1. Simplify the following:
   
   (a) $6e^{\ln(B^2)}$,
   
   (b) $\ln(e^{3AC})$,
   
   (c) $2e^{\ln(2)+A}$,
   
   (d) $(e^{\ln(B^2)})^2$,
   
   (e) $\ln(2e^{AB})$,
   
   (f) $2\ln(e^B) + 3\ln(B^e)$.

2. Explain the following equations using logarithm laws:
   
   (a) $\ln\left(\frac{1}{2}\right) = -\ln(2)$,
   
   (b) $\ln(2e) = 1 + \ln(2)$,
   
   (c) $\ln(100) = 2(\ln(5) + \ln(2))$.

3. Solve the following for $x$:
   
   (a) $3^x = 17$,
   
   (b) $20 = 50(1.04)^x$,
   
   (c) $2^x = e^{x+1}$,
   
   (d) $3e^{2x} = 5e^{4x}$.

4. Caffeine is eliminated from the body at a continuous rate of 17% per hour. A standard cup of coffee contains 150 mg of caffeine.
   
   (a) Write a formula of the form $C = C_0(1 + r)^t$ for the amount of caffeine in mg, $C$, as a function of the number of hours, $t$, after drinking a cup of coffee.
   
   (b) Find the number of hours it takes for half of the caffeine from a cup of coffee to be eliminated from the body.
   
   (c) Find the number of hours it takes for only 1% of the caffeine from a cup of coffee to remain in your system.

5. A sum of $5000 is invested at an interest rate of 5% per year. Find the time required for the money to double if the interest is compounded:
   
   (a) Annually.
   
   (b) Continuously i.e. according to a formula of the form $A = A_0e^{kt}$.

6. For each of the following angles, determine which of the sine, cosine and tangent of the angle are positive, negative, zero or undefined.
(a) $\frac{3\pi}{4}$,  
(b) $\frac{3\pi}{2}$,  
(c) $2\pi$,  
(d) $\frac{3\pi}{2}$,  
(e) $4$,  
(f) $-1$.

7. Calculate the following sin and cos values without using your calculator, but using your table of Special Values.
   (a) $\sin\left(-\frac{\pi}{6}\right)$ given that $\sin\left(\frac{\pi}{6}\right) = 0.5$
   (b) $\cos\left(\frac{\pi}{6}\right)$ given that $\cos\left(-\frac{\pi}{6}\right) = \frac{\sqrt{3}}{2}$

8. For each of the following sinusoidal functions, determine its amplitude and period, and hence sketch its graph.
   (a) $y = 4 + \cos(3x)$,
   (b) $y = 2 \sin(2x) + 1$,
   (c) $y = 2 + 2 \sin(\pi x)$,
   (d) $y = 3 \sin(2x - \frac{\pi}{2})$.

9. Find all solutions $x$ for the following equations, where $-\pi \leq x \leq \pi$.
   (a) $\sin(2x) = \frac{1}{2}$,
   (b) $\sin(x) = -\frac{1}{2}$,
   (c) $\sqrt{3} = 2 \sin(5x)$,
   (d) $1 = 6 \cos(3x - \pi) - 2$,
   (e) $-2 = \cos(0.5x + 1) + 1$.

10. As a wave passes by an offshore piling, the height of the water is modelled by the function
    $$ h(t) = 3 \cos\left(\frac{\pi}{10} t\right) $$
    where $h(t)$ is the height in metres above the mean sea level at time $t$ seconds.
    (a) Find the period of the wave.
    (b) Find the vertical distance between the trough and the crest of the wave.
    (c) What will be the height of the wave after 1 minute?
    (d) Give a time when the height of the wave is $-1$ metres.

11. The distance, $d$, that a thrown object travels is a function of its initial velocity, $v$, and the angle at which it is thrown, $\theta$. The function is given by:
    $$ d = \frac{v^2 \sin(2\theta)}{g}, $$
    where $g$ is the acceleration due to gravity.
    (a) Sketch $d$ as a function of $\theta$ for $0 \leq \theta \leq \pi/2$.
    (b) What value of $\theta$ gives the largest possible value for $d$?
    (c) What is this value of $d$?