Example 7: Calculating the Ebb and Flow of Tides

One particular July 4th in Galveston, TX, high tide occurred at 9:36 am. At that time the water at the end of the 61st Street Pier was 2.7 meters deep. Low tide occurred at 3:48 p.m, at which time the water was only 2.1 meters deep. Assume that the depth of the water is a sinusoidal function of time, t, algebraically then graph the function.

Period:

12 hrs 24 min

12.4 hrs

cosine ⟶ Max

Low

(t, depth)

(9:36, 2.7) → (9.6, 2.7)

(3:48, 2.1) → (15.8, 2.1)

36/60 = .6

48/60 = .8

time of max

① Amp: $\frac{2.7-2.1}{2} = .3$

② V.S: $\frac{2.7+2.1}{2} = 2.4$

③ Time of Max

④ period = 12.4

$12.4 = \frac{2\pi}{B}$

$B = \frac{2\pi}{12.4} = \frac{\pi}{6.2}$

$y = .3\cos\frac{\pi}{6.2}(x - 9.6) + 2.4$

b) At what time on the 4th of July did the first low tide occur.

2nd Trace 3.39 → 3:24 am

3

.39 × 60

c) What was the approximate depth of the water at 6:00 am and at 3:00 pm?

t = 6 → 2.32 m

t = 15 → 2.12 m

TRACE

d) What was the first time on July 4th when the water was 2.4 meters deep?

2nd Trace 5

.3 of 60 =

12:18 am

80) Temperature Data: The normal monthly Fahrenheit temperatures in Helena, MT, are shown in the table below (month 1 = January)

Model the temperature T as a sinusoidal function of time using 20 as the minimum value and 68 as the maximum value. Support your answer graphically by graphing your function with a scatter plot.

M	1	2	3	4	5	6	7	8	9	10	11	12
T	20	26	35	44	53	61	68	67	56	45	31	21

min

max

VS: $\frac{68+20}{2} = 44$

$y = 23.488 \sin(.513x - 2.028) + 43.481$

time of max

$y = 24 \cos \frac{\pi}{6}(x - 7) + 44$

Amp $= \frac{68-20}{2}$

$= 24$

Period = 12 months

$y = -24 \cos \frac{\pi}{6}(x - 1) + 44$

$12 = \frac{2\pi}{B}$

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

$y = 24 \sin \frac{\pi}{6}(x - 7 + 3) + 44$

$y = -24 \sin \frac{\pi}{6}(x - 1 + 3) + 44$