

電験どうでしょう管理人
KWG presents

電験オンライン塾

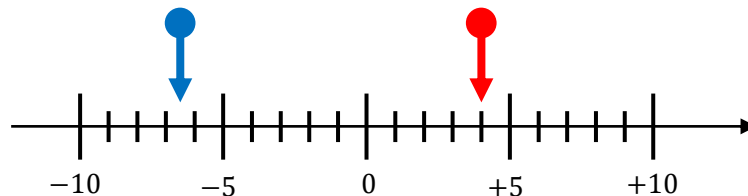
第8回 電気数学
ベクトル(3)

2022.10.23 Sun

ベクトル

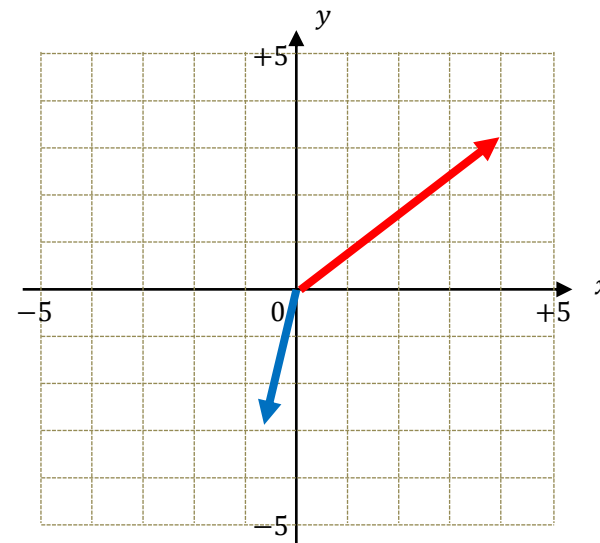
スカラー量 “大きさ”のみ

例) 時間、重さ、温度、面積、エネルギーなど
電荷、静電容量、電力など



ベクトル量 “大きさ”と“向き”

例) 位置、速度、加速度、力など
電流、電圧、インピーダンス、電界、磁界など



ベクトルの表し方

\vec{a}, \vec{b} 高校数学での表現

a, b 大学や専門科目での表現 (電磁気学)

\dot{a}, \dot{b} ベクトル (複素平面) の表現 ← 電験はこれ

ベクトルを理解するために

○計算に必要な知識

- A. xy 平面の座標の読み方
- B. 三平方の定理
- C. 三角関数(三角比)

○ベクトルとして知っておくこと

- 1. 位置ベクトル
- 2. ベクトルの大きさ
- 3. ベクトルの成分分解
- 4. ベクトルの合成

ベクトルの合成

$$A_x = A \cos \theta_1$$

$$A_y = A \sin \theta_1$$

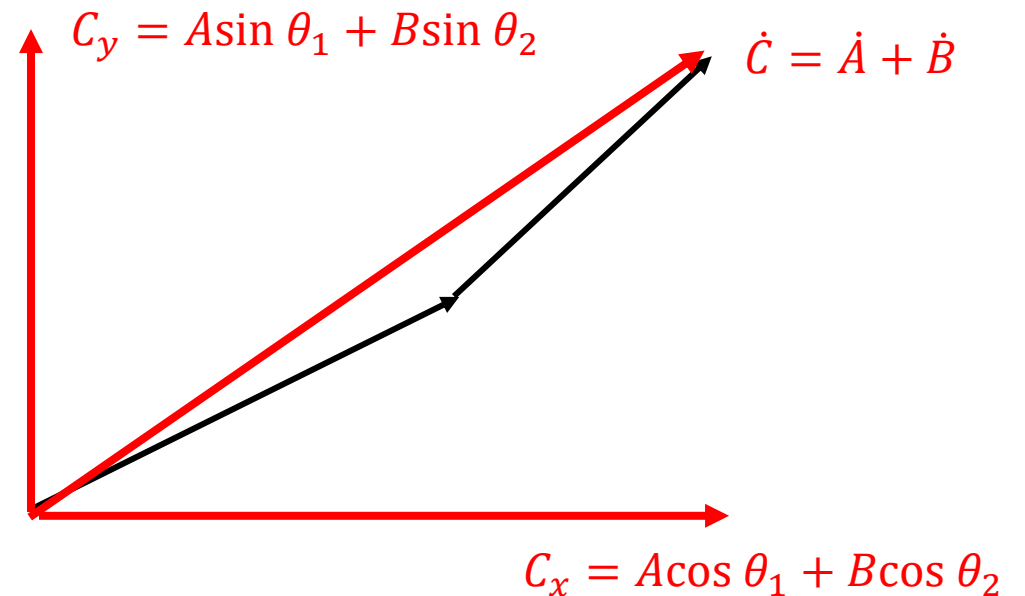
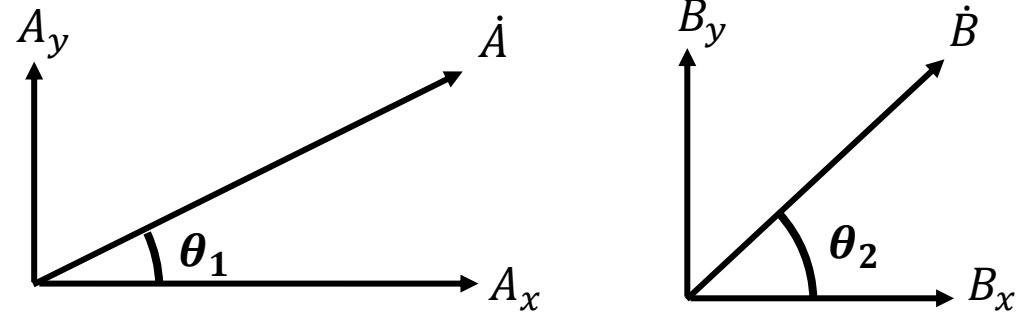
$$B_x = B \cos \theta_2$$

$$B_y = B \sin \theta_2$$

$$C_x = A \cos \theta_1 + B \cos \theta_2$$

$$C_y = A \sin \theta_1 + B \sin \theta_2$$

$$C = A + B = \sqrt{C_x^2 + C_y^2}$$



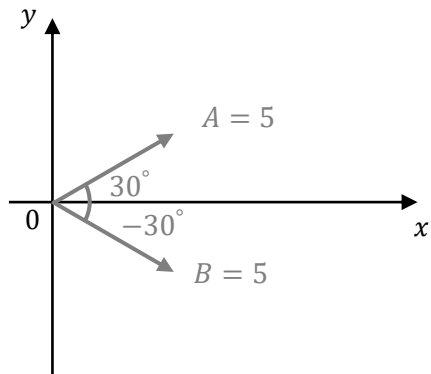
練習問題 I

$A_x + B_x, A_y + B_y$ を求めよ

(1)

$$A_x + B_x =$$

$$A_y + B_y =$$



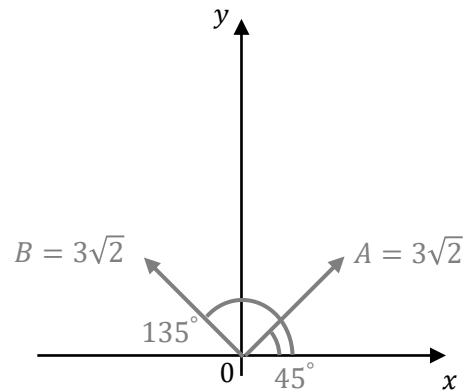
$$A_x + B_x =$$

Ans. $A_y + B_y =$

(2)

$$A_x + B_x =$$

$$A_y + B_y =$$



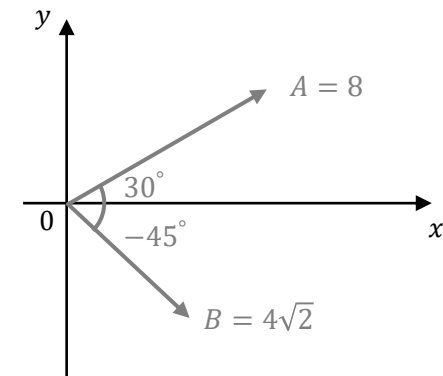
$$A_x + B_x =$$

Ans. $A_y + B_y =$

(3)

$$A_x + B_x =$$

$$A_y + B_y =$$



$$A_x + B_x =$$

Ans. $A_y + B_y =$

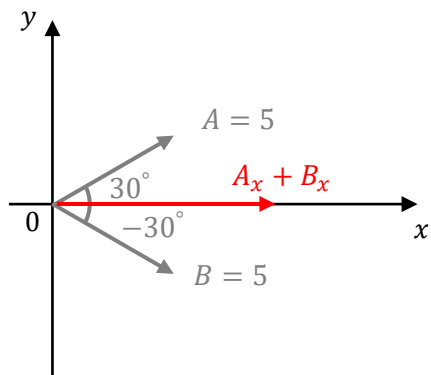
練習問題 I (解答)

$A_x + B_x, A_y + B_y$ を求めよ

(1)

$$\begin{aligned} A_x + B_x &= A \cos 30^\circ + B \cos(-30^\circ) \\ &= 5 \times \frac{\sqrt{3}}{2} + 5 \times \frac{\sqrt{3}}{2} = 5\sqrt{3} \end{aligned}$$

$$\begin{aligned} A_y + B_y &= A \sin 30^\circ + B \sin(-30^\circ) \\ &= 5 \times \frac{1}{2} + 5 \times \left(-\frac{1}{2}\right) = 0 \end{aligned}$$

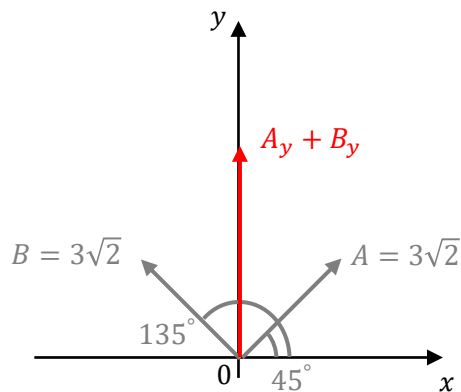


Ans. $A_x + B_x = 5\sqrt{3}$
 $A_y + B_y = 0$

(2)

$$\begin{aligned} A_x + B_x &= A \cos 45^\circ + B \cos 135^\circ \\ &= 3\sqrt{2} \times \frac{1}{\sqrt{2}} + 3\sqrt{2} \times \left(-\frac{1}{\sqrt{2}}\right) \\ &= 0 \end{aligned}$$

$$\begin{aligned} A_y + B_y &= A \sin 45^\circ + B \sin 135^\circ \\ &= 3\sqrt{2} \times \frac{1}{\sqrt{2}} + 3\sqrt{2} \times \frac{1}{\sqrt{2}} = 6 \end{aligned}$$

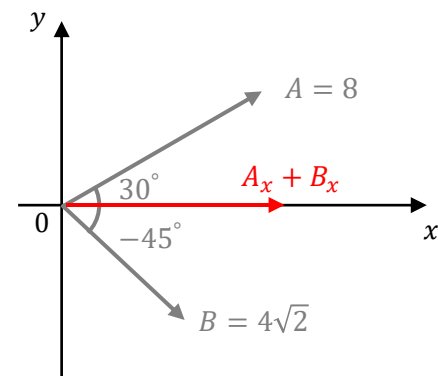


Ans. $A_x + B_x = 0$
 $A_y + B_y = 6$

(3)

$$\begin{aligned} A_x + B_x &= A \cos 30^\circ + B \cos(-45^\circ) \\ &= 8 \times \frac{\sqrt{3}}{2} + 4\sqrt{2} \times \frac{1}{\sqrt{2}} = 10\sqrt{3} \\ &= 4\sqrt{3} + 4 \end{aligned}$$

$$\begin{aligned} A_y + B_y &= A \sin 30^\circ + B \sin(-45^\circ) \\ &= 8 \times \frac{1}{2} + 4\sqrt{2} \times \left(-\frac{1}{\sqrt{2}}\right) = 0 \end{aligned}$$



Ans. $A_x + B_x = 4\sqrt{3} + 4$
 $A_y + B_y = 0$

練習問題2

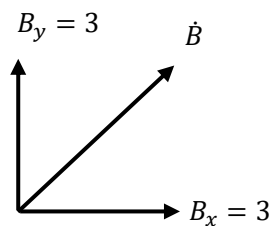
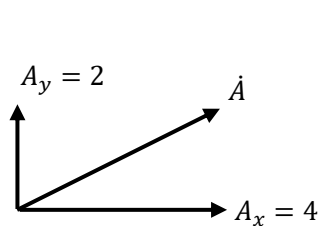
$A + B$ を求めよ

(1)

$$A_x + B_x =$$

$$A_y + B_y =$$

$$A + B =$$



Ans. $A + B =$

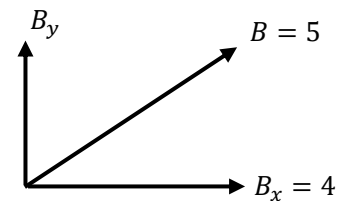
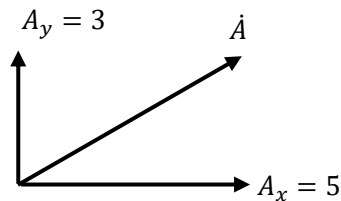
(2)

$$A_x + B_x =$$

$$B_y =$$

$$A_y + B_y =$$

$$A + B =$$



Ans. $A + B =$

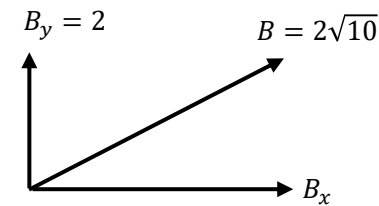
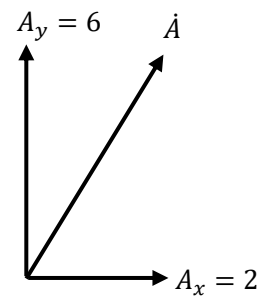
(3)

$$B_x =$$

$$A_x + B_x =$$

$$A_y + B_y =$$

$$A + B =$$



Ans. $A + B =$

練習問題2 (解答)

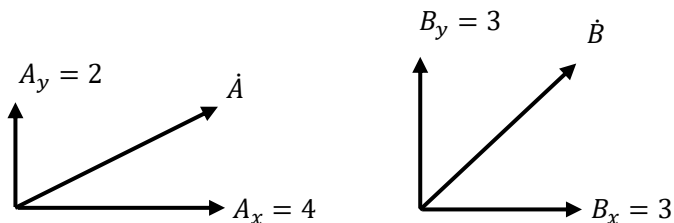
$A + B$ を求めよ

(1)

$$A_x + B_x = 4 + 3 = 7$$

$$A_y + B_y = 2 + 3 = 5$$

$$\begin{aligned} A + B &= \sqrt{7^2 + 5^2} \\ &= \sqrt{49 + 25} = \sqrt{74} \end{aligned}$$



Ans. $A + B = \sqrt{74}$

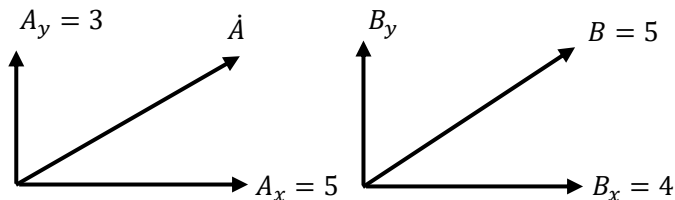
(2)

$$A_x + B_x = 5 + 4 = 9$$

$$\begin{aligned} B_y &= \sqrt{5^2 - 4^2} = \sqrt{25 - 16} \\ &= \sqrt{9} = 3 \end{aligned}$$

$$A_y + B_y = 3 + 3 = 6$$

$$\begin{aligned} A + B &= \sqrt{9^2 + 6^2} \\ &= \sqrt{81 + 36} = \sqrt{117} \\ &= \sqrt{9 \times 13} = 3\sqrt{13} \end{aligned}$$



Ans. $A + B = 3\sqrt{13}$

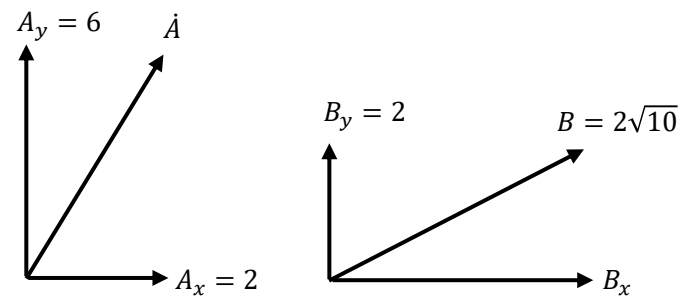
(3)

$$\begin{aligned} B_x &= \sqrt{(2\sqrt{10})^2 - 2^2} = \sqrt{40 - 4} \\ &= \sqrt{36} = 6 \end{aligned}$$

$$A_x + B_x = 2 + 6 = 8$$

$$A_y + B_y = 6 + 2 = 8$$

$$\begin{aligned} A + B &= \sqrt{8^2 + 8^2} \\ &= \sqrt{8^2 \times 2} = 8\sqrt{2} \end{aligned}$$

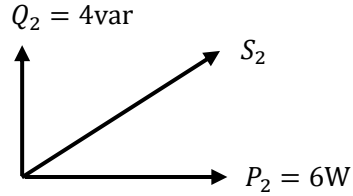
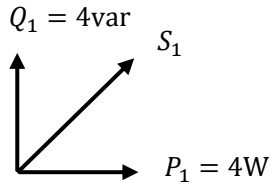


Ans. $A + B = 8\sqrt{2}$

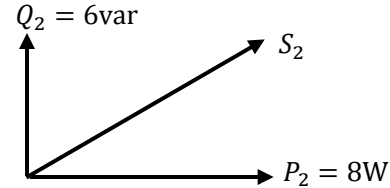
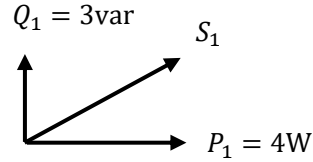
練習問題3

合成の皮相電力 $S_1 + S_2$ の大きさを求めよ。

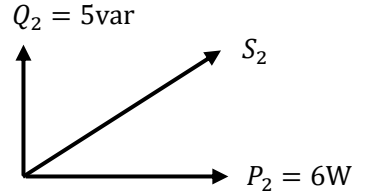
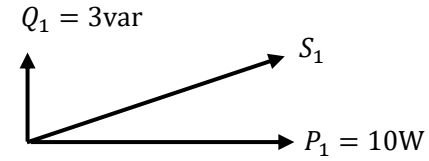
(1)



(2)



(3)



Ans. $|S_1 + S_2| =$ _____

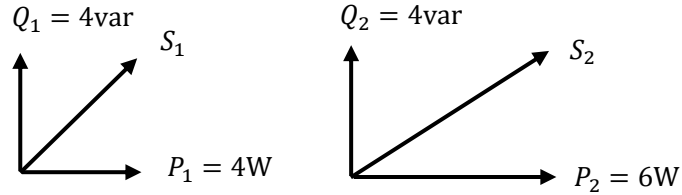
Ans. $|S_1 + S_2| =$ _____

Ans. $|S_1 + S_2| =$ _____

練習問題3 (解答)

合成の皮相電力 $S_1 + S_2$ の大きさを求めよ。

(1)



$$P_{12} = P_1 + P_2 = 4 + 6 = 10$$

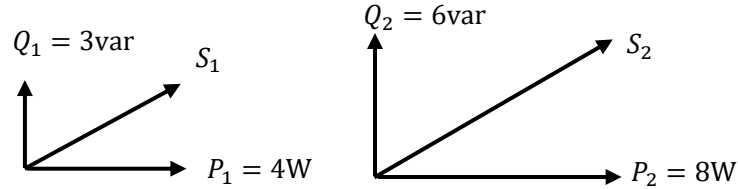
$$Q_{12} = Q_1 + Q_2 = 4 + 4 = 8$$

$$|S_1 + S_2| = \sqrt{P_{12}^2 + Q_{12}^2} = \sqrt{10^2 + 8^2} = \sqrt{164}$$

$$= 2\sqrt{41}$$

Ans. $|S_1 + S_2| = 2\sqrt{41}$ VA

(2)



$$P_{12} = P_1 + P_2 = 4 + 8 = 12$$

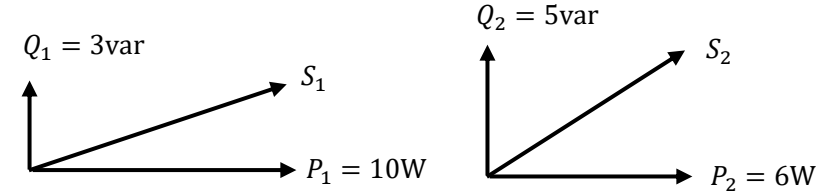
$$Q_{12} = Q_1 + Q_2 = 3 + 6 = 9$$

$$|S_1 + S_2| = \sqrt{P_{12}^2 + Q_{12}^2} = \sqrt{12^2 + 9^2}$$

$$= \sqrt{81 + 144} = \sqrt{225} = \sqrt{15^2} = 15$$

Ans. $|S_1 + S_2| = 15$ VA

(3)



$$P_{12} = P_1 + P_2 = 10 + 6 = 16$$

$$Q_{12} = Q_1 + Q_2 = 3 + 5 = 8$$

$$S_1 + S_2 = \sqrt{P_{12}^2 + Q_{12}^2} = \sqrt{16^2 + 8^2}$$

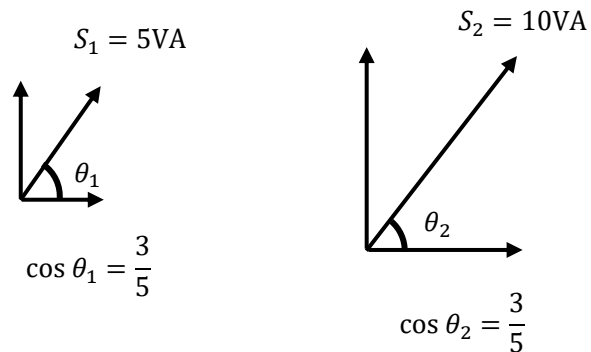
$$= 8\sqrt{1 + 2^2} = 8\sqrt{5}$$

Ans. $|S_1 + S_2| = 8\sqrt{5}$ VA

練習問題4

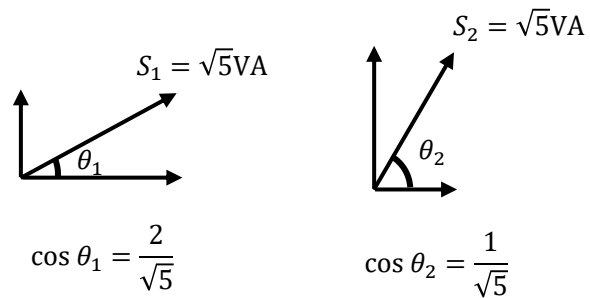
合成の皮相電力 $S_1 + S_2$ の大きさを求めよ。

(1)



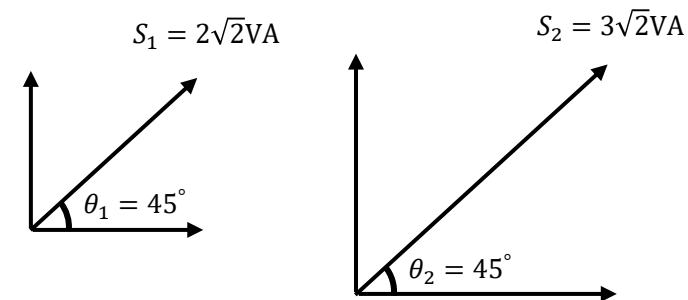
Ans. $|S_1 + S_2| =$ _____

(2)



Ans. $|S_1 + S_2| =$ _____

(3)

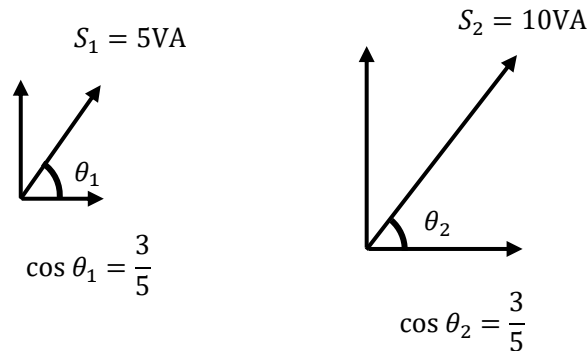


Ans. $|S_1 + S_2| =$ _____

練習問題4 (解答)

合成の皮相電力 $S_1 + S_2$ の大きさを求めよ。

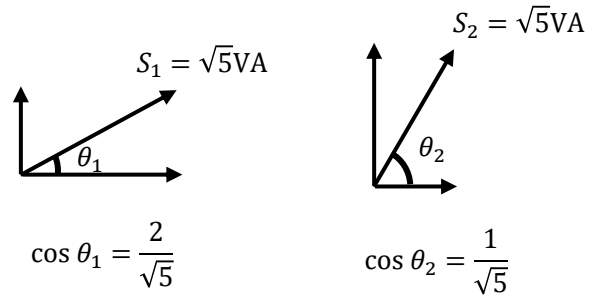
(1)



$\theta_1 = \theta_2$ より
 $|S_1 + S_2| = 5 + 10 = 15$

Ans. $|S_1 + S_2| = 15 \text{ VA}$

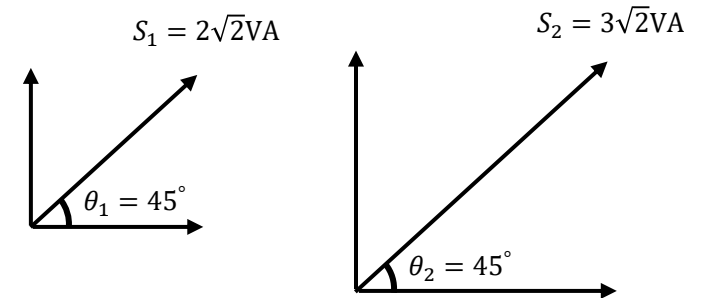
(2)



$P_1 = S_1 \cos \theta_1 = \sqrt{5} \cdot \frac{2}{\sqrt{5}} = 2$
 $Q_1 = S_1 \sin \theta_1 = S_1 \sqrt{1 - \cos^2 \theta_1} = \sqrt{5} \cdot \sqrt{1 - \left(\frac{2}{\sqrt{5}}\right)^2}$
 $= \sqrt{5} \cdot \sqrt{1 - \frac{4}{5}} = \sqrt{5} \cdot \sqrt{\frac{1}{5}} = \sqrt{5} \cdot \frac{1}{\sqrt{5}} = 1$
 $P_2 = S_2 \cos \theta_2 = \sqrt{5} \cdot \frac{1}{\sqrt{5}} = 1$
 $Q_2 = S_2 \sin \theta_2 = \sqrt{5} \cdot \frac{2}{\sqrt{5}} = 2$
 $|S_1 + S_2| = \sqrt{(2+1)^2 + (1+2)^2} = \sqrt{3^2 + 3^2}$
 $= \sqrt{9+9} = \sqrt{18} = 3\sqrt{2}$

Ans. $|S_1 + S_2| = 3\sqrt{2} \text{ VA}$

(3)



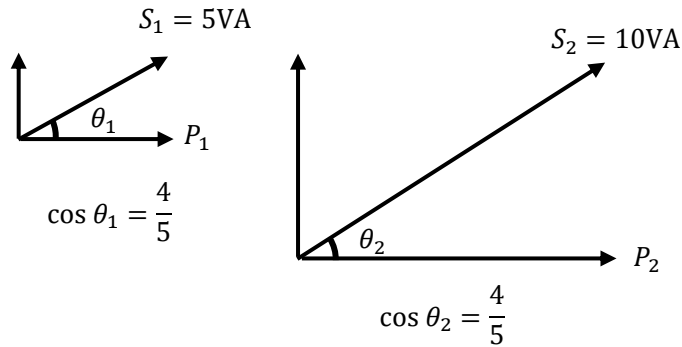
$P_1 = S_1 \cos \theta_1 = 2\sqrt{2} \cdot \frac{1}{\sqrt{2}} = 2$
 $Q_1 = S_1 \sin \theta_1 = 2\sqrt{2} \cdot \frac{1}{\sqrt{2}} = 2$
 $P_2 = S_2 \cos \theta_2 = 3\sqrt{2} \cdot \frac{1}{\sqrt{2}} = 3$
 $Q_2 = S_2 \sin \theta_2 = 3\sqrt{2} \cdot \frac{1}{\sqrt{2}} = 3$
 $|S_1 + S_2| = \sqrt{(2+3)^2 + (2+3)^2} = \sqrt{5^2 + 5^2}$
 $= \sqrt{25+25} = \sqrt{50} = 5\sqrt{2}$

Ans. $|S_1 + S_2| = 5\sqrt{2} \text{ VA}$

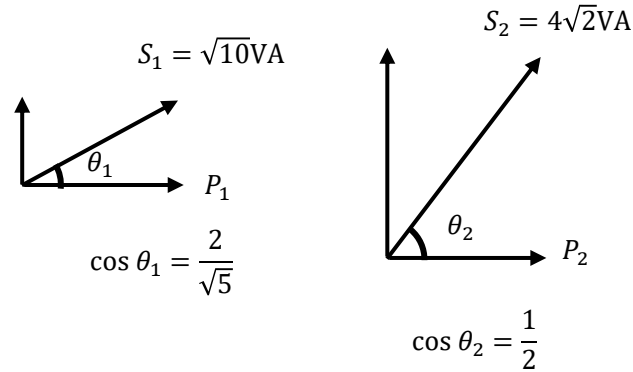
練習問題5

合成の有効電力 $P_1 + P_2$ の大きさを求めよ。

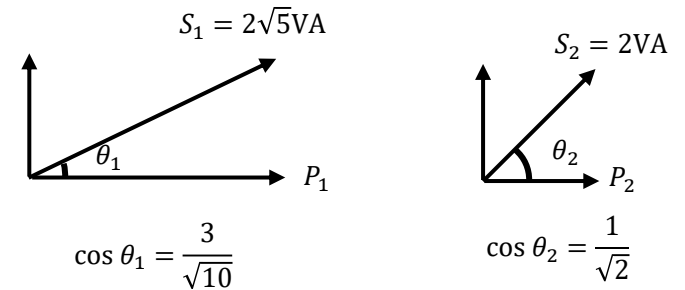
(1)



(2)



(3)



Ans. $|P_1 + P_2| =$ _____

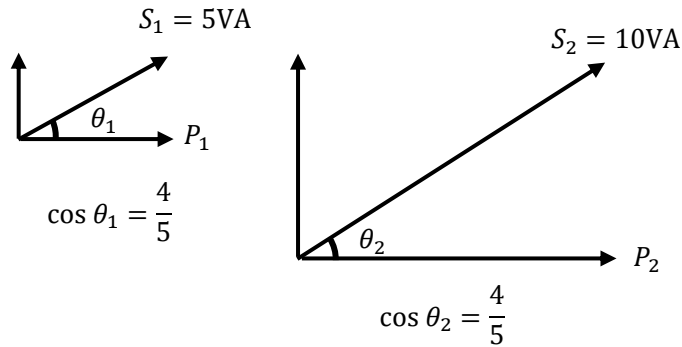
Ans. $|P_1 + P_2| =$ _____

Ans. $|P_1 + P_2| =$ _____

練習問題5 (解答)

合成の有効電力 $P_1 + P_2$ の大きさを求めよ。

(1)



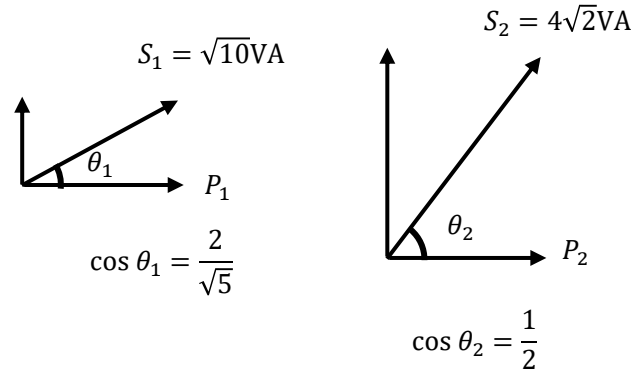
$$P_1 = S_1 \cos \theta_1 = 5 \cdot \frac{4}{5} = 4$$

$$P_2 = S_2 \cos \theta_2 = 10 \cdot \frac{4}{5} = 8$$

$$P_1 + P_2 = 4 + 8 = 12$$

Ans. $|P_1 + P_2| = 12 \text{ W}$

(2)



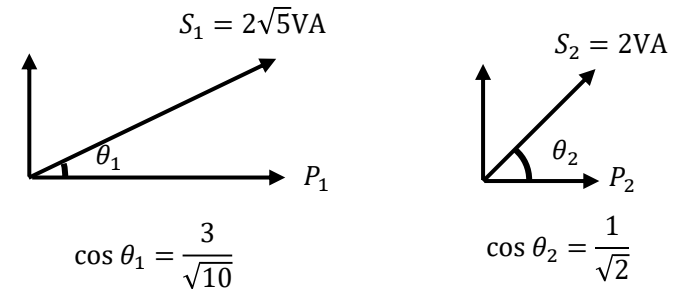
$$P_1 = S_1 \cos \theta_1 = \sqrt{10} \cdot \frac{2}{\sqrt{5}} = 2\sqrt{2}$$

$$P_2 = S_2 \cos \theta_2 = 4\sqrt{2} \cdot \frac{1}{2} = 2\sqrt{2}$$

$$P_1 + P_2 = 2\sqrt{2} + 2\sqrt{2} = 4\sqrt{2}$$

Ans. $|P_1 + P_2| = 4\sqrt{2} \text{ W}$

(3)



$$P_1 = S_1 \cos \theta_1 = 2\sqrt{5} \cdot \frac{3}{\sqrt{10}} = \frac{6}{\sqrt{2}} = \frac{6\sqrt{2}}{2} = 3\sqrt{2}$$

$$P_2 = S_2 \cos \theta_2 = 2 \cdot \frac{1}{\sqrt{2}} = 2 \cdot \frac{\sqrt{2}}{2} = \sqrt{2}$$

$$P_1 + P_2 = 3\sqrt{2} + \sqrt{2} = 4\sqrt{2}$$

Ans. $|P_1 + P_2| = 4\sqrt{2} \text{ W}$

ご聴講ありがとうございました
ございました!!