Fall 2006 NAME ___________________________

Math 122 Practice Exam 2

All resources may be used for this portion

1. A cake is removed from the oven with an initial temperature of 450 degrees Fahrenheit. It is set in a special room where it is allowed to cool. Ten minutes later, its temperature is 300 degrees. Twenty minutes after it was placed in the room, its temperature is 200 degrees. What is the temperature of the room? What kind of a room is it?

Recall Newton's law of cooling

$$\frac{dT}{dt} = -k\left(T - T_e\right)$$

$Te =$ _________________________

2. A certain lake was completely pollutant free ($c(0)=0$) on January 1, 1998 when the stream entering it began to have a constant pollutant concentration of k. On January 1, 2002 the concentration of pollutant is measured to be 3.2 ppm. If the volume of the lake is 100 km^3, and the inflow and outflow rate r = 15 km^3/year, what is the concentration of the pollutant, k in the stream entering the lake?

Recall that the equation for the time evolution of the concentration is

$$\frac{dc}{dt} = \frac{r}{V}\left(k - c\right)$$

$k =$ ________________

3. A certain function P(t) evolves according to the differential equation

$$\frac{dP}{dt} = P^2 - t^2$$

If $P(0)=1$, take **two** steps with Euler's method using a step size of $\Delta t = h = 1$ to predict an approximate value for $P(2)$.

$P(2) \approx$ _________________

4. A ball is released from a window with zero initial velocity and hits the ground with a velocity of 20 meters per second. How high is the window?

Only an index card may be used for this portion

5. Solve the following differential equations

$$\boxed{\frac{dy}{dx} = 2y, \qquad y(0) = 1.}$$

$y(x) =$ ____________________ $y(1) =$ ____________________

$$\boxed{\frac{dy}{dt} + y = 6, \qquad y(0) = 300.}$$

$y(t) =$ ____________________ $y(1000) =$ ____________________

$$\boxed{\frac{dy}{dx} = 2x, \qquad y(0) = 1.}$$

$y(x) =$ ____________________ $y(1) =$ ____________________

6. Find the following integrals

$$\int \left(3t - \frac{5}{t^2}\right) dt \quad =$$

$$\int \left(\frac{t+1}{t}\right) dt \quad =$$