

## Sample Test III.

The actual test will have less questions. You will have 75 minutes to answer them, without using your notes or communicating with other students. You will have to give the simplest possible answer and show all your work.

1. Find the absolute maximum and minimum values of  $f(x) = 1/(x^2 - 3x - 4)$  on  $[0, 2]$ .

**Answer:** absolute minimum at  $x = 0$ , absolute maximum at  $x = 3/2$ .

2. The demand function for a function is  $p(x) = 100 - x$  where  $x$  is the number of items sold. The cost function is  $C(x) = 10 + 2x$ . Maximize the profit.

**Answer:** Revenue:  $R(x) = xp(x)$ , Profit:  $P(x) = R(x) - C(x)$ , max. profit at  $x = 49$ , max. profit  $P(49) = 2391$ .

3. Geometric optimization question like 4.5/1,2, 11 or 12.

4. Evaluate  $3^{2/3} \cdot 9^{-1/2}$ . Give *exact answer*, without using your calculator.

**Answer:**  $3^{-1/3}$  or  $1/\sqrt[3]{3}$ .

5. Solve the equation  $4^x + 2^x - 2 = 0$ .

**Answer:**  $x = 0$

6. Solve the equation  $4^{2x-1} + 1 = 6$ .

**Answer:**  $\frac{\ln(5)/\ln(4) + 1}{2}$ .

7. Find the domain of  $\log_4(2 - x)$ .

**Answer:**  $x < 2$ .

8. Write  $\log(2) - 2/3 \cdot \log(x) + 10 \cdot \log(y)$  as a single logarithm.

**Answer:**  $\log\left(\frac{2y^{10}}{x^{2/3}}\right)$ .

9. Expand  $\ln\left(\frac{x^2z}{\sqrt{y}}\right)$  as a combination of the simplest possible logarithms.

**Answer:**  $2\ln(x) + \ln(z) - 1/2 \cdot \ln(y)$ .

10. If you invest into a savings account that pays 5% interest, compounded quarterly, how long does it take for your investment to double.

**Answer:** Solve  $2P = P \cdot (1 + 0.05/4)^{4t}$ , 13.95 years

11. What is the effective rate of interest if you have a nominal interest of 4% per year, compounded continuously?

**Answer:** 4.081%

12. Find the derivative of  $\sqrt{1 + e^x}$ .

**Answer:**  $\frac{e^x}{2\sqrt{1 + e^x}}$ .

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13. Find the derivative of  $e^{x^2-x}$ .

**Answer:**  $e^{x^2-x}(2x - 1)$ .

14. Find the derivative of  $3^x$ .

**Answer:**  $\ln(3) \cdot 3^x$

15. Find the derivative of  $\ln(x^3 - x)$ .

**Answer:**  $\frac{3x^2 - 1}{x^3 - x}$

16. The half-life of Carbon-14 is 5770 years. What is the age of an artifact that contains 15% of its original Carbon-14?

**Answer:** About 15800, 15792 if you work with  $\ln(1/2)$ , 15809 if you work with  $k = .00012$  in our textbook.

17. A bacteria culture contains  $Q(t) = 100 \cdot e^{0.23t}$  bacteria at  $t$  hours after the beginning of the experiment. What is the rate of growth of the population at the end of the fourth hour?

**Answer:**  $Q'(4) = 57.71$

18. Find the antiderivative of  $x^2 - \sqrt{x} + x^{-1}$ .

**Answer:**  $\int(x^2 - \sqrt{x} + x^{-1})dx = x^3/3 - 2/3 \cdot x^{3/2} + \ln(x) + C$ .