Name ____________________

- No calculators are allowed.

1. (9 points each) Evaluate the following integrals.

   (a) \[ \int \frac{(\sin x + \cos x)^2 - 1}{2\sin x} \, dx \]

   (b) \[ \int \frac{4x + 5}{x^2 + 1} \, dx \]
(c) \[ \int 2xe^{-4x} \, dx \]

(d) \[ \int x^2 \cos x \, dx \]
(e) \[ \int e^x \sin x \, dx \]

(f) \[ \int \sin^5 x \cos^2 x \, dx \]
(g) \[ \int \frac{x^3}{\sqrt{4 + x^2}} \, dx \]

(h) \[ \int \frac{4x^2 + 3x + 2}{x^2(x + 1)} \, dx \]
(i) \[ \int \frac{x^2 + 3}{x + 1} \, dx \]

(j) \[ \int_3^\infty \frac{1}{x \sqrt{\ln x}} \, dx \]
2. (5 points) Find a general formula for $a_n$, the $n$th term of the following sequence. Does this sequence converge or diverge? Explain. If the sequence converges, be sure to find its limit.

$$\frac{\cos 1}{2}, \frac{\cos 2}{4}, \frac{\cos 3}{6}, \frac{\cos 4}{8}, \frac{\cos 5}{10}, \frac{\cos 6}{12}, \frac{\cos 7}{14}, \ldots$$

3. (5 points) Prove that the sequence below is either strictly increasing or strictly decreasing.

$$\frac{n^n}{n!}$$