

Answer all of the questions. Calculators, pagers and mobile telephones are NOT allowed.

1. (4 pts) Find the following limits.

$$(a) \lim_{x \rightarrow 0} \frac{x e^x}{e^x - 1}$$

$$(b) \lim_{x \rightarrow 0^+} [1 + \ln(\cos x)]^{\cot x}$$

2. (12 pts) Evaluate the following integrals.

$$(a) \int \tan^3 x \sec^3 x \, dx$$

$$(b) \int \frac{dx}{1 + \sin x + \cos x}$$

$$(c) \int x \tan^{-1}(x^2) \, dx$$

$$(d) \int \frac{2x + 1}{\sqrt{6x - x^2}} \, dx$$

3. (4 pts) Determine whether the improper integral converges or diverges; if it converges, find its value.

$$\int_1^{\infty} \frac{dx}{x(x^2 + 1)}$$

4. (3+2 pts) Let  $C$  be the curve given by the parametric equations

$$x = 2 \sin t + \sin 2t \quad y = 2 \cos t + \cos 2t, \quad 0 \leq t \leq 2\pi.$$

(a) Find the length of  $C$ .

(b) Find all points on  $C$  where the tangent line is horizontal.