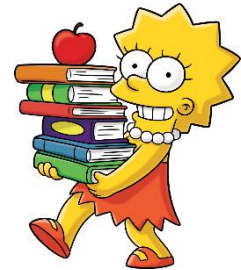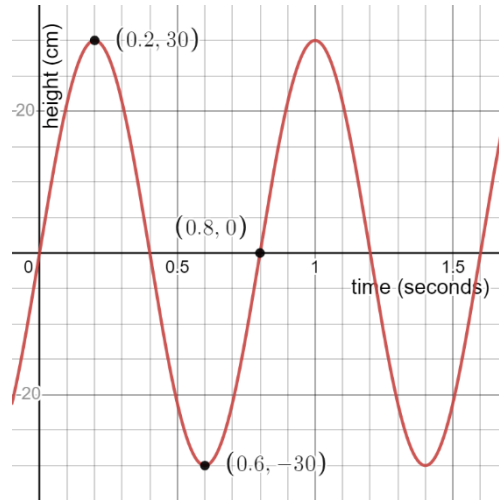## Unit Circle Problem-solving Practice Questions

Question 1 (1 + 2 + 1 +2 + 1 + 1 =8 marks)

Lisa attaches a tag onto one of the spokes at the rim of Bart's bike as he rides as a constant speed. She records the height of the tag with respect to its starting position with a video.

The vertical axis represents the height (cm) of the tag from its starting position with the video and the horizontal axis represents the time (seconds) since Bart started riding.

a) How long does it take for the wheel to rotate once?

_____

b) Find the equation of the graph above

c) What is the radius of the wheel?

_____

d) Calculate the circumference of the wheel.

_____

e) How would you expect the amplitude of the graph to change if Lisa repeated the experiment with her dad's bike- which has a larger wheel?

_____

f) How would you expect the graph to change if Bart started riding the bike faster?

1

Question 2 (2 + 2 + 2 + 1 = 7 marks)

A weather station models the daily temperature variation using the function $y = 12\sin(3\theta)$, where y represents the deviation in temperature (in degrees Celsius) from the average temperature throughout the day, and θ is the time in hours from midnight.

a) What is the amplitude of this function, and what does it represent in this context?

b) How many complete cycles of temperature variation occur in 24 hours? Explain your reasoning.

c) Calculate the period of the function and explain what it represents in this context.

d) Determine the frequency of this function in terms of the number of cycles per hour.

Question 3 (1 + 1 + 1 + 1 = 4 marks)

A company tracks the daily power consumption using the function $y = 8\sin(2\theta)$, where y represents the deviation from the average power consumption in kilowatts, and θ is the time in hours from midnight.

a) What does the amplitude of 8 represent in this context?

b) How many complete cycles of power consumption occur in a day

c) Calculate the period of the function.

d) If the company wants to minimize power consumption during peak hours (between 6 AM and 9 AM), suggest a strategy based on the function provided. What changes might indicate a successful implementation of this strategy?

Question 4 (2 + 1 + 1 + 1 = 5 marks)

A research team models the daily hours of sunlight in a remote area using the function $y = 10\cos(4\theta)$, where y represents the deviation in hours of sunlight from the average throughout the day, and θ is the time in hours from midnight.

a) What is the amplitude of this function, and what does it represent in this context?

b) How many complete cycles of sunlight variation occur in 24 hours?

c) Calculate the period of the function.

d) Determine the frequency of this function in terms of the number of cycles per hour.

Question 5 (2 + 4 + 4 = 10 marks)

The height of tides in a particular costal area is modeled by the function $y = 4sin\frac{\pi}{10}t$, where y is the height of the tide in metres and t is the time in hours from midnight, $0 \leq t \leq 24$.

a) Identify the amplitude and explain its significance in terms of tide height.

b) Sketch one complete cycle of this function over the course of 24 hours. Label the amplitude, period, and key points on your sketch.
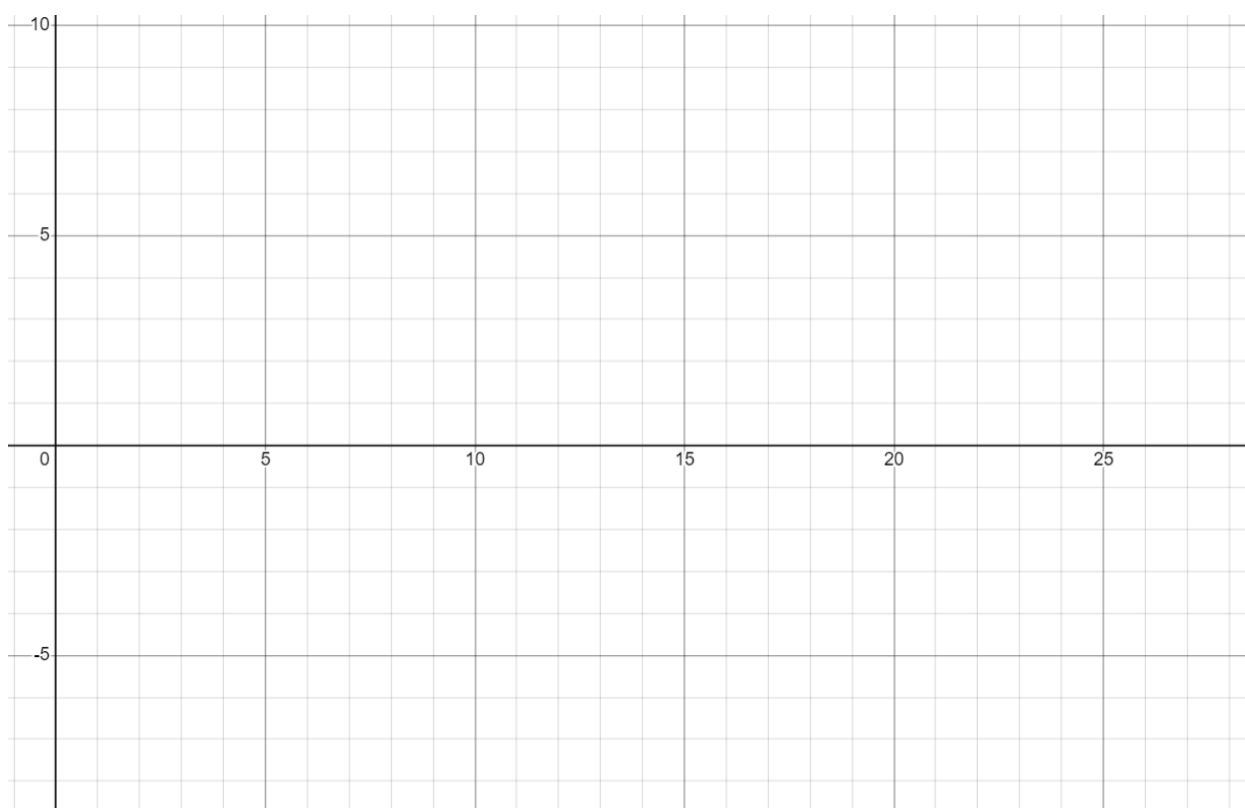
c) [Extension question]
   If a ship needs at least 2 meters of water to dock safely, during which hours of the day can the ship safely dock?

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