Calculators and mobile phones are not allowed.

Answer all of the following questions.

1. Evaluate the following limits, if they exist:

(a)
$$\lim_{x \to \infty} (1 + 2x)^{e^{-x}}$$

(b)
$$\lim_{x \to 1^+} \left(\frac{1}{x-1} - \frac{x}{\ln x} \right)$$

(5 points each)

2. Evaluate the following integrals:

(a)
$$\int \frac{x \sin^{-1} x}{\sqrt{1-x^2}}\, dx$$

(b)
$$\int \frac{\sin^5 x}{\sqrt{\cos x}}\, dx$$

(c)
$$\int \frac{6x^2 - 3x + 1}{(4x+1)(x^2+1)}\, dx$$

(d)
$$\int \frac{dx}{4 + \sin x}$$

(5 points each)

3. Determine whether the following integral converges, and if it converges, find its value.

$$\int_2^\infty \frac{dx}{x\sqrt{x^2+4}}$$

(5 points)

4. Let the curve C be given parametrically by

$$x = t + \sin t, \qquad y = 1 - \cos t \qquad (0 \le t \le \frac{\pi}{2})$$

(a) Find the slope of tangent line to C at $t = \frac{\pi}{3}$.   (2 points)
(b) Calculate the length of the curve C.   (3 points)