Problem 1  Assume that when we plot the relationship between $x$ and $y$ on a log-log plot, a straight line passing through the points $(0, 2)$ and $(-3, 4)$ appears. What is the relationship between $x$ and $y$?

Problem 2  Let $y = 10(2^x)$. Sketch the graph of this relationship on a log-linear plot. Be sure to state the slope and intercept of the resulting line.
Problem 3 Suppose we have 100 grams of an isotope with half-life of 12 hours. How much time will have elapsed when 10 grams remain?

Problem 4 Let $\theta$ be such that $\sin(\theta) = 1/4$. Assume also that $\pi/2 \leq \theta \leq \pi$. Find the values of $\cos(\theta)$ and $\tan(\theta)$. 
Problem 5 Graph the following functions. Draw your own axes, but be sure to label any important information (axes, vertices etc.).

(a) \( f : (-2, 2) \to \mathbb{R}, \, f(x) = (x - 2)^2 \)

(b) \( g : [-\pi, \pi] \to \mathbb{R}, \, g(t) = \cos(t) + 1 \)

(c) \( h : (-\infty, 1) \cup (1, \infty) \to \mathbb{R}, \, h(x) = \frac{1}{x - 1} + 3 \)
Problem 6  For each of the following recursions:

- Find the fixed points.
- Decide whether the sequence has a limit when starting at the provided $a_0$. If it does, state what the limit is.

(a) $a_{n+1} = \frac{a_n}{a_{n+2}}$; $a_0 = 2$.

(b) $a_{n+1} = 2\sqrt{a_n}$; $a_0 = 1$.

(c) $a_{n+1} = 2.1a_n(1 - a_n)$, $a_0 = 0.5$. 
Problem 7  Find the following limits.

(a) \[ \lim_{n \to \infty} \frac{n^3 + n - 2}{2n^3 + 1}. \]

(b) \[ \lim_{n \to \infty} \frac{3^n}{n^{102} - n^3 + 1}. \]

(c) \[ \lim_{n \to \infty} \frac{1}{n + 1} + \frac{1}{n^2 + 1}. \]
Problem 8 Assume that when we plot the relationship between \( x \) and \( y \) on a log-linear plot, the line \( 2x + 3Y + 1 = 0 \) appears. Find the relationship between \( x \) and \( y \).

Problem 9 Assume that, when plotting the relationship between \( x \) and \( y \) on a log-log plot, the line \( X + 2Y = 1 \) appears. Now let \( X^* = \ln(x) \), \( Y^* = \ln(y) \). Find the relationship between \( X^* \) and \( Y^* \).
Problem 10  A strain of bacteria reproduces asexually every 20 minutes. Initially, there are 120 bacteria. Let $N_k$ be the number of bacteria after $k$ periods of 20 minutes.

(a) Write down a recursive relation with initial condition $N_0$ that describes how the population changes.

(b) Write down an explicit formula for $N_k$ as a function of $k$. 