1. The family of orthogonal trajectories of the family \( y^2 = Cx^3 + 1 \) is:
   (a) \( 2x^2 - 3y^2 - 3 \ln y = C \)
   (b) \( 3y^2 - 2x^2 + 3 \ln y = C \)
   (c) \( 2x^2 + 3y^2 + \frac{6}{y^2} = C \)
   \( \text{(e) None of the above.} \)
   (d) \( 2x^2 + 3y^2 - 6 \ln y = C \)

2. The family of orthogonal trajectories of \( y^3 = Ce^{2x} + 4 \) is
   (a) \( 3x - y^2 + \frac{4}{y} = C \)
   (b) \( 3x + y + 4 \ln y = C \)
   \( \text{(c) None of the above.} \)
   (d) \( 3x + y^2 + \frac{8}{y} = C \)

3. The family of orthogonal trajectories for the family of parabolas with axis parallel to the \( y \)-axis and vertex at the point \((2,3)\) is:
   (a) \( y - 3 = \frac{C}{x - 2} \)
   \( \text{(c) None of the above.} \)
   (b) \( (x - 2)^2 + 2(y - 3)^2 = C \)
   (c) \( x - 2 = C(y - 3)^2 \)
   (d) \( (x - 2)^2 - 2(y - 3)^2 = C \)

4. If $1000 is deposited in a bank that pays 5% interest compounded continuously, then the amount in the account at the end of 10 years is: (Hint: The population growth law applies.)
   (a) $1491.82
   (b) $1572.67
   (c) $1397.16
   \( \text{(d) $1648.72} \)
   (e) None of the above.

5. A laboratory has 75 grams of a certain radioactive material. Two years ago, it had 100 grams. How much will the laboratory have 3 years from now?
   (a) 48.71 grams
   (b) 41.55 grams
   (c) 57.24 grams
   (d) 52.19 grams
   (e) None of the above.
6. A certain radioactive material loses 25% of its mass in 10 minutes. What is its half-life.

(a) 19.12 minutes
(b) 28.34 minutes
(c) 31.02 minutes
\(\mathbf{(d)}\) 24.09 minutes
(e) None of the above.

7. Scientists observed that a small colony of penguins on a remote Antarctic island obeys the population growth law. There were 2000 penguins initially and 3000 penguins 18 months later. How long will it take for the number of penguins to double?

(a) 4.11 years
(b) 2.56 years
(c) 3.24 years
(d) 2.07 years
(e) None of the above.

8. What is the half-life of a radioactive material if it takes 5 months for 1/3 of the material to decay?

(a) 10.26 months
\(\mathbf{(b)}\) 8.55 months
(c) 7.84 months
(d) 10.21 months
(e) None of the above.

9. At 12 noon on Jan. 1, the count in a bacteria culture was 400; at 4:00 pm the count was 1200. Let \(P(t)\) denote the bacteria count at time \(t\) and assume that the culture obeys the population growth law. What was the bacteria count at 9 am on Jan. 1?

(a) 231
(b) 198
\(\mathbf{(c)}\) 175
(d) 214
(e) None of the above.

10. At what rate of interest compounded continuously will a bank deposit double in value in 8 years?

\(\mathbf{(a)}\) 8.66%
(b) 7.41%
(c) 9.88%
(d) 10.2%
(e) None of the above.