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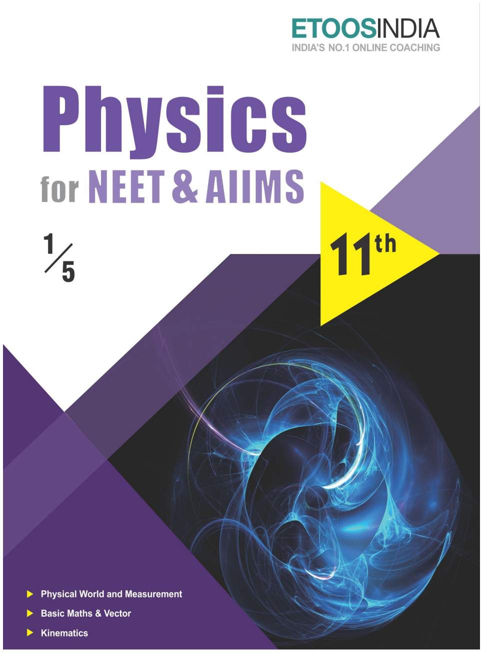


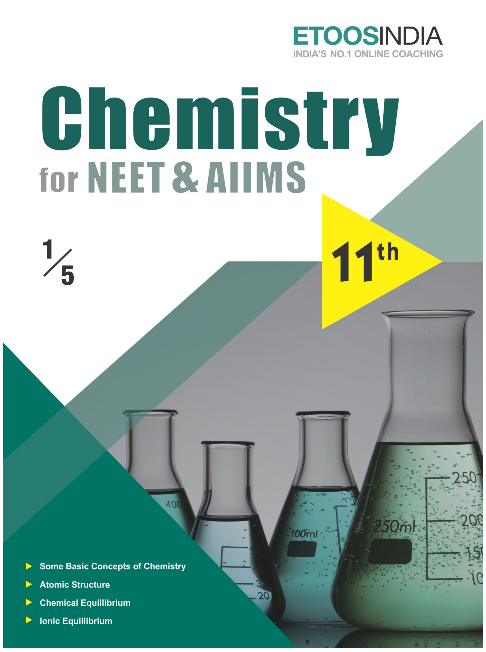


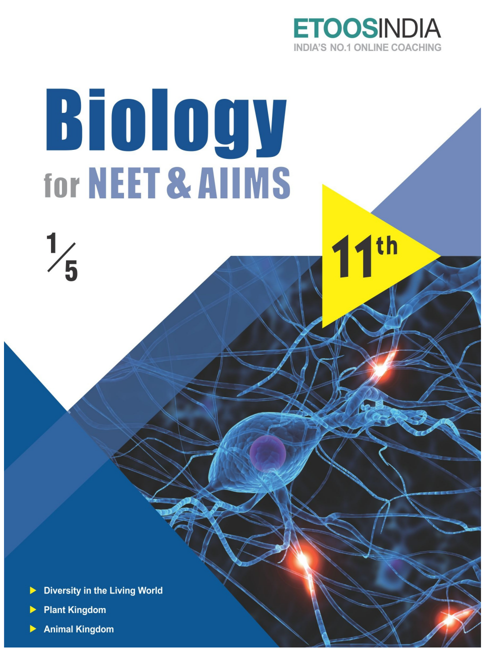


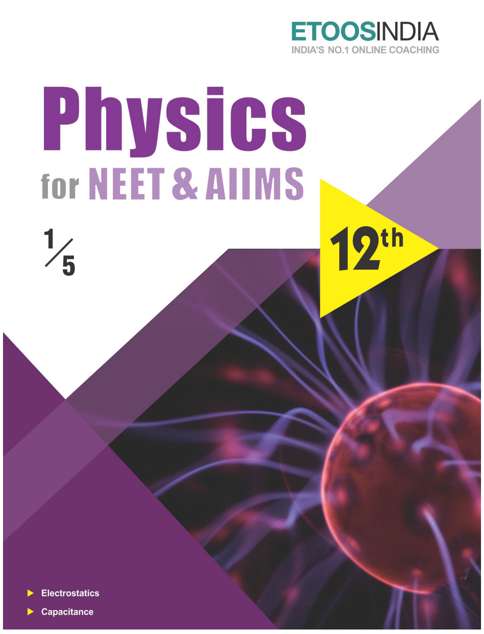


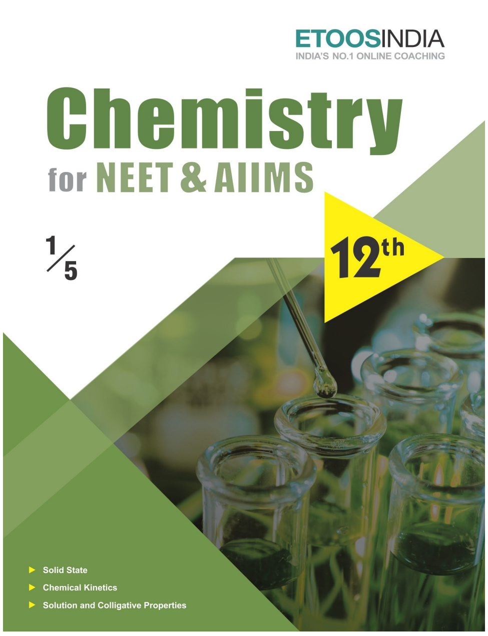


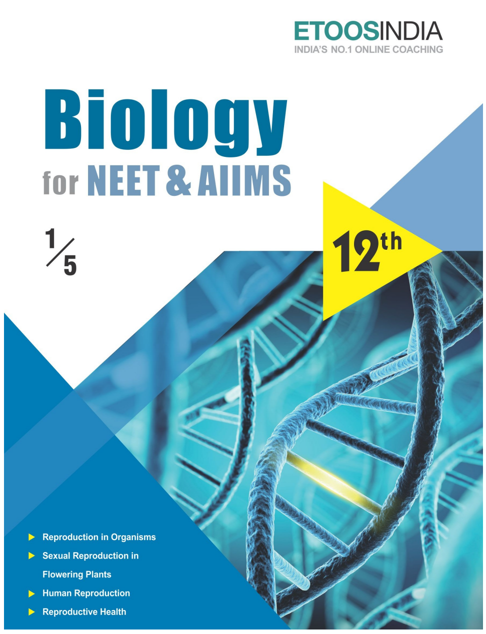


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CHAPTER 02

# BASIC MATHS & VECTOR

*"As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality."*

**"ALBERT EINSTEIN"**

## INTRODUCTION

The language of physics is mathematics. In order to study physics seriously, one needs to learn mathematics that took generations of brilliant people centuries to work out. The relationship between mathematics and physics has been a subject of study of philosophers, mathematicians and physicists since Antiquity, and more recently also by historians and educators.Generally considered a relationship of great intimacy, mathematics has already been described as "an essential tool for physics and physics has already been described as "a rich source of inspiration and insight in mathematics".

From the seventeenth century, many of the most important advances in mathematics appeared motivated by the study of physics, and this continued in the following centuries. The creation and development of calculus were strongly linked to the needs of physics. There was a need for a new mathematical language to deal with the new dynamics that had arisen from the work of scholars such as Galileo Galilei and Isaac Newton. As time progressed, increasingly sophisticated mathematics started to be used in physics. The current situation is that the mathematical knowledge used in physics is becoming increasingly sophisticated, as in the case of superstring theory.

## ETOOS KEY POINTS

**(i)** Vector product of two vectors is always a vector perpendicular to the plane containing the two vectors, i.e., orthogonal

(perpendicular) to both the vectors $\vec{A}$ and $\vec{B}$.

Unit vector perpendicular to $\vec{A}$ and $\vec{B}$ is $\hat{n} = \pm \dfrac{\vec{A}\times\vec{B}}{|\vec{A}\times\vec{B}|}$

**(ii)** Vector product of two vectors is not commutative i.e. cross

products $\vec{A}\times\vec{B}$ and $\vec{B}\times\vec{A}$ have equal magnitudes but opposite directions as shown in the figure.

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

**(iii)** The vector product is distributive when the order of the vectors is strictly maintained,

i.e. $\vec{A}\times(\vec{B}+\vec{C}) = \vec{A}\times\vec{B}+\vec{A}\times\vec{C}$

**(iv)** Angle θ between two vectors $\vec{A}$ and $\vec{B}$ is given by $\theta = \sin^{-1}\left[\dfrac{|\vec{A}\times\vec{B}|}{|\vec{A}|\,|\vec{B}|}\right]$

**(v)** The self cross product, i.e., product of a vector by itself is a zero vector or a null vector.

$\vec{A}\times\vec{A} = (AA\sin 0°)\hat{n} = \vec{0} = \hat{i}\times\hat{i} = \hat{j}\times\hat{j} = \hat{k}\times\hat{k}$

**(vi)** In case of orthogonal unit vectors $\hat{i}, \hat{j}$ and $\hat{k}$; according to right hand thumb rule

$\hat{i}\times\hat{j} = \hat{k}, \hat{j}\times\hat{k} = \hat{i}, \hat{k}\times\hat{i} = \hat{j}$ and $\hat{j}\times\hat{i} = -\hat{k}, \hat{k}\times\hat{j} = -\hat{i}, \hat{i}\times\hat{k} = -\hat{j}$

**(v)** If $\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$ and $\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$, their cross-products is given by

$$\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix} = \hat{i}(A_yB_z - A_zB_y) - \hat{j}(A_xB_z - A_zB_x) + \hat{k}(A_xB_y - A_yB_x)$$

**(vi)** If $\vec{A}$, $\vec{B}$ and $\vec{C}$ are coplanar, then $\vec{A}.(\vec{B}\times\vec{C}) = 0$.

### Rate of change of a vector with time

It is derivative of a vector function with respect to time. Cartesian components of a time dependent vector, if given as function of time as $\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j} + z(t)\hat{k}$, the time rate of change can be calculated according to equation

$$\frac{d\vec{r}(t)}{dt} = \frac{dx(t)\hat{i}}{dt} + \frac{dy(t)\hat{j}}{dt} + \frac{dz(t)\hat{k}}{dt}$$

### Methods of differentiation of vector functions

Methods of differentiation of scalar functions are also applicable to differentiation of vector functions.

**i.** $\dfrac{d}{dt}\left(\vec{F}\pm\vec{G}\right) = \dfrac{d\vec{F}}{dt} \pm \dfrac{d\vec{G}}{dt}$

**ii.** $\dfrac{d}{dt}\left(\vec{F}\cdot\vec{G}\right) = \dfrac{d\vec{F}}{dt}\cdot\vec{G} + \vec{F}\cdot\dfrac{d\vec{G}}{dt}$

**iii.** $\dfrac{d}{dt}\left(X\vec{F}\right) = \dfrac{dX}{dt}\vec{F} + X\dfrac{d\vec{F}}{dt}$ Here X is a scalar function of time.

**iv.** $\dfrac{d}{dt}\left(\vec{F}\times\vec{G}\right) = \dfrac{d\vec{F}}{dt}\times\vec{G} + \vec{F}\times\dfrac{d\vec{G}}{dt}$ Order of the vector functions $\vec{F}$ and $\vec{G}$ must be retained.

## Etoos Tips & Formulas

## BASIC MATHEMATICS

**1. Quadratic Equation**

Roots of $ax^2 + bx + c = 0$ are $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Sum of roots $= x_1 + x_2 = -\dfrac{b}{a}$ ; Product of roots $= x_1 x_2 = \dfrac{c}{a}$

**2. Binomial Theorem**

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2}x^2 + \frac{n(n-1)(n-2)}{6}x^3 + ......$$

$$(1-x)^n = 1 - nx + \frac{n(n-1)}{2}x^2 - \frac{n(n-1)(n-2)}{6}x^3 + .....$$

If $x << 1$ then $(1+x)^n \approx 1 + nx$ & $(1-x)^n \approx 1 - nx$

**3. Logarithm**

(i) $\log mn = \log m + \log n$ (ii) $\log \dfrac{m}{n} = \log m - \log n$ **(iii)** $\log m^n = n \log m$ **(iv)** $\log_e m = 2.303 \log_{10} m$

**4. Componendo and Dividendo Rule**

If $\dfrac{p}{q} = \dfrac{a}{b}$ then $\dfrac{p+q}{p-q} = \dfrac{a+b}{a-b}$

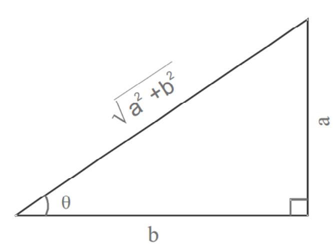
**5. Arithmetic progression (AP)**

$a, a + d, a + 2d, ..., a + (n-1)d$ here d = common difference

Sum of n terms $S_n = \dfrac{n}{2}[2a + (n-1)d]$

**Note :** (i) $1 + 2 + 3 + 4 + 5$ ............ $n = \dfrac{n(n+1)}{2}$

(ii) $1^2 + 2^2 + 3^2 + ...... + n^2 = \dfrac{n(n+1)(2n+1)}{6}$




**6. Geometrical Progression (GP)**

$a, ar, ar^2, ..., ar^{n-1}$ here r = common ratio

Sum of n terms $S_n = \dfrac{a(1-r^n)}{1-r}$ Sum of $\infty$ term $S_\infty = \dfrac{a}{1-r}$

**7. Trigonometry**

$2\pi$ rad $= 360° \Rightarrow 1$ rad $= 57.3°$

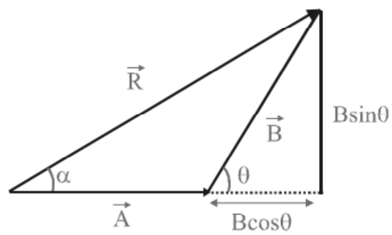
(i) $\sin\theta = \dfrac{\text{perpendicular}}{\text{hypotenuse}}$ (ii) $\cos\theta = \dfrac{\text{base}}{\text{hypotenuse}}$ (iii) $\tan\theta = \dfrac{\text{perpendicular}}{\text{base}}$

# VECTOR

**20.** Vector Quantities

A physical quantity which requires magnitude and a particular direction, when it is expressed.

**21. Triangle law of Vector addition** $\vec{R} = \vec{A} + \vec{B}$



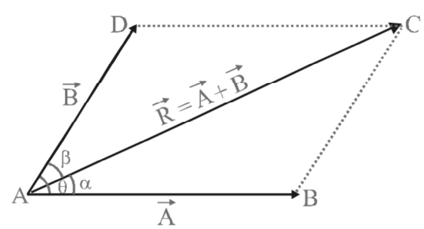

$R = \sqrt{A^2 + B^2 + 2AB\cos 90^\circ}$

$\Rightarrow \quad \tan\alpha = \dfrac{B\sin\theta}{A + B\cos\theta}$

If A = B then $R = 2A\cos\dfrac{\theta}{2}$ & $\alpha = \dfrac{\theta}{2}$

$R_{max} = A + B$ for $\theta = 0°$ ; $\quad R_{min} = A - B$ for $\theta = 180°$

**22. Parallelogram law of Addition of Two Vectors**

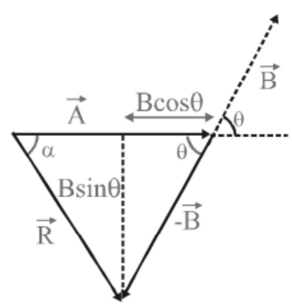



If two vectors are represented by two adjacent sides of a parallelogram which are directed away from their common point then their sum (i.e. resultant vector) is given by the diagonal of the parallelogram passing away through that common point.

$\overrightarrow{AB} + \overrightarrow{AD} = \overrightarrow{AC} = \vec{R}$ or $\vec{A} + \vec{B} = \vec{R} \Rightarrow R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

$\tan\alpha = \dfrac{B\sin\theta}{A + B\cos\theta}$ and $\tan\beta = \dfrac{A\sin\theta}{B + A\cos\theta}$

**23. Vector subtraction**



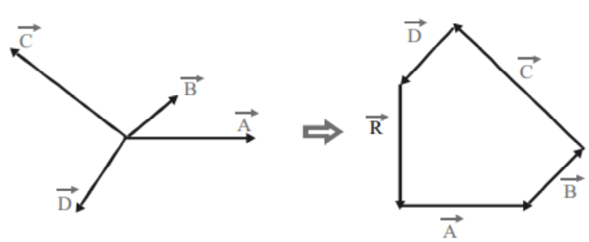

$\vec{R} = \vec{A} - \vec{B} \quad \Rightarrow \quad \vec{R} = \vec{A} + \left(-\vec{B}\right)$

$R = \sqrt{A^2 + B^2 - 2AB\cos 90^\circ}$, $\qquad \tan\alpha = \dfrac{B\sin\theta}{A - B\cos\theta}$

If A = B then $R = 2A\sin\dfrac{\theta}{2}$

**24. Addition of More than Two Vectors (Law of Polygon)**

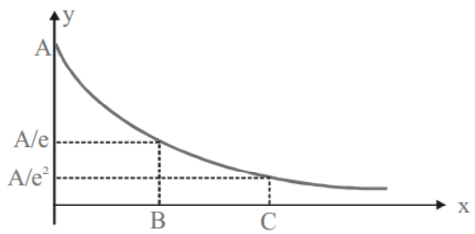
If some vectors are represented by sides of a polygon in same order, then their resultant vector is represented by the closing side of polygon in the opposite order.




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

## SOLVED EXAMPLE

**Ex. 1** In the given figure, a function $y = 15e^{-x}$ is shown. What is the numerical value of expression A/(B+C) ?

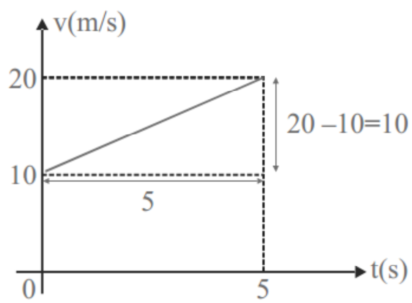



**Sol.** From graph A = 15 ; B =1 ; C =2 .
Therefore [ A/(B+C) = 15/3 = 5]

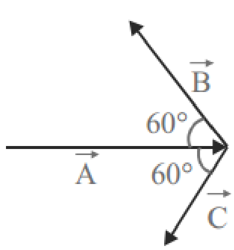
**Ex. 2** A car changes its velocity linearly from 10 m/s to 20 m/s in 5 seconds. Plot v-t graph and write velocity as a function of time.

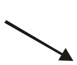
**Sol.** Slope = $\frac{20-10}{5-0} = 2 =$ m

y-intercept = 10 = c $\Rightarrow$ v = 2t + 10




**Ex. 3** Three coplanar vectors $\vec{A}, \vec{B}$ and $\vec{C}$ have magnitudes 4, 3 and 2 respectively. If the angle between any two vectors is 120° then which of the following vector may be equal to $\frac{3\vec{A}}{4} + \frac{\vec{B}}{3} + \frac{\vec{C}}{2}$




(A) 
(B) 
(C) 
(D) 

**Sol.** As $\left|\frac{\vec{B}}{3}\right| = \left|\frac{\vec{C}}{2}\right|$ so $\frac{\vec{B}}{3} + \frac{\vec{C}}{2} = -\frac{\vec{A}}{4}$

therefore $\frac{3\vec{A}}{4} + \frac{\vec{B}}{3} + \frac{\vec{C}}{2} = \frac{\vec{A}}{2}$

**Ex. 4** The magnitude of pairs of displacement vectors are given. Which pairs of displacement vectors cannot be added to give a resultant vector of magnitude 13 cm?

(A) 4 cm, 16 cm (B) 20 cm, 7 cm
(C) 1 cm, 15 cm (D) 6 cm, 8 cm

**Sol.** Resultant of two vectors $\vec{A}$ and $\vec{B}$ must satisfy $A \sim B \le R \le A + B$

**Ex. 5** Three non zero vectors $\vec{A}, \vec{B}$ and $\vec{C}$ satisfy the relation $\vec{A} \cdot \vec{B} = 0$ & $\vec{A} \cdot \vec{C} = 0$. Then $\vec{A}$ can be parallel to:

(A) $\vec{B}$ (B) $\vec{C}$
(C) $\vec{B} \cdot \vec{C}$ (D) $\vec{B} \times \vec{C}$

**Sol.** $\vec{A} \cdot \vec{B} = 0 \Rightarrow \vec{A} \perp \vec{B}$ & $\vec{A} \cdot \vec{C} = 0$
$\Rightarrow \vec{A} \perp \vec{C}$

But $\vec{B} \times \vec{C}$ is perpendicular to both $\vec{B}$ and $\vec{C}$ so $\vec{A}$ is parallel to $\vec{B} \times \vec{C}$ .

**Ex. 6** $\alpha$ and $\beta$ are the angle made by a vector from positive x & positive y-axes respectively. Which set of $\alpha$ and $\beta$ is not possible

(A) $45^0, 60^0$ (B) $30^0, 60^0$
(C) $60^0, 60^0$ (D) $30^0, 45^0$

**Sol.** $\alpha, \beta$ must satisfy $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

**Ex. 7** Let $\vec{A}, \vec{B}$ and $\vec{C}$, be unit vectors. Suppose that $\vec{A} \cdot \vec{B} = \vec{A} \cdot \vec{C} = 0$ and the angle between $\vec{B}$ and $\vec{C}$ is $\frac{\pi}{6}$ then

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

(C) $\vec{A} = 2(\vec{C} \times \vec{B})$ (D) $|\vec{B} \times \vec{C}| = \frac{\sqrt{3}}{2}$

# Exercise # 1

SINGLE OBJECTIVE | NEET LEVEL

1. Find points at which the tangent to the curve $y = x^3 - 3x^2 - 9x + 7$ is parallel to the x–axis

(A) (3,–20) and (–1, 12) (B) (3,20) and (1, 12)
(C) (3,–10) and (1, 12) (D) None of these

2. A stone is dropped into a quiet lake and waves move in circles at the speed of 5 cm/s. At the instant when the radius of the circular wave is 8 cm, how fast is the enclosed area increasing ?

(A) $80\pi$ cm²/s (B) $90\pi$ cm²/s
(C) $85\pi$ cm²/s (D) $89\pi$ cm²/s

3. The momentum of a moving particle given by $p = t\ell nt$. Net force acting on this particle is defined by equation $F = \frac{dp}{dt}$.
The net force acting on the particle is zero at time

(A) $t = 0$ (B) $t = \frac{1}{e}$
(C) $t = \frac{1}{e^2}$ (D) None of these

4. Let $\vec{A} = \hat{i}A\cos\theta + \hat{j}A\sin\theta$, be any vector. Another vector $\vec{B}$ which is normal to $\vec{A}$ is :–

(A) $\hat{i}B\cos\theta + \hat{j}B\sin\theta$
(B) $\hat{i}B\sin\theta + \hat{j}B\cos\theta$
(C) $\hat{i}B\sin\theta - \hat{j}B\cos\theta$
(D) $\hat{i}A\cos\theta - \hat{j}A\sin\theta$

5. An edge of a variable cube is increasing at the rate of 3 cm/s. How fast is the volume of the cube increasing when the edge is 10 cm long ?

(A) 900 cm³/s (B) 920 cm³/s
(C) 850 cm³/s (D) 950 cm³/s

6. Force 3N, 4N and 12N act at a point in mutually perpendicular directions. The magnitude of the resultant force is :–

(A) 19 N (B) 13 N
(C) 11 N (D) 5 N

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

(A) 1 (B) $\sqrt{0.11}$
(C) $\sqrt{0.01}$ (D) $\sqrt{0.39}$

8. The sum of magnitudes of two forces acting at a point is 16N. If the resultant force is 8N and its direction is perpendicular to smaller force, then the forces are :–

(A) 6N and 10N (B) 8N and 8N
(C) 4N and 12N (D) 2N and 14N

9. The unit vector parallel to the resultant of the vectors $\vec{A} = 4\hat{i} + 3\hat{j} + 6\hat{k}$ and $\vec{B} = -\hat{i} + 3\hat{j} - 8\hat{k}$ is :–

(A) $\frac{1}{7}(3\hat{i} + 6\hat{j} - 2\hat{k})$ (B) $\frac{1}{7}(3\hat{i} + 6\hat{j} + 2\hat{k})$
(C) $\frac{1}{49}(3\hat{i} + 6\hat{j} + 2\hat{k})$ (D) $\frac{1}{49}(3\hat{i} + 6\hat{j} - 2\hat{k})$

10. How many minimum number of coplanar vectors which represent same physical quantity having different magnitudes can be added to give zero resultant

(A) 2 (B) 3
(C) 4 (D) 5

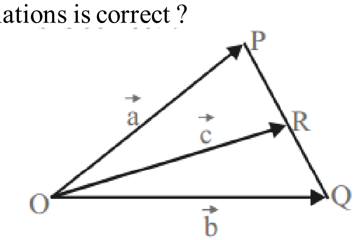
11. A physical quantity which has a direction :–

(A) Must be a vector (B) May be a vector
(C) Must be a scalar (D) None of the above

12. Following sets of three forces act on a body. Whose resultant cannot be zero ?

(A) 10, 10, 10 (B) 10, 10, 20
(C) 10, 20, 20 (D) 10, 20, 40

13. Figure shows three vectors $\vec{a}, \vec{b}$ and $\vec{c}$, where R is the midpoint of PQ. Then which of the following relations is correct ?



# Exercise # 2

SINGLE OBJECTIVE | AIIMS LEVEL

1. A particle moves along the curve $x^2 + 4 = y$. The points on the curve at which the y coordinates changes twice as fast as the x coordinate, is

(A) (1,5) (B) (5,1)
(C) (1,2) (D) None of these

2. A ladder 5m long is leaning against a wall. The foot of the ladder is pulled out along the ground away from the wall at a rate of 2m/s. How fast is the height of ladder on the wall decreasing at the instant when the foot of the ladder is 4m away from the wall?

(A) 10 m/s (B) $\frac{3}{2}$ m/s
(C) $\frac{8}{3}$ m/s (D) None of these

3. Moment of inertia of a solid about its geometrical axis is given by $I = \frac{2}{5}MR^2$ where M is mass & R is radius. Find out the rate by which its moment of inertia is changing keeping density constant at the moment R = 1m, M = 1 kg & rate of change of radius w.r.t. time 2 $ms^{-1}$

(A) 4 kg $ms^{-1}$ (B) 2 kg $m^2s^{-1}$
(C) 4 kg $m^2s^{-1}$ (D) None of these

4. Three forces P, Q & R are acting at a point in the plane. The angle between P & Q and Q & R are 150° & 120° respectively, then for equilibrium (i.e. net force = 0), forces P, Q & R are in the ratio

(A) 1 : 2 : 3 (B) 1 : 2 : √3
(C) 3 : 2 : 1 (D) √3 : 2 : 1

5. If the sum of two unit vectors is a unit vector, then magnitude of difference is –

(A) √2 (B) √3
(C) 1/√2 (D) √5

6. Let $\vec{a}, \vec{b}, \vec{c}$ are three unit vectors such that $\vec{a} + \vec{b} + \vec{c}$ is also a unit vector. If pairwise angles between $\vec{a}, \vec{b}, \vec{c}$ are $\theta_1$, $\theta_2$ and $\theta_3$ respectively then $\cos\theta_1 + \cos\theta_2 + \cos\theta_3$ equals

(A) 3 (B) – 3
(C) 1 (D) – 1

7. Let $\vec{a}$, $\vec{b}$, $\vec{c}$ be vectors of length 3, 4, 5 respectively. Let $\vec{a}$ be perpendicular to $\vec{b} + \vec{c}$, $\vec{b}$ to $\vec{c} + \vec{a}$ and $\vec{c}$ to $\vec{a} + \vec{b}$. Then $|\vec{a} + \vec{b} + \vec{c}|$ is :

(A) 2√5 (B) 2√2
(C) 10√5 (D) 5√2

8. *X*–component of $\vec{a}$ is twice of its *Y*–component . If the magnitude of the vector is 5√2 and it makes an angle of 135° with z–axis then the components of vector is :

(A) 2√3, √3, –3 (B) 2√6, √6, –6
(C) 2√5, √5, –5 (D) None of these

9. If $\vec{a}$ is a vector and x is a non–zero scalar, then

(A) x$\vec{a}$ is a vector in the direction of $\vec{a}$
(B) x$\vec{a}$ is a vector collinear to $\vec{a}$
(C) x$\vec{a}$ and $\vec{a}$ have independent directions
(D) None of these.

10. The two vectors $\vec{A}$ and $\vec{B}$ are drawn from a common point and $\vec{C} = \vec{A} + \vec{B}$ then angle between $\vec{A}$ and $\vec{B}$ is

(A) $90^0$ if $C^2 \neq A^2 + B^2$
(B) Greater than $90^0$ if $C^2 < A^2 + B^2$
(C) Greater than $90^0$ if $C^2 > A^2 + B^2$
(D) None of these

11. Following forces start acting on a particle at rest at the origin of the co–ordinate system simultaneously

$\vec{F}_1 = -4\hat{i} - 5\hat{j} + 5\hat{k}$, $\vec{F}_2 = -5\hat{i} + 8\hat{j} + 6\hat{k}$, $\vec{F}_3 = -3\hat{i} + 4\hat{j} - 7\hat{k}$ and $\vec{F}_4 = 12\hat{i} - 3\hat{j} - 2\hat{k}$ then the particle will move–

(A) In x–y plane
(B) In y – z plane
(C) In x–z plane
(D) Along x–axis

# Exercise # 3 — PART - 1 — MATRIX MATCH COLUMN

Following question contains statements given in two columns, which have to be matched. The statements in **Column-I** are labelled as A, B, C and D while the statements in **Column-II** are labelled as p, q, r and s. Any given statement in **Column-I** can have correct matching with one or more statement(s) in **Column-II**.

**1.** For component of a vector $\vec{A} = \left(3\hat{i} + 4\hat{j} - 5\hat{k}\right)$, match the following table :

| Column I | Column II |
|---|---|
| (A) Along y–axis | (P) 5 unit |
| (B) Along another vector $(2\hat{i} + \hat{j} + 2\hat{k})$ | (Q) 4 unit |
| (C) Along another vector $(6\hat{i} + 8\hat{j} - 10\hat{k})$ | (R) Zero |
| (D) Along another vector $(-3\hat{i} - 4\hat{j} + 5\hat{k})$ | (S) None |

**2.** Match the integrals (given in column - II) with the given functions (in column - I)

| Column - I | Column - II |
|---|---|
| (A) $\int \sec x \tan x \, dx$ | (P) $-\dfrac{\operatorname{cosec} Kx}{K} + C$ |
| (B) $\int \operatorname{cosec} Kx \cot Kx \, dx$ | (Q) $-\dfrac{\cot Kx}{K} + C$ |
| (C) $\int \operatorname{cosec}^2 Kx \, dx$ | (R) $\sec x + C$ |
| (D) $\int \cos Kx \, dx$ | (S) $\dfrac{\sin Kx}{K} + C$ |

**3.** Match the statements given in **Column-I** with statements given in **Column - II**

| Column - I | Column - II |
|---|---|
| (A) if $\lvert\vec{A}\rvert = \lvert\vec{B}\rvert$ and $\lvert\vec{A} + \vec{B}\rvert = \lvert\vec{A}\rvert$ then angle between $\vec{A}$ and $\vec{B}$ is | (P) 90° |
| (B) Magnitude of resultant of two forces $\left\lvert\vec{F}_1\right\rvert = 8N$ and $\left\lvert\vec{F}_2\right\rvert = 4$ N may be | (Q) 120° |
| (C) Angle between $\vec{A} = 2\hat{i} + 2\hat{j}$ & $\vec{B} = 3\hat{k}$ is | (R) 12 N |
| (D) Magnitude of resultant of vectors $\vec{A} = 2\hat{i} + \hat{j}$ & $\vec{B} = 3\hat{k}$ is | (S) $\sqrt{14}$ |

# Exercise # 4 — PART - 1 — PREVIOUS YEAR (NEET/AIPMT)

**1.** The vectors $\vec{A}$ and $\vec{B}$ are such that $|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}|$. The angle between vectors $\vec{A}$ and $\vec{B}$ is – **[AIPMT 2006]**

**(A)** 90° **(B)** 60°

**(C)** 75° **(D)** 45°

**2.** If $|\vec{A}\times\vec{B}| = \sqrt{3}\,\vec{A}.\vec{B}$, then the value of $|\vec{A}+\vec{B}|$ is : **[AIPMT 2007]**

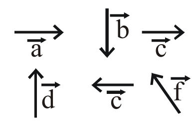
**(A)** $\left(A^2+B^2+\dfrac{AB}{\sqrt{3}}\right)^{1/2}$

**(B)** $A+B$

**(C)** $\left(A^2+B^2+\sqrt{3}\,AB\right)^{1/2}$

**(D)** $(A^2+B^2+AB)^{1/2}$

**3.** Six vectors, $\vec{a}$ through $\vec{f}$ have the magnitudes and directions indicated in the figure. Which of the following statements is true? **[AIPMT 2010]**




**(A)** $\vec{b}+\vec{e}=\vec{f}$ **(B)** $\vec{b}+\vec{c}=\vec{f}$

**(C)** $\vec{d}+\vec{c}=\vec{f}$ **(D)** $\vec{d}+\vec{e}=\vec{f}$

**4.** If vectors

$\vec{A} = \cos\omega t\hat{i} + \sin\omega t\hat{j}$ and $\vec{B} = \cos\dfrac{\omega t}{2}\hat{i} + \sin\dfrac{\omega t}{2}\hat{j}$

are functions of time, then the value of t at which they are orthogonal to each other is : **[Re-AIPMT 2015]**

**(A)** $t=0$ **(B)** $t=\dfrac{\pi}{4\omega}$

**(C)** $t=\dfrac{\pi}{2\omega}$ **(D)** $t=\dfrac{\pi}{\omega}$

# MOCK TEST

## STRAIGHT OBJECTIVE TYPE

1. The product of all the solutions of the equation $(x-2)^2 - 3|x-2| + 2 = 0$ is
(A) 2 (B) – 4 (C) 0 (D) none of these

2. The number of solutions of the equation $\log(-2x) = 2\log(x+1)$ is
(A) zero (B) 1 (C) 2 (D) none

3. Greatest integer less than or equal to the number $\log_2 15 . \log_{1/6} 2 . \log_3 1/6$ is
(A) 4 (B) 3 (C) 2 (D) 1

4. The number of solutions of $|[x] - 2x| = 4$ is
(where [.] denotes greatest integer function)
(A) 2 (B) 4 (C) 3 (D) Infinite

5. The solution set of the inequation $1 + \log_{\frac{1}{3}}(x^2 + x + 1) > 0$ is
(A) $(-\infty, -2) \cup (1, \infty)$ (B) $[-1, 2]$ (C) $(-2, 1)$ (D) $(-\infty, \infty)$

6. Number of values of x satisfying the equations $5\{x\} = x + [x]$ and $[x] - \{x\} = \frac{1}{2}$ is
(A) 1 (B) 2 (C) 3 (D) 4

7. If $|x^2 - 9| + |x^2 - 4| = 5$, then the set of values of x is
(A) $(-\infty, -3) \cup (3, \infty)$ (B) $(-\infty, -2) \cup (3, \infty)$ (C) $(-\infty, 3)$ (D) $[-3, -2] \cup [2, 3]$

8. If $\frac{|x+2| - x}{x} < 2$, then the set of values of x is
(A) $(-\infty, 1) \cup (2, \infty)$ (B) $(-\infty, 0) \cup (1, \infty)$ (C) $(-\infty, -1) \cup (0, \infty)$ (D) none of these

9. Solution set of the inequality $\log_e^2 [2x] - \log_e [2x] \le 0$ is
(A) $[1, 3)$ (B) $(0, 3)$ (C) $\{1, 2\}$ (D) $\left[\frac{1}{2}, \frac{3}{2}\right)$

10. Solution set of $|x^2 - 5x + 7| + |x^2 - 5x - 14| = 21$ is
(A) $[-2, 7]$ (B) $(-\infty, -2] \cup [7, \infty)$ (C) $[7, \infty)$ (D) $(-\infty, -2]$

11. The set of real value(s) of p for which the equation $|2x + 3| + |2x - 3| = px + 6$ has exactly two solutions is
(A) $[0, 4)$ (B) $(-4, 4) - \{0\}$ (C) $R - \{4, -4, 0\}$ (D) $\{0\}$

12. $e^{e^{\ell n\, \ell n 3}}$ is simplified to
(A) $e^3$ (B) $\ell n\, 3$ (C) 3 (D) $\ell n(\ell n\, 3)$

13. If $\vec{a}, \vec{b}$ are unit vectors such that $(\vec{a} + \vec{b}) . \{(2\vec{a} + 3\vec{b}) \times (3\vec{a} - 2\vec{b})\} = 0$, then angle between $\vec{a}$ and $\vec{b}$ is -
(A) 0 (B) $\pi/2$ (C) $\pi$ (D) indeterminate

# 11$^{th}$ Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

## PHYSICS

### Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

### Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

### Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

### Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

### Module-5

1. Oscillations
2. Waves

## CHEMISTRY

### Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

### Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

### Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

### Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

### Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

## BIOLOGY

### Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

### Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

### Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

### Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

### Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

# 12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

## PHYSICS

### Module-1

1. Electrostatics
2. Capacitance

### Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

### Module-3

1. Electromagnetic Induction
2. Alternating Current

### Module-4

1. Geometrical Optics
2. Wave Optics

### Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

## CHEMISTRY

### Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

### Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

### Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

### Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

### Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

## BIOLOGY

### Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

### Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

### Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

### Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

### Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues