

24.

$$\cos \theta - \sin \theta = 0$$

$$\cos \theta = \sin \theta$$

$$1 = \frac{\sin \theta}{\cos \theta}$$

$$1 = \tan \theta$$

$$\theta = \tan^{-1}(1)$$

$$\theta = \frac{\pi}{4} \text{ in Quadrant I}$$

$$\theta = \pi + \frac{\pi}{4} = \frac{5\pi}{4} \text{ in Quadrant III}$$

$\therefore$ the $\theta = \frac{\pi}{4}, \frac{5\pi}{4}$ are the solutions to the given equation.

25.

$$\sin(2\theta - 20^\circ) = \frac{1}{2}$$

$$(2\theta - 20^\circ) = \sin^{-1}\left(\frac{1}{2}\right)$$

$$(2\theta - 20^\circ) = 30^\circ$$

The sine function is positive in Quadrants I and II and $\sin 2\theta$

has a period of 180° . Then, $\sin^{-1}\left(\frac{1}{2}\right) = 30^\circ$ and

$$\sin^{-1}\left(\frac{1}{2}\right) = 180^\circ - 30^\circ = 150^\circ$$

Then,

$$(2\theta - 20^\circ) = 30^\circ$$

$$(2\theta - 20^\circ) = 150^\circ$$

$$2\theta = 50^\circ$$

$$2\theta = 170^\circ$$

$$\theta = 25^\circ$$

$$\theta = 85^\circ$$

$$\therefore \theta_1 = 25^\circ, \theta_2 = 85^\circ, \theta_3 = 25^\circ + 180^\circ = 205^\circ,$$

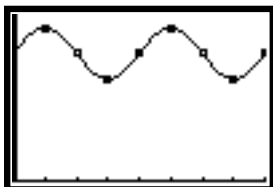
$$\theta_4 = 85^\circ + 180^\circ = 265^\circ$$

Practice 5.9, page 480

1. $y = 20 \sin(6.283x) + 100$

L1	L2	L3	3
0	100		
.25	120		
.5	100		
.75	80		
1	100		
1.25	120		
1.5	100		

WINDOW			
Xmin=0			
Xmax=2			
Xscl=.25			
Ymin=0			
Ymax=130			
Yscl=1			
Xres=1			

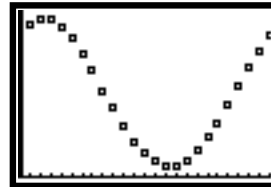


2nd F1 Plot2 Plot3			
Y1=20*sin(6.283			
1853071796X+3.63			
6363636363E-14)			
+100			
Y2=			
Y3=			
Y4=			

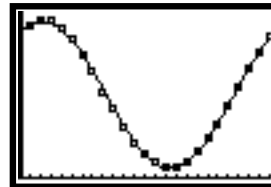
2. For question 14:

L1	L2	L3	3
0	38.59		
.1	41.49		
.2	42.85		
.3	42.75		
.4	40.93		
.5	37.73		
.6	33.51		

WINDOW			
Xmin=0			
Xmax=24			
Xscl=1			
Ymin=0			
Ymax=45			
Yscl=.1			
Xres=1			



SinReg			
y=a*sin(bx+c)+d			
a=19.90990768			
b=.2566899513			
c=1.01432174			
d=22.59306804			



The earlier equation was

$$E(t) = 19.91 \cos \frac{\pi}{12}(t-2) + 23.04$$

Notice that a and d are almost the same.

$$\frac{\pi}{12} \div 0.26 \div b$$

The difference between the values of c is about 1.53 or $\frac{\pi}{2}$

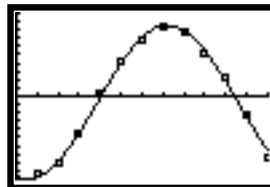
which is the phase shift difference between the sine function and the cosine function.

For question 15:

L1	L2	L3	3
1	-18.6		
2	-16.3		
3	-9.1		
4	4		
5	8.5		
6	13.8		
7	17		

WINDOW			
Xmin=0			
Xmax=12			
Xscl=1			
Ymin=-20			
Ymax=20			
Yscl=2			
Xres=1			

SinReg			
y=a*sin(bx+c)+d			
a=18.5443079			
b=.4697220476			
c=-1.812763069			
d=-1.437097362			

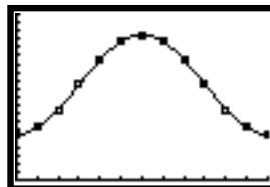


For question 16:

L1	L2	L3	3
0	5.5		
.1	8.2		
.2	8.5		
.3	11.5		
.4	14.5		
.5	16.7		
.6	17.5		

WINDOW			
Xmin=0			
Xmax=12			
Xscl=1			
Ymin=0			
Ymax=20			
Yscl=1			
Xres=1			

2nd F1 Plot2 Plot3			
Y1=6.0017144209			
984*sin(.5236688			
5301325X+-1.5712			
167912844)+11.50			
08561869			
Y2=			
Y3=			



$$D(t) = -6 \cos \frac{\pi}{6} t + 11.5$$

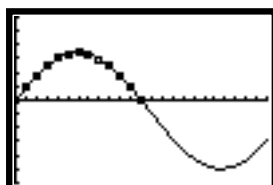
The difference is the $\frac{\pi}{2}$ phase shift.

For question 17:

L1	L2	L3	3
0	0		
.25	.22		
.5	.45		
.75	.61		
1	.75		
1.25	.82		
1.5	.85		
L3(1)=			

WINDOW
Xmin=0
Xmax=6
Xscl=.25
Ymin=-1.5
Ymax=1.5
Yscl=.25
Xres=1

Plot1 Plot2 Plot3
\Y1=1.0469230379
278*sin(.9236713
9391227X+.186010
79196801)+-.1937
4434364401
\Y2=
\Y3=



$$V(t) = 0.85 \sin \frac{\pi}{3} t$$

The equations are close but not the same. The calculator equation will be more accurate.

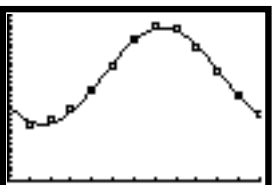
For question 18:

L1	L2	L3	1
1	12	13	
2	13	14	
3	15	16	
4	16	18	
5	19	21	
6	24	24	
7	30	24	
8	33	26	
L1={1,2,3,4,5,6...			

L2	L3	L4	4
12	13	-9	
13	14	-6	
14	15	0	
15	16	10	
16	18	19	
19	21	19	
24	24	21	
30	24	23	
33	26		
L4={-9,-6,0,10,...			

For Athens

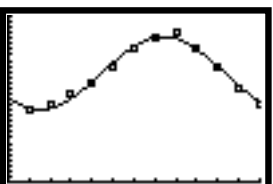
SinReg
y=a*sin(bx+c)+d
a=10.19726841
b=.552017908
c=-2.488461214
d=22.22142363



$$T(t) = -10.5 \cos \frac{\pi}{6} t + 22.5$$

For Lisbon

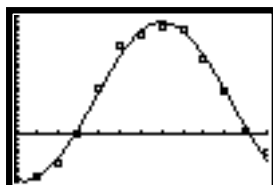
SinReg
y=a*sin(bx+c)+d
a=6.578138137
b=.5366067104
c=-2.393731518
d=19.72658359



$$T(t) = -7 \cos \frac{\pi}{6} t + 20$$

For Moscow

SinReg
y=a*sin(bx+c)+d
a=16.73321108
b=.4789684699
c=-1.773064691
d=6.986533286



$$T(t) = -16 \cos \frac{\pi}{6} t + 7$$

The equations generate the same graphs so have no real differences other than the phase angle and reflection.

3. The equation found by hand is

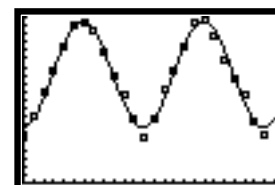
$$H(t) = 7 \sin \frac{\pi}{6} t(t-2) + 12.5$$

and is close to the graphing calculator equation. The calculator generated equation is more accurate.

L1	L2	L3	2
0	5.5		
1	8		
2	11		
3	13.5		
4	16.3		
5	19		
6	19.5		
L2={5.5,8,11,13...			

WINDOW
Xmin=0
Xmax=25
Xscl=1
Ymin=0
Ymax=20
Yscl=1
Xres=1

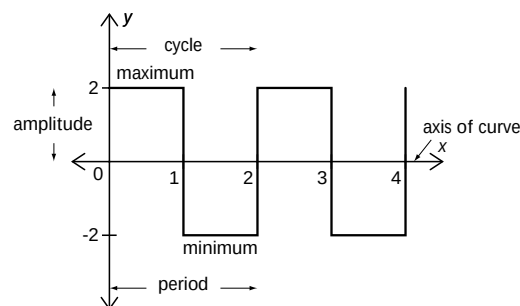
SinReg
y=a*sin(bx+c)+d
a=6.405276996
b=.5239257953
c=-1.504648375
d=13.09928365



Chapter 5, Review and Practice, page 485

1. If a function is self-replicating, then it is periodic.

2.



(a) cycle - the exact portion of the curve that repeats

(b) period - the length of one cycle

(c) amplitude - the distance from the axis of the curve to the maximum or minimum value. Amplitude = $\frac{\text{max} - \text{min}}{2}$

(d) axis of the curve - the horizontal line that is halfway between the maximum and minimum values.

$$\text{Axis of the curve} = \frac{\text{max} + \text{min}}{2}$$

(e) maximum - the upper most point reached in one cycle

minimum - the lowest point reached in one cycle

3. (a) Ice cream consumption follows a regular pattern as it increases from a low in the cooler months, to a high in the warmer months and then decreases as the temperature cools. This cycle repeats each year.

(b) If production were constant, natural gas use would be constant. However, as temperatures cool, natural gas for heating purposes would increase and as temperatures