**Modelling Periodic Phenomena**

1. A Ferris wheel has a diameter of 15 m, and starts 1 m above the ground. It takes 3 minutes to complete one revolution.
2. Sketch the graph of the height of a rider versus the time in minutes.
3. Determine the period, amplitude and axis of the curve.
4. Use the period, amplitude, axis of the curve, and phase shift (from the graph) to determine an equation to model the height of the rider given time, t.
5. Use your equation to determine the height of the rider at each of the following times:

i. 4 minutes ii. 6 minutes iii. 7.5 minutes iv. 12 minutes

1. The Double Scoop Ice Cream Company tracked its mean monthly production of ice cream over the last two years.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Ice Cream Production in Thousand of Litres | | | | | | | | | | | | |
|  | Month | J | F | M | A | M | J | J | A | S | O | N | D |
|  | Year 1 | 168 | 181 | 219 | 222 | 246 | 276 | 264 | 252 | 219 | 204 | 181 | 174 |
|  | Year 2 | 169 | 180 | 220 | 221 | 245 | 274 | 265 | 251 | 219 | 203 | 180 | 175 |

1. Explain why it is reasonable to expect ice cream production to be periodic.
2. Determine a trigonometric model that best represents the data.
3. The depth of water in a harbour on the Bay of 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 |

1. Graph the data and determine an equation that models the situation.
2. Use the equation to determine the depth of the water at 10:30.
3. Use the equation to determine the depth of the water at 18:00.
4. The maximum height of a Ferris wheel is 35 m. The wheel takes 2 min to make one revolution. Passengers board the Ferris wheel 2 m above the ground at the bottom of its rotation.
5. Write an equation to represent the position of a passenger at any time, t, in seconds.
6. How high is the passenger after 45 seconds?

Solutions:

1. a) b) period = 3 minutes, a = 7.5, axis is y = 8.5

2

20

15

10

5

g

x





= 7.5



sin

120



x-0.75









+8.5

c) h = 7.5 sin 120(t-0.75) + 8.5 d) i) 12.25 m ii) 1 m iii) 16 m iv) 1 m

2. a) weather forms seasonal patterns that repeat every year. Ice cream production goes up

when it’s hot, and down when it’s cold.

b) y = 54 sin [30(x-3)] + 222

3. a) d(t) = 6 sin [30(x-3)] + 11.5 b) 7.3 m c) 17.5 m

5

10

20

15

10

5

g

x





= 6



sin

30



x-3









+11.5

4. a) s(t) = 16.5 sin [3(t-30)] + 18.5 b) 30.2 m