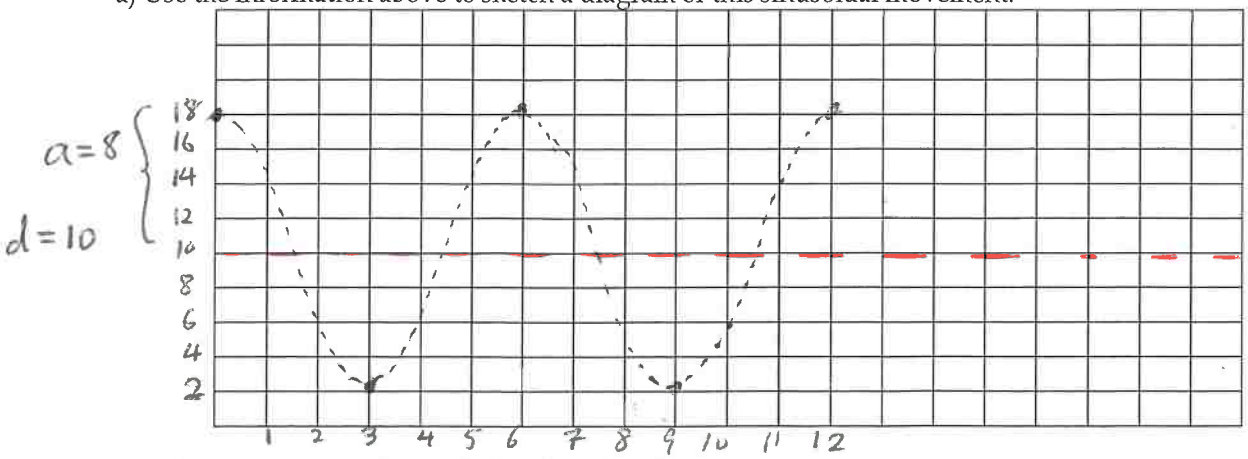
2.17 Sinusoidal Modeling Day 3 Date: _____

1. In Canada's wonderland there is a roller coaster that is a continuous series of identical hills that are 18m high from the ground. The platform to get on the ride is on top of the first hill. It takes 3 seconds for the coaster to reach the bottom of the hill 2m off the ground.

   a) Use the information above to sketch a diagram of this sinusoidal movement.



period = 6

period = $\frac{2\pi}{b}$

$6 = \frac{2\pi}{b}$

$6b = 2\pi$

$b = \frac{2\pi}{6} = \frac{\pi}{3}$

   b) Write a cosine function, h(t), that describes the situation in part a.

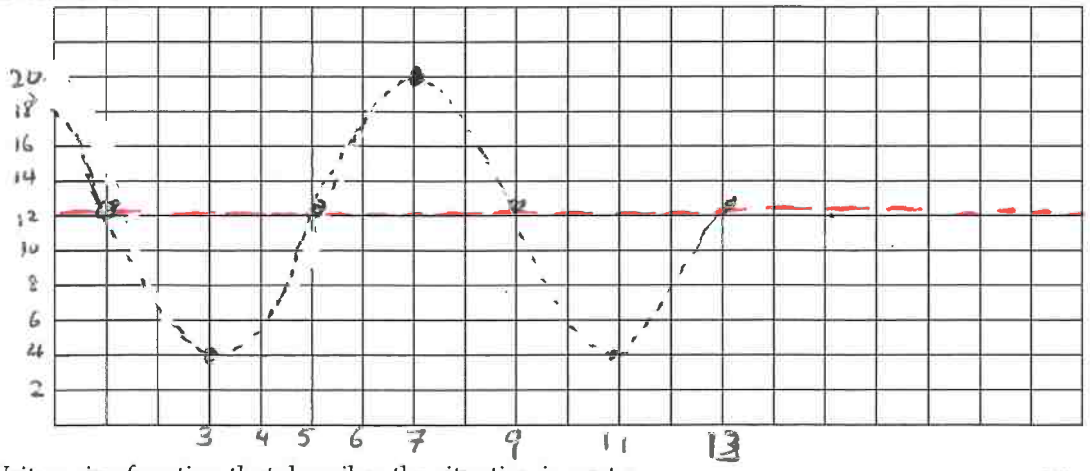
b) $h(t) = 8\cos\left(\frac{\pi}{3}t\right) + 10$

   c) Determine the height of the rider at 11 seconds. Answer in function notation.

c) $h(11) = 14$ ft.

2. Mr. Jones, disguised as Mathman, a costumed crime fighter, is swinging back and forth in front of the window for the Front Office. At t = 3 sec, he is at one end of his swing and 4m from the window. At t = 7 sec, he is at the other end of his swing and 20m from the window.

   a) Sketch the curve. Use the distance from the window on the vertical axis and the time in seconds along the horizontal axis.



period = 8

$8 = \frac{2\pi}{b}$

$8b = 2\pi$

$b = \frac{2\pi}{8} = \pi/4$

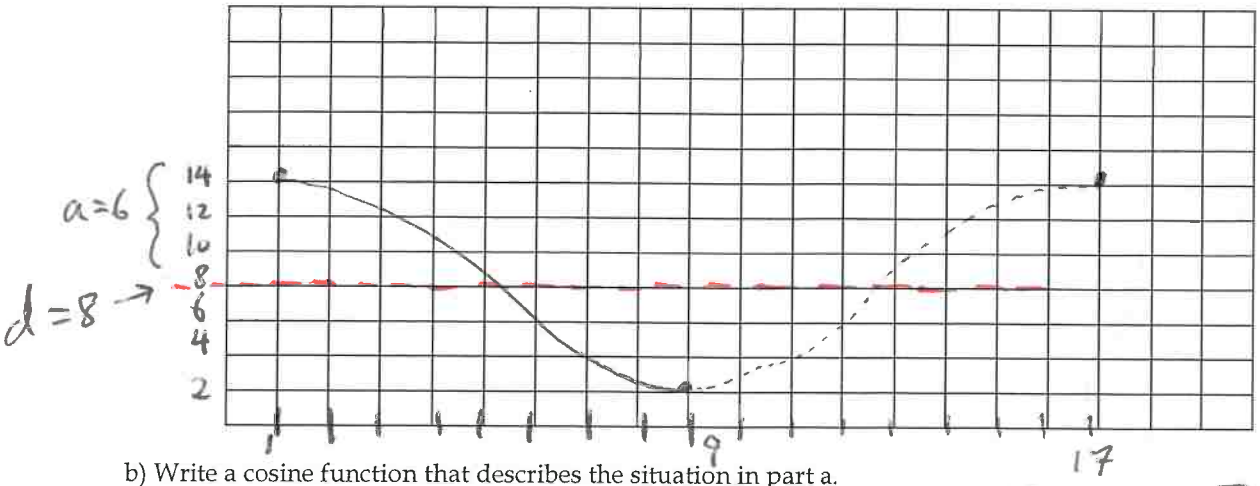
   b) Write a sine function that describes the situation in part a.

b) $d(t) = 8\sin\left[\pi/4(t-5)\right] + 12$

   c) When is the first time Mathman reaches 16m?

c) $t \approx 1/3$ second.

3. John is floating on a tube in a wave tank. At t = 1 second, John reaches a maximum height of 14m above the bottom of the pool. At t = 9 seconds, John reaches a minimum height of 2m above the bottom of the pool
a) Use the information above to sketch a diagram of this sinusoidal movement.



period = 8+8 = 16
$16 = \frac{2\pi}{b}$
$16b = 2\pi$
$b = \frac{2\pi}{16} = \frac{\pi}{8}$

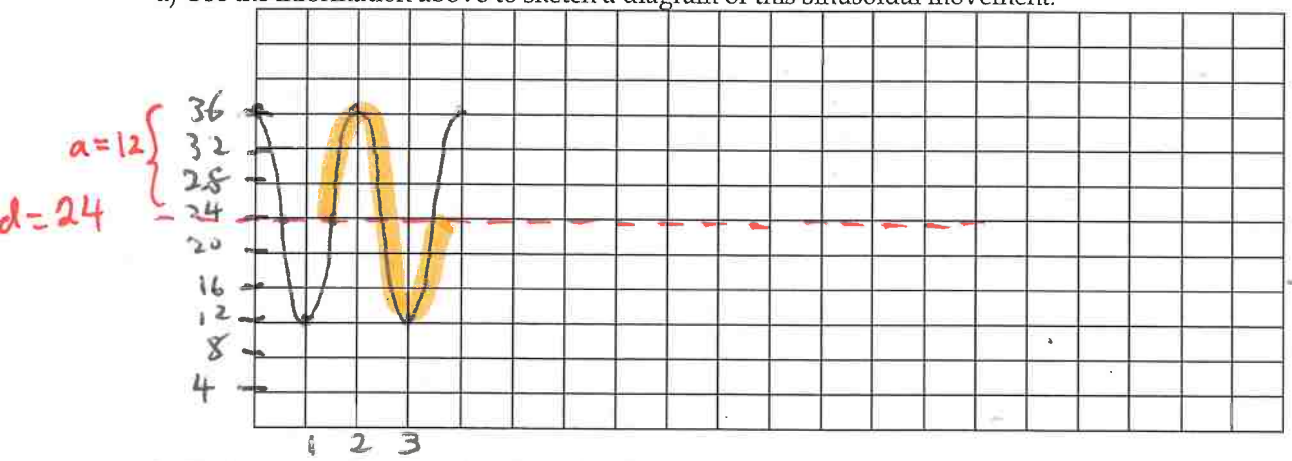
b) Write a cosine function that describes the situation in part a.

b) $h(t) = 6\cos\left[\frac{\pi}{8}(t-1)\right]+8$

c) What is John's height from the bottom of the pool at 21 seconds? c) 8m

4. A pendulum on a grandfather clock is swinging back and forth as it keeps time. A device is measuring the distance the pendulum is above the floor as it swings back and forth. At the beginning of the measurements the pendulum is at its highest point, 36 cm high exactly one second later it was at its lowest point of 12 cm. One second later it was back to its highest position.

a) Use the information above to sketch a diagram of this sinusoidal movement.



period = 2
$I = \frac{1}{4}\cdot P$
$I = \frac{1}{4}\cdot 2 = \frac{1}{2}$

$2 = \frac{2\pi}{b}$ | $b = \pi$
$2b = 2\pi$

b) Write a cosine function that describes the situation in part a.

b) $h(t) = 12\cos(\pi t)+24$

c) Write a sine function that describes the situation in part a.

$h(t) = -12\sin[\pi(t-0.5)]+24$

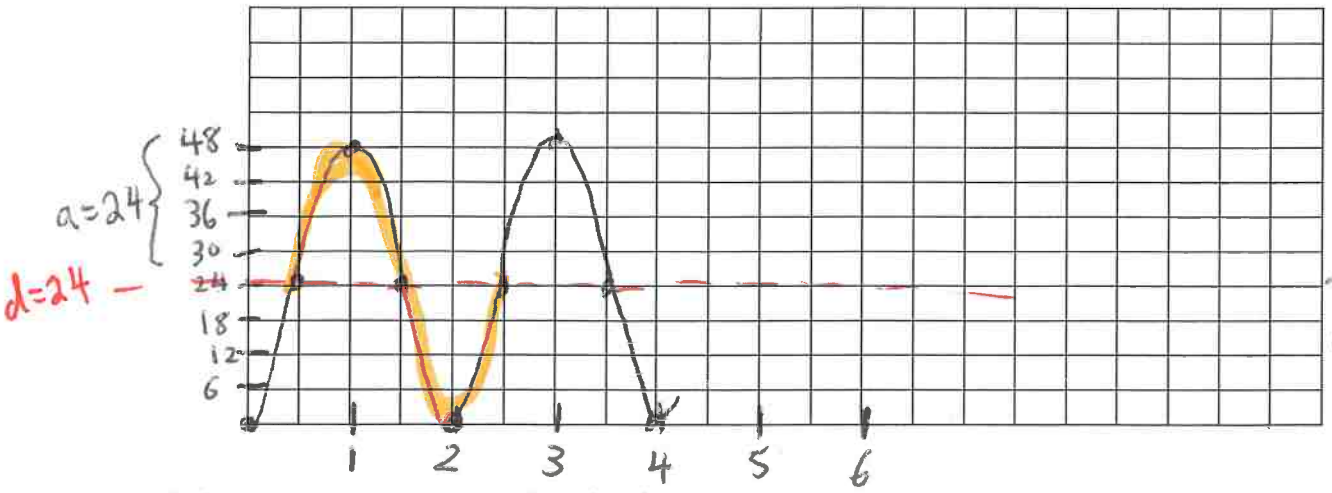
c) $h(t) = 12\sin[\pi(t-1.5)]+24$

d) When will the pendulum be at 15 cm if 2 < t < 3?

d) ≈ 2.7 secs.

5. Sam is riding his bike one day and picks up a nail in his tire. The nail hits the ground every 2 seconds and reaches a maximum height of 48 cm (assume the tire does not deflate).

a) Use the information above to sketch a diagram of this sinusoidal movement.



period = 2

$I = \frac{1}{4} \cdot P$

$I = \frac{2}{4} = \frac{1}{2}$

$2 = \frac{2\pi}{b}$

$2b = 2\pi$

$b = \pi$

b) Write a cosine function that describes the situation in part a.

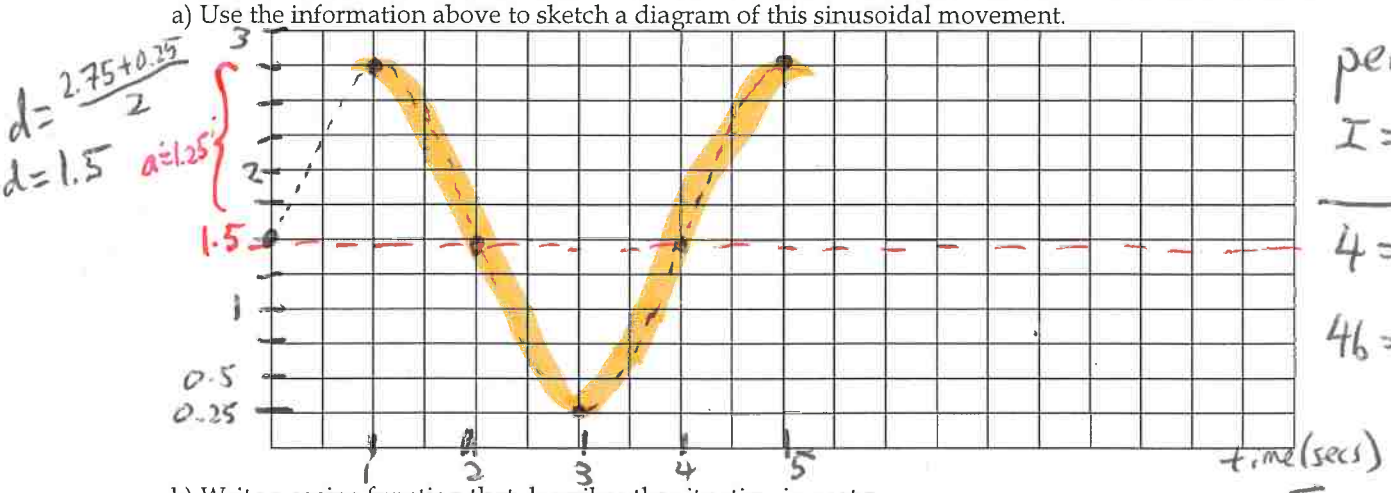
b) $h(t) = -24\cos(\pi t) + 24$

c) Write a sine function that describes the situation in part a.

c) $h(t) = 24\sin[\pi(t - \frac{1}{2})] + 24$

6. Jackie, Nicolle and Maegan are playing skip rope. As the rope rotates it is observed that its maximum height is 2.75m after 1 second. The first minimum height of 0.25m occurs 2 seconds after the maximum height.

a) Use the information above to sketch a diagram of this sinusoidal movement.



period = 4

$I = \frac{1}{4} \cdot 4 = 1$

$4 = \frac{2\pi}{b}$

$4b = 2\pi$

$b = \frac{\pi}{2}$

b) Write a cosine function that describes the situation in part a.

b) $h(t) = 1.25\cos[\frac{\pi}{2}(t - 1)] + 1.5$

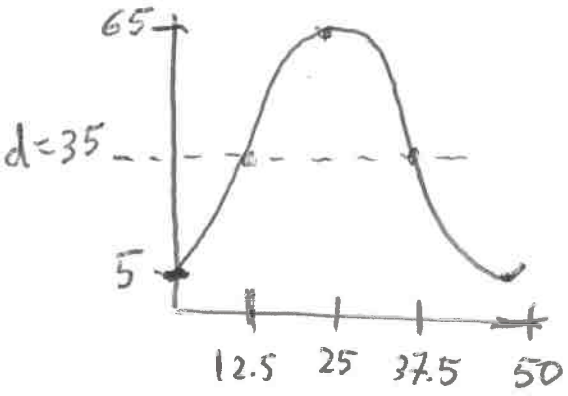
c) Write a sine function that describes the situation in part a.

c) $h(t) = 1.25\sin(\frac{\pi}{2}t) + 1.5$

d) What is the height of the rope at 2.75 seconds?

d) $h(2.75) = 0.345$ m

7. A Ferris wheel 60 ft in diameter makes one revolution every 50 seconds. If the center of the wheel is 35 feet above the ground, how long after reaching the low point is a rider 50 ft. above the ground? Write the function and the time. Show all your work.



period = 50 | $50b = 2\pi$

$50 = \frac{2\pi}{b}$ | $b = \frac{2\pi}{50} = \frac{\pi}{25}$

$I = \frac{1}{4} \cdot P$

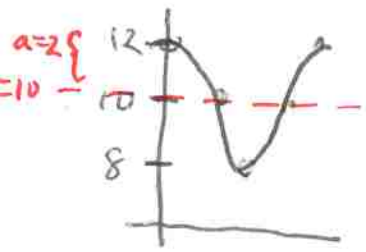
$I = \frac{1}{4} \cdot 50 = 12.5$

7. Function: $h(t) = -30\cos\left(\frac{\pi}{25}t\right) + 35$

Time: ≈ 17 secs.

8. Ebb and Flow: on a particular Labor Day, the high tide in South California occurs at 7:15 am. At that time, you measure the water at the end of the Santa Monica Pier to be 12 feet deep. At 1:36 pm, it is low tide and you measure the water to be only 8 feet deep. What is the depth at noon? Write the function and the depth.

$a = 2$



period = 381 + 381 = 762

$762 = \frac{2\pi}{b}$

$b = \frac{2\pi}{762} = \frac{\pi}{381}$

8. Function: $h(t) = 2\cos\left(\frac{\pi}{381}t\right) + 10$

Depth: $h(285) \approx 8.595$ ft.

↑ noon