PHYSICS

BOOKS - S CHAND PHYSICS (ENGLISH)

VECTORS SCALARS ELEMENTARY CALCULUS

Solved Examples

1. A man walks 2 km dur north .After that he walks

another 2 km along

due east

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2. A man walks 2 km dur north .After that he walks another 2 km along

due east

3. A man walks 2 km dur north .After that he walks another 2 km along

due West . What is the final displacement from the starting point in each case ?

4. An athlete runs along a circular track with a constant speed of 5 m/s . If A,B and C are his instantaneous positions at different times then find the change in velocity (a) from A to B and (b) from A to C.

5. A motor lanuch takes 50 s travel 100 m upstream and 25 s to travel the same distance downstream . What is the speed of the current and the launch ?

6. Two vectors 3 units and 5 units are acting at $60°$ to each other .What is the magnitude and direction of the resultant ?

7. The resultant of $\vec{P}$ and $\vec{Q}$ is $\vec{R}$ .If $\vec{Q}$ is doubled, $\vec{R}$ is doubled, when $\vec{Q}$ is reversed, $\vec{R}$ is again doubled, find P:Q:R.

8. A truck travels 25 km north and then 50 km in a direction $60°$ west of north .Find the magnitude and direction of the truuck's resultant displacement .

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9. A particle has a displacement of 8 m . If one of its rectangular components is 4 m what is the other rectangular component ?

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10. A body is thrown into air with a velocity 5 m/s making an angle $30°$ with the horizontal .If the vertical component of the velocity is 5 m/s what is the velocity of the body ? Also find the horizontal component .

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11. Two cars A and B are moving due east and due north at 60 km.p.h respetively. At noon A is west of B at a distance 40 km . When are the cars nearest to each other and what is the distance between them then ?

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12. ABCDEF is a regular hexagon , with the sides AB, AC, AD, AE and AF representing vectors 1 unit , 2 units , 3 units , 4 units and 5 units respetively . Find their resultant ?

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13. Twelve horizontal telephone wires are supported by a vertex telegraph post , 5 wires ecrossing from the north and 7 wires from the rest . If all the wires are under the same tension , in which direction should the stay wire be fixed ? What is the resultant ten be fixed ? What is the resultant tension in the stay wire ?

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14. Prove that the scalar product of two or thogonal vectors is zero .

15. Using scalar product of two vectors derive the cosine law for triangles .

16. The resultant and dot product of two vectors $\vec{a}$ and $\vec{b}$ is equal to the magnitude of $\vec{a}$. Show that

when the vector $\vec{a}$ is doubled , the new resultant is perpendicular to $\vec{b}$.

17. Find the angle between the vector $\vec{a} = 2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{b} = 4\hat{i} + 5\hat{j} - 2\hat{k}$.

18. Find the value of n such that the vectors $4\hat{i} + 3\hat{j} - 7\hat{k}$ and $5\hat{i} + 2\hat{j} - n\hat{k}$ may be orthogonal .

19. If $\vec{A}\,\vec{B}\,,\vec{C}$ are three vectors and one of them has zero magnitude , then given that $\vec{A} \times \vec{B} = 0$ and $\vec{B} \times \vec{C} = 0$, Prove that $\vec{A} \times \vec{c} = 0$

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20. If two vectors are represented by the two sides of a triangle , then show that half the magnitude of their cross product will give the area of the triangle .

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21. The vectors $2\hat{i} + 2\hat{j} + 4\hat{k}$ and $6\hat{i}$ represent the two sides of a triangle . Find the following .

the area of the triangle

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22. The vectors $2\hat{i} + 2\hat{j} + 4\hat{k}$ and $6\hat{i}$ represent the two sides of a triangle . Find the following .

the area of the triangle

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23. The vectors $2\hat{i} + 2\hat{j} + 4\hat{k}$ and $6\hat{i}$ represent the two sides of a triangle . Find the following .

a vector perpendicular to the plane of the triangle .

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24. Prove that

$$\left(\vec{A} + \vec{B}\right) \times \left(\vec{A} - \vec{B}\right) = 2\left(\vec{B} \times \vec{A}\right)$$

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25. Show that the vectors
$\vec{A} = 2\hat{i} - 3\hat{j} - 1\hat{k}$ and $\vec{B} = -6\hat{i} + 9\hat{j} + 3\hat{k}$ are

parallel .

26. Prove that the area of a parallelogram with sides $\overrightarrow{A}$ and $\overrightarrow{B}$ is $\overrightarrow{A} \times \overrightarrow{B}$

27. Integrate the following functions w.r.t x

$$x(x + 1)(x + 2)$$

28. Integrate the following functions w.r.t x

$$\frac{x^4 - 5x^3 + 3x}{x^2}$$

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29. Integrate the following functions w.r.t x

$$\frac{1}{1 - \sin x}$$

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30. Integrate the following functions w.r.t x

$$\frac{1 + \cos x}{x + \sin x}dx$$

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31. Integrate the following functions w.r.t x

$$\sin^2 x \cos^3 x$$

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32. Integrate the following functions

$$\int_0^{\pi/2} \cos x \, dx$$

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33. Integrate the following functions

$$\int_0^r \left(2x - x^3 \right) dx$$

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34. Integrate the following functions

$$\int_{\theta_1}^{\theta_2} \frac{d\theta}{\theta - \theta_0}$$

35. Integrate the following functions

$$10x$$

36. Integrate the following functions

$$10^x + e^{2x}$$

37. Integrate the following functions

$$\cos x / 1 - \cos^2 x$$

Additional Solved Problems

1. P,Q and R are three forces acting simultaneously on a particle . $\overrightarrow{S}$ is the vector sum, of the three forces show that if $\overrightarrow{S}$ = 0 , the vector representing these forces form a triangle.

2. $\vec{A}$ and $\vec{B}$ are two vectors having the same magnitude but acting at right angle to each other . On the same diagram represent $\vec{A} + \vec{B}$ and $\vec{A} - \vec{B}$ using a suitable scale ?

3. If two vector are equal and rheir resultant is also equal to one of them , then the angle between the two vector is

4. Show that the magnitude of vector sum of $\overrightarrow{a}$ and $\overrightarrow{b}$ cannot be greater than $\left|\overrightarrow{a}\right| + \left|\overrightarrow{b}\right|$ or smaller than $\left|\overrightarrow{a}\right| - \left|\overrightarrow{b}\right|$

5. The resultant of two vectors , having equal magnitudes E make an angle of $120°$ with each other . What is the magnitude and direction of the resultant ?

6. Two equal vectors are inclined at $60°$ .At what direction does the resultant act with the first vector ?

7. What are the properties fo two vectors $\vec{a}$ and $\vec{b}$ such that $\vec{a} + \vec{b} = \vec{a} - \vec{b}$?

8. If the magnitude of sum of two vectors is equal to the magnitude of different of the two vectors. The angle between these vectors is

9. The angle between two vectors $\vec{u}$ and $\vec{v}$ is $60°$ .Find (i) the scalar product of the two vectors and (ii) the vector product of the two vectors , if $\vec{u} = 7units, \vec{v} = 14$ units ?

10. If $\left|\vec{a} + \vec{b}\right| = \left|\vec{a} - \vec{b}\right|$, then show that $\vec{a}$ and $\vec{b}$ are perpendicular to each other.

11. If $\vec{A} = 2\hat{i} + 7\hat{j} - 2\hat{k}$ and $\vec{B} = 2\hat{i} - 3\hat{j} + 3\hat{k}$ find

(i) the magnitude of each other (ii) $\vec{A} + \vec{B}$, (iii) $\vec{A} - \vec{B}$

12. If the vectors given by $\vec{A} = \hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{B} = \hat{i} - \hat{j} + n\hat{k}$ are prerpendicular to each other find the value of n .

13. IF $\vec{a}$, $\vec{b}$ and $\vec{c}$ represent the three sides of a triangle as shown then using the properties of scalar product and vector product prove that

. B/sinB = C/sinC

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14. IF $\vec{a}$, $\vec{b}$ and $\vec{c}$ represent the three sides of a triangle as shown then using the properties of scalar product and vector product prove that

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15. Show that the two vectors $\vec{A}$ and $\vec{B}$ are parallel , where $\vec{A} = \hat{i} + 2\hat{j} + \hat{k}$ and $\vec{B} = 3\hat{i} + 6\hat{j} + 3\hat{k}$

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16. Find the value of the following

$$\left| \vec{a} \cdot \vec{b} \right|^2 + \left| \vec{a} \times \vec{b} \right|^2$$

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17. Find the value of the following

$$\left| \vec{a} \cdot \vec{b} \right|^2 - \left| \vec{a} \times \vec{b} \right|^2$$

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18. $\overrightarrow{AC}$ and $\overrightarrow{BD}$ are the diagonals of a parallelogram ABCD. Prove that

(i) $\overrightarrow{AC} + \overrightarrow{BD} - 2\overrightarrow{BC}$

(ii) $\overrightarrow{AC} - \overrightarrow{BD} - 2\overrightarrow{AB}$

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19. Give an example of two physical quantities such that their scalar product and vector product represent two different physical quantities .

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20. Given that $\vec{A} \times \vec{B} = 0, \vec{B} \times \vec{C} = 0,$ find the value of $\vec{A} \times \vec{C}$ if $\vec{A} \neq 0, \vec{B} \neq 0, \vec{B} \neq 0$ and $\vec{C} \neq 0$

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21. If $\hat{i}$ and $\hat{j}$ are unit vectors x and y axes repsectively, what is the magnitude and direction of $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$?

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22. Find the magnitude of the sum of $\vec{A}$ and $\vec{B}$ and its direction with respect to the X - axis .

Examples

1. Differentiate w.r.t

$$y = x^{10}$$

2. Differentiate w.r.t

$$y = x^{-2}$$

3. Differentiate w.r.t x

$$y = 8x^8$$

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4. Differentiate w.r.t x $y = 3x^4 + 2x^2 - 10x$

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5. Differentiate w.r.t x $y = x(x^2 - 2x)$. Here

$$u = x, v = x^2 - 2x$$

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6. Differentiate w.r.t x , $y = (x^2 + 1)/(x - 1)$. Here $u = x^2 + 1, v = x - 1$

7. Differentiate w.r.t x, y $y = (4x^2 - 5x + 10)^{10}$

8. Differentiate w.r.t x , $y = x^{\sin x}$

9. Differentiate w.r.t x Given $x = a\cos^3\theta$, $y = b\sin^3\theta$

10. Integrate the following

$$3x^2 - 6x + \frac{1}{x^3}$$

11. Integrate the following

$$\cos^2 3x$$

12. Integrate the following

$$\sin^3 x \cos^4 x$$

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13. Integrate the following

$$\frac{1}{\sqrt{x^2 + a^2}}$$

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14. Integrate the following

$$x \log x$$

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15. Differentiate the following with respect to x

$$2x^3 - 9 - 3x^2$$

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16. Differentiate the following with respect to x

$$2\sin x - 3\log x$$

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17. Differentiate the following with respect to x

$$\left(3x^2 - 5\right)\left(x^2 + 7\right)$$

18. Differentiate the following with respect to x

$$x^2 e^x \sin x$$

19. Differentiate the following with respect to x

$$e^x / (1 + \sin x)$$

20. Differentiate the following with respect to x

$$x^2 - 1/x^2 + 1$$

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21. Differentiate the following with respect to x

$$\sin^{-1} \sqrt{x}$$

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22. Differentiate the following with respect to x

$$\cos^{-1} \sqrt{\frac{1 + \cos x}{2}}$$

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23. Differentiate the following with respect to x

$x^{\sin x}$

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24. If x = a $(t + \sin t)$ and $y = a(1 - \cos t)$ find $\dfrac{dy}{dx}$

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25. Differentiate w.r.t x Given $x = a\cos^3 \theta, y = b\sin^3 \theta$

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26. Given that $y = 3\cos x + 2\sin x$. Show that

$$\frac{d^2y}{dx^2} + y = 0$$

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Applications Of Integration In Physics

1. The position of a particle at any point instant is x .

Find the velocity and acceleration at any instant .

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2. The momentum of a particle of mass of m moving with a velocity v is p= mv. What is the rate of change of momentum ? Assume that m is constant .

3. The displacement of a particel moving with uniform acceleration after r's given by $s = 10t + 4.9t^2$? What is the magnitude the final velocity at t = 3 s and the uniform acceleration .

4. Find $\displaystyle\int_{c}^{Q} dq$ where c is a constant .

5. Find $\displaystyle\int_{R}^{\infty} \frac{GMm}{x^2} dx$ where G, M and m are constants.

6. Find the value of $\displaystyle\int_{-\frac{l}{2}}^{+\frac{l}{2}} \frac{M}{l} x^2 dx$ where M and l are constants .

1. Why can't the vectors be added algebraically ?

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2. Is it possible to add any two vectors ?

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3. When can you say that two vectors $\vec{A}$ and $\vec{B}$ are

(a) parallel and (b) perpendicular .

4. Prove that $\hat{i} \times \hat{j} = \hat{k}$

$$\hat{i} \times \hat{j} = 1 \times 1 \sin 90 \widehat{n} = \widehat{n}$$

5. Can the coomponent of a vector to greater than vector itself ?

6. How can the resultant of 13 vectors acting at a point be found ?

7. A vector has magnitude and direction .Does it have a location in space ? Can it vary with time ? Will two equal vectors a and b at different locations in space necessartly have identically physical effect ? Give example in support of your answer .

8. A vector has both magnitude and direction. Does it mean that anything that has by the direction of the axis of rotation, and the angle of rotation about the axis. Does that makes any rotation a vector?

9. Can you associate vectors with (a) the length of a wire bent into a loop, (b) a plane area, (c) a sphere? Explain.

10. Can you apply commtutative and associate law to vector subtraction ?

11. Can two vectors of different magnitude be combined to give a zero resultant ? Can three vectors ?

12. Can three vectors not in a plane give zero resultant ? Can four vectors ?

Long Answer Questions

1. State parallelogram of law of vector addition .

2. State triangle law of of vector addition .

3. (a) Write law of parallelogram of vector and obtain the expression for the resultant of two vectors acting in two different directions.

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4. What is scalar product of two vectors ? Give two examples .

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5. What is vector product of two vectors ? Give two examples .

Short Answer Questions

1. Distinguish between scalar and vector quantities Give example .

2. Why do we point an arrow mark while representing a vector ?

3. When a body moved along a straight line from A to B its velocity vector is represented by a straight line - directed from A to B . But " when the same body rotates in circular path is velocity vector is represented by a straight line perpendicular to the plane of the circular path " . Why ?

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4. What are pseudo vectors ? Why are they called an axial vector ?

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5. What is the difference between a polar wector and an axial vector ?

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6. " Linear displacement is called a free vector whereas electric intensity is called a bound vector "/ Why ?

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7. What is a position vector ? Why is called so ?

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8. Is it possible to get a vector from a vector from a vector from a scalar ? If so give an example .

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9. What are reciprocal vectors ?

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10. What is the difference between scalar addition and vector addition ?

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11. With a suitable diagram show how two vectors are added ?

12. State triangle law of of vector addition .

13. State parallelogram of law of vector addition .

14. Is any difference between triangle law and parallelogram law of vector addition ?

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15. Is it possible that the magnitude of resultantof two vectors is equal toeach of the vectors ?

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16. Draw a diagram to show the associative law of vector addition .

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17. What is the use of polygen law of vectors ?

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18. What is a null vector ? What is its use ?

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19. What are the properties of a zero vector ?

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20. What is a resultant vector ?

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21. What is meant by resolution of vectors ?

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22. What is meant by uniqueness of resolution ?

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23. What is a unit vector?

24. What are the rectangular components of a vector ?

25. A given vector $\vec{v}$ is multiplied by 3 and -3 . Draw diagram to illustrate this .

26. What is difference between multiplying a vector by a real number and a scalar ?

27. What is scalar product of two vectors is vectors ? Why is it called so ?

28. The scalar produced of two vectors is zerois zero what does it imply?

29. Cross product of two vectors is called vector product .Why?

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30. How will you find the direction of the vector product of two vectors ?

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31. The vector product of two vectors is a zero vector ? What does it imply ?

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32. $\vec{A} \times \vec{B}$ not equal to $\vec{B} \times \vec{A}$. Why?

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33. Write down the components of a vector using the three unit vectors ?

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34. What are the direction cosines ?

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35. Is commutative law applicable to vector subtraction ?

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36. What is the condition for magnitude of $\vec{A} + \vec{B}$ to be equal to that of $\vec{A} - \vec{B}$?

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37. What is dot product of two orthogonal vector ?

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38. If $\vec{A} \times \vec{B}$ = 0 under the condition $\vec{A} = 0, \vec{B}$ = 0

what is the angle between them ?

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39. 'Time' , is scalar or vector ?

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40. Is it possible that dot product of two vectors is zero even if they are not perpendicular to each other ?

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41. Force and area are vectors ? Pressure is equal to force (thrust) divided by area . Is pressure scalar or vector ?

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42. What is the condition for parallelism of two vectors ?

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43. What is the condition for perpendicularity of two vectors ?

44. Is it possible that the scalar product of two vectors is negative ?

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Very Short Answer Questions

1. Can we add displacement and force vectors ?

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2. Is angle a scalar or vector ?

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3. A quantity has magnitude and direction .can you call

it a vector ?

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4. Is it possible that two non - zero vectors multiply

and give a zero result ?

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5. What is the condition under which the magnitude of cross product is equal to the dot product ?

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6. Is it possible that $\left|\vec{A} + \vec{B}\right| = \left|\vec{A}\right| = \left|\vec{B}\right|$?

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7. What is the angle be $\vec{a} \times \vec{b}$ and $\vec{b} \times \vec{a}$?

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8. Can you apply commtutative and associate law to vector subtraction ?

9. Given that $\vec{a} . \vec{b} = \vec{a} . \vec{c}$ Does this mean that $\vec{b} = \vec{c}$?

10. What is the angle between $\hat{i} + \hat{j}$ with the x - axis ?

1. At what angle two vectors $\overrightarrow{P} = 2N$ and $\overrightarrow{Q} = 3N$

act such that their sum is 4 N .

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2. If $\overrightarrow{a} = 3m,\ \overrightarrow{b} = 4$ m how will you combine them

to get a resultant vector of (a) 1m (b) 7m and (c) 5m .

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3. If $\vec{A}$, $\vec{B}$ and $\vec{C}$ are three vectors when you can say that $\vec{A} + \vec{B} = \vec{C}$ and $A + B = C$ are the same ?

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4. $\vec{A}$ and $\vec{B}$ are two vectors having the same magnitude . What is the condition that (i) the vector sum $\vec{A} + \vec{B}$ and (ii) the vector differece $\vec{A} + \vec{B}$ have the same magnitude as $\vec{A}$ and $\vec{B}$?

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5. If $\vec{A} + \vec{B} = \vec{C}$ under what condition $A^2 + B^2$ will be equal to C^2 ?
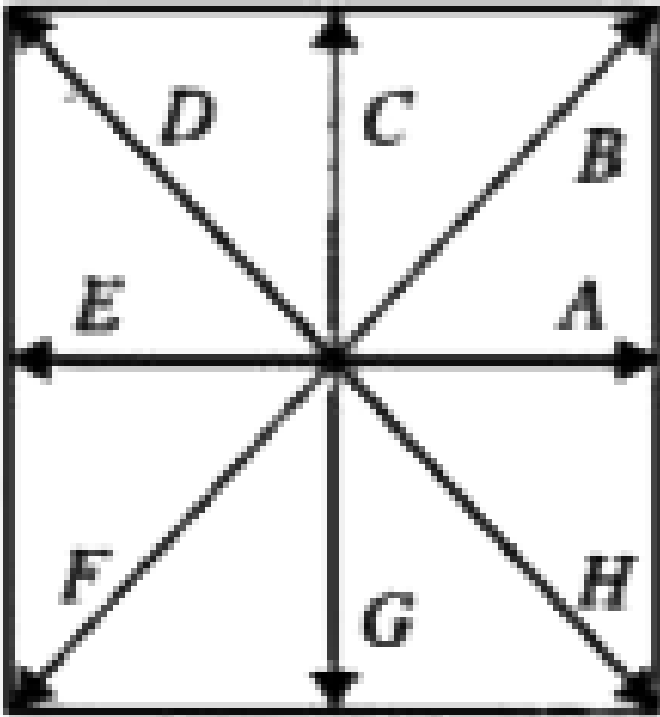
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6. $\vec{A}$ and $\vec{B}$ are two vectors such that $\vec{A}$ is 2 m long and is $60°$ above the x - axis in the first quadrant $\vec{B}$ is 2 m long and is $60°$ below the x - axis in the fourth quadrant .

Draw diagram to show $\vec{a} + \vec{B}, \vec{A} - \vec{B}$ and $\vec{B} - \vec{A}$

(b) What is the magnitude and direction of $\vec{A} + \vec{B}, \vec{A} - \vec{B}$ and $\vec{B} - \vec{A}$

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7. A number of vectors are as shown in .They can be combined in various ways , like $\vec{A} + \vec{C} = \vec{B}$. What is the value of (a) $\vec{E} + \vec{C}$ (b) $\vec{A} + \vec{F}$ (c) $\vec{A} + \vec{D}$ (d) $\vec{E} + \vec{A}$ (e) $\vec{A} - \vec{B}$.

8. how will you combine $\vec{E}$ and $\vec{A}$ such that their vector sum is

(i) $\vec{A}$ (ii) $\vec{E}$ (iii) $2\vec{A}$

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9. The greatest and least resultant of two forces acting at a point is 29 kgwt and 5 kgwt respectively . If each force is increased by 3 kgwt , find the resultant of the two new forces when acting at right angles to each other ?

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10. An aeroplane has a velocity of 110 m/s directed due north and is subjected to a wind blowing from west to east at a speed of 40 m/s . Calculate the actual velocity of the aeroplane relative to the earth .

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11. An athlete runs along a circular track of circumference 400 m with a uniform speed 15 m/s . What is the change in velocity when the runs through a distance (i) 100 m (ii) 200 m ?

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12. Two billiard balls are rolling on a flat table . One has the velocity component $V_x = 1ms^{-1}, V_y = \sqrt{3}m^{-1}$ and the other has components $V_x = 2ms^{-1}$ and $V_y = 2ms^{-1}$ .If both the balls start moving from the same point , what is the angle between their paths ?

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13. What should be the angle between $\left(\overrightarrow{A} + \overrightarrow{B}\right)$ and $\left(\overrightarrow{A} - \overrightarrow{B}\right)$ such that the magnitude of the resultant is $\sqrt{3A^2 + B^2}$?

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14. What is the resultantof two vectors 7 units and 8 units acting at an angle of $45°$ to each other ?

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1. A spider crawls 1 m due north , 2 m due east and then climbs 3 m vertically on a wall . What is the magnitude of the resultant dispalcemen ?

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2. Find the direction cosines of the vector $\overrightarrow{F} = 4\hat{i} + 3\hat{j} + 2\hat{k}$

3. Find the unit vector of the vector $\overrightarrow{r} = 4\hat{i} - 2\hat{j} + 3\hat{k}$

4. The vertical component of a force acting at $60°$ to the horizontal is 8.48 N . Find the force and the horizontal component .

5. A body of mass 10 kg is at rest on an iinclined plane of angle $30°$. What are its components parallel and perpendicular to the plane ?

6. A force acts on a body at a certain angle with the horizontal such that the vertical component is twice the horizontal component . What is the inclination of the force ?

1. If $\vec{F} = \hat{i} + 2\hat{j} + \hat{k}$ and $\vec{V} = 4\hat{i} - \hat{j} + 7\hat{k}$ what is $\vec{F} \cdot \vec{v}$?

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2. Find the projection of the vector $\vec{P} = 2\hat{i} - 3\hat{j} + 6\hat{k}$ on the vector $\vec{Q} = \hat{i} + 2\hat{j} + 2\hat{k}$

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3. Given $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = \hat{i} + \hat{j}$. What is the vector component of $\vec{A}$ in the direction of $\vec{B}$?

4. If $\hat{i}$ and $\hat{j}$ are unit vectors x and y axes repsectively , what is the magnitude and direction of $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$?

5. The result of scalar product and the vector product of two given vectors is zero . If one vector is $\hat{i}$ what is

the other vector ?

6. The magnitude to two vectors are $\sqrt{61}$ and $\sqrt{78}$ .If

their scalar prodcut is -59 , what is the angle between

the two vector ?

7. Given $\overrightarrow{A} = \hat{i} - 2\hat{j} - 3\hat{k}, \overrightarrow{B} = 4\hat{i} - 2\hat{j} + 6\hat{k}$ .Calculate the angle made by $\left(\overrightarrow{A} + \overrightarrow{B} \right)$ with the x - axis ?

8. Simplify : (i) $\left|\vec{a}.\vec{b}\right|^2 + \left|\vec{a} \times \vec{b}\right|^2$ (ii) $\left|\vec{a}.\vec{b}\right|^2 - \left|\vec{a} \times \vec{b}\right|^2$

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

10. The diagonals of a parallelogram are given by the vectors $\left(3\hat{i} + \hat{j} + 2\hat{k}\right)$ and $\left(\hat{i} - 3\hat{j} + 4\hat{k}\right)$ in m .

Find the area of the parallelogram .

11. Obtain the condition for the two vectors

$\overrightarrow{A} = x_1\hat{i} + y_1\hat{j} + z_1\hat{k}$ and $\overrightarrow{B} = x_2\hat{i} = x_2\hat{i} + y_2\hat{j} + z_2\hat{k}$

to be parallel ?

12. What are the values of the following

$\overrightarrow{A}.\overrightarrow{A}$

13. What are the values of the following

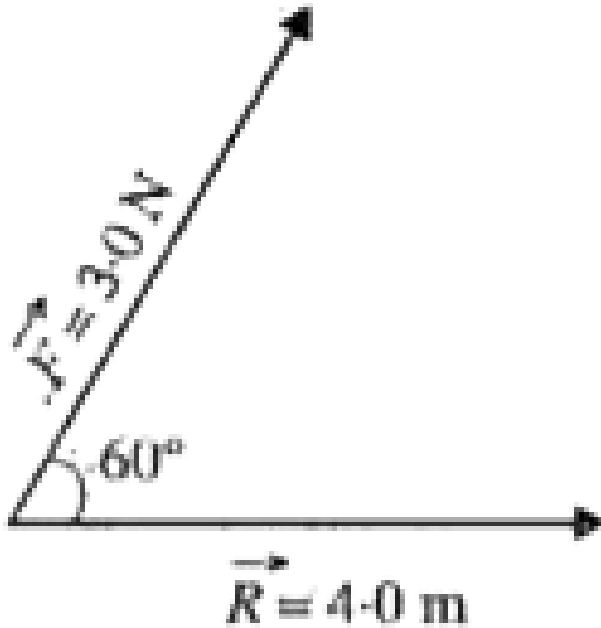$$\vec{A} \times \vec{A}$$

14. What are the values of the following

$$\vec{B} \times \vec{A}, \quad \text{if} \quad \vec{A} \times \vec{B} = \vec{C}$$

15. The vector $\vec{F}$ is a force of 3.0 newton making an angle of $60°$ with the displacement . $\vec{R}$ of magnitude 4.0 m , find

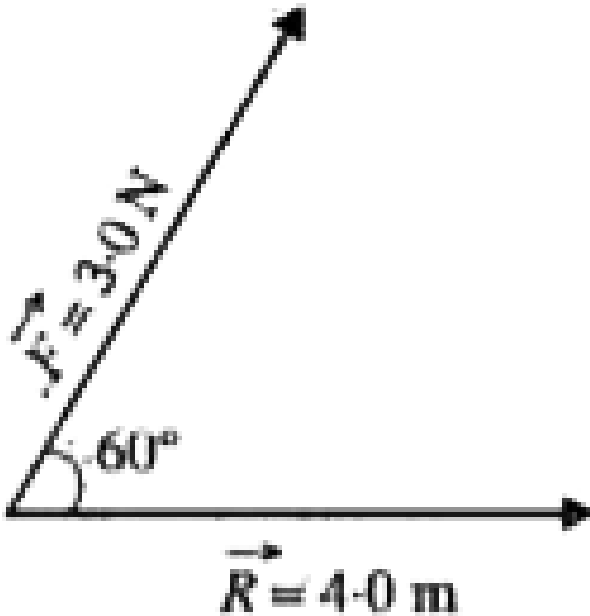the value of the dot product $\vec{F} . \vec{R}$

$R = 4 \cdot 0\ m$

16. The vector $\vec{F}$ is a force of 3.0 newton making an angle of $60°$ with the displacement . $\vec{R}$ of magnitude $4.0\ m$, find

the magnitude and direction of the cross product $\overrightarrow{R} \times \overrightarrow{F}$

$\overrightarrow{F} = 3.0\,N$

$60°$

$\overrightarrow{R} = 4.0\ m$

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17. If $\overrightarrow{A} = 5\hat{i} - 3\hat{j} + 4\hat{k}$ and $\overrightarrow{B} = \hat{j} - \hat{k}$, find the sine of the angle between $\overrightarrow{a}$ and $\overrightarrow{B}$

18. Find the cross product $\overrightarrow{r} \times \overrightarrow{F}$ given $\overrightarrow{F} = \hat{i} + \hat{j} + \hat{k}$ and $\overrightarrow{r}$ is the distance between two points whose coordinates are $(- 2, 3, 4)$ and $(1, 2, 3)$

19. Two vectors $5\hat{i} + 7\hat{j} - 3\hat{k}$ and $2\hat{i} + 2\hat{j} - a\hat{k}$ are mutually perpendicular . What is the value of a ?

20. Prove that

$$\left(\vec{A} + \vec{B}\right) \times \left(\vec{A} - \vec{B}\right) = 2\left(\vec{B} \times \vec{A}\right)$$

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Unsolved Problems

1. Differentiate the following w.r.t x

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2. Differentiate the following w.r.t x

π^2

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3. Differentiate the following w.r.t x

πe

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4. Differentiate the following w.r.t x

e^{-5}

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5. Differentiate the following w.r.t x

$16x^8$

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6. Differentiate the following w.r.t x

x^{-4}

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7. Differentiate the following w.r.t x

$x^{5/2}$

8. Differentiate the following w.r.t x

$$4x^3 - 10 - 6x^2$$

9. Differentiate the following w.r.t x

$$x^2 + 3x + \frac{3}{x}$$

10. Differentiate the following w.r.t x

$\tan(3x + 1)$

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11. Differentiate the following w.r.t x

cos 3x

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12. Differentiate the following w.r.t x

$\sqrt{\sin x}$

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13. Differentiate the following w.r.t x

$$3x^2 + 12x - 11/x$$

14. Differentiate the following w.r.t x

$$\tan x + 2\sin + 3\cos x - \frac{1}{2}\log x - e^x$$

15. Differentiate w.r.t x using product rule .

$$(5x + 2)(4 - 3x)$$

16. Differentiate w.r.t x using product rule .

$\sqrt{x}.\sec x$

17. Differentiate w.r.t x using product rule .

$\left(ax^2 + bx + c\right)(x - d)$

18. Differentiate w.r.t x using product rule .

$$x^3 \sin x$$

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19. Differentiate w.r.t x using product rule .

$$x \sin x \log x$$

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20. Differentiate w.r.t x using product rule .

$$(1 + 2\tan x)(5 + 4\cos x)$$

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21. Differentiate w.r.t x using quotient rule .

$$e^x \, / \, x$$

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22. Differentiate w.r.t x using quotient rule .

$$\left(x^3 + 3x + 1\right) / \left(x^2 - x + 1\right)$$

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23. Differentiate w.r.t x using quotient rule .

$$\left(x^4 + 1\right) / \left(x^2 - 1\right)$$

24. Differentiate w.r.t x using quotient rule .

$$x/\left(1+\tan x\right)$$

25. Differentiate w.r.t x using quotient rule .

log x/x

26. Differentiate w.r.t x using quotient rule .

$$(\sec x - 1) / (\sec x + 1)$$

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27. Differentiate w.r.t x using quotient rule .

$$(\sin x + \cos x) / (\sin x - \cos x)$$

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28. Differentiate w.r.t x using quotient rule .

$$(ax^2 + bx + c) / (px^2 + qx + c)$$

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29. Differentiate w.r.t x

$$(x \sin x)^3$$

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30. Differentiate w.r.t x

$$\sqrt{5 - 6x^2}$$

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31. Differentiate w.r.t x

$$\tan\left(\sqrt{x}\right)$$

32. Differentiate w.r.t x

sec (sec x)

33. Differentiate w.r.t x

$$(1 - \cos x) / (1 + \cos x)$$

34. Differentiate w.r.t x

$$e^x \log(\sin 2x)$$

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35. Differentiate the following w.r.t x

$$\sin^{-1}\left(2x / 1 + x^2\right)$$

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36. Differentiate the following w.r.t x

$$\cos^{-1}\left(\sqrt{1 + x / 2}\right)$$

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37. Differentiate the following w.r.t x

$$\tan^{-1}\left(\frac{\cos x - \sin x}{\cos x + \sin x}\right)$$

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38. Find $\dfrac{dy}{dx}$ if $\sin x + \cos y = xy$

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39. Differentiate w.r.t x

$$(\sin x)^x + \sin(x^x)$$

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40. Differentiate w.r.t x

$$\sqrt{x}(2x + 3)^2 / \sqrt{x + 1}$$

41. If x = a $(t + \sin t)$ and $y = a(1 - \cos t)$ find $\dfrac{dy}{dx}$

42. Find $\dfrac{dy}{dx}$ when

$$x = a \cos \theta \text{ and } y = b \sin \theta$$

43. Find $\dfrac{dy}{dx}$ when

$x = a\sec\theta$ and $y = b\tan\theta$

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44. Find the velocity of a particle moving on a line at t

= 3 seconds , if its position s is in m when

s = log t and

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45. Find the velocity of a particle moving on a line at t

= 3 seconds , if its position s is in m when

s = sin (t/9)

46. At time t , the displacement of a particle moving in

a straight line by $x = -4t^2 + 2t$. Find the velocity

and acceleration a when t = (1/2) s .

47. A car is running on a straight road . The distance travelled and time taken are connected by the formula $= t^2 - 2t$ where t is measured in hours and s in km. When the odometer reading is 15, what is the speedometer reading ? [Odometer measures s and the speedmeter measures velocity]

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48. The side of a square sheet of a metal is increasing at 3 cm per minute . At what rate is the area increasing when the side is 10 cm long ?

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49. A stone is dropped into a quiet pond and waves move in circle at a speed of 4 cm/s . At the instant when the radius of the circular wave is 10 cm, how fast is the enclosed area increasing ?

50. A particle starts rotating from rest according to the formula $\theta = \left(3t^3 / 20\right) - \left(t^2 / 3\right)$ .Find the angular velocity and the acceleration at the end of 5s.

51. The area of dot of ink in cm^2 is growing such that after 5s , $A = 3t^2 + (t/5) + 7$ .Calculate the rate of increase of area after 5s.

52. A particle starts rotating from rest according to the formula $\theta = (t^2/64) - (t/8)$ where θ is the angle in radian and t in s . Find the angular velocity and angular acceleration at the end of 4 s .

53. Integrate the following w.r.t x

$$\sqrt{x}$$

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54. Integrate the following w.r.t x

$$2/x^{3/2}$$

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55. Integrate the following w.r.t x

$$e^{mx}$$

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56. Integrate the following w.r.t x

2^x

57. Integrate the following w.r.t x

e^{2x+1}

58. Integrate the following w.r.t x

$1/(1 + \sin x)$

59. Integrate the following w.r.t x

$$\cos^2(x/2)$$

60. Integrate the following w.r.t x

$$(\sin x - \cos x)^2$$

61. Integrate the following w.r.t x

$$\cos^3 x$$

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62. Integrate the following w.r.t x

$$\sqrt{1 - \sin x}$$

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63. Integrate the following w.r.t x

$$(x - 2)\sqrt{x^2 - 4x + 5}$$

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64. Integrate the following w.r.t x

$$\sin x \cos^4 x$$

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65. Integrate the following w.r.t x

$$(1 + \cos x)^3 / x$$

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66. Integrate the following w.r.t x

$$x^3 / (1 + x^2)^5$$

67. Integrate the following w.r.t x

1/x log x

68. Integrate the following w.r.t x

$e^x (1 + x) / \cos^2 (xe^x)$

69. Integrate the following w.r.t x

cos (log x)/x

70. Evaluate.

$$\int_a^b \cos x \, dx$$

71. Evaluate the following :

$$\int_0^1 dx \, / 1 + x^2$$

72. Evaluate the following :

$$\int_0^{\pi/4} \tan x \, dx$$

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73. Evaluate the following :

$$\int_4^5 1 dx$$

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74. Evaluate the following :

$$\int_{-5}^{5} x \, dx$$

75. Evaluate the following :

$$\int_{0}^{\pi/2} \cos^2 x \, dx$$

76. Evaluate the following :

$$\int_{0}^{1} x e^x \, dx$$

77. Evaluate the following :

$$\int_u^v mv \, dv$$

78. Evaluate the following :

$$\int_{-\pi/2}^{+\pi/2} \sin 2x \, dx$$

79. Find the area enclosed between the curve $y = x^2$, the axis and the ordinates x = 1 and x=2 .

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