

**MATH117 Pre-Calculus for Scientists and Engineers      SAMPLE TEST 3 (page 1)**

1. Sketch the graph of  $y = 2^x - 3$
2. Sketch the graph of  $y = e^{x+1}$
3. When a certain medical drug is administered to a patient, the number of milligrams remaining in the patient's bloodstream after  $t$  hours is modeled by  $D(t) = 50e^{-0.2t}$   
How many milligrams of the drug remain in the patient's bloodstream after 3 hours?
4. If \$5000 is invested at an interest rate of 4 % per year and interest is compounded continuously how much is it worth after 18 years?
5. a) Express in exponential form  $\log_5 625 = 4$   
  
b) Express in logarithmic form  $2^{-3} = \frac{1}{8}$
6. a) Evaluate  $\log_7 49$   
  
b) Evaluate  $\ln e^7$
7. Graph  $y = \log_4 x$
8. Write as a single logarithm:  $3\ln x + 4 \ln y + 4\ln(z + 1)$
9. Use the laws of logarithms to expand  $\log_3 \left( \frac{x^3(x+1)}{(x-5)^2} \right)$

4pts 10. Solve  $e^{2x} - 4e^x + 3 = 0$

4pts 11. Solve  $\log_4 x + \log_4(3x - 8) = 2$

4pts 12. Solve  $\log_2(x - 3) + \log_2(x - 2) < 1$

4pts 13. A fox population in a certain region has a relative growth rate of 8% per year. It is estimated the population in 2005 was 18,000. Find a function  $n(t) = n_0 e^{rt}$  that models the population  $t$  years after 2005.

4pts 14. A hot bowl of soup is served at a dinner party. It starts to cool according to Newton's Law of Cooling so its temperature at time  $t$  is  $T(t) = 70 + 130e^{-0.04855t}$  where  $t$  is measured in minutes and  $T$  is the Fahrenheit temperature.

a) What is the initial temperature of the soup?

b) What is the temperature after 15 minutes?

4pts 15. First determine the value of  $x$  and then determine the value of the tangent at  $P$ . The point  $P$  is in QII of the unit circle.

$P(x, 3/5)$

In problems 16 – 21 use a unit circle, give the reference angle and quadrant, and then use trigonometric definition to give the numerical answer. (4 points each)

16.  $\sin(10\pi)$

17.  $\tan\left(-\frac{3\pi}{2}\right)$

18.  $\cos\left(\frac{5\pi}{6}\right)$

19.  $\sec\left(\frac{5\pi}{3}\right)$

20.  $\csc\left(\frac{17\pi}{4}\right)$

21.  $\cot\left(\frac{-5\pi}{6}\right)$

4pts 22. Graph  $y = 25\sin(4x)$

4pts 23. Graph  $y = -10\cos\left(2x - \frac{\pi}{3}\right)$

4pts 24. Graph  $y = 5\sec\left(\frac{1}{2}x\right)$

4pts 25. Evaluate a)  $\cos^{-1}\left(\cos\frac{5\pi}{6}\right)$

b)  $\cos^{-1}\left(\frac{\sqrt{2}}{2}\right)$

4pts 26. Evaluate  $\tan\left(\tan^{-1}\frac{4\pi}{3}\right)$

4pts. 27. Find a function that models the simple harmonic motion having the given properties. Assume displacement is zero is at time  $t = 0$ .

Amplitude 35cm period 8s

**Some formulas you may need**

$(y = a \sin \omega t$  amplitude  $|a|$  period  $\frac{2\pi}{\omega}$  frequency  $\frac{\omega}{2\pi}$

$A \sin(Bx + C)$  or  $A \cos(Bx + C)$ ,  $|A| = \text{amp.}$ , period =  $2\pi / B$ , p.s. =  $-C / B$

$T(t) = T_s + D_0 e^{-kt}$   $D_0$  is initial difference in temperature between an object and its surroundings

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$        $\left(\frac{-b}{2a}, \frac{-b^2 + 4ac}{4a}\right)$        $A = Pe^{rt}$        $A = P\left(1 + \frac{r}{n}\right)^{nt}$

$\cos^2\theta + \sin^2\theta = 1$        $1 + \tan^2\theta = \sec^2\theta$        $\cot^2\theta + 1 = \csc^2\theta$