Principles of Calculus Modeling: An Interactive Approach by Donald Kreider, Dwight Lahr, and Susan Diesel
Exercises for Section 3.3

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1. (1 pt)
Solve the following first-order differential equation:

$\frac{dy}{dx} = \frac{y}{5x}$

Simplify your answer **completely**. Your answer should look like $y = f(x)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{dy}{dx} = y$ would look like Ce^x.

$y =$ _____

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2. (1 pt)
Solve the following first-order differential equation:

$\frac{dy}{dx} = -4xy$

Simplify your answer **completely**. Your answer should look like $y = f(x)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{dy}{dx} = y$ would look like Ce^x.

$y =$ _____

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3. (1 pt)
Solve the differential equation

$\frac{dx}{dt} = e^x \sin(t)$

Simplify your answer **completely**. Your answer should look like $x = f(t)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{dx}{dt} = x$ would look like Ce^t.

$x =$ _____

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4. (1 pt)
Solve the differential equation:

$\frac{dy}{dx} - 6y = 4$

Simplify your answer **completely**. Your answer should look like $y = f(x)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{dy}{dx} = y$ would look like Ce^x.

$y =$ _____

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5. (1 pt)

The differential equation $m\frac{dv}{dt} = mg - kv$ expresses Newton's second law of motion, where m is the mass of a falling object, g is the acceleration due to gravity, k is a positive constant, and $v = v(t)$ is the velocity of the object at time t.

Solve the differential equation, subject to the initial condition $v(0) = 0$. Choose the answer from the list below.

$v(t) =$ ___

A. $\frac{mg}{k}$

B. $\frac{mg}{k} + Ce^{-\frac{k}{m}t}$

C. $\frac{mg}{k} - \frac{mg}{k}e^{\frac{k}{m}t}$

D. $\frac{mg}{k}\left(1 - e^{-\frac{k}{m}t}\right)$

E. None of these.

What is the limit of $v(t)$ as $t \to \infty$?

Simplify your answer **completely**. If the limit is ∞ or $-\infty$, type **infinity** or **-infinity** in the box, without quotes.

$\lim_{t\to\infty} v(t) =$ _____

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6. (1 pt)
Solve the separable first-order differential equation:

$\frac{dy}{dx} = \frac{-15}{y^2\cos^2(x)}$

Simplify your answer **completely**. Your answer should be in the form $y = f(x)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{dy}{dx} = y$ would look like Ce^x.

$y =$ _____

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7. (1 pt)
Solve the differential equation:

$\frac{dy}{dx}\sec(4x) = -9$

Simplify your answer **completely**. Your answer should be in the form $y = f(x)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{dy}{dx} = y$ would look like Ce^x.

$y =$ _____

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8. (1 pt)
Solve the separable differential equation:

$\left(\csc(t) + \frac{2}{\sin(t)}\right)\frac{ds}{dt} = 32$

Simplify your answer **completely**. Your answer should be in the form $s = f(t)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{ds}{dt} = s$ would look like Ce^t.

$s =$ _____

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9. (1 pt)
Solve the separable differential equation:

$\left(\frac{w^{10}}{10t^9}\right)\frac{dw}{dt} = e^{t^{10}}$

Simplify your answer **completely**. Your answer should be in the form $w = f(t)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{dw}{dt} = w$ would look like Ce^t.

$w =$ _____

10. (1 pt)
Solve the separable differential equation:

$$\left(x^{-23}\right)\frac{dz}{dx}+\left(\frac{1}{2x^{23}}\right)\frac{dz}{dx}=24$$

Simplify your answer **completely**. Your answer should be in the form $z=f(x)$. If an arbitrary constant appears in your answer, you must enter it as an uppercase C. For example, a valid answer for the differential equation $\frac{dz}{dx}=z$ would look like Ce^x.

$z=$ _____