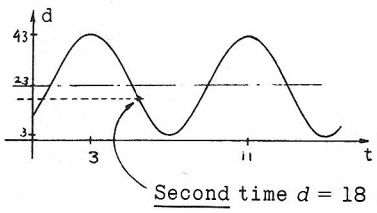
3	3.5
3.5	3.92836283
4	4.29813333
4.5	4.59807621
5	4.81907786
5.5	4.95442326
6	5
6.5	4.95442326
7	4.81907786
7.5	4.59807621
8	4.29813333
8.5	3.92836283
9	3.5
9.5	3.02606043
10	2.52094453

EXERCISE 2-12, page 59; Sinusoidal Functions as Mathematical Models

1. *Ferris Wheel Problem*

(a) Graph.



(b) The lowest you go is 3 feet above the ground, because seats in a Ferris wheel do not scrape the ground.

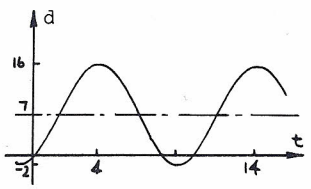
(c) Let d = no. of feet above ground.
$d = C + A \cos B(t - D)$
$C = 23,\ A = 43 - 23 = 20,$
$B = 2\pi/(11 - 3) = \pi/4,\ D = 3.$
$\therefore\ d = 23 + 20 \cos \frac{\pi}{4}(t - 3)$

(d) **(i)** $d = 23 + 20 \cos \frac{\pi}{4}(6 - 3) \approx 8.86$ ft
(ii) $d = 23 + 20 \cos \frac{\pi}{4}(4\frac{1}{3} - 3) = 33$ ft
(iii) $d = 23 + 20 \cos \frac{\pi}{4}(9 - 3) = 23$ ft
(iv) $d = 23 + 20 \cos \frac{\pi}{4}(0 - 3) \approx 8.86$ ft

(e) $23 + 20 \cos \frac{\pi}{4}(t - 3) = 18$
$t = 3 + \frac{4}{\pi} \cos^{-1}(-0.25)$
$t = 5.321\ldots + 8n$ or $0.678\ldots + 8n$
Positive values of t are about 0.68, 5.32, 8.68,
$\therefore$ Second time $d = 18$ is $t \approx 5.32$ sec.

2. *Steamboat Problem*

(a) Graph



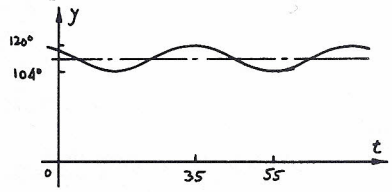
(b) Let d = no. of ft above water.
Let t = no. of seconds.
$d = C + A \cos B(x - D)$
$C = 7,\ A = 9,\ B = 2\pi/10 = \pi/5$
$D = 4$
$\therefore\ d = 7 + 9 \cos \frac{\pi}{5}(t - 4)$

(c) **(i)** $d = 7 + 9 \cos \frac{\pi}{5}(5 - 4) \approx 14.28$ ft
(ii) $d = 7 + 9 \cos \frac{\pi}{5}(17 - 4) \approx 4.22$ ft

(d) $7 + 9 \cos \frac{\pi}{5}(t - 4) = 0$
$t = 4 + \frac{5}{\pi} \cos^{-1}(-7/9) = 7.918\ldots + 10n$ or $0.081\ldots + 10n$
First positive time is 0.08 sec, coming out (see graph).

3. *Extraterrestrial Being Problem*

(a) Graph.



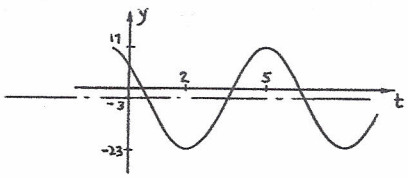
(b) Let y = no. of degrees temp.
Let t = no. of min.
$y = C + A \cos B(t - D)$
$C = \frac{1}{2}(120 + 104) = 112,$
$A = 120 - 112 = 8,$
$B = 2\pi/40 = \pi/20,\ D = 35$
$\therefore\ y = 112 + 8 \cos \frac{\pi}{20}(t - 35)$

(c) $y = 112 + 8 \cos \frac{\pi}{20}(0 - 35) \approx 117.7°$

(d) $112 + 8 \cos \frac{\pi}{20}(t - 35) = 114$
$t = 35 + \frac{20}{\pi} \cos^{-1} 0.25 = 43.39\ldots + 40n$ or $26.60\ldots + 40n$
First positive times are 3.39 min, 26.61 min, 43.39 min.

3 ~~4.~~ *Tarzan Problem*

(a) Graph.



(b) $y = C + A \cos B(t - D)$
$C = \frac{1}{2}(17 + (-23)) = -3,$
$A = 17 - (-3) = 20,\ D = 5,$
Per. $= 2(5 - 2) = 6,\ B = 2\pi/6 = \pi/3.$
$\therefore\ y = -3 + 20 \cos \frac{\pi}{3}(t - 5)$

(c) **(i)** $y = -3 + 20 \cos \frac{\pi}{3}(2.8 - 5) \approx -16.38$ m
(ii) $y = -3 + 20 \cos \frac{\pi}{3}(6.3 - 5) \approx 1.16$ m
(iii) $y = -3 + 20 \cos \frac{\pi}{3}(15 - 5) = -13$ m

(d) $y = -3 + 20 \cos \frac{\pi}{3}(0 - 5) = 7$ m

(e) $-3 + 20 \cos \frac{\pi}{3}(t - 5) = 0$
$t = 5 + \frac{3}{\pi} \cos^{-1} 0.15 = 6.356\ldots + 6n$ or $3.643\ldots + 6n$
Least positive value is $6.356\ldots - 6$, or about 0.36 sec.