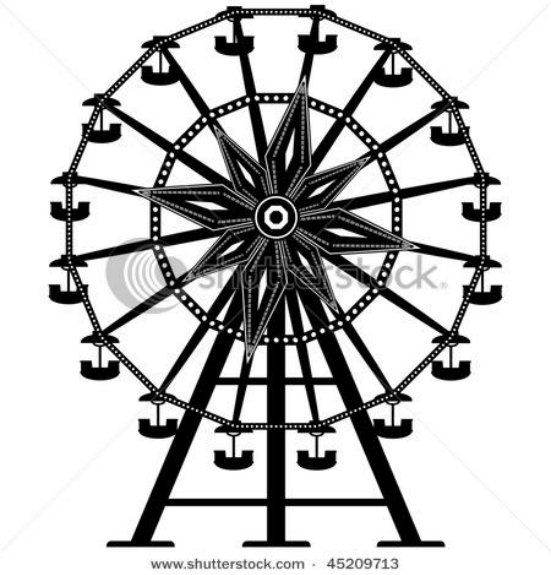
(A) Opening Challenge

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 40 seconds to go around the Ferris wheel one time.

Challenge: Determine your EXACT height after 15 seconds.

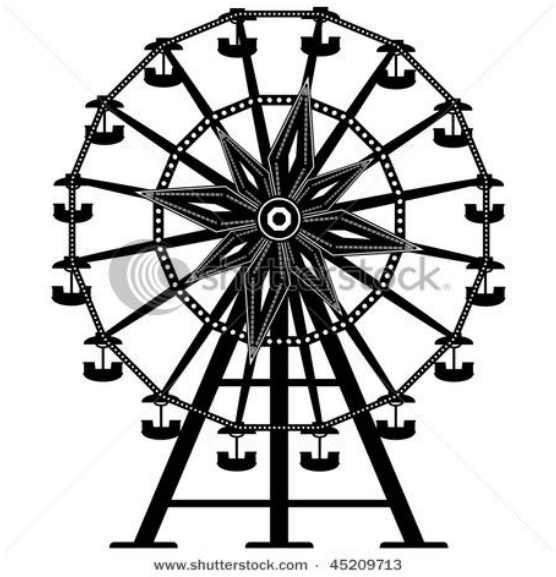


(B) Lesson Objectives

a. Introduce periodic phenomenon through several data driven investigations:
   i. the relationship between a riders height on a Ferris Wheel and the time of the ride
   ii. The relationship between the fraction of the moon that is visible and the day of the year
b. Introduce the key analysis features of periodic phenomenon

(C) Periodic Phenomenon – Investigating the Ride on a 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 40 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.

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

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

3. 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.

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

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

6. 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.

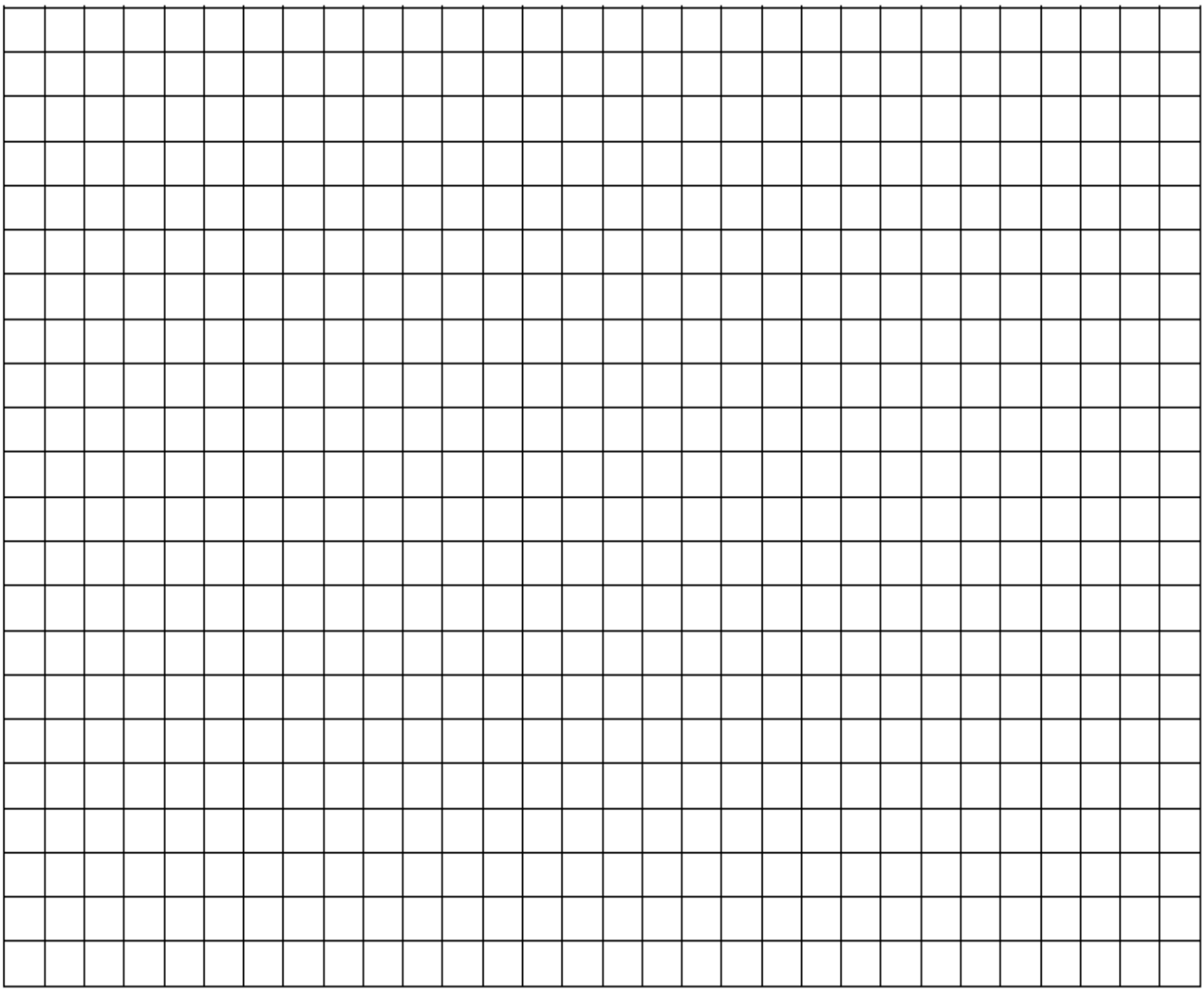
7. When will your height (h) be 2 meters? Plot this point on your graph.

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

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

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

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



(D) Key Features of Periodic Phenomenon – Analysis of the Phenomenon

a. The graph you just produced models a PERIODIC phenomenon. Explain what the concept of periodic means.

b. List two other examples of PERIODC phenomenon.

c. The PERIOD of the graph/context refers to the CYCLE LENGTH (the length of one cycle). What is the period of this periodic phenomenon? Explain the PERIOD in the context of this problem.

d. All periodic phenomenon have MAXIMUM and MINIMUM POINTS as well.
   i. Where are the maximum points in this example and what do they represent?

   ii. Where are the minimum points in this example and what do they represent?

e. All graphs of data that illustrates periodic phenomenon have an EQUILIBRIUM AXES or AXES OF THE CURVE or MEDIAN LINE. Where would the axes of the curve be in this example and what does it represent?

f. The AMPLITUDE is the distance between median line 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?

(E) Periodic Phenomenon – Visibility of the Moon

Look up at the moon on a clear night. Sometimes the moon is full and the night sky is bright. At other times, there is a new moon with no visible light and the sky is dark. The moon is said to wax from dark to bright and wane back to dark.

Fraction of the Moon Visible at Midnight ➔ Days 1 to 66 of the Year 2000

Day of the Year	1	2	3	4	5	6	10	15	20	21
Fraction of Moon Visible	0.25	0.18	0.11	0.06	0.02	0.00	0.11	0.57	0.99	1.00

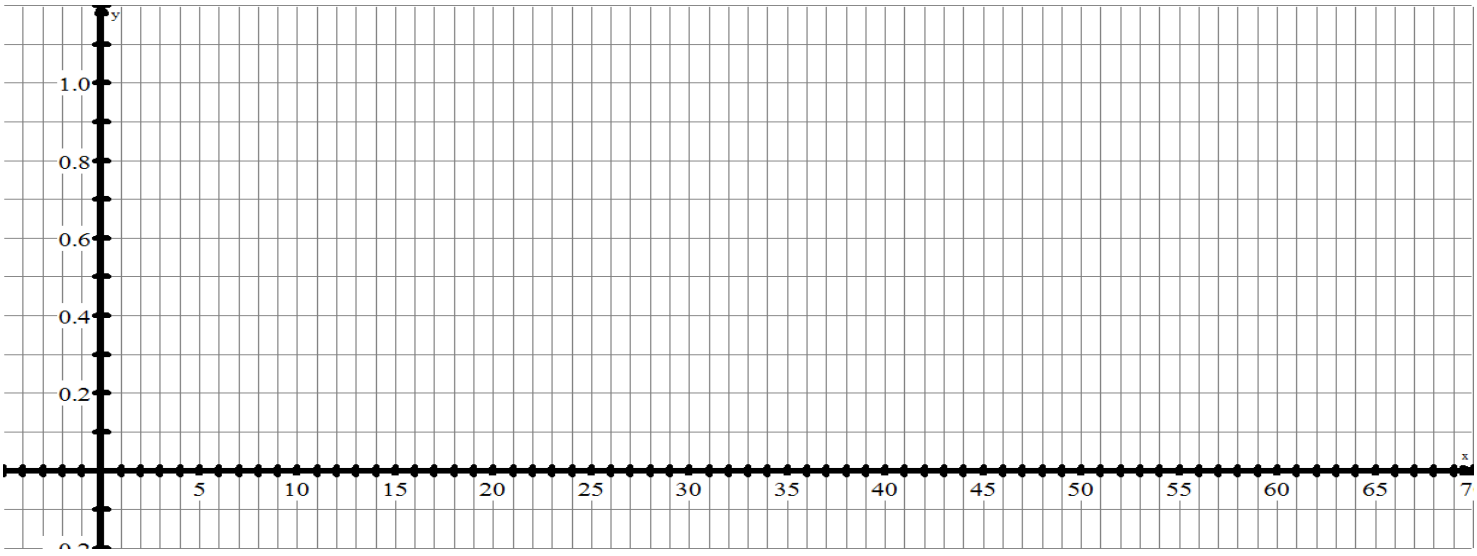
Day of the Year	25	30	35	40	45	50	55	60	65	66
Fraction of Moon Visible	0.80	0.32	0.02	0.14	0.64	1.00	0.77	0.31	0.01	0.00

Source: US Naval Observatory, Washington.

1. (a) Draw and label a scatter plot of the data.
(b) Draw the curve of best fit.

2. (a) Starting with day 1, how many days does it take for the shortest complete pattern of the graph to repeat?
(b) Starting with day 6, how many days does the graph take to repeat?
(c) On what other day could the graph begin and still repeat?

3. (a) Extend the pattern of the graph to include the 95th day of the new millennium. Was the phase of the moon closer to a full moon or a new moon? Explain.
(b) Extend the graph to predict the fraction of the moon that was visible on the summer solstice, June 21. Was the moon waxing or waning? Explain.

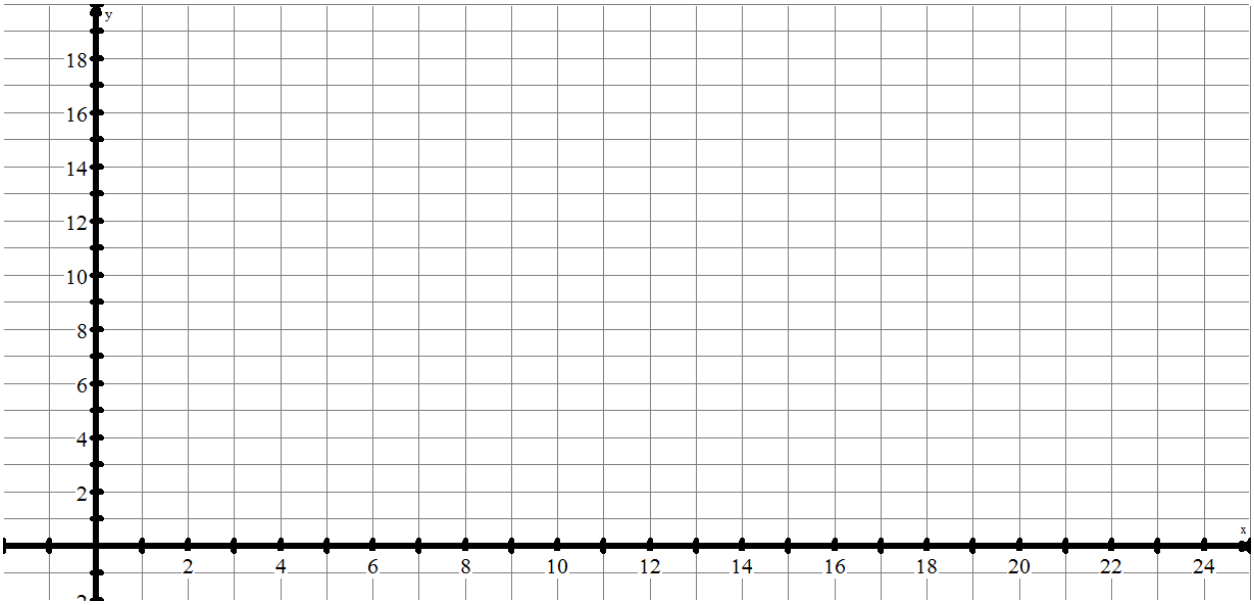


(F) Periodic Phenomenon – Tidal Data

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) Graph the data to start modeling the situation.



(b) Present the graph using a graphing calculator or an EXCL spreadsheet.

(c) Determine the depth of water at 20:30. Justify your answer.

(d) When is the water 7 m deep?