

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, but unsimplifiable exponentials and common or natural logarithms may be left unevaluated.

1. **(15 points)** Answer the following questions about growth and decay.
  - (a) **(5 points)** A metal ingot is removed from a furnace into a warm metalworking studio; its temperature  $t$  minutes after removal is given by the function  $f(t) = 90 + 410e^{-0.05t}$ . How long will it take the ingot to cool to  $200^\circ\text{F}$ ?
  
  
  
  
  
  
  
  
  
  
  - (b) **(4 points)** You have \$500 invested in an account which bears 2% annual interest, compounding quarterly. Produce a function describing the value in your account after  $t$  years.
  
  
  
  
  
  
  
  
  
  
  - (c) **(6 points)** You hope to cash the account from the previous question out when it reaches a balance of \$600. Based on the function from the previous question, how many years do you need to wait until you can do so?

2. **(20 points)** Solve the inequality  $\frac{s+3}{(s-1)^2} \leq \frac{1}{s+2}$ .

1	/15
2	/20
3	/20
4	/15
5	/15
6	/15
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3. **(20 points)** Answer the following questions preparatory to sketching the rational function

$$h(x) = \frac{-5(x+2)(x-3)}{(x-1)^2}.$$

(a) **(4 points)** What is the function's domain?

(b) **(5 points)** Does this function have  $x$ -intercepts, and if so, what are they?

(c) **(4 points)** Where, if anywhere, are this function's vertical asymptotes?

(d) **(5 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) **(2 point)** Does this function have a maximum or minimum value? Why or why not?

4. **(15 points)** Answer the following questions about the quadratic  $q(x) = -2x^2 + 12x - 20$ .
- (a) **(8 points)** Put the quadratic  $q(x)$  in standard form.
  
  
  
  
  
  
  
  
  
  
  - (b) **(2 point)** Does  $q(x)$  have a maximum or minimum value? If so, identify which it is and what its value is.
  
  
  
  
  
  
  
  
  
  
  - (c) **(5 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.
5. **(15 points)** Answer the following questions concerning logarithms.
- (a) **(5 points)** Solve for  $x$  in the exponential equation  $5 \cdot 2^{(x^2-4x-1)} = 80$ .
  
  
  
  
  
  
  
  
  
  
  - (b) **(6 points)** Find the domain of the function  $g(x) = \frac{\ln(15-2x)}{\sqrt{x-5}-1}$ .
  
  
  
  
  
  
  
  
  
  
  - (c) **(4 points)** Determine the value of  $2 \log_3 6 + \log_3 12 - 4 \log_3 2$ .

6. **(15 points)** Answer the following questions about polynomial functions.

(a) **(3 points)** Identify all the *potential* rational roots of  $2x^4 - 3x^3 + x^2 - 6$ . Do not check which are actual roots.

(b) **(7 points)** Identify the  $x$ -intercepts,  $y$ -intercept, and long-term behavior of the polynomial  $f(x) = 4(x + 1)^3(x - 3)$ .

(c) **(5 points)** Using either synthetic or long division, find the quotient and remainder of the operation  $\frac{x^4 + 8x^2 - 2x + 7}{x + 3}$ .