PHYSICS

BOOKS - BHARATI BHAWAN PHYSICS (HINGLISH)

VECTOR AND SCALARS

Others

1. If $\vec{a} = 3\vec{i} - 2\vec{j}$ and $\vec{b} = 2\vec{i} + 3\vec{j}$, calculate (i) $\vec{a} + \vec{b}$, (ii) $\vec{a} - \vec{b}$, (iii) $\vec{b} - \vec{a}$

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2. Calculate the angle between the vectors $\vec{a} = 3\vec{i} + 2\vec{j}$ and $\vec{b} = 2\vec{i} + \vec{j}$

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3. If $\vec{A} + \vec{B} = \vec{A} - \vec{B}$ then which of the following is correct ?

(i)$\vec{A} = 0$, (ii)$\vec{B} = 0$, (iii)$\vec{A}$ and $\vec{B}$ are simultaneously zero, (iv)$\vec{A} + \vec{B} = 0$

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4. Show that the vectors $\vec{a} = 2\vec{i} + 3\vec{j}$ and $\vec{b} = 6\vec{i} - 4\vec{j}$ are at right angles to each other.

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5. Find the dot and cross product of the vectors $\vec{a} = 2\vec{i} - 3\vec{j} + \vec{k}$ and $\vec{b} = -\vec{i} + 3\vec{j} + \vec{k}$

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6. Show that numerically magnitude of a vector product gives the area of the parallelogram formed by the two component vectors as slides.

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7. The coordinates of the initial point of a vector are (2,3) and those of the terminal point are (10,6).Find the magnitude and direction of the vector.

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8. If $\vec{a} + \vec{b} = \vec{c}$ and a+b=c, what is the angle between $\vec{a}$ and $\vec{b}$?

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9. Find the equation of a line which passes through a given point of position vector $\vec{c}$ and is parallel to a given vector $\vec{b}$.

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10. A particle of mss m=2 kg moves with velocity $\vec{v} = 2\vec{i} + 2\vec{j} - \vec{k}$.Find its angular momentum about the origin when its position vector is $\vec{r} = \vec{i} + \vec{j}$

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11. The velocity of a particle is $\vec{v} = 3\hat{i} + 2\hat{j} + 3\hat{k}$.Find the vector component of the velocity along the line $\hat{i} - \hat{j} + \hat{k}$ and its magnitude.

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12. The resultant of two forces $\vec{P}$ and $\vec{Q}$ acting at O at $\vec{R}$. If any traversal cuts them at A,B and C, respectively, show that $\frac{P}{OA} + \frac{Q}{OB} = \frac{R}{OC}$

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13. $\vec{a} + \vec{a} = \vec{a}$ is (i) always possible, (ii)never possible, (iii)possible if $\vec{a}$ is a null vector, (iv)possible if $\vec{a}$ is a unit vector.Which is correct ?

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14. $\vec{a} + \vec{b} = \vec{c}$ and $|\vec{a}| = |\vec{b}| = |\vec{c}|$

This is (i)impossible (ii)possible when angle between $\vec{a}$ and $\vec{b}$ is 60°, (iii)possible when angle between $\vec{a}$ and $\vec{b}$ is 120° , (iv)always possible.

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15. If $\vec{a} + \vec{b} = \vec{c}$ and $c = \sqrt{a^2 + b^2}$. What is the angle between $\vec{a}$ and $\vec{b}$?

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16. The coordinates of the initial point of a vector are (1,2) and those of the terminal pt. are (5,9).Find the magnitude and direction of the vector.

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17. If $\vec{a} = 2\vec{i} + 3\vec{j}$ and $\vec{b} = \vec{i} + \vec{j}$, find (i) $\vec{a} . \vec{b}$, (ii) $\vec{a} \times \vec{b}$ and (iii) $\vec{b} \times \vec{a}$

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18. If $\vec{a} = 2\vec{i} - 3\vec{j} + 2\vec{k}$ and $\vec{b} = \vec{i} + 2\vec{j} + \vec{k}$, find (i) $\vec{a} . \vec{b}$, (ii) $\vec{a} \times \vec{b}$ and (iii) $\vec{b} \times \vec{a}$

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19. If $\vec{a} = x_1\vec{i} + y_1\vec{j}$ and $\vec{b} = x_2\vec{i} + y_2\vec{j}$, find the condition that would make them (i)perpendicular to each other, (ii)parallel to each other.

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20. If $\vec{a} = 4\vec{i} - 3\vec{j}$ and $\vec{b} = 6\vec{i} + 8\vec{j}$, find the magnitude and direction of $\vec{a}$, of $\vec{b}$, of $\vec{a} + \vec{b}$ and of $\vec{a} - \vec{b}$

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21. Three vectors which are coplanar with respect to a certain reactangular coordinate system are given by $\vec{a} = 4\vec{i} - \vec{j}$, $\vec{b} = -3\vec{i} + 2\vec{j}$ and

$\vec{c} = -3\vec{j}$ .Find (i) $\vec{a} + \vec{b} + \vec{c}$,(ii) $\vec{a} + \vec{b} - \vec{c}$.

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22. Find the angle between $\vec{a} = 3\vec{i} + 3\vec{j} - 3\vec{k}$ and $\vec{b} = 2\vec{i} + \vec{j} + 3\vec{k}$.

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23. A car is driven eastward for a distance of 50 km, then northward for 30 km and then in a direction 30° east of north for 25 km.Draw a vector diagram and determine the total displacement of the car from the starting point.

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24. A golfer takes his ball into the hole in the three strokes.The first stroke displaces the ball 4 m north , the second stroke 2 m south-east, and the third stroke 1 m south-west.What

displacement would have been needed to get the ball into the hole in the first stroke ?

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25. Four forces of magnitude P, 2P, 3P and 4P act along the four sides of a square ABCD in cyclic order. Use the vector method to find the magnitude of resultant force.

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26. Find the direction cosines and unit vector along the vector $\vec{r} = 2\vec{i} + \vec{j} + 3\vec{k}$.

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27. Prove by the method of vectors that in a triangle $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$.

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28. Show that if $\vec{A} . \left(\vec{B} \times \vec{c} \right) = 0$, then $\vec{A}$, $\vec{B}$ and $\vec{c}$ are coplanar .

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29. Show that $\vec{a} . \left(\vec{b} \times \vec{c} \right)$ is equal in magnitude to the volume of the parallelpiped formed by the vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$

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30. Prove that for a vector $\vec{a}$ defined by $\vec{a} = a_x \vec{i} + a_y \vec{j} + a_z \vec{k}$, the scalar components are given by $a_x = \vec{i} . \vec{a}$, $a_y = \vec{j} . \vec{a}$ and $a_z = \vec{k} . \vec{a}$

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31. If $\vec{b}$ and $\vec{c}$ be the intersecting face-diagonals of a cube of edge a in the planes XOY and YOZ respectively with respect to a frame of reference erected at the point of intersection of the vectors and edges of the cube as the axes,

find (a) the components of the vector $\vec{d}$, where $\vec{d} = \vec{b} \times \vec{c}$ and (b) the values of $\vec{b} . \vec{c}$ and $\vec{d} . \vec{c}$.

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32. Show that the position vector of a place on the surface of the earth with latitude and longitude $\alpha^\circ N$ and $\beta^\circ E$ respectively, is $\vec{r} = R\cos\alpha\sin\beta\hat{i} + R\cos\alpha\cos\beta\hat{j} + R\sin\alpha\hat{k}$, where R is the radius of the earth.The frame of reference is erected at the centre of the earth with the polar radius as the z-axis and the

intersection of the equatorial plane and the meridian plane through Greenwich as the y-axis.

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33. A man rows a boat with a speed 10 m/s along N-E direction. The shore line is 15° south of east. . What are components of the velocity

vector along and perpendicular to shore?

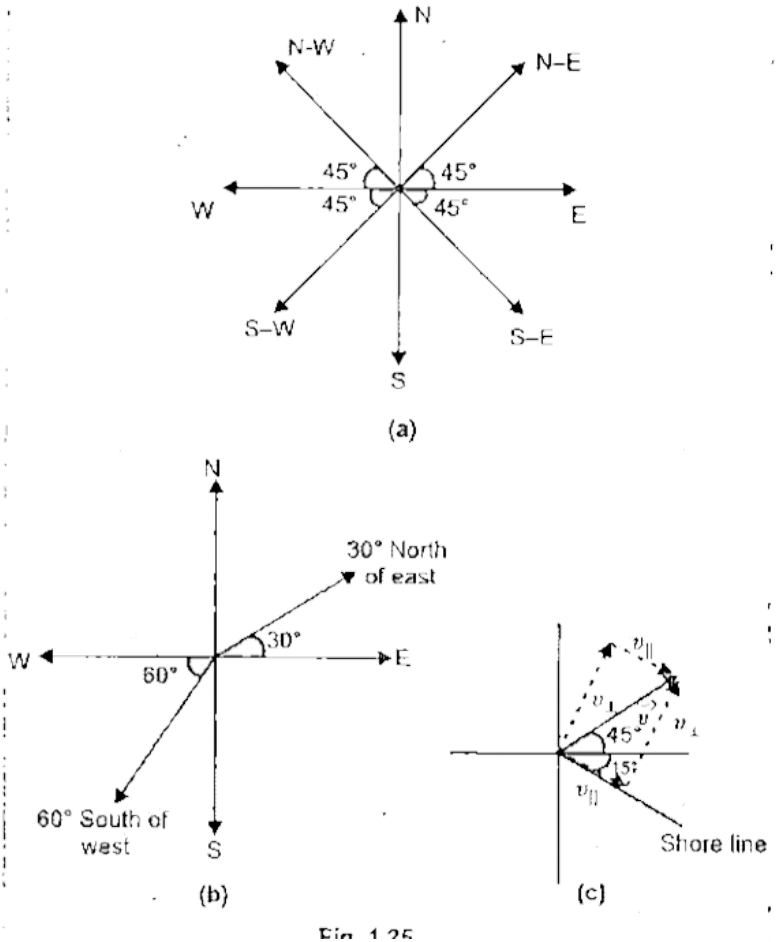

Fig. 1.25

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34. Prove that in any triangle ABC, $\lambda\overrightarrow{AB}+\mu\overrightarrow{AC}=(\lambda+\mu)\overrightarrow{AD}$ where D is a point on BC such that BD:DC=μ: λ.Hence prove that if resultant of $\overrightarrow{AB}$, $2\overrightarrow{AC}$ and $3\overrightarrow{BC}$ cuts BC and CA at E and F respectively, 3EC=BC and 4CF=AC and the resultant is 12 $\overrightarrow{FE}$

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35. A force $\overrightarrow{F}=5\overrightarrow{i}+2\overrightarrow{j}+\overrightarrow{k}$ displaces a body from a point with coordinates (1,1,1) to

another point with coordinates (2,0,3).Calculate the work done by the force.All are in SI units.

36. If the sum and difference of two vectors are at right angles, show that the vectors are equal in magnitude.

37. With reference to a frame erected at the point of incidence with outward normal as z-axis and two mutually perpendicular lines in the plane of incidence as x- and y-axes, write the unit vectors along incident, reflected and refracted rays taking θ and θ' as angle of incidence and angle of refraction respectively.

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38. Prove that $\left(\vec{a} \times \vec{b}\right)^2 = \vec{a}^2 b^2 - \left(\vec{a} . \vec{b}\right)^2$.

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39. Show that if two vectors are equal in magnitude, their vector sum and difference are at right angles.

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40. Find the area of the parallelogram whose sides are represented by

$2\hat{i} + 4\hat{j} - 6\hat{k}$ and $\hat{i} + 2\hat{k}$

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41. Show that $\left(\vec{a}+\vec{b}\right)\times\left(\vec{a}-\vec{b}\right)=-2\left(\vec{a}\times\vec{b}\right)$ and use this result to find the area of a parallelogram whose diagonals are $\hat{i}-2\hat{j}-3\hat{k}$ and $2\hat{i}-3\hat{j}+2\hat{k}$

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42. Express the law of reflection vectorially taking the direction of unit vectors along the

incident ray and reflected ray as $\hat{e}$ and $\hat{e}'$ and the outward normal to the reflector as $\hat{n}$.

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43. Use the result of the above problem to show that a light ray reflected from three mutually perpendicular plane mirrors in succession reverses its direction.

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44. Find the equation of a line through a point C of position vector $\vec{c} = 3\vec{i} + 2\vec{j}$ and perpendicular to the vector $\vec{b} = \vec{i} - \vec{j}$ in the xy-plane.

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45. Find the moment of a force , $\vec{F} = 3\vec{i} + 2\vec{j}$ acting at point $\vec{r} = \vec{i} + 2\vec{k}$ about a point of position vector $\vec{r} = \vec{i} + \vec{j}$.

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46. If $\vec{P} + \vec{Q} = \vec{R}$ and $\vec{P} - \vec{Q} = \vec{S}$, prove that $\vec{R}^2 + \vec{S}^2 = 2\left(\vec{P}^2 + \vec{Q}^2\right)$

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47. Show that a vector remains invariant (unchanged) under rotation of coordinate axes.

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48. Find the components of a vector $\vec{A} = 2\hat{i} + 3\hat{j}$ along the directions of $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$

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49. The force on a positively charged particle is given by $\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$.In a certain space there is a magnetic field B along y-axis and an electric field along x-axis.A positively charged particle is projected into this space.Find the direction and magnitude of

minimum velocity so that it may pass on undeviated.

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50. A point P lies on a vector $\vec{a}$.the position vector of the point is $\vec{r}$.Show that $\vec{a} \times \vec{r}$ is independent of the position of the point on the vector.

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51. Show that if $\vec{u} \cdot \frac{d\vec{u}}{dt} = 0$ the vector $\vec{u}$ is of constant magnitude.

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52. If $\vec{a} = m\vec{b} + \vec{c}$, find the scalar m.

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53. Using vector method prove that in any triangle $ABCa^2 = b^2 + c^2 - 2bc\cos A$.

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54. Prove vectorially that $\sum_{S=0}^{S=N-1} \cos \frac{2\pi S}{N} = 0$ and $\sum_{S=0}^{S=N-1} \sin \frac{2\pi S}{N} = 0$

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