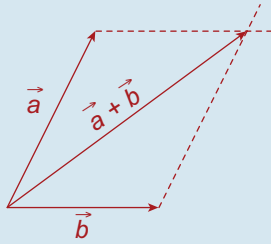
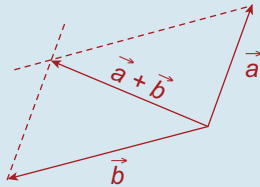


Chapter 1 Exercise 1A

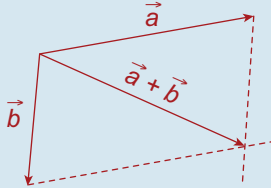
Q. 1. (i)



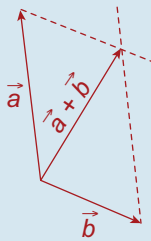
(ii)



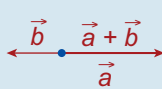
(iii)



(iv)

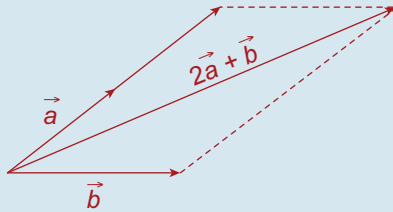


(v)

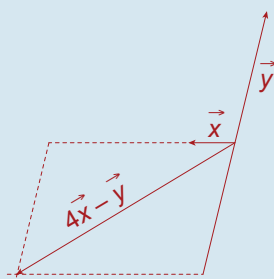


(vi)  $\vec{0}$ , The null vector

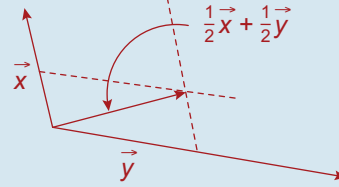
Q. 2.



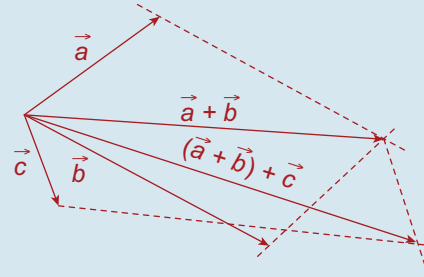
Q. 3.



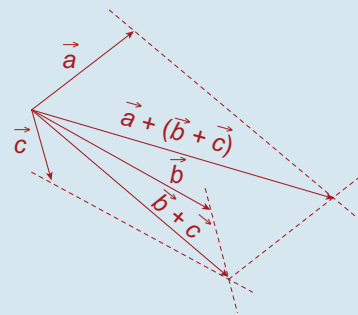
Q. 4.



Q. 5.

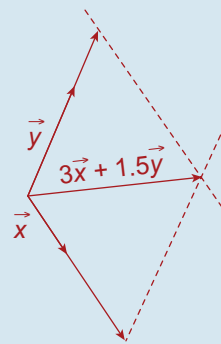


Q. 6.

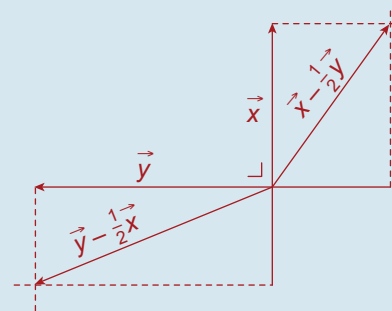


Yes;  $(\vec{a} + \vec{b}) + \vec{c} = \vec{a} + (\vec{b} + \vec{c})$ .

Q. 7.



Q. 8.



Q. 9. 5 cm; E  $53^\circ$  N.

**Q. 10.** Approximately 7 cm due East.

**Q. 11.** 13 cm.

### Exercise 1B

**Q. 1.** (i)  $\sqrt{29}$ , E  $21^\circ 48'$  N.

(ii)  $\sqrt{8}$ , NE.

(iii) 5, E  $36^\circ 52'$  S.

(iv) 13, W  $67^\circ 23'$  S.

(v)  $\sqrt{20}$ , W  $26^\circ 34'$  N.

(vi)  $\sqrt{2}$ , NE.

(vii)  $\frac{1}{\sqrt{2}}$ , SE.

(viii) 1, W  $53^\circ 8'$  S.

(ix) 2, W  $30^\circ$  N.

(x)  $\sqrt{12}$ , E  $30^\circ$  N.

(xi) 4, due West.

**Q. 2.** (i)  $\vec{a} + \vec{b} = (3\vec{i} - \vec{j}) + (2\vec{i} - 3\vec{j})$   
 $= 5\vec{i} - 4\vec{j}$

(ii)  $\vec{a} - \vec{b} = (3\vec{i} - \vec{j}) - (2\vec{i} - 3\vec{j})$   
 $= \vec{i} + 2\vec{j}$

(iii)  $\vec{b} - \vec{a} = (2\vec{i} - 3\vec{j}) - (3\vec{i} - \vec{j})$   
 $= -\vec{i} - 2\vec{j}$

(iv)  $2\vec{a} - 3\vec{b} = 2(3\vec{i} - \vec{j}) - 3(2\vec{i} - 3\vec{j})$   
 $= 7\vec{j}$

**Q. 3.**  $\vec{x} + \vec{y} = (2\vec{i} + 3\vec{j}) + (10\vec{i} + 2\vec{j})$   
 $= 12\vec{i} + 5\vec{j}$

(i)  $\sqrt{13}$

(ii)  $\sqrt{104}$

(iii)  $|\vec{x} + \vec{y}| = \sqrt{12^2 + 5^2} = 13$

(iv)  $|\vec{x}| + |\vec{y}| = \sqrt{13} + \sqrt{104}$   
 $= 3.606 + 10.20$   
 $= 13.806$

$\therefore |\vec{x} + \vec{y}| < |\vec{x}| + |\vec{y}|$   
 (since  $13 < 13.806$ )

**Q. 4.** (i)  $4\vec{i} + 8\vec{j}$

(ii)  $\sqrt{16 + 64} = \sqrt{80} = 8.944$

(iii)  $\sqrt{80} < \sqrt{10} + \sqrt{50}$   
 since  $8.944 < 10.233$

**Q. 5.**  $\sqrt{5} \geq \sqrt{20} - \sqrt{5}$   
 since  $2.236 \geq 4.472 - 2.236$

**Q. 6.** (i) Magnitude  $= \sqrt{3^2 + 4^2} = 5$   
 $\therefore$  Unit vector  $= \frac{1}{5}(3\vec{i} + 4\vec{j})$

(ii)  $\frac{1}{\sqrt{5}}(\vec{i} + 2\vec{j})$

(iii)  $\frac{1}{\sqrt{2}}(\vec{i} - \vec{j})$

(iv)  $\frac{1}{\sqrt{10}}(-3\vec{i} - \vec{j})$

(v)  $\frac{1}{2}(\sqrt{3}\vec{i} + \vec{j})$

**Q. 7.**  $k(2\vec{i} - \vec{j}) + l(4\vec{i} + 3\vec{j}) = 2\vec{i} - 11\vec{j}$   
 $\therefore 2k + 4l = 2$  and  $-k + 3l = -11$   
 Solving gives  $l = -2, k = 5$

**Q. 8.**  $4\vec{i} - 2\vec{j} + t(7\vec{i} + 5\vec{j}) = k\vec{i} + 0\vec{j}$   
 $\therefore 4 + 7t = k$  and  $-2 + 5t = 0$   
 $\therefore t = 0.4$

**Q. 9.**  $\sqrt{65} = \sqrt{49 + k^2}$   
 $\therefore k = \pm 4$

**Q. 10.**  $\sqrt{50} = \sqrt{2p^2}$   
 $\therefore p = \pm 5$

**Q. 11.**  $\sqrt{121 + k^2} = \sqrt{125}$   
 $\therefore k = \pm 2$

**Q. 12.**  $\sqrt{2k^2} = \sqrt{50}$   
 $\therefore k = \pm 5$

**Q. 13.**  $\frac{3}{4} \times \frac{-8}{6} = \frac{-24}{24} = -1$   
 $\therefore \perp$

**Q. 14.**  $\frac{-2}{5} \times \frac{20}{8} = \frac{-40}{40} = -1$   
 $\therefore \perp$

**Q. 15.**  $\frac{3}{1} \times \frac{-2}{6} = \frac{-6}{6} = -1$   
 $\therefore \perp$

**Q. 16.**  $\frac{-t}{9} \times \frac{6}{2} = -1$   
 $\therefore t = 3$

**Q. 17.**  $\frac{p}{4} \times \frac{-2}{p+1} = -1$   
 $\therefore 4p + 4 = 2p$   
 $\therefore p = -2$

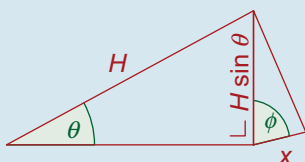
### Exercise 1C

- Q. 1. (i)  $|AB| = H \cos \theta$ ;  $|BC| = H \sin \theta$   
 (ii)  $|AB| = H \sin \theta$ ;  $|BC| = H \cos \theta$   
 (iii)  $|AC| = H \cos \theta$ ;  $|BC| = H \sin \theta$   
 (iv)  $|AC| = H \cos \theta$ ;  $|AB| = H \sin \theta$

- Q. 2. (i)  $\cos A = \frac{12}{13}$ ,  $\sin \theta = \frac{5}{13}$   
 (ii)  $\cos A = \frac{35}{37}$ ,  $\sin \theta = \frac{12}{37}$   
 (iii)  $\sin A = \frac{\sqrt{7}}{4}$ ,  $\tan A = \frac{\sqrt{7}}{3}$   
 (iv)  $\cos = \frac{40}{41}$

- Q. 3. (i)  $|AB| = 4\sqrt{3}$  cm;  $|BC| = 4$  cm  
 (ii)  $|XY| = 2$  m;  $|YZ| = 2$  m  
 (iii)  $|AB| = 10 \sin 40^\circ = 6.428$  m  
 $|BC| = 10 \cos 40^\circ = 7.66$  m  
 (iv)  $|XY| = 20 \cos 35^\circ = 16.38$  cm  
 $|XZ| = 20 \sin 35^\circ = 11.47$  cm  
 (v)  $|PQ| = 40 \cos 20^\circ = 37.59$  m  
 $|QR| = 40 \sin 20^\circ = 13.68$  m  
 (vi)  $|PQ| = 12 \cos 60^\circ = 6$  m  
 $|RQ| = 12 \sin 60^\circ = 6\sqrt{3}$  m  
 (vii)  $|AB| = 15 \cos \theta = 12$  cm  
 $|BC| = 15 \sin \theta = 9$  cm  
 (viii)  $|RQ| = 78 \cos \alpha = 30$  m  
 $|PQ| = 78 \sin \alpha = 72$  m  
 (ix)  $|XY| = \sqrt{13} \cos \theta = 3$   
 $|YZ| = \sqrt{13} \sin \theta = 2$   
 (x)  $|AB| = \sqrt{20} \cos \alpha = 4$   
 $|BC| = \sqrt{20} \sin \alpha = 2$

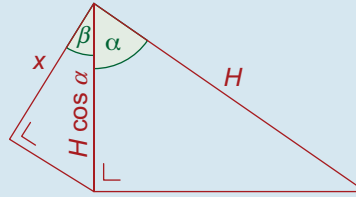
Q. 4.



$$x = ADJ = H \sin \theta \cos \phi$$

$$\therefore x = (13) \left( \frac{3}{5} \right) \left( \frac{5}{13} \right) = 3$$

Q. 5.



$$x = ADJ = H \cos \alpha \cos \beta$$

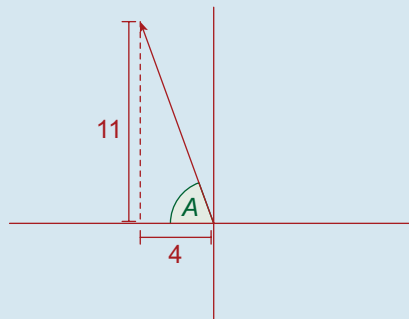
$$\therefore x = H \left( \frac{7}{\sqrt{50}} \right) \left( \frac{1}{\sqrt{2}} \right) = \frac{7}{10} H$$

$$\therefore H : x = 10 : 7$$

### Exercise 1D

- Q. 1. (i)  $2 \cos 60^\circ \vec{i} + 2 \sin 60^\circ \vec{j} = \vec{i} + \sqrt{3} \vec{j}$   
 (ii)  $10 \cos 18^\circ \vec{i} + 10 \sin 18^\circ \vec{j}$   
 $= 9.511 \vec{i} + 3.09 \vec{j}$   
 (iii)  $8 \cos 45^\circ \vec{i} - 8 \sin 45^\circ \vec{j}$   
 $= 4\sqrt{2} \vec{i} - 4\sqrt{2} \vec{j}$   
 (iv)  $-20 \cos 20^\circ \vec{i} + 20 \sin 20^\circ \vec{j}$   
 $= -18.794 \vec{i} + 6.84 \vec{j}$   
 (v)  $-\sqrt{50} \cos 45^\circ \vec{i} - \sqrt{50} \sin 45^\circ \vec{j}$   
 $= -5 \vec{i} - 5 \vec{j}$   
 (vi)  $12 \cos 39^\circ \vec{i} - 12 \sin 39^\circ \vec{j}$   
 $= 9.3252 \vec{i} - 7.5516 \vec{j}$

Q. 2.



$$\vec{u} = -10 \cos \alpha \vec{i} - 10 \sin \alpha \vec{j}$$

$$= -8 \vec{i} - 6 \vec{j}$$

$$\vec{v} = 13 \cos \beta \vec{i} - 13 \sin \beta \vec{j}$$

$$= 12 \vec{i} - 5 \vec{j}$$

$$\therefore \vec{u} + \vec{v} = 4 \vec{i} - 11 \vec{j}$$

$$\vec{w} = -(\vec{u} + \vec{v})$$

$$= -4 \vec{i} + 11 \vec{j}$$

$$|\vec{w}| = \sqrt{(-4)^2 + (11)^2}$$

$$= \sqrt{137}$$

$$= 11.7$$

$$\tan A = \frac{11}{4}$$

$$\Rightarrow A = 70^\circ$$

Direction is W  $70^\circ$  N.

**Q. 3.**  $\vec{p} = \sqrt{8} \cos 45^\circ \vec{i} + \sqrt{8} \sin 45^\circ \vec{j}$

$$= 2\vec{i} + 2\vec{j}$$

$$\vec{q} = 4 \cos 30^\circ \vec{i} - 4 \sin 30^\circ \vec{j}$$

$$= 2\sqrt{3}\vec{i} - 2\vec{j}$$

$$\therefore \vec{p} + \vec{q} = (2 + 2\sqrt{3})\vec{i} + 0\vec{j}$$

**Q. 4.**  $\vec{r} = -10 \cos 40^\circ \vec{i} - 10 \sin 40^\circ \vec{j}$

$$= -7.66\vec{i} - 6.428\vec{j}$$

$$\vec{s} = -10 \cos 58^\circ \vec{i} + 10 \sin 58^\circ \vec{j}$$

$$= -5.299\vec{i} + 8.48\vec{j}$$

$$\vec{t} = 11 \cos 20^\circ \vec{i} + 11 \sin 20^\circ \vec{j}$$

$$= 10.3367\vec{i} + 3.762\vec{j}$$

$$\therefore \vec{r} + \vec{s} + \vec{t} = -2.6\vec{i} + 5.8\vec{j}$$

**Q. 5.** (i)  $\vec{a} = 12\vec{i}$

$$\vec{b} = -13 \cos \alpha \vec{i} + 13 \sin \alpha \vec{j}$$

$$= -12\vec{i} + 5\vec{j}$$

(ii)  $\therefore \vec{a} + \vec{b} = 12\vec{i} - 12\vec{i} + 5\vec{j}$

$$= 5\vec{j}, \text{ along the } \vec{j}\text{-axis}$$

(iii)  $|\vec{a} + \vec{b}| = 5$  units

**Q. 6.** (i)  $\vec{x} = -25 \cos A \vec{i} + 25 \sin A \vec{j}$

$$= -20\vec{i} + 15\vec{j}$$

$$y = 17 \cos B \vec{i} - 17 \sin B \vec{j}$$

$$= 8\vec{i} - 15\vec{j}$$

(ii)  $\therefore \vec{x} + \vec{y} = -20\vec{i} + 15\vec{j} + 8\vec{i} - 15\vec{j}$

$$= -12\vec{i}, \text{ which has no } \vec{j}\text{-component}$$

(iii)  $|\vec{x} + \vec{y}| = 12$  units

## Exercise 1E

**Q. 1.**  $\vec{a} = 10\vec{i}$

$$\vec{b} = -26 \cos \alpha \vec{i} + 26 \sin \alpha \vec{j}$$

$$\therefore \vec{a} + \vec{b} = (10 - 26 \cos \alpha)\vec{i} + 26 \sin \alpha \vec{j}$$

No  $\vec{i}$ -component

$$\Rightarrow 10 - 26 \cos \alpha = 0$$

$$\Rightarrow \cos \alpha = \frac{5}{13}$$

$$\Rightarrow \sin \alpha = \frac{12}{13}$$

$$\therefore \vec{a} + \vec{b} = 0\vec{i} + 26\left(\frac{12}{13}\right)\vec{j}$$

$$= 24\vec{j}$$

$$\therefore |\vec{a} + \vec{b}| = 24 \text{ units}$$

**Q. 2.**  $\vec{a} = \sqrt{32}\left(\frac{1}{\sqrt{2}}\right)\vec{i} - \sqrt{32}\left(\frac{1}{\sqrt{2}}\right)\vec{j}$

$$= 4\vec{i} - 4\vec{j}$$

$$\vec{b} = -5 \cos \alpha \vec{i} + 5 \sin \alpha \vec{j}$$

$$\therefore \vec{a} + \vec{b} = (4 - 5 \cos \alpha)\vec{i} + (-4 + 5 \sin \alpha)\vec{j}$$

No  $\vec{i}$ -component

$$\Rightarrow 4 - 5 \cos \alpha = 0$$

$$\Rightarrow \cos \alpha = \frac{4}{5}$$

$$\Rightarrow \sin \alpha = \frac{3}{5}$$

$$\therefore \vec{a} + \vec{b} = 0\vec{i} + \left(-4 + 5\left(\frac{3}{5}\right)\right)\vec{j}$$

$$= 0\vec{i} - \vec{j}$$

**Q. 3.** Let  $|\vec{b}| = x$

$$\vec{a} = -4\vec{i}$$

$$\vec{b} = \frac{1}{2}x\vec{i} + \frac{\sqrt{3}}{2}x\vec{j}$$

$$\therefore \vec{a} + \vec{b} = \left(-4 + \frac{1}{2}x\right)\vec{i} + \frac{\sqrt{3}}{2}x\vec{j}$$

No  $\vec{i}$ -component  $\Rightarrow -4 + \frac{1}{2}x = 0$

$$\Rightarrow x = 8$$

i.e.  $|\vec{b}| = 8$

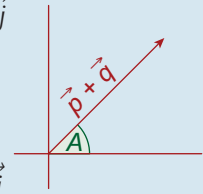
$$\therefore \vec{a} + \vec{b} = 0\vec{i} + 4\sqrt{3}\vec{j}$$

$$|\vec{a} + \vec{b}| = 4\sqrt{3} \text{ units}$$

**Q. 4.**  $\vec{i} = -10 \cos 70^\circ \vec{i} + 10 \sin 70^\circ \vec{j}$   
 $= -3.420\vec{i} + 9.397\vec{j}$   
 Let  $|\vec{s}| = x \Rightarrow \vec{s} = x\vec{i}$   
 $\therefore \vec{r} + \vec{s} = (-3.420 + x)\vec{i} + 9.397\vec{j}$   
 No  $\vec{i}$ -component  $\Rightarrow x = 3.420$   
 i.e.  $|\vec{s}| = 3.420$

**Q. 5.**  $\vec{a} = 10 \cos \theta \vec{i} + 10 \sin \theta \vec{j}$   
 $= 10\left(\frac{4}{5}\right)\vec{i} + 10\left(\frac{3}{5}\right)\vec{j}$   
 $= 8\vec{i} + 6\vec{j}$   
 Let  $|\vec{b}| = x \Rightarrow \vec{b} = -x\vec{j}$   
 $\therefore \vec{a} + \vec{b} = 8\vec{i} + (6 - x)\vec{j}$   
 $= k\vec{i} + 0\vec{j}$   
 $\therefore x = 6$  and  $k = 8$

**Q. 6.** (i)  $\vec{p} = 35 \cos \alpha \vec{i} + 35 \sin \alpha \vec{j}$   
 $= 35\left(\frac{3}{5}\right)\vec{i} + 35\left(\frac{4}{5}\right)\vec{j}$   
 $= 21\vec{i} + 28\vec{j}$   
 $\vec{q} = 13 \cos \beta \vec{i} + 13 \sin \beta \vec{j}$   
 $= 13\left(\frac{12}{13}\right)\vec{i} + 13\left(\frac{5}{13}\right)\vec{j}$   
 $= 12\vec{i} + 5\vec{j}$   
 (ii)  $\therefore \vec{p} + \vec{q} = 21\vec{i} + 28\vec{j} + 12\vec{i} + 5\vec{j}$   
 $= 33\vec{i} + 33\vec{j}$   
 $\therefore \tan A = \frac{33}{33} = 1$   
 $\Rightarrow A = 45^\circ$



**Q. 7.**  $\vec{r} = -3.42\vec{i} + 9.397\vec{j}$   
 Let  $|\vec{s}| = x$   
 $\therefore \vec{s} = x \cos 10^\circ \vec{i} + x \sin 10^\circ \vec{j}$   
 $= 0.9848x\vec{i} + 0.1736x\vec{j}$   
 $\therefore \vec{r} + \vec{s} = (-3.42 + 0.9848x)\vec{i} + (9.397 + 0.1736x)\vec{j}$   
 Since  $(\vec{r} + \vec{s})$  is in a NE direction, the  $\vec{i}$  and  $\vec{j}$  components must be equal.  
 $\therefore -3.42 + 0.9848x = 9.397 + 0.1736x$   
 $\Rightarrow x = 15.8$

**Q. 8.** (i)  $|\vec{p}| = \sqrt{8^2 + 1^2} = \sqrt{65}$   
 $|\vec{q}| = \sqrt{(-7)^2 + 4^2} = \sqrt{65}$   
 $\therefore |\vec{p}| = |\vec{q}|$   
 (ii) "Slope" of  $p = \frac{j\text{-bit}}{i\text{-bit}} = \frac{1}{8} = m_1$   
 "Slope" of  $q = \frac{4}{-7} = -\frac{4}{7} = m_2$   
 $m_1 \times m_2 = -\frac{1}{14} \neq -1$   
 $\therefore$  Not perpendicular

**Q. 9.**  $|-7\vec{i} + \vec{j}| = \sqrt{49 + 1} = \sqrt{50}$   
 $|p(\vec{i} + \vec{j})| = |p\vec{i} + p\vec{j}|$   
 $= \sqrt{p^2 + p^2} = \sqrt{2p^2}$   
 $\therefore 2p^2 = 50$   
 $\Rightarrow p = 5$  (since  $p > 0$ )

**Q. 10.**  $\vec{a} = 10 \cos 80^\circ \vec{i} + 10 \sin 80^\circ \vec{j}$   
 $= 1.736\vec{i} + 9.848\vec{j}$   
 Let  $|\vec{b}| = x$   
 Therefore,  $\vec{b} = x\vec{i}$   
 $\therefore \vec{a} + \vec{b} = (1.736 + x)\vec{i} + 9.848\vec{j}$   
 Since the direction of  $(\vec{a} + \vec{b})$  is  $21^\circ 48'$ ,  
 the slope of  $(\vec{a} + \vec{b})$  must equal  $\tan 21^\circ 48'$ .  
 $\therefore \frac{9.848}{1.736 + x} = 0.4$   
 $\Rightarrow x = 22.88$