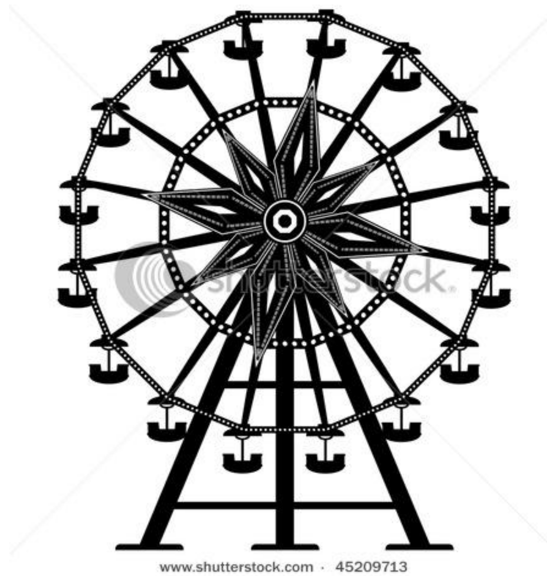
(A) Lesson Objectives

a. Introduce graphs of periodic phenomenon through a Ferris Wheel investigation
b. Review the graphs of y = sin(x) and y = cos(x) and determine their characteristics
c. Review basic transformations of the parent sinusoidal graphs
d. Relate transformed sinusoidal graphs to data sets

(B) Modeling Investigation – Ferris Wheel

You are going for a ride on a Ferris wheel. The Ferris wheel rotates at a constant speed. It has a radius of 10 meters and the bottom of the wheel is 2 meters off the ground. It takes 20 seconds to go around the Ferris wheel one time.



You will be graphing the height (H), of your carriage in meters above the ground, at time (t) seconds.

a. Imagine what shape the graph might look like. Explain why you think this. Sketch the shape.

b. Identify the dependent and independent variables in this scenario.

c. You just get into your carriage at the bottom of the wheel. What is your height when t=0? Plot this point on your graph.

d. What is the highest you will go? When will this happen? Plot this point on your graph.

e. How high will you be after 10 seconds? Plot this point on your graph.

f. Is there another time (t) when you will be at the same height as above at 10 seconds? When will this be? Plot this point on your graph.

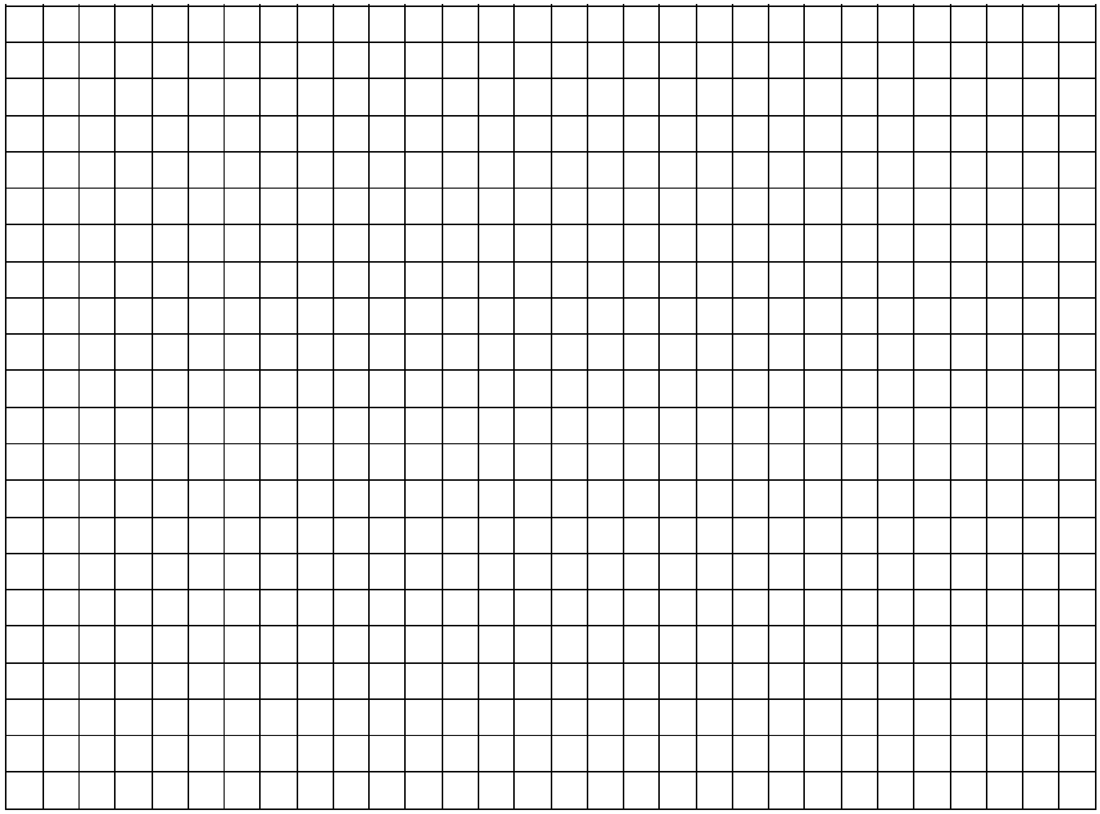
g. When will your height (h) be 2 meters? Plot this point on your graph.

h. Plot another 4 points on the graph that make sense in this scenario.

i. Does it make sense to draw a smooth curve through the points? If YES, then do so.

j. Expand your graph to show your height on the Ferris wheel over 2 cycles of rotation.

k. Write 3 observations about the shape and quantities on your graph.



Definitions:

l. We call this a Periodic graph. It repeats its patterns over regular intervals. The Period of the graph is the distance on the horizontal axis before it repeats itself. Find the period of your graph. ______________

m. Explain what this means in context of the scenario.

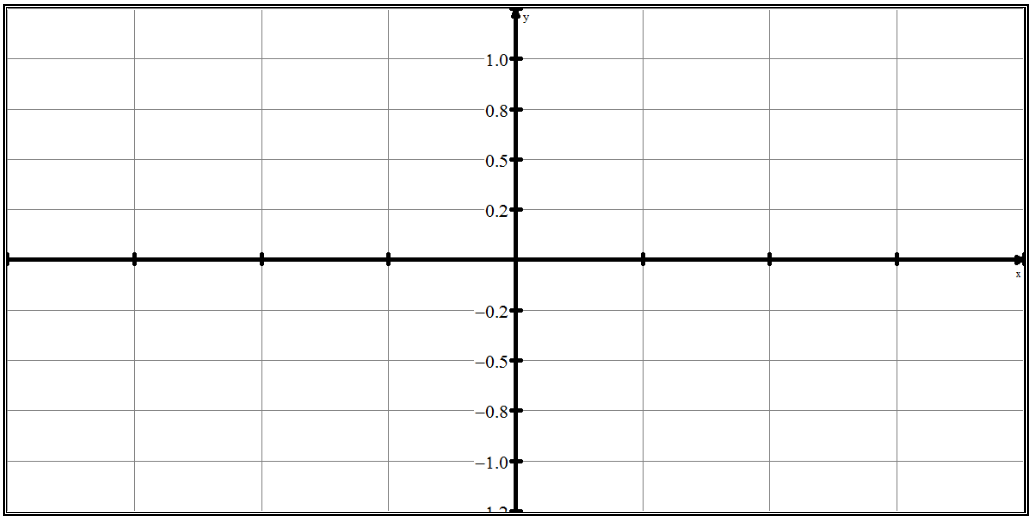
n. The axis of the curve (or axis of equilibrium) is the horizontal line that cuts the graph into equal top and bottom halves. Draw the axis of the curve on you graph.

o. Explain what the axis of equilibrium mean in context of the scenario.

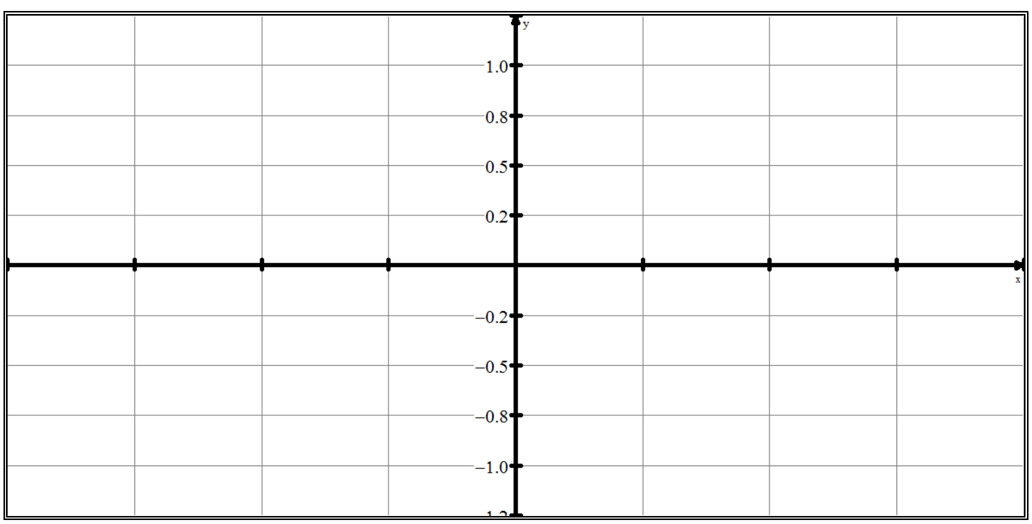
p. The Amplitude is the distance between axis of the curve and the maximum or minimum value of the graph. Find the amplitude and show it on your graph. What does the amplitude mean in context of this scenario?

(C) ***<u>Characteristics of the graphs y = sin(x) and y = cos(x)</u>***

a. Basic sinusoidal functions ➔ Graph and analyze 2 periods of $f(x) = \sin(x)$



b. Basic sinusoidal functions ➔ Graph and analyze 2 periods of $f(x) = \cos(x)$



(D)Transformations of the parent functions y = sin(x) and y = cos(x)

a. ***Investigating the role of the parameter A in y = Asin(x)***

Open the link http://www.geogebratube.org/student/m2702 to the interactive applet and change the slider controlling the parameter A. Notice how the appearance of the graph changes.

1. What happens when A > 1?
2. What happens when 0 < A < 1 (i.e the value of A is a decimal)?
3. What happens when A < 1?
4. What feature of a sinusoidal curve does the parameter A affect?

b. ***Investigating the role of the parameter B in y = sin(Bx)***

Open the link http://www.geogebratube.org/student/m2702 to the interactive applet and change the slider controlling the parameter B. Notice how the appearance of the graph changes.

1. What happens when B > 1?
2. What happens when 0 < B < 1 (i.e the value of B is a decimal)?
3. What happens when B < 1?
4. What feature of a sinusoidal curve does the parameter B affect?

c. ***Investigating the role of the parameter C in y = sin(x - C)***

Open the link http://www.geogebratube.org/student/m2702 to the interactive applet and change the slider controlling the parameter C. Notice how the appearance of the graph changes.

1. What happens when C > 0?
2. What happens when C < 0?
3. What feature of a sinusoidal curve does the parameter C affect?

d. ***Investigating the role of the parameter D in y = sin(x)+D***

Open the link http://www.geogebratube.org/student/m2702 to the interactive applet and change the slider controlling the parameter D. Notice how the appearance of the graph changes.

1. What happens when D > 0?
2. What happens when D < 0?
3. What feature of a sinusoidal curve does the parameter D affect?

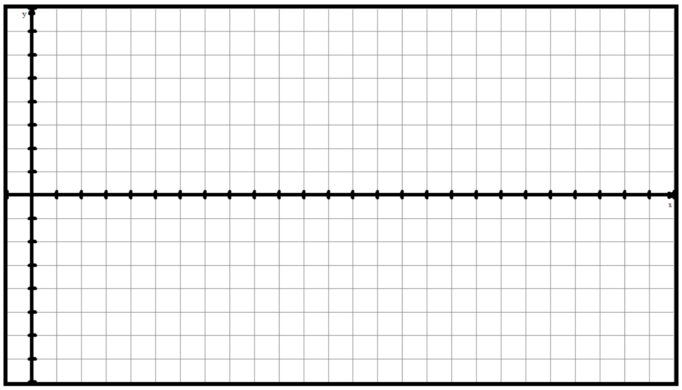
Lesson 38 – Modeling Periodic Phenomenon Date:

(E) *Modeling Investigation – Temperatures in Kapuskasing*

15. The table shows the average monthly high temperature for one year in Kapuskasing.

Time (months)	J	F	M	A	M	J	J	A	S	O	N	D
Temperature (°C)	−18.6	−16.3	−9.1	0.4	8.5	13.8	17.0	15.4	10.3	4.4	−4.3	−14.8

Source: Environment Canada.

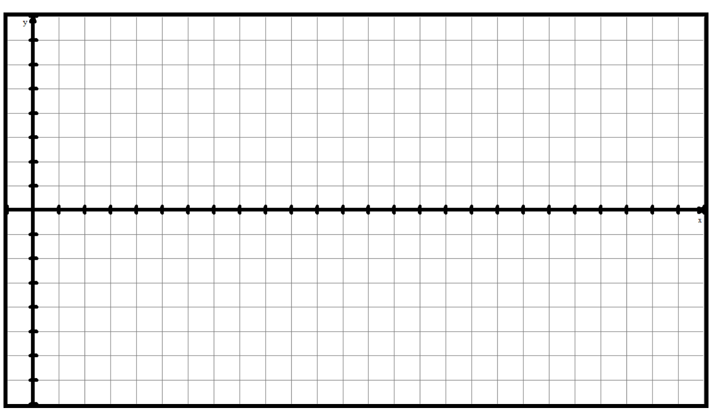


1. Complete a scatter plot (by hand & on GDC)
2. Determine the sinusoidal equation modeling temperature as a function of the time in months.
3. What is the average monthly temperature for the 38th month?

(F) *Modeling Investigation – Water Levels in the Bay of Fundy*

16. The depth of water in a harbour on the Bay Fundy that faces the ocean changes each hour, as shown.

Time (h)	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00
Depth (m)	5.5	6.3	8.5	11.5	14.5	16.7	17.5	16.7	14.5	11.5	8.5	6.3	5.5

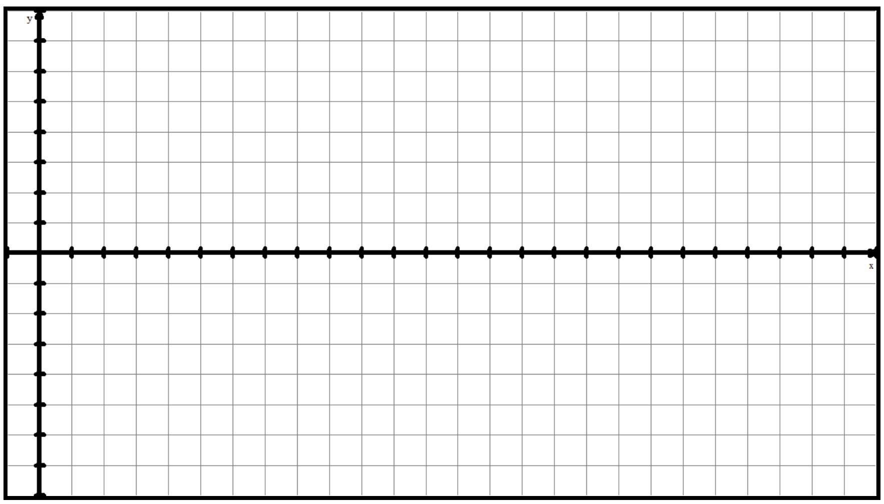


a. Complete a scatter plot (by hand & on GDC)
b. Determine equation.
c. Use the equation to determine the depth of water at 10:30. Verify your answer using the graph.
d. When is the water 7 m deep?

(G)<u>Investigation – Angles of Elevation of Sun</u>

14. Application: In the "land of the midnight sun," it is daylight all the time during the summer. The first coordinate is the hour of the day. The second coordinate is the angle of elevation of the sun, in degrees, above the horizon at a location in Canada's Far North.

(00:00, 38.59), (01:00, 41.49), (02:00, 42.95), (03:00, 42.75), (04:00, 40.93), (05:00, 37.73), (06:00, 33.51), (07:00, 28.67), (08:00, 23.56), (09:00, 18.52), (10:00, 13.82), (11:00, 9.73), (12:00, 6.46), (13:00, 4.22), (14:00, 3.13), (15:00, 3.26), (16:00, 4.61), (17:00, 7.09), (18:00, 10.55), (19:00, 14.80), (20:00, 19.59), (21:00, 24.67), (22:00, 29.74), (23:00, 34.47), (24:00, 38.48)



a. Complete a scatter plot (by hand & on GDC)

b. Determine equation

c. How could you use the model to calculate the elevation of the sun at 02:00 for the given location?

d. When is the elevation of the sun above the horizon 30°?