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Application of Trigonometry in Meteorology and Seismology

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Abstract: The main aim of the paper is to use trigonometry in real life to solve the real world problems. Trigonometry has vast applications in our life both directly and indirectly. It has been used in meteorology and seismology. It has helped us to modelling data for weather forecast. In seismology it has helped us to find the depth of the water. This paper further explores how to solve such real world problems.
Keywords: Amplitude, Period, Vertical shift , Horizontal shift, Temperature

I. INTRODUCTION

Meteorology mainly focuses on atmosphere and its phenomena. This defines that anything happens with weather like wind, rain, snow, sun, frost, fog. Meteorology mainly define in the side of science, and the study of physics of the world. Especially as they related to weather and weather forecasting. Seismology mainly focus on earthquakes and about seismic waves through the earth or through other bodies. This defines the study of environmental effects such as tsunami, volcanic, oceanic, and artificial processes like explosions.

A. Steps In Weather Forecasting Process

1) Weather forecasting is the process of collecting data about the current state of the atmosphere strictly the temperature understanding of atmospheric processes through meteorology to evaluate how the atmosphere evolves in the future.
2) On the season of information osmosis process, data picked up from the perceptions is utilized related to a numerical model's latest estimate for the time that perceptions were made to deliver the meteorological examination.
3) And then they take the analysis as the starting point and evolve the state of the atmosphere forward in time using understanding of physics and fluid dynamics.
4) Finally ,the output from the model gives the basis of the weather forecast.

B. Importance Of Meteorology

1) The Aviation industry and shipping industry rely on Weather Forecasts to get from point A to B. There exist international laws that prohibit flight without obtaining a weather briefing of some kind.
2) The construction industry is weather sensitive as well. If it can get extensions to projects when rain fell above certain thresholds. Also some construction cannot be conducted when it is raining as working in wet conditions can be dangerous and even undermine the integrity of the structures.
3) Farmers totally rely on weather forecasts as rainfall determines when to plow and sow and reap. Also they require an idea of the seasonal forecast for forward planning.
4) There are many reasons and industries using the weather forecasts on daily basis, noy just for what to wear and if washing can be done.

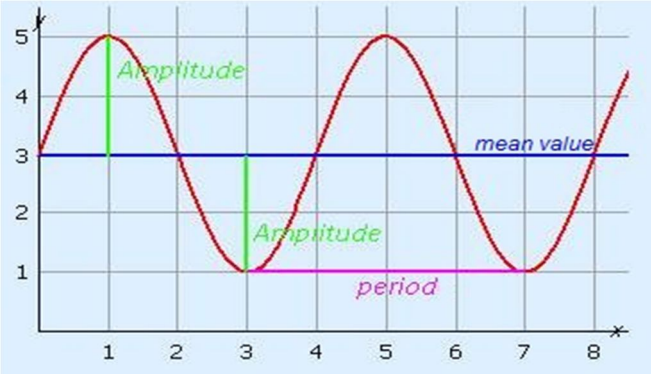
C. Seismic Waves

Seismic waves are the waves of energy which was caused by the sudden breaking of rock within the earth. They are the energy that travels through the earth .

D. Types Of Seismic Waves

Body waves :Body waves can only travel through earth's inner layers
Surface waves: surface waves can only move along the surface of the planet like ripples on water.

a) *Periodic Graphs:* shows visually the magnitude of the shaking of the earthquake. It is the most simple way to measure the magnitude.



1) *Problem1:* The average monthly temperatures for a small town in sagara are given in Table. Find a model for the given data.

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
TEMPERATURE^0 F	42.5	44.5	48.5	52.5	58	63	68.5	69	64.5	55.5	46.5	43.5

a) *Solution*

Amplitude:

$$A=\frac{highestvalue-lowestvalue}{2}$$

$$A=\frac{69-42.5}{2}$$

$$A=13.25$$

Thus the amplitude is A=13.25

b) *Period*

Given period is 12 months,

$$period=\frac{2\pi}{B}=12$$

$$\Rightarrow B=\frac{2\pi}{12}=\frac{\pi}{6}$$

c) *Vertical shift*

$$D=\frac{highestvalue+lowestvalue}{2}$$

$$D=\frac{69+42.5}{2}$$

$$D=55.8$$

we have the equation = $y=13.3\sin(\frac{\pi}{6}x-C)+55.8$

To find the horizontal shift, we input the x and y values for the first month for finding for C

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$$y = A\sin B(x - C) + D$$

$$y = 13.3\sin(\frac{\pi}{6}x - C) + 55.8$$

$$42.5 = 13.3\sin(\frac{\pi}{6}(1) - C) + 55.8$$

$$-13.3 = 13.3\sin(\frac{\pi}{6} - C)$$

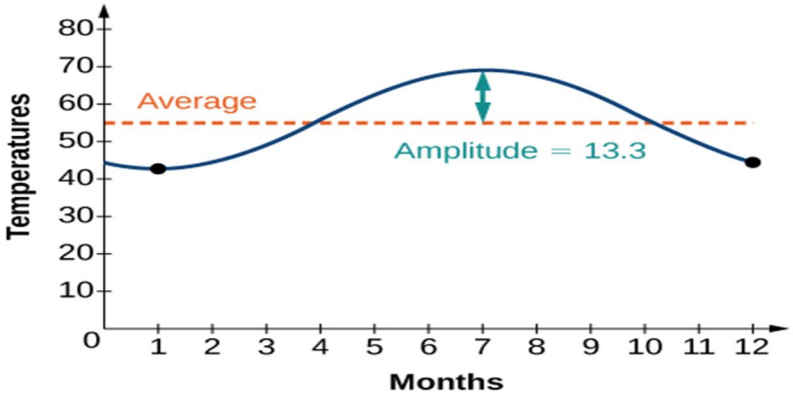
$$\sin\theta = -1 \rightarrow \theta = -\frac{\pi}{2}$$

$$-1 = \sin(\frac{\pi}{6} - C)$$

$$\frac{\pi}{6} - C = \frac{-\pi}{2}$$

$$\frac{\pi}{6} + \frac{\pi}{2} = C \Rightarrow \frac{2\pi}{3}$$

We have the equation $y = 13.3\sin(\frac{\pi}{6}x - \frac{2\pi}{3}) + 55.8$

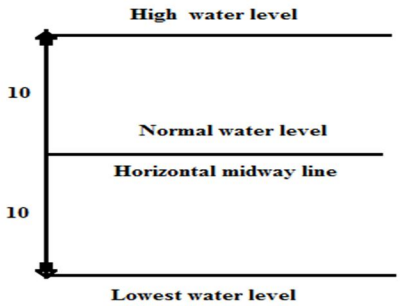


2) *Problem 2:* A tsunami is a fast moving wave which is caused by an underwater earthquake. water oscillates about its normal level, with equal amplitudes above and below this level. The period is 15 minutes. suppose that tsunami with an amplitude of 10m approaches the pier at Honolulu, where the normal depth of water is 9m. Let us assume that the depth of water varies sinusoidally with time as the tsunami passes, predict the depth of the following meters after the tsunami first reaches the pier

a) Two minutes, four minutes, and twelve minutes.

b) According to our model what will be the minimum depth of the water?

i) *Solution*



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ii) Given

a = horizontal midway line

⇨ a= 9

b=amplitude

⇨ b =10

$$period = \frac{2\pi}{c} = 15$$

$$\Rightarrow c = \frac{2\pi}{15}$$

iii) Solution

iv) Formula

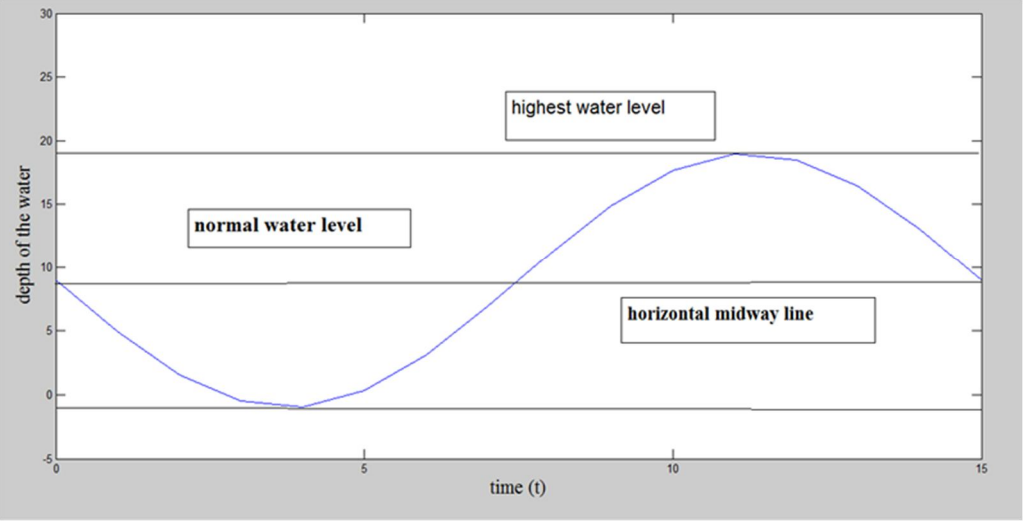
a ± bsincx (or)

a ± bcoscx

shape =sin function is reflected .

h = depth of water

$$h = 9\text{-}10\sin\frac{2\pi}{15}t$$



a. after 2 mins,

$$h = 9\text{-}10\sin\frac{2\pi}{15}(2)$$

h=1.569m

b. after 4 mins,

$$h = 9\text{-}10\sin\frac{2\pi}{15}(4)$$

h=-0.945m

c. after 12 mins

$$h = 9\text{-}10\sin\frac{2\pi}{15}(12)$$

h =18.511 m

The minimum level of water appears to be -1m

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3) *Problem 3:* In Australia, the highest average monthly temperature is 32^0C occurring in the month of February and lowest average monthly temperature is -14^0C occurring in the month of August. Model the average monthly temperature, T in degree Celsius at any month t of the year .List key characteristic of the periodic function .for t=0 the month is January.

a) Given

Max =32 , Min =-14

b) Solution

i) Amplitude

$$a = \frac{\max - \min}{2}$$

$$a = \frac{32-(-14)}{2} \Rightarrow \frac{46}{2}$$

$$a = 23$$

ii) vertical shift

$$d = \frac{\max + \min}{2}$$

$$d = \frac{32+(-14)}{2} \Rightarrow \frac{18}{2}$$

$$d = 9$$

iii) Period

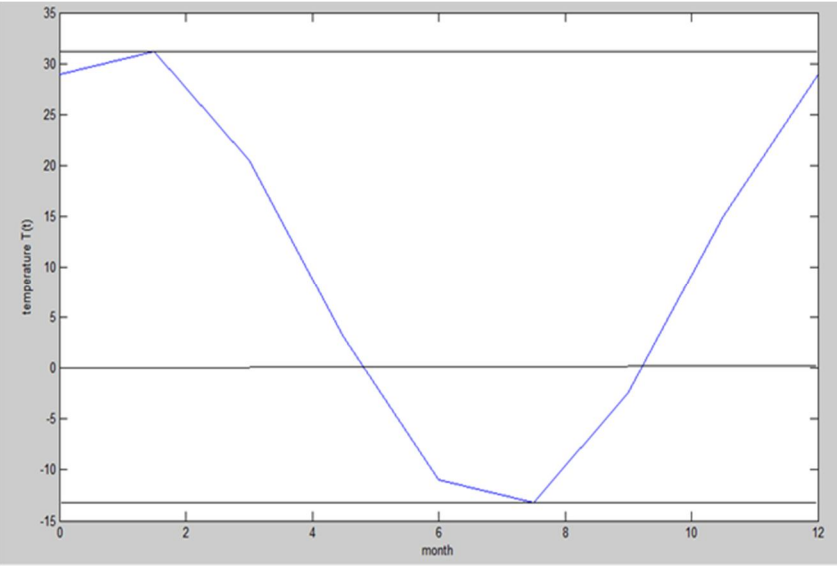
$$k = \frac{360}{12} \Rightarrow 30$$

a=23; d=9; c=1

iv) Equation :

$$T(t) = a\cos[k(t-c)] + d$$

$$T(t) = 23\cos[30(t-1)] + 9$$



4) Problem:4: At a seaport , the depth of the water h meters at a time t hours during a certain day is given by this formula;

$$h = 1.8 \sin[\ 2\pi \frac{t - 4.00}{12.4}] + 3.1$$

Find the maximum depth of the water .
When does it occur?

a) Given

$$h = 1.8 \sin[2\pi \frac{t-4.00}{12.4}] + 3.1$$

Solution:

We have to find max h $= \max 1.8 \sin[2\pi \frac{t-4.00}{12.4}] + 3.1$

We know that $\max \sin[2\pi \frac{t-4.00}{12.4}] = 1$

Hence max h= 1.8+3.1 = 4.9
Therefore , the Maximum depth of the water is 4.9 m.
To find time t to calculate when the maximum height will occur , for t=1

$$1 = \sin[2\pi \frac{t-4.00}{12.4}]$$

$$\frac{\pi}{2} = 2\pi \frac{t-4.00}{12.4}$$

$$\Rightarrow t = 7.1$$

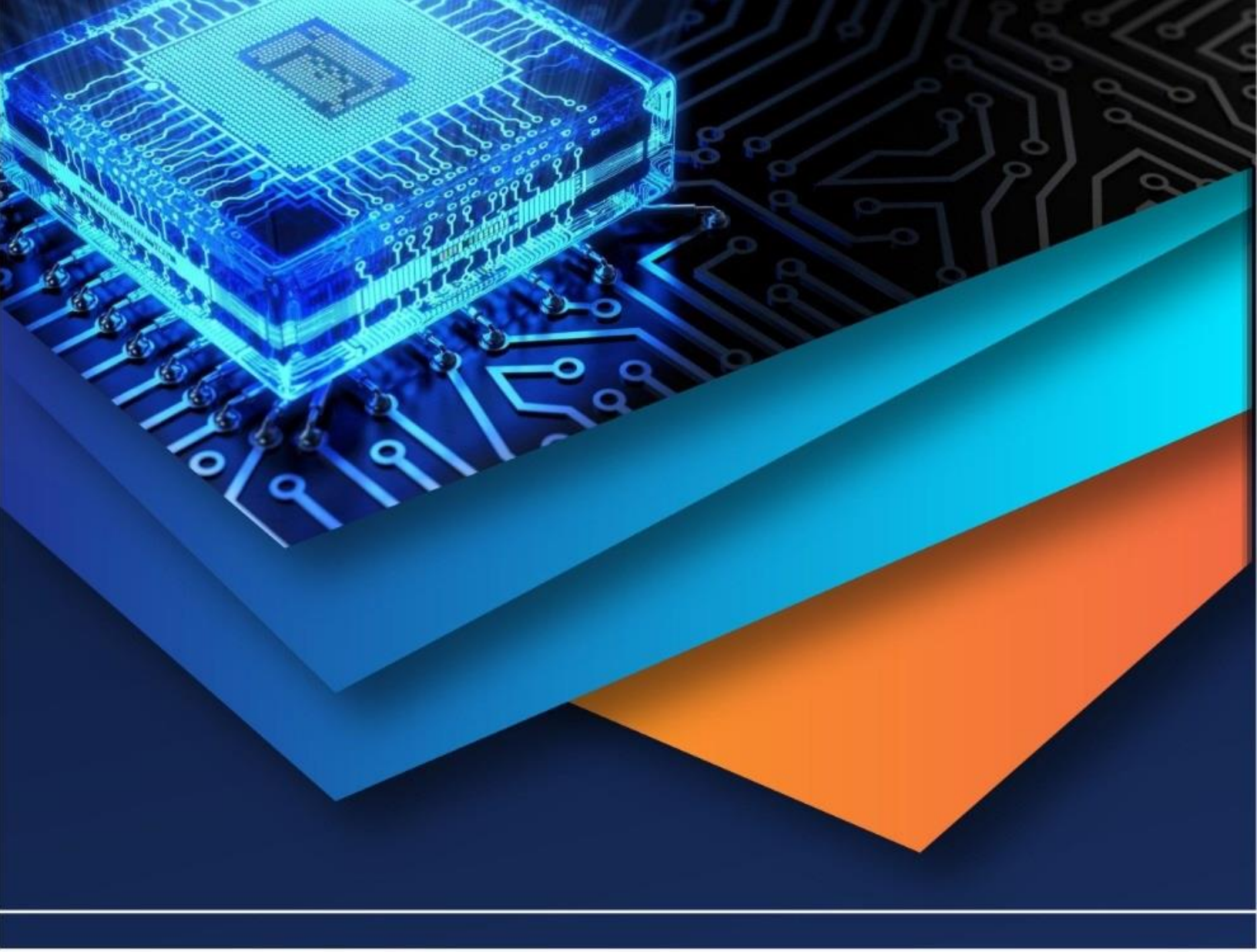
At t = 7.1 the maximum height will occur.

II. CONCLUSION

In this paper, we used the trigonometric function to modelling temperature for weather forecasting in meteorology, it gives a clear view about the temperature throughout the year. And to find the depth of the water in the field of seismology. This gives an idea of meteorology and seismology in the context of trigonometry.

REFERENCES

[1] Stull RB. 1988. An Introduction to Boundary Layer Meteorology. Kluwer Academic: Boston, MA; 618.
[2] Stull RB. 2000. Meteorology for Scientists and Engineers, 2nd edn. Brooks/Cole Thomson Learning: Pacific Grove, CA; 502
[3] Kunz M, Kottmeier CH. 2006a. Orographic enhancement of precipitation over low mountain ranges. Part I: Model formulation and idealized simulations. Journal of Applied Meteorology and Climatology 45: 1025–1040.
[4] Revenaugh, J., and S. A. Sipkin, Seismic evidence for silicate melt atop the 410-km mantle discontinuity, Nature, 369, 474–476, 1994.
[5] https://www.sciencedaily.com/terms/weather_forecasts.htm
[6] https://en.wikibooks_org/wiki/meteorology/introduction_to_the_definition
[7] https://math.libretexts.org/Bookshelves/Precalculus/Book%3A_Precalculus_(OpenStax)/07%3A_Trigonometric_Identities_and_Equations/7.6%3A_Modeling_with_Trigonometric_Equations



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