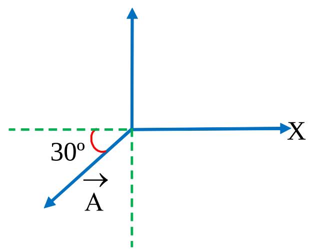
Angle between two vectors DPP-01

1. **Vector $\vec{A}$ is shown in figure. The angle made by $\vec{A}$ with positive X-axis is –**



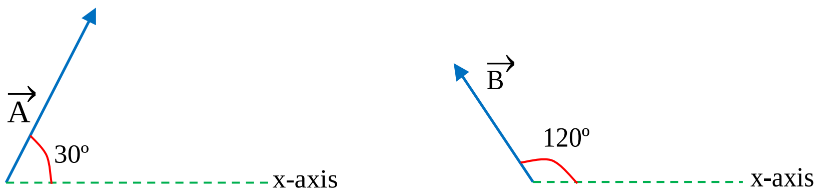
(1) 30°

(2) 90°

(3) 210°

(4) 60°

2. **Vector $\vec{A}$ and $\vec{B}$ are shown in the figure. The angle between vector $\vec{A}$ and $\vec{B}$ is –**



(1) 60°

(2) 90°

(3) 30°

(4) none of these

3. **Which of the following is a scalar quantity?**

(1) Electric current

(2) Electric field

(3) Acceleration

(4) Linear momentum

4. **Which of the following is a vector?**

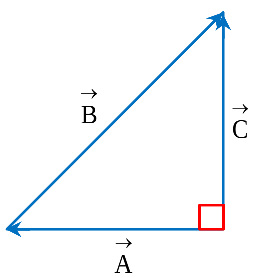
(1) Energy

(2) Power

(3) Force

(4) Mass

5. **In the adjoining vector diagram, what is the angle between $\vec{A}$ and $\vec{B}$? (Given: C = B/2).**



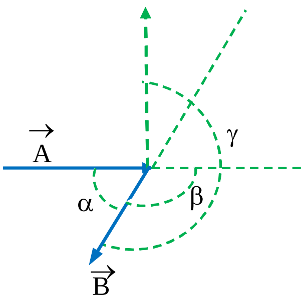
(1) 30°

(2) 60°

(3) 120°

(4) 150°

6. **Vectors $\vec{A}$ and $\vec{B}$ are shown in figure. Then angle between these two vectors is**



(1) α

(2) β

(3) γ

(4) Can not find

7. **Identify the vector quantity -**

(1) Work

(2) Time

(3) Heat

(4) Angular momentum

8. **Identify the scalar quantity -**

(1) Work

(2) Force

(3) Acceleration

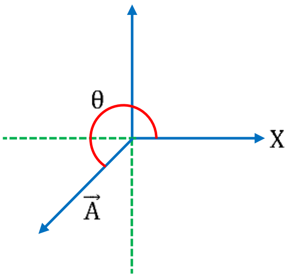
(4) Displacement

Answer Key

Question	1	2	3	4	5	6	7	8
Answer	**3**	**2**	**1**	**3**	**4**	**2**	**4**	**1**

SOLUTIONS DPP-01

1. **(3)**

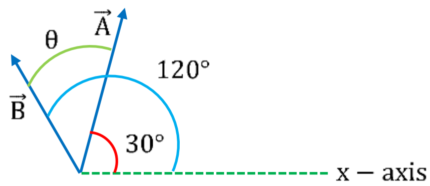


Angle is always calculated in AC direction

∴ Angle made with +ve x axis

$\theta = 180° + 30° = 210°$

2. **(2)**



$\theta = 120° - 30° = 90°$

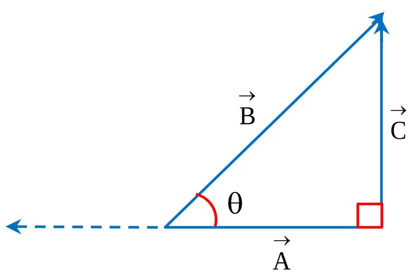
3. **(1)**

Only electric current does not follow law of vector addition.

4. **(3)**

Only force follows law of vector addition.

5. **(4)**

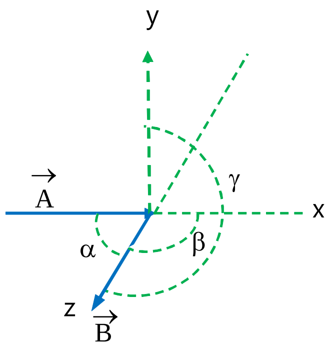


$\sin\theta = \frac{C}{B} = \frac{\frac{B}{2}}{B} = \frac{1}{2}$

$\theta = 30°$

Angle b/w $\vec{A}$ and $\vec{B}$ = 180° – 30° =150°

6. **(2)**



Direction of $\vec{A}$ is along x

Direction of $\vec{B}$ is along z

Angle b/w $\vec{A}$ and $\vec{B}$ = angle b/w x and z = β

7. **(4)**

Only angular momentum follows law of vector addition.

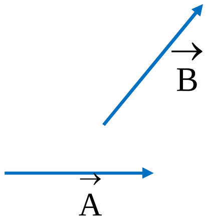
8. **(1)**

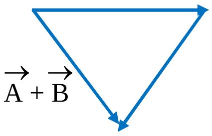
Only work does not follow law of vector addition.

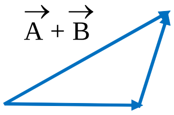
DAILY PRACTICE PROBLEM

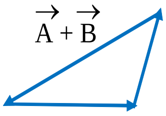
Addition of Vectors-Analytical Method DPP-02

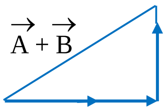
1. **Vectors $\vec{A}$ and $\vec{B}$ are shown in figure then diagram representing $\vec{A}+\vec{B}$ is**



(1) 

(2) 

(3) 

(4) 

2. **The resultant of two forces, each P, acting at an angle θ is -**

(1) $2P \sin\frac{\theta}{2}$

(2) $2P\cos\frac{\theta}{2}$

(3) $2P\cos\theta$

(4) $P\sqrt{2}$

3. **Two forces each of magnitude F have a resultant of the same magnitude F. The angle between the two forces is -**

(1) 45°

(2) 120°

(3) 150°

(4) 60°

4. **There are two force vectors, one of 5N and other of 12N, at what angle the two vectors be added to get resultant vector of 17N, 7N and 13N respectively –**

(1) 0°, 180° and 90°

(2) 0°, 90° and 180°

(3) 0°, 90° and 90°

(4) 180°, 0° and 90°

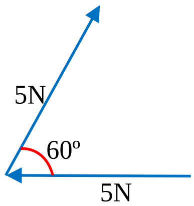
5. **Two forces of magnitudes F and $\sqrt{3}$ F act at right angles to each other. Their resultant makes an angle β with F. The value of β is -**

(1) 30°
(2) 45°
(3) 60°
(4) 135°

6. **Given : $\vec{R} = \vec{A} + \vec{B}$ and R = A = B. The angle between $\vec{A}$ and $\vec{B}$ is–**

(1) 60°
(2) 90°
(3) 120°
(4) 180°

7. **Two forces, each numerically equal to 5 N, are acting as shown in the Fig. Then the resultant is–**



(1) 2. 5 N
(2) 5 N
(3) $5\sqrt{3}$ N
(4) 10 N.

8. **The maximum and minimum resultants of two forces are in the ratio 7 : 3. The ratio of the forces is –**

(1) 4 : 1
(2) 5 : 2
(3) $\sqrt{7} : \sqrt{3}$
(4) 49 : 9

9. **Forces F_1 and F_2 act on a point mass in two mutually perpendicular directions. The resultant force on the point mass will be -**

(1) $F_1 + F_2$
(2) $F_1 - F_2$
(3) $\sqrt{F_1^2 + F_2^2}$
(4) $F_1^2 + F_2^2$

10. **A particle is simultaneously acted by two forces equal to 4N and 5N. The net force on the particle is:**

(1) 7 N
(2) 5 N
(3) 1 N
(4) Between 1N and 9N

Answer Key

Question	1	2	3	4	5	6	7	8	9	10
Answer	2	2	2	1	3	3	2	2	3	4

SOLUTIONS DPP-02

1. **(2)**

From triangle law of vector addition option (2) is correct.

2. **(2)**

$\sqrt{P^2 + P^2 + 2P^2\cos\theta}$

$= \sqrt{2P^2(1 + \cos\theta)}$

$= P\sqrt{2 \times 2\cos^2\frac{\theta}{2}}$ $\quad\because \left(1 + \cos\theta = 2\cos^2\frac{\theta}{2}\right)$

$= 2P\cos\frac{\theta}{2}$

3. **(2)**

$F = \sqrt{F^2 + F^2 + 2F^2\cos\theta}$

$F = F\sqrt{2 + 2\cos\theta}$

$1 = 2 + 2\cos\theta$

$\cos\theta = -\frac{1}{2}$

$\theta = 120°$

4. **(1)**

Max. value of resultant of vector 5N and 12N = 17 N at an angle of 0°.

Min. value of resultant of vector 5N and 12N = 7 N at an angle of 180°.

5. **(3)**

$\tan\beta = \frac{B\sin\theta}{A+B\cos\theta}$

$= \frac{F\sqrt{3}\sin\theta}{F+F\sqrt{3}\cos\theta}$

$= \frac{\sqrt{3}\sin\theta}{1+\sqrt{3}\cos\theta}$

$\tan\beta = \frac{\sqrt{3}}{1}$ $\quad(\theta = 90°)$

$\beta = 60°$

6. **(3)**

$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

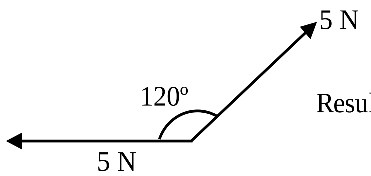
given R = A = B

$A^2 = A^2 + A^2 + 2A^2\cos\theta$

cos = −1/2

$\theta = 120°$

7. **(2)**



Resultant = 5N

8. **(2)**

$\frac{F_1+F_2}{F_1-F_2} = \frac{7}{3}$

Applying componendo-dividendo rule

$\Rightarrow \frac{F_1}{F_2} = \frac{10}{4} = \frac{5}{2}$

9. **(3)**

$\sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 90°}$ [$\because$ vectors are perpendicular, $\therefore \theta = 90°$]

$= \sqrt{F_1^2 + F_2^2}$

10. **(4)**

$\because$ Angle b/w vectors is not mentioned

$\therefore$ Resultant can be from minimum possible value to maximum possible value

Minimum possible value = 5N – 4N = 1N

Maximum possible value = 5N + 4 N = 9N

Properties of Vector Addition & Polygon Law DPP-03

1. **If $\vec{R} = \vec{a} + \vec{b}$ and $|\vec{R}|$ = 5 units, $|\vec{a}|$ = 3 units, $|\vec{b}|$ = 4 units. Then angle between $\vec{a}$ and $\vec{b}$ is-**

(1) 0°

(2) 180°

(3) 270°

(4) None of these

2. **Two forces of 4 dyne and 3 dyne act upon a body. The resultant force on the body can only be -**

(1) More than 3 dynes

(2) More than 4 dynes

(3) Between 3 and 4 dynes

(4) Between 1 and 7 dynes

3. **The resultant of A and B makes an angle α with A and β with B -**

(1) $\alpha < \beta$

(2) $\alpha < \beta$ if $A < B$

(3) $\alpha < \beta$ if $A > B$

(4) $\alpha < \beta$ if A = B

4. **The resultant of two vectors of magnitudes 3 units and 4 units is $\sqrt{37}$. The angle between the two vectors is -**

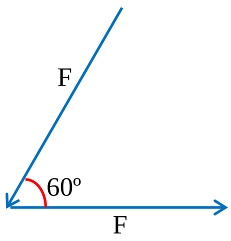
(1) 0°

(2) 30°

(3) 60°

(4) 90°

5. **Two forces, each equal to F, act as shown in figure. Their resultant is -**



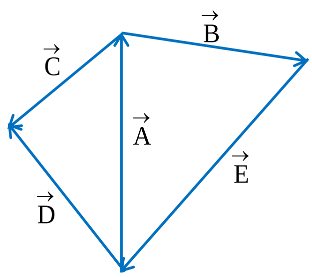
(1) $\frac{F}{2}$

(2) F

(3) $\sqrt{3}\,F$

(4) $\sqrt{5}\,F$

6. **In figure, $\vec{E}$ equals -**



(1) $\vec{A}$

(2) $\vec{B}$

(3) $\vec{A} + \vec{B}$

(4) $-(\vec{A} + \vec{B})$

7. **A force of 6 kg and another of 8 kg can be applied together to produce the effect of a single force of-**

(1) 1kg

(2) 11kg

(3) 15 kg

(4) 20 kg

8. **Two vectors have magnitudes 3 unit and 4 unit respectively. What should be the angle between them if the magnitude of the resultant is -**

(i) 1 unit **(ii) 5 unit** **(iii) 7 unit**

(1) 180º, 90º, 0º

(2) 80º, 70º, 0º

(3) 90º, 170º, 50º

(4) None of these

9. **The vector sum of the forces of 10 N and 6 N can be-**

(1) 2 N

(2) 8 N

(3) 18 N

(4) 20 N

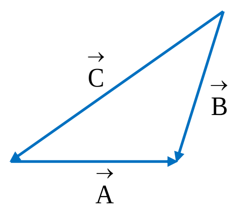
10. **For the given figure, which option is correct -**

(1) $\vec{A} + \vec{B} = \vec{C}$

(2) $\vec{B} + \vec{C} = \vec{A}$

(3) $\vec{C} + \vec{A} = \vec{B}$

(4) $\vec{A} + \vec{B} + \vec{C}$



11. **Which pair of the following forces will never give resultant force of 2 N-**

(1) 2 N and 2 N

(2) 1 N and 1 N

(3) 1 N and 3 N

(4) 1 N and 4 N

Answer Key

Question	1	2	3	4	5	6	7	8	9	10	11
Answer	**4**	**4**	**3**	**3**	**2**	**4**	**2**	**1**	**2**	**3**	**4**

SOLUTIONS DPP-03

1. **(4)**

$|\vec{R}| = \sqrt{a^2 + b^2 + 2ab\cos\theta}$

$\Rightarrow 5 = \sqrt{3^2 + 4^2 + 2 \times 3 \times 4 \times \cos\theta}$

$\Rightarrow \cos\theta = 0$

$\Rightarrow \theta = 90°$

2. **(4)**

Minimum value of resultant force = 4 dyne – 3 dyne = 1 dyne

Maximum value of resultant force = 4 dyne + 3 dyne = 7 dyne

3. **(3)**

Resultant makes smaller angle with vector of greater magnitude and vice-versa.

$\therefore$ If A > B

Then $\alpha < \beta$

and if A < B

Then $\alpha > \beta$

4. **(3)**

$\sqrt{37} = \sqrt{3^2 + 4^2 + 2 \times 3 \times 4 \times \cos\theta}$

$\Rightarrow \cos\theta = \frac{1}{2}$

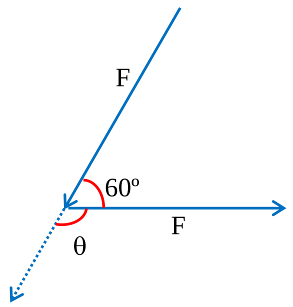
$\Rightarrow \theta = 60°$

5. **(2)**

$\sqrt{F^2 + F^2 + 2F^2\cos\theta}$

$= \sqrt{F^2 + F^2 + 2F^2\left(-\frac{1}{2}\right)}$ $\quad \because \theta = 120°$

$= F$



6. **(4)**

From triangle law

$-\vec{E} = \vec{A} + \vec{B}$

$\therefore \vec{E} = -(\vec{A} + \vec{B})$

7. **(2)**

Possible range of resultant

Minimum value = 8 kg – 6kg = 2 kg

Maximum value = 8 kg + 6 kg = 14 kg

Only (2) option lies within this range.

8. **(1)**

(i) Resultant of 3 unit and 4 unit = 1 unit ⇒ minimum possible value

∴ Angle b/w the vectors = 180°

(ii) $5 = \sqrt{3^2 + 4^2 + 2 \times 3 \times 4 \times \cos\theta}$

$\Rightarrow \cos\theta = 0$

$\Rightarrow \theta = 90°$

(iii) Resultant of 3 unit and 4 unit = 7 unit ⇒ maximum possible value

∴ Angle b/w the vectors = 0°

9. **(2)**

Possible range of resultant

Minimum value = 10 N – 6 N = 4 N

Maximum value = 10 N + 6 N = 16 N

Only option (2) lies within this range.

10. **(3)**

From triangle law

$\vec{B} = \vec{A} + \vec{C}$

11. **(4)**

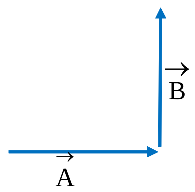
If two vectors A and B are given then Range of their resultant can be written as $(A - B) \le R \le (A + B)$.

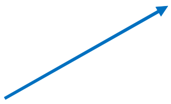
i.e. $R_{max} = A + B$ and $R_{min} = A - B$

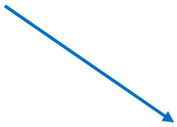
If B = 1 and A = 4 then their resultant will lie in between 3N and 5N. It can never be 2N.

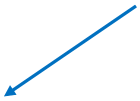
Vector Subtraction, Miscellaneous problems on Vector addition and Subtraction DPP-04

1. **Vectors $\vec{A}$ and $\vec{B}$ are shown in figure. Then diagram of $\vec{B} - \vec{A}$ is**



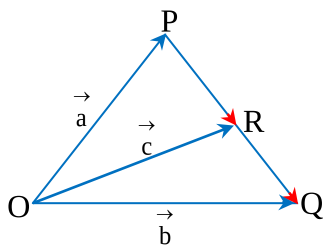
(1) 

(2) 

(3) 

(4) None of these

2. **Figure shows the vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ where $\vec{R}$ is the mid-point of PQ. Then which of the following is correct?**



(1) $\vec{a} + \vec{b} = 2\vec{c}$

(2) $\vec{a} + \vec{b} = \vec{c}$

(3) $\vec{a} - \vec{b} = 2\vec{c}$

(4) $\vec{a} - \vec{b} = \vec{c}$

3. **If the sum of two-unit vectors is a unit vector, then the magnitude of their difference is**

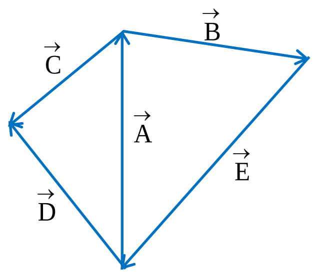
(1) $\sqrt{2}$

(2) $\sqrt{3}$

(3) $\frac{1}{\sqrt{2}}$

(4) $\sqrt{5}$

4. **In figure, $\vec{D} - \vec{C}$ equals -**



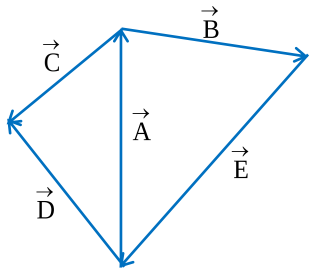
(1) $\vec{A}$

(2) $-\vec{A}$

(3) $\vec{B}$

(4) $-\vec{B}$

5. **In figure, $\vec{E}+\vec{D}-\vec{C}$ equals -**



(1) $\vec{A}$

(2) $2\vec{A}-\vec{B}$

(3) $\vec{B}$

(4) $-\vec{B}$

6. **A truck travelling due north with 20 m/s turns towards west and travels at the same speed. Then the change in velocity is**

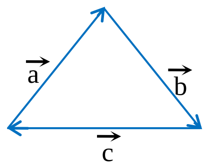
(1) 40 m/s north-west

(2) $20\sqrt{2}$m/s north-west

(3) 40 m/s south-west

(4) $20\sqrt{2}$m/s south-west

7. **Vector $\vec{c}$ in figure represents –**



(1) $\vec{a}+\vec{b}$

(2) $\vec{a}-\vec{b}$

(3) $\vec{b}-\vec{a}$

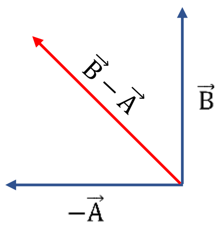
(4) $-\vec{a}-\vec{b}$

Answer Key

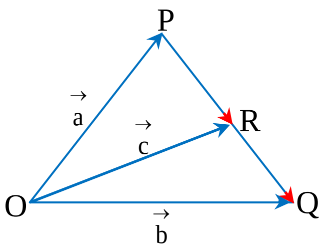
Question	1	2	3	4	5	6	7
Answer	4	1	2	1	4	4	4

SOLUTIONS DPP-04

1. **(4)**



2. **(1)**



From triangle law in ΔOPR

$\vec{a}+\overrightarrow{PR}=\vec{c} \Rightarrow \overrightarrow{PR}=\vec{c}-\vec{a}$

From triangle law in ΔORQ

$\vec{c}+\overrightarrow{RQ}=\vec{b} \Rightarrow \overrightarrow{RQ}=\vec{b}-\vec{c}$

$\vec{c}-\vec{a}=\vec{b}-\vec{c}$ $\quad$ [$\because \overrightarrow{PR}=\overrightarrow{RQ}$, as R is midpoint of PQ]

$2\vec{c}=\vec{a}+\vec{b}$

3. **(2)**

$1=\sqrt{1^2+1^2+2\cos\theta}$

$\Rightarrow \cos\theta=-\frac{1}{2}$

Now magnitude of difference of vectors $=\sqrt{1^2+1^2-2\cos\theta}$

$\Rightarrow \sqrt{1^2+1^2-2\left(-\frac{1}{2}\right)}$

$\Rightarrow \sqrt{3}$

4. **(1)**

From triangle law of vector addition

$\vec{D}=\vec{A}+\vec{C}$

$\Rightarrow \vec{D}-\vec{C}=\vec{A}$

5. **(4)**

From triangle law of vector addition

$\vec{D} = \vec{A} + \vec{C}$

$\Rightarrow \vec{D} - \vec{C} = \vec{A}$

From triangle law of vector addition

$\vec{E} + \vec{B} = -\vec{A}$

$\Rightarrow \vec{E} = -\vec{A} - \vec{B}$

Now, $\vec{E} + \vec{D} - \vec{C}$

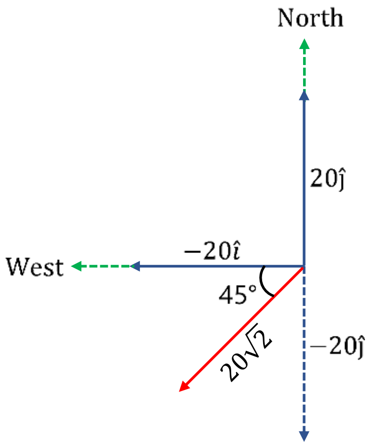
$\Rightarrow -\vec{A} - \vec{B} + \vec{A} = -\vec{B}$

6. **(4)**

Initial velocity, $\vec{u} = 20\hat{j}$

Final velocity, $\vec{v} = -20\hat{i}$

Change in velocity = $\vec{v} - \vec{u} = -20\hat{i} - 20\hat{j}$



7. **(4)**

From triangle law of vector addition

$-\vec{c} = \vec{a} + \vec{b}$

$\Rightarrow \vec{c} = -(\vec{a} + \vec{b})$

$\Rightarrow \vec{c} = -\vec{a} - \vec{b}$

Resolution of Vectors in 3D-in space DPP-05

1. **A vector $\vec{A}$ is rotated through an angle 2π, the magnitude of new vector is -**

(1) 2A

(2) A

(3) A/2

(4) none of these

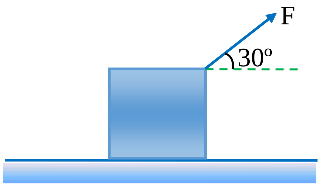
2. **A child pulls a box with a force of 200N at an angle of 30° above the horizontal. Then the horizontal and vertical components of the force are -**

(1) 173 N, 100N

(2) 86.6N, 100N

(3) 100N, 86.6N

(4) 100N, 0N



3. **The component of a vector is -**

(1) Its less than or equal to its magnitude

(2) Always greater than its magnitude

(3) Always equal to its magnitude

(4) None of these

4. **A displacement vector, at an angle of 30° with y-axis has an x-component of 10 units. Then the magnitude of the vector is -**

(1) 5.0

(2) 10

(3) 11.5

(4) 20

5. **A displacement vector $\vec{r}$ has magnitude of 25 m and makes an angle of 210° with the x-axis. Then its y-component is -**

(1) 21.7 m

(2) –21.7 m

(3) 12.5 m

(4) –12.5 m

6. **If a unit vector is represented by $0.5\hat{i} + 0.8\hat{j} + c\hat{k}$, then the value of $'c'$ is -**

(1) 1

(2) $\sqrt{0.11}$

(3) $\sqrt{0.01}$

(4) $\sqrt{0.39}$

7. **The magnitude of $3\hat{i} + 2\hat{j} + \hat{k}$ is -**

(1) $\sqrt{5}$

(2) $\sqrt{6}$

(3) $\sqrt{14}$

(4) $\sqrt{24}$

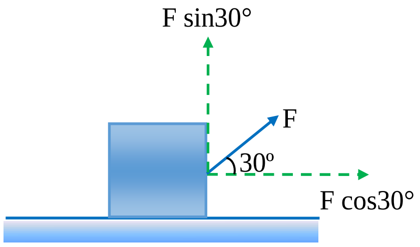
Answer Key

Question	1	2	3	4	5	6	7
Answer	**2**	**1**	**1**	**4**	**4**	**2**	**3**

SOLUTIONS DPP-05

1. Rotating a vector by angle (θ) does not change is magnitude.

2.



So, Horizontal component

$F\cos 30° \Rightarrow 200 \times \frac{\sqrt{3}}{2} \Rightarrow 173 \text{ N}$

Vertical component

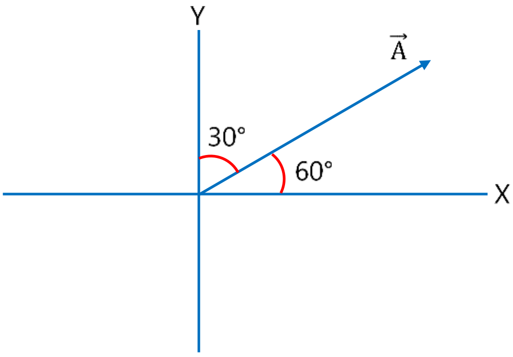
$F\sin 30° \Rightarrow 200 \times \frac{1}{2} \Rightarrow 100 \text{ N}$

3. Magnitude of components are $F\cos\theta$ & $F\sin\theta$,

as $\cos\theta < 1$ & $\sin\theta < 1$

∴ Magnitude of components < F

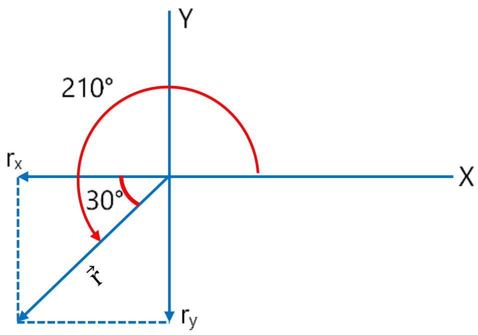
4.



$A\cos 60° = 10$

$A = 20$

5.



$|\vec{r}| = r = 25$

$|\vec{r_y}| = r\sin 30° = 25 \times \frac{1}{2} = 12.5 \text{ m}$

$\vec{r_y} = -12.5 \text{ m}$

6. $(0.5)^2 + (0.8)^2 + C^2 = 1$

$C^2 = 0.11$

$C = \sqrt{0.11}$

7. $|\vec{r}| = \sqrt{x^2 + y^2 + z^2}$

$|\vec{r}| = \sqrt{3^2 + 2^2 + 1^2}$

$|\vec{r}| = \sqrt{14}$

Multiplication of Vectors by Scalar and Dot product DPP-06

1. **A force $\vec{F} = 3\hat{i} - 2\hat{j} + 4\hat{k}$ displaces a body from a point A(8, –2, –3) to the point B(–2, 0, 6). The work done is**

(1) 1 unit
(2) 2 units
(3) 3 units
(4) 4 units

2. **If $\vec{P} = 4\hat{i} - 2\hat{j} + 6\hat{k}$ and $\vec{Q} = \hat{i} - 2\hat{j} - 3\hat{k}$, then the angle which $\vec{P} + \vec{Q}$ makes with x-axis is**

(1) $\cos^{-1}\left(\frac{3}{\sqrt{50}}\right)$
(2) $\cos^{-1}\left(\frac{4}{\sqrt{50}}\right)$
(3) $\cos^{-1}\left(\frac{5}{\sqrt{50}}\right)$
(4) $\cos^{-1}\left(\frac{12}{\sqrt{50}}\right)$

3. **Angle that the vector A = 2 $\hat{i}$ + 3 $\hat{j}$ makes with y-axis is –**

(1) $\tan^{-1} 3/2$
(2) $\tan^{-1} 2/3$
(3) $\sin^{-1} \frac{2}{3}$
(4) $\cos^{-1} 3/2$

4. **The angle between the two vectors $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$ and $\vec{B} = 3\hat{i} + 4\hat{j} - 5\hat{k}$ will be –**

(1) 90°
(2) 0°
(3) 60°
(4) 45°

5. **If a vector $(2\hat{i} + 3\hat{j} + 8\hat{k})$ is perpendicular to the vector $-4\hat{i} + 4\hat{j} + \alpha\hat{k}$, then the value of α is-**

(1) –1
(2) $\frac{1}{2}$
(3) $\frac{-1}{2}$
(4) 1

Answer Key

Question	1	2	3	4	5
Answer	2	3	2	1	3

SOLUTIONS DPP-06

1. $W = \vec{F} \cdot \Delta\vec{S}$

$\Delta\vec{S} = -10\hat{i} + 2\hat{j} + 9\hat{k}$

$W = (3\hat{i} - 2\hat{j} + 4\hat{k}) \cdot (-10\hat{i} + 2\hat{j} + 9\hat{k})$

$\therefore W = 2$ units

2. $\vec{A} = \vec{P} + \vec{Q} = 5\hat{i} - 4\hat{j} + 3\hat{k}$

$\vec{B} = \hat{i}$

$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta$

$5 = \sqrt{50} \cos\theta$

$\theta = \cos^{-1}\left(\frac{5}{\sqrt{50}}\right)$

3. $\vec{A} = 2\hat{i} + 3\hat{j}, \; \vec{B} = \hat{j}$

$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta$

$3 = \sqrt{13}\cos\theta \quad \cos\theta = \frac{3}{\sqrt{13}}$

$\therefore \tan\theta = \frac{2}{3}$

4. $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}, \; \vec{B} = 3\hat{i} + 4\hat{j} - 5\hat{k}$

$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta$

$0 = AB\cos\theta$

$\therefore \theta = 90°$

5. $\vec{a}.\vec{b} = 0$ if $\vec{a} \perp \vec{b}$

$(2\hat{i} + 3\hat{j} + 8\hat{k}) \, . \, (-4\hat{i} + 4\hat{j} + \alpha\hat{k}) = 0$

$\Rightarrow -8 + 12 + 8\alpha = 0 \Rightarrow \alpha = \frac{-1}{2}$

.DAILY PRACTICE PROBLEM

Application of Dot Product DPP-07

1. **A body constrained to move in y direction is subjected to a force given by $\vec{F} = (-2\hat{i} + 15\hat{j} + 6\hat{k})$ N. What is the work done by this force in moving the body through a distance of 10 m along positive y-axis?**

(1) 190 J
(2) 160 J
(3) 150 J
(4) 200 J

2. **An engine exerts a force $\vec{F} = (20\hat{i} - 3\hat{j} + 5\hat{k})N$ and moves with velocity $\vec{v} = (6\hat{i} + 20\hat{j} - 3\hat{k})$ m/s. The power of the engine (in watt) is -**

(1) 45
(2) 75
(3) 20
(4) 10

3. **If $\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{B} = -\hat{i} + 3\hat{j} + 4\hat{k}$, then projection of $\vec{A}$ on $\vec{B}$ will be -**

(1) $\frac{3}{\sqrt{13}}$
(2) $\frac{3}{\sqrt{26}}$
(3) $\sqrt{\frac{3}{26}}$
(4) $\sqrt{\frac{3}{13}}$

4. **The resultant of two forces, one double the other in magnitude, is perpendicular to the smaller of the two forces. The angle between the two forces is -**

(1) 120°
(2) 60°
(3) 90°
(4) 150°

5. **The angle between the vectors $(\vec{i} + \vec{j})$ and $(\vec{j} + \vec{k})$ is -**

(1) 90°
(2) 180°
(3) 0°
(4) 60°

6. **There are two vectors $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{B} = \hat{i} + 2\hat{j} - 2\hat{k}$ then component of $\vec{A}$ along $\vec{B}$ is -**

(1) $\frac{2}{9}(\hat{i} + 2\hat{j} - 2\hat{k})$
(2) $\frac{2}{3}(2\hat{i} + \hat{j} + \hat{k})$
(3) $\frac{2}{3}(\hat{i} + 2\hat{j} - 2\hat{k})$
(4) None of these

7. **Work is -**

(1) $\vec{F} \times \vec{S}$

(2) $-\vec{S} \times \vec{F}$

(3) $\vec{F}.\vec{S}$

(4) $-\vec{F}.\vec{S}$

8. **The velocity of a particle is $\vec{v} = 6\hat{i} + 2\hat{j} - 2\hat{k}$. The component of the velocity of a particle parallel to vector $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ in vector form is-**

(1) $6\hat{i} + 2\hat{j} + 2\hat{k}$

(2) $2\hat{i} + 2\hat{j} + 2\hat{k}$

(3) $\hat{i} + \hat{j} + \hat{k}$

(4) $6\hat{i} + 2\hat{j} - 2\hat{k}$

Answer Key

Question	1	2	3	4	5	6	7	8
Answer	**3**	**1**	**2**	**1**	**4**	**1**	**3**	**2**

SOLUTIONS DPP-07

1. **(3)**

$W = \vec{F} \cdot \Delta\vec{S}$

$\Delta\vec{S} = 10\hat{j}$

$W = (-2\hat{i} + 15\hat{j} + 6\hat{k}) \cdot (10\hat{j})$

$\therefore W = 150J$

2. **(1)**

$\because \ P = \vec{F}.\vec{v} = (20\hat{i} - 3\hat{j} + 5\hat{k}) \cdot (6\hat{i} + 20\hat{j} - 3\hat{k})$

$= 120 - 60 - 15 = 45 \text{ W}$

3. **(2)**

Projection of $\vec{A}$ on $\vec{B}$ = $\frac{\vec{A}.\vec{B}}{B} = \frac{3}{\sqrt{26}}$

4. **(1)**

$\vec{P}.(\vec{P} + \vec{Q}) = 0$

$P^2 + PQ\cos\theta = 0$ and $P = \frac{Q}{2}$

$\therefore P^2 + 2P^2\cos\theta = 0$

or $\cos\theta = -\frac{1}{2} \Rightarrow \theta = 120°$

5. **(4)**

$\cos\theta = \frac{(\hat{i}+\hat{j}).(\hat{j}+\hat{k})}{\sqrt{2}\sqrt{2}}$

or $\cos\theta = \frac{1}{2} \Rightarrow \theta = 60°$

6. **(1)**

Component of $\vec{A}$ along $\vec{B} = \frac{\vec{A}.\vec{B}}{|\vec{B}|}.\hat{B}$

7. **(3)**

As we know that,

$W = \vec{F} \cdot \vec{S}$

8. **(2)**

Component of $\vec{v}$along $\vec{a} = (\vec{v}.\hat{a})$

$= (6\hat{i} + 2\hat{j} - 2\hat{k}) \cdot \frac{(\hat{i}+\hat{j}+\hat{k})}{\sqrt{3}}$

$= \frac{6+2-2}{\sqrt{3}} = \frac{6}{\sqrt{3}} = 2\sqrt{3}$

In vector form = $(2\sqrt{3})\,\hat{a}$

$= 2\sqrt{3}\frac{(\hat{i}+\hat{j}+\hat{k})}{\sqrt{3}}$

$= 2\,(\hat{i} + \hat{j} + \hat{k})$

Vector Product DPP-08

1. What is the value of linear velocity, if $\vec{\omega} = 3\hat{i} - 4\hat{j} + \hat{k}$ and $\vec{r} = 5\hat{i} - 6\hat{j} + 6\hat{k}$?

(1) $4\hat{i} - 13\hat{j} + 6\hat{k}$

(2) $6\hat{i} - 2\hat{j} + 3\hat{k}$

(3) $6\hat{i} - 2\hat{j} + 8\hat{k}$ c

(4) $-18\hat{i} - 13\hat{j} + 2\hat{k}$

2. The value of a unit vector in the direction of vector $A = 5\hat{i} - 12\hat{j}$, is

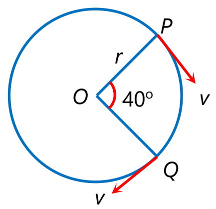
(1) $\hat{i}$

(2) $\hat{j}$

(3) $(\hat{i} + \hat{j})/13$

(4) $(5\hat{i} - 12\hat{j})/13$

3. A particle is moving on a circular path of radius r with speed v. The change in velocity when the particle moves from P to Q is $(\angle POQ = 40°)$



(1) $2v\cos 40°$

(2) $2v\sin 40°$

(3) $2v\sin 20°$

(4) $2v\cos 20°$

4. Which of the following is the unit vector perpendicular to $\vec{A}$ and $\vec{B}$

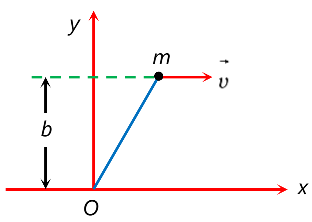
(1) $\frac{\hat{A}\times\hat{B}}{AB\sin\theta}$

(2) $\frac{\hat{A}\times\hat{B}}{AB\cos\theta}$

(3) $\frac{\vec{A}\times\vec{B}}{AB\sin\theta}$

(4) $\frac{\vec{A}\times\vec{B}}{AB\cos\theta}$

5. If a particle of mass m is moving with constant velocity v parallel to x-axis in x-y plane as shown in fig. Its angular momentum with respect to origin at any time t will be



(1) $mvb\hat{k}$

(2) $-mvb\hat{k}$

(3) $mvb\hat{i}$

(4) $mv\hat{i}$

6. **The position vectors of radius are $2\hat{i} + \hat{j} + \hat{k}$ and $2\hat{i} - 3\hat{j} + \hat{k}$ while those of linear momentum are $2\hat{i} + 3\hat{j} - \hat{k}$. Then the angular momentum is**

(1) $2\hat{i} - 4\hat{k}$

(2) $4\hat{i} + 8\hat{k}$

(3) $2\hat{i} - 4\hat{j} + 2\hat{k}$

(4) $4\hat{i} - 8\hat{k}$

7. **If a vector $\vec{A}$ is parallel to another vector $\vec{B}$ then the resultant of the vector $\vec{A} \times \vec{B}$ will be equal to**

(1) A

(2) $\vec{A}$

(3) Zero vector

(4) Zero

8. **The linear velocity of a rotating body is given by $\vec{v} = \vec{\omega} \times \vec{r}$, where $\vec{\omega}$ is the angular velocity and $\vec{r}$is the radius vector. The angular velocity of a body $\vec{\omega} = \hat{i} - 2\hat{j} + 2\hat{k}$and the radius vector $\vec{r} = 4\hat{j} - 3\hat{k}$, then $|\vec{v}|$ is**

(1) $\sqrt{29}$units

(2) $\sqrt{31}$units

(3) $\sqrt{37}$units

(4) $\sqrt{41}$units

9. **A vector $\vec{A}$ of magnitude $5\sqrt{3}$ units, another vector $\vec{B}$ of magnitude 10 units are inclined to each other at an angle of 30°. The magnitude of the vector product of the two vectors is –**

(1) 1 units

(2) $5\sqrt{3}$units

(3) 75 units

(4) $25\sqrt{3}$units

Answer Key

Question	1	2	3	4	5	6	7	8	9
Answer	**4**	**4**	**3**	**3**	**2**	**2**	**3**	**1**	**4**

SOLUTIONS DPP-08

1. **(4)**

As we know that

$\vec{V} = \vec{\omega} \times \vec{r}$

$\vec{V} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -4 & 1 \\ 5 & -6 & 6 \end{vmatrix}$

$\therefore\ \vec{V} = -18\hat{i} - 13\hat{j} + 2\hat{k}$

2. **(4)**

$\vec{A} = 5\hat{i} + 12\hat{j}, |\vec{A}| = \sqrt{5^2 + (-12)^2} = \sqrt{25 + 144} = 13$

Unit vector $\hat{A} = \frac{\vec{A}}{|\vec{A}|} = \frac{5\hat{i} - 12\hat{j}}{13}$

3. **(3)**

$\Delta v = 2v \sin\left(\frac{\theta}{2}\right) = 2v\sin 20°$

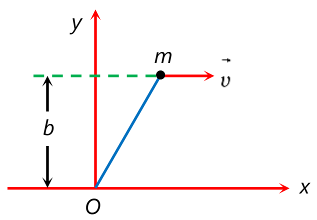
4. **(3)**

Vector perpendicular to A and B, $\vec{A} \times \vec{B} = AB\sin\theta\ \hat{n}$

$\therefore$ Unit vector perpendicular to A and B

$\hat{n} = \frac{\vec{A} \times \vec{B}}{AB\sin\theta}$

5. **(2)**



We know that, Angular momentum

$\vec{L} = \vec{r} \times \vec{p}$ in terms of component becomes

$\vec{L} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ x & y & z \\ p_x & p_y & p_z \end{vmatrix}$

As motion is in x-y plane (z = 0 and $P_z = 0$), so $\vec{L} = \vec{k}\,(xp_y - yp_x)$

Here x = vt, y = b, $p_x = mv$ and $p_y = 0$

$\therefore\ \vec{L} = \vec{k}\,[vt \times 0 - bmv] = -mvb\hat{k}$

6. **(2)**

Radius vector $\vec{r} = \vec{r_2} - \vec{r_1} = (2\hat{i} - 3\hat{j} + \hat{k}) - (2\hat{i} + \hat{j} + \hat{k})$

$\therefore \quad \vec{r} = -4\hat{j}$

Linear momentum $\vec{p} = 2\hat{i} + 3\hat{j} - \hat{k}$

$\vec{L} = \vec{r} \times \vec{p} = (-4\hat{j}) \times (2\hat{i} + 3\hat{j} - \hat{k})$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -4 & 0 \\ 2 & 3 & -1 \end{vmatrix} = 4\hat{i} + 8\hat{k}$$

7. **(3)**

$\vec{A} \times \vec{B} = AB \sin\theta\, \hat{n}$

for parallel vectors $\theta = 0°$ or $180°$, $\sin\theta = 0$

$\therefore \vec{A} \times \vec{B} = \hat{0}$

8. **(1)**

$$\vec{V} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 2 \\ 0 & 4 & -3 \end{vmatrix} \Rightarrow \vec{V} = -2\hat{i} + 3\hat{j} + 4\hat{k}$$

$|\vec{V}| = \sqrt{(-2)^2 + (3)^2 + (4)^2}$

$|\vec{V}| = \sqrt{29}$

9. **(4)**

$|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}| sin\theta$

$|\vec{A} \times \vec{B}| = 5\sqrt{3} \times 10 \times \sin 30°$

$= 25\sqrt{3}$ units

DAILY PRACTICE PROBLEM

Application of Vector Product DPP-09

1. **If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle between A and B is –**

(1) π

(2) $\pi/3$

(3) $\pi/2$

(4) $\pi/4$

2. **The vectors from origin to the points A and B are $\vec{A} = 3\hat{i} - 6\hat{j} + 2\hat{k}$ and $\vec{B} = 2\hat{i} + \hat{j} - 2\hat{k}$ respectively. The area of the triangle OAB will be -**

(1) $\frac{5}{2}\sqrt{17}$ sq. unit

(2) $\frac{2}{5}\sqrt{17}$ sq. unit

(3) $\frac{3}{5}\sqrt{17}$ sq. unit

(4) $\frac{5}{3}\sqrt{17}$ sq. unit

3. **The area of the triangle whose vertices are A (1, –1, 2), B(2, 1, –1) and C (3, –1, 2) is -**

(1) 26

(2) $7\sqrt{13}$

(3) $\sqrt{13}$

(4) 8

4. **A vector $\vec{F}_1$ is along the positive x-axis. If its vector product with another vector $\vec{F}_2$ is zero then $\vec{F}_2$ may be -**

(1) $4\hat{j}$

(2) $-(\hat{i} + \hat{j})$

(3) $(\hat{i} + \hat{k})$

(4) $-4\hat{i}$

5. **Find out the unit vector perpendicular to both vectors $\hat{i} - \hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + \hat{k}$.**

(1) $\hat{i} + \hat{j}$

(2) $\frac{-\hat{i}+\hat{k}}{\sqrt{2}}$

(3) $\hat{j} + \hat{k}$

(4) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

6. **The adjacent sides of a parallelogram are represented by co-initial vectors $2\hat{i} + 3\hat{j}$ and $\hat{i} + 4\hat{j}$. The area of the parallelogram is–**

(1) 5 units along z-axis

(2) 5 units in x-y plane

(3) 3 units in x-z plane

(4) 3 units in y-z plane

7. **The torque of the force $\vec{F} = (2\hat{i} - 3\hat{j} + 4\hat{k})N$ acting at the point $\vec{r} = (3\hat{i} + 2\hat{j} + 3\hat{k})$ m about the origin be-**

(1) $6\hat{i} - 6\hat{j} + 12\hat{k}$

(2) $17\hat{i} - 6\hat{j} - 13\hat{k}$

(3) $-6\hat{i} + 6\hat{j} - 12\hat{k}$

(4) $-17\hat{i} + 6\hat{j} + 13\hat{k}$

8. **If $\vec{A} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{B} = -\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{C} = 3\hat{i} - 3\hat{j} - 12\hat{k}$, then find the angle between the vectors $(\vec{A} + \vec{B} + \vec{C})$ and $(\vec{A} \times \vec{B})$ in degrees.**

(1) 90°

(2) 45°

(3) 0°

(4) 180°

Answer Key

Question	1	2	3	4	5	6	7	8
Answer	**1**	**1**	**3**	**4**	**2**	**1**	**2**	**1**

SOLUTIONS DPP-09

1. **(1)**

Using property of vector product

As we know that

$(\vec{A} \times \vec{B}) = -(\vec{B} \times \vec{A})$

As per given in the question

$\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$

$(\vec{A} \times \vec{B}) = -(\vec{A} \times \vec{B})$

$2(\vec{A} \times \vec{B}) = 0$

$\because \sin\theta = 0$

$\therefore \theta = \pi$

2. **(1)**

Area of $\Delta = \frac{1}{2}\left|\overrightarrow{OA} \times \overrightarrow{OB}\right|$

$= \frac{1}{2}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -6 & 2 \\ 2 & 1 & -2 \end{vmatrix}$

$= \frac{1}{2}\left|(10\hat{i} + 10\hat{j} + 15\hat{k})\right| = \frac{1}{2}\sqrt{425} = \frac{5}{2}\sqrt{17}$

3. **(3)**

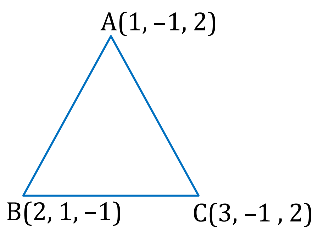
$\overrightarrow{AB} = \hat{i} + 2\hat{j} - 3\hat{k}$

$\overrightarrow{BC} = \hat{i} - 2\hat{j} + 3\hat{k}$

$\overrightarrow{AB} \times \overrightarrow{BC} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & -3 \\ 1 & -2 & 3 \end{vmatrix} = -6\hat{j} - 4\hat{k}$

$|\overrightarrow{AB} \times \overrightarrow{BC}| = \sqrt{(-6)^2 + (-4)^2} = \sqrt{52}$ unit

$\therefore$ Area of $\Delta = \frac{1}{2}|\overrightarrow{AB} \times \overrightarrow{BC}| = \sqrt{13}$ unit



4. **(4)**

$\vec{F}_1 = F_1\,\hat{i}$ and $F_1\,\hat{i} \times (-4\hat{i}) = 0$

5. **(2)**

$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 1 \\ 1 & 1 & 1 \end{vmatrix} = -2\hat{i} + 2\hat{k}$

here $\vec{a} \times \vec{b}$ is perpendicular to both $\vec{a}$ and $\vec{b}$ unit vector along $\vec{a} \times \vec{b} = \frac{-2\hat{i}+2\hat{k}}{\sqrt{(-2)^2+2^2}}$

$= \frac{-\hat{i}+\hat{k}}{\sqrt{2}}$

6. **(1)**

$$\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & 0 \\ 1 & 4 & 0 \end{vmatrix} = \hat{k}\,(8-3) = 5\hat{k}$$

7. **(2)**

$$\vec{\tau} = \vec{r}\times\vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 2 & 3 \\ 2 & -3 & 4 \end{vmatrix}$$

$= 17\hat{i} - 6\hat{j} - 13\hat{k}$

8. **(1)**

Let $\vec{P} = \vec{A} + \vec{B} + \vec{C} = 3\hat{i} - 5\hat{k}$ and $\vec{Q} = \vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ -1 & 1 & 4 \end{vmatrix} = 5\hat{i} - 7\hat{j} + 3\hat{k}$

Angle between $\vec{P}$ & $\vec{Q}$ is given by $\cos\theta = \frac{\vec{P}\cdot\vec{Q}}{PQ} = \frac{15-15}{PQ} = 0 \Rightarrow \theta = 90°$