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K225195
BSE - 1B

Date 1/9/2022

Assignment 1

Q1 $\vec{r} = 4.3$ m $\quad \theta = 40^\circ$

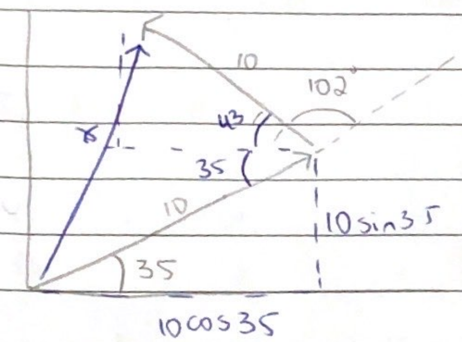
a)

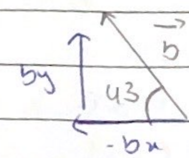
$r_x = r\cos\theta$
$= 4.3\cos 40$
$= 3.29$ m

b)

$r_y = r\sin\theta$
$= 4.3\sin 40$
$= 2.76$ m

Q2.





a)

$r_x = a_x + b_x$
$= a\cos\theta + (-b\cos\theta)$
$= 10\cos 35 - 10\cos 43$
$= 0.88$ m

$r_y = a_y + b_y$
$= a\sin\theta + b\sin\theta$
$= 10\sin 35 + 10\sin 43$
$= 12.6$ m

b)

$\vec{r} = r_x\hat{i} + r_y\hat{j}$
$|r| = \sqrt{r_x^2 + r_y^2}$
$= \sqrt{(0.88)^2 + (12.6)^2}$

$= 12.6$ m

c)

$\cancel{\theta = \tan^{-1}\left(\frac{r_x}{r_y}\right) = }$

$\cancel{\tan^{-1}\left(\frac{0.88}{12.6}\right)}$

$\theta = \tan^{-1}\left(\frac{r_y}{r_x}\right)$

$\tan^{-1}\left(\frac{12.6}{0.88}\right)$

$\theta = 86^\circ$

Q3. Area of parallelogram

$a = 2i - 13j + 5k \qquad b = 5i + 2j - 4k$

Area of parallelogram $= |\vec{a} \times \vec{b}|$

$$\vec{a} \times \vec{b} = \begin{vmatrix} i^{+} & j^{-} & k^{+} \\ 2^{-} & -13^{+} & 5^{-} \\ 5^{+} & 2^{-} & -4^{+} \end{vmatrix} = (52-10)i + (8+25)j + (4+65)k$$

$$= 42i + 33j + 69k$$

$|\vec{a} \times \vec{b}| = \sqrt{(42)^2 + (33)^2 + (69)^2}$

Area of parallelogram $= 87.3 \text{ unit}^2$

Area of triangle

$a = 3i + 4j - k \qquad b = -3i + 7j - 4k$

Area of triangle $= \frac{1}{2} \times |\vec{a} \times \vec{b}|$

$$\vec{a} \times \vec{b} = \begin{vmatrix} i^{+} & j^{-} & k^{+} \\ 3^{-} & 4^{+} & -1^{-} \\ -3^{+} & 7^{-} & -4^{+} \end{vmatrix} = (-16+7)i + (12+3)j + (21+12)k$$

$$= -9i + 15j + 33k$$

$|\vec{a} \times \vec{b}| = \sqrt{(-9)^2 + (15)^2 + (33)^2} = 3\sqrt{155}$

Area of $\Delta = \frac{1}{2} \times 3\sqrt{155} = 18.7 \text{ unit}^2$

Q4. $A_x = 25\text{ m} \qquad A_y = 40\text{ m}$

a) $|A|$

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

$= \sqrt{25^2 + 40^2}$

$= 47.2\text{ m}$

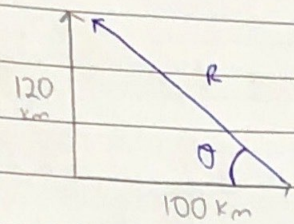
b) θ :

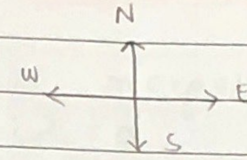
$\theta = \tan^{-1}\left(\frac{A_y}{A_x}\right)$

$\tan^{-1}\left(\frac{40}{25}\right)$

$= 58^{\circ}$

Q5.





a) $R = \sqrt{120^2 + 100^2}$

$= 156.2\text{ km}$

b) $\theta = \tan^{-1}\left(\frac{120}{100}\right) = 50.2^\circ$

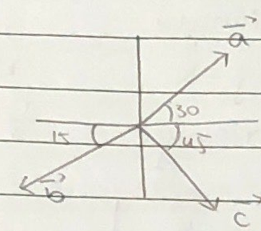
West 50.2° North

from +ve x axis $= 180^\circ - 50.2^\circ$

$= 129.8^\circ$

Q6. $|a| = |b| = |c| = 50\text{ m}$

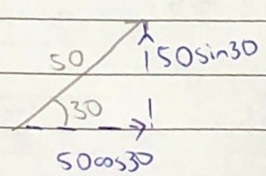
30° 195° 315°

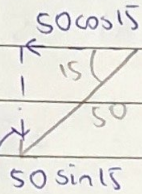


a) $r = a + b + c$

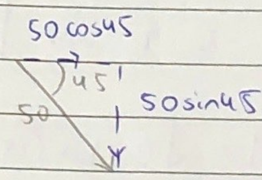
$|r|$ & θ

a)





b)



c)

$r_x = a_x + b_x + c_x$

$= 50\cos30 - 50\cos15 + 50\cos45$

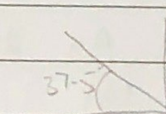
$= 30.4\text{ m}$

$r_y = a_y + b_y + c_y$

$= 50\sin30 - 50\sin15 - 50\sin45$

$= -23.3\text{ m}$

~~$r_z = a_z + b_z + c_z$~~



$|r| = \sqrt{r_x^2 + r_y^2}$

$= \sqrt{30.4^2 + (23.3)^2}$

$= 38.3\text{ m}$

$\theta = \tan^{-1}\left(\frac{r_y}{r_x}\right)$

$\tan^{-1}\left(\frac{-23.3}{30.4}\right) = -37.5^\circ$

$\theta = 180^\circ - 37.5^\circ$

$= 142.5^\circ$ (from +ve x axis)

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Q6.

b) $s = a - b + c$

$s_x = a_x - b_x + c_x$

$= 50\cos 30 + 50\cos 15 + 50\cos 45$

$= 126.95$ m

$s_y = a_y - b_y + c_y$

$= 50\sin 30 + 50\sin 15 - 50\sin 45$

$= 2.5856$ m

$|s| = \sqrt{s_x^2 + s_y^2}$

$= \sqrt{126.95^2 + 2.5856^2}$

$= 127$ m

$\theta = \tan^{-1} \frac{s_y}{s_x}$

$\tan^{-1}\left(\frac{2.5856}{126.95}\right)$

$\theta = 1.17°$

c) $(a+b) - (c+d) = 0$

$(a+b) = (c+d)$

$c + d = a + b$

$d = a + b - c$

$d_x = a_x + b_x - c_x$

$50\cos 30 - 50\cos 15 - 50\cos 45$

$= -40.35$ m

$d_y = a_y + b_y - c_y$

$= 50\sin 30 - 50\sin 15 + 50\sin$

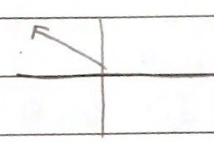
$= 47.41$ m

$|d| = \sqrt{d_x^2 + d_y^2}$

$= \sqrt{(-40.35)^2 + (47.41)^2}$

$= 62.3$ m

$\theta = \tan^{-1} \frac{d_y}{d_x}$



$\theta = \tan^{-1} \frac{47.41}{-40.35}$

$= -49.6°$

$\theta = 180 - 49.6$

$= 130.4°$ (from +ve x axis)

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Q7. $A = 2i - 3j + 5k$

$A \cdot B = AB\cos\theta$

$|A| = \sqrt{2^2 + (-3)^2 + (5)^2} = \sqrt{38}$

between x-axis

$\cos\theta = \dfrac{A_x}{|A|}$

$= \dfrac{2}{\sqrt{38}}$

$\theta = 71.1°$

between y axis

$\cos\theta = \dfrac{A_y}{|A|}$

$= \dfrac{-3}{\sqrt{38}}$

$\theta = 119.1°$

between z axis

$\cos\theta = \dfrac{A_z}{|A|}$

$= \dfrac{5}{\sqrt{38}}$

$\theta = 35.8°$

Q8. $a = 5i + 4j - 6k$ $\quad b = -2i + 2j + 3k$ $\quad c = 4i + 3j + 2k$

$A \cdot B = AB\cos\theta$

$r = a + b + c$

between r & z

$r_x = a_x + b_x + c_x$

$= (5 - 2 + 4)i$

$= 7i$

$r_y = a_y + b_y + c_y$

$= (4 + 2 + 3)j$

$= 9j$

$r_z = a_z + b_z + c_z$

$= (-6 + 3 + 2)k$

$= -k$

$|r| = \sqrt{r_x^2 + r_y^2 + r_z^2} = \sqrt{(7)^2 + (9)^2 + (-1)^2} = \sqrt{131}$

$\cos\theta = \dfrac{r_z}{|r|} = \dfrac{-1}{\sqrt{131}}$ $\cancel{1}$ $\cancel{95°}$

$\theta = 95°$

between a & b

$A \cdot B = AB\cos\theta$

$-20 = \sqrt{77} \times \sqrt{17} \cos\theta$

$\cos\theta = \dfrac{-20}{\sqrt{77} \times \sqrt{17}}$

$\theta = 123.6°$

$A \cdot B = -10 + 8 - 18$

$= -20$

$|A| = \sqrt{5^2 + 4^2 + 6^2}$

$= \sqrt{77}$

$|B| = \sqrt{2^2 + 2^2 + 3^2}$

$= \sqrt{17}$

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Q9. $|A| = 6$ $|B| = 7$ $A \cdot B = 14$

$$A \cdot B = AB\cos\theta$$

$$14 = 6 \times 7 \cos\theta$$

$$\cos\theta = \frac{14}{6 \times 7}$$

$$\theta = 70.5^\circ$$

Q10. $A = 4i + Xj + 2k$ & $B = 4i - 8j - 2k$ are perpendicular

find $X = ?$

$A \cdot B = 0$ because A & B are perpendicular

$$A \cdot B = 16 - 8X - 4$$

$$16 - 8X - 4 = 0$$

$$12 - 8X = 0$$

$$-8X = -12$$

$$X = \frac{3}{2} = 1.5$$