

$$1. \quad a = 5 \quad c^2 = a^2 + b^2$$

$$b = 12 \quad c^2 = 25 + 144$$

$$c^2 = 169$$

$$c = 13$$

let $x = 13$

$$\frac{169}{25} - 1 = \frac{y^2}{144}$$

$$5.76 = \frac{y^2}{144}$$

$$829.44 = y^2$$

$$28.8 = y$$

$$k = 0$$

$$A = 28.8 \Rightarrow a = \pm 28.8$$

$$\textcircled{1} \quad h = 0$$

$$p = 26 \Rightarrow b = \pm \pi/13$$

$$f(x) = -28.8 \cos(\pi/13 x)$$

$$\textcircled{2} \quad h = 13$$

$$f(x) = 28.8 \cos(\pi/13(x-13))$$

$$\textcircled{3} \quad h = 6.5$$

$$f(x) = 28.8 \sin(\pi/13(x-6.5))$$

$$2. \quad 9 = 6 \sin\left(\frac{\pi t}{12} + \frac{2\pi}{3}\right) + 6$$

$$3 = 6 \sin\left(\frac{\pi t}{12} + \frac{2\pi}{3}\right)$$

$$1/2 = \sin\left(\frac{\pi t}{12} + \frac{2\pi}{3}\right)$$

$$\frac{\pi t}{12} + \frac{2\pi}{3} = \frac{\pi}{6} \quad \text{or} \quad \frac{\pi t}{12} + \frac{2\pi}{3} = \frac{5\pi}{6}$$

$$\frac{\pi t}{12} = \frac{\pi}{6} - \frac{4\pi}{6}$$

$$\frac{\pi t}{12} = \frac{5\pi}{6} - \frac{4\pi}{6}$$

$$\frac{\pi t}{12} = -\frac{3\pi}{6}$$

$$\frac{\pi t}{12} = \frac{\pi}{6}$$

$$t = -\frac{3\pi}{6} \cdot \frac{12}{\pi}$$

$$t = \frac{\pi}{6} \cdot \frac{12}{\pi}$$

$$t = -6$$

$$t = 2$$

$$b = \pi/12$$

$$p = \frac{2\pi}{\pi/12} = 2\pi \cdot \frac{12}{\pi}$$

$$= 24$$

Over 120 seconds

$$-6 + 24 = 18$$

$$2 + 24 = 26$$

$$18 + 24 = 42$$

$$26 + 24 = 50$$

$$42 + 24 = 66$$

$$50 + 24 = 74$$

$$66 + 24 = 90$$

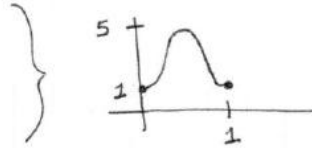
$$74 + 24 = 98$$

$$90 + 24 = 114$$

$$98 + 24 = 122$$

Answer: 10 signals are emitted during the experiment

3. minimum = 1m
 maximum = 5m
 period = 1 minute
 13.00 = time 0



$$A = \frac{5-1}{2} = \frac{4}{2} = 2 \quad a = \pm 2$$

$$b = \frac{2\pi}{1} \Rightarrow \pm 2\pi$$

$$h = 0$$

$$k = 5 - 2 = 3$$

$$\therefore f(x) = -2 \cos(2\pi x) + 3$$

x = time in minutes

$$\text{let } x = 12 \frac{40}{60}$$

$$= 12 \frac{2}{3}$$

$$= \frac{38}{3}$$

$$f\left(\frac{38}{3}\right) = -2 \cos\left(2\pi\left(\frac{38}{3}\right)\right) + 3$$

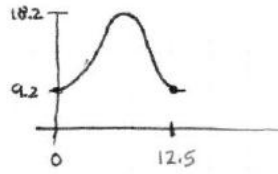
$$= -2\left(-\frac{1}{2}\right) + 3$$

$$= 1 + 3$$

$$= 4$$

The height of the water jet is 4 metres.

4. minimum = 9.2
 maximum = 18.2
 $p = 12.5$



$$A = \frac{18.2 - 9.2}{2} = \frac{9}{2} = 4.5 \quad a = \pm 4.5$$

$$k = 18.2 - 4.5 = 13.7$$

$$b = \frac{2\pi}{12.5} \text{ or } \frac{4\pi}{25}$$

$$h = 0$$

$$f(x) = -4.5 \cos\left(\frac{4\pi}{25}(x)\right) + 13.7$$

$$\text{let } y = 14.5$$

$$14.5 = -4.5 \cos\left(\frac{4\pi x}{25}\right) + 13.7$$

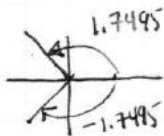
$$0.8 = -4.5 \cos\left(\frac{4\pi x}{25}\right)$$

$$-0.17 = \cos\left(\frac{4\pi x}{25}\right)$$

$$\frac{4\pi x}{25} = \cos^{-1}(-0.17)$$

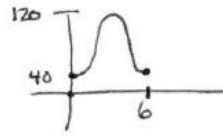
$$\frac{4\pi x}{25} = 1.7495 \quad \text{or} \quad \frac{4\pi x}{25} = 4.5337$$

$$x = 3.48 \quad \text{or} \quad x = 9.02$$



Answer: $9.02 - 3.48 = 5.54$ hours

5. minimum = 40 cm
 maximum = 120 cm
 frequency = $\frac{10 \text{ cycles}}{1 \text{ minute}} = \frac{10 \text{ cycles}}{60 \text{ seconds}}$
 period = $\frac{1}{f} = \frac{60 \text{ seconds}}{10 \text{ cycles}} = 6 \text{ seconds/cycle}$



$$A = \frac{80}{2} = 40$$

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

$$K = 40 + 40 = 80$$

$$h = 0$$

$$f(x) = -40 \cos(\pi/3(x)) + 80$$

let $x = 5$

$$f(5) = -40 \cos\left(\frac{5\pi}{3}\right) + 80$$

$$f(5) = -40\left(\frac{1}{2}\right) + 80$$

$$f(5) = -20 + 80$$

$$f(5) = 60$$

The height of the head is 60 cm.

6. $A = \frac{22-2}{2} = \frac{20}{2}$

$$= 10$$

$$K = 22 - 10 = 12$$

$$h = 0$$

$$p = 30 \Rightarrow b = \frac{2\pi}{30} = \frac{\pi}{15}$$

$$f(x) = -10 \cos\left(\frac{\pi}{15}x\right) + 12$$

let $x = 20$

$$f(20) = -10 \cos\left(\frac{10\pi}{15}\right) + 12$$

$$= -10 \cos\left(\frac{2\pi}{3}\right) + 12$$

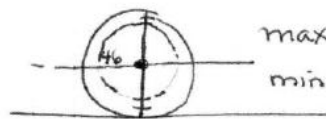
$$= -10\left(-\frac{1}{2}\right) + 12$$

$$= 5 + 12$$

$$= 17$$

Tom's seat is 17 m above the ground

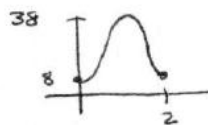
7. $p = 2$ seconds
radius = 23 cm = middle
 $23 - 4 - 4 = 15$ cm = $A = a$



$\max = 46 - 8 = 38$
 $\min = 8$

$k = 23$

$p = 2 = b = \pi$
 $h = 0$



$f(x) = -15 \cos(\pi x) + 23$
let $y = 33$

$33 = -15 \cos(\pi x) + 23$
 $10 = -15 \cos(\pi x)$
 $-\frac{10}{15} = \cos(\pi x)$
 $-\frac{2}{3} = \cos(\pi x)$



$\pi x = \cos^{-1}(-\frac{2}{3})$

$\pi x = 2.3$

$x = 0.73$ seconds

$\pi x = 2\pi - 2.3$

$\pi x = 3.9832$

$x = 1.27$ seconds

Times: $\{0.73, 1.27, 2.73, 3.27\}$

8. $A = \frac{3 - (-3)}{2} = \frac{6}{2} = 3$

$a = \pm 3$

$p = \pi \Rightarrow b = \frac{2\pi}{\pi} \Rightarrow \pm 2$

$h = 0$

$k = 0$

$f(x) = 3 \sin(2x)$

let $x = 3.2$

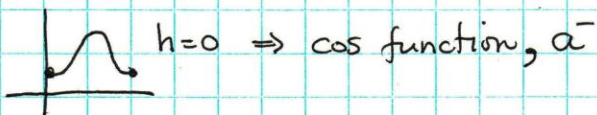
$f(3.2) = 3 \sin(2 \cdot 3.2)$
 $= 3 \sin(6.4)$
 $= 0.35$ mm

9. $\min = 1.5 \text{ m or } 150 \text{ cm}$
 $\max = 150 + 9.08 = 159.08$

$$A = \frac{159.08 - 150}{2} = 4.54 \Rightarrow a = \pm 4.54$$

$$p = 0.875 \Rightarrow b = \pm \frac{2\pi}{0.875} = \pm \frac{16\pi}{7}$$

$$K = 150 + 4.54 = 154.54$$

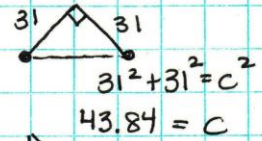


$$f(x) = -4.54 \cos\left(\frac{16\pi}{7}x\right) + 154.54$$

let $x = 1 \text{ hour} = 3600 \text{ seconds}$

$$f(3600) = -4.54 \cos\left(\frac{16\pi(3600)}{7}\right) + 154.54$$

$$= 155.55 \text{ m}$$



$43.84 \div 2 = 21.92$
 $x^2 = 31^2 - 21.92^2$
 $x = \sqrt{31^2 - 21.92^2}$
 $x = 21.92$

