

The alternating half daily cycles of the rise and fall of the ocean are called tides.

Tides in one section of the Bay of Fundy caused the water level to rise 7.5 m. above sea level drop to 8.5 below sea level.

The tide completes one cycle every 9 hours. Assume height of water with respect to mean sea level to be modeled by sinusoidal relationship.

If high tide is at 9:00 AM, determine the following:

- Determine the model's period given that the high tide mark is at 9:00AM and the length of the period is 9 hours

First period [12:00am, 9:00am)

Second period [9:00am, 6:00pm)

Third Period [6:00pm, 3:00am) (next day)

- Determine the time of the low tide

First time of high tide (clock)

- 12:00 am

First time of low tide (hour model)

- 9 hours before 9: 00 am

First time of low tide (minute model)

- 540 minutes before 9: 00 am

Second time of high tide (clock)

- 9:00 am

Second time of low tide (hour model)

- 0 hours after 9: 00 am

Second time of low tide (minute model)

- 0 minutes after 9: 00 am

Third time of high tide (clock)

- 6:00 pm

Third time of low tide (hour model)

- 9 hours after 9: 00 am

Third time of low tide (minute model)

- 540 minutes after 9: 00 am

- Build a sinusoidal (sine or cosine) model of height that models the height of the wave in meters in relation to mean sea level in terms of time since the beginning of the period measured in minutes

This is a cosine model

$$\text{amplitude} = \frac{7.5 - (-8.5)}{2} = \frac{7.5 + 8.5}{2} = \frac{16}{2} = 8$$

$$a > 0 \text{ so } a = 8$$

$$\text{midline} = \frac{7.5 + (-8.5)}{2} = \frac{-1}{2} = -0.5$$

HOUR Model

This model works from  $x = 0$  at 7:00am

$$y = 8\cos\left(\frac{2\pi}{9}x\right) - 0.5 \text{ with } x = \text{measuring hours past 9:00am}$$

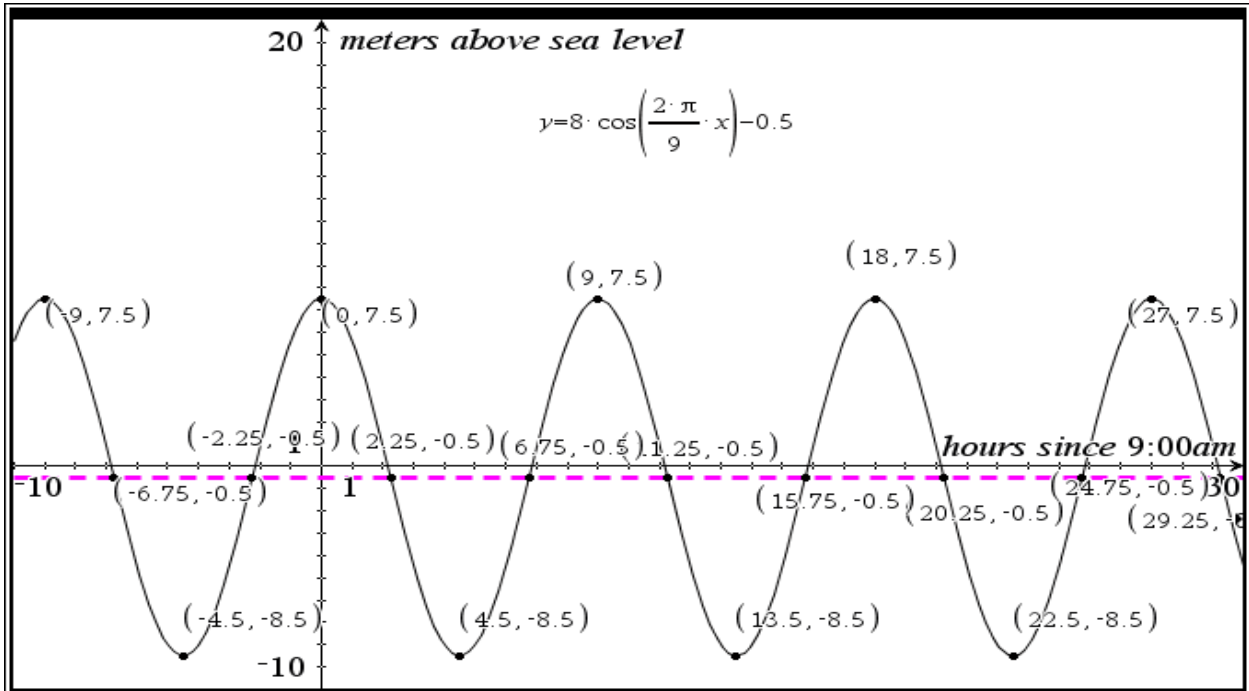
MINUTE Model

NOTE: 9 hours = 540 minutes

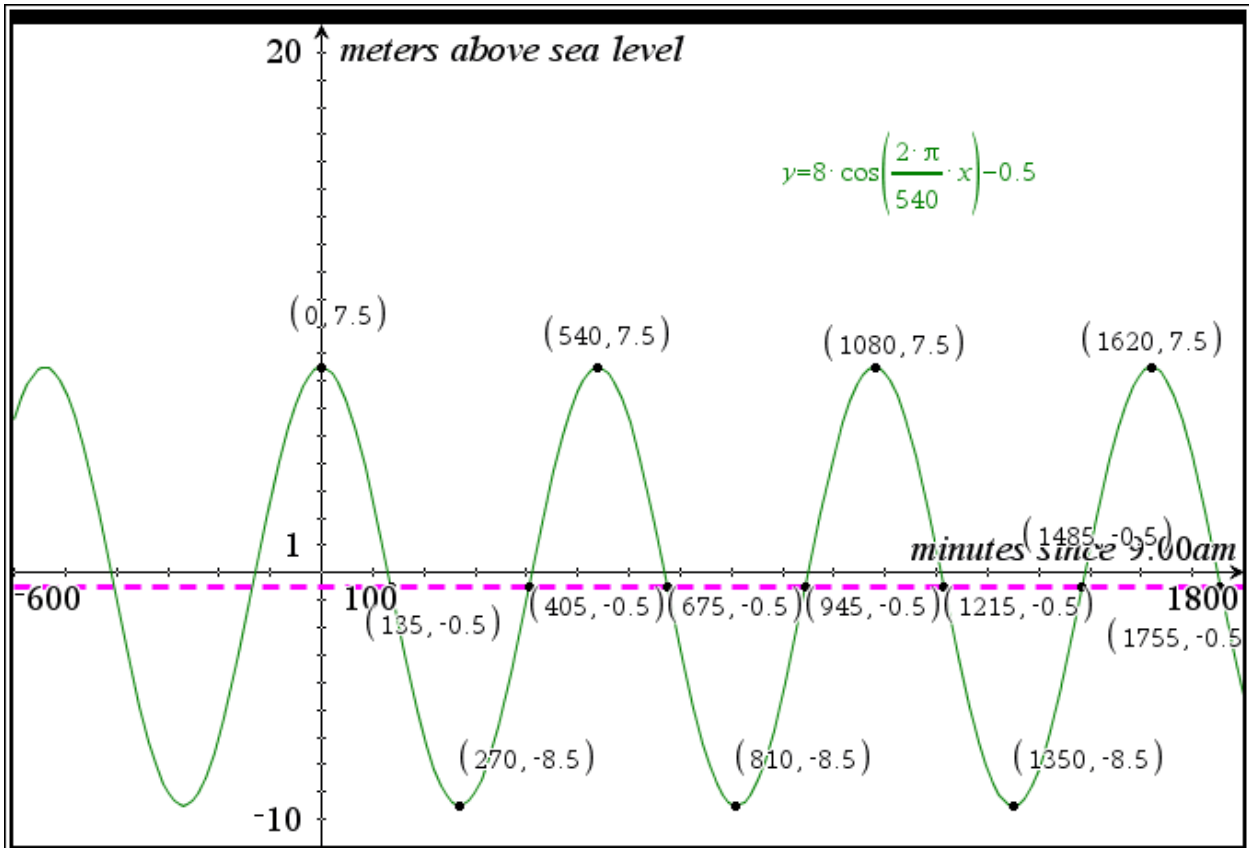
$$y = 8\cos\left(\frac{2\pi}{540}x\right) - 0.5 \text{ with } x = \text{measuring minutes past 9:00am}$$

4. Label the critical points on the model you built on the provided graph

HOURLY MODEL

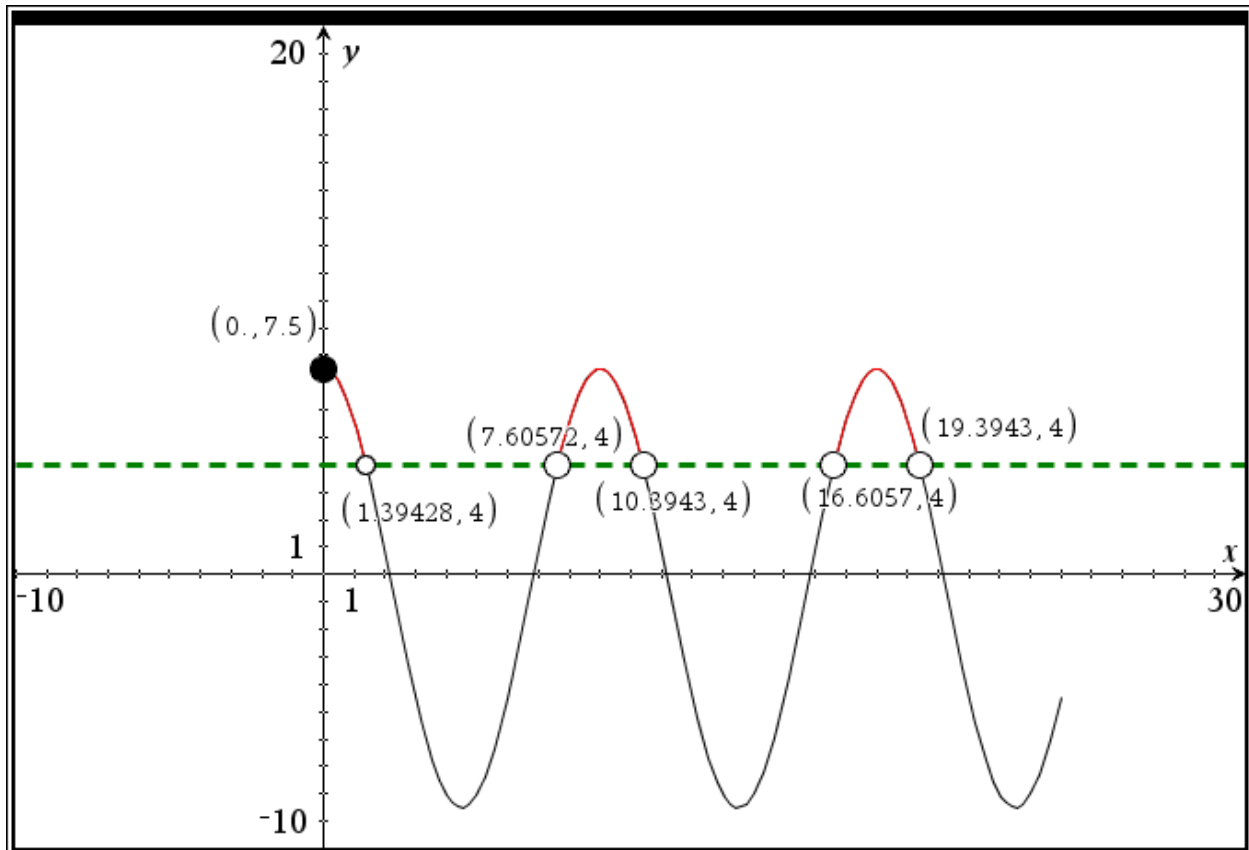


MINUTE MODEL



5. State the time intervals when the tide is 4 meters above the mean level of the ocean

Time intervals when height is 4 meters above mean sea level



These are all hours since 9:00 am

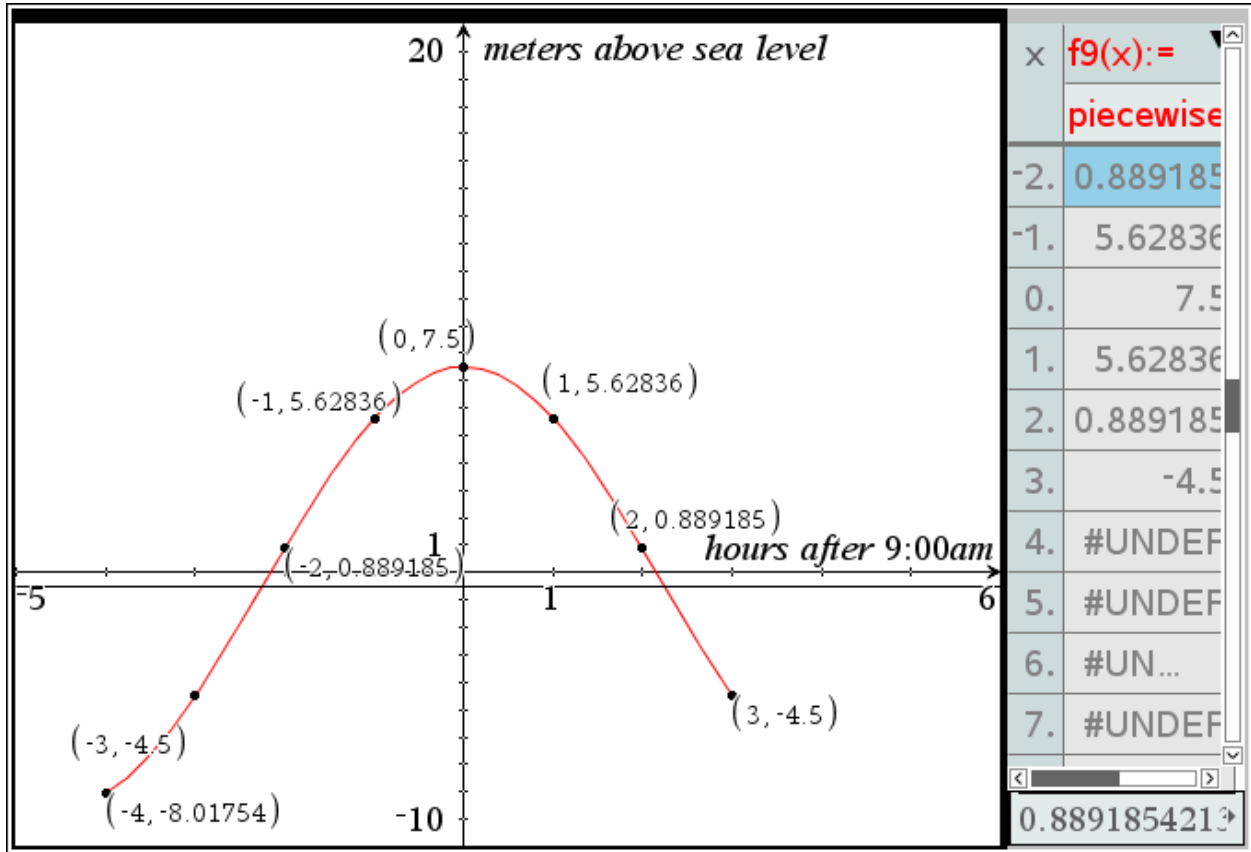
Intervals when wave is ABOVE 4 meters  $[0, 1.39)$  or  $(7.61, 10.39)$  or  $(16.61, 19.39)$

Intervals when wave is BELOW 4 meters  $(1.39, 7.61)$  or  $(10.39, 16.61)$  or  $(19.39, 24]$

TIMES when wave is AT 4 meters  $x = \{1.39, 7.61, 10.39, 16.61, 19.39\}$

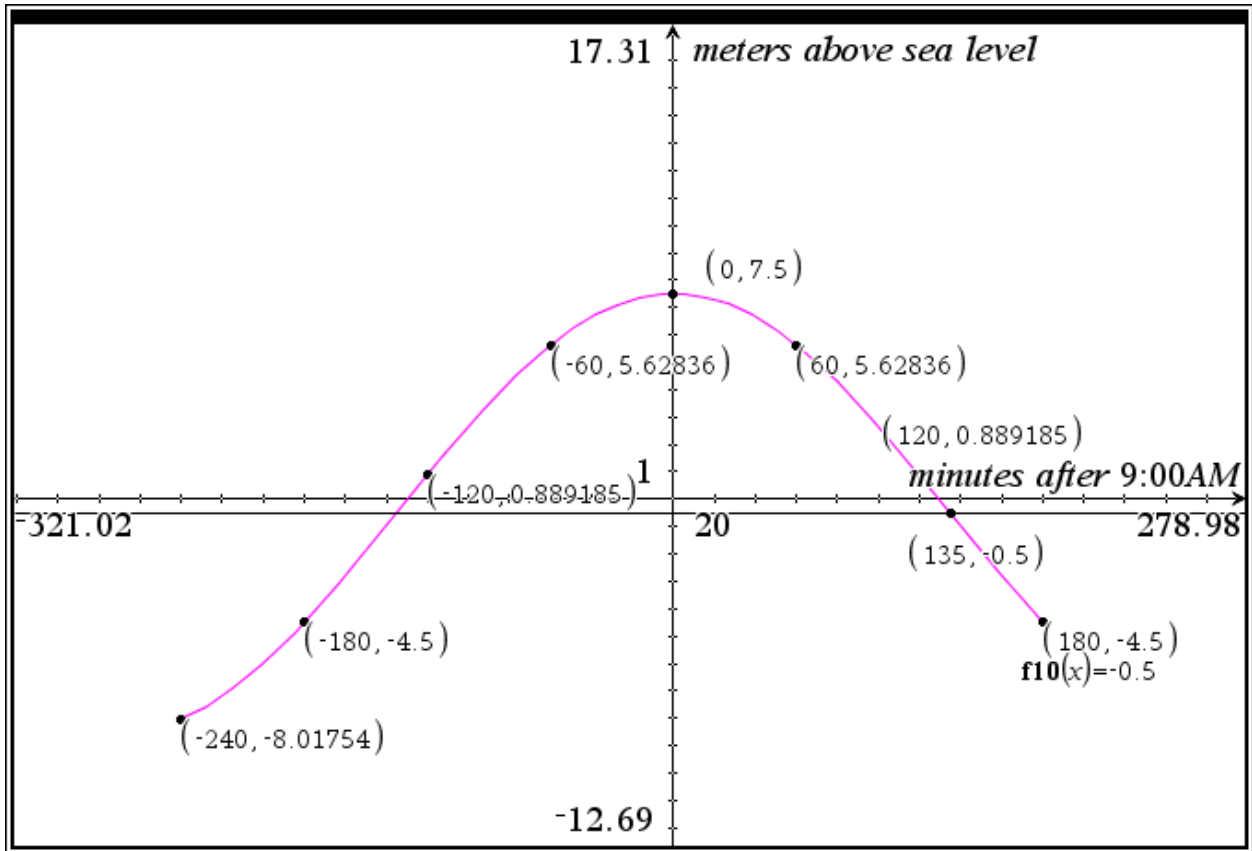
6. Complete the table as it relates to this model  
 HOUR MODEL

Time	5:00AM	6:00AM	7:00AM	8:00AM	9:00AM	10:00AM	11:00AM	12:00PM
X	-4	-3	-2	-1	0	1	2	3
Y	-8.01	-4.5	0.89	5.63	7.5 High Tide	5.63	0.89	-4.5



MINUTE Model

Time	5:00AM	6:00AM	7:00AM	8:00AM	9:00AM	10:00AM	11:00AM	12:00PM
X	-240	-180	-120	-60	0	60	120	180
Y	-8.01	-4.5	0.89	5.63	7.5 High Tide	5.63	0.89	-4.5

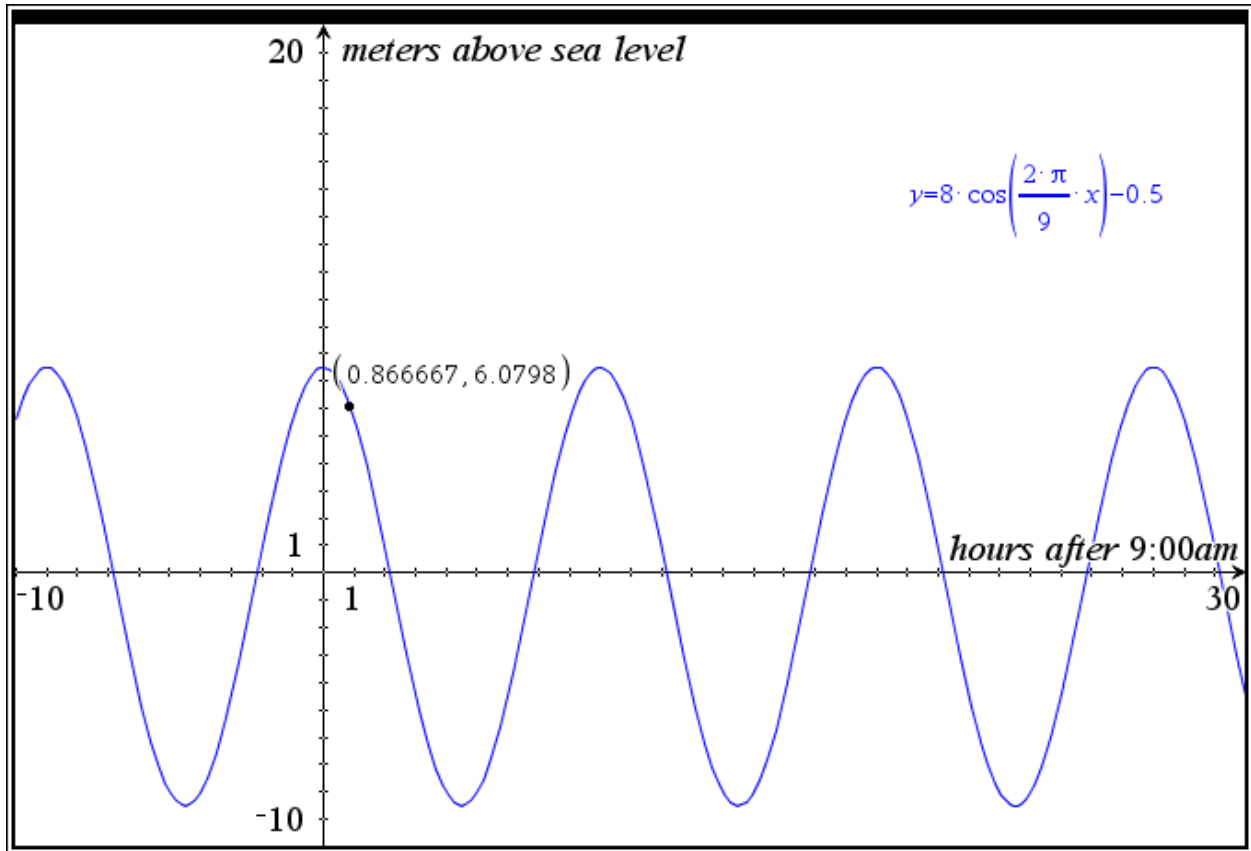


7. What is the height of the tide at 6:52PM (show the paper and pencil method and check with a graphing calculator)

Note: 9:52AM is 0 hours and 52 minutes past 9:00AM

Time = 52/60      Hour Model  $y = 8 \cos\left(\frac{2\pi}{9} \left(\frac{52}{60}\right)\right) - 0.5 \approx 6.08$

HOUR MODEL



What is the height of the tide at 9:52AM (show the paper and pencil method and check with a graphing calculator)

Note: 9:52AM is 52 minutes past 9:00AM

Time = 52 minutes      MINUTE Model  $y = 8 \cos\left(\frac{2\pi}{540}(52)\right) - 0.5 \approx 6.08$

