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WeBWorK assignment number Homework_3 is due: 09/08/2011 at 11:00pm MDT.

The
(* replace with url for the course home page *)
for the course contains the syllabus, grading policy and other information.

This file is /conf/snippets/setHeader.pg you can use it as a model for creating files which introduce each problem set.

The primary purpose of WeBWorK is to let you know that you are getting the correct answer or to alert you if you are making some kind of mistake. Usually you can attempt a problem as many times as you want before the due date. However, if you are having trouble figuring out your error, you should consult the book, or ask a fellow student, one of the TA's or your professor for help. Don’t spend a lot of time guessing – it’s not very efficient or effective.

Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2^3$ instead of 8, $\sin(3 \pi / 2)$ instead of -1, $e^{\ln(2)}$ instead of 2, $(2 + \tan(3)) \cdot (4 - \sin(5)) \cdot 6 - 7/8$ instead of 27620.3413, etc. Here’s the list of the functions which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professors.

1. (1 pt) Library/maCalcDB/setDiffEQ5ModelingWith1stOrder-/ur_de_5.10.pg
Suppose that a population develops according to the logistic equation
\[ \frac{dP}{dt} = 0.25P - 0.00125P^2 \]
where $t$ is measured in weeks.

(a) What is the carrying capacity? 
(b) Is the solution increasing or decreasing when $P$ is between 0 and the carrying capacity? 
(c) Is the solution increasing or decreasing when $P$ is greater than the carrying capacity?

2. (1 pt) Library/maCalcDB/setDiffEQ5ModelingWith1stOrder-/ur_de_5.11.pg
Biologists stocked a lake with 186 fish and estimated the carrying capacity (the maximal population for the fish of that species in that lake) to be 7700. The number of fish tripled in the first year.

(a) Assuming that the size of the fish population satisfies the logistic equation
\[ \frac{dP}{dt} = kP \left( 1 - \frac{P}{K} \right), \]
determine the constant $k$, and then solve the equation to find an expression for the size of the population after $t$ years.

$k =$ \[
\]
$P(t) =$ \[
\]
(b) How long will it take for the population to increase to 3850 (half of the carrying capacity)?
It will take \[
\] years.

3. (1 pt) Library/maCalcDB/setDiffEQ5ModelingWith1stOrder-/ns7_6.1.pg
A population $P$ obeys the logistic model. It satisfies the equation
\[ \frac{dP}{dt} = \frac{5}{1100} P(11 - P) \quad P > 0. \]

(a) The population is increasing when \[ \]
(b) The population is decreasing when \[ \]
(c) Assume that $P(0) = 2$. Find $P(64)$.
\[ P(64) = \]

4. (1 pt) hw3/p4.pg
The time rate of change of a fish population, $P(t)$, in a lake is proportional to the square of $P(t)$, where $t$ is measured in days. The lake started out with 100 fish and 10 days later there are 200 fish in the lake. Find the function $P(t)$ that describes the growth of the fish population in the lake.

\[ P(t) = \]

In how many days will the fish population reach 1000? \[
\] days

5. (1 pt) hw3/p5.pg
For the following differential equation, find both equilibrium points and for each one determine whether it is stable or unstable.
\[ \frac{dx}{dt} = x^2 - 6x \]

NOTE: Enter the smaller equilibrium point first and then the larger one.
6. For the following differential equation, find both equilibrium points and for each one determine whether it is stable or unstable.

\[ \frac{dx}{dt} = 16 - x^2 \]

**NOTE:** Enter the smaller equilibrium point first and then the larger one.

1. \[ x = \ ? \]
2. \[ x = \ ? \]

7. For the following differential equation, find the equilibrium point and determine whether it is stable or unstable.

\[ \frac{dx}{dt} = x - 5 \]

8. The population of deer in a forest, before humans began hunting them, grew according to the logistic population growth equation

\[ \frac{dP}{dt} = 0.02P - 0.00001P^2 \]

Rewrite this differential equation in the form

\[ \frac{dP}{dt} = kP(M - P) \]

to find the value of \( k \) and \( M \).

\[ k = \ ? \]
\[ M = \ ? \]

What is the stable equilibrium population of deer in the forest?

Now suppose that the deer begin to be hunted at a rate of \( h = 6.4 \) deer per year so that the new differential equation now has the form

\[ \frac{dP}{dt} = kP(M - P) - h \]

What is the stable equilibrium population of deer in the forest now that they are being hunted?