1. Complete the following table. Do **NOT** use a calculator! When the value for the sine or cosine function is given, state all possible solutions for the angles with $0 \leq x \leq 2\pi$ or $0 \leq \theta \leq 360°$.

radian (x)	degree (θ)	$\sin(x)$	$\cos(x)$
$\frac{3\pi}{4}$			
		$-\frac{1}{2}$	
	$330°$		
			$-\frac{\sqrt{3}}{2}$
$\frac{10\pi}{3}$			
		$\frac{\sqrt{2}}{2}$	
	$210°$		
			-1
$-\frac{5\pi}{4}$			
		0	
	$270°$		
			$-\frac{1}{2}$

Sketch a graph of the following trigonometric functions for $-2\pi \leq x \leq 2\pi$. Give the period of the function.

2. $y = 3\cos(2x)$

3. $y = 2 - 4\sin(3x)$

4. $y = 1 + 3\cos(2x)$

5. $y = 4\sin(x/2)$

6. $y = 2\sin(4x) + 1$

7. $y = 5 - 2\cos(x/2)$

8. $y = 2 - \cos(2(x - \pi))$

9. $y = 2\sin\left(3\left(x + \frac{\pi}{2}\right)\right)$

10. The lungs do not completely empty or completely fill in normal breathing. The volume of the lungs normally varies between 2200 ml and 2800 ml with a breathing rate of 24 breaths/min. This exchange of air is called the *tidal volume*. One approximation for the volume of air in the lungs uses the cosine function written in the following manner:

$$V(t) = A + B\cos(\omega t),$$

where A, B, and ω are constants and t is in minutes. Use the data above to create a model, *i.e.,* find A, B, and ω that simulates the normal breathing of an individual for one minute. Graph the function for 10 sec., clearly showing the maximum and minimum volumes, and frequency of inhalation.

11. a. The heart pumps blood at a regular rate of about 60 pulses per minute . The heart volume is about 140 ml, and it pushes out about 1/2 its volume (70 ml) with each beat. Use a model of the following form to simulate the volume of blood, $B(t)$, in the heart at any time t:

$$B(t) = a + b\sin(\omega t),$$

where a, b, and ω are constants and t is in minutes. Sketch a graph of this function for 5 sec., clearly showing the maximum and minimum volumes, and frequency of the beating heart.

b. When the heart pushes out blood, the pressure, $P(t)$, in the aorta and arterioles increases to 120 mm Hg. When the heart fills with blood, the pressure falls to about 80 mm Hg. Use a similar model of the form

$$P(t) = c + d\sin(\omega t),$$

where c, d, and ω are constants and t is in minutes. Again you sketch a graph of this function for 5 sec., clearly showing the maximum and minimum volumes, and frequency of the beating heart.

12. The average body temperature for a human is about 37°C. However, this temperature normally varies a few tenths of a degree in each individual with distinct regularity. The body is usually at its hottest around 10 or 11 am and at its coolest in the late evening, which helps encourage sleep. When an individual switches to night shift work, his body temperature cycle has to switch also. Suppose that a worker on the night shift finds his hottest body temperature to be at 2 am with a body temperature of 37.1°C, then 12 hours later his body temperature achieves a minimum of 36.7°C. Assume that the body temperature can be modeled using a trigonometric function and is given by

$$T(t) = A + B\cos(\omega(t - \phi)),$$

where A, B, ω, and ϕ are constants and t is in hours. Use the data above to find the four parameters, then sketch a graph for the temperature of this individual for one day.

13. a. Iguanas are cold-blooded or ectothermic organisms with their body temperature depending on the external temperature. (See http://www.sonic.net/melissk/ig_short.html for more information.) Their natural habitat lies near the equator, where the sun shines about 12 hours a day. The iguana's temperature cycles during the day, with a low of 75°F at about 3 am and a high of 104°F at about 3 pm. Assume that the body temperature of an iguana can be modeled using the following function:

$$T(t) = A + B\sin(\omega(t - \phi)),$$

where A, B, ω, and ϕ are constants and t is in hours. Use the data above to find the four parameters, then sketch a graph for the temperature of a typical iguana for one day.

b. A temperature of 88°F for at least 12 hours a day is critical for the health of an iguana. About how many hours a day does your iguana model give this temperature? (Use the graph which you have created to make a reasonable estimate.)

14. During the human female menstrual cycle, the gonadotropin, FSH or follicle stimulating hormone, is released from the pituitary in a sinusoidal manner with a period of approximately 28 days. Guyton's text on *Medical Physiology* shows that if we define day 0 ($t = 0$) as the beginning of menstration, then FSH, $F(t)$, cycles with a high concentration of about 4 ("relative units") around day 9 and a low concentration of about 1.5 around day 23.

a. Consider a model of the concentration FSH (in "relative units") given by

$$F(t) = A + B\cos(\omega(t - \phi)),$$

where A, B, ω, and ϕ are constants and t is in days. Use the data above to find the four parameters, then sketch a graph for the concentration of FSH over one period. If ovulation occurs around day 14, then what is the approximate concentration of FSH at that time?

b. Find the derivative of $F(t)$ and give its value at the time of ovulation. (Don't forget to set your calculator to radians for the evaluations at ovulation.)