1. If y is the solution to the equation

$$y' = \frac{x^2 + 1}{y^3}, \qquad y(0) = 2,$$

then $y(3) =$

A. ± 2
B. $\pm 2\sqrt{2}$
C. $\pm 4\sqrt{2}$
D. 0
E. ± 4

2. If y is the solution to the equation

$$y' = \frac{3}{x}y + x, \qquad y(1) = 0,$$

then $y(\sqrt{3}) =$

A. $-3\sqrt{3}$
B. $3\sqrt{3}$
C. $3(\sqrt{3} - 1)$
D. $3(\sqrt{3} + 1)$
E. $\dfrac{27 - \sqrt{3}}{45}$

3. Which of the following is the implicit solution to the initial value problem

$$(e^x \sin y - 2y \sin x - 1) + (e^x \cos y + 2\cos x + 3)y' = 0, \qquad y(0) = \pi?$$

A. $e^x \sin y + 2y \cos x + 3x - y = \pi$

B. $e^x \sin y + 2y \cos x + 3x - y = -1 - \pi$

C. $e^x \sin y + 2y \cos x + 3y - x = \pi$

D. $e^x \sin y + 2y \cos x + 3y - x = 5\pi$

E. $e^x \sin y - 2y \cos x + 3y - x = 5\pi$

4. The general solution of

$$\frac{dy}{dx} = \frac{2xy + 3x^2}{y^2 - x^2}$$

is

A. $\frac{y^3}{3} - x^2y - x^3 = c$

B. $\frac{y^3}{3} + x^2y + x^3 = c$

C. $\frac{y^3}{3} - x^2y + x^3 = c$

D. $2xy + y^2 + 3x^2 = c$

E. $2xy + y^2 - 3x^2 = c$

5. Consider the equation

$$\frac{dy}{dx} + \frac{1}{4x}y = 2xy^2.$$

If $v = y^{-1}$, then v satisfies

A. $\frac{dv}{dx} + \frac{1}{4x}v = -2x$

B. $\frac{dv}{dx} - \frac{1}{4x}v = -2x$

C. $\frac{dv}{dx} + \frac{1}{4x}v = 2x$

D. $\frac{dv}{dx} - \frac{1}{4x}v = 2x$

E. $\frac{dv}{dx} + \frac{1}{2x}v = -2x$

6. Two minutes after a hot metal object is taken from a furnace, the temperature of the object is $320F$. One minutes later its temperature is $240F$. If the temperature of the room is 80F, what was the temperature of the object when it was removed from the furnace? Hint: Newton's law of cooing $\frac{dT}{dt} = -k(T - T_m)$.

A. $540F$

B. $620F$

C. $640F$

D. $\frac{1280}{3}F$

E. $\frac{5120}{9}F$

7. Initially a tank holds 100-gallon of pure water. A salt solution containing 0.2lb of salt per gallon runs into the tank at a rate of 3 gallons per minute. The well mixed solution runs out of the tank at a rate of 2 gallons per minute. Let $A(t)$ be the amount of salt in the tank at time t. Then $A(t)$ satisfies the differential equation

A. $\frac{dA}{dt} = 0.2 - \dfrac{3A}{t + 100}$

B. $\frac{dA}{dt} = 0.4 - \dfrac{3A}{t + 100}$

C. $\frac{dA}{dt} = 0.6 - \dfrac{3A}{t + 100}$

D. $\frac{dA}{dt} = 0.4 - \dfrac{2A}{t + 100}$

E. $\frac{dA}{dt} = 0.6 - \dfrac{2A}{t + 100}$

8. The equilibrium solution(s) to the differential equation

$$\frac{dy}{dx} = y(y - 1)(y - 2)$$

are

A. $y = 0, 1$

B. $y = 0, 2$

C. $y = 1, 2$

D. $y = 0, 1, 2$

E. None of the above.

9. For what values of a, b and c is it true that

$$\begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} a & b \\ 0 & c \end{bmatrix} = \begin{bmatrix} a & b \\ 0 & c \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}?$$

10. Find the general solution to

$$(x - 1)(x - 2)y'' = y' - 1, \quad x > 2.$$