1. Evaluate the values (每題 5 分, 共 20 分).

   (a) $\lim\limits_{x \to 2} \dfrac{x^2 - 6x + 8}{x - 2}$.

   (b) $\lim\limits_{x \to 0} [\dfrac{1}{x} - \dfrac{1}{e^x - 1}]$.

   (c) $\lim\limits_{n \to \infty} (\dfrac{1}{n+1} + \dfrac{1}{n+2} + \cdots + \dfrac{1}{n+(n-1)} + \dfrac{1}{n+n})$.

   (d) Suppose $f : (-2, 2) \to \mathbb{R}$ is a differentiable function, $f(1) = 1$ and $f'(1) = 2$. Evaluate $\lim\limits_{x \to \pi/4} \dfrac{f(\tan(x)) - 1}{x - \pi/4}$.

2. Test for convergence of divergence (每題 6 分, 共 12 分).

   (a) $\int_0^\infty e^{-x^2} dx$.

   (b) $\sum\limits_{n=2}^{\infty} \dfrac{1}{n \ln n}$.

3. Evaluate the integrals (每題 8 分, 共 32 分).

   (a) $\displaystyle\int_0^1 \cos^2 x \sin x \, dx$.

   (b) $\displaystyle\int_0^{\pi/2} x \sin x \, dx$.

   (c) $\displaystyle\iint_\Omega \cos(\dfrac{x-y}{x+y}) dA$, where Ω is the trapezoidal region with vertices $(1, 0)$, $(2, 0)$, $(0, 2)$ and $(0, 1)$.

   (d) $\displaystyle\iiint_B e^{4(x^2+y^2+z^2)^{3/2}} dV$, where $B = \{(x, y, z) \in \mathbb{R}^3 | x^2 + y^2 + z^2 \le 1\}$.

4. Use $\delta - \varepsilon$ argument to prove $\lim_{x \to 3} x^2 = 9$. (12 分)

5. Let $f(x) = e^x$, for $x \in \mathbb{R}$.

   (a) Find the Maclaurin series for $f(x) = e^x$. (4 分)

   (b) Show the Maclaurin series of f and f are identical for all $x \in \mathbb{R}$. (8 分)

6. The plane $x + y + 2z = 2$ intersects the paraboloid $z = x^2 + y^2$ in a eclipse. Find the points on this eclipse that are nearest and farthest from the origin. (12 分)