02/08/2018 BS (CS) FAST NUCES SEMESTER
(APPLIED PHYSICS) ASSIGNMENT

VECTOR:-

QUESTION NO 01 (a):-

$r = a + b + c$

$a = 5i + 4j - 6k \qquad b = -2i + 2j + 3k \qquad c = 4i + 3j + 2k$

$\therefore r = (5i + 4j - 6k) + (-2i + 2j + 3k) + (4i + 3j + 2k)$

$\boxed{r = 7i + 9j - k}$

Now, angle b/w r and positive 3-axis:-

$r \cdot 3 = |\vec{r}| \cos\theta$

$(7i + 9j - k) \cdot k = \sqrt{(7)^2 + (9)^2 + (-1)^2} \cos\theta$

$-1 = \sqrt{131} \cos\theta$

$\theta = \cos^{-1}\left(\frac{-1}{\sqrt{131}}\right)$

$\boxed{\theta = 95.01^\circ}$ Ans.

QUESTION NO 01 (b):-

$\because \vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z$

$\vec{a} \cdot \vec{b} = (5)(-2) + (4)(2) + (-6)(3)$

$\vec{a} \cdot \vec{b} = -10 + 8 - 18$

$\boxed{\vec{a} \cdot \vec{b} = -20}$

$|\vec{a}| = \sqrt{(5)^2 + (4)^2 + (-6)^2}$

$|\vec{a}| = \sqrt{25 + 16 + 36}$

$\boxed{|\vec{a}| = \sqrt{77} \text{ units}}$

$|\vec{b}| = \sqrt{(-2)^2 + (2)^2 + (3)^2}$

$|\vec{b}| = \sqrt{4 + 4 + 9}$

$\boxed{|\vec{b}| = \sqrt{17} \text{ units}}$

$\because \vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos\theta$

ESTER I

MENT_1

QUESTION NO 02(a):-

$A = 5i + 3j$ $\quad B = -3i + 2j$

Let the sum of two vectors A and B in unit vector notation is

$\vec{C} = 5i + 3j - 3i + 2j$

$\boxed{\vec{C} = 2i + 5j}$ Ans

QUESTION NO 02(b):-

Magnitude:-

$|\vec{C}| = \sqrt{(2)^2 + (5)^2}$

$|\vec{C}| = \sqrt{4 + 25}$

$\boxed{|\vec{C}| = \sqrt{29} \text{ units}}$ Ans

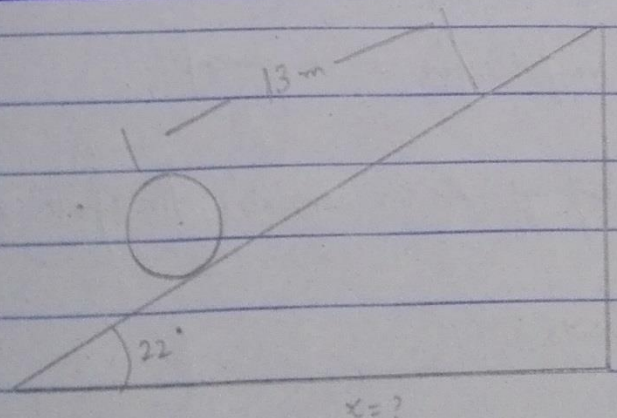
Direction:-

$\theta = \tan^{-1}\left(\frac{C_y}{C_x}\right)$

$\theta = \tan^{-1}\left(\frac{5}{2}\right)$

$\boxed{\theta = 68.19^\circ}$ Ans.

QUESTION NO 03(a):-



Let y be the height.

$\sin\theta = \frac{P}{H}$

$y = (13)\sin 22^\circ$

$\boxed{y = 4.86 \text{ m}}$ Ans

QUESTION NO 03 (b):-

Let x be the horizontal distance.

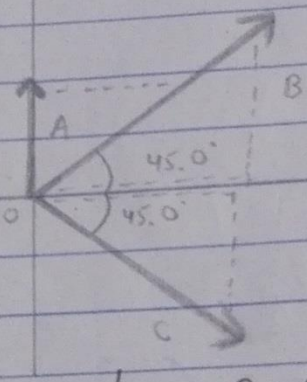
$$\cos\theta = \frac{B}{H}$$

$$\cos 22^\circ = \frac{x}{13}$$

$$x = (\cos 22^\circ)(13)$$

$$\boxed{x = 12.05\ m}$$ Ans

QUESTION NO 04 (a):-



$A = 20$ units $\quad B = 40$ units $\quad C = 30$ units.

x-component of the resultant vector:-

Let 'R_x' be the resultant vector for x-component.

$$R_x = A_x + B_x + C_x$$

As there is no component of $\vec{A}$ on x-axis. Therefore,

$$R_x = 0 + B\cos\theta + C\cos\theta$$

$$R_x = 0 + 40\cos 45^\circ + 30\cos 45^\circ$$

$$\boxed{R_x = 35\sqrt{2}\ \text{units}}$$ Ans

y-component of the resultant vector:-

$R_y = 20\sin 45^\circ + 30\sin 45^\circ + 40\sin 45^\circ$

$R_y = 45\sqrt{2}$ units ~~$R_y = 45\sqrt{2}$ units~~ $R_y = 15\sqrt{2}$ units Ans

QUESTION NO 04 (b):-

Magnitude:-

$$R = \sqrt{R_x^2 + R_y^2}$$

$$R = \sqrt{(35\sqrt{2})^2 + (15\sqrt{2})^2}$$

$R = 10\sqrt{29}$ units OR $R = 53.85$ units Ans

Direction:-

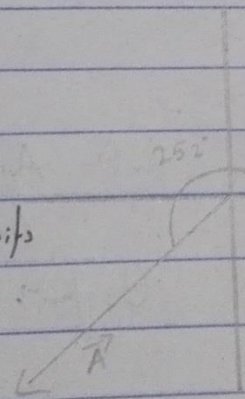
$$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right)$$

$$\theta = \tan^{-1}\left(\frac{3\cancel{5}\sqrt{2}}{7\cancel{35}\sqrt{2}}\right)$$

$$\theta = \tan^{-1}\left(\frac{3}{7}\right)$$

$\theta = 23.19^\circ$ Ans

QUESTION ON 05 (a):-



$|\vec{A}| = 7.34$ units

$\therefore A_x = A\cos\theta$

$A_x = 7.34\cos 252^\circ$

$A_x = -2.26$ units. Ans

$\therefore A_y = A\sin\theta$

QUESTION NO 05 (b):-

$B_x = -25$ units, $B_y = +43$ units

$|\vec{B}| = \sqrt{B_x^2 + B_y^2}$

$|\vec{B}| = \sqrt{(-25)^2 + (+43)^2}$

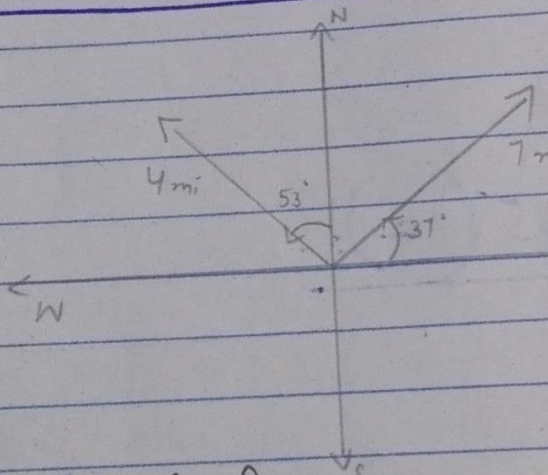
$\boxed{|\vec{B}| = 49.73 \text{ units}}$ Ans

$\therefore \theta = \tan^{-1}\left(\frac{B_y}{B_x}\right)$

$\theta = \tan^{-1}\left(\frac{43}{-25}\right)$

$\boxed{\theta = -59.82^\circ}$ Ans

QUESTION NO 06 (a):-



$\therefore A_x = A_1\cos\theta_1 + A_2\cos\theta_2$

$A_x = 7\cos 37^\circ + 7\cos 53^\circ$

$\boxed{A_x = 9.80 \text{ mi}}$

$\therefore A_y = A_2\sin\theta_1 + A_2\sin\theta_2$

$A_y = 4\sin 37^\circ + 4\sin 53^\circ$

$\boxed{A_y = 5.60 \text{ mi}}$

$|\vec{A}| = \sqrt{A_x^2 + A_y^2}$

$|\vec{A}| = \sqrt{(9.80)^2 + (5.60)^2}$

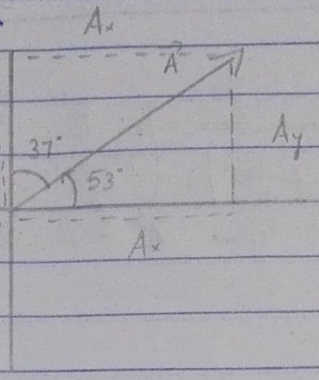
$\tan\theta = \frac{A_y}{A_x}$

$\theta = \tan^{-1}\left(\frac{A_y}{A_x}\right)$

$\theta = \tan^{-1}\left(\frac{5.60}{9.80}\right)$

$\boxed{\theta = 29.74^\circ}$ A

QUESTION NO 07:-



$A_x = 10\,m$

$\theta = 37°$

$|\vec{A}| = ?$

$\because A_x = A\cos\theta$

$10 = A\cos 53°$

$A = \dfrac{10}{\cos 53°}$

$\boxed{A = 16.61\,m}$ Ans

QUESTION NO 08:(a):-

$|\vec{A}| = 3m \quad |\vec{B}| = 4m \quad \theta = 30° \quad \vec{A}\cdot\vec{B} = ? \quad |\vec{A}\times\vec{B}| = ?$

$\vec{A}\cdot\vec{B} = AB\cos\theta$

$\vec{A}\cdot\vec{B} = (3)(4)\cos 30°$

$\boxed{\vec{A}\cdot\vec{B} = 6\sqrt{3}\ m}$ Ans

$|\vec{A}\times\vec{B}| = AB\sin\theta$

$|\vec{A}\times\vec{B}| = (3)(4)\sin 30°$

$\boxed{|\vec{A}\times\vec{B}| = 6\,m}$ Ans

QUESTION NO 08 (b):-

$\vec{A}\cdot\vec{B} = ? \quad |\vec{A}\times\vec{B}| = ? \quad \theta = 137°$

$\vec{A}\cdot\vec{B} = AB\cos\theta$

$\vec{A}\cdot\vec{B} = (3)(4)\cos 137°$

$\boxed{\vec{A}\cdot\vec{B} = -8.77\ m}$ Ans

$|\vec{A}\times\vec{B}| = AB\sin\theta$

$|\vec{A}\times\vec{B}| = (3)(4)\sin 137°$

$\boxed{\quad}$ A

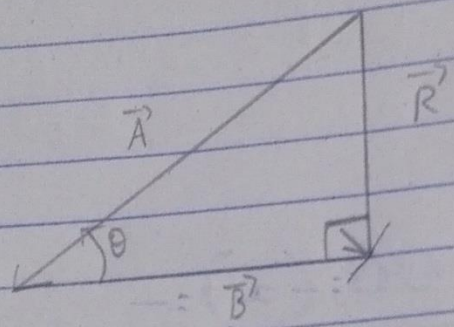
QUESTION NO 09:-

Resultant = R

R is perpendicular to $\vec{B}$.

$|\vec{A}| = 5$ units, $|\vec{R}| = |\vec{A}|/2 = 5/2 = 2.5$ units

$|\vec{B}| = ?$ θ b/w $\vec{A}$ and $\vec{B}$



Using pythagorous theorem:-

$H^2 = P^2 + B^2$

$(\vec{A})^2 = (\vec{R})^2 + (\vec{B})^2$

$5^2 = 2.5^2 + \vec{B}^2$

$25 - 6.25 = (\vec{B})^2$

$|\vec{B}| = 4.33$ units Ans

$\because \sin\theta = P/H$

$\sin\theta = \vec{R}/\vec{A}$

$\sin\theta = \frac{5/2}{5}$

$\sin\theta = \frac{5}{2} \times \frac{1}{5}$

$\theta = \sin^{-1}(1/2)$

QUESTION NO 10:-

$\vec{A} = 2i - 3j + 5k$

Angle b/w $\vec{A}$ and x-axis.

$$A \cdot x = |\vec{A}| \cos\theta$$

$$(2i - 3j + 5k) \cdot i = \sqrt{(2)^2 + (-3)^2 + (5)^2} \cos\theta$$

$$2 = \sqrt{38} \cos\theta$$

$$\theta = \cos^{-1}\left(\frac{2}{\sqrt{38}}\right)$$

$$\boxed{\theta = 71.06^\circ} \text{ Ans}$$

Angle b/w $\vec{A}$ and y-axis.

$$A \cdot y = |\vec{A}| \cos\theta$$

$$(2i - 3j + 5k) \cdot j = \sqrt{38} \cos\theta$$

$$\frac{-3}{\sqrt{38}} = \cos\theta$$

$$\theta = \cos^{-1}\left(\frac{-3}{\sqrt{38}}\right)$$

$$\boxed{\theta = 119.12^\circ} \text{ Ans}$$

Angle b/w $\vec{A}$ and z-axis.

$$A \cdot z = |\vec{A}| \cos\theta$$

$$(2i - 3j + 5k) \cdot k = \sqrt{38} \cos\theta$$

$$\frac{5}{\sqrt{38}} = \cos\theta$$

$$\theta = \cos^{-1}\left(\frac{5}{\sqrt{38}}\right)$$