9:30 - 10:50 (Sunday / Tuesday)
4G45 (HSN)

| Sec - 17 |

Date / /

Marks Distribution

- Attendance → 5% (90% - 100%)
- Quiz → 15%
  (4 to 5 Quizzes) {Average of Best 3}
- Assignment → 15%
  (3 to 4 Assignments) {Average of Best 3}
- Lab → 10%
- Mid → 20% (3 Questions) {1 hour} (30 converted to 20)
- Final → 35% (4 Questions) [3 out of 4]

Physical Quantities

Scalar
Magnitude

Vector
Magnitude and Direction (Arrow)

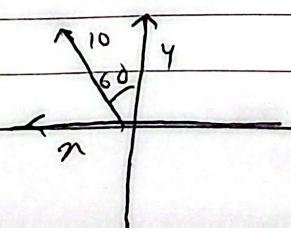
$\vec{p} = 3\hat{i} - 2\hat{j}$

Resolving Vector :-

- Tail should be at the origin of the coordinate system.

S	x y - +	x y + +	A
T	x y - -	x y + -	C

- Cartesian Coordinate System (x, y)
- Polar (r, θ)
  r = length of vector
  θ = angle produced between x axis and anticlockwise towards vector.



$y = 10 \cos 150$
$x = 10 \sin 150$

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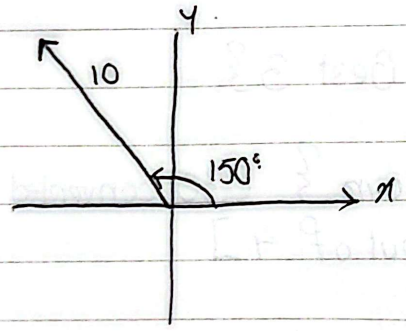
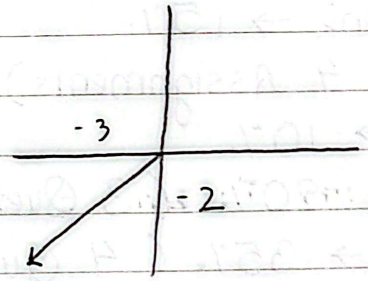
Pg - 57

15, 43

$\vec{A}$ (10, 150°). {Polar}



$\vec{R}$ (-3, -2). {Cartesian}



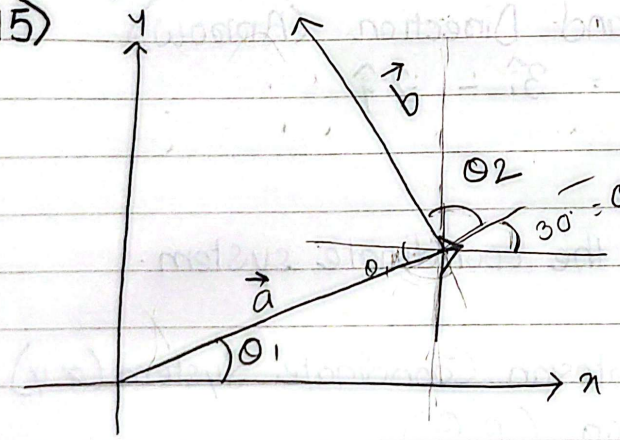
$r = 3\hat{i} + 5\hat{j}$

$r = \sqrt{x^2+y^2}$ $\theta = \tan^{-1} y/x$

Chapter - 3

{Polar to Cartesian}

15)



$\vec{a}$ (10, 30)

$\vec{b}$ (10, 135)

For $\vec{a}$

$x = 10\cos 30 = 8.66$

$y = 10\sin 30 = 5$

$\vec{a} = 8.66\hat{i} + 5\hat{j}$

For $\vec{b}$

$x = 10\cos 135 = -7.07$

$y = 10\sin 135 = 7.07$

$\vec{b} = -7.07\hat{i} + 7.07\hat{j}$

* 2 decimal places.

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$\vec{r} = \vec{a} + \vec{b}$

$= 8.66\hat{i} + 5\hat{j} - 7.07\hat{i} + 7.07\hat{j}$

$= 1.59\hat{i} + 12.07\hat{j}$

a) x of $r = 1.59$.

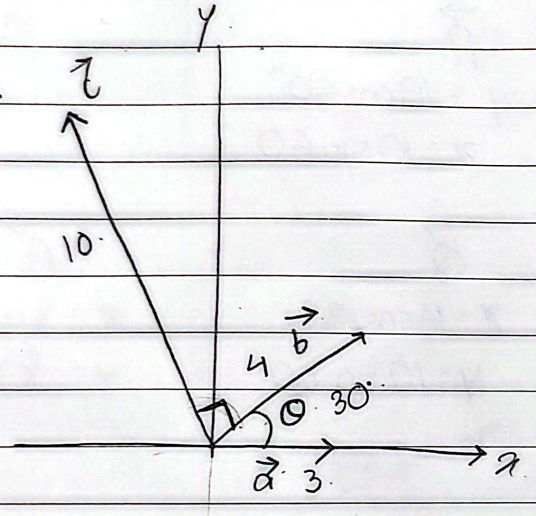
b) y of $j = 12.07$

c) magnitude of $r = \sqrt{(1.59)^2 + (12.07)^2}$

$= 12.17m$

d) $\theta = \tan^{-1}\left(\frac{12.07}{1.59}\right) = 82.49°$

43.



$\vec{a} = 3\hat{i}$

$\vec{b}$:

$x = 4\cos 30$

$y = 4\sin 30$

$\vec{b} = 2\sqrt{3}\hat{i} + 2\hat{j}$

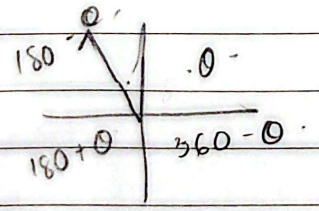
$\vec{c}$

$x = 10\cos(120)$

$y = 10\sin(120)$

$\vec{c} = -5\hat{i} + 5\sqrt{3}\hat{j}$

$3i - (xi + yj) - [(2\sqrt{3}i + 2j) - (-5\hat{i} + 5\sqrt{3}\hat{j})]$



$3i - xi - yj - [2\sqrt{3}i + 2j + 5i - 5\sqrt{3}j]$

$3i - xi - yj - 2\sqrt{3}i - 2j - 5i - 5\sqrt{3}j$

$3 - x - 2\sqrt{3} - 5 = 0$

$-x - 2 - 2\sqrt{3} = 0$

$x = -5.46$

$3i - xi - 2\sqrt{3}i - 5i = 0i$

$-yj - 2j - 5\sqrt{3}j = 0j$

$-y - 2 - 5\sqrt{3} = 0$

$y = -6.66j$

magnitude = ~~11.98m~~ 8.61m

direction: ~~67.88°~~ 129.34

head → tail

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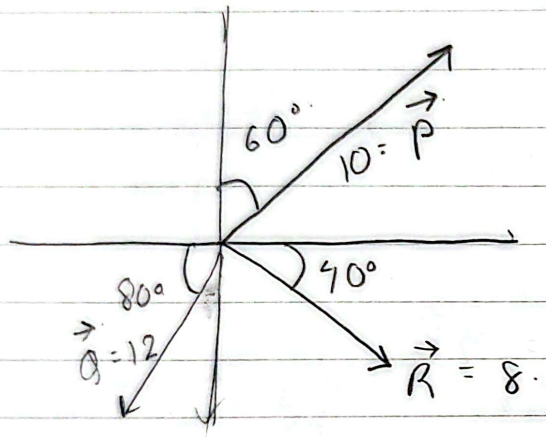
* $\vec{c} = p\vec{a} + q\vec{b}$

$\Rightarrow -5\hat{i} + 8.66\hat{j} = p(3i) + q(3.46\hat{i} + 2\hat{j})$

$\Rightarrow -5\hat{i} + 8.66\hat{j} = 3p\hat{i} + 3.46q\hat{i} + 2q\hat{j}$

$-5 = 3p + 3.46q$

$8.66 = 2q$



Find $\vec{P} - \vec{R} - \vec{Q}$

$\vec{P}$

$y = 10\cos 60°$

$x = 10\sin 60°$

$\vec{Q}$

$x = 10\cos 80$

$y = 10\sin 80$

$\vec{R}$

$x = 8\cos 40$

$y = 8\sin 40$

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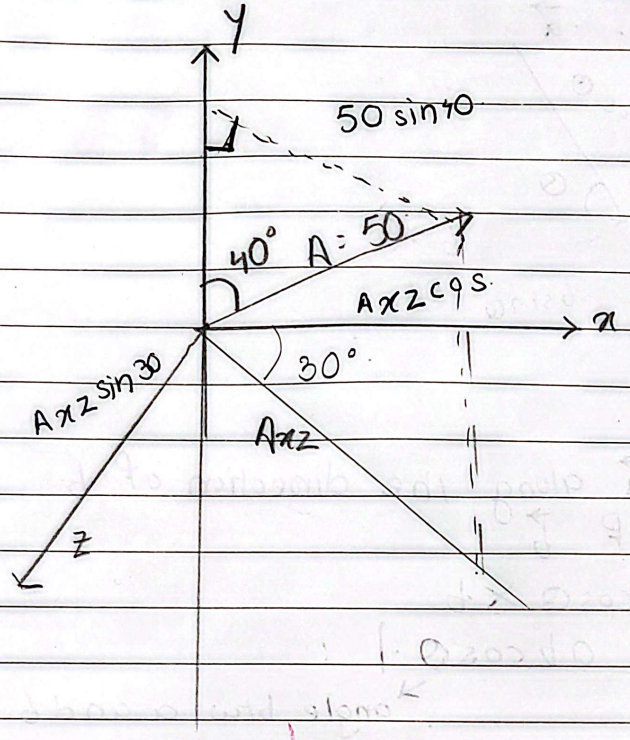
3D Vectors

i).



$A_y = 50\cos 40 = 38.3$

$A_{xz} = 50\sin 40° = 32.1°$

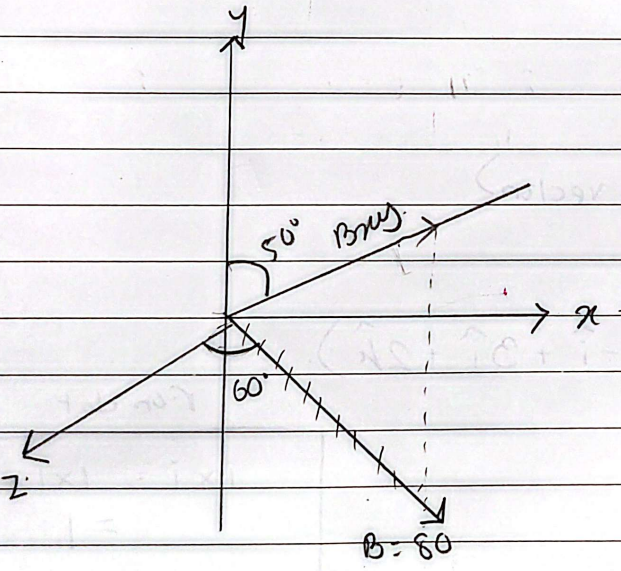
$A_x = 32.1\cos 30 = 27.79$

$A_z = 32.1\sin 30 = 16.05$

~~A = 38 → 38.3~~

$A = 27.79\,\hat{i} + 38.3\,\hat{j} + 16.05\,\hat{k}$

ii).



$B_z = 80\cos 60 = 40°$

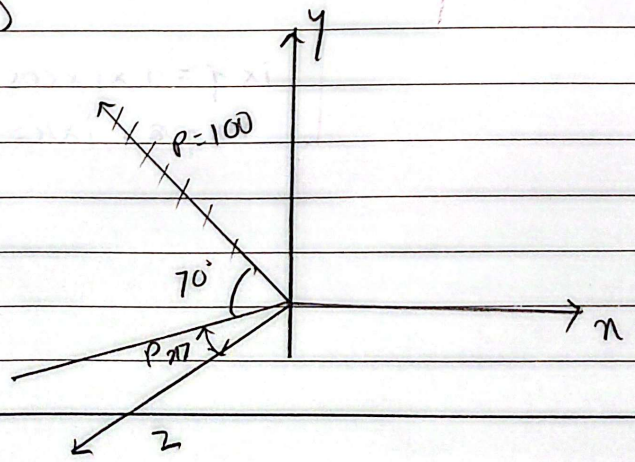
$B_{xy} = 80\sin 60° = 40\sqrt{3}$

$B_x = 40\sqrt{3}\sin 50 = 53.07$

$B_y = 40\sqrt{3}\cos 50 = 44.53$

$\vec{B} = 53.07\,\hat{i} + 44.53\,\hat{j} + 40\,\hat{k}$

iii)



vector × vector = scalar.

$$\boxed{\begin{aligned} i \times i &= 1 \\ i \times j &= 0 \end{aligned}}$$

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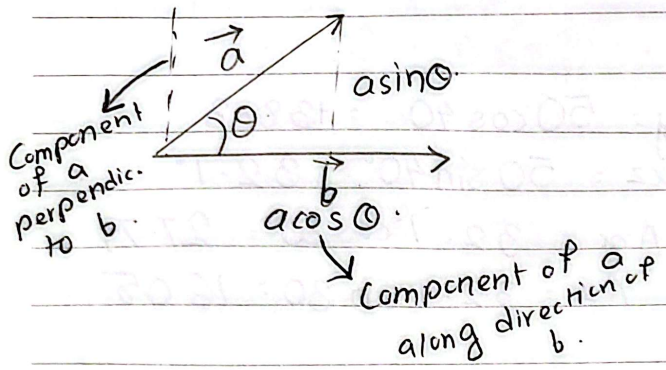
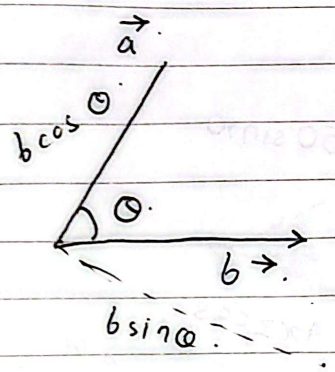
Dot product





$\vec{a} \cdot \vec{b}$ = component of $\vec{a}$ along the direction of b × magnitude of $\vec{b}$

$= a\cos\theta \times b$

$$\boxed{\vec{a} \cdot \vec{b} = ab\cos\theta}$$

angle btw a and b.

magnitude = $\sqrt{x^2+y^2+z^2}$

\# $\vec{a} = 3\hat{i} - 2\hat{j} + 4\hat{k}$ (unit vector)

$\vec{b} = -\hat{i} + 3\hat{j} + 2\hat{k}$

$\vec{a} \cdot \vec{b} = (3\hat{i} - 2\hat{j} + 4\hat{k})(-\hat{i} + 3\hat{j} + 2\hat{k})$

$= -3 - 6 + 8$

$= -1$

For dot

$i \times i = 1 \times 1 \times \cos(0)$

$= 1$

$\therefore i \times i = j \times j \times k \times k$

$i \times j = 1 \times 1 \times \cos 90 = 0$

$i \times j = i \times k = j \times k = 0$

$\vec{a}\cdot\vec{b} = ab\cos\theta$.

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~~50~~ 41. $\vec{a} = 3i + 3\hat{j} + 3\hat{k}$

$\vec{b} = 2.0\hat{i} + 1.0\hat{j} + 3.0\hat{k}$.

$\vec{a}\cdot\vec{b} = (3i + 3j + 3k)(2.0i + 1.0j + 3.0k)$.

$6 + 3 + 9 = \sqrt{3^2+3^2+3^2} \times \sqrt{2^2+1^2+3^2} \times \cos\theta$.

$\theta = 22.21°$ (Ans).

* Find the angle between $\vec{b}$ and negative z axis.

$\vec{b}$ and $-\hat{k}$

$\vec{b}\cdot -\hat{k} = b|-\hat{k}|\cos\theta$.

$\Rightarrow (2i + \hat{j} + 3\hat{k})\cdot -\hat{k} =$

52.c) Component of d_1 along the direction of $\vec{d_2}$.

$= d_1\cos\theta$.

$\vec{d_1}\cdot\vec{d_2} = d1\, d2\cos\theta$.

$d_1\cos\theta = \frac{d1\cdot d2}{d2}$ [component of d_1 " " d_2].

$\frac{(4i+5j-6k)(-1i+2j+3k)}{\sqrt{(-1)^2+2^2+3^2}} = \frac{-4+10-18}{\sqrt{14}}$.

$= -3.21$

d) $d_1\sin\theta$.

$|\vec{a}\times\vec{b}|$ = component of a vector perpendicular to second vector × magnitude of second vector.

$= a\sin\theta \times b$.

$|\vec{a}\times\vec{b}| = ab\sin\theta$.

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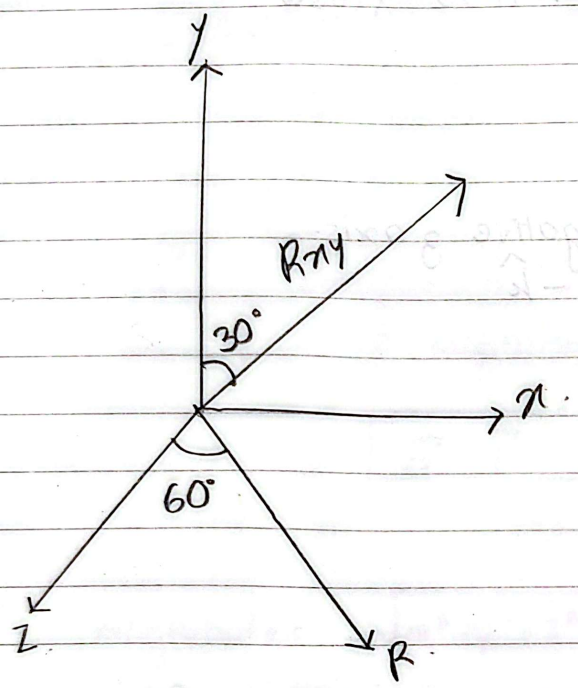
Quiz -01.
Chapter - 03 (Vector).
07/07/25 (Monday).



Dot product.
$\vec{a} \cdot \vec{b} = ab\cos\theta$.

63 a). $\vec{d_1} \cdot (\vec{d_2} + d_3)$.

$\vec{d_1} = -3\hat{i} + 3\hat{j} + 2\hat{k}$
$\vec{d_2} = -2\hat{i} - 4\hat{j} + 2\hat{k}$
$\vec{d_3} = 2\hat{i} + 3\hat{j} + 1\hat{k}$

$= (-3i + 3j + 2k) \cdot (-2i - 4j + 2k + 2i + 3j + \hat{k})$.
$= (-3i + 3j + 2k)(-j + 3k)$
$= -3 + 6$
$= 3$. (Always scalar).

Find angle between d_2 and d_3.
$\vec{a} \cdot \vec{b} = ab\cos\theta$.
$a\cos\theta$ is the component along b.

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Cross product:

$|\vec{a} \times \vec{b}| = ab\sin\theta\,\hat{n}$

= component of $\vec{a}$ perpendicular to the direction of $\vec{b}$ × magnitude of $\vec{b}$

Result of vector is:

→ perpendicular to plane of $\vec{a}$ and $\vec{b}$ (outward or inward).

- smallest angle should be measured.

$\vec{a} \times \vec{b} = ab\sin\theta\,\hat{n}$

$\hat{i} \times \hat{j} = 1 \times 1 \times \sin 0 = 0 = \cancel{j \times j = k \times j} - \hat{k}$

$k \times \hat{j} = 1 \times 1 \times \sin 90\,(-\hat{i}) = -\hat{i}$

$(\hat{i} \times \hat{k}) \cdot 2j = -j \times 2j = -2.$

$\vec{d_2} \times \vec{d_3} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -2 & -4 & 2 \\ 2 & 3 & 1 \end{vmatrix}$ {Cross product}.

$i \begin{vmatrix} -4 & 2 \\ 3 & 1 \end{vmatrix} - j \begin{vmatrix} -2 & 2 \\ 2 & 1 \end{vmatrix} + \hat{k} \begin{vmatrix} -2 & -4 \\ 2 & 3 \end{vmatrix}$

$= \hat{i}(-4-6) - j(-2-4) + k(-6+8)$

$= -10i + 6j + 2\hat{k}$

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6 | c). $a\cos\theta = \frac{\vec{a}\cdot\vec{b}}{b} = \frac{-10+8-18}{\sqrt{(-2)^2+2^2+3^2}} = -4.85$

d) $a\sin\theta = \frac{|\vec{a}\times\vec{b}|}{b}$

$$|\vec{a}\times\vec{b}| = \begin{vmatrix} i & j & k \\ 5 & 4 & -6 \\ -2 & 2 & 3 \end{vmatrix}$$

$$= \hat{i}\begin{vmatrix} 4 & -6 \\ 2 & 3 \end{vmatrix} - j\begin{vmatrix} 5 & -6 \\ -2 & 3 \end{vmatrix} + k\begin{vmatrix} 5 & 4 \\ -2 & 2 \end{vmatrix}$$

$$= \hat{i}(12-(-12)) - j(15-12) + \hat{k}(10+8)$$

$$= 24\hat{i} - 3\hat{j} + 18\hat{k}$$

$$= \frac{\sqrt{24^2+(-3)^2+(18)^2}}{\sqrt{(-2)^2+2^2+3^2}}$$

$= 7.31$. (component of a perp to direction of b).