

**MIDTERM 2 – PART 1****(CHAPTERS 2 AND 3: POLYNOMIAL, RATIONAL, EXP'L, LOG FUNCTIONS)****MATH 141 – SPRING 2017 – KUNIYUKI****150 POINTS TOTAL: 49 FOR PART 1, AND 101 FOR PART 2****Show all work, simplify as appropriate, and use “good form and procedure” (as in class).****Box in your final answers!****No notes or books allowed.**

Unless otherwise specified, give exact answers.

**Write units where appropriate in your answers.****PART 1: USING SCIENTIFIC CALCULATORS (49 PTS.)**

- 1) An astronaut kicks a ball over a flat region of a (very) distant moon. The height of the ball in feet is given by:  $h(t) = -3t^2 + 18t + 2$  (if  $t \geq 0$ ), where  $t$  is the amount of time in seconds since the ball was kicked. (The formula is relevant up until the time the ball hits the ground.) Write units! (19 points total)
- Use a formula we used in class to find how much time it takes (since the ball was kicked) for the ball to reach its maximum height.
  - What is the maximum height achieved by the ball?
  - What was the height of the ball at the time it was kicked?
  - How much time does it take (since the ball was kicked) for the ball to hit the ground? Give an exact answer and also round it off to three significant digits.

2) Consider  $f(t) = t^3 - 7t^2 + 17t - 14$ . Hint: One of the zeros is 2. (16 points)

a) Write the two other complex zeros of  $f$  in simplest, standard form. Box in your answers! (13 points)

b) Write the polynomial  $f(t)$  as a product of three linear factors over  $\mathbb{C}$ , the set of complex numbers. We basically want the Linear Factorization Theorem (LFT) Form of the factorization. (3 points)

3) On the day of a child's birth, a deposit of \$2000 is made in a trust fund that pays 5.5% annual interest compounded continuously. Assuming there are no further deposits or withdrawals, how old will the child be when there is \$15,000 in the account? Give **both** an **exact** answer (which may look ugly; you don't have to simplify it) and an **approximate** answer rounded off to three significant digits. Write units! (10 points)

4) Approximate  $\log_7(902)$  to four decimal places. Use a formula we have discussed in class! (4 points)

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Unless otherwise specified, give exact answers, and graphs are assumed to be in the usual  $xy$ -plane.

- 5) Write the “Vertex Form” of the equation of the parabola in the usual  $xy$ -plane that has  $(-1, 4)$  as its vertex and that passes through the point  $(1, -16)$ .

(7 points)

- 6) Write the list of the possible rational zeros of  $f$ , where

$$f(x) = 5x^5 - 7x^4 - x^2 + 2, \text{ based on the Rational Zero Test (Rational Roots}$$

Theorem). You do not have to determine which of these candidates are, in fact, zeros. (6 points)

- 7) Match the equations with their corresponding graphs by writing the appropriate letters in the blanks. Assume that there are no other turning (turnaround) points outside the “scope” of the figures below. The  $x$ - and  $y$ -axes are not necessarily scaled the same way within and between graphs. (8 points)

The graph of  $y = x^4 + 3x^2 - x + 1$  is Graph \_\_\_\_\_.

The graph of  $y = -x^5 + 2x^2 + 1$  is Graph \_\_\_\_\_.

The graph of  $y = x^5 - 10x^3 + 9x + 1$  is Graph \_\_\_\_\_.

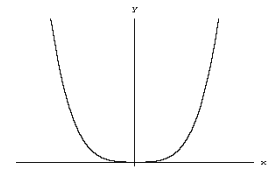
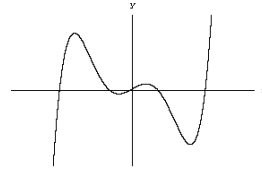
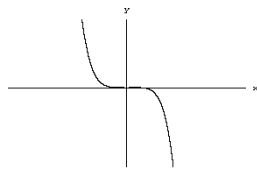
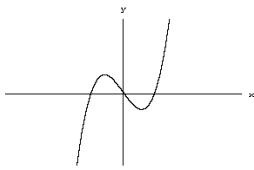
The graph of  $y = x^3 - 8x + 1$  is Graph \_\_\_\_\_.

Graph A

Graph B

Graph C

Graph D



- 8) Use Long Division to perform the division:  $\frac{6x^5 + 4x^4 - 15x^2 - 14x}{2x^3 - 5}$ .

Write your answer in the form: (polynomial) + (proper rational expression).

(11 points)

9) Factor  $3x^4 - 75$  as a product of a constant and four linear factors over  $\mathbb{C}$ , the set of complex numbers. We basically want the Linear Factorization Theorem (LFT) Form of the factorization. (8 points)

10) Let  $f(x) = \frac{2x^2 - x - 1}{x^3 - x^2}$ . Consider the graph of  $y = f(x)$ . If an answer to a part below is none, write "NONE." Box in the answers! (19 points total)

a) Factor the numerator and the denominator of  $\frac{2x^2 - x - 1}{x^3 - x^2}$ .

b) Give the  $x$ -coordinate(s) of the hole(s), if any.  
(Holes correspond to "removable discontinuities.")

c) Find the equation(s) of the vertical asymptote(s) (VAs), if any.

d) Find the equation of the horizontal asymptote (HA), if any.

e) Find the  $x$ -intercept(s), if any.

f) Find the  $y$ -intercept, if any.

11) Write the domain of  $f$ , where  $f(x) = \sqrt[4]{x^2 - 16}$  using interval form (the form using parentheses and/or brackets). (5 points)

12) Simplify  $\log_8\left(\frac{1}{64}\right)$ . (2 points)

13) Simplify  $\log_8(8^{12})$ . (2 points)

14) Simplify  $\log_{25}(5)$ . (2 points)

15) Write the domain of  $f$ , where  $f(x) = e^x + \ln(x)$ , using interval form (the form using parentheses and/or brackets). (3 points)

16) Write the range of  $g$ , where  $g(x) = e^x$ , using interval form (the form using parentheses and/or brackets). (2 points)

17) Expand and evaluate where appropriate:  $\log_4\left[\frac{16(\sqrt[3]{x})}{y^2z^5}\right]$ .

Assume  $x, y, z > 0$ . (10 points)

- 18) Find all real solution(s) of the equation:  $\log_5(x) - \log_5(x - 100) = 1$ .  
Write the solution set. Show all work, as in class; do not use trial-and-error!  
(9 points)

- 19) Find all real solution(s) (in simplified form) of the equation:  $4^{x-1} = 16^{2x}$ .  
Write the solution set. Show all work, as in class; do not use trial-and-error!  
(7 points)