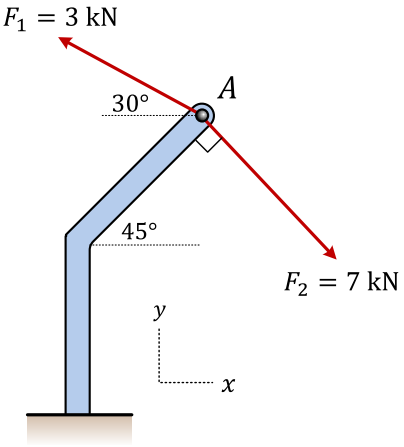
Question 1.11.



The two forces shown act at point A of the bent bar as shown. Determine the resultant R of the two forces.

Solution

Referring to Fig. (a)

$R_x = \sum F_x = -3\cos 30° + 7\cos 45°$

$R_x = 2.35$ kN

$R_y = \sum F_y = 3\sin 30° - 7\sin 45°$

$R_y = -3.45$ kN

$R = 2.35\,\underline{i} - 3.43\,\underline{j}$ kN (Answer)

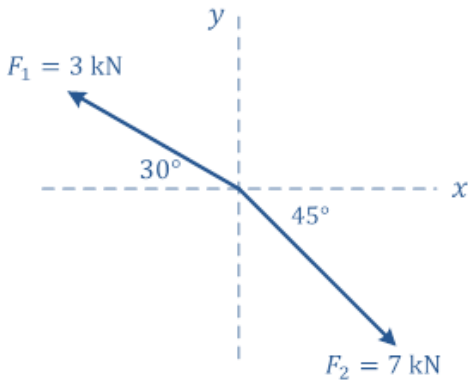
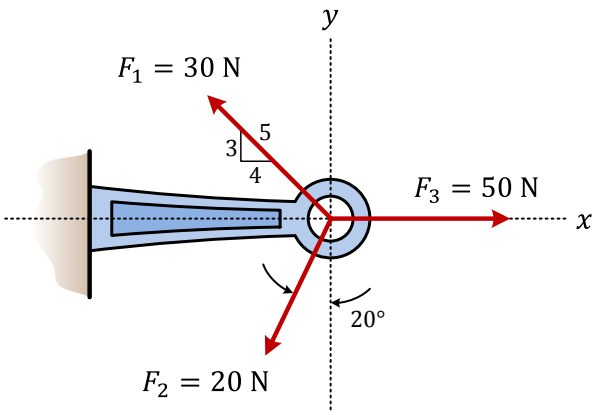


Fig. (a)

Question 1.12.

Determine the magnitude and direction of the resultant force, measured clockwise from the positive x - axis.



Solution

Resolve force F_1 into x and y components

$F_1 = F_{1x}\,\underline{i} + F_{1y}\,\underline{j}$

$F_1 = -30\left(\frac{4}{5}\right)\,\underline{i} + 30\left(\frac{3}{5}\right)\,\underline{j}$

$F_1 = (-24)\,\underline{i} + (18)\,\underline{j}$

Resolve force F_2 into x and y components

$F_2 = F_{2x}\,\underline{i} + F_{2y}\,\underline{j}$

$F_2 = (-20\sin 20°)\,\underline{i} + (-20\cos 20°)\,\underline{j}$

$F_2 = (-6.84)\,\underline{i} - (18.79)\,\underline{j}$

Resolve force F_3 into x and y components

$F_3 = F_{3x}\,\underline{i} + F_{3y}\,\underline{j}$

$F_3 = (50)\,\underline{i} + (0)\,\underline{j}$

$F_3 = (50)\,\underline{i}$

Sum the x and y components

$F_R = (-24 - 6.84 + 50)\,\underline{i} + (18 - 18.79 + 0)\,\underline{j}$

$F_R = (19.16)\,\underline{i} + (-0.8)\,\underline{j}$

Thus the magnitude of the resultant force is

$|\mathrm{F_R}| = \sqrt{F_x{}^2 + F_y{}^2} = \sqrt{(19.16\ \mathrm{N})^2 + (-0.8\ \mathrm{N})^2}$

$|\mathrm{F_R}| = 19.17\ \mathrm{kN}$ (Answer)

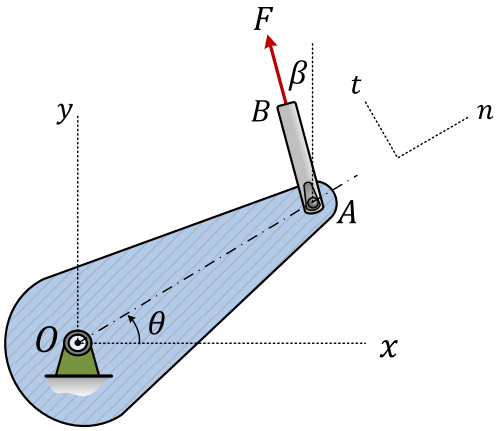
and the direction θ of F_R measured clockwise from the positive x - axis, is

$\theta = \tan^{-1}\left(\frac{0.8}{19.16}\right) = 2.39°$

(Answer)

Question 1.13.

Determine the $n-$ and $t-$ components of the force F which is exerted by the rod AB on the crank OA. Evaluate your general expression for $F = 100$ N and (a) $\theta = 30°,\ \beta = 10°$ and (b) $\theta = 15°,\ \beta = 25°$.



Solution

Referring to Fig. (a)

$F_n = F\sin(\theta - \beta)$

$F_t = F\cos(\theta - \beta)$

(a) For $\theta = 30°$ and $\beta = 10°$

$F_n = 100\sin(30° - 10°) = 34.2$ N (Answer)

$F_t = 100\cos(30° - 10°) = 94.0$ N (Answer)

(b) For $\theta = 15°$ and $\beta = 25°$

$F_n = 100\sin(15° - 25°) = -17.36$ N (Answer)

$F_t = 100\cos(15° - 25°) = 98.5$ N (Answer)

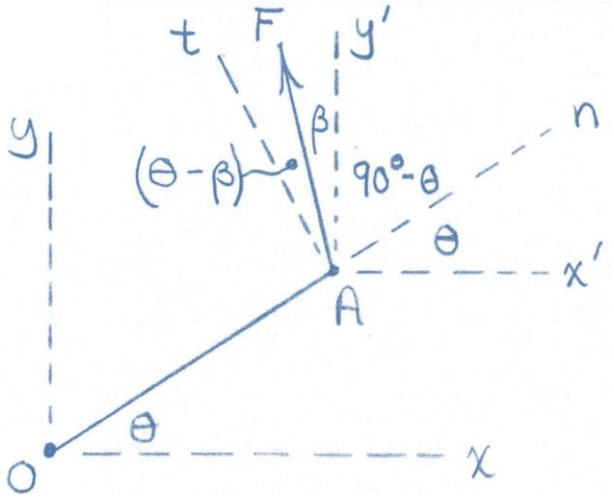
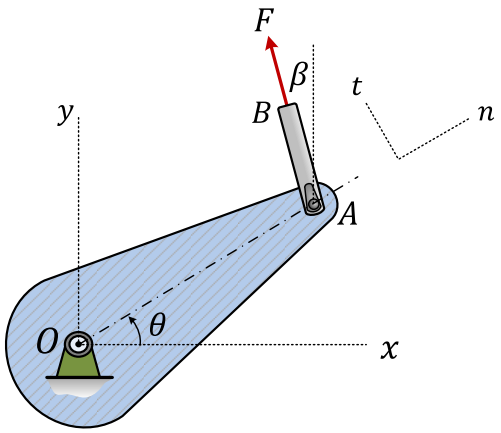


Fig. (a)

Question 1.14.

The crank of previous problem is repeated here. If $\overline{OA} = 50$ mm, $\theta = 25°$ and $\beta = 55°$, determine the moment of the force F of magnitude $F = 20$ N about point O.



Solution

From the solution to Question 1.13

$F_t = F\cos(\theta - \beta)$

$F_t = 20\cos(25° - 55°) = 17.32$ N

$+\circlearrowleft \sum M_o = F_t\,\overline{OA} = 17.32 \times 0.05$

$M_o = 0.866$ N.m (CCW) (Answer)