MODELLING WITH CIRCULAR FUNCTIONS

Question 1

After jumping, a bungee jumper finds that his motion can be described by the equation:

$h(t) = 9 - 5\cos(\frac{\pi t}{10})$, where h is the height in metres above the ground and t is the time in seconds after reaching his lowest point.

a. Find the period and the amplitude of the motion.

b. Sketch the graph of $h(t)$ versus t for two complete cycles.

c. Find his height when $t = 2.5$. Give your answer as an exact value.

d. Find, by solving a trigonometric equation, the times, over the first 40 seconds, when the jumper is 11.5 metres above the ground.

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e.i. Find, correct to three decimal places, the times, during the first ~~10~~ seconds, for which the height is over 13 metres.

ii. Hence calculate the percentage of time during the motion for which the jumper is more than 13 metres above the ground. Give your answer correct to one decimal place.

Question 2

The temperature inside a house can be described by the function:

$T(t) = 15 + 8\sin(\frac{\pi t}{12})$, $0 \le t \le 24$, where T is the temperature in degrees Celsius and t is the number of hours after midday.

a. Sketch the graph of T over the specified domain.

b. Determine the maximum and minimum temperatures inside the house.

c. Find, to the nearest minute, the times when it is 21°C inside the house.

d. Find the temperature at 2 pm.

The house is insulated and it now has an average temperature of 12°C and the largest variation from this is 4°C. The function now has the form:

$T(t) = a + b\sin(\frac{\pi t}{12})$.

e. Find the values of a and b.

f. At what values of t would the house, before and after insulation, have had the same temperature? Give your answer correct to two decimal places.