ANSWERS:
1. First order, linear;
   Second order, linear;
   First order, nonlinear;
   Third order, nonlinear.

2. C

3. A

4. D

5. \( y(t) = -4 + \sqrt{x^4 - 3x^2 + 3x + 3} \).

6. (a) \( \frac{\partial}{\partial y}(2x + ye^{xy}) = e^{xy} + ye^{xy} = \frac{\partial}{\partial x}(xe^{xy} + 1) \)
   (b) \( x^2 + e^{xy} + y = 2 \)

7. (a) Equilibrium solutions are \( y = -3 \), \( y = 0 \), and \( y = 2 \).
   (b) \( y = -3 \) is unstable, \( y = 0 \) is (asymptotically) stable, \( y = 2 \) is unstable.
   (c) \( \lim_{t \to \infty} y(t) = 0 \)
   (d) \( \lim_{t \to \infty} y(t) = -3 \)

8. (a) \( Q(t) = 25000 - 20000e^{-\frac{t}{1000}} \)
   (b) The limiting concentration is \( \lim_{t \to \infty} \frac{Q(t)}{500} = \frac{25000}{500} = 50 \left( \frac{\text{g}}{\text{m}^3} \right) \), which is the same as the concentration of the inflow.

9. \( y(t) = 2e^{3t} - te^{3t} \)

10. \( y(t) = C_1t + C_2t^4 \)