Exercise - I

(only one option is correct)

SECTION - A : FUNCTION

1. f(x) = cos x + sin x Find f(π/2)

Sol.

2. f(x) = 4x + 3 Find f(f(2))

Sol.

3. f(x) = log x^3 and g(x) = log x

Which of the following statement is / are true-

(a) f(x) = g(x) (b) 3f(x) = g(x)

(c) f(x) = 3g(x) (d) f(x) = $(g(x))^3$

Sol.

SECTION - B : DIFFERENTIATION OF ELEMENTRY FUNCTIONS

Find the derivative of given function w.r.t. corresponding independent variable.

4. $y = x^2 + x + 8$

Sol.

5. $s = 5t^3 - 3t^5$

Sol.

6. $y = 5\sin x$

Sol.

7. $y = x^2 + \sin x$

Sol.

8. $y = \tan x + \cot x$

Sol.

Find the first derivative & second derivative of given functions w.r.t. corresponding independent variable.

9. $y = 6x^2 - 10x - 5x^{-2}$

Sol.

10. $r = \frac{12}{\theta} - \frac{4}{\theta^3} + \frac{1}{\theta^4}$

Sol.

11. $\omega = 3z^7 - 7z^3 + 21z^2$

Sol.

12. $y = \sin x + \cos x$

Sol.

13. $y = \ell nx + e^x$

Sol.

SECTION - C : DIFFERENTIATION BY PRODUCT RULE

Find derivative of given functions w.r.t. the independent variable x.

14. $x \sin x$

Sol.

15. $y = e^x \ell nx$

Sol.

16. $y = (x-1)(x^2+x+1)$

Sol.

17. $y = (x^2+1)\left(x+5+\frac{1}{x}\right)$

Sol.

18. $y = \sin x \cos x$

Sol.

SECTION - D : DIFFERENTIATION BY QUOTIENT RULE

Find derivative of given function w.r.t. the independent variable.

19. $y = \frac{\sin x}{\cos x}$

Sol.

20. $y = \frac{2x+5}{3x-2}$

Sol.

21. $y = \frac{\ell nx}{x}$

Sol.

22. $f(t)=\dfrac{t^2-1}{t^2+t-2}$, find f'(t)

Sol.

23. $z=\dfrac{2x+1}{x^2-1}$

Sol.

24. $y=x^2\cot x$

Sol.

SECTION - E : DIFFERENTIATION BY CHAIN RULE

Find $\dfrac{dy}{dx}$ as a function of x

25. $y=(2x+1)^5$

Sol.

26. $y=(4-3x)^9$

Sol.

27. $y=\left(1-\dfrac{x}{7}\right)^{-7}$

Sol.

28. $y = \left(\frac{x}{2} - 1\right)^{-10}$

Sol.

29. $y = \sin 5x$

Sol.

30. $y = \sin(x) + \ln(x^2) + e^{2x}$

Sol.

31. $y = 2\sin(\omega x + \phi)$ where ω and ϕ constants

Sol.

SECTION - G : DIFFERENTIATION AS A RATE MEASUREMENT

32. Suppose that the radius r and area $A = \pi r^2$ of a circle are differentiable functions of t. Write an equation that relates dA / dt to dr / dt.

Sol.

33. Suppose that the radius r and surface area $S = 4\pi r^2$ of a sphere are differentiable functions of t. Write an equation that relates $\frac{ds}{dt}$ to $\frac{dr}{dt}$.

Sol.

SECTION - H : MAXIMA & MINIMA

34. Particle's position as a function of time is given by $x = -t^2 + 4t + 4$ find the maximum value of position coordinate of particle.

Sol.

35. Find the maximum and minimum values of function $2x^3 - 15x^2 + 36x + 11$

Sol.

SECTION - I

Given y = f(u) and u = g(x) Find $\frac{dy}{dx}$

36. $y = 2u^3, u = 8x - 1$

Sol.

37. $y = \sin u,\ u = 3x + 1$

Sol.

38. $y = 6u - 9,\ u = (1/2)x^4$

Sol.

39. $y = \cos u,\ u = -\frac{x}{3}$

Sol.

PART - II : INTEGRATION

Find integrals of given functions

1. (a) $2x$

Sol.

(b) x^2

Sol.

(c) $x^2 - 2x + 1$

Sol.

2. (a) $-3x^{-4}$

Sol.

(b) x^{-4}

Sol.

(c) $x^{-4} + 2x + 3$

Sol.

3. (a) $\frac{1}{x^2}$

Sol.

(b) $\frac{5}{x^2}$

Sol.

(c) $2-\frac{5}{x^2}$

Sol.

4. (a) $\frac{3}{2}\sqrt{x}$

Sol.

(b) $\frac{3}{2\sqrt{x}}$

Sol.

(c) $\sqrt{x}+\frac{1}{\sqrt{x}}$

Sol.

5. (a) $\frac{4}{3}\sqrt[3]{x}$

Sol.

(b) $\frac{1}{3\sqrt[3]{x}}$

Sol.

(c) $\sqrt[3]{x}+\frac{1}{\sqrt[3]{x}}$

Sol.

6. (a) $\frac{1}{2}x^{-1/2}$

Sol.

(b) $-\frac{1}{2}x^{-3/2}$

Sol.

(c) $-\frac{3}{2}x^{-5/2}$

Sol.

7. $(1-x^2-3x^5)$

Sol.

8. $3\sin x$

Sol.

9. $\frac{1}{3x}$

Sol.

Integrate by using the substitution suggested in bracket.

10. $\int \sin 3x\,dx$, (use, u = 3x)

Sol.

11. $\int \sec 2t \tan 2t\,dt$, (use, u = 2t)

Sol.

12. $\int_{-2}^{1} 5\,dx$

Sol.

13. $\int_{-4}^{-1} \frac{\pi}{2} d\theta$

Sol.

14. $\int_{-2}^{4} \left(\frac{x}{2}+3\right) dx$

Sol.

15. $\int_{\sqrt{2}}^{5\sqrt{2}} r\, dr$

Sol.

16. $\int_{0}^{2\pi} \sin\theta\, d\theta$

Sol.

17. $\int_{0}^{1} e^x dx$

Sol.

Use a definite integral to find the area of the region between the given curve and the x-axis on the interval [0, b]

18. $y = 2x$

Sol.

19. $y = \frac{x}{2}+1$

Sol.

Use a definite integral to find the area of the region between the given curve and the x-axis on the interval [0, π]

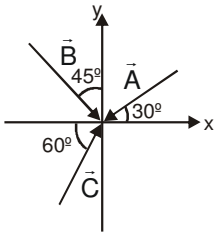
20. $y = \sin x$

Sol.

PART - III VECTOR

SECTION - A : DEFINITION OF VECTOR & ANGLE BETWEEN VECTORS

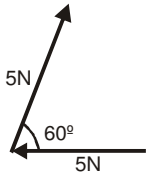
1. Vectors $\vec{A},\vec{B}$ and $\vec{C}$ are shown in figure. Find angle between



(i) $\vec{A}$ and $\vec{B}$ (ii) $\vec{A}$ and $\vec{C}$ (iii) $\vec{B}$ and $\vec{C}$.

Sol.

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



Sol.

3. Rain is falling vertically down wards with a speed 5 m/s. If unit vector along upward is defined as $\hat{j}$, represent velocity of rain in vector form.

Sol.

4. The vector joining the points A(1, 1, –1) and B(2, –3, 4) & pointing from A to B is

(a) $-\hat{i}+4\hat{j}-5\hat{k}$ (b) $\hat{i}+4\hat{j}+5\hat{k}$

(c) $\hat{i}-4\hat{j}+5\hat{k}$ (d) $-\hat{i}-4\hat{j}-5\hat{k}$

Sol.

SECTION - B : ADDITION OF VECTORS

5. A man walks 40 m North, then 30 m East and then 40 m South. Find the displacement from the starting point?

Sol.

6. Two forces $\vec{F}_1$ and $\vec{F}_2$ are acting at right angles to each other, find their resultant ?

Sol.

7. A vector of magnitude 30 and direction eastwards is added with another vector of magnitude 40 and direction Northwards. Find the magnitude and direction of resultant with the east.

Sol.

8. Two force of $\vec{F}_1 = 500\text{N}$ due east and $\vec{F}_2 = 250\text{N}$ due north. Find $\vec{F}_2 - \vec{F}_1$?

Sol.

9. Two vectors $\vec{a}$ and $\vec{b}$ inclined at an angle θ w.r.t. each other have a resultant $\vec{c}$ which makes an angle β with $\vec{a}$. If the directions of $\vec{a}$ and $\vec{b}$ are interchanged, then the resultant will have the same

(A) magnitude

(B) direction

(C) magnitude as well as direction

(D) neither magnitude nor direction.

Sol.

10. Two vectors $\vec{A}$ and $\vec{B}$ lie in a plane. Another vector $\vec{C}$ lies outside this plane. The resultant $\vec{A}+\vec{B}+\vec{C}$ of these three vectors

(A) can be zero

(B) cannot be zero

(C) lies in the plane of $\vec{A}+\vec{B}$

(D) lies in the plane of $\vec{A}-\vec{B}$

Sol.

11. The vector sum of the forces of 10 N and 6 N can be

(A) 2N (B) 8N (C) 18N (D) 20N

Sol.

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

(A) scalar quantity (B) pseudo vector

(C) unit vector (D) null vector

Sol.

13. The vector sum of two force P and Q is minimum when the angle θ between their positive directions, is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{2}$ (D) π

Sol.

14. The vector sum of two vectors $\vec{A}$ and $\vec{B}$ is maximum, then the angle θ between two vectors is

(A) 0º (B) 30º (C) 45º (D) 60º

Sol.

15. Given : $\vec{C} = \vec{A} + \vec{B}$. Also, the magnitude of $\vec{A}, \vec{B}$ and $\vec{C}$ are 12, 5 and 13 units respectively. The angle between $\vec{A}$ and $\vec{B}$ is

(A) 0º (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{2}$ (D) π

Sol.

16. If $\vec{P} + \vec{Q} = \vec{P} - \vec{Q}$ and θ is the angle between $\vec{P}$ and $\vec{Q}$, then

(A) $\theta = 0^o$ (B) $\theta = 90^o$ (C) P = 0 (D) Q = 0

Sol.

17. The sum and difference of two perpendicular vectors of equal lengths are
(A) of equal lengths and have an acute angle between them
(B) of equal lengths and have an obtuse angle between them
(C) also perpendicular to each other and are of different lengths
(D) also perpendicular to each other and are of equal lengths
Sol.

20. What are the x and the y components of a 25 m displacement at an angle of 210º with the x-axis (clockwise) ?
Sol.

21. One of the rectangular components of a velocity of 60 km h^{-1} is 30 km h^{-1}. Find other rectangular component ?
Sol.

SECTION - C : RESOLUTION OF VECTORS

18. Find the magnitude of $3\hat{i}+2\hat{j}+\hat{k}$?
Sol.

22. If $0.5\hat{i}+0.8\hat{j}+C\hat{k}$ is a unit vector. Find the value of C
Sol.

19. If $\vec{A}=3\hat{i}+4\hat{j}$ then find $\hat{A}$
Sol.

23. The rectangular components of a vector are (2, 2). The corresponding rectangular components of another vector are $\left(1,\sqrt{3}\right)$. Find the angle between the two vectors.

Sol.

24. The x and y components of a force are 2N and – 3N. The force is

(A) $2\hat{i}-3\hat{j}$ (B) $2\hat{i}+3\hat{j}$ (C) $-2\hat{i}-3\hat{j}$ (D) $3\hat{i}+2\hat{j}$

Sol.

SECTION-D : PRODUCT OF VECTORS

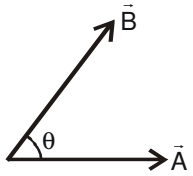
25. If $\vec{A}=\hat{i}+\hat{j}+\hat{k}$ and $\vec{B}=2\hat{i}+\hat{j}$ find

(a) $\vec{A}.\vec{B}$ (b) $\vec{A}\times\vec{B}$

Sol.

26. If $|\vec{A}|=4$, $|\vec{B}|=3$ and $\theta = 60^o$ in the figure. Find

(a) $\vec{A}.\vec{B}$ (b) $|\vec{A}\times\vec{B}|$



Sol.

27. Three non-zero vectors $\vec{A},\vec{B}$ & $\vec{C}$ satisfy the relation $\vec{A}.\vec{B}=0$ & $\vec{A}.\vec{C}=0$. Then $\vec{A}$ can be parallel to:

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

Sol.

28. The magnitude of scalar product of two vectors is 8 and that of vector product is $8\sqrt{3}$. The angle between them is

(A) 30º (B) 60º (C) 120º (D) 150º

Sol.

Exercise - II (One or more than one option correct)

SECTION - A : FUNCTION

1. If $f(x)=\frac{x-1}{x+1}$ then find $f\{f(x)\}$

Sol.

2. If $f(x)=\begin{cases}x+2, & x<2\\ 2x-1, & x\geq 2\end{cases}$ Evalute f(2), f(1), and f(3)

Sol.

SECTION - B : DIFFERENTIATION OF ELEMENTRY FUNCTIONS

Find the first derivative and second derivative of given functions w.r.t. the independent variable x.

3. $y=\ell nx^2+\sin x$

Sol.

4. $y=\sqrt[7]{x}+\tan x$

Sol.

SECTION - C : DIFFERENTIATION BY PRODUCT RULE

Find derivative of given functions w.r.t. the corresponding independent variable.

5. $y=e^x\tan x$

Sol.

6. $y=x^2\sin^4 x+x\cos^{-2}x$

Sol.

7. $y=\left(x+\frac{1}{x}\right)\left(x-\frac{1}{x}+1\right)$

Sol.

8. $y = x^2 \sin x + 2x\cos x - 2\sin x$

Sol.

9. $y = x^2 \cos x - 2x\sin x - 2\cos x$

Sol.

10. $r = (1+\sec\theta)\sin\theta$

Sol.

SECTION - D : DIFFERENTIATION BY QUOTIENT RULE

Find derivative of given functions w.r.t. the respective independent variable.

11. $y = \dfrac{\sin x + \cos x}{\cos x}$

Sol.

12. $y = \dfrac{\cot x}{1+\cot x}$

Sol.

13. $y = \dfrac{\cos x}{x} + \dfrac{x}{\cos x}$

Sol.

14. $p = \frac{\tan q}{1+\tan q}$

Sol.

17. $y = x(x^2+1)^{-1/2}$

Sol.

SECTION - E : DIFFERENTIATION BY CHAIN RULE

Find $\frac{dy}{dx}$ as a function of x

15. $y = \sin^3 x + \sin 3x$

Sol.

18. $q = \sqrt{2r - r^2}$, find $\frac{dq}{dr}$

Sol.

16. $\sin^2(x^2+1)$

Sol.

19. $y = \left(\frac{x^2}{8} + x - \frac{1}{x}\right)^4$

Sol.

SECTION - F : DIFFERENTIATION AS A RATE MEASUREMENT

20. The radius r and height h of a circular cylinder are related to the cylinder's volume V by the formula $V = \pi r^2 h$.

(a) If height is increasing at a rate of 5 m/s while radius is constant, Find rate of increase of volume of cylinder.

(b) If radius is increasing at a rate of 5 m/s while height is constant, Find rate of increase of volume of cylinder.

(c) If height is increasing at a rate of 5 m/s and radius is increasing at a rate of 5 m/s. Find rate of increase of volume of cylinder.

Sol.

SECTION - G : MAXIMA & MINIMA

21. Find two positive numbers x & y such that x + y = 60 and xy is maximum.

Sol.

22. A sheet of area 40 m^2 in used to make an open tank with a square base, then find the dimensions of the base such that volume of this tank is maximum.

Sol.

SECTION - H : MISCELLANEOUS

23. Find y'' if

(a) $y = \cos x$

Sol.

(b) $y = \sec x$

Sol.

24. $y = \cos u,\ u = \sin x$

Sol.

25. $y = \sin u,\ u = x - \cos x$

Sol.

PART - II : INTEGRATION

Find integrals of given functions

1. $\int (2x^3 - 5x + 7)\,dx$

Sol.

2. $\int \left(\frac{1}{5} - \frac{2}{x^3} + 2x\right) dx$

Sol.

3. $\int \left(\sqrt{x} + \sqrt[3]{x}\right) dx$

Sol.

4. $\int x^{-3}(x+1)\,dx$

Sol.

5. $\int \frac{t\sqrt{t} + \sqrt{t}}{t^2}\,dt$

Sol.

6. $\int \frac{4 + \sqrt{t}}{t^3}\,dt$

Sol.

7. $\int \cos\theta(\tan\theta + \sec\theta)\,d\theta$

Sol.

8. $\int_{\pi}^{2\pi} \theta \, d\theta$

Sol.

9. $\int_{0}^{\sqrt[3]{7}} x^2 \, dx$

Sol.

10. $\int_{0}^{\pi} \cos x \, dx$

Sol.

11. $\int_{0}^{1} \frac{dx}{3x+2}$

Sol.

Use a definite integral to find the area of the region between the given curve and the x-axis on the interval [0, b]

12. $y = 3x^2$

Sol.

13. $y = \sqrt{b^2 - x^2}$

Sol.

PART - III : VECTOR

SECTION - A : DEFINITION OF VECTOR & ANGLE BETWEEN VECTORS

1. Vector $\vec{A}$ points N–E and its magnitude is 3 kg ms^{-1} it is multiplied by the scalar λ such that $\lambda = -4$ second. Find the direction and magnitude of the new vector quantity. Does it represent the same physical quantity or not ?

Sol.

2. A hall has the dimensions 10 m × 12 m × 14 m. A fly starting at one corner ends up at a diametrically opposite corner. The magnitude of its displacement is nearly

(A) 16 m (B) 17 m

(C) 18 m (D) 21 m

Sol.

3. A vector is not changed if

(A) it is displaced parallel to itself

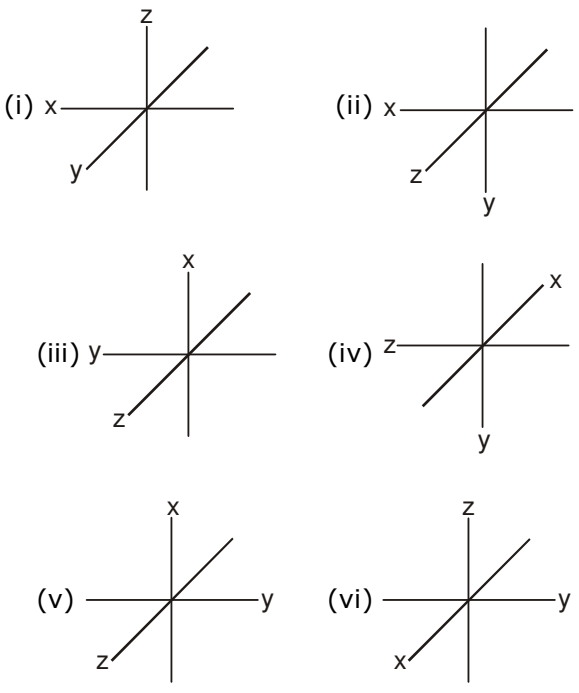
(B) it is rotated through an arbitrary angle

(C) it is cross-multiplied by a unit vector

(D) it is multiplied by an arbitrary scalar

Sol.

4. 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.



(A) (i), (ii) (B) (iii) (iv)

(C) (vi) (D) (v)

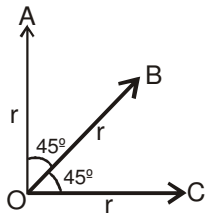
Sol.

SECTION : B ADDITION OF VECTOR

5. The angle θ between directions of forces $\vec{A}$ and $\vec{B}$ is 90º where A = 8 dyne and B = 6 dyne. If the resultant $\vec{R}$ makes an angle α with $\vec{A}$ then find the value of 'α' ?

Sol.

6. Find the resultant of three vectors $\vec{OA}, \vec{OB}$ and $\vec{OC}$ each of magnitude r as shown in figure ?



Sol.

7. If the angle between two forces increases, the magnitude of their resultant

(A) decreases

(B) increases

(C) remains unchanged

(D) first decreases and then increases

Sol.

8. A car is moving on a straight road due north with a uniform speed of 50 km h^{-1} when it turns left through 90°. If the speed reamins unchanged after turning, the change in the velcoity of the car in the turning process is :

(A) zero

(B) $50\sqrt{2}kmh^{-1}S-W$ direction

(C) $50\sqrt{2}kmh^{-1}N-W$ direction

(D) $50kmh^{-1}$ due West

Sol.

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

(A) 5, 10, 30 and 50 km

(B) 5, 9, 9 and 16 km

(C) 40, 40, 90 and 200 km

(D) 10, 20, 40 and 90 km

Sol.

10. When two vector $\vec{a}$ and $\vec{b}$ are added, the magnitude of the resultant vector is always

(A) greater than (a + b)

(B) less than or equal to (a + b)

(C) less than (a + b)

(D) equal to (a + b)

Sol.

11. Given : $\vec{A}=2\hat{i}+3\hat{j}$ and $\vec{B}=5\hat{i}-6\hat{j}$. The magnitude of $\vec{A}+\vec{B}$ is

(A) 4 units (B) 10 units

(C) $\sqrt{58}$ units (D) $\sqrt{61}$ units

Sol.

12. Given : $\vec{A} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{B} = -\hat{i} - \hat{j} + \hat{k}$. The unit vector of $\vec{A} - \vec{B}$ is

(A) $\frac{3\hat{i} + \hat{k}}{\sqrt{10}}$ (B) $\frac{3\hat{i}}{\sqrt{10}}$ (C) $\frac{\hat{k}}{\sqrt{10}}$ (D) $\frac{-3\hat{i} - \hat{k}}{\sqrt{10}}$

Sol.

13. If $|\vec{A} + \vec{B}| = |\vec{A}| = |\vec{B}|$, then the angle between $\vec{A}$ and $\vec{B}$ is

(A) 0 (B) 60º (C) 90º (D) 120º

Sol.

14. Given : $\vec{a} + \vec{b} + \vec{c} = 0$. Cut of the three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ two are equal in magnitude. The magnitude of the third vector is $\sqrt{2}$ times that of either of the two having equal magnitude. The angles between the vectors are

(A) 90º, 135º, 135º (B) 30º, 60º, 90º
(C) 45º, 45º, 90º (D) 45º, 60º, 90º

Sol.

15. Which of the following is a true statement ?

(A) A vector cannot be divided by another vector
(B) Angular displacement can either be a scalar or a vector
(C) Since addition of vectors is commutative therefore vector subtraction is also commutative
(D) The resultant of two equal forces of magnitude F acting at a point is F if the angle between the two forces is 120º.

Sol.

SECTION - C : RESOLUTION OF VECTORS

16. If $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = \hat{i} + \hat{j} + 2\hat{k}$ then find out unit vector along $\vec{A} + \vec{B}$.

Sol.

17. Vector $\vec{A}$ is of length 2 cm and is 60º above the x-axis in the first quadrant. Vector $\vec{B}$ is of length 2 cm and 60º below the x-axis in the fourth quadrant. The sum $\vec{A} + \vec{B}$ is a vector of magnitude.

(A) 2 along + y axis (B) 2 along + x-axis
(C) 1 along – x-axis (D) 2 along – x-axis

Sol.

18. Six forces, 9.81 N each, acting at a point are coplanar. If the angles between neighbouring forces are equal, then the resultant is

(A) 0 N (B) 9.81 N
(C) 2 × 9.81 N (D) 3 × 9.81 N

Sol.

SECTION : D PRODUCT OF VECTORS

19. If $\vec{a} = x_1\hat{i} + y_1\hat{j}$ & $\vec{b} = x_2\hat{i} + y_2\hat{j}$. The condition that would make $\vec{a}$ & $\vec{b}$ parallel to each other is _____.

Sol.

20. A vector $\vec{A}$ points vertically downward & $\vec{B}$ points towards east, then the vector product $\vec{A} \times \vec{B}$ is

(A) along west (B) along east
(C) zero (D) none of above

Sol.

Exercise - III

Subjective Level-I

1. Match the statements given in column-I with statements given in column-II

Column - I	**Column - II**
(A) If $\|\vec{A}\|=\|\vec{B}\|$ and $\|\vec{A}+\vec{B}\|=\|\vec{A}\|$ then angle between $\vec{A}$ and $\vec{B}$ is	(p) 90º
(B) Magnitude of resultant of two forces $\|\vec{F}_1\|=8N$ and $\|\vec{F}_2\|=4N$ may be	(q) 120º
(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) $\sqrt{14}$

Sol.

2. Position of particle is given by $S = t^3 - 2t^2 + 5t + 4$

(a) Find the position of particle at t = 1 sec

(b) Find the first derivative of S at t = 1 sec

(c) Find the second derivative of S t = 1 sec

Sol.

3. Two forces $\vec{F}_1=2\hat{i}+2\hat{j}N$ amd $\vec{F}_2=3\hat{i}+4\hat{k}N$ are acting on a particle

(a) Find the resultant force acting on particle

(b) Find the angle between $\vec{F}_1$ & $\vec{F}_2$

(c) Find the componant of force $\vec{F}_1$ along force $\vec{F}_2$

Sol.

4. Statement-1 : A vector is a quantity that has both magnitude and direction and obeys the triangle law of addition.

Statement-2 : The magnitude of the resultant vector of two given vectors can never be less than the magnitude on any the given vector.

(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

Sol.

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

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

(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; Stateent-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

Sol.

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

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

(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

Sol.

7. Statement-1 : The minimum number of vectors of unequal magnitude required to produce zero resultant is three.

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

(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

Sol.

8. Statement-1 : The angle between the two vectors $\left(\hat{i}+\hat{j}\right)$ and $\left(\hat{k}\right)$ is $\frac{\pi}{2}$ radian.

Statement-2 : Angle between two vectors $\vec{A}$ and $\vec{B}$ is given by $\theta=\cos^{-1}\left(\frac{\vec{A}.\vec{B}}{AB}\right)$.

(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

Sol.

9. Statement-1 : Distance is scalar quantity.

Statement-2 : Distance is the length of path transversed.

(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

Sol.

10. State true or false

(i) If $\vec{A}$ & $\vec{B}$ are two force vectors $\vec{A}.\vec{B}=\vec{B}.\vec{A}$

Sol.

(ii) If $\vec{A}$ & $\vec{B}$ are two force vectors then $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$

Sol.

(iii) If the vector product of two non-zero vectors vanishes, the vectors are collinear.

Sol.

(iv) If a function has maximum value at point P theh slope of tangent drawn on function at point P is zero.

Sol.

11. Fill in the blanks

(i) The scalar product of vector $\vec{A}=2\hat{i}+5\hat{k}$ and $\vec{B}=3\hat{j}+5\hat{k}$ is .....

Sol.

(ii) If $\vec{A}=3\hat{i}+4\hat{j}$ and $\vec{B}=7\hat{i}+24\hat{j}$, then the vector having the same magnitude as $\vec{B}$ and parallel to $\vec{A}$ is .....

Sol.

(iii) If $\vec{A}\|\vec{B}$ then $\vec{A}\times\vec{B}=$ .....

Sol.

(iv) The magnitude of area of the parallelogram formed by the adjacent sides of vectors $\vec{A}=3\hat{i}+2\hat{j}$ a nd $\vec{B}=2\hat{i}-2\hat{k}$ is .....

Sol.

(v) A force is represented by $2\hat{i}+3\hat{j}+6\hat{k}$. The magnitude of the force is .....

Sol.

(vi) The unit vector along vector $\hat{i}+\hat{j}+\hat{k}$ is .....

Sol.

(vii) If $\vec{A}$ is ..... to $\vec{B}$, then $\vec{A}.\vec{B}=0$

Sol.

(viii) The vector $\vec{A}=\hat{i}+\hat{j}$, where $\hat{i}$ and $\hat{j}$ are unit vectors along x-axis and y-axis respectively, makes an angle of ..... degree with x-axis.

Sol.

(ix) If $\vec{A}+\vec{B}+\vec{C}=\vec{0}$, then $\vec{A}.(\vec{B}\times\vec{C})=$.....

Sol.

Exercise - IV

Subjective Level-II

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

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

Sol.

2. The resultant of two forces F_1 and F_2 is P. If F_2 is reversed, then resultant is Q. Then the value of $(P^2 + Q^2)$ in terms of F_1 and F_2 is

(A) $2(F_1^2 + F_2^2)$ (B) $F_1^2 + F_2^2$

(C) $(F_1 + F_2)^2$ (D) none of these

Sol.

3. A man moves towards 3m north then 4m towards east and finally 5m towards 37º south of west. His displacement from origin is

(A) $5\sqrt{2}$ m (B) 0 m (C) 1 m (D) 12 m

Sol.

4. Three forces P, Q & R are acting at a point in the plane. The angle between P & Q and Q & R are 150º & 120º respectively, then for equilibrium, forces P, Q & R are in the ratio

(A) 1 : 2 : 3 (B) 1 : 2 : $\sqrt{3}$ (C) 3 : 2 : 1 (D) $\sqrt{3}$: 2 : 1

Sol.

5. A man rows a boat with a speed of 18 km/hr in northwest direction. The shoreline makes an angle of 15º south of west. Obtain the component of the velocity of the boat along the shoreline.

(A) 9 km/hr (B) $18\frac{\sqrt{3}}{2}$ km / hr

(C) 18 cos 15º km/hr (D) 18 cos 75º km/hr

Sol.

6. A brid moves from point (1, – 2, 3) to (4, 2, 3). If the speed of the bird is 10m/sec, then the velocity vector of the bird is

(A) $5(\hat{i} - 2\hat{j} + 3\hat{k})$ (B) $5(4\hat{i} + 2\hat{j} + 3\hat{k})$

(C) $0.6\,\hat{i} + 0.8\,\hat{j}$ (D) $6\,\hat{i} + 8\,\hat{j}$

Sol.

7. The resultant of two forces, one double the other in magnitude is perpendicular to the smaller of the two forces. The angle between the two forces is

(A) 150º (B) 90º (C) 60º (D) 120º

Sol.

8. If the angle between the unit vectors $\hat{a}$ and $\hat{b}$ is 60º, then $|\hat{a} - \hat{b}|$ is

(A) 0 (B) 1 (C) 2 (D) 4

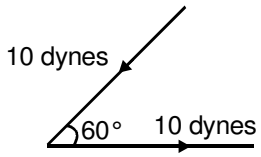
Sol.

9. For a particle moving in a straight line, the position of the particle at time (t) is given by $x = t^3 - 6t^2 + 3t + 7$ what is the velocity of the particle when it's acceleration is zero ?

(A) $-9ms^{-1}$ (B) $-12ms^{-1}$ (C) $3ms^{-1}$ (D) $42ms^{-1}$

Sol.

10. Two forces each numerically equal to 10 dynes are acting as shown in the following figure, then their resultant is -



(A) 10 dynes (B) 20 dynes

(C) $10\sqrt{3}$ dynes (D) 5 dynes

Sol.

11. Two vectors $\vec{A}$ and $\vec{B}$ are such that $|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}|$. The angle between the vectors $\vec{A}$ and $\vec{B}$ is -

(A) 0 (B) $\pi/3$ (C) $\pi/2$ (D) π

Sol.

12. A particle moves through angular displacement θ on a circular path of radius r. The linear displacement will be -

(A) $2r \sin(\theta/2)$ (B) $2r \cos(\theta/2)$

(C) $2r \tan(\theta/2)$ (D) $2r \cot(\theta/2)$

Sol.

13. The vector $\vec{P}$ makes 120° with the x-axis and vector $\vec{Q}$ makes 30° with the y-axis. What is their resultant ?

(A) P + Q (B) P – Q (C) $\sqrt{P^2+Q^2}$ (D) $\sqrt{P^2-Q^2}$

Sol.

14. A man travels 1 mile due east, then 5 miles due south, then 2 miles due east and finally 9 miles due north, how far is he from the starting point -

(A) 3 miles (B) 5 miles

(C) 4 miles (D) between 5 and 9 miles

Sol.

15. The angle that the vector $\vec{A} = 2\hat{i} + 3\hat{j}$ makes with y-axis is-

(A) $\tan^{-1}(3/2)$ (B) $\tan^{-1}(2/3)$

(C) $\sin^{-1}(2/3)$ (D) $\cos^{-1}(3/2)$

Sol.

16. A man moves towards 3m north then 4m towards east and finally 5 m towards 37° south of west. His displacement from origin is -

(A) $5\sqrt{2}$ m (B) 0 m (C) 12 m (D) 5 m

Sol.

17. If $3\hat{i}+2\hat{j}+8\hat{k}$ and $2\hat{i}+x\hat{j}+\hat{k}$ are at right angles that x=

(A) 7 (B) –7 (C) 5 (D) –4

Sol.

18. $a_1\hat{i}+a_2\hat{j}$ is a unit vector perpendicular to $4\hat{i}-3\hat{j}$ if -

(A) $a_1 = .6, a_2 = .8$ (B) $a_1 = 3, a_2 = 4$

(C) $a_1 = .8, a_2 = .6$ (D) $a_1 = 4, a_2 = 3$

Sol.

19. 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

Sol.

Exercise - V

JEE-Problems

1. Two vectors have magnitudes 3 unit and 4 unit respectively. What should be the angle between them if the magnitude of the resultant is

(a) 1unit,

Sol.

(b) 5 unit and

Sol.

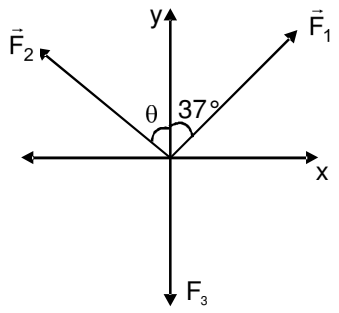
(c) 7 unit.

Sol.

2. When two forces of magnitude P and Q are perpendicular to each other, their resultant is of magnitude R. When they are at an angle of 180º to each other their resultant is of magnitude $\frac{R}{\sqrt{2}}$. Find the ratio of P and Q.

Sol.

3. A body acted upon by 3 given forces is under equilibrium.



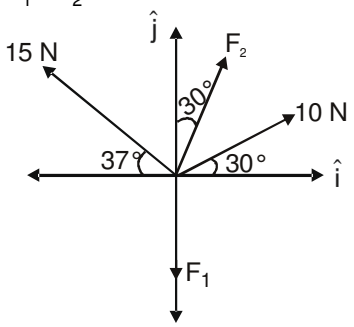
(a) If $|\vec{F}_1| = 10\,Nt., |\vec{F}_2| = 6\,Nt.$ Find the values of $|\vec{F}_3|$ & angle (θ).

Sol.

(b) Express $\vec{F}_2$ in unit vector form

Sol.

4. If the four forces as shown are in equilibrium Express $\vec{F}_1$ & $\vec{F}_2$ in unit vector form.



Sol.

5. A particle is acted upon by the forces $\vec{F}_1 = 2\hat{i} + a\hat{j} - 3\hat{k}$, $\vec{F}_2 = 5\hat{i} + c\hat{j} - b\hat{k}$, $\vec{F}_3 = b\hat{i} + 5\hat{j} - 7\hat{k}$, $\vec{F}_4 = c\hat{i} + 6\hat{j} - a\hat{k}$. Find the values of the constants a, b, c in order that the particle will be in equilibrium.

Sol.

6. A plane body has perpendicular axes OX and OY marked on it and is acted on by following forces

5P in the direction OY

4P in the direction OX

10P in the direction OA where A is the point (3a, 4a)

15P in the direction AB where B is the point (–a, a)

Express each force in the unit vector from & calculate the magnitude & direction of sum of the vector of these forces.

Sol.

7. A vector $\vec{A}$ of length 10 units makes an angle of 60º with the vector $\vec{B}$ of length 6 units. Find the magnitude of the vector difference $\vec{A}-\vec{B}$ & the angle it makes with vector $\vec{A}$.

Sol.

8. (a) Calculate $\vec{r}=\vec{a}-\vec{b}+\vec{c}$ where $\vec{a}=5\hat{i}+4\hat{j}-6\hat{k}$, $\vec{b}=-2\hat{i}+2\hat{j}+3\hat{k}$ and $\vec{c}=4\hat{i}+3\hat{j}+2\hat{k}$.

Sol.

(b) Calculate the angle between $\vec{r}$ and the z-axis.

Sol.

(c) Find the angle between $\vec{a}$ and $\vec{b}$

Sol.

ANSWER KEY

Exercise-I

PART - I

SECTION - A

1. 1 **2.** 47 **3.** (c)

SECTION - B

4. $\frac{dy}{dx} = 2x + 1$ **5.** $\frac{ds}{dt} = 15t^2 - 15t^4$ **6.** $\frac{dy}{dx} = 5\cos x$ **7.** $\frac{dy}{dx} = 2x + \cos x$ **8.** $\sec^2 x - \operatorname{cosec}^2 x$

9. $\frac{dy}{dx} = 12x - 10 + 10x^{-3}, \frac{d^2y}{dx^2} = 12 - 30x^{-4}$

10. $\frac{dr}{d\theta} = -12\theta^{-2} + 12\theta^{-4} - 4\theta^{-5}, \quad \frac{d^2r}{d\theta^2} = 24\theta^{-3} - 48\theta^{-5} + 20\theta^{-6}$

11. $\frac{d\omega}{dz} = 21z^6 - 21z^2 + 42z, \frac{d^2\omega}{dz^2} = 126z^5 - 42z + 42$

12. $\frac{dy}{dx} = \cos x - \sin x, \frac{d^2y}{dx^2} = -\sin x - \cos x$ **13.** $\frac{dy}{dx} = \frac{1}{x} + e^x, \frac{d^2y}{dx^2} = -\frac{1}{x^2} + e^x$

SECTION - C

14. $\sin x + x\cos x$ **15.** $e^x \ell nx + \frac{e^x}{x}$ **16.** $\frac{dy}{dx} = 3x^2$ **17.** $y' = 3x^2 + 10x + 2 - \frac{1}{x^2}$

18. $\cos^2 x - \sin^2 x$

SECTION - D

19. $\sec^2 x$ **20.** $y' = \frac{-19}{(3x-2)^2}$ **21.** $\frac{1}{x^2} - \frac{\ell nx}{x^2}$ **22.** $f'(t) = \frac{t^2 - 2t + 1}{(t^2 + t - 2)^2}$

23. $\frac{dz}{dx} = \frac{-2x^2 - 2x - 2}{(x^2 - 1)^2}$ **24.** $\frac{dy}{dx} = -x^2 \csc^2 x + 2x\cot x$

SECTION - E

25. **With** $u = (2x + 1)$

$y = u^5 : \frac{dy}{dx} = \frac{dy}{du} = 5u^4 . 2 = 10(2x + 1)^4$

26. $\frac{dy}{dx} = -27(4 - 3x)^8$

27. **With** $u = (1 - \left(\frac{x}{7}\right))$ $y = u^{-7} : \frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx} = -7u^{-8}.\left(-\frac{1}{7}\right) = \left(1 - \frac{x}{7}\right)^{-8}$

28. $\frac{dy}{dx} = -5\left(\frac{x}{2} - 1\right)^{-11}$ **29.** $5\cos 5x$ **30.** $\cos(x) + \frac{2}{x} + 2e^{2x}$ **31.** $2\omega\cos(\omega x + \phi)$

SECTION - G

32. $\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$ **33.** $\frac{ds}{dt} = 8\pi r \frac{dr}{dt}$

SECTION - H

34. 8 **35.** $y_{max} = 39, y_{min} = 38$

SECTION - I

36. $\frac{dy}{dx} = 48(8x-1)^2$ **37.** $3\cos(3x+1)$ **38.** $12x^3$ **39.** $\frac{dy}{dx} = -\frac{1}{3}\sin\frac{x}{3}$

PART - II

1. (a) x^2 (b) $\frac{x^3}{3}$ (c) $\frac{x^3}{3} - x^2 + x$ **2.** (a) x^{-3} (b) $-\frac{1}{3}x^{-3}$ (c) $-\frac{1}{3}x^{-3} + x^2 + 3x$

3. (a) $-\frac{1}{x}$ (b) $-\frac{5}{x}$ (c) $2x + \frac{5}{x}$ **4.** (a) $\sqrt{x^3}$ (b) $3\sqrt{x}$ (c) $\frac{2\sqrt{x^3}}{3} + 2\sqrt{x}$

5. (a) $x^{4/3}$ (b) $\frac{x^{\frac{2}{3}}}{2}$ (c) $\frac{3x^{\frac{4}{3}}}{4} + \frac{3x^{\frac{2}{3}}}{2}$ **6.** (a) $x^{1/2}$ (b) $x^{-1/2}$ (c) $x^{-3/2}$ **7.** $x - \frac{x^3}{3} - \frac{x^6}{2} + C$

8. $-3\cos x$ **9.** $\frac{1}{3}\ell nx$ **10.** $-\frac{1}{3}\cos 3x + C$

11. $\frac{1}{2}\sec 2t + C$ **12.** 15 **13.** $\frac{3\pi}{2}$ **14.** Area = 21 **15.** 24 **16.** 0

17. $e - 1$ **18.** Using n subintervals of length $\Delta x = \frac{b}{n}$ and right-endpoint values : Area = $\int_0^b 2x\,dx = b^2$

19. $\frac{b^2}{4} + b = \frac{b(4+b)}{4}$ **20.** 2

PART - III

SECTION - A

1. (i) 105º, (ii) 150º, (iii) 105º **2.** 120º **3.** $\vec{V}_R = -5\hat{j}$ **4.** (C)

SECTION - B

5. 30 m East **6.** $\sqrt{F_1^2 + F_2^2}$ **7.** 50, 53º with East **8.** $250\sqrt{5}$ N, $\tan^{-1}(2)$ W of N

9. (A) **10.** (B) **11.** (B) **12.** (D) **13.** (D) **14.** (A)
15. (C) **16.** (B) **17.** (D)

SECTION - C

18. $\sqrt{14}$ **19.** $\frac{3\hat{i} + 4\hat{j}}{5}$ **20.** – 25 cos 30º and + 25 sin 30º **21.** $30\sqrt{3}$ km h^{-1}

22. $\sqrt{0.11}$ **23.** 15º **24.** (A)

SECTION - D

25. (a) 3 (b) $-\hat{i} + 2\hat{j} - \hat{k}$ **26.** (a) 6 (b) $6\sqrt{3}$ **27.** (D) **28.** (B)

ANSWER KEY

Exercise-II

PART-I

SECTION-A

1. $-\frac{1}{x}$ **2.** f(2) = 3, f(1) = 3, f(3) = 5

SECTION-B

3. $\frac{dy}{dx}=\frac{2}{x}+\cos x$, $\frac{d^2y}{dx^2}=\frac{-2}{x^2}-\sin x$ **4.** $\frac{dy}{dx}=\frac{x^{-\frac{6}{7}}}{7}+\sec^2 x \Rightarrow \frac{d^2y}{dx^2}=\frac{-6}{49}\times^{\frac{-13}{7}}+2\tan x\sec^2 x$

SECTION-C

5. $e^x(\tan x+\sec^2 x)$ **6.** $2x\sin^4 x+4x^2\sin^3 x\cos x+\cos^{-2}x+2x\cos^{-3}x\sin x$ **7.** $\frac{dy}{dx}=1+2x+\frac{2}{x^3}-\frac{1}{x^2}$

8. $x^2\cos x$ **9.** $\frac{dy}{dx}=-x^2\sin x$ **10.** $\frac{dr}{d\theta}=\cos\theta+\sec^2\theta$

SECTION-D

11. $\frac{dy}{dx}=\sec^2 x$ **12.** $\frac{-\csc^2 x}{(1+\cot x)^2}$ **13.** $\frac{dy}{dx}=\frac{-x\sin x-\cos x}{x^2}+\frac{x\sin x+\cos x}{\cos^2 x}$ **14.** $\frac{\sec^2 q}{(1+\tan q)^2}$

SECTION-E

15. $3\sin^2 x\cos x+3\cos 3x$ **16.** $4x\sin(x^2+1)\cos(x^2+1)$ **17.** $\frac{1}{(x^2+1)^{3/2}}$ **18.** $\frac{1-r}{\sqrt{2r-r^2}}$

19. With $u=\left(\frac{x^2}{8}\right)+x-\left(\frac{1}{x}\right)$, $y=u^4$: $\frac{dy}{dx}=\frac{dy}{du}\frac{du}{dx}=4u^3.\left(\frac{x}{4}+1+\frac{1}{x^2}\right)=4$, $4\left(\frac{x^2}{8}+x-\frac{1}{x}\right)^3\left(\frac{x}{4}+1+\frac{1}{x^2}\right)$

SECTION-F

20. (a) $\frac{dV}{dt}=\pi r^2\frac{dh}{dt}=5\pi r^2$ (b) $\frac{dV}{dt}=2\pi hr\frac{dr}{dt}=10\pi rh$ (c) $\frac{dV}{dt}=\pi r^2\frac{dh}{dt}+2\pi hr\frac{dr}{dt}=5\pi r^2+10\pi rh$

SECTION - G

21. x = 30 & y = 30 **22.** $x=\sqrt{\frac{40}{3}}m$

SECTION-H

23. **(a)** –cosx, **(b)** $2\sec^3 x-\sec x$

Given y = f(u) and u = g(x), find $\frac{dy}{dx}$

24. $-\sin(\sin x)\cos x$. **25.** $\frac{dy}{dx}=\cos(x-\cos x)(1+\sin x)$

PART - II

1. $\frac{x^4}{2}-\frac{5x^2}{2}+7x+C$ **2.** $\frac{x}{5}+\frac{1}{x^2}+x^2+C$ **3.** $\frac{2}{3}x^{3/2}+\frac{3}{4}x^{4/3}+C$ **4.** $-\frac{1}{x}-\frac{1}{2x^2}+C$ **5.** $2\sqrt{t}-\frac{2}{\sqrt{t}}+C$

6. $-2t^{-2}-\frac{2}{3}t^{-3/2}+C$ **7.** $-\cos\theta+\theta+C$ **8.** $\frac{3\pi^2}{2}$ **9.** $\frac{7}{3}$ **10.** 0 **11.** $\frac{1}{3}\ell n\frac{5}{2}$

12. Using n subintervals of length $\Delta x=\frac{b}{n}$ and right-end point values : Area = $\int_0^b 3x^2dx=b^3$ **13.** $\frac{\pi b^2}{4}$

PART - III

SECTION - A

1. $\vec{B} = \lambda\vec{A} = -4 \times 3N - E = 12$ S-W

No it does not represent the same physical quantity.

2. (D) **3.** (A) **4.** (A), (B), (C)

SECTION-B

5. 37° **6.** $r(1+\sqrt{2})$ **7.** (A) **8.** (B) **9.** (B) **10.** (B) **11.** (C)

12. (A) **13.** (D) **14.** (A) **15.** (A), (B), (D)

SECTION-C

16. $\frac{4\hat{i}+5\hat{j}+2\hat{k}}{\sqrt{45}}$ **17.** B **18.** (A)

SECTION- D

19. $\frac{x_1}{x_2} = \frac{y_1}{y_2}$ **20.** (D)

ANSWER KEY — Exercise-III

1. (A) → Q, (B) → R, (C) → P, (D) → S

2. (a) 8, (b) 4, (c) 2 (b) $\cos\theta = \frac{\vec{F}_1.\vec{F}_2}{|\vec{F}_1||\vec{F}_2|} \Rightarrow \theta = \cos^{-1}\left(\frac{3}{5\sqrt{2}}\right)$ (c) $F_1\cos\theta = \frac{\vec{F}_1.\vec{F}_2}{|\vec{F}_2|} = \frac{6}{5}$

3. (a) $\vec{F}_R = \vec{F}_1 + \vec{F}_2 = 2\hat{i} + 5\hat{j} + 4\hat{k}$

4. (C) **5.** (B) **6.** (A) **7.** (A) **8.** (A) **9.** (B)

10. **(i)** True **(ii)** False **(iii)** True **(iv)** True

11. **(i)** 25 Units. **(ii)** $15\hat{i} + 20\hat{j}$ **(iii)** Null vector **(iv)** $\sqrt{224}$ units **(v)** 7 units **(vi)** $\frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$

(vii) Perpendicular **(viii)** 45 **(ix)** zero.

ANSWER KEY — Exercise-IV

1. C **2.** A **3.** B **4.** D **5.** A **6.** D **7.** D **8.** B **9.** A **10** A **11.** C **12.** A **13.** A **14.** B **15.** B **16.** B **17.** B **18.** A **19.** B

ANSWER KEY — Exercise-V

1. (a) 180°, (b) 90°, (c) 0 **2.** $2 \pm \sqrt{3}$ **3.** (a) $|\vec{F}_3| = 8$ N, $\theta = 90°$ (b) $\vec{F}_2 = -6\hat{i}$

4. $\vec{F}_1 = -(12\sqrt{3} - 1)\hat{j}$ & $\vec{F}_2 = (12 - 5\sqrt{3})\hat{i} + (12\sqrt{3} - 15)\hat{j}$ **5.** a = – 7, b = – 3, c = – 4

6. $5P\hat{j}, 4P\hat{i}, 6P\hat{i} + 8P\hat{j}, -12P\hat{i} - 9P\hat{j}$, $\sqrt{20}P$, $\tan^{-1}[-2]$ with the +ve x axis. **7.** $2\sqrt{19}$; $\cos^{-1}\frac{7}{2\sqrt{19}}$

8. (a) $11\hat{i} + 5\hat{j} - 7\hat{k}$, (b) $\cos^{-1}\left(\frac{-7}{\sqrt{195}}\right)$, (c) $\cos^{-1}\left(\frac{-20}{\sqrt{1309}}\right)$