1. Show that $y = e^{x^2} \int_0^x e^{-t^2}\, dt$ is a solution of $y' = 2xy + 1$.

2. Consider $y'' - 5y' + 6y = 0$. Prove the following:
   (a) $y = e^{2x}$ and $y = e^{3x}$ are solutions of the given differential equation.
   (b) $y = c_1 e^{2x} + c_2 e^{3x}$ is a solution of the differential equation for every choice of the constants c_1 and c_2.

3. For what values of the constant m will $y = e^{mx}$ be a solution of the differential equation $2y''' + y'' - 5y' + 2y = 0$? Also find a solution similar to the one in Q2(b) containing three arbibrary constants.

4. A curve rises from the origin in the xy-plane into the first quadrant. The area under the curve from $(0, 0)$ to (x, y) is one-third the area of the rectangle with these points as opposite corners. Find the equation of the curve.

5. Solve
$$\frac{4y^2 - 2x^2}{4xy^2 - x^3}dx + \frac{8y^2 - x^2}{4y^3 - x^2 y}dy = 0$$
   (a) as a homogeneous equation;
   (b) as an exact equation.

6. Test whether the equation $(x^3 + xy^3)dx + 3y^2 dy = 0$ is exact. If not, solve it by finding an integrating factor.

7. Under what circumstance will equation $M(x, y)dx + N(x, y)dy = 0$ have an integrating factor that is a function of the sum $z = x + y$?

8. Solve $y' = 2xy + 1$.

9. Solve $xdy + ydx = xy^2 dx$.

10. Find a solution of the following initial value problem:
$$y' + y = |x|, \quad y(-1) = 0.$$
    Also prove that such a solution has $y(1) = \frac{2}{e} - \frac{2}{e^2}$.

11. Let $Mdx + Ndy = 0$ be exact. Suppose $\mu(x,y)$ is a non-constant function such that $\mu(Mdx + Ndy) = 0$ is also an exact equation. Prove that $\mu(x,y) = c$ is the general solution of given D.E.