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

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

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

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

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

$$\frac{dy}{dx} = \frac{x^6}{y^7} = 0$$

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

$$\frac{dy}{dx} = \frac{8 + \frac{1}{10}y}{e^x} = 0$$

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 $D(x) = \ldots$

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

__________ years

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.

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>Population (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.000</td>
</tr>
<tr>
<td>3</td>
<td>1.059</td>
</tr>
<tr>
<td>5</td>
<td>1.100</td>
</tr>
<tr>
<td>6.5</td>
<td>1.131</td>
</tr>
</tbody>
</table>

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

$k = \ldots$

How big is the population of bacteria one hour after the last measurement in the table?

Population = \ldots

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

- A
- B
- C
- D

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?

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

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.

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>Population (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4.000</td>
</tr>
<tr>
<td>8</td>
<td>2.109</td>
</tr>
<tr>
<td>11.5</td>
<td>1.594</td>
</tr>
<tr>
<td>13.5</td>
<td>1.358</td>
</tr>
</tbody>
</table>

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 = ___________

10. (1 pt)

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

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