Question 1: Use Shifts and Expansion techniques to graph the following function: $y = \frac{1}{2}(\frac{x-1}{3})^2 - 4$

Question 2: A particle is moving along the curve $y^3 + y - x^2 = 9$. At time $t = 0$,the particle is at the point $(1, 2)$. The x-coordinate of the particle satisfies $x(t) = 1 + 4t + \sin(\pi t)$. Let $y(t)$ denote the y-coordinate of the particle at time t. Find $\dfrac{dy}{dt}$ at time $t = 0$.

Question 3: Let $\alpha > 0$. Let $f(x) = |x|^\alpha$ when x is rational, and $f(x) = 0$ when x is irrational. For what values of $\alpha > 0$ is f differentiable at $x = 0$?

Question 4: $f(x) = xe^{-x}$. Find the

1. Zeros of f.
2. Critical points and characterise them as local maxima, local minima and inflection points.
3. interval where f is increasing.
4. interval where f' increasing.
5. interval where the graph is concave down.
6. rough-sketch of graph of f