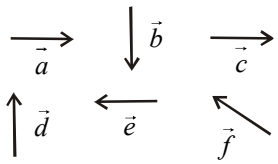
3 Motion in a Plane

Diagram Based Questions :

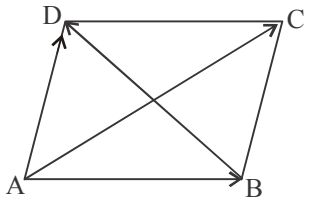
1. Six vectors, $\vec{a}, \vec{b}, \vec{c}, \vec{d}, \vec{e}$ and $\vec{f}$ have the magnitudes and directions indicated in the figure. Which of the following statements is true?



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

(c) $\vec{d}+\vec{e}=\vec{f}$ (d) $\vec{b}+\vec{e}=\vec{f}$

2. Which of the following holds true for the given figure?



(a) $\overrightarrow{AC}+\overrightarrow{BD}=2\overrightarrow{BC}$

(b) $\overrightarrow{AB}+\overrightarrow{BC}=2\overrightarrow{CD}$

(c) $\overrightarrow{AC}-\overrightarrow{AB}=2\overrightarrow{BD}$

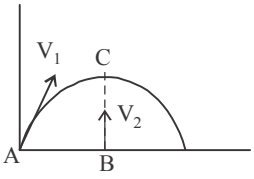
(d) All of these

3. If V_1 is velocity of a body projected from the point A and V_2 is the velocity of a body projected from point B which is vertically below the highest point C. If both the bodies collide, then

(a) $V_1=\frac{1}{2}V_2$

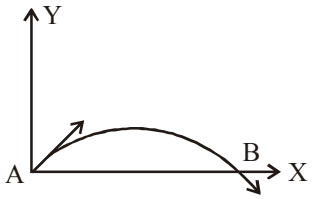
(b) $V_2=\frac{1}{2}V_1$

(c) $V_1=V_2$



(d) Two bodies can't collide.

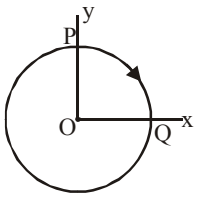
4. The velocity of a projectile at the initial point A is $\left(2\hat{i}+3\hat{j}\right)$ m/s its velocity (in m/s) at point B is



(a) $-2\hat{i}+3\hat{j}$ (b) $2\hat{i}-3\hat{j}$

(c) $2\hat{i}+3\hat{j}$ (d) $-2\hat{i}-3\hat{j}$

5. A particle moves in a circle of radius 4 cm clockwise at constant speed 2 cm/s. If $\hat{x}$ and $\hat{y}$ are unit acceleration vectors along X and Y-axis respectively (in cm/s^2), the acceleration of the particle at the instant half way between P and Q is given by

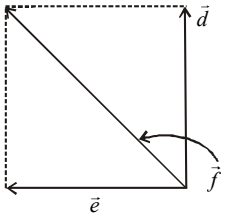


(a) $-4(\hat{x}+\hat{y})$ (b) $4(\hat{x}+\hat{y})$

(c) $-(\hat{x}+\hat{y})/\sqrt{2}$ (d) $(\hat{x}-\hat{y})/4$

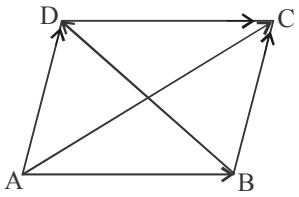
Solution

1. **(c)** Using the law of vector addition, $(d+e)$ is as shown in the fig.



$\therefore \quad \vec{d}+\vec{e}=\vec{f}$

2. **(a)**



$\overrightarrow{AC}+\overrightarrow{BD}=(\overrightarrow{AB}+\overrightarrow{BC})+(\overrightarrow{BC}+\overrightarrow{CD})$

$= \overrightarrow{AB}+2\overrightarrow{BC}+\overrightarrow{CD}$

$= \overrightarrow{AB}+2\overrightarrow{BC}-\overrightarrow{AB}$

$= 2\overrightarrow{BC}$

3. **(b)** Two bodies will collide at the highest point if both cover the same vertical height in the same time.

So $\dfrac{V_1^2\sin^2 30°}{2g}=\dfrac{V_2^2}{2g}\Rightarrow \dfrac{V_2}{V_1}=\sin 30°=\dfrac{1}{2}$

$\therefore \quad V_2=\dfrac{1}{2}V_1$

4. **(b)** At point B the direction of velocity component of the projectile along Y - axis reverses.

Hence, $\vec{V}_B=2\hat{i}-3\hat{j}$

5. **(c)** $a=\dfrac{v^2}{r}$ = 1 cm/s. Centripetal acceleration is directed towards the centre. Its magnitude = 1. Unit vector at the mid point on the path between P and Q is $-(\hat{x}+\hat{y})/\sqrt{2}$.