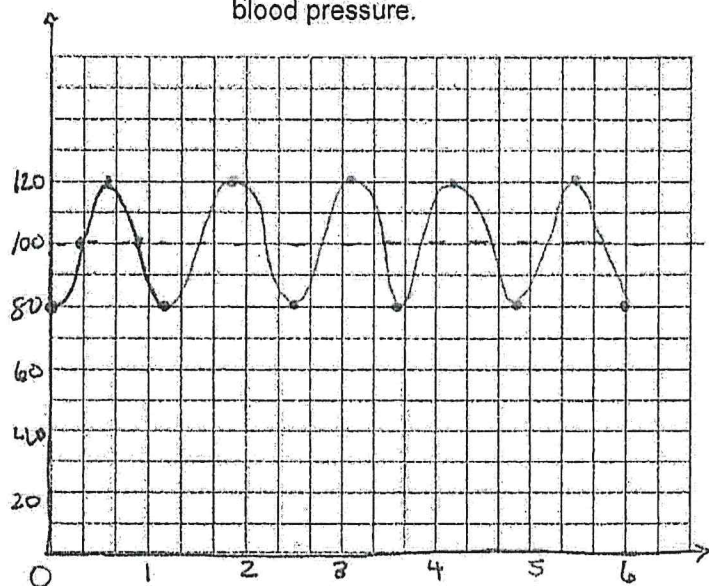


## 5.7 - Applications of Trigonometric Functions (Day 2)

**Example 1:** Each person's blood pressure is different, but there is a range of blood pressure values that is considered healthy. The function  $P(t) = -20 \cos\left(\frac{5\pi}{3}t\right) + 100$  models the blood pressure of a person at rest, where "P" is the blood pressure in millimetres of mercury, and "t" is the time in seconds.

- What is the period of the function? What does the period represent for an individual?
- How many times does this person's heart beat each minute?
- Sketch the graph of  $y = P(t)$  for  $0 \leq t \leq 6$ . *5 cycles.*
- What is the range of the function? Explain the meaning of the range in terms of a person's blood pressure.



$$\begin{aligned} \text{max} &= 120 \\ \text{axis} &= 100 \\ \text{min} &= 80 \end{aligned}$$

$$\begin{aligned} \text{a) Period} &= \frac{2\pi}{5\pi/3} \\ &= 2 \times \left(\frac{3}{5}\right) \\ &= \frac{6}{5} \end{aligned}$$

This means that one full pressure cycle (heartbeat) occurs every  $\frac{6}{5}$  sec. (1.2 sec).

$$\text{b) } \frac{60 \text{ sec}}{1.2} = 50 \text{ beats/sec.}$$

$$\text{c) } \left\{ \text{PER} \mid 80 \leq P \leq 120 \right\}$$

A healthy person's heart ranges in pressure from 80 to 120

**Example 2:** The water depth in a harbour is 21m at high tide and 11m at low tide. One cycle is completed approximately every 12h.

a) Determine an equation for the water depth as a function of time,  $t$  hours, after low tide.

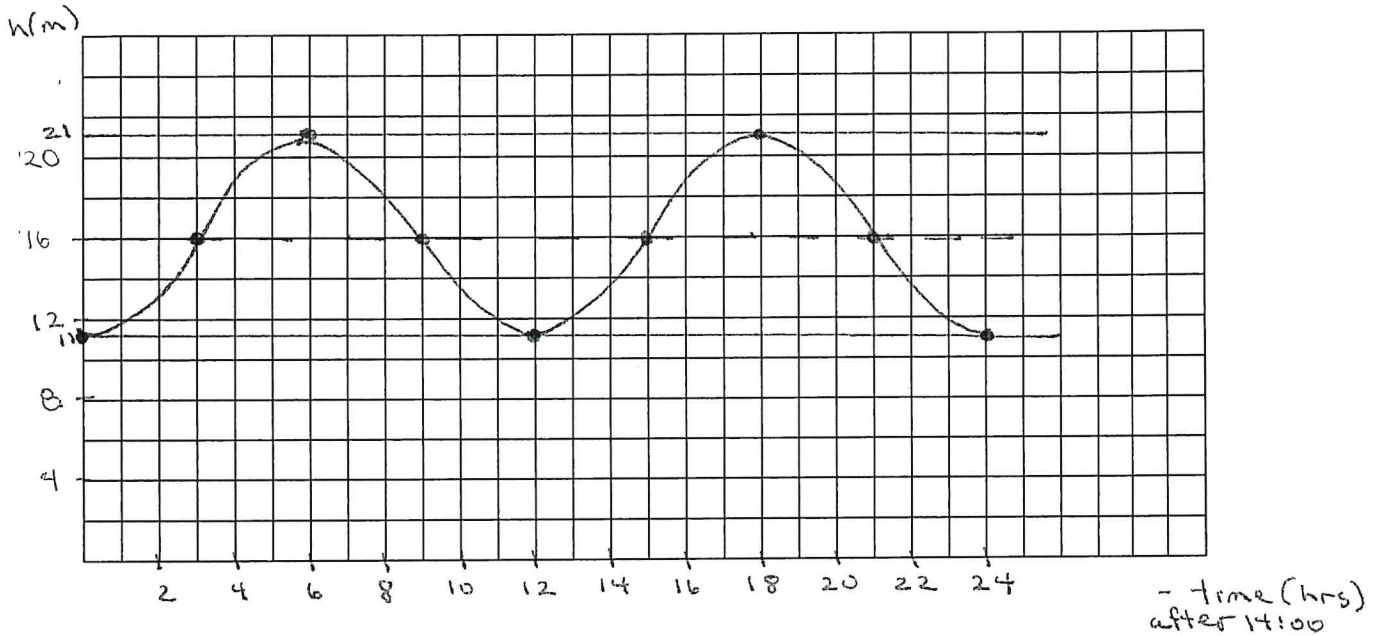
b) Draw a graph of the function for 24h after low tide, which occurred at 14:00. (2 pm)

c) State the times at which the water depth was  
i) a maximum. ii) a minimum.

d) Estimate the depth of the water at  
i) 17:00 ii) 21:00

e) Estimate the times at which the depth of the water was 14m.

Let  $y$  rep water depth (m)  
Let  $x$  rep elapsed time (hrs)



min: 11m

max: 21m

$$\text{axis: } \frac{11+21}{2} = 16$$

$$\text{amp: } \frac{21-11}{2} = 5$$

1 cycle = 12 hrs

2 cycles: 24

key points:  $\frac{12}{4} = 3$

$$k \text{ value: } \frac{2\pi}{12} = \frac{\pi}{6}$$

$$y = -5 \cos \frac{\pi}{6} x + 16$$

c) max: 6 hrs after 14:00 + 12 hrs later (period)  
 $\therefore$  20:00 and 08:00

min: 14:00 + 12n  $\therefore$  14:00, 2:00

d) depth at 17:00 is 16m and at 21:00 is 21m.

e)  $14 = -5 \cos \frac{\pi}{6} x + 16$

$$\frac{3}{5} = \cos \frac{\pi}{6} x$$

$$0.4 = \cos \theta$$

$\theta = 1.1593$  or  $5.1207$   
 $\frac{\pi}{6} x = 1.1593$      $\frac{\pi}{6} x = 5.1207$   
 $x = 2.2$      $x = 9.78$

14:00 + 2:12 = 16:12  
 + 12 hours (1 cycle)  
 = 4:12  
 14:00 + 9:47 = 11:47  
 + 12 hours = 23:47

let  $\theta = \frac{\pi}{6} x$

\* 0.2 hours = 0.2 x 60 = 12 min.