Principles of Calculus Modeling: An Interactive Approach by Donald Kreider, Dwight Lahr, and Susan Diesel
Exercises for Section 3.1

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1. (1 pt)
Which of the following is a solution to the differential equation $y'' + y = 0$?

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A. $\frac{5}{6}$
B. $x^3 - 6x$
C. Ce^{x^2}
D. $-13\sin(x) + 13\cos(x)$

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2. (1 pt)
Which of the following is a solution to the differential equation $y' = -16xy$?

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A. $7\sin(x) + \frac{7}{8}\cos(x)$
B. $\frac{1}{-16x}$
C. Ce^{-8x^2}
D. 1

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3. (1 pt)
Solve the following differential equation by separation of variables. Express your answer in terms of variables x, y, and C.

$$\frac{dy}{dx} = \frac{x^6}{y^3}$$

__________________ = 0

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4. (1 pt)
Solve the following differential equation by separation of variables. Express your answer in terms of variables x, y, and C.

$$\frac{dy}{dx} = \frac{8 + \frac{1}{10}y}{e^x}$$

__________________ = 0

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5. (1 pt)
Rule of 72 This rule of thumb states that to find the approximate doubling time for an investment that earns x percent interest compounded per period, divide x into 72 to find the number of periods. So, if an investment earns 7 percent per year, it would take about $\frac{72}{7} = 10.29$ years for the investment to double in value.

Give the formula for the doubling time as a function of x.
Doubling time $D(x) =$ __________________

What is the exact time for the investment earning 7 percent annually to double?
__________________ years

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6. (1 pt)
A scientist in a lab monitors the growth of a population of bacteria. Her observations on the size of the population are given in the following table.

Time (hours)	Population (in thousands)
0	1.000
3	1.059
5	1.100
6.5	1.131

Assume the population follows an exponential model of the form ae^{kt}. What is the growth constant k?
$k =$ __________________
How big is the population of bacteria one hour after the last measurement in the table?
Population = __________________

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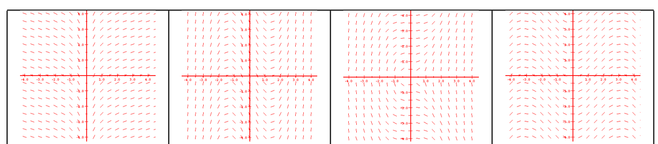
7. (1 pt)
Match each of the slope fields with its differential equation.



A	B	C	D

___ $\frac{dy}{dx} = \sin(x)$
___ $\frac{dy}{dx} = x^2 - 2$
___ $\frac{dy}{dx} = \frac{3x^2}{2y}$
___ $\frac{dy}{dx} = \frac{1}{x}$

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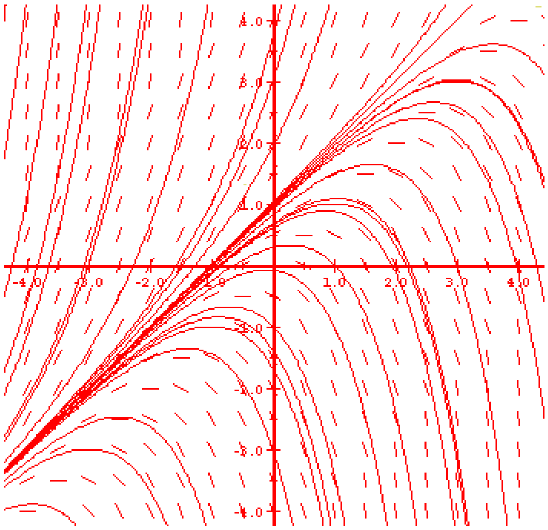
8. (1 pt)
This problem assumes you can run the Slope Field applet, or another application that displays slope fields and families of solution curves for a differential equation.

The following graph shows a family of solution curves for the differential equation $\frac{dy}{dx} = y - x$.



Consider the solution curve passing through the point $(-2,1)$. How would you describe this curve?

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- A. The solution curve is concave up
- B. The solution curve has a maximum
- C. The solution curve is a straight line
- D. There are infinitely many solution curves
- E. The solution curve is periodic

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9. (1 pt)

A scientist in a lab monitors the decrease of a population of bacteria after a toxic agent is introduced into the bacteria's environment. Her observations on the size of the population are given in the following table.

Time (hours)	**Population (in thousands)**
0	4.000
8	2.109
11.5	1.594
13.5	1.358

Assume the population follows an exponential model of the form ae^{kt}. What is the decay constant k?

$k =$ ____________________

At what time is the population of bacteria equal to one half its initial population?

Time = ____________________

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10. (1 pt)

Which of the following differential equations are separable? Check all that apply.

- A. $\dfrac{dy}{dx} = \dfrac{x^2}{y+3}$
- B. $\dfrac{dy}{dx} = x - y$
- C. $\dfrac{dy}{dx} = \dfrac{\cos(4x)}{\sqrt{y}}$
- D. $\dfrac{dy}{dx} = \sin(x+y)$
- E. $\dfrac{dy}{dx} = y^2 \tan(x)$