Applied Physics R# 200828

Assigment # 1

Muhammad Junaid Nazir

Chapter 1 and 3

Chapter 1

Problem 1

Solution

Radius of Earth = 6.37×10^6 m

(a) circumference in km = ?

Circumference = $2\pi r$

$= 2 \times \frac{22}{7} \times 6.37 \times 10^6$

$= 40.04 \times 10^6$ m

$= \frac{10^3}{10^3} \times 40.04 \times 10^6$ m

$= 40.04 \times 10^3$ km

$= 4 \times 10^4$ km

(b) Surface Area in km^2 = ?

Surface Area = $4\pi r^2$

$= 4\pi . (6370\ km)^2$

$= 4\pi . 40,576,900\ km^2$

$= 5.10 \times 10^8\ km^2$

(b) volume in Km^3

Volume $= \frac{4}{3}\pi r^3$

$= \frac{4}{3}\pi \cdot (6370\ km)^3$

$= \frac{4}{3}\pi \cdot (2.58474853 \times 10^{11})\ km^3$

$= 1.08 \times 10^{12}\ Km^3$

Problem 3

Solution

(a)

$1\ Km = 10^3\ m$

$= \frac{10^9}{10^9} \cdot 10^3\ m$

$= 10^9 \cdot 10^{-6}\ m$

$= 10^9\ \mu m$

(b)

$1\ \mu m = 10^{-6}\ m$

$= \frac{10^{-4}}{10^{-4}} \cdot 10^{-6}\ m$

$= 10^{-4} \cdot 10^{-2}\ m$

$= 10^{-4}\ cm$

(c)

1 yard = 3 ft

$= 3(.5048\ m)$

$= 0.914\ m$

$= \frac{10^6}{10^6} \cdot 0.914\ m$

$= (10^6)(0.914) \cdot 10^{-6}\ m$

$= 914000\ \mu m$

$= 9.14 \times 10^5\ \mu m$

Problem 9

Solution:

Radius of Semicircle = 2000 km

$= 2000 \times 10^3\ m$

$= \frac{10^{-2}}{10^{-2}} \cdot 2 \times 10^6\ m$

$= 2 \times 10^8\ cm$

Height of Cylinder = 3000 m

$= 3 \times 10^3$ m

$= \frac{10^{-2}}{10^{-2}} \cdot 3 \times 10^3$ m

$= 3 \times 10^5$ cm

As volume of cylinder equals area of circle (πr^2) multiplied by height (h). But here we are only considering semi-circle so we will divide area by 2.

$$\text{Volume} = \frac{\pi r^2 \cdot h}{2}$$

$$= \frac{(\pi)(2 \times 10^3)^2 \cdot (3 \times 10^5)}{2}$$

$$= \frac{(\pi)(4 \times 10^{16})(3 \times 10^5)}{2}$$

$$= 18.8 \times 10^{21} \text{ cm}^3$$

$$= 1.88 \times 10^{22} \text{ cm}^3$$

Or $= 1.9 \times 10^{22} \text{ cm}^3$

Problem 11:

Solution:

(a) French decimal week to standard week.

French week consisted of 10 days

Standard week consists of 7 days

$$\text{Ratio} = \frac{10}{7} = 1.43$$

(b) French decimal second to standard second.

Standard day consists of $24 \times 60 \times 60 = 86400$ sec

or we can say 1 second $= \frac{1}{86400}$ days

French day consisted of $10 \times 100 \times 100 = 10^5$ sec

or 1 sec $= \frac{1}{10^5}$ days

$$\text{Ratio} = \frac{1/10^5}{1/86400} = \frac{1}{10^5} \times \frac{86400}{1}$$

$$= 0.864$$

Problem 12

Solution:

height of plant = 3.7 m

$= \frac{10^{+6}}{10^{+6}} \cdot 3.7 \text{ m}$

$= 3.7 \times 10^{6}\ 10^{-6} \text{ m}$

$= 3700000 \ \mu m$

Time = 14 days

$= 14 \times 24 \times 60 \times 60$ s

$= 1{,}209{,}600$ seconds

Ratio of Growth $= \frac{3700000}{1{,}209{,}600} \ \mu m/s$

$= 3.06 \ \mu m/s$

Chapter 3:

Problem 3.

Solution

(a) magnitude of $\vec{A}$

$$|\vec{A_x}| = -25\ m$$

$$|\vec{A_y}| = 40\ m$$

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

$$= \sqrt{(-25)^2 + (40)^2}$$

$$= \sqrt{2225}$$

$$|\vec{A}| = 47.17$$

(b) direction

$$\phi = \tan^{-1} \frac{A_y}{A_x}$$

$$= \tan^{-1} \frac{40}{25} = 58^\circ$$

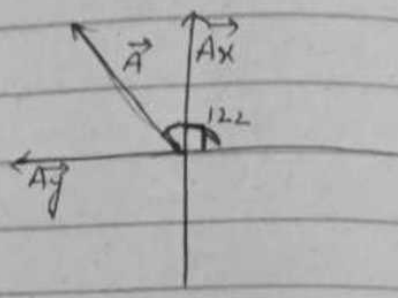
As θ lies in II quadrant

So $\theta = 180^\circ - \phi$

$$\theta = 180^\circ - 58 = 122^\circ$$

This is the angle between origin and $\vec{A}$.

As the $\vec{A_x}$ will be formed on 90° in plane as shown



Angle between $\vec{A}$ & $\vec{A_x}$ will be

$= 122° - 90°$

$= 32°$

Problem 2:

Solution

vector $\vec{r} = 15$ m

$\theta = 30°$

$|\vec{r_x}| = r \cos\theta$

$|\vec{r_x}| = 15 \cos 30$

$|\vec{r_x}| = 13$ m

$|\vec{r}_y| = r \sin\theta$

$= 15 \sin 30$

$|\vec{r}_y| = 7.5\,m$

Problem 4:

(a) 20.0°

$= 20^\circ \times \frac{\pi}{180}$

$= 0.34$ rad

(b) 50.0°

$= 50 \times \frac{\pi}{180}$

$= 0.87$ rad

(c) 100°

$= 100 \times \frac{\pi}{180}$

$= 1.74$ rad

(d) 0.330 rad

$= 0.330 \times \frac{180}{\pi}$

$\approx 19^\circ$

(e) 2.10 rad

$= 2.10 \times \frac{180}{\pi}$

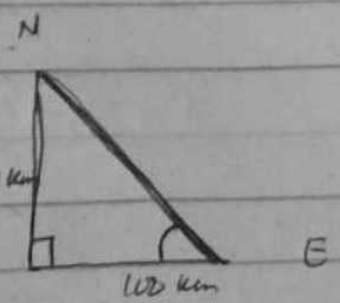
$\approx 120^\circ$

(f) 7.70 rad

$= 7.70 \times \frac{180}{\pi}$

$\approx 441^\circ$

Problem 5



Solution

Finding third side of the triangle

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

$$(H)^2 = (100)^2 + (120)^2$$

$$H = \sqrt{10000 + 14400}$$

$$H = 156.20 \text{ Km}$$

As $\cos\theta = \frac{\text{base}}{\text{hyp}}$

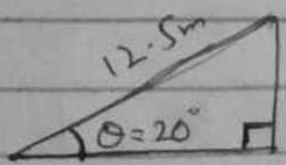
$$\cos\theta = \frac{100}{156.20}$$

$$\theta = \cos^{-1}\frac{100}{156.20}$$

$$\theta = 50.2^\circ$$

So the ship has to travel 156.20 Km in North-West direction or at an angle of 50.2° from x-axis

Problem 6



Solution (b)

$$\cos\theta = \frac{\text{base}}{\text{hyp}}$$

$$\cos 20 = \frac{\text{base}}{12.5} \Rightarrow \text{base} = 11.75\text{m}$$

Thus machinery is moved horizontally by 11.75 m

(a)

$$\sin\theta = \frac{\text{perp}}{\text{hyp}}$$

$$\sin 20^\circ = \frac{\text{perp}}{12.5}$$

$$\text{perp} = 4.28\ \text{m}$$

Thus machinery is moved vertically by 4.28 m.

Problem 7

(a)

$$3 + 4 = 7 \quad \text{if}$$

$$|\vec{r}_1| + |\vec{r}_2|$$

Two vectors must be parallel and in the same direction.

(b)

$$4 - 3 = 1 = |\vec{r}_2| - |\vec{r}_1|$$

Two vectors must be parallel and in opposite direction

(c)

$$= \sqrt{(4)^2 + (3)^2}$$

$$= 5$$

$$= \sqrt{(|\vec{r}_2|)^2 + (|\vec{r}_1|)^2}$$

Two vectors must be perpendicular

Problem 9

(a) $\vec{a} + \vec{b}$

$$\vec{a} + \vec{b} = [4 + (-1)]\hat{i} + [(-3) + 1]\hat{j} + [1 + 4]\hat{k}$$

$$= 3\text{m}\,\hat{i} + -2\text{m}\,\hat{j} + 5\text{m}\,\hat{k}$$

or $= 3\text{m}\,\hat{i} - 2\text{m}\hat{j} + 5\text{m}\,\hat{k}$

(b) $\vec{a} - \vec{b}$

$$\vec{a} - \vec{b} = [4 - (-1)]\hat{i} + [(-3) - 1]\hat{j} + [1 - 4]\hat{k}$$

$$= 5\text{m}\hat{i} - 4\text{m}\hat{j} - 3\text{m}\hat{k}$$

(C) find vector $\vec{C}$

$|\vec{C_x}| = -5m\hat{i}$

$|\vec{C_y}| = 4m\hat{j}$

$|\vec{C_z}| = 3m\hat{k}$

$\vec{C} = -5m\hat{i} + 4m\hat{j} + 3m\hat{k}$