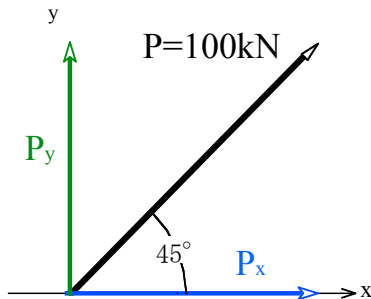


演習問題：力の合成と分解

1. P の水平分力  $P_x$  と鉛直分力  $P_y$  を求め、図示せよ.

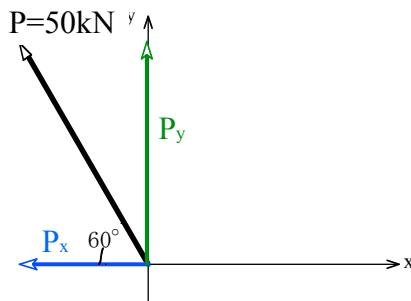
(1)



$$P_x = P \times \cos 45^\circ = 100kN \times \cos 45^\circ = 70.7kN$$

$$P_y = P \times \sin 45^\circ = 100kN \times \sin 45^\circ = 70.7kN$$

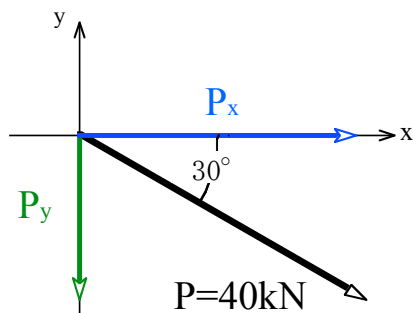
(2)



$$P_x = -P \times \cos 60^\circ = 50kN \times \cos 60^\circ = -25kN$$

$$P_y = P \times \sin 60^\circ = 50kN \times \sin 60^\circ = 43.3kN$$

(3)

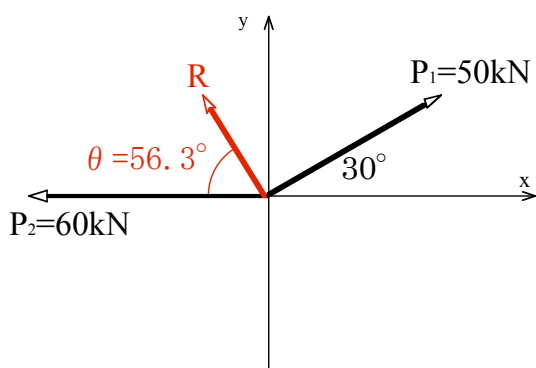


$$P_x = P \times \cos 30^\circ = 40kN \times \cos 30^\circ = 34.6kN$$

$$P_y = -P \times \sin 30^\circ = 40kN \times \sin 30^\circ = -20kN$$

2. 1 点に作用する 2 つの力  $P_1$  と  $P_2$  の合力  $R$  とその方向  $\theta$  を求め、図示せよ.

(1)



$$P_{1x} = P_1 \times \cos 30^\circ = 50kN \times \cos 30^\circ = 43.3kN$$

$$P_{1y} = P_1 \times \sin 30^\circ = 50kN \times \sin 30^\circ = 25kN$$

$$\Sigma H = P_{1x} - P_2 = 43.3kN - 60kN = -16.7kN$$

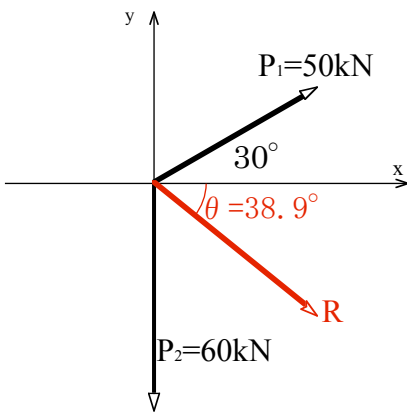
$$\Sigma V = P_{1y} = 25kN$$

三平方の定理より

$$R = \sqrt{(\Sigma H)^2 + (\Sigma V)^2} = \sqrt{(-16.7)^2 + (25)^2} = 30.1kN$$

$$\theta = \tan^{-1} \left( \frac{\Sigma V}{\Sigma H} \right) = \tan^{-1} \left( \frac{25}{-16.7} \right) = -56.3^\circ$$

(2)



$$P_{1x} = P_1 \times \cos 30^\circ = 50kN \times \cos 30^\circ = 43.3kN$$

$$P_{1y} = P_1 \times \sin 30^\circ = 50kN \times \sin 30^\circ = 25kN$$

$$\Sigma H = P_{1x} = 43.3kN$$

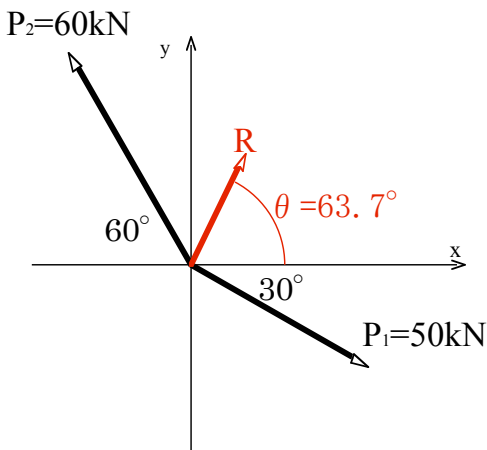
$$\Sigma V = P_{1y} - P_2 = 25kN - 60kN = -35kN$$

三平方の定理より

$$R = \sqrt{(\Sigma H)^2 + (\Sigma V)^2} = \sqrt{(43.3)^2 + (-25)^2} = 55.7kN$$

$$\theta = \tan^{-1}\left(\frac{\Sigma V}{\Sigma H}\right) = \tan^{-1}\left(\frac{-35}{43.3}\right) = -38.9^\circ$$

(3)



$$P_{1x} = P_1 \times \cos 30^\circ = 50kN \times \cos 30^\circ = 43.3kN$$

$$P_{1y} = -P_1 \times \sin 30^\circ = -50kN \times \sin 30^\circ = -25kN$$

$$P_{2x} = -P_2 \times \cos 60^\circ = -60kN \times \cos 60^\circ = -30kN$$

$$P_{2y} = P_2 \times \sin 60^\circ = 60kN \times \sin 60^\circ = 52kN$$

$$\Sigma H = P_{1x} - P_{2x} = 43.3kN - 30kN = 13.3kN$$

$$\Sigma V = -P_{1y} + P_{2y} = -25kN + 52kN = 27kN$$

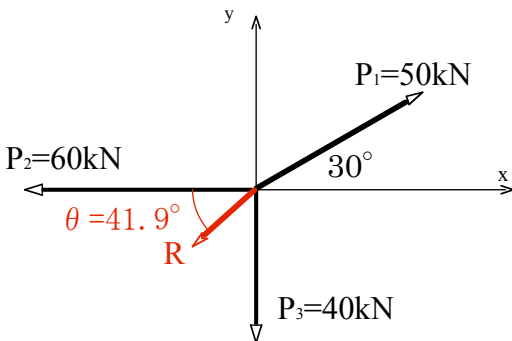
三平方の定理より

$$R = \sqrt{(\Sigma H)^2 + (\Sigma V)^2} = \sqrt{(13.3)^2 + (27)^2} = 30.1kN$$

$$\theta = \tan^{-1}\left(\frac{\Sigma V}{\Sigma H}\right) = \tan^{-1}\left(\frac{27}{13.3}\right) = 63.8^\circ$$

3. 1 点に作用する 3 つの力  $P_1$ ,  $P_2$ ,  $P_3$  の合力とその方向(角度)を求め、図示せよ。

(1)



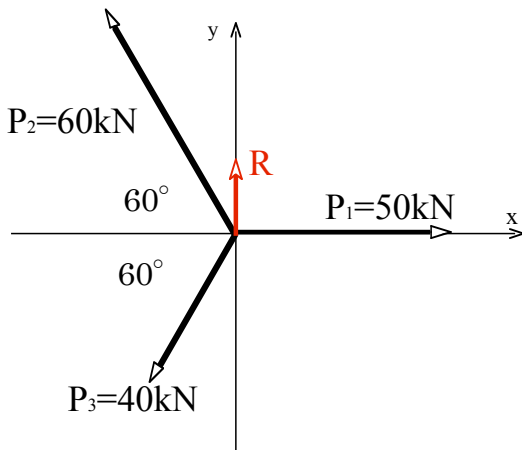
	→H	↑V
$P_1$	$P_1 \cos 30^\circ = 43.3kN$	$P_1 \sin 30^\circ = 25kN$
$P_2$	$-P_2 = -60kN$	0
$P_3$	0	$-P_3 = -40kN$
$\Sigma$	H = -16.7kN	V = -15kN

三平方の定理より

$$R = \sqrt{(\Sigma H)^2 + (\Sigma V)^2} = \sqrt{(-16.7)^2 + (-15)^2} = 22.4kN$$

$$\theta = \tan^{-1}\left(\frac{\Sigma V}{\Sigma H}\right) = \tan^{-1}\left(\frac{-15}{-16.7}\right) = 41.9^\circ$$

(2)



	→H	↑V
$P_1$	$P_1=50\text{kN}$	0
$P_2$	$-P_2\cos 60^\circ=-30\text{kN}$	$P_2\sin 60^\circ=52\text{kN}$
$P_3$	$-P_3\cos 60^\circ=-20\text{kN}$	$-P_3\sin 60^\circ=-34.6\text{kN}$
$\Sigma$	$H=0\text{kN}$	$V=17.4\text{kN}$

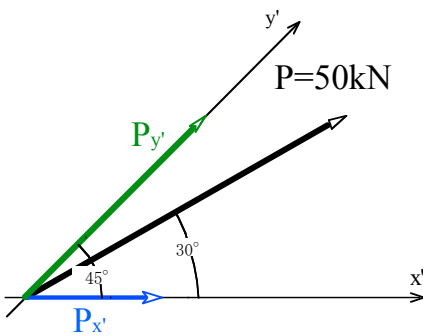
三平方の定理より

$$R = \sqrt{(\Sigma H)^2 + (\Sigma V)^2} = \sqrt{(0)^2 + (17.4)^2} = 17.4\text{kN}$$

$$\theta = \tan^{-1}\left(\frac{\Sigma V}{\Sigma H}\right) = \tan^{-1}\left(\frac{17.4}{0}\right) = 90^\circ$$

4. 力 P の  $x'$  方向と  $y'$  方向の分力を求めよ。

(1)



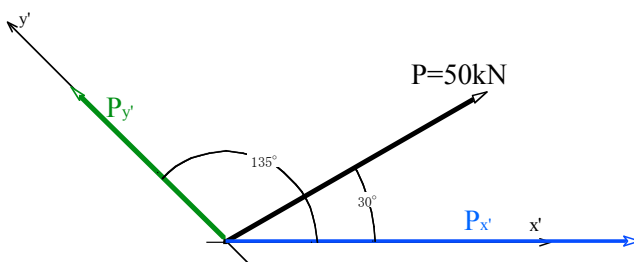
正弦定理より

$$\frac{P_{y'}}{\sin 30^\circ} = \frac{P_{x'}}{\sin 15^\circ} = \frac{P}{\sin 135^\circ}$$

$$P_{y'} = \frac{P}{\sin 135^\circ} \times \sin 30^\circ = \frac{50}{\sin 135^\circ} \times \sin 30^\circ = 35.4\text{kN}$$

$$P_{x'} = \frac{P}{\sin 135^\circ} \times \sin 15^\circ = \frac{50}{\sin 135^\circ} \times \sin 15^\circ = 18.3\text{kN}$$

(2)



正弦定理より

$$\frac{P_{y'}}{\sin 30^\circ} = \frac{P_{x'}}{\sin 105^\circ} = \frac{P}{\sin 45^\circ}$$

$$P_{y'} = \frac{P}{\sin 45^\circ} \times \sin 30^\circ = \frac{50}{\sin 45^\circ} \times \sin 30^\circ = 35.5\text{kN}$$

$$P_{x'} = \frac{P}{\sin 45^\circ} \times \sin 105^\circ = \frac{50}{\sin 45^\circ} \times \sin 105^\circ = 68.3\text{kN}$$