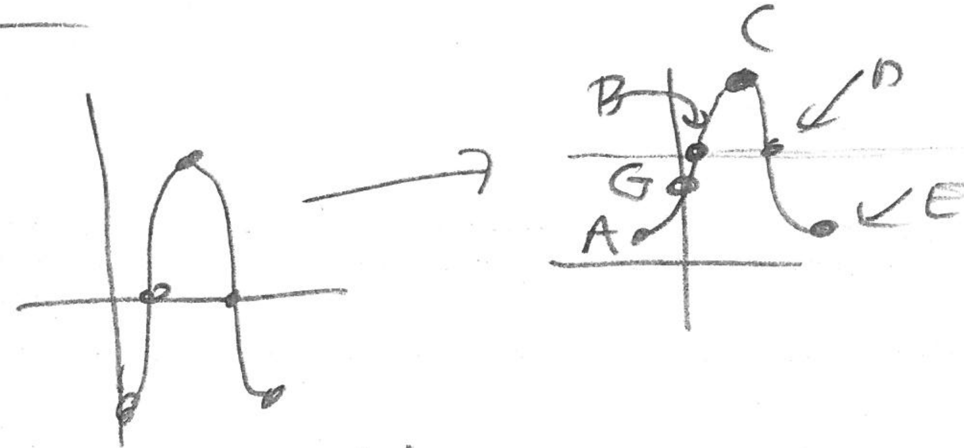
Problem (1) cont

So since 

G = given starting height

(0, f(G)) = starting height

time from G to C is 3 seconds
time from A to E is 8 seconds
time from A to C is 4 seconds
So time from A to G is 1 second
this means $y = a\,trig\left(\frac{2\pi}{period}(x+1)\right)+d$

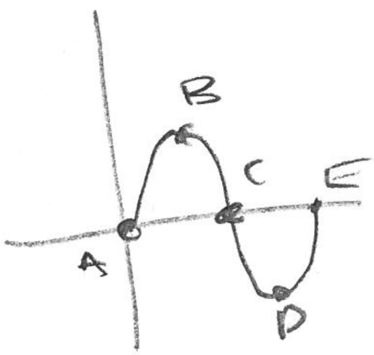
this is THE hardest part of this model

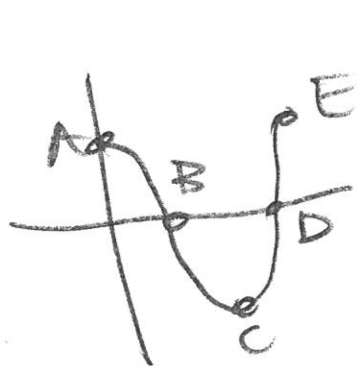
# PROBLEM ①

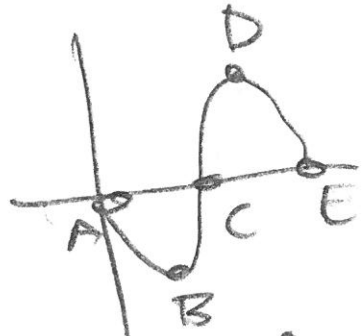
Start with time

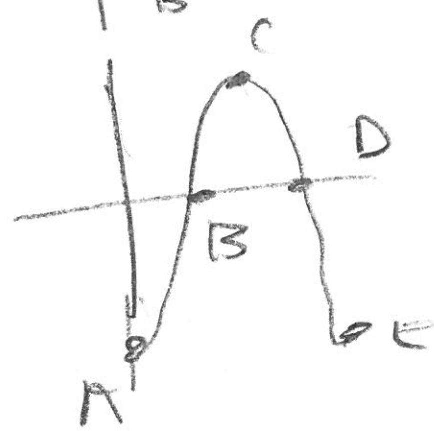
Time fact ① = 1 revolution = 8 sec
(this is period)

What does time fact ① tell us




If A = start
$= 0$

$B = \frac{1}{4}$ ride $= 2$ sec

$C = \frac{2}{4}$ ride $= 4$ sec

$D = \frac{3}{4}$ ride $= 6$ sec

$E = \frac{4}{4}$ ride $= 8$ sec

Problem (1) cont

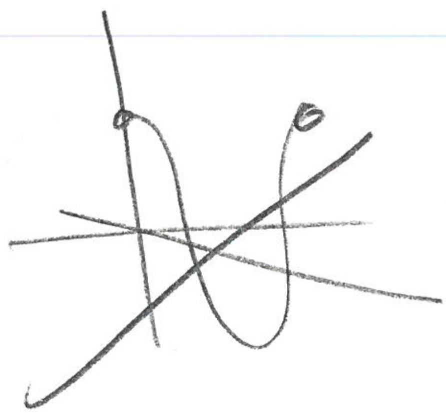
Time Fact (2) It took 3seconds

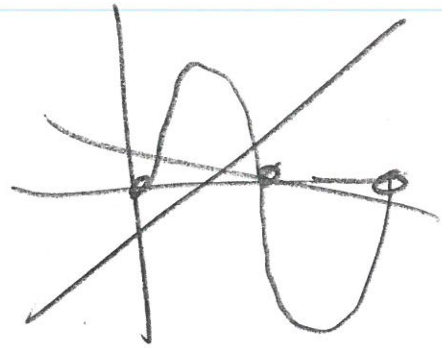
to reach maximum,

Timefact (2) implies we start BELOW max $\longrightarrow a < 0$

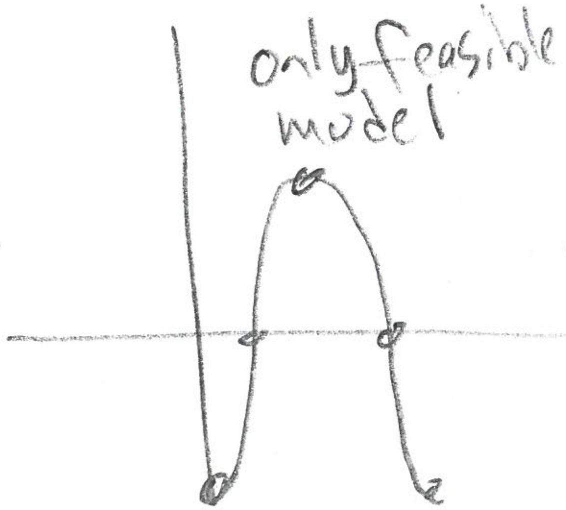
also we start somewhere other than pts A, B, C, D or E

so

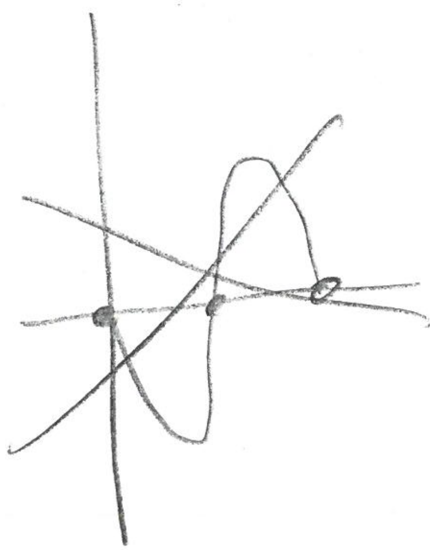




eliminate three possible models




or



Problem ① cont

Wheel fact ① diameter = 40 ft

implies $r = 20$ ft

Note in ferris wheel model

$$y = a \text{ trig}\left(\frac{2\pi}{\text{period}}(x \pm \text{phase})\right) + d$$

$a = \pm$ radius

So we Now know

$$y = -20\cos\left(\frac{2\pi}{\text{period}}(x+1)\right) + d$$

but we know period = 8 sec

So $y = -20\cos\left(\frac{2\pi}{8}(x+1)\right) + d$

Problem 1 cont

Height Fact 1   Max height = 43 ft

Note   max height = Diameter + platform

Note   max height = 2 radius + platform

So this gets us 1 platform height
2 "d"

max height = diameter + platform
43 = 40 + platform
43 − 40 = platform

$\boxed{\text{platform} = 3 \text{ ft}}$

Note d = radius + platform

$\boxed{d = 20 + 3 = 23}$

So finally    Problem 1

Model    General Mode

$$h(x) = a\,\text{trig}\left(\frac{2\pi}{\text{period}}\left(x \pm \text{phase shift}\right)\right) + d$$

a depends on mode of travel

a = ± radius

period = length of ride

phase shift    depends on where rider start sout

d = radius + platform height

platform height = Max − diameter

= midline − radius

Problem(1) cont

Max − radius
radius + platform

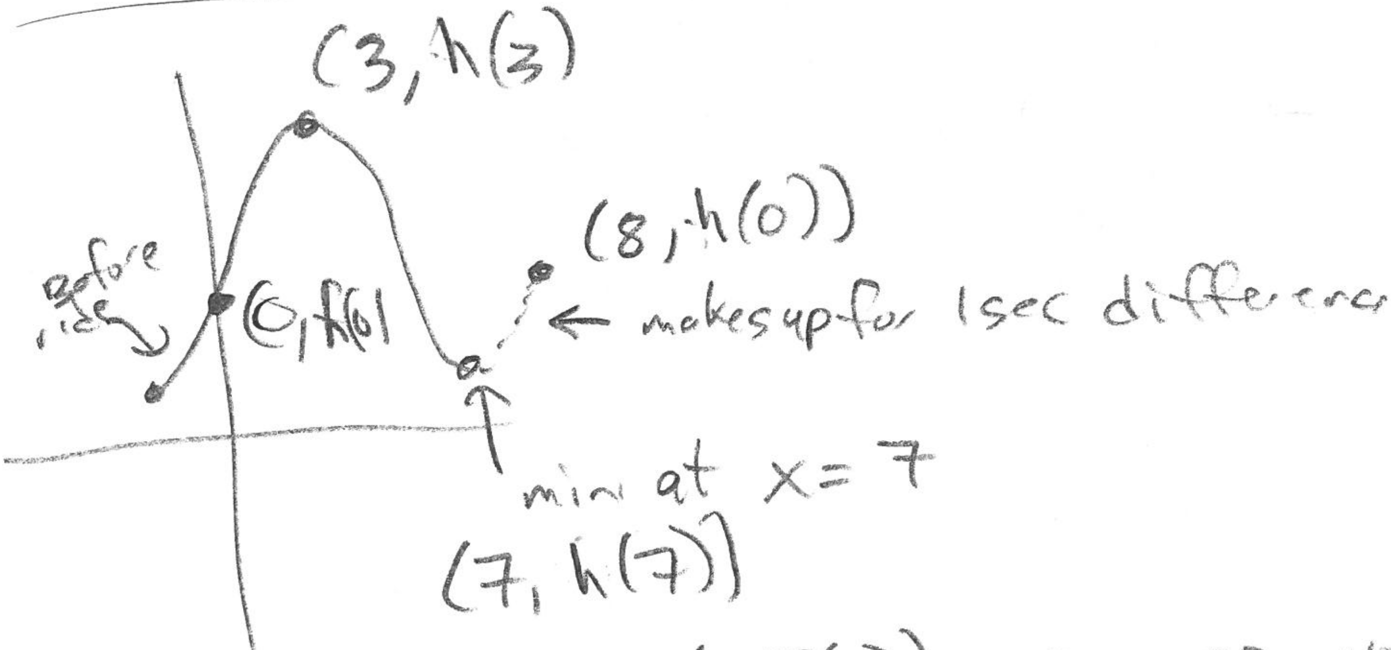
## Our model

$$h(x) = -20\cos\left(\frac{2\pi}{8}(x+1)\right)+23$$

−radius

length of ride

~~tough~~ but 3 sec to top told us




test $h(0) = -20\cos\left(\frac{2\pi}{8}(1)\right)+23 = 23-10\sqrt{2} \approx 8.$

$h(3) = -20\cos\left(\frac{2\pi}{8}(4)\right)+23 = 43$

$h(7) = -20\cos\left(\frac{2\pi}{8}(8)\right)+23 = 3$

Problem 1 Now lets answer Paul's Questions

1A) Done

1B) we did not "officially do

Max - diameter = platform height

$43 - 40 = \boxed{3 = \text{platform height}}$

1C) Done $h(x) = -20\cos\left(\frac{2\pi}{8}(x+1)\right)+23$

(easiest to see)

1d) $h(6) = -20\cos\left(\frac{2\pi}{8}(6+1)\right)+23$

$= -20\cos\left(\frac{14\pi}{8}\right)+23$

$= -20\cos\left(\frac{7\pi}{4}\right)+23$

$= -20\left(\frac{\sqrt{2}}{2}\right)+23 = 23 - 10\sqrt{2}$

$\approx 8.858$ ft

1d $h\left(\frac{13}{3}\right) = -20\cos\left(\frac{2\pi}{8}\left(\frac{13}{3}+1\right)\right) + 23$

$= -20\cos\left(\frac{2\pi}{8}\cdot\frac{16}{3}\right) + 23$

$= -20\cos\left(\frac{32\pi}{24}\right) + 23$

$= -20\cos\left(\frac{4\pi}{3}\right) + 23$

$= -20\left(-\frac{1}{2}\right) + 23$

$= 33$

---

$h(0) = -20\cos\left(\frac{2\pi}{8}(0+1)\right) + 23$

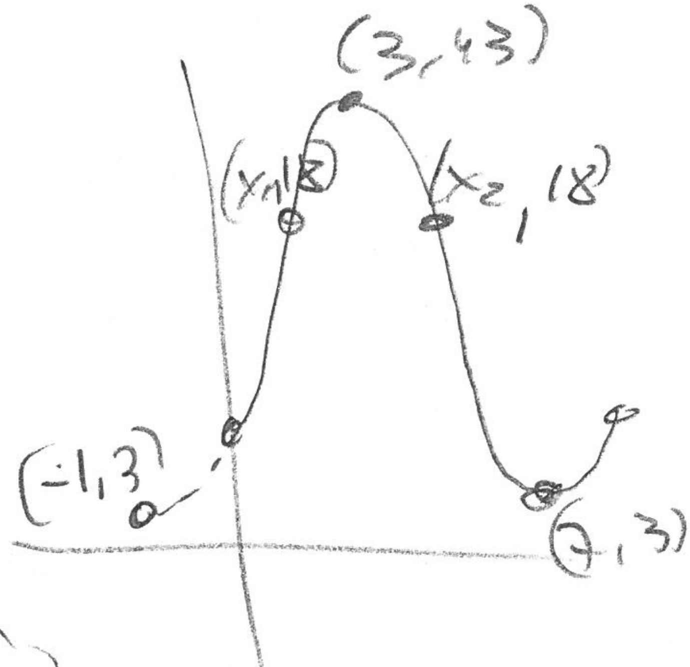
$= -20\cos\left(\frac{2\pi}{8}\right) + 23$

$= -20\left(\frac{\sqrt{2}}{2}\right) + 23$

$= -10\sqrt{2} + 23$

$\approx 8.858$

Problem ①




1e

$\boxed{h(x) = 18 \text{ for 2nd time}}$

Easy with calculator (graphing)

Set $18 = h(x)$

$18 = -20\cos\left(\frac{2\pi}{8}(x+1)\right) + 23$

take $x_2 > 3$ solution

$\boxed{x \approx 5.32}$

(1E) without calculator

$$18 = -20\cos\left(\frac{2\pi}{8}(x+1)\right)+23$$

$$18-23 = -20\cos\left(\frac{2\pi}{8}(x+1)\right)$$

$$-5 = -20\cos\left(\frac{2\pi}{8}(x+1)\right)$$

$$\frac{-5}{-20} = \cos\left(\frac{2\pi}{8}(x+1)\right)$$

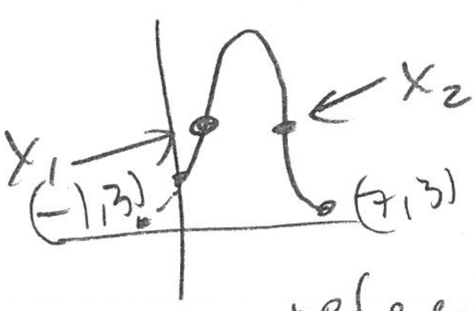
$$\frac{1}{4} = \cos\left(\frac{2\pi}{8}(x+1)\right)$$

$$\cos^{-1}\left(\frac{1}{4}\right) = \frac{2\pi}{8}(x+1)$$

$$\frac{8}{2\pi}\left(\cos^{-1}\left(\frac{1}{4}\right)\right) = x+1$$

$$x_1 = -1 + \frac{8}{2\pi}\cos^{-1}\left(\frac{1}{4}\right)$$

$$\approx 0.678$$

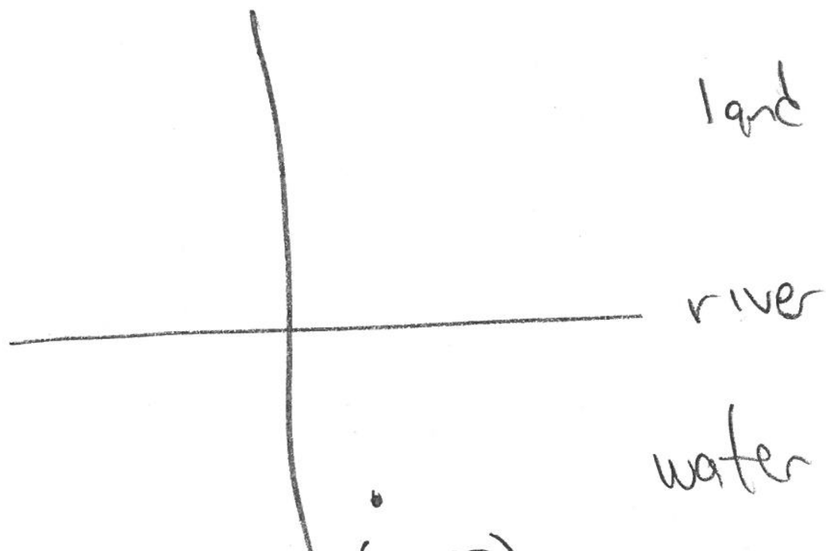



$$\boxed{\begin{aligned} x_2 &= 7 - \frac{8}{2\pi}\cos^{-1}\left(\frac{1}{4}\right) \\ &\approx 5.322 \end{aligned}}$$

referencing is awesome!

Problem 2

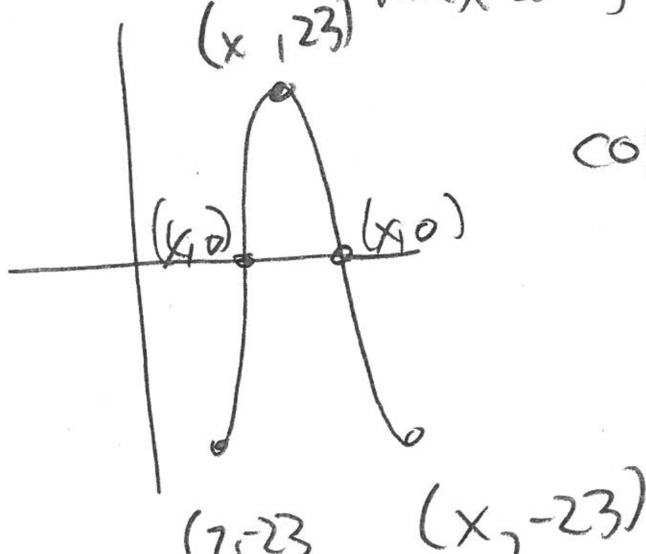
tarzon Problem




(2,-23)

time — distance away from river bank

max away from river bank



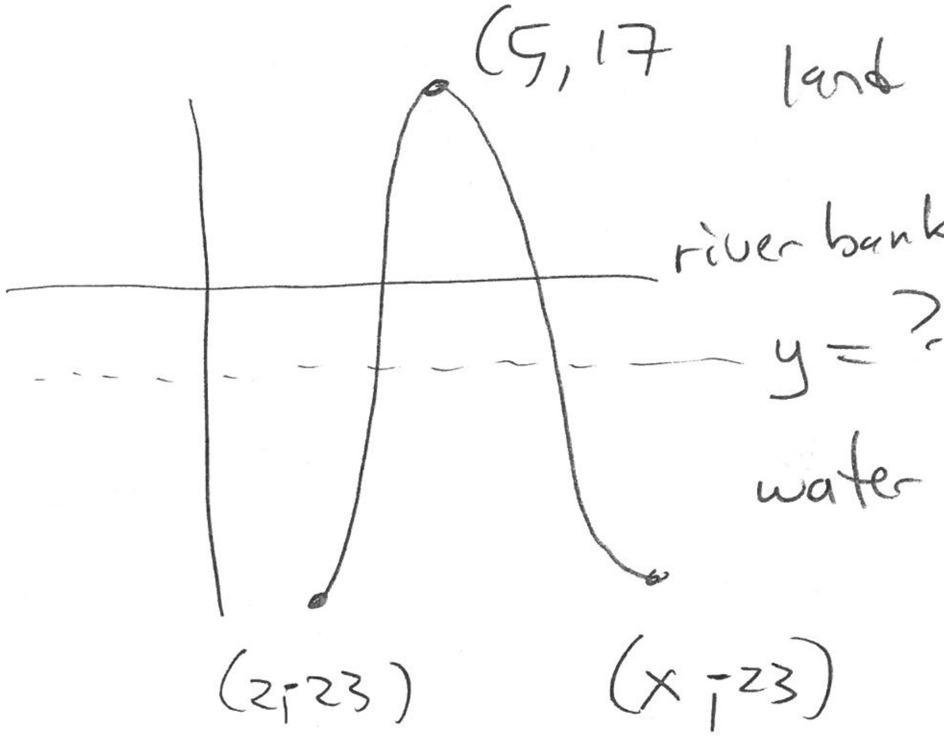

cosine model

we know

$$y = a \cos\left(\frac{2\pi}{\text{period}}(x-2)\right) + d$$

with $a<0$

## Problem ② Tarzan Problem




$\left|\underset{\text{water}}{\text{max}}\right|$ to $\left|\underset{\text{land}}{\text{max}}\right| = |-23| + |17| = 40$

So range $= 40$   $\frac{1}{2}$ range $=$ amplitude $= \boxed{20}$

$$\text{So } y = -20\cos\left(\frac{2\pi}{\text{period}}\left(x-2\right)\right) + d$$

reflected cosine

can find now

shifts right

can find now

Problem (2)

$\frac{1}{2}$ ride is for 2 to 5 or 3 sec

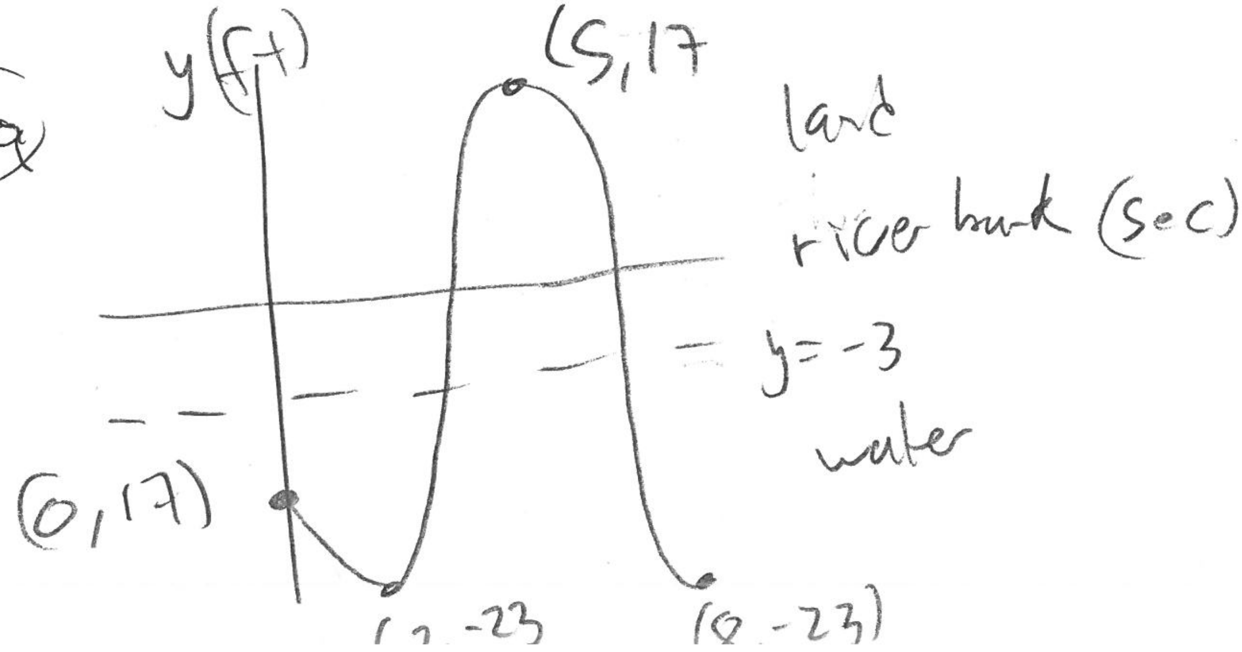
period = whole ride = 2(3) = 6 sec.

So $y = -20\cos\left(\frac{2\pi}{6}(x-2)\right) + d$

$d = \frac{1}{2}(-23+17) = \frac{1}{2}(-6) = -3$

So model $\boxed{y = -20\cos\left(\frac{2\pi}{6}(x-2)\right) - 3}$

(2a)



Problem 2b $f(x) = -20\cos\left(\frac{2\pi}{6}(x-2)\right) - 3$

---

Problem 2d $f(0) = -20\cos\left(\frac{2\pi}{6}(0-2)\right) - 3$

$$= -20\cos\left(-\frac{4\pi}{6}\right) - 3$$

$$= -20\cos\left(-\frac{2\pi}{3}\right) - 3$$

$$= 17$$

Jane is 17 ft over water when she starts stopwatch

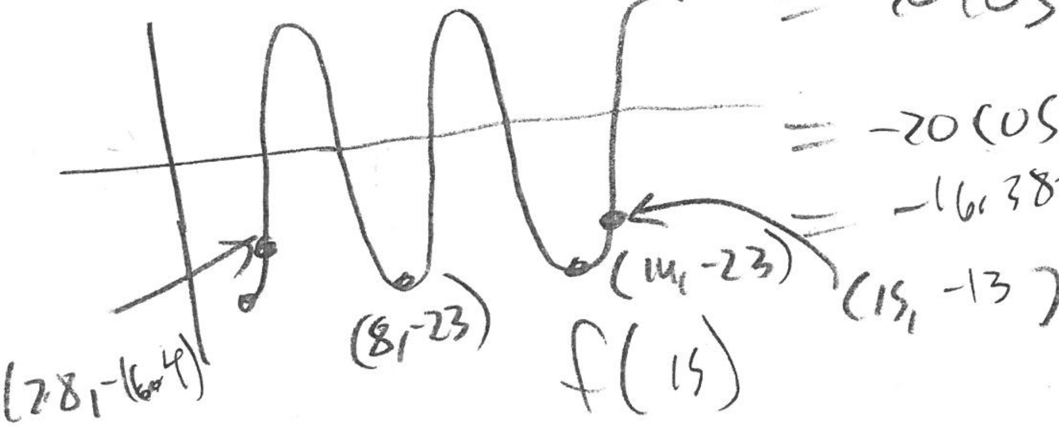
---

Problem 2c $f(2.8) = -20\cos\left(\frac{2\pi}{6}(2.8-2)\right) - 3$

$$= -20\cos\left(\frac{1.6}{6}\pi\right) - 3$$

$$= -20\cos\left(\frac{16}{60}\pi\right) - 3$$

$$= -16.383$$

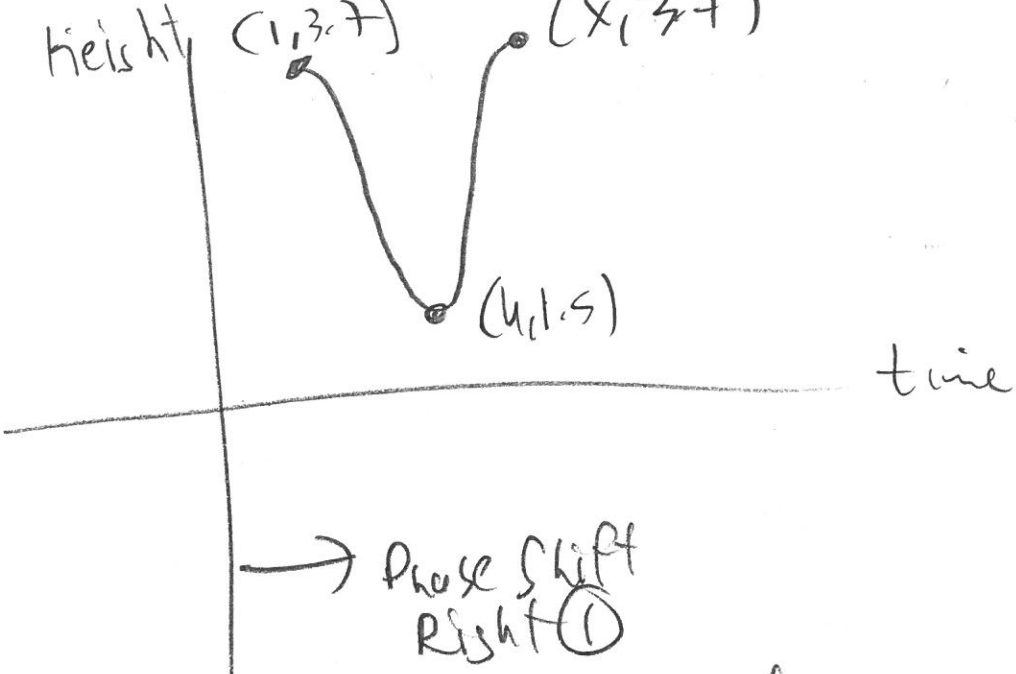



$f(15)$

$$f(15) = -20\cos\left(\frac{2\pi}{6}(15-2)\right) - 3$$

$$= -20\cos\left(\frac{26\pi}{6}\right) - 3 = -13$$

Problem 3 Oil well




This is phase shifted cosine model

$$\text{max} - \text{min} = \text{range} = 3.7 - 1.5$$
$$= 2.2$$

$$\frac{1}{2}\text{range} = \text{amplitude} = \frac{1}{2}(2.2) = 1.1$$

$$y = 1.1\cos\left(\frac{2\pi}{\text{period}}(x-1)\right) + d$$

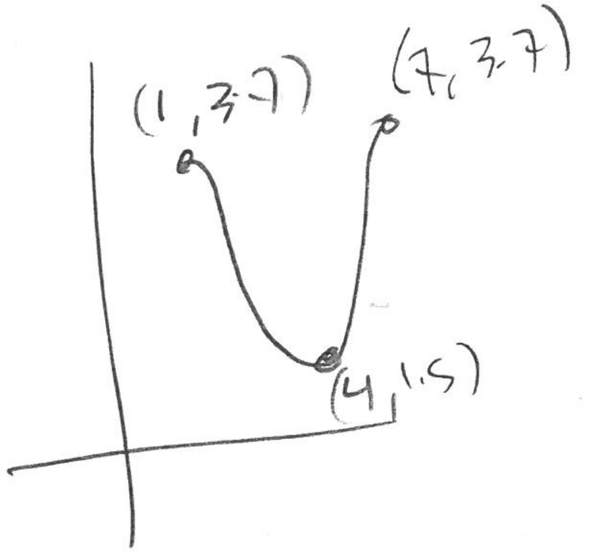
we can find now

phase shift R

$\frac{\text{max}+\text{min}}{2}$

# Problem 4 cont

4a




1 to 4 = 3 sec = $\frac{1}{2}$ time

period 2(3) = 6

$$y = 1.1\cos\left(\frac{2\pi}{6}(x-1)\right) + d$$

$$d = \frac{\text{max}+\text{min}}{2} = \frac{3.7+1.5}{2} = \frac{5.2}{2}$$

$$= 2.6$$

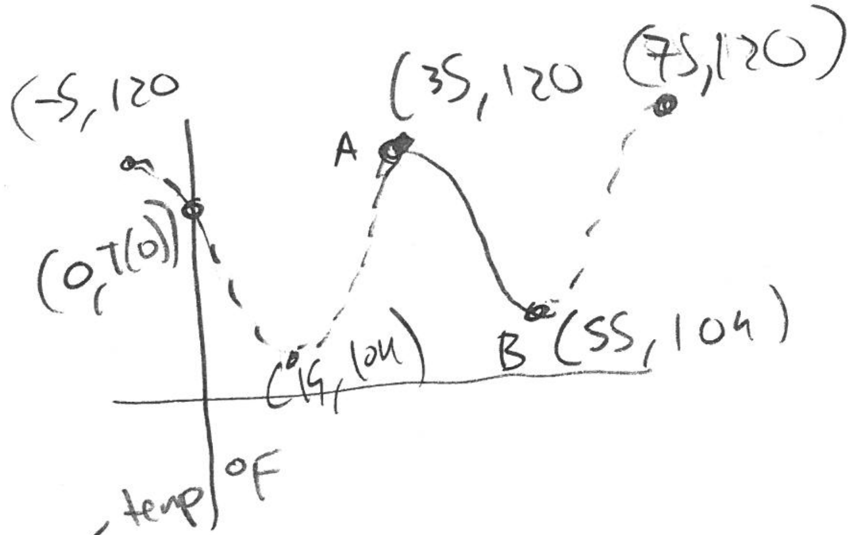
4b Model $\boxed{y = 1.1\cos\left(\frac{2\pi}{6}(x-1)\right) + 2.6}$

E.T. Boiling Problem

(4) high temp = 120 ← after 35 min

low temp = 104 ← after 55 min

20+35




$T(x) = a \text{ trig}\left(\frac{2\pi}{\text{period}}(x - \text{shift})\right) + d$

↳ time min

A = (35, 120) given

(x, T(x))

(time, temp)

implied

35 + 20 = 55

(B) (55, 104)

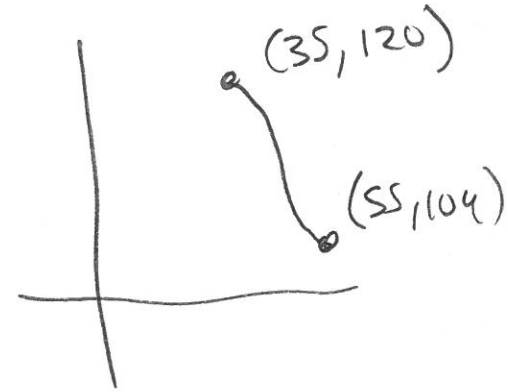
↳ given

120 max temp

104 min temp

Et Beings cont

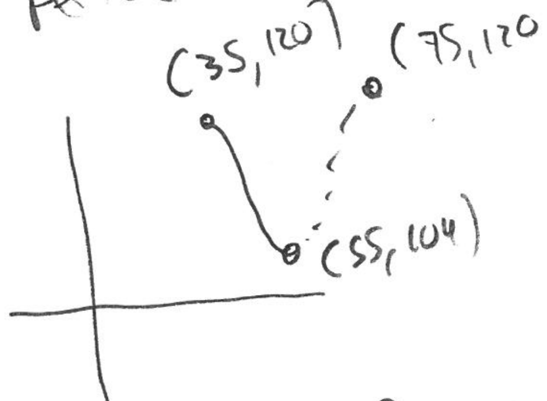
4




This is the given (implied given)

$\frac{1}{2}$ period = 20 min

period = 40 min

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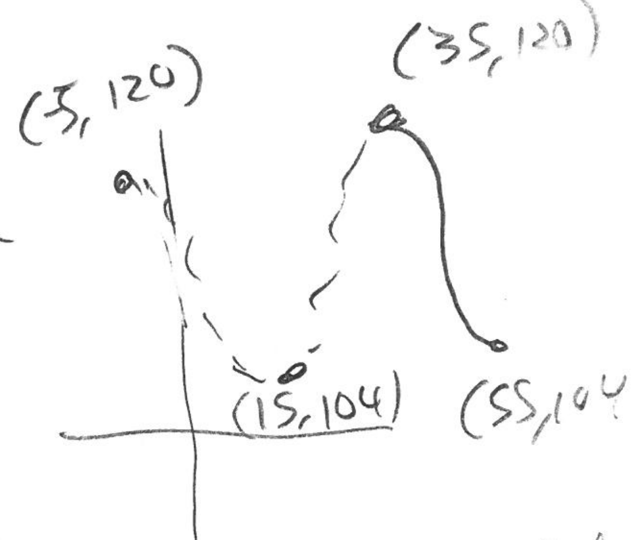
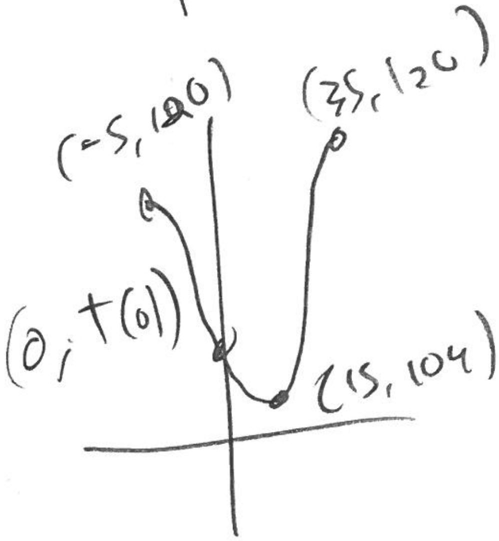



This is more helpful in writing model

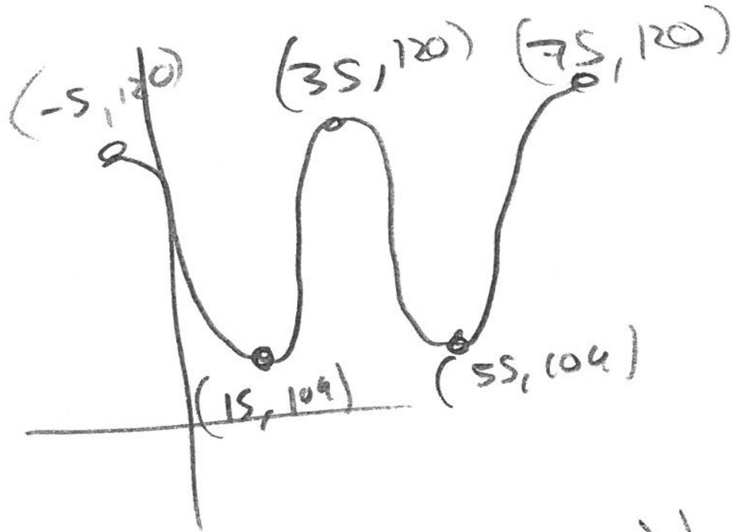
PHASE = -5 5 left

$y = a\,trig\left(\frac{2\pi}{period}(x+5)\right)+d$

Period = 40

for any version → $\boxed{y = a\,trig\left(\frac{2\pi}{40}(x+5)\right)+d}$

④ ET being con't




$y = a\,\text{trig}\left(\frac{2\pi}{40}(x+5)\right) + d$

↓

cosine model $a > 0$

$y = a\cos\left(\frac{2\pi}{40}(x+5)\right) d$

min 104°F

max 120°F

$d =$ midline

$= \frac{1}{2}(120 + 104)$

$= \frac{1}{2}(224)$

$\boxed{d = 112}$

Range $= 120 - 104$

$= 16$

$\frac{1}{2}$ Range $= 8$ so $a = 8$ ← not reflected

$a = -8$

Et Beirs cont

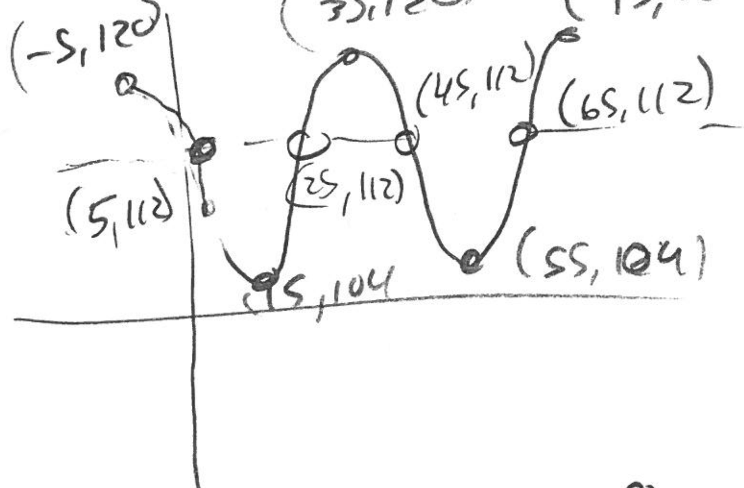
$$y = 9\cos\left(\frac{2\pi}{40}(x+5)\right) + 112$$

temp in F°

$$\boxed{T(x) = 8\cos\left(\frac{2\pi}{40}(x+5)\right) + 112}$$ x = time min

4b

(75, 120 4a




4c What is T(0)

$$= 8\cos\left(\frac{2\pi}{40}(5)\right) + 112$$

$$= 8\cos\left(\frac{10\pi}{40}\right) + 112$$

$$= 8\cos\left(\frac{\pi}{4}\right) + 112$$

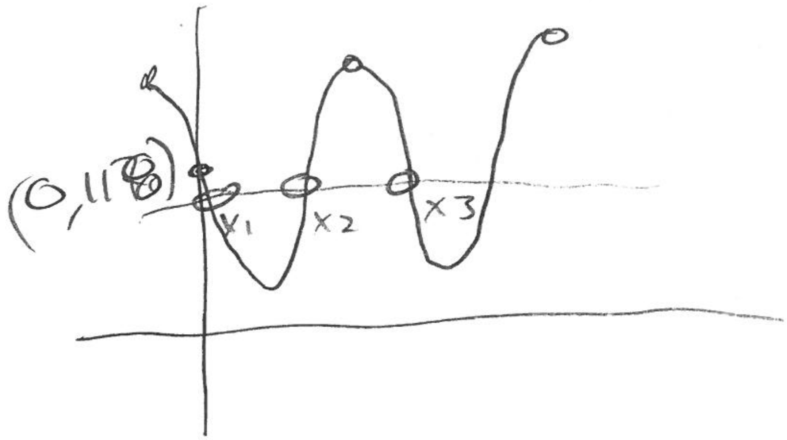
$$= 8\frac{\sqrt{2}}{2} + 112$$

$$= 4\sqrt{2} + 112$$

$$\approx 117.657\ ^\circ F$$

Ex Being cont

$$T(x) = 8\cos\left(\frac{2\pi}{40}(x+5)\right) + 112$$




$x_1, x_2, x_3$ times such that

$$T(x_1) = T(x_2) = T(x_3) = 114$$

$$114 = 8\cos\left(\frac{2\pi}{40}(x+5)\right) + 112$$

$$2 = 8\cos\left(\frac{2\pi}{40}(x+5)\right)$$

$$\frac{2}{8} = \cos\left(\frac{2\pi}{40}(x+5)\right)$$

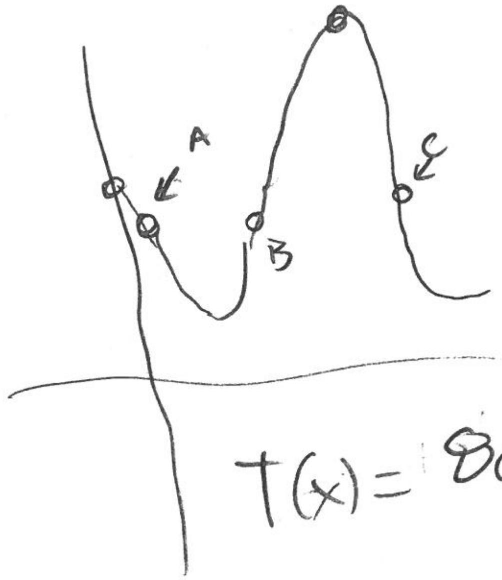
$$\cos^{-1}\left(\frac{2}{8}\right) = \frac{2\pi}{40}(x+5)$$

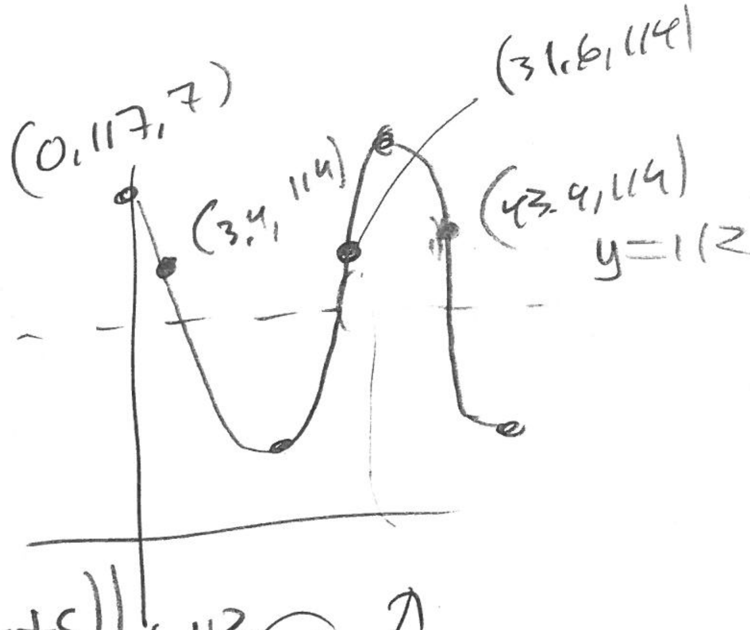
$$x+5 = \frac{40}{2\pi}\left(\cos^{-1}\left(\frac{1}{4}\right)\right)$$

$$x = -5 + \frac{40}{2\pi}\cos^{-1}\left(\frac{1}{4}\right)$$

$$\approx 3.391 \text{ minutes} = x_1$$

ET Debs cont




$$T(x) = 8\cos\left(\frac{2\pi}{40}(x+5)\right) + 112$$ 4a

$$A_x = -5 + \frac{40}{2\pi}\left(\cos^{-1}\left(\frac{1}{4}\right)\right) \simeq 3.391$$

$$A_y = 114$$

$$C_x = A_x + 40 = 35 + \frac{40}{2\pi}\cos^{-1}\left(\frac{1}{4}\right) \approx 43.391$$

$$C_y = 114$$

$$B_x = 35 - \frac{40}{2\pi}\cos^{-1}\left(\frac{1}{4}\right) = 31.619°$$

$$B_y = 114$$ 4d $\boxed{x = 3.391,\ 43.391,\ 31.619}$

All

$$x_1 = -5 + \frac{40}{2\pi}\cos^{-1}\left(\frac{1}{4}\right) + 40n \quad n \in \mathbb{Z}$$

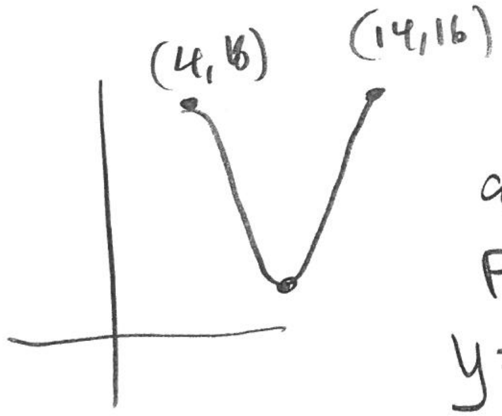
$$x_2 = 35 - \frac{40}{2\pi}\cos^{-1}\left(\frac{1}{4}\right) + 40n \quad n \in \mathbb{Z}$$

STEAM BOAT Problem

(5) $x = 4_{sec} \rightarrow 16\text{ ft} \rightarrow$ max height

$x = 4 + 10 \longrightarrow$ period 10 sec

$= 14 sec \longrightarrow 16$ again




$y = a\cos\left(\cancel{\frac{2\pi}{period}(x - shift)}\right)$
$+ d$

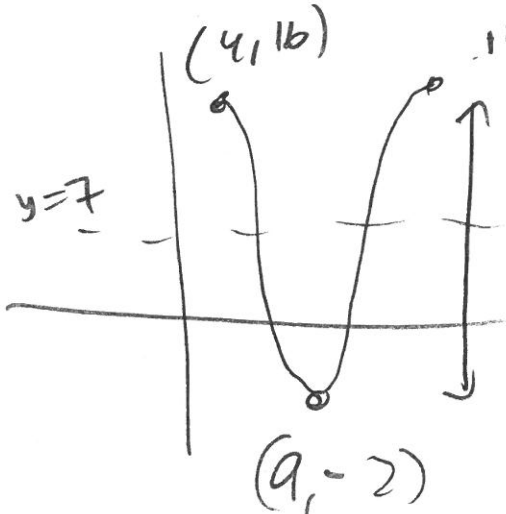
$a > 0$ (starts at max)

period = 10 sec

$y = a\cos\left(\frac{2\pi}{10}(x - shift)\right) + d$

atxy max at 4 & 14 sec

Implies (-6, max) true / not feasible
but true



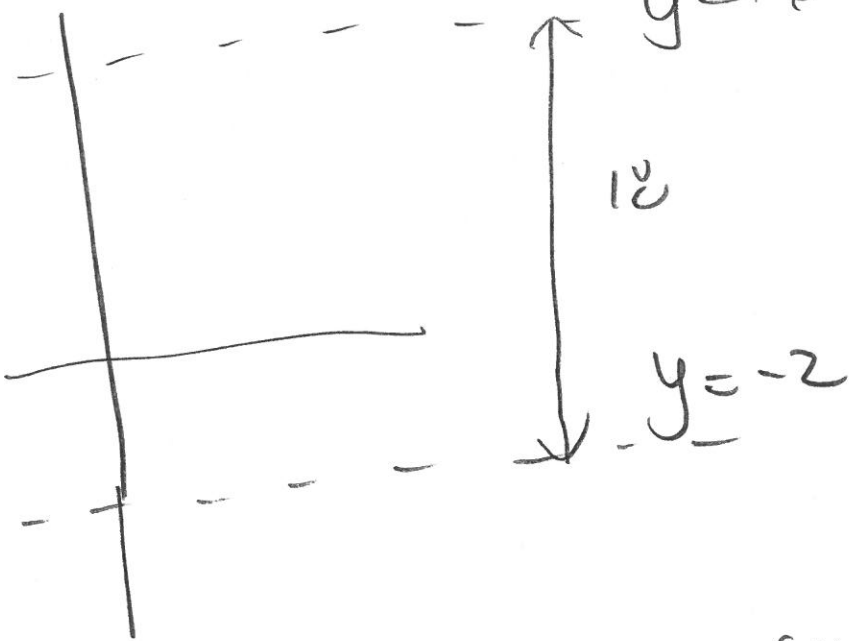

wheel = 18 ft diameter

$r = 9$ ft

$a = 9$

$y = 9\cos\left(\frac{2\pi}{10}(x - shift)\right) + d$

# Steamboat Problem (cont)




min = max − diameter

min = 16 − 18 = −2

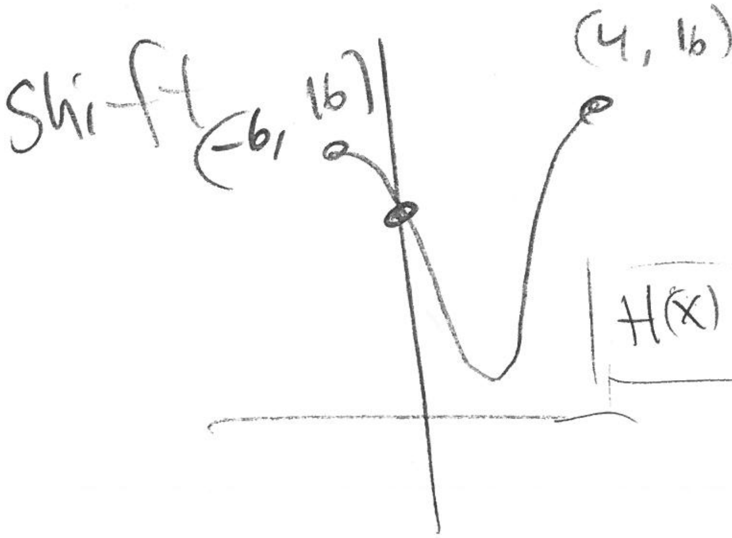
below water!

$$d = \frac{1}{2}(\text{max} + \text{min}) = \frac{1}{2}(16 + -2) = \frac{1}{2}(14) = 7$$

$$= \text{max} - \text{amp} = 16 - 9 = 7$$

$$= \text{min} + \text{amp} \quad -2 + 9 = 7$$

So $H(x) = 9\cos\left(\frac{2\pi}{10}(x - \text{shift})\right) + 7$




shift = 4 − period

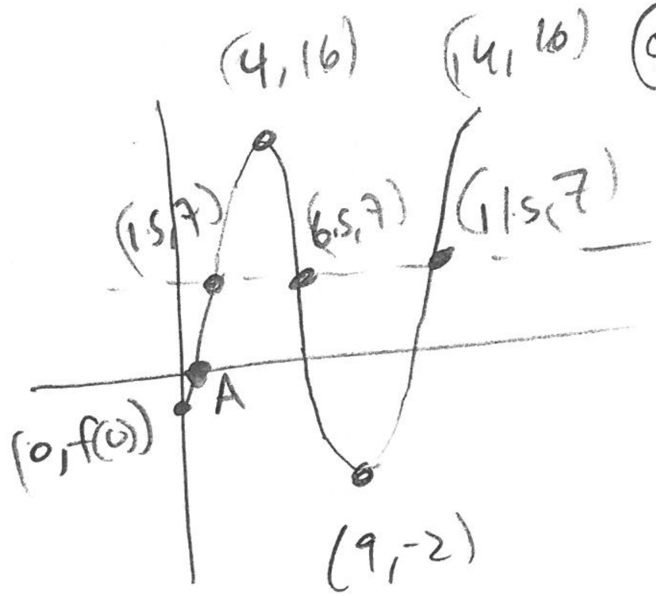
= 4 − 10

= −6

$$\boxed{H(x) = 9\cos\left(\frac{2\pi}{10}(x + 6)\right) + 7}$$

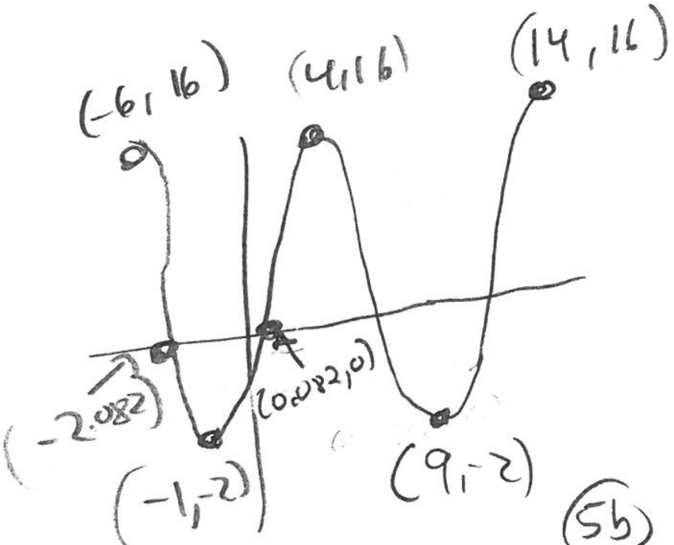
# Steamboat Problem

5a




5c

$$h(5) = 9\cos\left(\frac{2\pi}{10}(11)\right) + 7$$
$$\approx 14.281$$
$$h(17) = 9\cos\left(\frac{2\pi}{10}(23)\right) + 7$$
$$\approx 4.219$$




5b

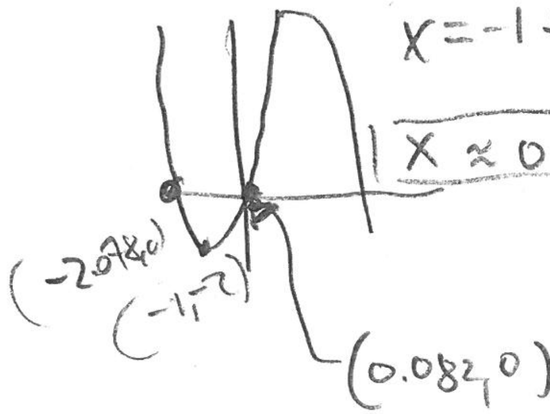
$$\boxed{h(x) = 9\cos\left(\frac{2\pi}{10}(x+6)\right) + 7}$$

5b

$$0 = 9\cos\left(\frac{2\pi}{10}(x+6)\right) + 7$$
$$-7 = 9\cos\left(\frac{2\pi}{10}(x+6)\right)$$
$$-\frac{7}{9} = \cos\left(\frac{2\pi}{10}(x+6)\right)$$
$$\cos^{-1}\left(-\frac{7}{9}\right) = \frac{2\pi}{10}(x+6)$$
$$x+6 = \frac{10}{2\pi}\cos^{-1}\left(-\frac{7}{9}\right)$$
$$x = -6 + \frac{10}{2\pi}\cos^{-1}\left(-\frac{7}{9}\right)$$
$$x \approx -2.082$$

$$x = -1 + \frac{10}{2\pi}\cos^{-1}\left(\frac{7}{9}\right)$$

$$\boxed{x \approx 0.082}$$




5d

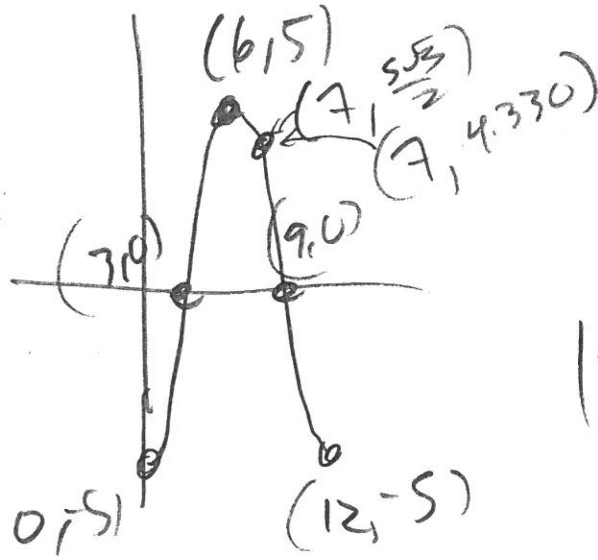
$$x = -1 + \frac{10}{2\pi}\cos^{-1}\left(\frac{7}{9}\right)$$

$$x = 0.082$$

on way out of water

# Boat Problem 6

$y = -5\cos\left(\frac{\pi}{6}x\right) \rightarrow y = -5\cos\left(\frac{2\pi}{12}x\right)$




$b = \frac{\pi}{6}$

$PL = \frac{2\pi}{\frac{\pi}{6}} = \frac{2\pi}{1} \cdot \frac{6}{\pi} = \frac{12\pi}{\pi}$

$\boxed{PL = 12}$

6a

$y(0) = -5\cos\left(\frac{\pi}{6}(0)\right) = -5(1) = -5$

$y(7) = -5\cos\left(\frac{\pi}{6}(7)\right)$

$= -5\cos\left(\frac{7\pi}{6}\right)$

$= -5\left(-\frac{\sqrt{3}}{2}\right)$

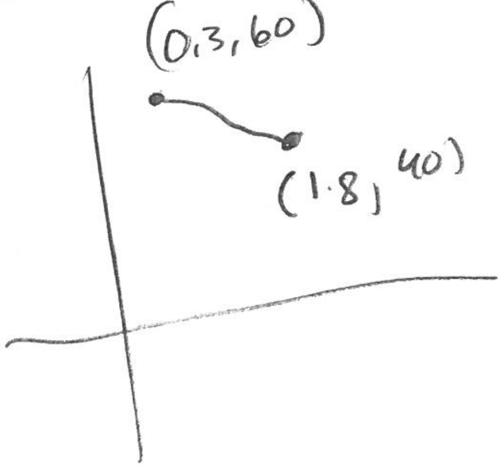
$= \frac{5\sqrt{3}}{2}$

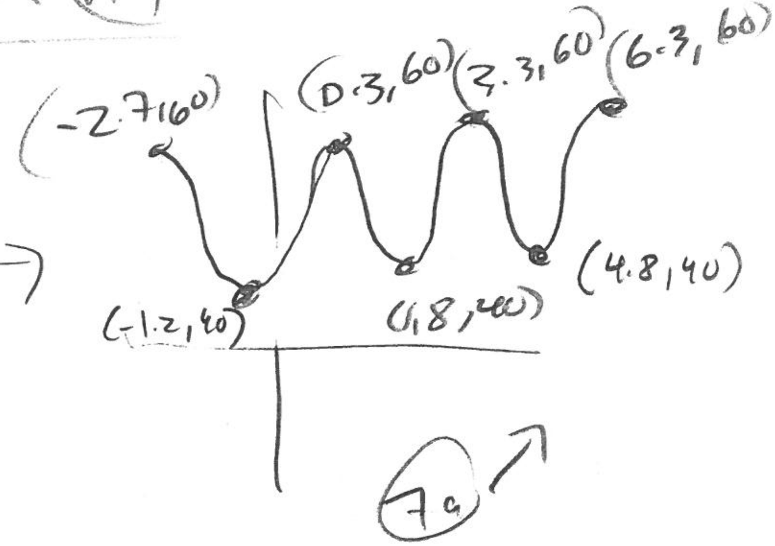
$\approx 4.330$

6b max occurs at 5 ft
min occurs at -5 ft

6c period 12 secs

# SPRING PROBLEM #7




$\frac{1}{2}$ Period $= 1.8 - 0.3$

$= 1.5$

Period $= 2(1.5) = 3$

$$y = a \text{ trig}\left(\frac{2\pi}{\text{period}}(x - \text{shift})\right) + d$$

max = 60 range = 60 - 40 = 20

min = 40 $\frac{1}{2}$ range = amplitude = $\frac{20}{2} = 10$

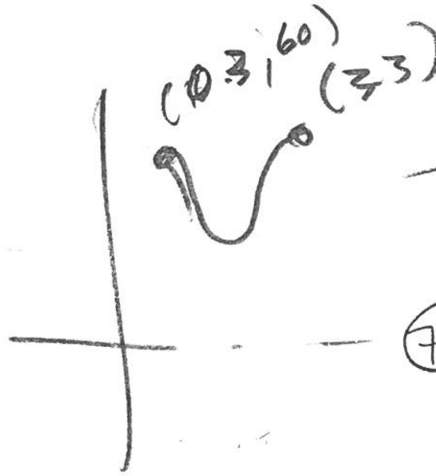
$$y = 10 \text{ trig}\left(\frac{2\pi}{\text{Period}}(x - \text{shift})\right) + d$$

$$d = \frac{1}{2}(\text{max} + \text{min}) = \frac{1}{2}(60 + 40) = \frac{1}{2}(100) = 50$$

$$\boxed{y = 10 \cos\left(\frac{2\pi}{\text{Period}}(x - \text{shift})\right) + 50}$$

why shape

# SPRING PROBLEM con't




0.3 = Shift Right

$$\boxed{y = 10\cos\left(\frac{2\pi}{3}(x - 0.3)\right) + 50}$$

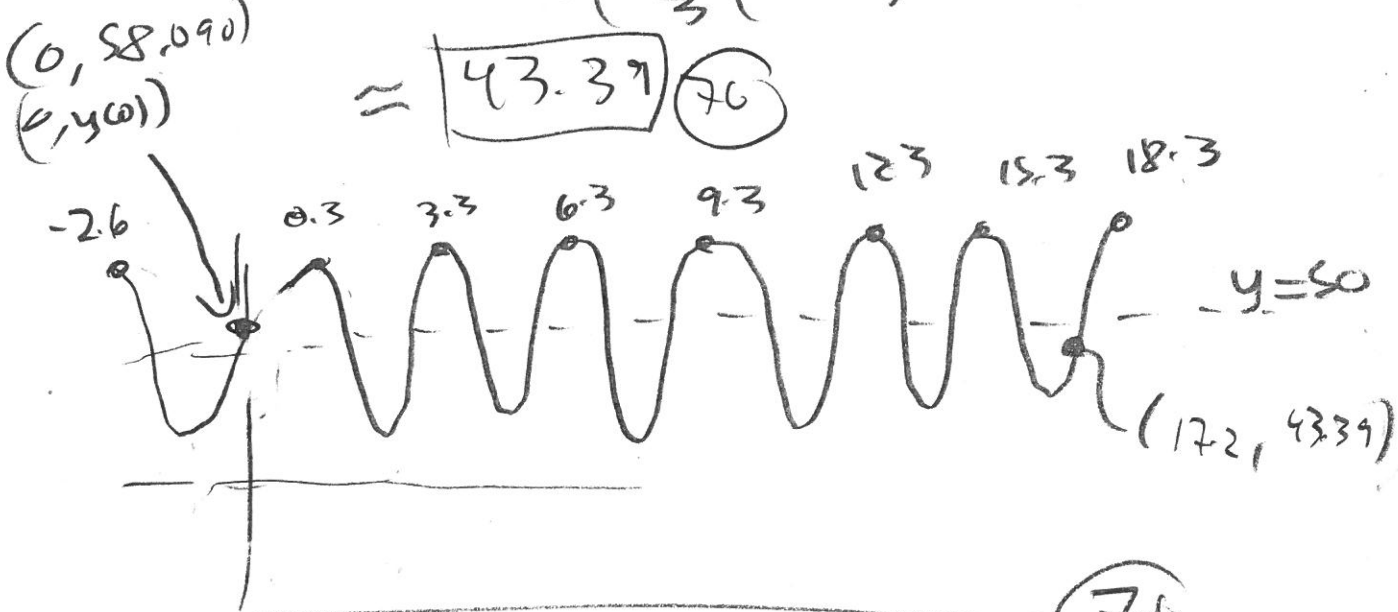
7b

period = 3

$$y(17.2) = 10\cos\left(\frac{2\pi}{3}(17.2 - 0.3)\right) + 50$$

$$= 10\cos\left(\frac{2\pi}{3}(16.9)\right) + 50$$

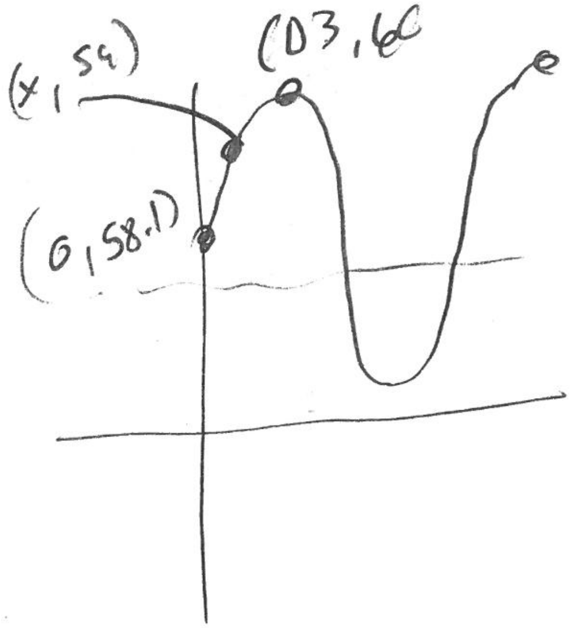
$$\approx \boxed{43.39}$$ 7c




7d

$$\boxed{\begin{aligned} y(0) &= 10\left(\cos\left(\frac{2\pi}{3}(-0.3)\right)\right) + 50 \\ &\approx 58.090 \end{aligned}}$$

Spring Problem (7 cont)




$$59 = 10\cos\left(\frac{2\pi}{3}(x - 0.3)\right) + 50$$

$$9 = 10\cos\left(\frac{2\pi}{3}(x - 0.3)\right)$$

$$\frac{9}{10} = \cos\left(\frac{2\pi}{3}(x - 0.3)\right)$$

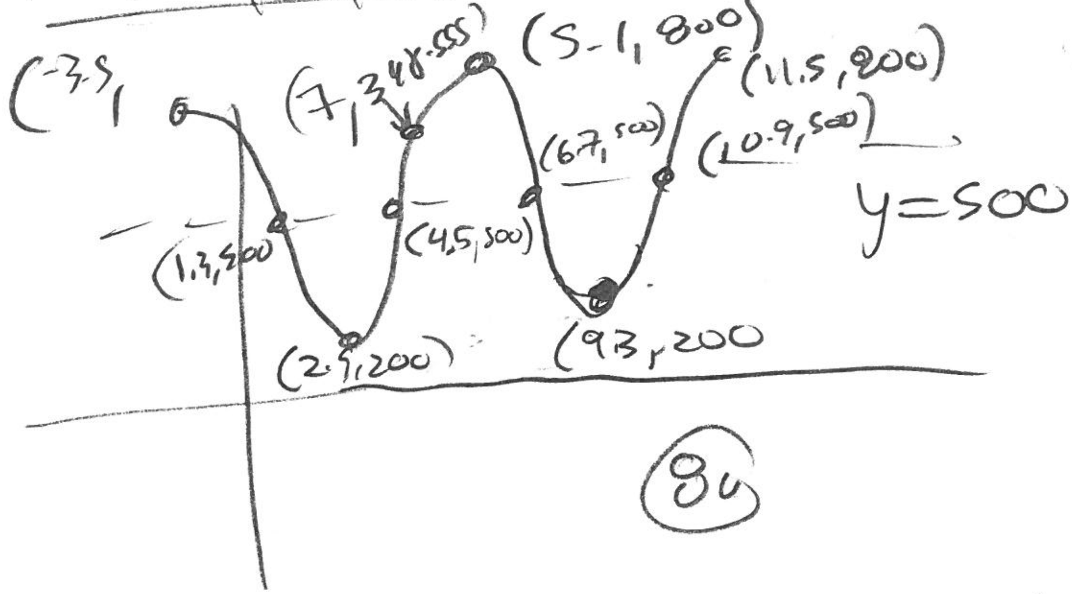
$$\frac{2\pi}{3}(x - 0.3) = \cos^{-1}\left(\frac{9}{10}\right)$$

$$x - 0.3 = \frac{3}{2\pi}\cos^{-1}\left(\frac{9}{10}\right)$$

$$\boxed{x = 0.3 + \frac{3}{2\pi}\cos^{-1}\left(\frac{9}{10}\right)}$$

$$\boxed{x \approx 0.515}$$ (7e)

# FOX POPULATION cont'd

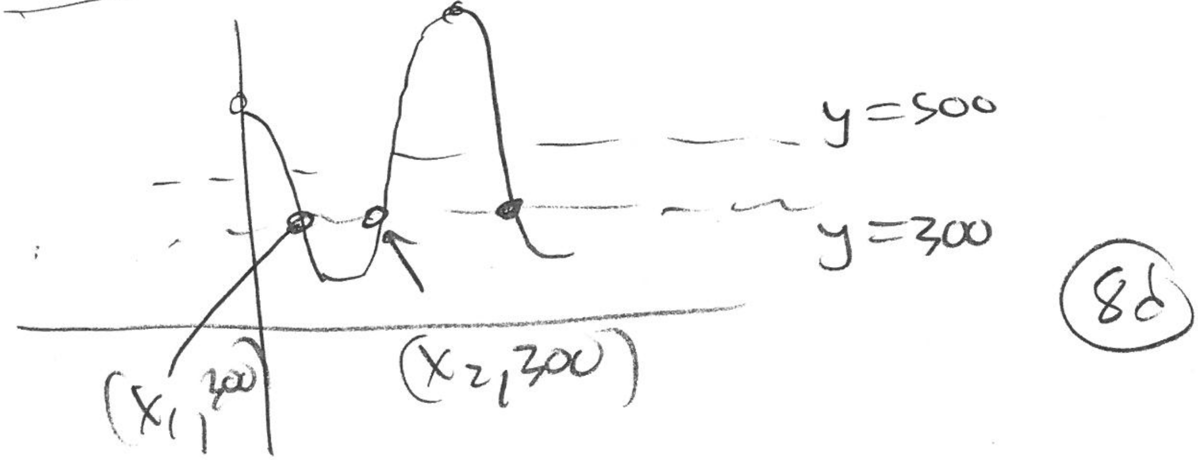



$$P(x) = -300\cos\left(\frac{2\pi}{6.4}(x-2.9)\right)+500$$

8c

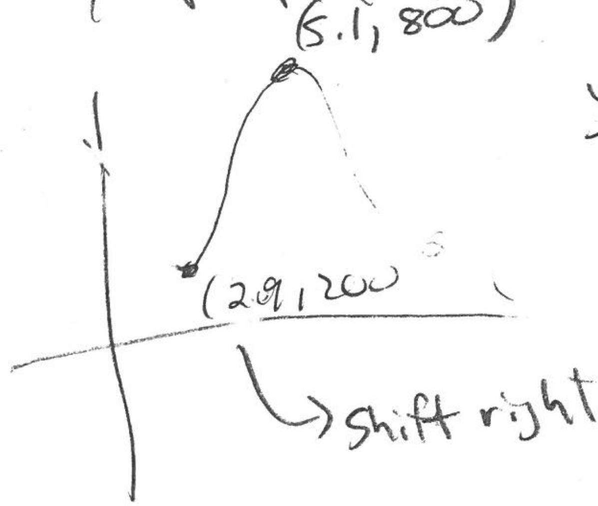
$$P(7) = -300\left(\cos\left(\frac{2\pi}{6.4}(3.1)\right)\right)+10$$

$$P(7) \simeq 348.555$$




$x_1 = 2.043 \qquad x_2 = 3.757$

FOX POPULATION #8




$y = a\cos\left(\frac{2\pi}{\text{period}}(x - \text{shift})\right) + d$

$\downarrow$

$a < 0$

$\frac{1}{2}$ period $= 5.1 - 2.9 = 3.2$ second

period $= 6.4$

$y = -\text{amp}\cos\left(\frac{2\pi}{6.4}(x - 2.9)\right) + d$

$\frac{1}{2}$ range $=$ amp $= \frac{1}{2}(800 - 200) = \frac{1}{2}(600) = 300$

$y = -300\cos\left(\frac{2\pi}{6.4}(x - 2.9)\right) + d$

$d = \frac{1}{2}(\text{max} + \text{min}) = \frac{1}{2}(800 + 200) = \frac{1}{2}(1000)$

$d = 500$

8b

$$\boxed{P(x) = -30\cos\left(\frac{2\pi}{6.4}(x - 2.9)\right) + 500}$$

# FOX POPULATION

$$300 = -300\cos\left(\frac{2\pi}{6.4}(x-2.9)\right) + 500$$

$$-200 = -300\left(\cos\left(\frac{2\pi}{6.4}(x-2.9)\right)\right)$$

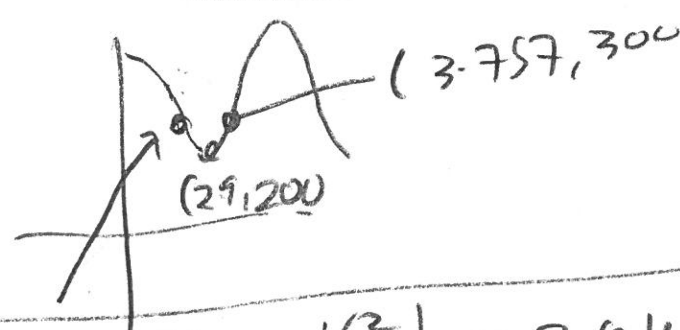
$$\frac{2}{3} = \cos\left(\frac{2\pi}{6.4}(x-2.9)\right)$$

$$\frac{2\pi}{6.4}(x-2.9) = \cos^{-1}\left(\frac{2}{3}\right)$$

$$x-2.9 = \frac{6.4}{2\pi}\cos^{-1}\left(\frac{2}{3}\right)$$

$$x = 2.9 + \frac{6.4}{2\pi}\cos^{-1}\left(\frac{2}{3}\right)$$

$$\boxed{x \approx 3.757}$$ 8d

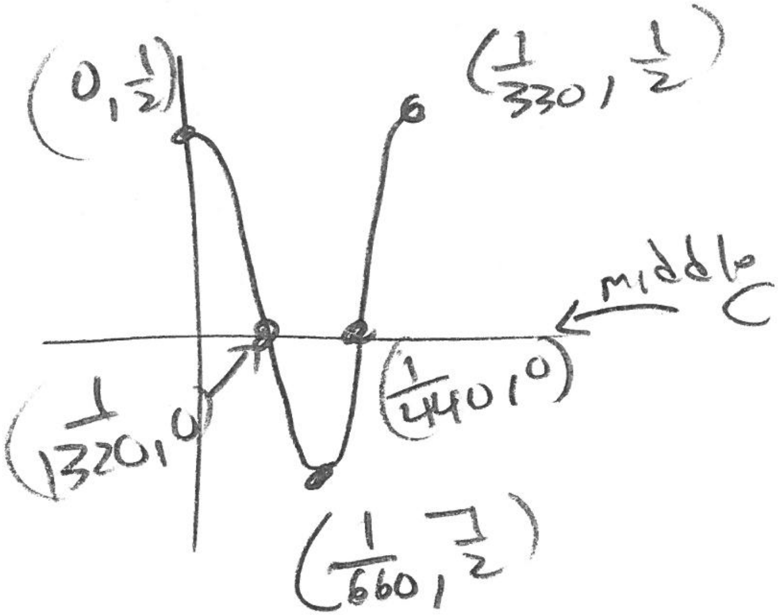



$$\boxed{x_1 = 2.9 - \frac{6.4}{2\pi}\cos^{-1}\left(\frac{2}{3}\right) \simeq 2.043}$$

$2.043 < x < 3.757$ ← 8d

$200 \leq P(x) < 300$ ← Result of 8d

(9) Music Problem




$PL = \frac{2\pi}{b}$ $\quad b = 660\pi$

$PL = \frac{2\pi}{660} = \frac{1}{330}$

amp $= |a|$ $\quad y = 0.5\cos(660\pi\, t)$

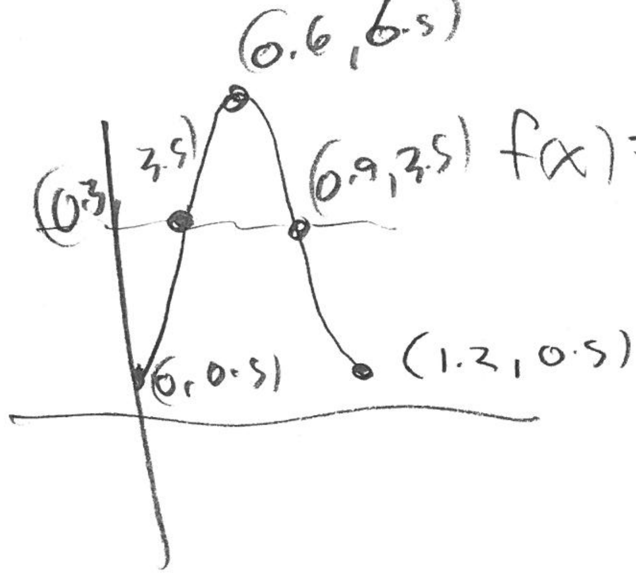
(9a) $a \rightarrow$ amp $= 0.5$

(9b)

Period $= \frac{1}{330}$

(9c) Range $[-\frac{1}{2}, \frac{1}{2}]$ $\quad \boxed{E = C \pm \frac{1}{2}}$

ENTERTAINMENT PROBLEM cont




$f(x) = -3\cos\left(\frac{5\pi}{3}x\right) + 3.5$

(1a) max = 6.5 $\qquad 3.5 + 3 = 6.5$

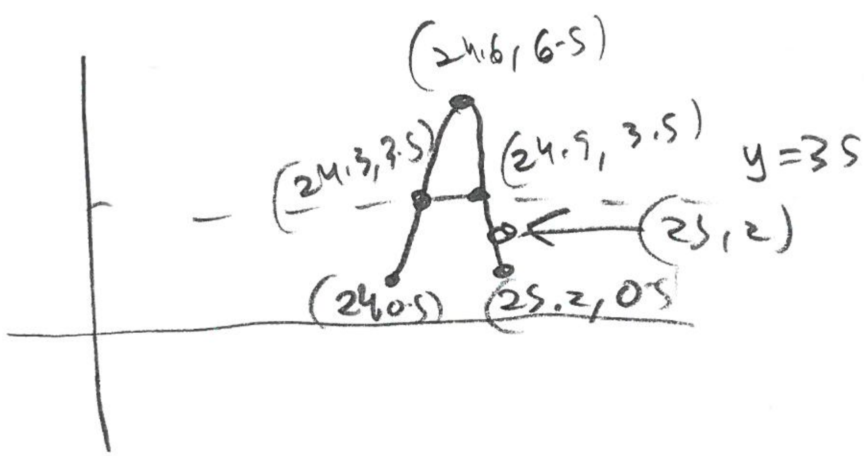
$\qquad\qquad\qquad\qquad \underbrace{3.5}_{d} + \underbrace{3}_{amp}$

(1b) min = 0.5 $\qquad 3.5 - 3 = 0.5$

$\qquad\qquad\qquad\qquad d - amp$

(1c) Period $= \dfrac{2\pi}{\frac{5\pi}{3}} = \dfrac{2}{1} \cdot \dfrac{3}{5} = \dfrac{6}{5} = 1.2$

Entertainment Problem (#10 cont'd)




$$f(x) = -3\cos\left(\frac{5\pi}{3}x\right) + 3.5$$

$$f(25) = -3\cos\left(\frac{5}{3}\pi(25)\right) + 3.5$$

$$= -3\cos\left(\frac{125\pi}{3}\right) + 3.5$$

$$= -3\cos\left(41\tfrac{2}{3}\pi\right) + 3.5$$

$$= -3\left(\frac{1}{2}\right) + 3.5$$

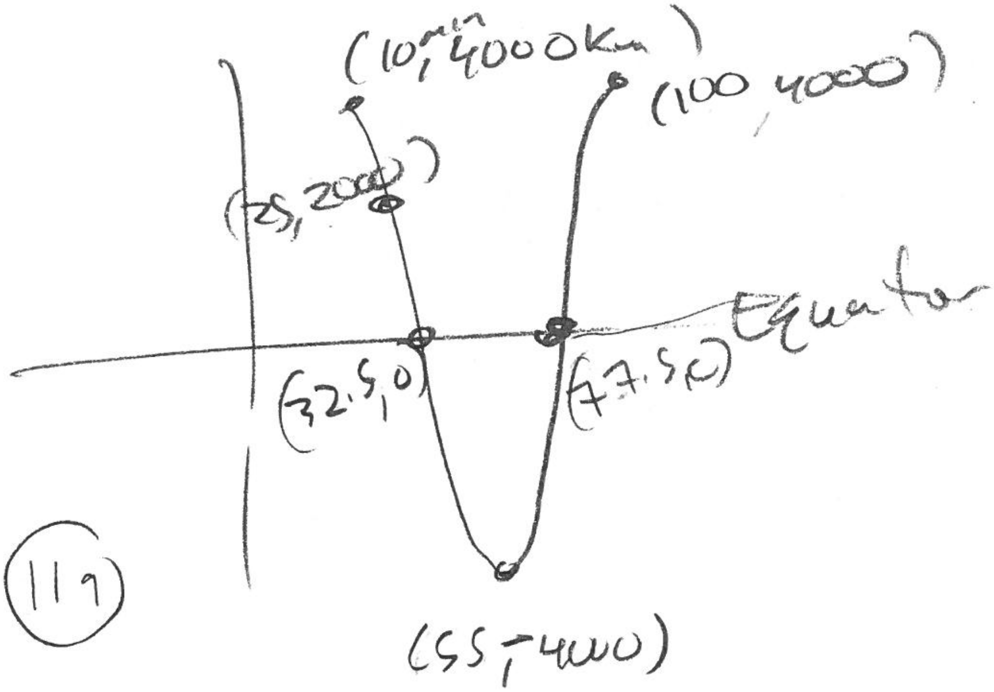
$$= -1.5 + 3.5$$

$$f(25) = 2$$

$$\boxed{(25, 2) \text{ on } f(x)}$$

# Space SHIP Problem #11

(11a)




max = 4000

min = -4000

$\Big\}$ amp = 4000 $\Big<$ a = +4000, a = -4000

$$y = +4000 \cos\left(\frac{2\pi}{90}(x-10)\right) + 0$$

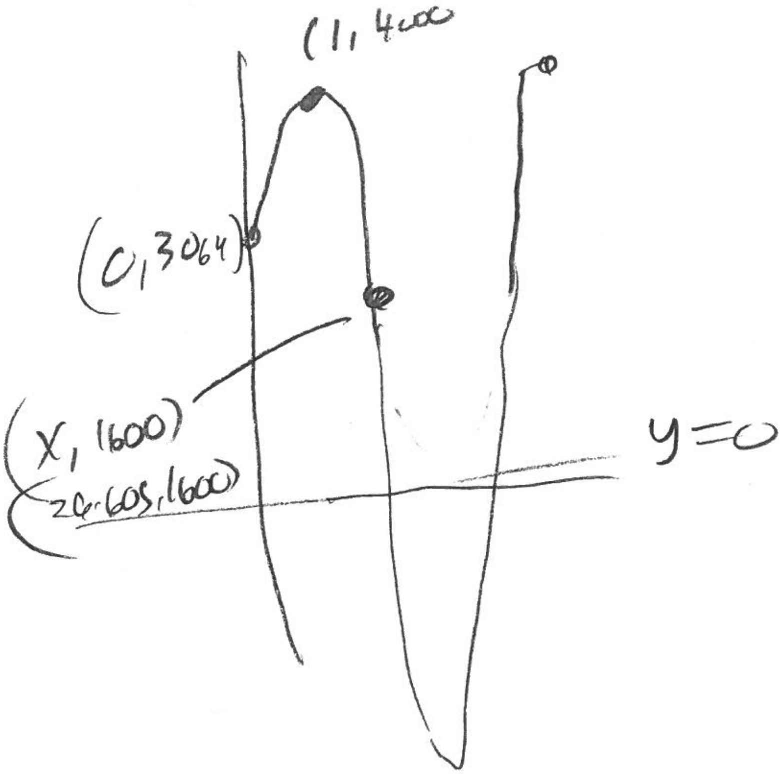
$$\boxed{y = 4000\cos\left(\frac{2\pi}{90}(x-10)\right)}$$

(11b) $y(25) = 4000\cos\left(\frac{2\pi}{90}(25-10)\right)$

$= 4000\cos\left(\frac{30\pi}{90}\right)$

$= 4000\cos(\pi/3) = \boxed{2000}$

Space Ship Problem cont




$$1600 = 4000\cos\left(\frac{2\pi}{90}(x-10)\right)$$

$$\frac{1600}{4000} = \cos\left(\frac{2\pi}{90}(x-10)\right)$$

$$\cos^{-1}\left(\frac{1600}{4000}\right) = \frac{2\pi}{90}(x-10)$$

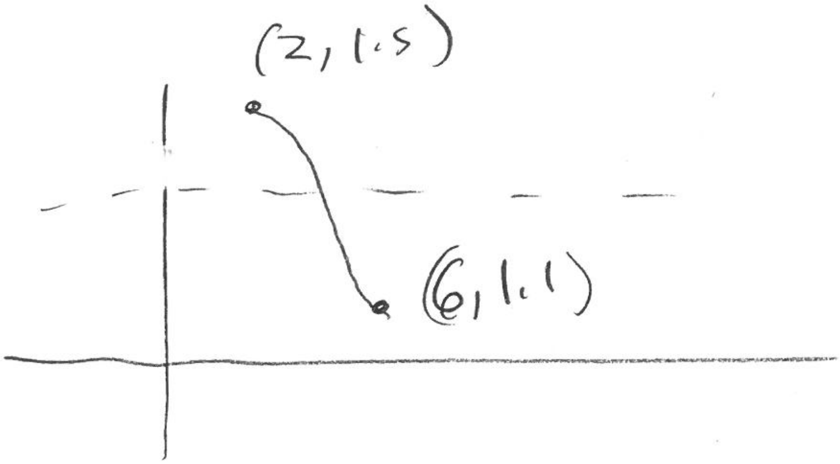
$$\frac{2\pi}{90}(x-10) = \cos^{-1}\left(\frac{1600}{4000}\right)$$

$$x-10 = \frac{90}{2\pi}\left(\cos^{-1}\left(\frac{1600}{4000}\right)\right)$$

11c

$$\boxed{x = 10 + \frac{90}{2\pi}\cos^{-1}\left(\frac{1600}{4000}\right) \approx 26.605}$$

TIDE Problem # 12




max 1.5

min 1.1

$\frac{1}{2}(\text{max}+\text{min}) = d = \frac{1}{2}(1.5+1.1) = \frac{1}{2}(2.6)$

$\boxed{d = 1.3}$

$\frac{1}{2}(\text{max}-\text{min}) = \text{amp} = \frac{1}{2}(1.5-1.1) = \frac{1}{2}(0.4)$

$\boxed{\text{amp} = 0.2}$

$$y = \pm 0.2 \text{ trig}\left(\frac{2\pi}{\text{Period}}(x - \text{shift})\right) + 1.3$$

shift to cosine model

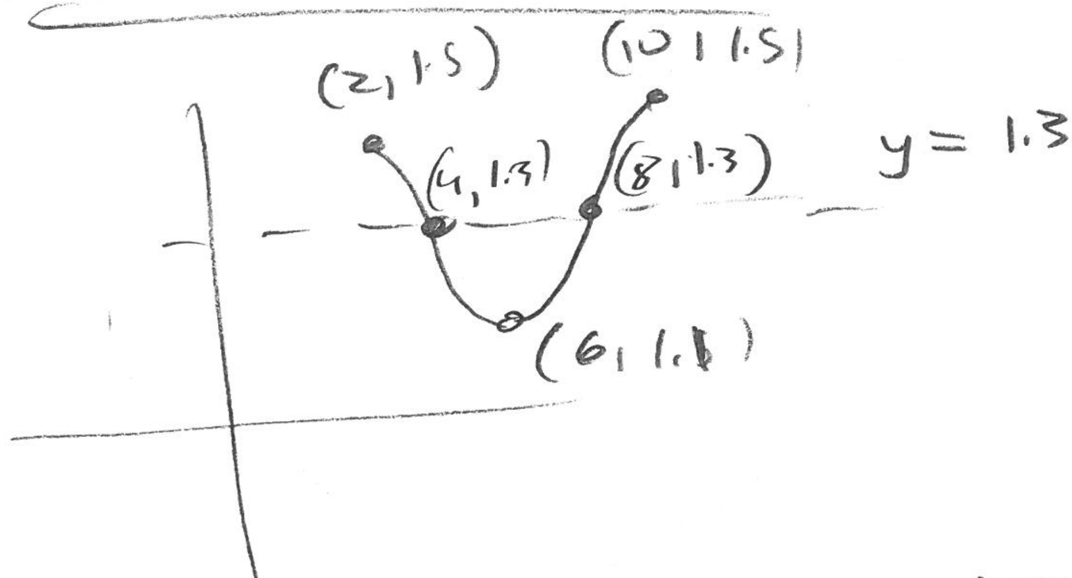
$$y = 0.2\cos\left(\frac{2\pi}{\text{period}}(x-2)\right) + 1.3$$

$\frac{1}{2}\text{Period} = 4$

Period $= 8$

$$\boxed{h(x) = 0.2\cos\left(\frac{2\pi}{8}(x-2)\right) + 1.3}$$

# TIDE Problem #12 cont




$$\boxed{h(x) = 0.2\cos\left(\frac{2\pi}{8}(x-2)\right) + 1.3}$$

12a

$(x, h(x))$

$x$ → time hrs since 12:00 noon

$h(x)$ → height at time $x$

$$h(4) = 0.2\cos\left(\frac{2\pi}{8}(4-2)\right) + 1.3$$

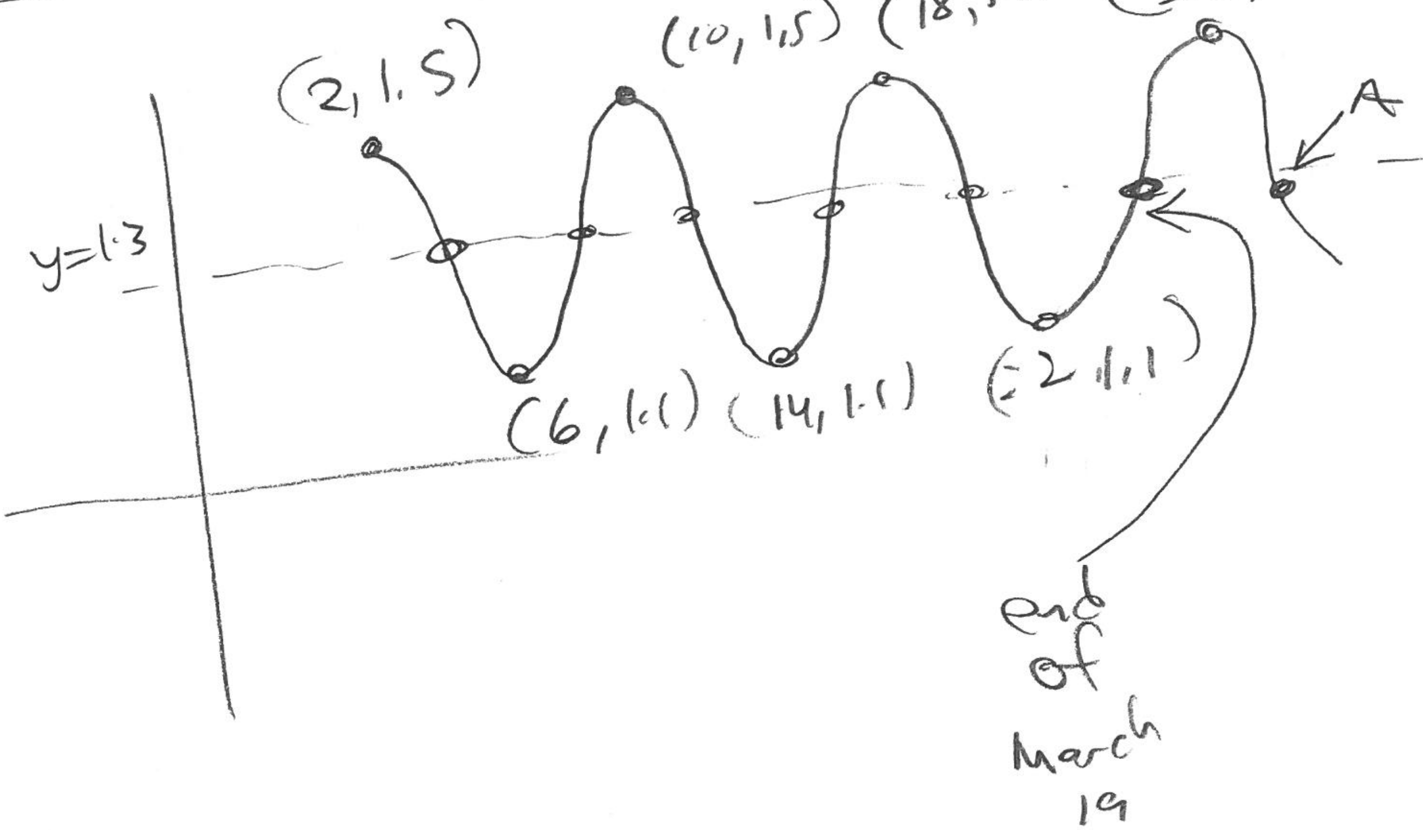
$$= 0.2\cos\left(\frac{4\pi}{8}\right) + 1.3$$

$$= 0.2\cos\left(\frac{\pi}{2}\right) + 1.3$$

$$\boxed{h(4) = 1.3}$$ or by graph

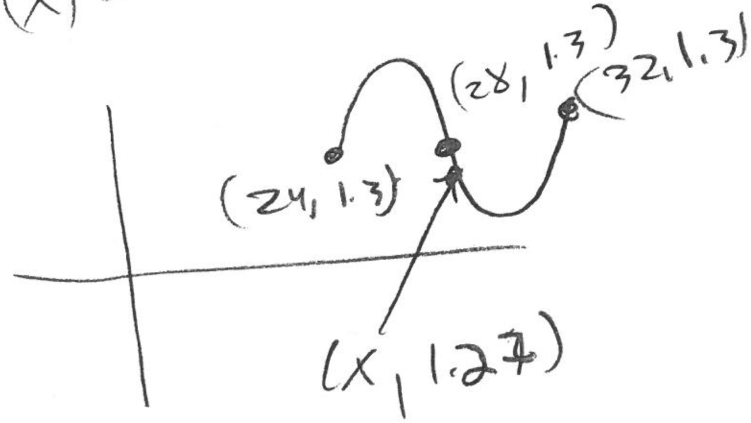
12b

# TIDE PROBLEM #12 cont




A = earliest time on f(x) that

$f(x) = 1.27$m with $x > 24$



Tide Problem #12

$$f(x) = 0.2\cos\left(\frac{2\pi}{8}(x-2)\right) + 1.3$$

$$1.27 = 0.2\cos\left(\frac{2\pi}{8}(x-2)\right) + 1.3$$

$$-0.03 = 0.2\cos\left(\frac{2\pi}{8}(x-2)\right)$$

$$-0.15 = \cos\left(\frac{2\pi}{8}(x-2)\right)$$

$$\frac{2\pi}{8}(x-2) = \cos^{-1}(-0.15)$$

$$x-2 = \frac{8}{2\pi}\cos^{-1}(-0.15)$$

$$x = 2 + \frac{8}{2\pi}\cos^{-1}(-0.15)$$

$$\boxed{x = 4.192}$$

$$\boxed{x = 2 - \frac{8}{2\pi}\cos^{-1}(-0.15) = -0.192}$$

$$x = \begin{cases} -0.192 + 8n \\ 4.192 + 8n \end{cases} \quad n \in \mathbb{Z}$$

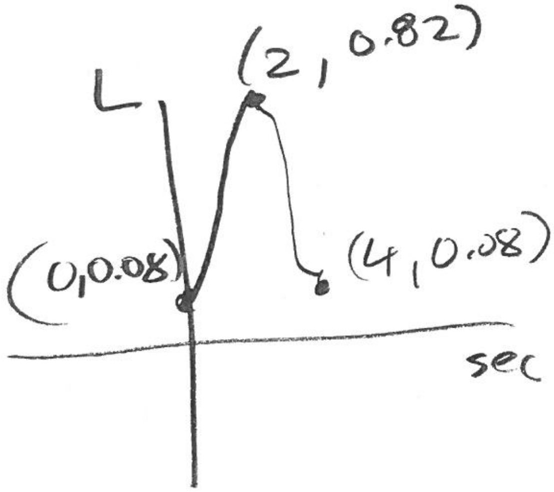
$$\boxed{\text{Let } n = 3 \qquad 4.192 + 8(3) = 28.192}$$

# Health Problem # B

In & out each 4 seconds

min 0.08 L max 0.82 L

min at t = 0 max at t = 2




13a

$$\frac{1}{2}(\text{min}+\text{max}) = d = \frac{1}{2}(0.08+0.82)$$

$$= \frac{1}{2}(0.90)$$

$$\boxed{d = 0.45}$$

---

$$\frac{1}{2}(\text{max}-\text{min}) = \text{amp} = \frac{1}{2}(0.82-0.08)$$

$$= \frac{1}{2}(0.74)$$

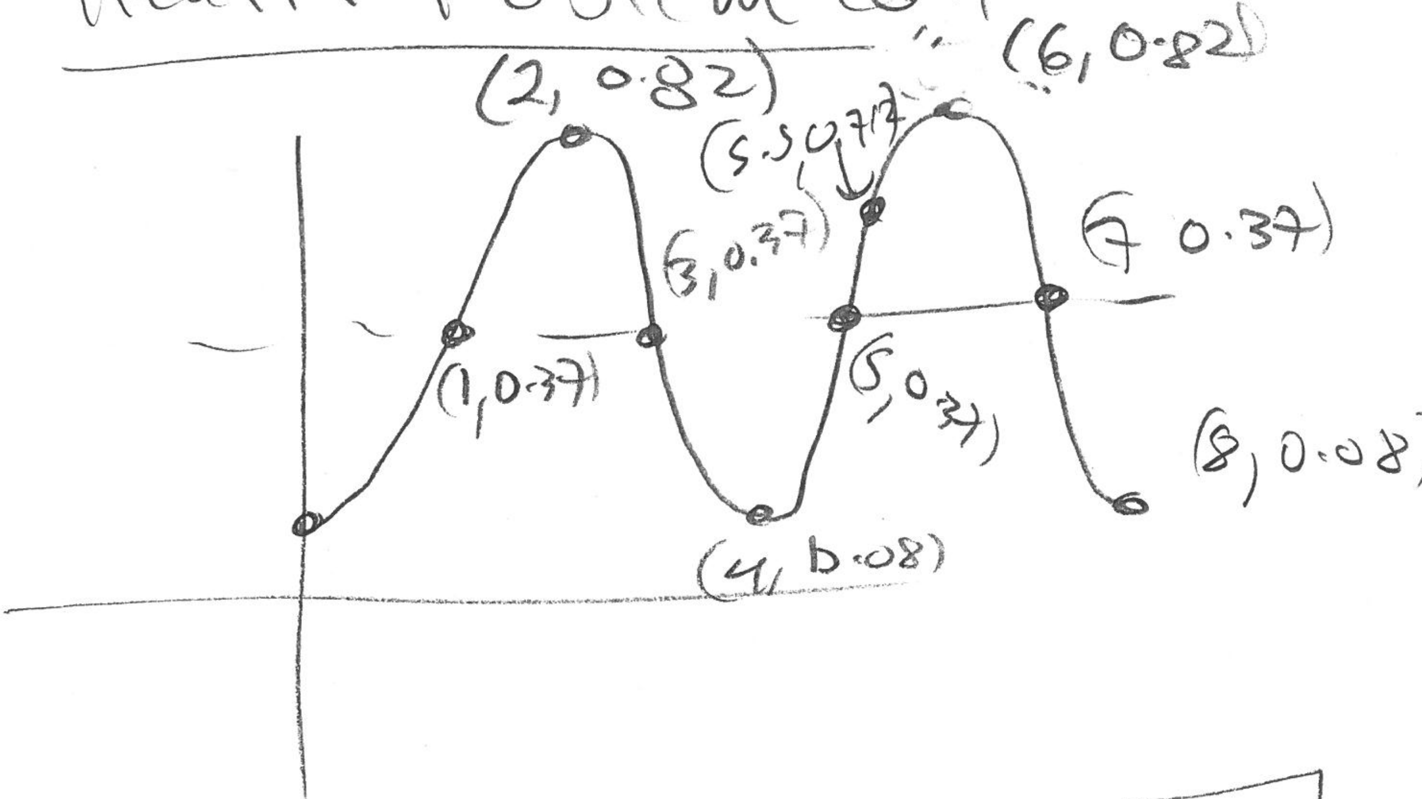
$$= 0.37$$

$$\boxed{\text{amp} = 0.37}$$

13b

PL = 4 $\boxed{y = -0.37\cos\left(\frac{2\pi}{4}(x-0)\right) + 0.45}$

# Health Problem con't




$$\boxed{f(x) = -0.37\cos\left(\frac{2\pi}{4}x\right) + 0.45}$$

13b

$$f(5.5) = -0.37\cos\left(\frac{2\pi}{4}\left(\frac{11}{2}\right)\right) + 0.45$$

13c

$$= -0.37\cos\left(\frac{22\pi}{8}\right) + 0.45$$

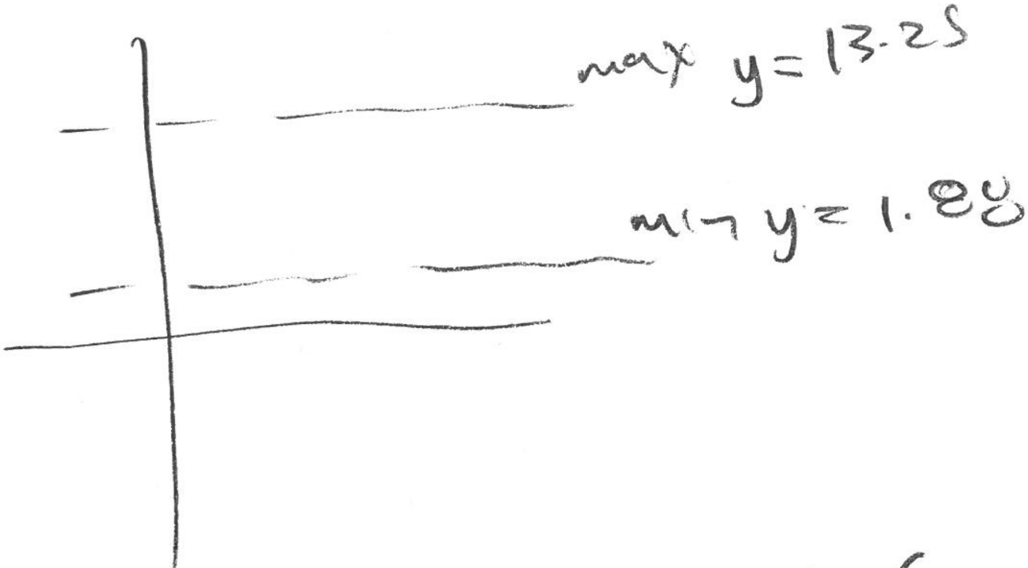
$$= -0.37\cos\left(\frac{11\pi}{4}\right) + 0.45$$

$$= \frac{-37}{100}\cdot\frac{-\sqrt{2}}{2} + \frac{45}{100}$$

$$= \frac{+37\sqrt{2}}{200} + \frac{90}{200} = \frac{90+37\sqrt{2}}{200}$$

$$\boxed{\approx 0.712}$$

Problem 14 tidal Problem 2




$$d = \frac{1}{2}(\max + \min) = \frac{1}{2}(13.25 + 1.88)$$

$$= \frac{1}{2}(15.13) = 7.565$$

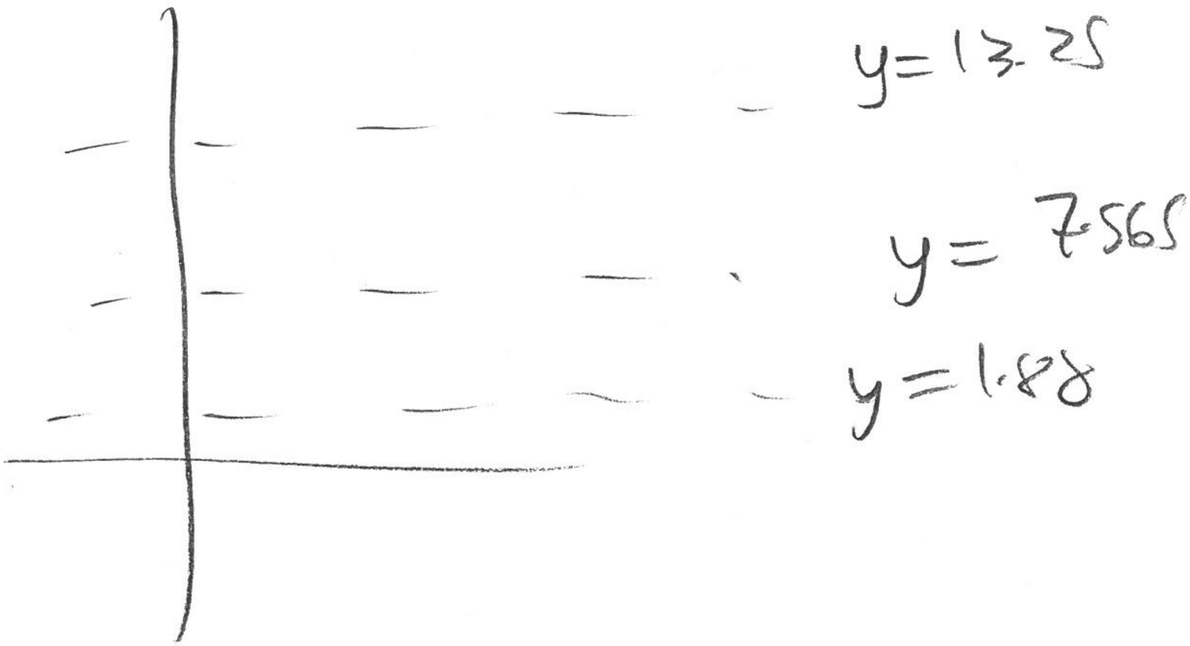
$$\text{amp} = \frac{1}{2}(\max - \min) = \frac{1}{2}(11.37) = 5.685$$

$$= \max - d = 13.25 - 7.565 = 5.685$$

$$= d - \min = 7.565 - 1.88 = 5.685$$

$$f(x) = \pm 5.685 \text{ trig}\left(\frac{2\pi}{\text{period}}(x - \text{shift})\right) + 7.56$$

## Problem 14 cont




time

4:30am high tide = 13.25

4.5 hrs

---

10:15 am low tide = 1.88

10.25 hrs

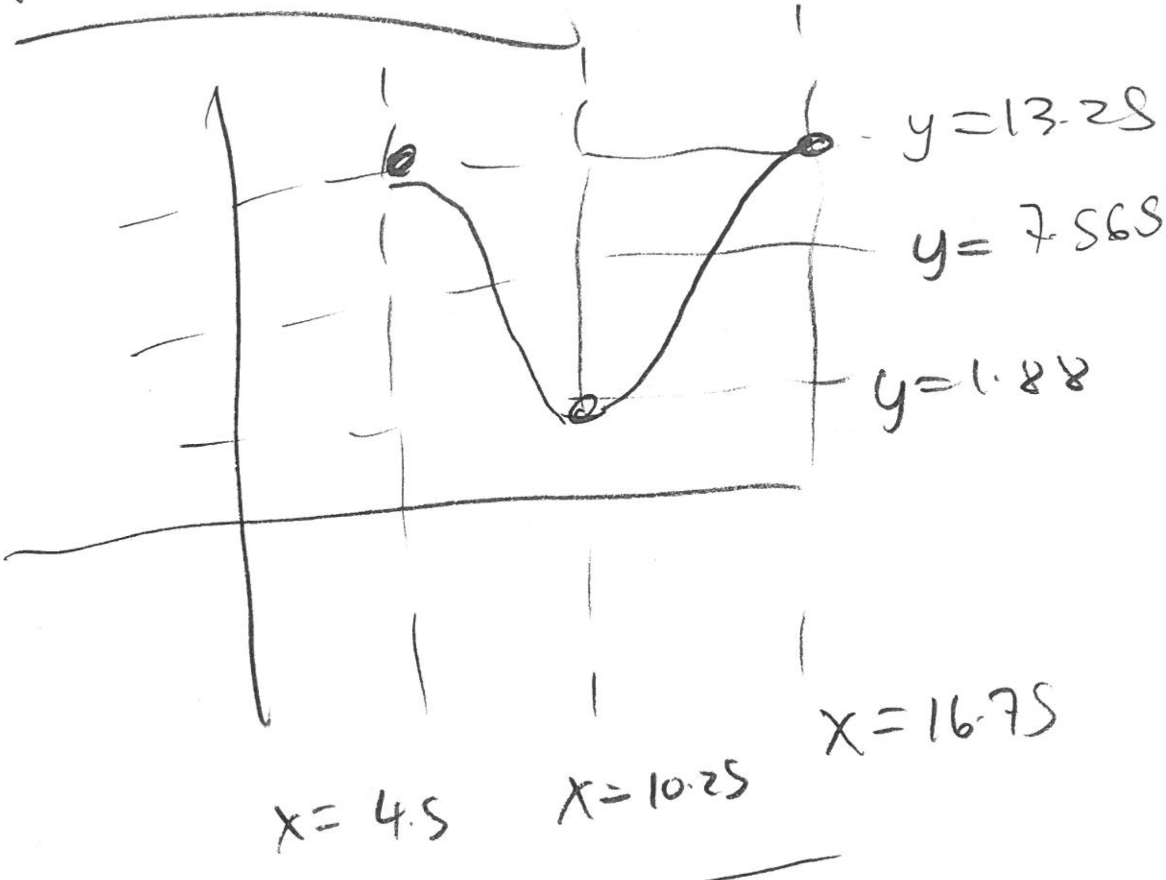
---

4:45 pm high tide = 13.25

12+4.75

16.75 hrs

Problem 14 cont




not
Symmetrical