{DG} = 21i - (15+23)j + 18k$

$= 21i - 38j + 18k$

Calculate the unit vector of $\vec{DG}$

$\lambda_{DG} = \frac{\vec{DG}}{|\vec{DG}|} = \frac{21i - 38j + 18k}{|21i - 38j + 18k|} = \frac{21i - 38j + 18k}{\sqrt{21^2 + (-38)^2 + 18^2}}$

$= 0,447i - 0,81j + 0,383k$

Calculate the force vector for the force P, $P = P.\lambda_{DG}$

$P = 470(0,447i - 0,81j + 0,383k)$

$= 210,09i - 380,7j + 180,01k$

$\vec{AB} = 32i - 30j - 24k$ $\quad \lambda_{AB} = \frac{\vec{AB}}{|\vec{AB}|} = \frac{32i - 30j - 24k}{\sqrt{32^2 + 30^2 + 24^2}}$

$\lambda_{AB} = 0,64i - 0,6j - 0,48k$

$\vec{AD} = 16i + 8j - 12k$

Calculate the vector product for the line AD and force vector P,

$(\vec{AD}) \times (P) = (16i + 8j - 12k) \times (210,09i - 380,7j + 180,01k)$

$= -6012k - 2880,16j - 1680,72k + 1440,08i - 2521,08$

$-4568,4i$

$= -3128,32i - 5401.24j - 7771,92k$

Calculate the moment about of the given force P about line AB,

$M_{AB} = \lambda_{AB} \cdot ((\vec{AD}) \times (P))$

$= (0,64i - 0,6j - 0,48k)(-3128,32i - 5401.24j - 7771.92k)$

$= 2002,1248 + 3240,744 + 3730,5216 = 4969,1408 Nm$

93

$AE = 120i + 120k - [-90i + 160j] = 210i - 160j + 120k$

unit vector $AE = \frac{210i}{290} - \frac{160j}{290} + \frac{120k}{290} = \frac{21i}{29} - \frac{16j}{29} + \frac{12k}{29}$

F in the direction of $AB = 435 \times \left[\frac{21i}{29} - \frac{16j}{29} + \frac{12k}{29}\right]$

$= 315i - 240j + 180k$

a.) Moment about O due to force on A

$= OA \times F = [-90i + 160j] \times [315i - 240j + 180k] = 21600k$

$+ 16200j - 50490k + 28800i$

$= 28800i + 16200j - 28800k$

b.) Moment about O due to force on E

$= OE \times F = [120i + 120k] \times (315i - 240j + 180k]$

$= -28800k - 21600j + 37800j + 28800i =$

$= 28800i - 16200j - 28800k$