Chapter 01

Basic Mathematics

JEE-RANKER'S STUFF

SINGLE CORRECT QUESTIONS

Q.1 Which of the following is correct.

(1) $\sin 1° > \sin 1$

(2) $\sin 1° < \sin 1$

(3) $\sin 1° = \sin 1$

(4) $\sin 1° = \frac{\pi}{180}\sin 1$

Q.2 At what angle must the two forces (x + y) and (x – y) act so that the resultant may be $\sqrt{(x^2+y^2)}$?

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

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

Q.3 Given that P = Q = R. If $\vec{P}+\vec{Q}=\vec{R}$ then the angle between $\vec{P}\&\vec{R}$ is θ_1. If $\vec{P}+\vec{Q}+\vec{R}$ = 0 then the angle between $\vec{P}\&\vec{R}$ is θ_2. What is the relation between θ_1 and θ_2:

(1) $\theta_1 = \theta_2$ (2) $\theta_1 = \frac{\theta_2}{2}$

(3) $\theta_1 = 2\theta_2$ (4) None of the above

Q.4 Given that $\vec{A}+\vec{B}+\vec{C}=0$. Out of these three vectors two are equal in magnitude and the magnitude of the third vector is $\sqrt{2}$ times as that of either of the two having equal magnitude. Then the angles between vectors are given by:

(1) 30°, 60°, 90° (2) 45°, 45°, 90°

(3) 45°, 60°, 90° (4) 90°, 135°, 135°

Q.5 The resultant of two vectors $\vec{P}$ and $\vec{Q}$ is $\vec{R}$. If $\vec{Q}$ is doubled then the new resultant vector is perpendicular to '$\vec{P}$'. Then R is equal to :

(1) $\left(\frac{P^2-Q^2}{2PQ}\right)$ (2) Q

(3) $\frac{P}{Q}$ (4) $\frac{P+Q}{P-Q}$

Q.6 A vector of length ℓ is turned through the angle θ about its tail. What is the change in the position vector of its head ?

(1) $\ell\cos(\theta/2)$ (2) $2\ell\sin(\theta/2)$

(3) $2\ell\cos(\theta/2)$ (4) $\ell\sin(\theta/2)$

Q.7 A line passes through (x_1, y_1). This point bisects the segment of the line between the axes. Its equation is.

(1) $\frac{x}{x_1}+\frac{y}{y_1}=2$ (2) $\frac{x}{x_1}+\frac{y}{y_1}=\frac{1}{2}$

(3) $\frac{x}{x_1}+\frac{y}{y_1}=1$ (4) None

Q.8 Acceleration of a particle in a magnetic field is given by $\vec{a} = \frac{q}{m}(\vec{V}\times\vec{B})$ if a charged particle is projected in a magnetic field $(2\hat{i}+2\hat{j}+2\hat{k})$ tesla, then acceleration of the particle at an instant is $(x\hat{i}+2\hat{j}-6\hat{k})$ m/s^2. value of x is

(1) 4 (2) 2 (3) 3 (4) 1

Q.9 Select incorrect statement for three vectors

$\vec{a}=-3\hat{i}+2\hat{j}-\hat{k}$

$\vec{b}=\hat{i}-3\hat{j}+5\hat{k}$ and $\vec{c}=2\hat{i}+\hat{j}-4\hat{k}$

(1) Angle between vectors $\vec{a}$ and $\vec{b}$ is obtuse

(2) Vector $\vec{a},\vec{b},\vec{c}$ form right angled triangle

(3) Vector $\vec{a},\vec{b},\vec{c}$ form acute angled triangle

(4) $\vec{a}.\vec{b}$ = 0 and $a^2 \neq c^2 = b^2$

Q.10 The angle subtended at the centre of the circle of diameter 50 cm by an arc of 11 cm, is (in degree)

(1)22° 10 ' (2)23° 10 '
(3)20° 12 ' (4)25° 12 '

Q.11 If $\vec{a}$ and $\vec{b}$ are two unit vector such that $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other then angle between $\vec{a}$ and $\vec{b}$ is
(1) 45° (2) 60°
(3) $\cos^{-1}\left(\frac{1}{3}\right)$ (4) $\cos^{-1}\left(\frac{2}{7}\right)$

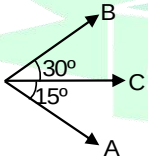
Q.12 Two vector A and B have equal magnitude. Then $\vec{A}+\vec{B}$ is perpendicular to
(1) $\vec{A}+2\vec{B}$ (2) $\vec{A}-\vec{B}$
(3) $3\vec{A}-2\vec{B}$ (4) All of these

Q.13 If for two vector $\vec{A}$ and $\vec{B}$., Sum ($\vec{A}+\vec{B}$) is perpendicular to the difference ($\vec{A}-\vec{B}$). The ratio of their magnitudes is
(1) 1 (2) 2 (3) 3 (4) None

Q.14 $\log_4 18$ is
(1) 4 log (2×9)
(2) 9 log (4×2)
(3) $\left(\frac{\log_{10}3}{\log_{10}2}+1\right)$
(4) $\frac{2\log_{10}3+\log_{10}2}{\log_{10}2}$

Q.15 The displacement vector of a particle is given as $\vec{S} = (t^2 - 2t + 12)\hat{i}+t^2\hat{j}$. The time after which velocity vector and acceleration vector becomes perpendicular to each other is equal to
(1) 1 (2) 1/2 (3) 1/3 (4) 1/4

Q.16 If $\vec{A}$ and $\vec{B}$ are the components of $\vec{C}$, then :



(1) B = C $\frac{\sqrt{3}}{2}$ (2) A = $\frac{C}{\sqrt{2}}$
(3) B = $\frac{C}{\sqrt{2}}$ (4) A = $\frac{\sqrt{3}C}{2}$

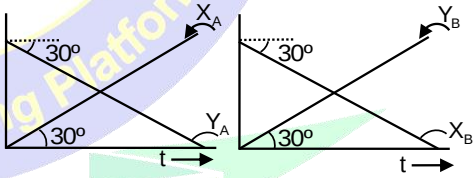
Q.17. If the angle between two forces increases, the magnitude of their resultant
(1) decreases
(2)increases
(3)remains unchanged
(4)first decreases and then increases

Q.18 A vector $\overrightarrow{OA}=3\hat{i}$ is rotated by an angle θ about its starting point O in x-z plane in clockwise sense, as seen by an observer located at a point on +y -axis. The new vector will be :
(1) 3 cos θ $\hat{i}$ + 3sin θ $\hat{j}$ (2) 3[cos θ $\hat{i}$ – sin θ $\hat{k}$]
(3) 3[cos θ $\hat{i}$ – 3sin θ $\hat{k}$] (4) 3[sin θ $\hat{i}$ + 3cosθ $\hat{k}$]

Q.19 Let there be two vectors $\vec{a}$ and $\vec{b}$ such that $\vec{a}+\vec{b}$ is in same direction as $\vec{a}-\vec{b}$. Select the correct alternative.
(1) $\vec{a}\times\vec{b}=0$
(2) $|\vec{a}|>|\vec{b}|$
(3) Both(1) & (2) must be simultaneously true
(4) $\vec{a}.\vec{b}$ = 0

Q.20 There are three vectors $\vec{P}$, $\vec{Q}$, and $\vec{R}$. The angle between $\vec{P}$ and $\vec{Q}$ is 60° and $\vec{R}$ is perpendicular to the plane containing the vectors $\vec{P}$ and $\vec{Q}$. Consider the following relations.
(a) $\vec{P}+\vec{Q}+\vec{R}=0$ (b) $\vec{P}\times\vec{Q}=\vec{R}$
(c) $\vec{P}\times\vec{R}=\vec{Q}$
The possible relations are
(1) (a) & (b) (2) (a) & (c)
(3) (b) & (c) (4) Only (b)

Q.21 Displacement versus time plot for two particles A and B is shown below. X_A X_B and Y_A Y_B refger to x and y coordinates of particles A and B.



Velocity of particle A with respect to particle B is
(1) $0\hat{i}+0\hat{j}$ (2) Dependent of time t
(3) $\frac{2}{\sqrt{3}}\hat{i}-\frac{2}{\sqrt{3}}\hat{j}$ (4) $-\frac{2}{\sqrt{3}}\hat{i}+\frac{2}{\sqrt{3}}\hat{j}$

Q.22 If the m^{th} term of an A.P. is $\frac{1}{n}$ and the n^{th} term is $\frac{1}{m}$ then sum to mn terms is –
(1) $\frac{mn+1}{2}$ (2) $\frac{mn-1}{2}$
(3) $\frac{mn+1}{3}$ (4) $\frac{mn-1}{3}$

Q.23 If $\vec{a}$ denotes a unit vector along an incident light $\vec{b}$ a unit vector along refracted ray into a medium having refractive index 'μ' (relative to first medium and $\vec{c}$ is a unit vector normal to boundary of two media and directed towards first medium, then law of refraction is [$\sin\theta_1 = \mu \sin\theta_2$]

(1) $\vec{a}.\vec{c} = x(\vec{b}.\vec{c})$ (2) $\vec{a}\times\vec{c} = x(\vec{c}\times\vec{b})$

(3) $\vec{a}\times\vec{c} = x(\vec{b}\times\vec{c})$ (4) $x(\vec{a}\times\vec{c}) = (\vec{b}\times\vec{c})$

Q.24 The sum of the magnitudes of two forces acting at point is 18 and the magnitude of their resultant is 12. If the resultant is at 90° with the force of smaller magnitude, what are the magnitudes of forces ?

(1) 12, 5 (2) 14, 4

(3) 5, 13 (4) 10, 8

Q.25 Three forces P, Q and R are acting on a particle in the plane, the angle between P and Q & Q and R are 150° and 120° respectively. Then for equilibrium, forces P, Q and R are in the ratio :

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

(3) 3 : 2 : 1 (4) $\sqrt{3}$: 2 : 1

Q.26 Following forces start acting on a particle at rest at the origin of the co-ordinate system simultaneously

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

(1) In x-y plane (2) In y-z plane

(3) In x-z plane (4) Along x-axis

Q.27 The vector that must be added to the vector $\hat{i} - 3\hat{j} + 2\hat{k}$ and $3\hat{i} + 6\hat{j} - 7\hat{k}$ so that the resultant vector is a unit vector along the y-axis is

(1) $4\hat{i} + 2\hat{j} + 5\hat{k}$ (2) $-4\hat{i} - 2\hat{j} + 5\hat{k}$

(3) $3\hat{i} + 4\hat{j} + 5\hat{k}$ (4) Null vector

Q.28 Let $\vec{A} = \hat{i}A\cos\theta + \hat{j}A\sin\theta$ be any vector. Another vector $\vec{B}$ which is normal to A is

(1) $\hat{i}B\cos\theta + \hat{j}B\sin\theta$

(2) $\hat{i}B\sin\theta + \hat{j}B\cos\theta$

(3) $\hat{i}B\sin\theta - \hat{j}B\cos\theta$

(4) $\hat{i}B\cos\theta - \hat{j}B\sin\theta$

Q.29 Which of the following sets of displacements might be capable of bringing a car to its returning point?

(1)5, 10, 30 and 50 km

(2)5, 9, 9 and 16 km

(3)40, 40, 90 and 200 km

(4)10, 20, 40 and 90 km

NUMERICAL VALUE TYPE QUESTIONS

Q.30 If the resultant of two forces of magnitudes P and Q acting at a point at an angle of 60° is $\sqrt{7}$ Q, then P/Q is

Q.31 A particle is displaced from position $\left(2\hat{i} - \hat{j} + \hat{k}\right)$ to another position $\left(3\hat{i} + 2\hat{j} - 2k\right)$ under the action of the force of $\left(2\hat{i} + \hat{j} - \hat{k}\right)$. The work done by the force in an arbitrary unit is :

Q.32 Vectors $\vec{a}$ and $\vec{b}$ are inclined at an angle θ = 120°. If $|\vec{a}| = 1$, $|\vec{b}| = 2$, then $[(\vec{a} + 3\vec{b}) + (3\vec{a} - \vec{b})]^2 =$

Q.33 A particle starts from rest with a uniform acceleration. Its displacement x after t seconds is given in metres by the relation $x = 5 + 6t + 7t^2$ Calculate the magnitude of its uniform acceleration

Q.34 The mass of a body is 2.5 kg. It is in motion and its velocity υ after time t is $\upsilon = \frac{t^3}{3} + \frac{t^2}{2} + 1$ Calculate the force acting on the body at the time t = 3 second.

Q.35 The air is filled in a balloon and the volume of balloon increases gradually. Find the rate of increase of volume of balloon with radius when radius of balloon becomes 30 cm.

Q.36 A particle is at rest. It start rotation about a fixed point. Its angle of rotation (θ) with time (t) is given by the relation:

$\theta = \frac{6t^3}{15} - \frac{t^2}{2}$

Where θ is in radian and t is seconds. Find the angular velocity and angular acceleration of particle at the end of 6 second.

Q.37 If the Displacement x of a particle (in metre) is related with time (in second) according to relation
$x = 2t^3 - 3t^2 + 2t + 2$
find the position, velocity and acceleration of a particle in the end of 2 seconds.

Q.38 A particle starts from rest and its angular displacement (in rad) is given by $\theta = \frac{t^2}{20} + \frac{t}{5}$;
calculate the angular velocity at the end of t = 4 second.

STATEMENT TYPE QUESTIONS

Each of the following contains two statements. Read the statements and choose any one of the following four responses:

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Q.39 **Statement -I :** $\cos 10^\circ$ & $\cos(-10)^\circ$ both are positive & have same value

Statement-II : $\cos\theta = \cos(-\theta)$ & 10° & $(-10)^\circ$ both lie in IIIrd quadrant.

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

Q.40 **Statement-1 :** The minimum number of non-zero vectors of unequal magnitude required to produce zero resultant is three.

Statement-2 : Three vectors of unequal magnitude which can be represented by the three sides of a triangle taken in order, produce zero resultant.

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

Q.41 **Statement-1 :** If three vectors $\vec{A}$, $\vec{B}$ **and** $\vec{C}$ satisfy the relation $\vec{A}\cdot\vec{B}=0$ & $\vec{A}\cdot\vec{C}=0$ then the vector $\vec{A}$ is parallel to $\vec{B}\times\vec{C}$.

Statement-2 : $\vec{A}\perp\vec{B}$ and $\vec{A}\perp\vec{C}$ and $\vec{B}\times\vec{C}\neq 0$ hence $\vec{A}$ is perpendicular to plane formed by $\vec{B}$ and $\vec{C}$.

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

Q.42 **Statement-1:** If the rectangular components of a force are 8 N and 6N, then the magnitude of the force is 10N.

Statement-2: If $|\vec{A}|=|\vec{B}|=1$ then $|\vec{A}\times\vec{B}|^2+|\vec{A}.\vec{B}|^2=1$.

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

MORE THAN ONE CORRECT TYPE QUESTIONS

Q.43 Which of the following is a true statement?

(1) A vector cannot be divided by another vector

(2) Angular displacement can either be a scalar or a vector.

(3) Since addition of vectors is commutative therefore vector subtraction is also commutative.

(4) The resultant of two equal forces of magnitude F acting at a point is F if the angle between the two forces is 120º.

Q.44 The vectors $\vec{A}$ and $\vec{B}$ lie in the plane. Vector $\vec{C}$ lies in a different plane. Then, $\vec{A}+\vec{B}+\vec{C}$

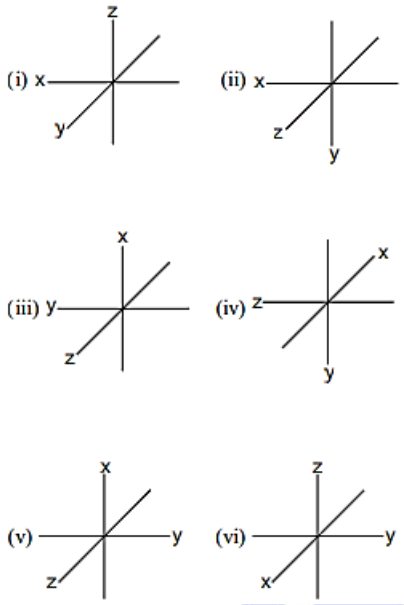
(1) Cannot be zero

(2) Can be zero

(3) Lies in the plane of $\vec{A}$ or $\vec{B}$

(4) Lies in a plane different from that of any of the three vectors

Q.45 Which of the arrangement of axes in fig. can be labelled "right handed coordinate system" ? As usual, each axis lable indicates the positive side of the axis.



(1)(i), (ii) (2)(iii) (iv) (3)(vi) (4)(v)

Q.46 If $\vec{a}$ and $\vec{b}$ are two vectors with $|\vec{a}| = |\vec{b}|$ and $|\vec{a} + \vec{b}| + |\vec{a} - \vec{b}| = 2|\vec{a}|$, then angle between $\vec{a}$ and $\vec{b}$

(1) 0° (2)90° (3)60° (4)180°

Q.47 A vector is equally inclined to all of the coordinates axes then the angle made by it with x-axis is θ then –

(1) $\cos\theta = \frac{2}{\sqrt{3}}$ (2) $\cos\theta = \frac{1}{\sqrt{3}}$

(3) $\sin\theta = \frac{2}{\sqrt{3}}$ (4) $\sin\theta = \frac{1}{\sqrt{3}}$

Q.48 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 –

(1) 90° if $C^2 = A^2 + B^2$

(2) Greater than 90° if $C^2 < A^2 + B^2$

(3) Greater than 90° if $C^2 > A^2 + B^2$

(4) Less than 90° if $C^2 > A^2 + B^2$

COMPREHENSION TYPE QUESTIONS

Q.49 A particle is moving along positive x-axis. Its position varies as $x = t^3 - 3t^2 + 12t + 20$, where x is in meters and t is in seconds.

(i) Initial velocity of the particle is.

(1) 1 m/s (2) 3 m/s

(3) 12 m/s (4) 20 m/s

(ii) Initial acceleration of the particle is

(1) Zero (2) 1 m/s^2

(3) –3m/s^2 (4) – 6 m/s^2

(iii) Velocity of the particle when its acceleration zero is

(1)1 m/s (2)3 m/s

(3)6 m/s (4) 9 m/s

MATCH THE COLUMN TYPE QUESTIONS

Q.50

Column-I		Column-II	
(1)	The maximum value of $12\sin\theta - 9\sin^2\theta$ is	(P)	$-\sqrt{2}$
(2)	Maximum value of $5\sin^2\theta + 4\cos^2\theta$	(Q)	$4-\sqrt{10}$
(3)	The minimum value of $\cos\theta - \sin\theta$ is	(R)	4
(4)	The least value of $\cos^2\theta - 6\sin\theta\cos\theta + 3\sin^2\theta + 2$ is attained at θ =	(S)	5

(1) 1 → R, 2 → S, 3 → P, 4 → Q

(2) 2 → R, 2 → S, 1 → P, 4 → Q

(3) 1 → R, 4 → S, 3 → P, 2 → Q

(4) 4 → R, 2 → S, 3 → P, 1 → Q

ANSWER KEY

JEE-RANKER'S STUFF

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	2	1	2	4	2	2	1	1	4	4	2	2	1	3	2
Que.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	1	1	2	3	4	3	1	3	3	4	2	2	3	2	2
Que.	**31**	**32**	**33**	**34**	**35**	**36**	**37**		**38**	**39**	**40**	**41**	**42**	**43**	**44**
Ans.	8	192	14	30	1.13	13.4	10,14,18		0.6	3	1	4	2	1,2,4	1,4
Que.	**45**	**46**	**47**	**48**	**49(i)**	**49(ii)**	**49(iii)**	**50**							
Ans.	1,2,3	1,4	2,3	1,2,4	3	4	4	1							