請回答下述問題（並詳述推理與計算過程）.

1. Let $\{x_n\}_{n=1}^{\infty}$ be a real sequence, and let $g : \mathbb{R} \to \mathbb{R}$ be a real-valued function. Given $x_0, y_0 \in \mathbb{R}$, please write down the $\epsilon - \delta$ definition for each following statement:
   (1.1) The sequence $\{x_n\}_{n=1}^{\infty}$ converges to x_0 as n tends to ∞. **(5pts.)**
   (1.2) The sequence $\{x_n\}_{n=1}^{\infty}$ diverges as n tends to ∞. **(5pts.)**
   (1.3) $g(x)$ is continuous at $x = x_0$. **(10pts.)**
   (1.4) $g(x)$ is differentiable at $x = x_0$. **(10pts.)**

2. Test the convergence of the following series.
   (2.1) $\sum_{n=1}^{\infty} \frac{n^n}{n!}$. **(5pts.)**
   (2.2) $\sum_{m=1}^{\infty} \frac{5}{3^m - 1}$. **(5pts.)**
   (2.3) $\sum_{n=1}^{\infty} \frac{(-1)^n}{3n!}$. **(5pts.)**

3. Find $\frac{dy}{dx}$ for each following equation:
   (3.1) $3x^3 + 2y^3 = 6xy$. **(10pts.)**
   (3.2) $y = \int_0^{2x} \frac{e^{-xt}}{3} dt$. **(5pts.)**

4. Evaluate the following integrals:
   (4.1) $\int_0^{\infty} x^2 e^{-x} dx$. **(5pts.)**
   (4.2) $\int_{-\infty}^{\infty} \frac{1}{\sqrt{2}} e^{-\frac{1}{2}x^2} dx$. **(5pts.)**

5. Find the Taylor approximation of order **two** of each following function at the given point:
   (5.1) $g(x) = xe^{-x^2}$ at $x = 1$. **(10pts.)**
   (5.2) $G(x, y) = e^x \ln(1 + y)$ at $(x, y) = (0, 0)$. **(10pts.)**

6. Find the local and absolute extreme values of the following function on the given domain: **(10pts.)**
$$g(x) = 3x^3(x - 2)^2, \quad -1 \leq x \leq 3.$$