Shiksha Classes, Bhandara

Physics

Topic : Basic Mathematics including Vectors **M.M. : 180**

Marking Scheme:
(i) Each question is allotted 4 (four) marks for each correct response.
(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 A body is rotating with angular velocity $\vec{\omega} = (3\hat{i} - 4\hat{j} + \hat{k})$. The linear velocity of a point having position vector $\vec{r} = (5\hat{i} - 6\hat{j} + 6\hat{k})$ is – $[\vec{v} = \vec{\omega} \times \vec{r}]$

(1) $6\hat{i} + 2\hat{j} - 3\hat{k}$ (2) $18\hat{i} + 13\hat{j} - 2\hat{k}$

(3) $-18\hat{i} - 13\hat{j} + 2\hat{k}$ (4) $6\hat{i} - 2\hat{j} + 8\hat{k}$

Q.2 If force $\vec{F} = 5\hat{i} + 3\hat{j} + 4\hat{k}$ makes a displacement of $\vec{s} = 6\hat{i} - 5\hat{k}$ work done by the force is –

(1) 10 units (2) $122\sqrt{5}$ units

(3) $5\sqrt{122}$ (4) 20 units

Q.3 The sum of two vectors $\vec{A}$ and $\vec{B}$ is at right angles to their difference. Then –

(1) A = B

(2) A = 2B

(3) B = 2A

(4) $\vec{A}$ and $\vec{B}$ have the same direction

Q.4 Two vectors are perpendicular, if –

(1) $\vec{A}.\vec{B} = 1$ (2) $\vec{A} \times \vec{B} = 1$

(3) $\vec{A}.\vec{B} = 0$ (4) $\vec{A} \times \vec{B} = AB$

Q.5 What is the vector joining the points (3, 1, 14) and (–2, –1, –6) ?

(1) $2\hat{i} + \hat{j} + 2\hat{k}$ (2) $5\hat{i} + 2\hat{j} + 20\hat{k}$

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

Q.6 $\vec{A}$ is directed vertically downwards and $\vec{B}$ is directed along the north. What is the direction of $\vec{B} \times \vec{A}$ –

(1) east (2) west

(3) north (4) north west

Q.7 A body of 3 kg moves in the XY plane under the action of a force given by $6t\,\hat{i} + 4t\,\hat{j}$. Assuming that the body is at rest at time t = 0, the velocity of the body at t = 3s is –

(1) $6\hat{i} + 6\hat{j}$ (2) $18\hat{i} + 6\hat{j}$

(3) $9\hat{i} + 6\hat{j}$ (4) $12\hat{i} + 18\hat{j}$

Q.8 If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = 0$, then find the angle between $\vec{a}$ and $\vec{b}$.

(1) $\pi/3$ (2) $\pi/4$

(3) $2\pi/3$ (4) $2\pi/5$

Q.9 A force $\vec{F}$ of magnitude 12N has non-rectangular components $\vec{P}$ and $\vec{Q}$. The sum of the magnitude of $\vec{P}$ and $\vec{Q}$ is 18N. The direction of $\vec{Q}$ is at right angles to . Find the magnitude of $\vec{Q}$.

(1) 4N (2) 5N

(3) 2N (4) 7N

Q.10 If a vector $2\hat{i} + 3\hat{j} + 8\hat{k}$ is perpendicular to the vector $4\hat{j} - 4\hat{i} + \alpha\hat{k}$, then the value of α is –

(1) 1/2 (2) –1/2

(3) 1 (4) – 1

Q.11 If the angle between the vectors $\vec{A}$ and $\vec{B}$ is θ, the value of the product $(\vec{B} \times \vec{A}).\vec{A}$ is equal to –

(1) $BA^2 \sin\theta$ (2) $BA^2 \cos\theta$

(3) $BA^2 \sin\theta \cos\theta$ (4) zero

Q.12 A particle having simultaneous velocities 3m/s, 5 m/s and 7m/s is at rest. Find the angle between the first two velocities.

(1) 45° (2) 30°

(3) 90° (4) 60°

Q.13 A set of vectors taken in a given order gives a closed polygon. Then the resultant of these vectors is a –

(1) scalar quantity (2) pseudo vector

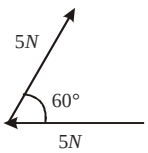
(3) unit vector (4) null vector

Q.14 If $0.3\hat{i} + 0.4\hat{j} + c\hat{k}$ is a unit vector, value of c = ?

(1) $\sqrt{0.75}$ (2) $\sqrt{0.25}$

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

Q.15 The forces, each numerically equal to 5N, are acting as shown in the figure. Find the angle between forces ?



(1) 60° (2) 120°

(3) 30° (4) None of these

Q.16 Find the angle between two vectors of magnitude 12 and 18 units when their resultant is 24 units.

(1) $\cos\theta = 1/4$ (2) $\cos\theta = 1/2$

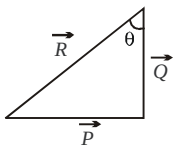
(3) $\cos\theta = 1/\sqrt{2}$ (4) $\cos\theta = \sqrt{3}/2$

Q.17 Two forces have magnitudes in the ratio 3 : 5 and the angle between their directions is 60°. If their resultant is 35N, find the sum of their magnitudes.

(1) 50 N (2) 60 N

(3) 30 N (4) 40N

Q.18 If vectors P, Q and R have magnitude 5, 12 and 13 units and $\vec{P}+\vec{Q}=\vec{R}$, find the angle between Q and R.



(1) $\theta = \cos^{-1}\left(\frac{12}{13}\right)$ (2) $\theta = \cos^{-1}\left(\frac{5}{13}\right)$

(3) $\theta = \cos^{-1}\left(\frac{1}{13}\right)$ (4) None of these

Q.19 The resultant of two vectors of magnitudes 2A and $\sqrt{2}$A acting at an angle θ is $\sqrt{10}$A. Find the value of θ.

(1) 90° (2) 60°

(3) 45° (4) 30°

Q.20 The resultant of two vectors P and Q acting at a point inclined to each other at an angle θ is R. If the magnitude of vector Q is doubled, R is also doubled. If the vector Q is reversed in direction R is again doubled. Find the ratio between P, Q and R.

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

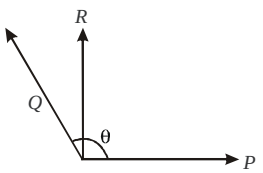
(3) $\sqrt{2}:\sqrt{5}:\sqrt{2}$ (4) $\sqrt{1}:\sqrt{2}:\sqrt{3}$

Q.21 If the resultant of two forces of magnitudes P and Q acting at a point at an angle of 60° is $\sqrt{13}$Q, then find P/Q.

(1) 6 (2) 1

(3) 3 (4) 5

Q.22 The resultant of $\vec{P}$ and $\vec{Q}$ is perpendicular to $\vec{P}$. What is the angle between $\vec{P}$ and $\vec{Q}$.



(1) $\theta = \cos^{-1}\left(\frac{-P}{Q}\right)$ (2) $\theta = \cos^{-1}\left(\frac{-P}{2Q}\right)$

(3) $\theta = \cos^{-1}\left(\frac{Q}{2P}\right)$ (4) None of these

Q.23 A vector of modulus a is turned through θ. Find the change in the vector.

(1) a sin (θ/2) (2) 2a sin (θ/2)

(3) 2a cos (θ/2) (4) 3a sin (θ/2)

Q.24 Two forces of $\vec{F}_1 = 250\text{N}$ due east and $\vec{F}_2 = 250\text{N}$ due north have their common initial point. Find $\vec{F}_2 - \vec{F}_1$

(1) $250\sqrt{2}$ N (2) $150\sqrt{2}$ N

(3) $350\sqrt{2}$ N (4) None

Q.25 One of the rectangular components of a velocity of 60 kmh^{-1} is 30 kmh^{-1}. Find other rectangular component ?

(1) $10\sqrt{3}\ \text{kmh}^{-1}$ (2) $25\sqrt{3}\ \text{kmh}^{-1}$

(3) $2\sqrt{3}\ \text{kmh}^{-1}$ (4) $30\sqrt{3}\ \text{kmh}^{-1}$

Q.26 A woman walks 250m in the direction 30° east of north, then 175m directly east. Find the magnitude of the displacement.

(1) 170m (2) 235m

(3) 370m (4) 145m

Q.27 A force $\vec{F} = 6\hat{i} + x\hat{j}$ acting on a particle displaces it from the point A (3, 4) to the point B (1, 1). If the work done is 3 units, then find value of x.

(1) 6 (2) –1

(3) 3 (4) –5

Q.28 Find the angle between the vectors $\vec{A} = \hat{i} + \hat{j} - 2\hat{k}$ and $\vec{B} = -\hat{i} + 2\hat{j} - \hat{k}$.

(1) 90° (2) 60°

(3) 45° (4) 30°

Q.29 A vector $\vec{a}$ of magnitude 10 units and another vector $\vec{b}$ of magnitude 6.0 units differ in directions by 60°. Find the magnitude of the vector product $\vec{a}\times\vec{b}$.

(1) 16 (2) 12

(3) 32 (4) 52

Q.30 Considering two vectors, $\vec{F} = (4\vec{i} - 10\vec{j})$ newton and $\vec{r} = (-5\vec{i} - 3\vec{j})$ m compute $\vec{r} \times \vec{F}$.

(1) $62\,\hat{k}$ N-m (2) $62\,\hat{i}$ N-m

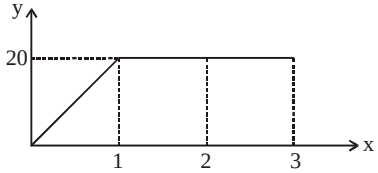
(3) $52\,\vec{k}$ N-m (4) None of these

Q.31 Two particles A and B are moving in x-y plane. Their positions vary with time t according to relation $x_A(t) = 3t$, $x_B(t) = 6$ and $y_A(t) = t$, $y_B(t) = 2+3t^2$. The distance between these particles at t = 1 is:-

(1) 5 (2) 3

(3) 4 (4) 12

Q.32 For the given (y – x) graph, find average value of y over an interval $0 \le x \le 3$:-



(1) 10 (2) 50/3

(3) 20/3 (4) 20

Q.33 If $\theta_1 + \theta_2 = \pi/2$ and $\theta_1 = 2\theta_2$, then the value of $\sin^2\theta_1 + \cos^2\theta_2$ is :-

(1) 1/2 (2) 1

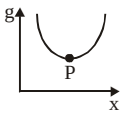
(3) 3/2 (4) 2

Q.34 If the ratio of maximum and minimum magnitudes of the resultant of two vectors and is 3 : 1 then $|\vec{a}|$ is equal to :

(1) $|\vec{a}|$ (2) $2|\vec{b}|$

(3) $3|\vec{b}|$ (4) $4|\vec{b}|$

Q.35 At point P, the value of $\frac{dy}{dx}$ is :



(1) Zero (2) Positive

(3) Negative (4) Infinite

Q.36 The angle between two vectors $\vec{R} = -\hat{i} + \frac{\hat{j}}{3} + \hat{k}$ and $\vec{S} = X\hat{i} + 3\hat{j} + (X-1)\hat{k}$

(1) Is obtuse angle (2) Is acute angle

(3) Is right angle (4) Depend on X

Q.37 The component of vector $2\hat{i} - 3\hat{j} + 2\hat{k}$ perpendicular to $\hat{i} + \hat{j} + \hat{k}$ is –

(1) $\frac{5}{3}(\hat{i} - 2\hat{j} + \hat{k})$ (2) $\frac{1}{3}(\hat{i} + \hat{j} - 2\hat{k})$

(3) $\frac{(7\hat{i} - 10\hat{j} + 7\hat{k})}{3}$ (4) $\frac{(5\hat{i} - 8\hat{j} + 5\hat{k})}{3}$

Q.38 The side of a square is increasing at rate of 0.2cm/s. The rate of increase of perimeter w.r.t. time is :

(1) 0.2 cm/s (2) 0.4 cm/s

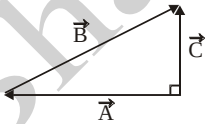
(3) 0.6 cm/s (4) 0.8 cm/s

Q.39 If $\vec{A} = 2\hat{i} + p\hat{j} + q\hat{k}$, $\vec{B} = 5\hat{i} + 7\hat{j} + 3\hat{k}$ are parallel then the value of p and q are –

(1) 14/5 and 6/5 (2) 14/3 and 6/5

(3) 6/5 and 1/3 (4) 3/4 and 1/4

Q.40 In the figure shown below the angle in between $\vec{A}$ and $\vec{B}$ is : (C = B/2)



(1) 30° (2) 60°

(3) 120° (4) 150°

Q.41 A physical quantity which has a direction :-

(1) must be a vector

(2) must be a scalar

(3) may be scalar or vector

(4) none of the above

Q.42 Sun rays cast 16m long shadow of a pole, when Sun is 37° above horizontal. When Sun rises to 53° above horizontal, length of shadow become:-

(1) 8 m (2) 16 m

(3) 9 m (4) 4 m

Q.43 The unit vector along $\hat{i} + \hat{j}$ is :-

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

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

Q.44 100 coplanar forces each equal to 10 N acting on a body. Each force makes angle $\pi/50$ with the preceding force, what is the resultant of the forces:

(1) 1000 N (2) 500 N

(3) 250 N (4) zero

Q.45 Magnitude of resultant of two vectors $\vec{P}$ and $\vec{Q}$ is equal to magnitude of $\vec{P}$. Find the angle between $\vec{Q}$ and resultant of $2\vec{P}$ and $\vec{Q}$.

(1) 30° (2) 45°

(3) 60° (4) 90°