PHYSICS

BOOKS - HC VERMA PHYSICS (ENGLISH)

PHYSICS AND MATHEMATICS

Example

1. Two vectors having equal magnitudes A make an angle θ with eahc other. Find the magnitude and direction of the resultant.

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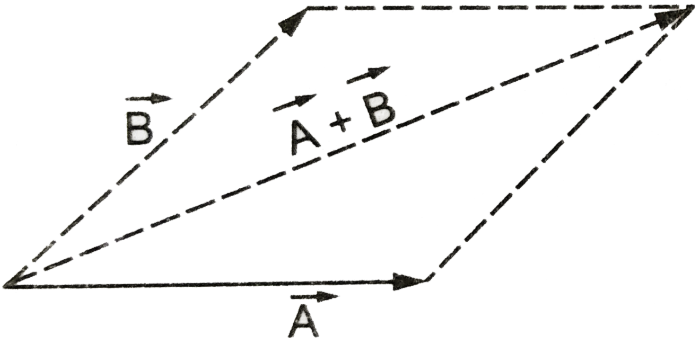
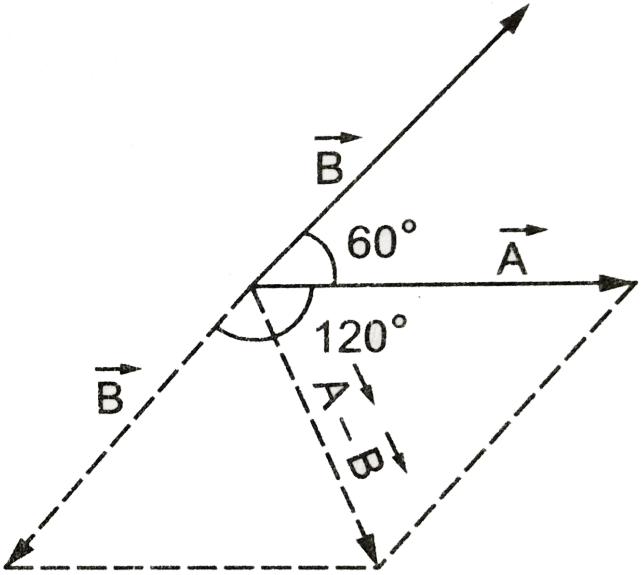
2. Two vectors of equal magnitude of 5 unit have an angle 60^0 between them. Find the magnitude of (a) the sum of the vectors and (b) the difference of the vectors.





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3. A force of 10.5 N acts on a particle along a direction making an angle of 37^0 with the vertical. Find the component of the force in the vertical direction.

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4. The work done by a force $\vec{F}$ during a displacement $\vec{r}$ is given by $\vec{F}.\vec{r}$. Suppose a force of 12 N acts on a particle in vertically upward directionand the particle is displaced through 2.0 m in vertically downward direction. Find the work done by the force during this displacement.

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5. The vectors $\vec{A}$ has a magnitude of 5 unit $\vec{B}$ has a magnitude of 6 unit and the cross product of $\vec{A}$ and $\vec{B}$ has a magnitude of 15 unit. Find the angle between $\vec{A}$ and $\vec{B}$.

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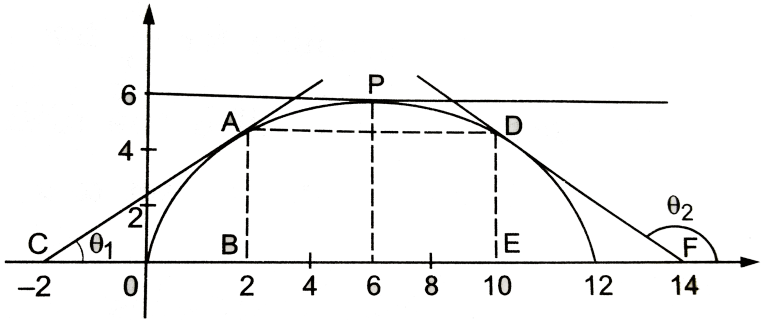
6. From the curve given in figure find $\frac{dy}{dx}$ at x=2, 6 and 10.



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7. Find $\frac{dy}{dx}$ if $y = e^x \sin x$

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8. The height reached in time t by a particle thrown upward with a speed u is given by

$h = ut - \frac{1}{2}gt^2$

where $g = 9.8\frac{m}{s^2}$ is a constant. Find the time taken in reaching the maximum height.

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9. Evaluate $\int_{\_}^{6} 3(2x\text{^}2+3x+5)dx$`.

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10. Round off the followng numbers to three significant digit a. 15462, b. 14.745, c. 14.750 and d. 14.650×10^{12}.

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11. Evaluate $\frac{25.2 \times 1374}{33.3}$. All the digits in this expression are significant.

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12. Evaluate 24.36+0.0623+256.2

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Work Out Example

1. A vector has component along the X-axis equal to 25 unit and along the Y-axis equl to 60 unit. Find the magnitude and direction of the vector.

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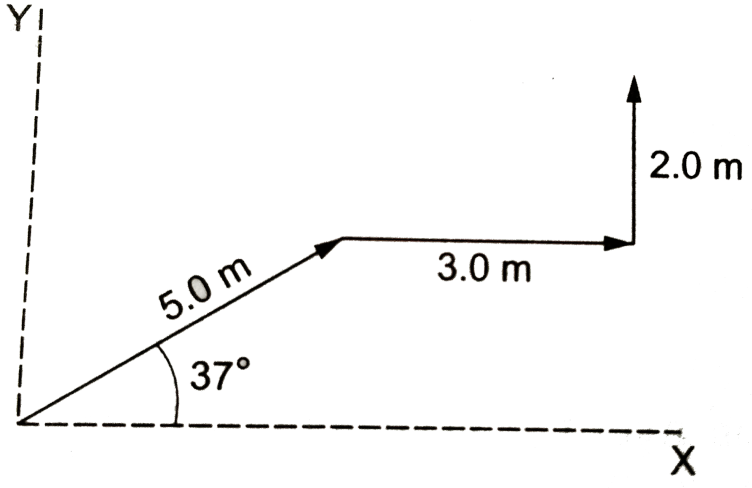
2. Find the resultant of the three vectors shown in figure .



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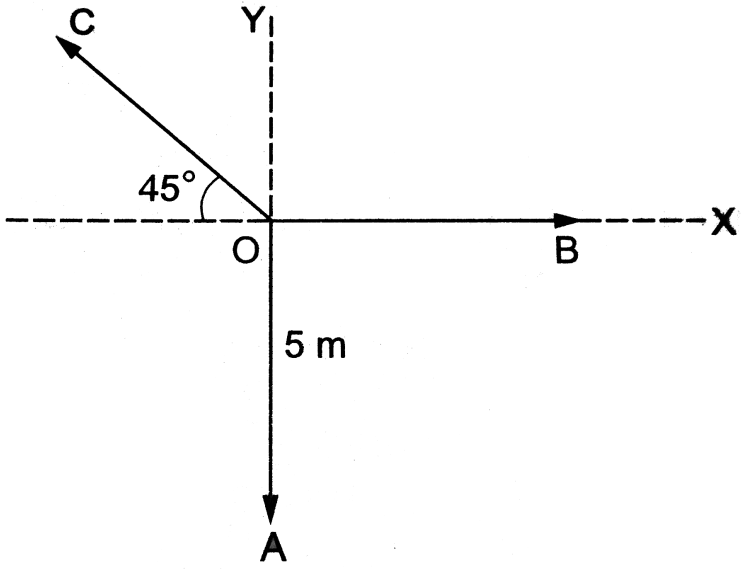
3. The sum of the three vectors shown in figure is zero. Find the magnitudes of the vectors $\overrightarrow{OB}$ and $\overrightarrow{OC}$.



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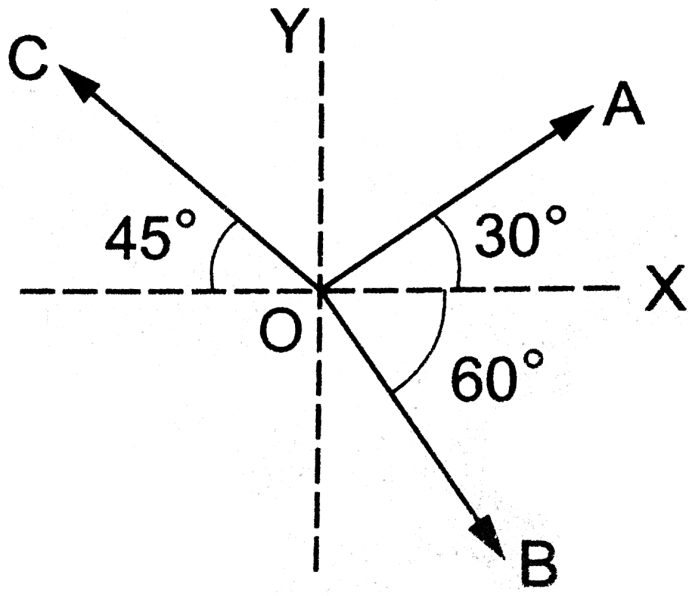
4. The magnitude of vectors $\overrightarrow{OA}, \overrightarrow{OB}$ and $\overrightarrow{OC}$ in figure are equal. Find the direction of $\overrightarrow{OA} + \overrightarrow{OB} - \overrightarrow{OC}$.



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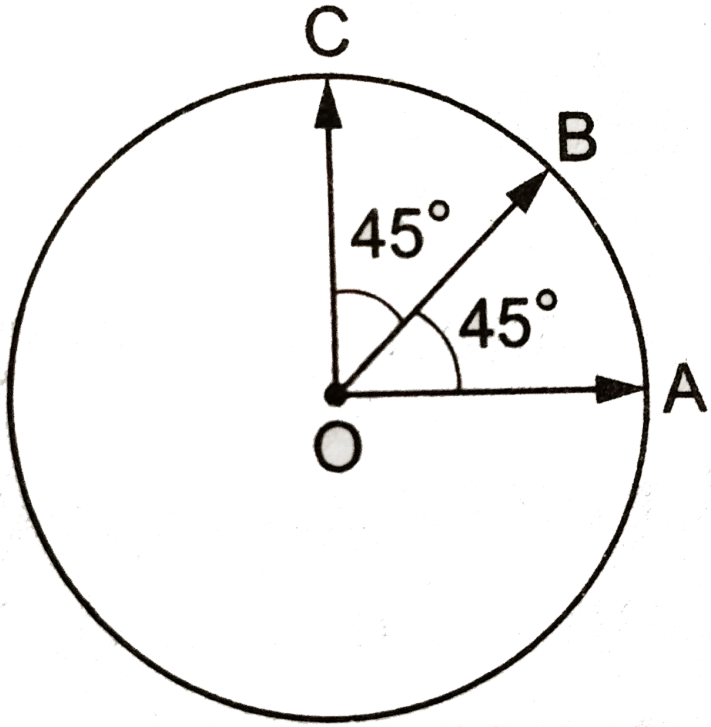
5. Find the resultant of the three vectors $\overrightarrow{OA}, \overrightarrow{OB}$ and $\overrightarrow{OC}$ shown in figure. Radius of the circle is R.



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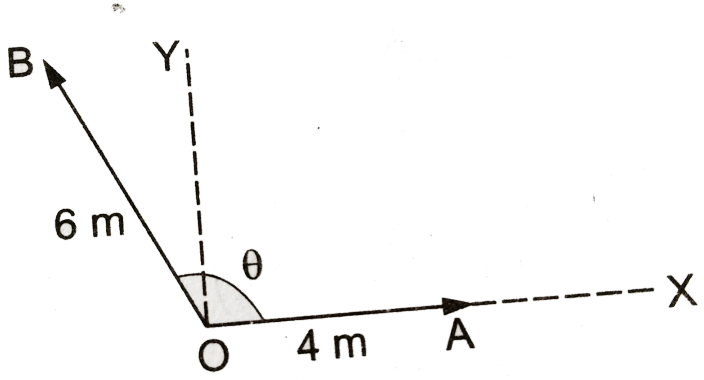
6. The resultant of vectors $\overrightarrow{OA}$ and $\overrightarrow{OB}$ is perpendicular to $\overrightarrow{OA}$

. Find the angle AOB.



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7. Write the unit vector in the direction of $\vec{A} = 5\vec{i} + \vec{j} - 2\vec{k}$.

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8. If $\left|\vec{a} + \vec{b}\right| = \left|\vec{a} - \vec{b}\right|$ show that $\vec{a} \perp \vec{b}$.

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9. If $\vec{a} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{b} = 4\vec{i} + 3\vec{j} + 2\vec{k}$, find the angle between $\vec{a}$ and $\vec{b}$.

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10. If $\vec{A} = 2\vec{i} - 3\vec{j} + 7\vec{k}, \vec{B} = \vec{i} + 2\vec{k}$ and $\vec{C} = \vec{j} - \vec{k}$ find $\vec{A} \cdot \left(\vec{B} \times \vec{C}\right)$.

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11. The volume of a sphere is given by

$$V = \frac{4}{3}\pi R^3$$

where R is the radius of the sphere (a). Find the rate of change of volume with respect to R. (b). Find the change in volume of

the sphere as the radius is increased from 20.0 cm to 20.1 cm. Assume that the rate does not appreciably change between R=20.0 cm to R=20.1 cm.

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12. Find the derivative of the following functions with respect to x. a. $y = x^2 \sin x$, b. y= (sin x)/x and c. y=sin (x^2)`

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13. Find the maximum and minium values of the function $\left(x + \frac{1}{x}\right)$.

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14. Figure shows the curve $y = x^2$. Find the area of the shaded part between $x = 0$ and $x = 6$.

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15. Evaluate

where A and omega are constants. $\int_{\_}^{t} 0A \sin \omega dt$

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16. The velocity v and displacement x of a particle executing simple harmonic motion are related as

$$v\frac{dv}{dx} = -\omega^2 x.$$

$Atx = 0, v = v_0$. Find the velocity v when the displacement becomes x.

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17. The charge flown through a circuit in the time interval between t and $t + dt$ is givne by $edq = e^{-\frac{t}{\tau}}dt$, where τ is a constnt. Find the total charge flown through the circuit betweent $t = 0 \to t = \tau$.

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18. Evaluate $(21.6002 + 234 + 2732.10) \times 13$.

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Objective 1

1. A vector is not changed if

A. it is rotated through an aribitrary angle

B. it is multiplied by an arbitrary scalar

C. it is cross multiplied by a unit vector

D. it is slid parallel to itself

Answer: D

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2. Which of the sets given below may represent the magnitudes of three vectors adding to zero?

A. 2,4,8

B. 4,8,16

C. 1,2,1

D. 0.5,1,2

Answer: C

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3. The resultant of $\vec{A}$ and $\vec{B}$ makes an angle α with $\vec{A}$ and β and $\vec{B}$,

A. $\alpha < \beta$

B. $\alpha < \beta$ if $A < B$

C. $\alpha < \beta$ if $A > B$

D. $\alpha < \beta$ if $A = B$.

Answer: C

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4. The component of a vector is

A. always less than its magnitude

B. always greater than its magnitude

C. always equal to its magnitude

D. none of these

Answer: D

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5. A vector $\overrightarrow{A}$ points vertically upward and $\overrightarrow{B}$ points towards north. The vector product $\overrightarrow{A} \times \overrightarrow{B}$ is

A. along west

B. along east

C. zero

D. vertically downward

Answer: A

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6. The radius of a circle is stated as 2.12 cm. Its area should be written as

A. $14cm^2$

B. $14.1cm^2$

C. $14.11cm^2$

D. $14.1124cm^2$

Answer: B

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Objective 2

1. A situation may be described by using different sets of coordinate axes having different orientations. Which of the following do not depend on the orientation of the axes?

A. the value of a scalar

B. component of a vector

C. a vector

D. the magnitude of a vector

Answer: A::C::D

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2. Let $\vec{C} = \vec{A} + \vec{B}$

A. $\left|\vec{C}\right|$ is always greater than $\left|\vec{A}\right|$

B. It is possible to have $\left|\vec{C}\right| < \left|\vec{A}\right|$ and $\left|\vec{C}\right| < \left|\vec{B}\right|$

C. C is always equal to A+B

D. C is never equal to A+B

Answer: B

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3. Let the angle between two nonzero vector $\vec{A}$ and $\vec{B}$ is 120° and its resultant be $\vec{C}$.

A. C must be equal to $|A - B|$

B. C must be less than $|A - B|$

C. C must be greater than $|A - B|$

D. C may be equal to $|A - B|$

Answer: C

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4. The x-component of the resultant of several vectors

A. is equal to the sum of the x-components of the vectors

B. may be smaller than the sum of the magnitudes of the vectors

C. may be greater than the sum of the magnitude of the vectors

D. may be equal to the sum of the magnitude of the vectors.

Answer: A::B::D

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5. The magnitude of the vectors product of two vectors $\vec{A}$ and $\vec{B}$ may be

A. greater than AB

B. equal to AB

C. less than AB

D. equal to zero

Answer: B::C::D

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Exercises

1. A vector $\vec{A}$ makes an angle of 20° and $\vec{B}$ makes an angle of $\overrightarrow{110}^\circ$ with the X-axis. The magnitude of these vectors are 3 m and 4 m respectively.Find the resultant

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2. Let $\vec{A}$ and $\vec{B}$ be the two vectors of magnitude 10 unit each. If they are inclined to the X-axis at angles 30° and 60° respectively, find the resultant.

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3. Add vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ each having magnitude of 100 unit and inclined to the X-axis at angles 45°, 135° and 315° respectively.

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4. Letveca=4veci+3vecj and vecb=3veci+4vecj . $a.\ F \in dthemagnitudesofa.\ \vec{a}$, $b.$ vecb, c. veca+vecb and d. veca-vecb.`

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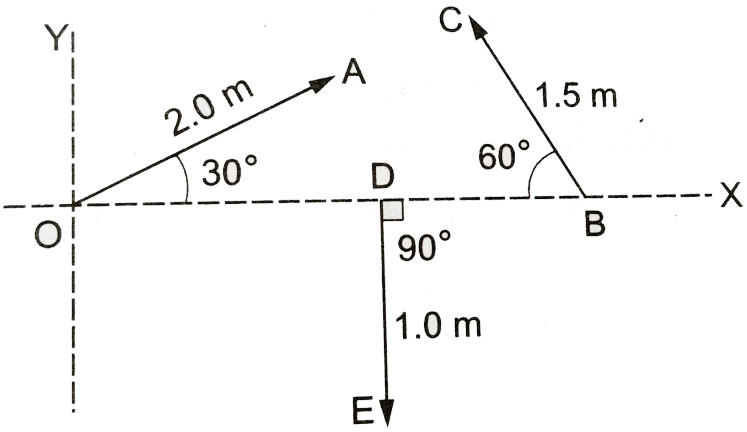
5. Refer to figure Find a the magnitude, b x and y components and c. the angle with the X-axis of the resultant of $\overrightarrow{OA}, \overrightarrow{BC}$ and $\overrightarrow{DE}$.



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6. Two vectors have magnitudes 3 unit and 4 unit respectively. What should be the angel between them if the magnitude of

the resultant ils a. 1 unit, b. 5 unit and c. 7 unit.

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7. A spy report about a suspected car reads as follows. The car moved 2.00 km towards east, made a perpendicular left turn, ran for 500 m, made a perpendicular right turn, ran for 4.00 km and stopped. Find the displacement of the car.

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8. A carrom board $(4ft \times 4ft)$ has the queen at the centre. The queen hit by the striker moves to the front edge, rebounds and goes in the hole behind the striking line. Find the magnitude of displacement of the queen a. from the centre to the front edge

b. from the front edge to the hole and c. from the centre to the hole.

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9. A mosquito net over a $7ft \times 4ft$ bed is 3 ft high. The net hs a hole at one corner of the bed through which diagonally opposite upper corner of the net. A. Find the magnitude of the displaceentof the mosquito. B. Taking the hole as the origin, the length of the bed as the X-axis, its width as teh Y-axis, and verticallup as the Z-axis, write the components of the displacement vector.

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10. Suppose $\vec{a}$ is a vector of magnitude 4.5 unit due north. What is the vector a. $3\vec{a}$, $b - 4\vec{a}$?

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11. Two vectors have magnitudes 2 m and 3m. The angle between them is 60^0. Find a the scalar product of the two vectors b. the magnitude of their vector product.

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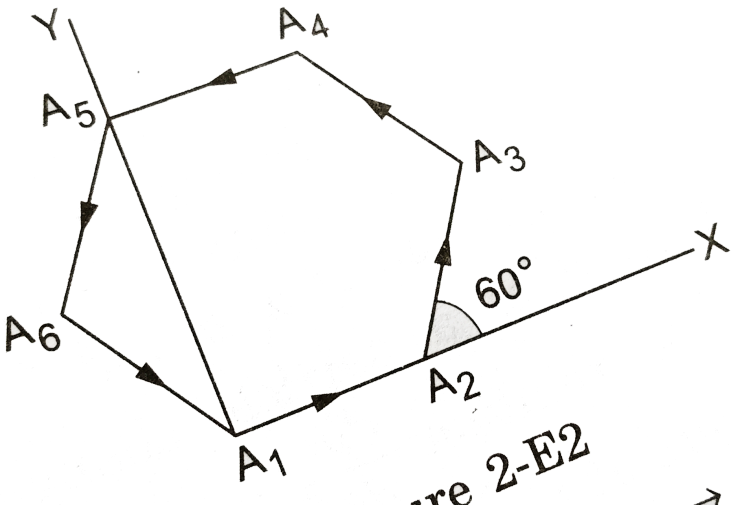
12. Let $A_1A_2A_3A_4A_5A_6A_1$ be a regular hexagon. Write the x-components of the vectors representeed by the six sides taken in order. Use the fact that the resultant of these six vectors is zero, to prove that

$\cos 0 + \frac{\cos \pi}{3} + \frac{\cos(2\pi)}{3} + \frac{\cos(4\pi)}{3} + \frac{\cos(5\pi)}{3} = 0$ Use the known cosine values of verify the result.



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13. Let $\vec{a} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{b} = 3\vec{i} + 4\vec{j} + 5\vec{k}$.

Find the angle between them.

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14. Prove that $\vec{A} \cdot \left(\vec{A} \times \vec{B}\right) = 0$

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15. If $\vec{A} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{B} = 4\vec{i} + 3\vec{j} + 2\vec{k}$, $f \in d\vec{A} \times \vec{B}$.

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16. If $\vec{A}, \vec{B}, \vec{C}$ are mutually perpendicular show that $\vec{C} \times \left(\vec{A} \times \vec{B}\right) = 0$. Is the converse true?

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17. A particle moves on a given straight line with a constant speed v. At a certain time it is at a point P o its straight lline path.O is a fixed point. Show than $\overrightarrow{OP} \times \overrightarrow{v}$ is independent of the position P.?

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18. The force on a charged particle due to electric and magnetic fields is given by $\overrightarrow{F} = q\overrightarrow{E} + q\overrightarrow{v}X\overrightarrow{B}$. Suppose $\overrightarrow{E}$ is along the X-axis and $\overrightarrow{B}$ along the Y-axis. In what direction and with what minimum speed v should a positively charged particle be sent so that the net force on it is zero?

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19. Give an example for which $\vec{A} . \vec{B} = \vec{C} . \vec{B}$ but $\vec{A} \neq \vec{C}$.

A. `

B.

C.

D.

Answer:

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20. A curve is represented by $y = \sin x$. If x is changed from $\frac{\pi}{3} \rightarrow \frac{\pi}{3} + \frac{\pi}{100}$ find approximately the change in y.

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21. The electric curren in a charging R-C circuit is given by $i = i_0 e^{-\frac{t}{R}C}$ when i_0, R and C aere constant parameters of the circuit and t is time. Find the rate of change of current at $a.\ t = 0, b.\ t = RC c.\ t = 10RC.$

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22. The electric current in a discharging R-C circuit is given by $i = i_0 e^{-\frac{t}{RC}}$ where i_0 $R$and $C$are constant parameters and $t$is time. Let $i_0 = 2.00A, R = 6.00 \times 10^5 ohm$ and $C = 0.500\mu F.$

a. Find the current at t=0.3 s.

b. Find the rate of change of current at t=0.3 s.

Find approximately the current at t=0.31 s.

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23. Find the area bounded under the curve $y = 3x^2 + 6x + 7$ X-axis with the oridinateks at x=5 and x=10.

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24. Find the area enclosed the curve y=sin x and the X-axis between $x = 0$ and $x = \pi$.

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25. Find the area bounded by the curve $y = e^{-x}$ the X-axis and the Y-axis.

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26. A rod of length L is placed along the X-axis between $x = 0$ and $x = L$. The linear density (mass/length) ρ of the rod varies with the distance x from the origin as $\rho = a + bx$. a.) Find the SI units of a and b b.) Find the mass of the rod in terms of a,b, and L.

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27. The momentum p of a particle changes with the t according to the relation $d\frac{p}{dt} = (10N) + \left(2\frac{N}{s}\right)t$. If the momentum is zero at t=0, what will the momentum be at t=10?.

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28. The changes in a function y and the independent variable x are related as $\frac{dy}{dx} = x^2$. Find y as a function of x.

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29. Write the number of significant digits in a 1001, b. 100.1, c.100.10 d. 0.001001.

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30. A metre scale is graduated at every millimetre. How many significant digits will be there in a length measurement with this scale?

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31. Round the following numbers to 2 significant digits. A. 3472, b. 84.16 c. 2.55 d. 28.5.

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32. The length and the radius of a cylinder measured with a slide cllipers re found to be 4.54 cm and 1.75 cm respectively. Calculate the volume of the cylinder.

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33. The thicknes of a glass plate is measured to be 2.17 and 2.17 mm and 2.18 mm at three different places. Find the average thickness of the plate from this data.

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34. The length of the string of a simple pendulum is measured with a metre scale to be 90.0 cm.The radius of the bob plus thelength of the hook is calculated to be 2.13 cm using measurements with a slide callipers. What is the effective lengthof the pendulum? (The effective length is defined as the distance between the point of suspension and the centre of the bob.)

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Question For Short Answer

1. Is a vector necessarily changed if it is rotated through anangle?

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2. Is it possible to add two vectors of unequal magnitudes and get zero? Is it possible to add three vectors of equal magnitudes and get zero?

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3. Does the phrase "direction of zero vector" have physical significance? Discuss in terms of velocity, force etc.

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4. can you add three unit vectors to get a unit vector? Does your answer change if two unit vectors are along the coordinate axes?

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5. Can we have physical quantities having magnitude and direction which are not vectors?

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6. Which of the following two statements is more appropriate?

a. Two forces are added using triangle rule because force is a vector quantity.

b. Force is a vector quantity because two forces are added using triangle rule.

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7. Can you add two vectors representing physical quantities having different dimensions? Can you multiply two vectors representing physical quantities having different dimensions?

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8. Can a vector have zero component along line and still have non zero magnitude?

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9. Let ε_1 and ε_2 be the angles made by $\vec{A}$ and $-\vec{A}$ with the positive X-axis. Show that $\tan\varepsilon_1 = \tan\varepsilon_2$. Thus giving $\tan\varepsilon$ does not uniquely determine of $\vec{A}$.

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10. Is the vector sum of the unit vectors $\vec{i}$ and $\vec{j}$ a unit vector? If no, can you multiply this sum by a scalar number to get a unit vector?

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11. Let $\vec{A} = 3\vec{i} + 4\vec{j}$. Write four vector $\vec{B}$ such that $\vec{A} \neq \vec{B}$ but $A = B$.

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12. Can you have $\vec{A} \times \vec{B} = \vec{A} . \vec{B}$ with $A \neq 0$ and $B \neq 0$? What if one of the two vectors is zero?

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13. If $\vec{A} \times \vec{B} = 0$, can you say that $a.\ \vec{A} = \vec{B}$, $b.\ \vec{A} \neq \vec{B}$?

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14. Let $\vec{A} = 5\vec{i} - 4\vec{j}$ and $\vec{B} = -7.5\vec{i} + 6\vec{j}$. Do we have $\vec{B} = k\vec{A}$? Can we say $\frac{\vec{B}}{\vec{A}} = k$?

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