Vector Addition

1. If the angle between two forces each equal to p is, then the resultant is equal to

(1) p (2) $\sqrt{3}$ p (3) 2pcos(θ/2) (4) 2psin(θ/2)

2. A force equal and opposite to the resultant of a number of forces is called

(1) Equillibrant (2) Couple (3) Torque (4) Moment

3. Two vectors $\vec{A}$ and $\vec{B}$ lie in a plane and another vector $\vec{C}$ lies outside this plane. Then the resultant of these three vectors

(1) Can be zero

(2) Can never be zero

(3) Lies in the plane containing $\vec{A}+\vec{B}$

(4) Lies in the plane containing $\vec{A}-\vec{B}$

4. If two vectors $\vec{A}$ and $\vec{B}$ are such that, $\vec{A}+\vec{B}=\vec{A}-\vec{B}$ then

(1) $\vec{A}+\vec{B}=0$

(2) $\vec{A}=0$

(3) $\vec{B}=0$

(4) $\vec{A}$ is perpendicular to $\vec{B}$

5. Minimum number of equal forces required for a zero resultant is

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

6. Minimum number of unequal forces required for a zero resultant is

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

7. The component of a vector is

(1) Always less than its magnitude

(2) Always greater than its magnitude

(3) Always equal to its magnitude

(4) None

8. If the resultant of $\vec{A}$ and $\vec{B}$ makes an angle with $\vec{A}$ and β with $\vec{B}$, then

(1) $\alpha<\beta$ (2) $\alpha<\beta$ if A < B (3) $\alpha<\beta$ if A > B (4) $\alpha<\beta$ if A = B

9. (A): Electric current density is a vector.

(R): A physical quantity having magnitude and direction should be a vector.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A).

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

(3) (A) is true but (R) is false.

(4) (A) is false but (R) is true.

10. (A): A vector can not be resolved into two independent components if the axes are not at right angle.

(R): This is because the components can be further resolved along two axes which are perpendicular to each other.

(1) A is true, R is true and R is the correct explanation of A.

(2) A is true, R is true but R is not the correct explanation of A.

(3) A is true, R is false.

(4) Both A and R are false.

11. (A): The direction of velocity vector remains unchanged though the coordinate system is changed.

(R): The direction of real vector is independent of coordinate system.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A).

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

(3) (A) is true but (R) is false.

(4) (A) is false but (R) is true.

12. Pick of out from the following quantities which are pseudo vectors

(a) Torque (b) Velocity

(c) Electric field (d) Angular momentum

(1) a, d (2) a, c (3) c, d (4) b, c

13. Arrange the following vectors in the increasing order for their orientation with the x-axis

(a) $\hat{i}+\sqrt{2}\hat{j}$ **(b)** $5\hat{i}$ **(c)** $\hat{i}+\hat{j}$ **(d)** $\sqrt{2}\hat{i}+\hat{j}$

(1) a, b, d, c (2) c, a, b, d (3) d, c, b, d (4) b, d, c, a

14. Arrange the following vectors in the decreasing order of their magnitude.

(a) $\hat{i}+\hat{j}-\hat{k}$ (b) $\hat{i}+2\hat{j}-2\hat{k}$ (c) $\hat{i}+\hat{j}$ (d) $\sqrt{2}\hat{i}-\sqrt{3}\hat{j}+\hat{k}$

1) b, d, a, c 2) d, b, a, c 3) a, b, c, d 4) b, c, d, a

15. The set containing only scalar quantities is

1) Temperature gradient, Specific heat and Latent heat.

2) Electric intensity, Electric potential and Electric capacity.

3) Pole strength, Permeability and Permittivity.

4) Torque, Angular acceleration and Linear momentum.

16. The set containing only vector quantities is

1) Thermal Capacity, Magnetic susceptibility and Electric charge.

2) Magnetic moment, Electric intensity and Torque.

3) Magnetic flux, Electric potential and Force

4) Magnetic induction, Electric capacity impulse.

17. If the components of a force are P along East and P along North directions, then the force is

1) P 2) $\frac{P}{2}$ 3) $\sqrt{2}P$ 4) 2P

18. Choose the correct statement.

1) Temperature is a scalar but temperature gradient is a vector.

2) Velocity of a body is a vector but velocity of light is a scalar.

3) Electric intensity and Electric current density are vectors.

4) All the above.

19. Which one of the following is a null vector?

1) Net displacement of a particle moving once around, a circle

2) Velocity of a body projected vertically up, when the body is at the highest point

3) Acceleration of a particle executing S.H.M. at the mean position

4) All the above.

20. The maximum number of components a vector can be split are?

1) 2 2) 3 3) 4 4) Infinite

21. A boat moves relative to water with a velocity which is 'n' times the river flow

a) If n < 1 boat can not cross the river

b) If n = 1 boat can not cross the river without drifting

c) If n > 1 boat can cross the river along shortest path

d) Boat can cross the river what ever is the value of n excluding zero value

1) Only a is correct 2) a, b are correct

3) c, d are correct 4) b, c & d are correct

22. Arrange the vectors additions so that their magnitudes are in the increasing order.

a) Two vector $\vec{A}$ and $\vec{B}$ are parallel

b) Two vectors $\vec{A}$ and $\vec{B}$ are anti-parallel

c) Two vectors $\vec{A}$ and $\vec{B}$ making an angle 60^0

d) Two vectors A and $\vec{B}$ making 120^0.

1) b, d, c, a 2) b, c, d, a 3) a, c, d, b 4) c, d, a, b

23. The maximum and minimum resultants of two forces are in the ratio 4:3. The forces are in ratio

1) 3: 2 2) 2: 7 3) 7: 1 4) 1: 3

24. The resultant of two equal forces is 141.4N when they are mutually perpendicular. When they are inclined at an angle 120^0, then the resultant force will be

1) 100 N 2) 141.4 N 3) 196 N 4) Zero

25. The resultant of two forces 2P and $\sqrt{2}P$ is $\sqrt{10}P$. The angle between the forces is

1) 30^0 2) 60^0 3) 45^0 4) 90^0

26. Which of the following sets of forces acting simultaneously on a particle keep it in equilibrium?

1) 3N, 5N, 10N 2) 4N, 7N, 12N 3) 2N, 6N, 5N 4) 5N, 8N, 1N

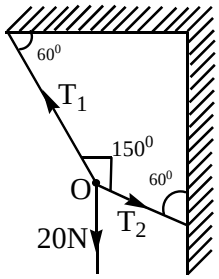
27. If $\overline{P}+\overline{Q}=\overline{R}$ and $\overline{P}-\overline{Q}=\overline{S}$, then $R^2 + S^2$ is equal to

1) P^2+Q^2 2) $2(P^2-Q^2)$ 3) $2(P^2+Q^2)$ 4) 4 PQ

28. The direction cosines of a vectors A are $\cos\alpha=\frac{4}{5\sqrt{2}}$, $\cos\beta=\frac{1}{\sqrt{2}}$ and $\cos\gamma=\frac{3}{5\sqrt{2}}$ then the vector A is

1) $4\hat{i}+\hat{j}+3\hat{k}$ 2) $4\hat{i}+5\hat{j}+3\hat{k}$ 3) $4\hat{i}-5\hat{j}-3\hat{k}$ 4) $\hat{i}+\hat{j}-\hat{k}$

29. If 'O' is in equilibrium then the values of the Tension T_1 and T_2 are x, y, if 20N is vertically down. Then x, y are



1) 20 N 30 N 2) $20\sqrt{3}$N, 20 N 3) $20\sqrt{3}$N , $20\sqrt{3}$N 4) 10 N, 30 N

30. A man is travelling at 10.8 kmph in a topless car on a rainy day. It is raining vertically down wards. He holds an umbrella at an agnle of 53^0 to the horizontal to protect himself from the rain. The velocity of rain drop is [given cos 53^0 = 3/5]

1) $1ms^{-1}$ 2) $2ms^{-1}$ 3) $3ms^{-1}$ 4) $4ms^{-1}$

31. Resultant of two vectors of magnitudes P and Q is of magnitude 'Q'. If the magnitude of $\vec{Q}$ is doubled now the angle made by new resultant with $\vec{P}$ is

1) 30^0 2) 90^0 3) 60^0 4) 120^0

32. Two forces F_1 and F_2 are acting at a point, having resultant as F. If F_2 is doubled F is also doubled. If F_2 is reversed then also F is doubled. Then $F_1 : F_2 : F$ is

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

33. When forces F_1, F_2, F_3 are acting on a particle of mass m such that F_2 and F_3 are mutually perpendicular, then the particle remains stationary. If the force F_1 is now removed then acceleration of the particle is

1) F_1 / m 2) $F1\ F_3 / mF_1$ 3) $(F_2 - F_3)/m$ 4) F_2 / m

34. A river is of width 120m which flows at a speed of $8ms^{-1}$. If a man swims with a speed of $5ms^{-1}$ at an angle of 127^0 with the stream, his drift on reaching other bank is

1) 50 m 2) 150 m 3) 200 m 4) 300 m

35. If the magnitudes of $\vec{A}, \vec{B}$ and $\vec{C}$ are 12, 5 and 13 units respectively and $\vec{A}+\vec{B}=\vec{C}$ then the angle between $\vec{A}$ and $\vec{B}$ is

(1) 0 (2) π (3) $\pi/2$ (4) $\pi/4$

36. A river is flowing from West to East at a speed of 5 metre/min. A man on the South bank of the river, capable of swimming at 10m/min in still water, wants to swim across the river in shortest time. He should swim in a direction

(1) Due to North (2) 30^0 East of North (3) 30^0 West to North (4) 60^0East of North

37. A boy is hanging from a horizontal branch of a tree. The tention in the arms will be maximum when the angle between the arms is

(1) 0^0 (2) 30^0 (3) 60^0 (4) 120^0

38. Find the value of c if $\vec{A} = 0.4\hat{i} + 0.3\hat{j} + c\hat{k}$ is a unit vector.

(1) 0.5 (2) $\sqrt{0.75}$

(3) 1 (4) Cannot be calculated

Key

1) 3	2) 1	3) 2	4) 3	5) 1	6) 3	7) 4	8) 3
9) 3	10) 1	11) 1	12) 1	13) 4	14) 1	15) 3	16) 2
17) 3	18) 4	19) 4	20) 4	21) 4	22) 1	23) 3	24) 1
25) 3	26) 3	27) 2	28) 2	29) 2	30) 4	31)2	32) 4
33) 1	34) 2	35) 3	36) 1	37) 4	38)2		

Hints

23. $R_{max} = P+Q$, $R_{min} = P-Q$

$\frac{P+Q}{P-Q} = \frac{4}{3}$ $\quad\quad$ $\therefore \frac{P}{Q} = \frac{4+3}{4-3} = 7:1$

24. $R_1 = 141.4N$, $\theta_1 = 90°$

$R_2 = ?$ $\quad$ $\theta_2 = 120°$

$\therefore R_1 = 2P\cos\left(\frac{90}{2}\right)$ $\quad$ $\therefore R_2 = 2P\cos\left(\frac{120}{2}\right)$

$\therefore \frac{R_2}{R_1} = \frac{Cos60}{Cos45} = \frac{1}{\sqrt{2}}$

$\therefore R_2 = R_1/\sqrt{2} = \frac{100\sqrt{2}}{\sqrt{2}} = 100N$

25. $R^2 = P^2 + Q^2 + 2PQCos\theta$

$10P^2 = 4P^2 + 2P^2 + 4\sqrt{2}P^2\cos\theta$

$4P^2 = 4\sqrt{2}P^2\cos\theta$

$\cos\theta = 1/\sqrt{2}$ $\quad\quad$ $\therefore \theta = 45°$

26. Sum of any two should be greater than (or) equal to the third side

27. $\bar{R} = \bar{P} + \bar{Q}$ & $\bar{S} = \bar{P} - \bar{Q}$

$R^2 = P^2 + Q^2 + 2PQ\cos\theta$

$S^2 = P^2 + Q^2 - 2PQ\cos\theta$

$R^2 + S^2 = 2\left(P^2 + Q^2\right)$

28. $\cos\alpha = \frac{4}{5\sqrt{2}}$

$\cos\beta = \frac{1}{\sqrt{2}} = \frac{5}{5\sqrt{2}}$

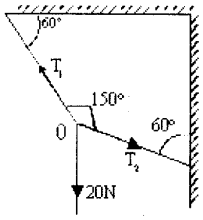
$\cos\gamma = \frac{3}{5\sqrt{2}}$

$\therefore \left|\bar{A}\right| = 5\sqrt{2}$

$\left.\begin{aligned} Ax &= 4 \\ Ay &= 5 \\ Az &= 3 \end{aligned}\right\}$

$\therefore \bar{A} = 4i + 5j + 3k$

29.



$T_1 \sin 30° = T_2 \sin 30°$

$T_1 = \sqrt{3} T_2 \rightarrow (1)$

$T_1 \cos 30° = 20 + T_2 \rightarrow (2)$

Solving (1) & (2)

$T_1 = 20\sqrt{3}, \qquad T_2 = 20N$

30. $\cos 53 = \frac{3}{5} \qquad \therefore Tan53 = \frac{4}{3}$

$Tan53 = \frac{V_R}{V_M}$

$\therefore V_R - V_M \; Tan53 = 3x\frac{4}{3} = 4m/\sec$

31. $R^2 = P^2 + Q^2 + 2PQ\cos\theta$

$Q^2 = P^2 + Q^2 + 2PQ\cos\theta \Rightarrow \cos\theta = \frac{-P}{Q}$

$Tan\alpha = \frac{2Q.\sin\theta}{P + 2Q.\cos\theta} \qquad Tan\alpha = \frac{2Q.\sin\theta}{0}$

$\alpha = 90^0$

32. $F^2 = F_1^2 + F_2^2 + 2F_1F_2\cos\theta \rightarrow 1$

$4F^2 = F_1^2 + F_2^2 + 4F_1F_2\cos\theta \rightarrow 2$

$4F^2 = F_1^2 + F_2^2 - 2F_1F_2\cos\theta \rightarrow 3$

(1) x 2 + (2) and (2) x 2+ (3)

$F_1 : F_2 : F = 1 : \sqrt{\frac{3}{2}} : 1$

$= \sqrt{2} : \sqrt{3} : \sqrt{2}$

33. $\left|\overline{F_2}+\overline{F_2}\right|=\overline{F_1}$

If F_1 is removed

$a=\frac{F_1}{m}$

34. d = 120m u = 5 ms^{-1} v= 8 ms^{-1}

$t=\frac{d}{u\cos 37}=\frac{120}{5\times\frac{4}{3}}=30s$

$x(V-u\sin 37)t$

$=\left(8-\frac{5\times 3}{5}\right)\times 30 = 150\text{m}$

35. $\vec{A},\vec{B},\vec{C}$ are forming

a right angled triangle

As shown in figure.

Clearly the angle between

And

$\vec{B}$ is $\pi/2$

37. P = Q = R

$\therefore R^2 = P^2 + Q^2 + 2PQ\cos\theta$

Or $R^2 = R^2 + 2R^2\cos\theta, \cos\theta = -1/2$

$\theta = 120^0$

38. $|\vec{A}|=1 \therefore (0.4)^2+(0.3)^2+c^2=1$

Or $c=\sqrt{1-0.16+0.09}=\sqrt{0.75}$