This test is closed-book and closed-notes. No calculator is allowed for this test. For full credit show all of your work (legibly!), unless otherwise specified. Answers should be simplified down to arithmetic expressions whenever possible – only unsimplifiable exponentials and common or natural logarithms may be left unevaluated.

1. **(10 points)** Answer the following questions concerning logarithms.

   (a) **(4 points)** Find the domain of the function $f(x) = \frac{\sqrt{x}}{\log_5(5-x)}$.

   (b) **(2 points)** Determine the value of $\log_2 14 - 2\log_2 6 + \log_2 \frac{9}{7}$.

   (c) **(4 points)** Solve for x in the exponential equation $2 \cdot 5^{(x^2+x)} = 50$.

2. **(7 points)** Answer the following questions about the quadratic $q(x) = 6x^2 + 12x - 5$.

   (a) **(3 points)** Put the quadratic $q(x)$ in standard form.

   (b) **(1 point)** Does $q(x)$ have a maximum or minimum value? If so, identify which it is and what its value is.

   (c) **(3 points)** Determine the x-intercepts of this quadratic if they exist (explicitly stating if they do not exist), and its y-intercept. Label which is which.

3. **(10 points)** Answer the following questions about polynomial functions,

   (a) **(2 points)** Identify all the *potential* rational roots of $3x^3 + 7x - 4$. Do not check which are actual roots.

   (b) **(4 points)** Identify the x-intercepts, y-intecept, and long-term behavior of the polynomial $f(x) = -2(x-3)(x+1)(x+2)$.

   (c) **(4 points)** Using either synthetic or long division, find the quotient and remainder of the operation $\frac{4x^3-3x+5}{x+2}$.

4. **(12 points)** Solve the inequality $\frac{1}{x+2} + \frac{3}{x-3} \leq \frac{4}{x}$.

5. **(10 points)** Answer the following questions about growth and decay.

   (a) **(3 points)** The temperature in degrees Fahrenheit of a glass of cold milk t minutes after it was removed from the fridge is given by the function $f(t) = 70 - 30e^{-0.02t}$. How long will it take the milk to warm up to 55°F?

   (b) **(3 points)** The radioactive alloy Cobalt-Thorium-G has a half-life of 93 years. Produce a function describing the quantity of Co-Th-G remaining in a 75 gram sample after t years.

   (c) **(4 points)** The environmental safety rating for Cobalt-Thorium-G indicates that unshielded human exposure will again be safe after a 75 gram sample has decayed down to 5 grams. Using your function from the previous part of this question, how many years will this take?

6. **(10 points)** Answer the following questions preparatory to sketching the rational function $h(x) = \frac{3(x-1)(x+1)}{x+2}$.

   (a) **(2 points)** What is the function's domain?

   (b) **(2 points)** Does this function have x-intercepts, and if so, what are they?

   (c) **(2 points)** Where are this function's vertical asymptotes?

   (d) **(3 points)** How does this function behave as x becomes very large? How does it behave as x becomes very highly negative? Label which is which.

   (e) **(1 point)** Does this function have a maximum or minimum value? Why or why not?