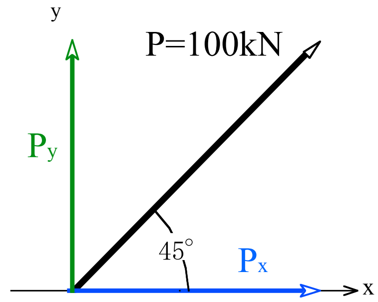
R1 年度　基礎力学　　担当 岩城・子田　　提出日：2019 年 5 月 27 日

演習問題：力の合成と分解

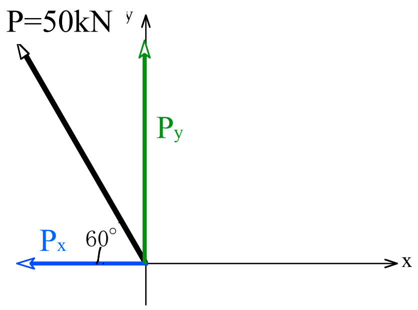
１．P の水平分力 P_x と鉛直分力 P_y を求め，図示せよ．

(1)



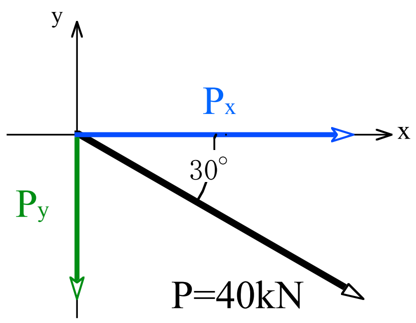
$$P_x = P \times \cos 45^\circ = 100kN \times \cos 45^\circ = 70.7kN$$
$$P_y = P \times \sin 45^\circ = 100kN \times \sin 45^\circ = 70.7kN$$

(2)



$$P_x = -P \times \cos 60^\circ = 50kN \times \cos 60^\circ = -25kN$$
$$P_y = P \times \sin 60^\circ = 50kN \times \sin 60^\circ = 43.3kN$$

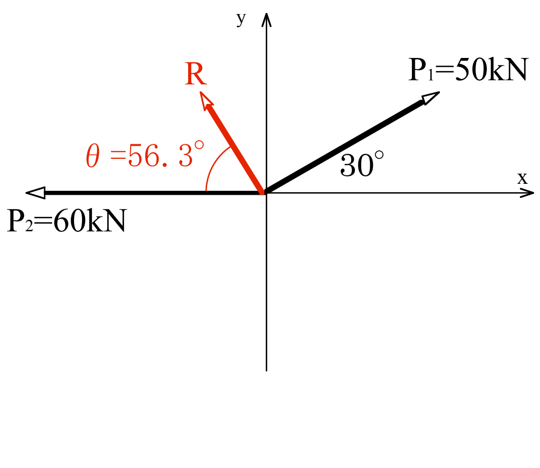
(3)



$$P_x = P \times \cos 30^\circ = 40kN \times \cos 30^\circ = 34.6kN$$
$$P_y = -P \times \sin 30^\circ = 40kN \times \sin 30^\circ = -20kN$$

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 θ を求め，図示せよ．

(1)



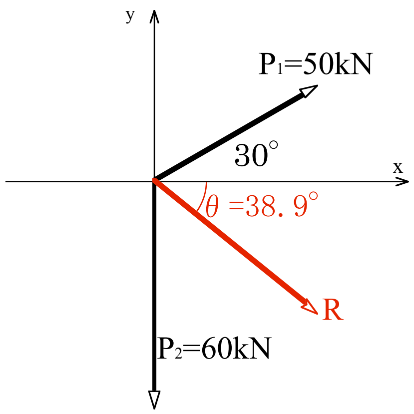
$$P_{1x} = P_1 \times \cos 30^\circ = 50kN \times \cos 30^\circ = 43.3kN$$
$$P_{1y} = P_1 \times \sin 30^\circ = 50kN \times \sin 30^\circ = 25kN$$

$$\Sigma H = P_{1x} - P_2 = 43.3kN - 60kN = -16.7kN$$
$$\Sigma V = P_{1y} = 25kN$$

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)



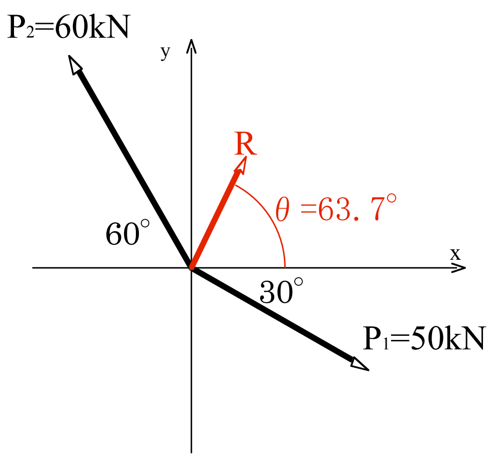
$$P_{1x} = P_1 \times \cos 30^\circ = 50kN \times \cos 30^\circ = 43.3kN$$
$$P_{1y} = P_1 \times \sin 30^\circ = 50kN \times \sin 30^\circ = 25kN$$

$$\Sigma H = P_{1x} = 43.3kN$$
$$\Sigma V = P_{1y} - P_2 = 25kN - 60kN = -35kN$$

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)



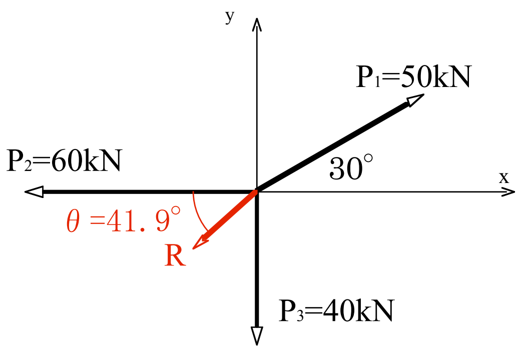
$$P_{1x} = P_1 \times \cos 30^\circ = 50kN \times \cos 30^\circ = 43.3kN$$
$$P_{1y} = -P_1 \times \sin 30^\circ = -50kN \times \sin 30^\circ = -25kN$$
$$P_{2x} = -P_2 \times \cos 60^\circ = -60kN \times \cos 60^\circ = -30kN$$
$$P_{2y} = P_2 \times \sin 60^\circ = 60kN \times \sin 60^\circ = 52kN$$
$$\Sigma H = P_{1x} - P_{2x} = 43.3kN - 30kN = 13.3kN$$
$$\Sigma V = -P_{1y} + P_{2y} = -25kN + 52kN = 27kN$$

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)

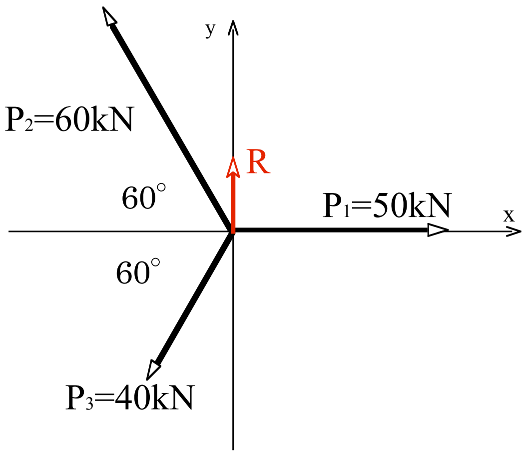


	→H	↑V
P_1	$P_1 cos30°$=43.3kN	$P_1 sin30°$=25kN
P_2	$-P_2$=-60kN	0
P_3	0	$-P_3$=-40kN
Σ	H=-16.7kN	V=-15kN

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=50kN	0
P_2	$-P_2 cos60°$=-30kN	$P_2 sin60°$=52kN
P_3	$-P_3 cos60°$=-20kN	$-P_3 sin60°$=-34.6kN
Σ	H=0kN	V=17.4kN

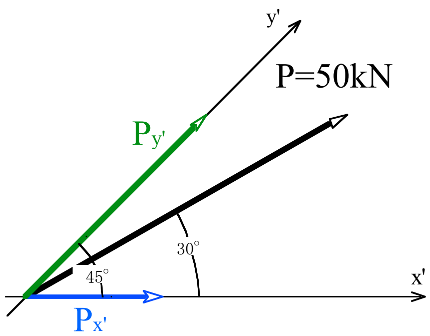
三平方の定理より

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

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

４．力 P の x'方向と y'方向の分力を求めよ．

(1)



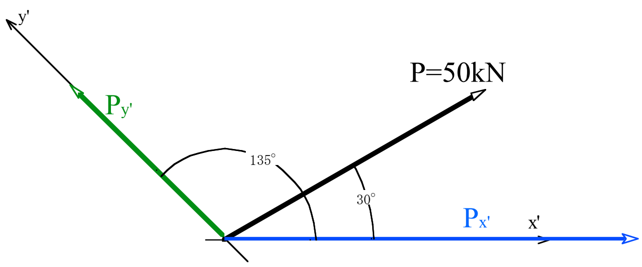
正弦定理より

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

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

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

(2)



正弦定理より

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

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

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