

1. A jug of buttermilk is set to cool on a front porch, where the temperature is 0°C. The jug was originally at 87°C. If the buttermilk has cooled to 15°C after 26 minutes, after how many minutes will the jug be at 8°C?

The jug of buttermilk will be at 8°C after 35 minutes.
(Round the final answer to the nearest whole number as needed. Round all intermediate values to six decimal places as needed.)

ID: 1.4.43

2. A large tank initially contains 20g of salt in 20L of water. A solution containing 6g/L salt flows into the tank at a rate of 4L/min, and the well stirred mixture flows out at the rate of 3L/min. Which of the following differential equations and initial conditions describe the amount of salt $A = A(t)$ in the tank at time t before the tank is full.

- ☐ A. $\frac{dA}{dt} + \frac{A}{5+t} = 24, \quad A(0) = 20$
- ☐ B. $\frac{dA}{dt} + \frac{3A}{20+2t} = 20, \quad A(0) = 20$
- ☐ C. $\frac{dA}{dt} - \frac{A}{20+4t} = 20, \quad A(0) = 20$
- ☒ D. $\frac{dA}{dt} + \frac{3A}{20+t} = 24, \quad A(0) = 20$

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3. Assume that $y = y(x)$ is a solution of the equation

$(3x^2 + y) \, dx + (x + 2y) \, dy = 0$

and $y(1) = 2$. What is the value of $y(2)$?

- ☐ A. 1
- ☐ B. 3
- ☐ C. 2
- ☒ D. -1
- ☐ E. -2

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4. If the function $f(x,y)$ is continuous near the point (a,b) , then at least one solution of the differential equation $y' = f(x,y)$ exists on some open interval I containing the point $x = a$ and, moreover, that if in addition the partial derivative $\frac{\partial f}{\partial y}$ is continuous near (a,b) then this solution is unique on some (perhaps smaller) interval J . Determine whether existence of at least one solution of the given initial value problem is thereby guaranteed and, if so, whether uniqueness of that solution is guaranteed.

$\frac{dy}{dx} = \sqrt{x - y}; \, y(1) = 1$

Select the correct choice below and fill in the answer box(es) to complete your choice.
(Type an ordered pair.)

- ☐ A. The theorem implies the existence of at least one solution because $f(x,y)$ is continuous near the point . This solution is unique because $\frac{\partial f}{\partial y} = \text{$ is also continuous near that same point.
- ☐ B. The theorem implies the existence of at least one solution because $f(x,y)$ is continuous near the point . However, this solution is not necessarily unique because $\frac{\partial f}{\partial y} = \text{$ is not continuous near that same point.
- ☒ C. The theorem does not imply the existence of at least one solution because $f(x,y)$ is not continuous near the point (1,1).

ID: 1.3.15

5. Let $y = y(x)$ satisfy the following initial value problem

$\frac{dy}{dx} + \frac{2}{x}y = 8x^2\sqrt{y}$

$y(1) = 4$.

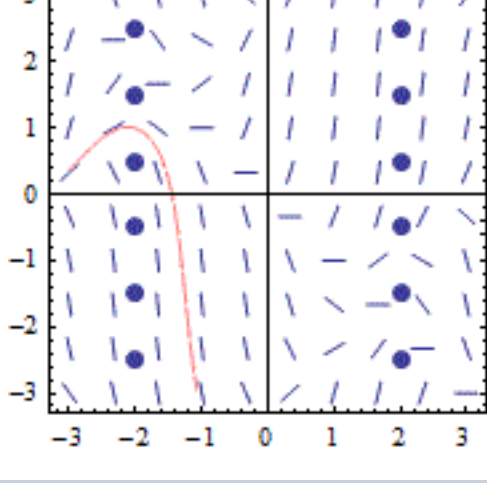
What is the value of $y(\sqrt{2})$?

- ☒ A. $y(\sqrt{2}) = \frac{25}{2}$
- ☐ B. $y(\sqrt{2}) = \frac{5}{8}$
- ☐ C. $y(\sqrt{2}) = \frac{5}{2}$
- ☐ D. $y(\sqrt{2}) = \frac{25}{4}$
- ☐ E. $y(\sqrt{2}) = \frac{25}{8}$

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6. The slope field of the indicated differential equation has been provided, together with a solution curve. Sketch solution curves through the additional points marked in the slope field.

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



Choose the correct graph below.

- ☐ A.
- ☒ B.
- ☐ C.
- ☐ D.

ID: 1.3.7

7. A Las Vegas casino tells their customers who want to play poker that $C(t)$, the amount of cash a poker player has at time t after they start playing, satisfies the differential equation

$\frac{dC(t)}{dt} = (C(t) - 300)(C(t) - 400)(600 - C(t))$

There are four players playing the game, P1, P2, P3 and P4. If $C(0)$ is the amount of money the gambler brings to the table, P1 brings \$50, P2 brings \$650, P3 brings \$390 and P4 brings \$500, which of the following is correct if the players keep playing at the same poker game for a very long time?

- ☒ A. P1 will win the most money and P3 will lose the most money
- ☐ B. P4 will win the most money and P3 will lose the most
- ☐ C. Players P1 and P4 will win the same amount while P2 and P3 will lose the same amount.
- ☐ D. P1 will win the most money and P2 will lose the most money
- ☐ E. P4 will win the most money and P2 will lose the most money

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8. If $y = y(t)$ is the solution of the initial value problem

$t y' - y = t^2 e^{-t},$

$y(1) = 3,$

what is the value of $y(3)$?

- ☒ A. $9 + 3e^{-1} - 3e^{-3}$
- ☐ B. $e^{-1} - 3e^3$
- ☐ C. $3e^{-1} - 7e^{-3} + 5$
- ☐ D. $2 + e^{-1}$
- ☐ E. $3 - e^{-3} + 5e^{-1}$

ID: Instructor-created question

9. Find the explicit particular solution of the differential equation for the initial value provided.

$\frac{dy}{dx} = 5x^2y - y, \, y(1) = -3$

The explicit particular solution of the differential equation is $y = \underline{-3e^{\frac{5}{3}x^3 - x} - \frac{2}{3}}$.

ID: 1.4.22

10. A population of tilapias in a pond, denoted by $x = x(t)$, where t is counted in years, obeys the following differential equation

$\frac{dx}{dt} = 1200x - x^2$

If the initial population was $x(0) = 2500$ tilapias, what will be the time T until half of the tilapias die? What will be the population of tilapias in the pond after 10 years?

- ☐ A. $T = \frac{1}{1200} \ln(13)$ years and 10 years the population will be close to 1000 tilapias
- ☐ B. $T = \frac{1}{1200} \ln(37)$ years and after 10 years the population will be close to 1300 tilapias
- ☐ C. $T = \frac{1}{1200} \ln(12)$ years and after a long time the population will be close to 1200 tilapias
- ☒ D. $T = \frac{1}{1200} \ln(13)$ years and after 10 years the population will be close to 1200 tilapias
- ☐ E. $T = \frac{1}{1200} \ln(15)$ years and after 10 years the population will be close to 1200 tilapias

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11. Consider the differential equation

$\frac{dy}{dx} = \frac{y}{x} + \frac{x}{2(x+y)},$

which is satisfied for $x > 0$. Suppose a solution $y(x)$ satisfies $y(1) = 1$. What is the value of $y(e^5)$?

- ☒ A. $2e^5$
- ☐ B. $\sqrt{3}e^5 - 6 \ln 3$
- ☐ C. $e^5 + 3$
- ☐ D. $-3e^{-5}$
- ☐ E. $e^5(\sqrt{5} - 1)$

ID: Instructor-created question