

1) (16 points) Find the derivative of

$$f(x) = \int_x^{x^2} \frac{e^t}{t} dt$$

State any rules and theorems you are applying and where you are applying them.

2) (16 points) If  $f(x)$  is continuous and

$$\int_1^4 f(x) dx = 9$$

Find the value of

$$\int_1^2 xf(x^2) dx$$

You must explain your answer.

3) (16 points ) Find the value of the definite integral

$$\int_1^e (\ln x)^2 dx$$

Simplify your answer.

4) (16 points) Find the indefinite integral

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

5) (16 points) Find the value of the definite integral

$$\int_1^e \frac{\sqrt{1 + (\ln x)^2}}{x} dx$$

using the  $u$ -substitution rule for **definite** integrals and one of the following formulas:

$$\int \frac{\sqrt{a^2 + u^2}}{u} du = \sqrt{a^2 + u^2} - a \ln \left| \frac{a + \sqrt{a^2 + u^2}}{u} \right| + C$$

$$\int \sqrt{a^2 + u^2} du = \frac{u}{2} \sqrt{a^2 + u^2} + \frac{a^2}{2} \ln(u + \sqrt{a^2 + u^2}) + C$$

Simplify your answer.

6) (16 points) Find the value of the following limit.

$$\lim_{x \rightarrow 0} \frac{\sin x}{x}$$

You must explain your answer using properties of limits in order to receive credit.