Chapter 01

Basic Mathematics

JEE–FLASHBACK

Q.1 A Force $\vec{F} = -K\left(y\hat{i} + x\hat{j}\right)$ (where K is a positive constant) acts on a particle moving in the x-y plane. Starting from the origin the particle is taken along the positive x-axis to the point (a,0) and then parallel to the y-axis to the point (a,a). The total work done by the forces $\vec{F}$ on the particle is

[IIT-JEE 1998]

(1) $-2Ka^2$ (2) $2Ka^2$ (3) $-Ka^2$ (4) Ka^2

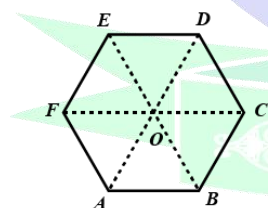**Q.2** The speed of a boat is 5 km/h in still water. it crosses a river of width 1 km along the shortest possible path in 15 minutes. The velocity of the river water is

[CBSE PMT 1998, 2000; Odisha JEE 2008]

(1) 1 km/h (2) 3 km/h (3) 4 km/h (4) 5 km/h

Q.3 Figure shows ABCDEF as a regular hexagon. What is the value of $\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF}$

[CBSE PMT 1998, 2000; Odisha JEE 2008]

(1) $\overrightarrow{AO}$ (2) $2\overrightarrow{AO}$ (3) $4\overrightarrow{AO}$ (4) $6\overrightarrow{AO}$

Q.4 A metal sphere is hung by a string fixed to a wall. The sphere is pushed away from the wall by a stick. The forces acting on the sphere are shown in the second diagram. Which of the following statements is wrong **[WB-JEE 2009]**
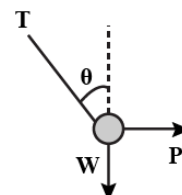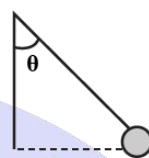
(1) $P = W\tan\theta$ (2) $\vec{T} + \vec{P} + \vec{W} = 0$

(3) $T^2 = P^2 + W^2$ (4) $T = P + W$

Q.5 Two vectors $\vec{A}$ and $\vec{B}$ have components A_x, A_y, A_z and B_x, B_y, B_z respectively. If $\vec{A} + \vec{B} = 0$, then **[Odisha JEE 2010]**

(1) $A_x = B_x, A_y = -B_y, A_z = -B_z$

(2) $A_x = B_x, A_y = B_y, A_z = -B_z$

(3) $A_x = B_x, A_y = B_y, A_z = B_z$

(4) $A_x = -B_x, A_y = -B_y, A_z = -B_z$

Q.6 A truck travelling due north at 20 m/s turns west and travels at the same speed. The change in its velocity be **[UPSEAT 1999; Odisha JEE 2011]**

(1) 40 m/s N-W   (2) $20\sqrt{2}$ m/s N-W

(3) 40 m/s S-W   (4) $20\sqrt{2}$ m/s S-W

Q.7 The magnitudes of vectors $\vec{A}, \vec{B}$ and $\vec{C}$ are 3,4 and 5 units respectively. If $\vec{A} + \vec{B} = \vec{C}$, the angle between $\vec{A}$ and $\vec{B}$ is

[CPMT 1997; CEET 1998 WB-JEE 2012]

(1) $\dfrac{\pi}{2}$ (2) $\cos^{-1}(0.6)$

(3) $\tan^{-1}\left(\dfrac{7}{5}\right)$ (4) $\dfrac{\pi}{4}$

Q.8 Two vector are given by $\vec{A} = \hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{B} = 3\hat{i} + 6\hat{j} + 2\hat{k}$. Another vector $\vec{C}$ has the same magnitude as $\vec{B}$ but has the same direction as $\vec{A}$. Then which of the following vectors represent $\vec{C}$.

[WB-JEE 2013]

(1) $\frac{7}{3}(\hat{i}+2\hat{j}+2\hat{k})$ (2) $\frac{3}{7}(\hat{i}-2\hat{j}+2\hat{k})$

(3) $\frac{7}{9}(\hat{i}-2\hat{j}+2\hat{k})$ (4) $\frac{9}{7}(\hat{i}+2\hat{j}+2\hat{k})$

**Q.9** The angle made by the vector $A=\hat{i}+\hat{j}$ with x-axis is **[EAMCET (Engg.) 1999; WB-JEE 2013]**
(1) 90° (2) 45°
(3) 22.5° (4) 30°

Q.10 For the following set(s) of forces (in the same unit) the resultant can never be zero
[WB-JEE 2016]
(1) 10, 10, 10 (2) 10, 10, 20
(3) 10, 20, 30 (4) 10, 20, 40

Q.11 Three vector $\vec{P}, \vec{Q}$ and $\vec{R}$ are shown in the figure. Let S be any point on the vector $\vec{R}$. The distance between the point P and S is $b|\vec{R}|$. The general relation among vectors $\vec{P}, \vec{Q}$ and $\vec{S}$ is
[IIT-JEE 2017]

(1) $\vec{S}=(b-1)\vec{P}+b\vec{Q}$

(2) $\vec{S}=(1-b^2)\vec{P}+b\vec{Q}$

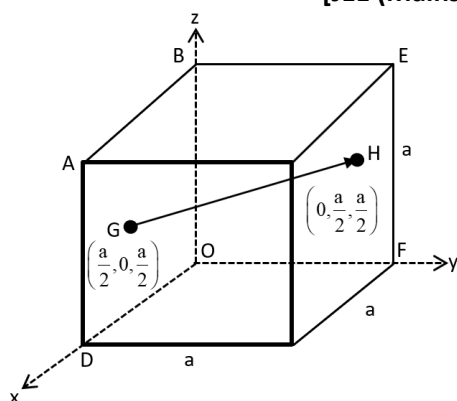(3) $\vec{S}=(1-b)\vec{P}+b^2\vec{Q}$

(4) $\vec{S}=(1-b)\vec{P}+b\vec{Q}$
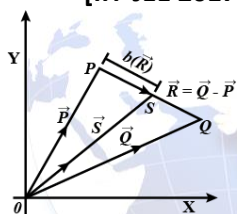
Q.12 Two forces 3 N and 2 N are at an angle θ such that the resultant is R. The first force is now increased to 6 N and the resultant become 2R. The value of θ is
[HP PMT 2000; JEE (Main) 2019]
(1) 30° (2) 60° (3) 90° (4) 120°

Q.13 In the cube of side's 'a' shown in the figure, the vector from the central point of the face ABOD to the central point of the face BEFO will be
[JEE (Mains) 2019]

(1) $\frac{1}{2}a(\hat{i}-\hat{k})$ (2) $\frac{1}{2}a(\hat{j}-\hat{i})$

(3) $\frac{1}{2}a(\hat{k}-\hat{i})$ (4) $\frac{1}{2}a(\hat{j}-\hat{k})$

Q.14 A particle moves from the point $(2.0\hat{i}+4.0\hat{j})$ m, at t = 0, with an initial velocity $(5.0\hat{i}+4.0\hat{j})$ ms^{-1}. It is acted upon by a constant force which produces a constant acceleration $(4.0\hat{i}+4.0\hat{j})$ ms^{-2}. What is the distance of the particle the origin at time 2s **[JEE (Mains) 2019]**
(1) $20\sqrt{2}$ m (2) $10\sqrt{2}$ m
(3) 5 m (4) 15 m

Q.15 Two vectors $\vec{A}$ and $\vec{B}$ have equal magnitudes. The magnitude of $(\vec{A}+\vec{B})$ is 'n' times the magnitude of $(\vec{A}-\vec{B})$. The angle between $\vec{A}$ and $\vec{B}$ is **[JEE (Mains) 2019]**

(1) $\sin^{-1}\left[\frac{n^2-1}{n^2+1}\right]$ (2) $\cos^{-1}\left[\frac{n-1}{n+1}\right]$

(3) $\cos^{-1}\left[\frac{n^2-1}{n^2+1}\right]$ (4) $\sin^{-1}\left[\frac{n-1}{n+1}\right]$

Q.16 Ship A is sailing towards north-east with velocity $\vec{v}=30\hat{i}+50\hat{j}$ km/hr where $\hat{i}$ points east and $\hat{j}$, north. Ship B is at a distance of 80 km east and 150 km north of ship A and is sailing towards west at 10 km/hr. A will be at minimum distance from B in **[JEE (Mains) 2019]**
(1) 4.2 hrs (2) 2.2 hrs
(3) 3.2 hrs (4) 2.6 hrs

Q.17 Let $|\vec{A}_1|=3, |\vec{A}_2|=5$ and $|\vec{A}_1+\vec{A}_2|=5$. the value of $(2\vec{A}_1+3\vec{A}_2)\cdot(3\vec{A}_1-2\vec{A}_2)$ is **[JEE (Mains) 2019]**
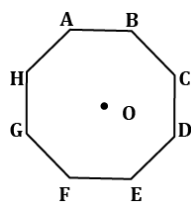(1) −112.5 (2) −106.5
(3) −118.5 (4) −99.5

Q.18 $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$, then the angle between A and B is **[AIEEE 2004; JEE (Main) Feb. 2021]**
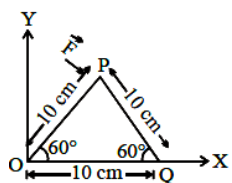(1) $\pi/2$ (2) $\pi/3$ (3) π (4) $\pi/4$

Q.19 In a octagon ABCDEFGH of equal side, what is the sum of $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}+\overrightarrow{AG}+\overrightarrow{AH}$ if, $\overrightarrow{AO}=2\hat{i}+3\hat{j}-4\hat{k}$ **[JEE (Main) Feb. 2021]**

(1) $-16\hat{i}-24\hat{j}+32\hat{k}$ (2) $16\hat{i}+24\hat{j}-32\hat{k}$

(3) $16\hat{i}+24\hat{j}+32\hat{k}$ (4) $16\hat{i}-24\hat{j}+32\hat{k}$

Q.20 A triangular plate is shown. A force $\vec{F}=4\hat{i}-3\hat{j}$ is applied at point P. The torque at point P with respect to point 'O' and 'Q' are

[JEE (Main) March 2021]

(1) $-15-20\sqrt{3},15-20\sqrt{3}$

(2) $15+20\sqrt{3},15-20\sqrt{3}$

(3) $15-20\sqrt{3},15+20\sqrt{3}$

(4) $-15+20\sqrt{3},15+20\sqrt{3}$

Q.21 When vector $\vec{A}=2\hat{i}+3\hat{j}+2\hat{k}$ is subtracted from vector $\vec{B}$ it gives a vector equal to $2\hat{j}$ Then the magnitude of vector $\vec{B}$ will be:

[JEEMain-2023]

(1) $\sqrt{5}$ (2) 3   (3) $\sqrt{6}$ (4) $\sqrt{33}$

Q.22 A vector in x – y plane makes an angle of 30° with y-axis. The magnitude of y-component of vector is $2\sqrt{3}$. The magnitude of x-component of the vector will be :   **[JEEMain-2023]**

(1) $\dfrac{1}{\sqrt{3}}$ (2) 6   (3) 2   (4) $\sqrt{3}$

Q.23 Vector $a\hat{i}+b\hat{j}+\hat{k}$ and $2\hat{i}-3\hat{j}+4\hat{k}$ are perpendicular to each other when 3a + 2b = 7, the ratio of a to b is $\dfrac{x}{2}$. The value of x ____.

[JEEMain-2023(24 Jan. shift-1)]

Q.24 If two vectors $\vec{P}=\hat{i}+2m\hat{j}+m\hat{k}$ and $\vec{Q}=4\hat{i}-2\hat{j}+m\hat{k}$ are perpendicular to each other. Then, the value of m will be:

[JEEMain-2023(24 Jan. shift-2)]

(1) 1   (2) –1   (3) –3   (4) 2

Q.25 If $\vec{P}=3\hat{i}+\sqrt{3}\hat{j}+2\hat{k}$ and $\vec{Q}=4\hat{i}+\sqrt{3}\hat{j}+2.5\hat{k}$ then, the unit vector in the direction of $\vec{P}\times\vec{Q}$ is $\dfrac{1}{x}\left(\sqrt{3}\hat{i}+\hat{j}-2\sqrt{3}\hat{k}\right)$. The value of x is

[JEEMain-2023(25 Jan. shift-1)]

ANSWER KEY

JEE-FLASHBACK

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	3	2	4	4	4	4	1	1	2	4	4	4	2	1	3
Que.	16	17	18	19	20	21	22	23	24	25					
Ans.	4	3	3	2	1	4	3	1	4	4					