

MTH 114, Exam 2
1:00 – 2:15 pm, Nov. 15, 2001
Instructor: Govind Menon

Your Name: _____

Your TA: _____

Question 1: _____

Question 2: _____

Question 3: _____

Question 4: _____

Question 5: _____

Total: _____

Instructions

1. No books or notes of any kind are allowed.
2. You may use calculators.
3. Each question is worth 20 points. Answer all questions.
4. This exam is worth 20% of your course grade.

Your Name: _____

Question 1: (20 points) Evaluate the following expressions *exactly* (do not express your answer as a decimal expansion). Each answer carries five points.

(a) $\cot \frac{5\pi}{6}$

(b) $\sec \frac{15\pi}{4}$

(c) $\log_2 \left(\frac{\log_7 343}{\log_3 27} \right)$

(d) $\frac{2^{\log_3 95}}{2^{\log_3 855}}$

Question 2:

- (a) (5 points) Use the remainder theorem to factor the polynomial $x^3 - 3x^2 + 4$.
- (b) (5 points) Find the quotient and remainder when $x^3 - 3x^2 + 4$ is divided by $x^2 + 2x$.
- (c) (10 points) Sketch the graph of the rational function

$$R(x) = \frac{x^3 - 3x^2 + 4}{x^2 + 2x}.$$

You should include all asymptotes (4 points), all zeros of $R(x)$ (2 points), and the rest of the graph (4 points).

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Question 3: (20 points) The population of bacteria in a petri dish grows exponentially according to the formula $n(t) = n_0e^{rt}$, where n_0 is the initial population, r is the rate of growth, and t is time. We will consider two species of bacteria (A and B).

- (a) (7 points) Assume $n_0 = 7800$, and $r = 0.09$ for Species A. How long does it take for the population of A to double?
- (b) (7 points) The population of Species B is found to be 10500 at time $t = 1$ and 11000 at time $t = 2$. What is the rate of growth of Species B?
- (c) (6 points) Sketch a graph of $n(t)$ vs t for species A and B, marking the values at $t = 0$, $t = 1$, $t = 2$, and indicating clearly which population is larger as $t \rightarrow \infty$.

Question 4: (20 points) An airplane monitoring traffic is flying above a straight highway. The angle of depression to a car (say A) behind the plane is found to be 28° . The angle of depression to a car (say B) ahead of the plane is 37° . The cars are 6000 ft apart. What is the elevation of the airplane?

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Question 5:

- (a) (7 points) Sketch the graph of $y = 2 \tan(2x)$. Indicate the zeros, asymptotes, the period, and the value of y at $x = \pi/8$.
- (b) (7 points) Sketch the graph of $y = \cot x$. Indicate the zeros, asymptotes, the period and the value of y at $x = \pi/3$.
- (c) (6 points) Explain how the graph in (b) can be obtained from the graph in (a). Your answer should be a sequence of operations such as stretching in x or y , shifting in x or y , reflection in a horizontal or vertical line etc.