Any answers which require logarithms to be expressed should be put in terms of natural or common logarithms. Show all work.

1. **(3 points)** *If $f(x) = 2x^2 - 3x$, simplify the expression $f(a+h) - f(a)$.*

$$\begin{aligned} f(a+h) - f(a) &= \left[2(a+h)^2 - 3(a+h)\right] - \left[2a^2 - 3a\right] \\ &= (2a^2 + 4ah + 2h^2 - 3a - 3h) - (2a^2 - 3a) \\ &= 4ah + 2h^2 - 3h \end{aligned}$$

2. **(3 points)** *Find the equation of the line through the points $(-2, 8)$ and $(2, 2)$.*

   The slope of this line is given by $m = \frac{2-8}{2-(-2)} = \frac{-6}{4} = \frac{-3}{2}$. Thus the equation of the line is $y = \frac{-3}{2}x + b$ for some b. Plugging in either of the known points on the line lets us solve for b:

$$\begin{aligned} 8 &= \frac{-3}{2}(-2) + b \\ 8 &= 3 + b \\ 5 &= b \end{aligned}$$

   so the resulting equation is $y = \frac{-3}{2}x + 5$.

3. **(6 points)** *Identify the domains of the following functions:*

   (a) **(3 points)** $g(t) = \sqrt{3-t} - \sqrt{2+t}$.
   We have two square roots appearing in this function, so both of them must have non-negative arguments in order for the function to be evaluatable. Thus, it is necessary that $3 - t \geq 0$ and $2 + t \geq 0$; from these we respectively derive the conditions $t \leq 3$ and $t \geq -2$, so $-2 \leq t \leq 3$, or, in interval form, t must lie in $[-2, 3]$.

   (b) **(3 points)** $f(x) = \frac{2x^3-5}{x^2+x-6}$.
   This function contains a fraction, so the denominator must be nonzero; we thus have the condition $x^2 + x - 6 \neq 0$. Using the quadratic formula, it thus follows that x is not equal to either value of $\frac{-1\pm\sqrt{1+24}}{2} = -3, 2$. Thus $x \neq -3$ and $x \neq 2$, or, in interval form, x is in $(-\infty, -3) \cup (-3, 2) \cup (2, \infty)$.

4. **(8 points)** *There are currently 2000 inhabitants of the luckless town of Dunwich, MA, and its population decreases by 7% each year due to emigration, death, and mysterious disappearances.*

   (a) **(4 points)** *Construct a function $f(t)$ to describe the population of Dunwich in t years.*
   Since the population each year becomes 93% of its former value, after one year the population would be $2000 \cdot 0.93$, after two years it would be $2000 \cdot 0.93 \cdot 0.93$, and so forth. Thus after t years it has gone through this depletion procedure t times, resulting in a population of $f(t) = 2000(0.93)^t$.

   (b) **(4 points)** *The remaining denizens of the town will abandon it when there are only 100 people left. When will this occur?*

We are solving for when $f(t) = 100$, as such:

$$\begin{aligned} 2000(0.93)^t &= 100 \\ (0.93)^t &= \frac{100}{2000} = \frac{1}{20} \\ t &= \log_{0.93} \frac{1}{20} = \frac{\ln \frac{1}{20}}{\ln 0.93} \end{aligned}$$

This would evaluate to approximately 41 years, if calculated; such a calculation is neither necessary nor feasible under assessment conditions.