Instructions: Do not write on this paper. Write your complete solutions on your answer paper.

(1) (15 pts.) Find the limits:
   (a) \( \lim_{x \to \infty} \frac{\cos x}{x^2} \)
   (b) \( \lim_{x \to \infty} \frac{3x^2 + 8}{e^x} \)
   (c) \( \lim_{x \to 0^+} \sqrt{x} \ln x \)

(2) (15 pts.) Determine whether the sequence converges or diverges. If it converges, find the limit.
   (a) \( a_n = \frac{3^n}{5^n} \)
   (b) \( a_n = \frac{(-1)^n n}{n + 1} \)
   (c) \( a_n = \frac{(-1)^n}{n + 1} \)

(3) (30 pts.) Determine whether the integral converges or diverges. Evaluate each convergent integral.
   (a) \( \int_0^4 \frac{6}{(4 - x)^7} \, dx \)
   (b) \( \int_0^\infty xe^{-x^2} \, dx \)

(4) (20 pts.) For the curve \( C \) defined by polar equation \( r = \sin \theta \), answer the following.
   (a) Sketch the curve in the \( xy \)-plane. Indicate by an arrow the direction in which the curve is traced as \( \theta \) increases.
   (b) Set up, but don’t evaluate, an integral for the area of the region enclosed by \( C \).
   (c) Set up, but don’t evaluate, an integral for the area of the region lying inside \( C \) and below the line \( y = x \).

(5) (20 pts.) For the parametric curve \( C \) defined by \( x = t^{-2}, \quad y = \cos 2t, \quad 1 \leq t \leq 2 \) do the following:
   (a) Find a formula for \( \frac{dy}{dx} \), as a function of \( t \).
   (b) Set up an integral for the length of \( C \). Do not evaluate.