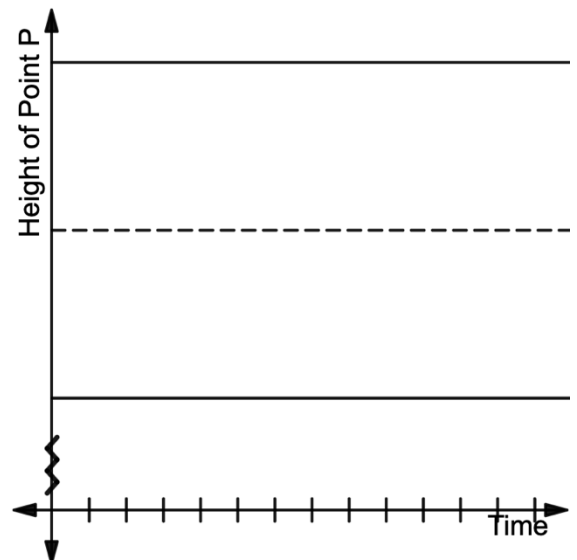


What Does the Clock Say?

The Desmond family has an analog clock in their living room. The clock has a diameter of 16 inches and the bottom of the clock is 6 feet above the floor. The minute hand is 7 inches long and the hour hand is 4 inches long. Let P be a point on the tip of the minute hand. The function p models the height of Point P above the ground, in inches, as a function of time t in minutes. The time $t = 0$ corresponds to the time shown, 10:10 AM.



1. How high above the ground, in inches, is the center of the clock? How do you know?
2. What is the maximum and minimum height of Point P ? How do you know?
3. How long does it take for Point P to make one full rotation?
4. After how many minutes will Point P reach its lowest height? After how many minutes will Point P reach its highest height?
5. Sketch a graph of $y = p(t)$. Scale and label your axes appropriately.



6. What is the height of Point P at $t = 0$? Explain your reasoning.
7. The function p can be written as $p(t) = a \cos(b(t - c)) + d$ for some constants a, b, c , and d . Find the values of the constants.
8. An alternate equation for p is given by $p(t) = A \sin(B(t - C)) + D$ for some constants, A, B, C , and D . Explain how A, B, C , and D compare to a, b, c , and d .
9. Let Q be a point on the tip of the hour hand. The function q can be used to model the height of Point Q , measured in inches, after t minutes, where $t = 0$ corresponds to 10:10 AM. Compare and contrast the graphs of p and q with respect to each of the following features:
- Amplitude
 - Maximum
 - Minimum
 - Midline
 - Period