

1) (16 points) Find the derivative dy/dx of

$$y = \int_3^{\sqrt{x}} \frac{\cos t}{t} dt$$

Give reasons for your work.

2) (16 points) Find the value of the definite integral

$$\int_0^1 x^2 \cos(\pi x) dx$$

Indicate clearly which techniques of integration you use. Be careful with the constants!

3) and 4) (16 points each) Find the following indefinite integrals. Indicate clearly which techniques of integration you use.

3)

$$\int \frac{10}{(x-1)(x^2+9)} dx$$

4)

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

5) (16 points) Find the value of the following limit

$$\lim_{x \rightarrow \infty} \left(1 - \frac{1}{x}\right)^x$$

Clearly indicate any indeterminate forms and which laws of limits you are using.

6) (16 points) Use the comparison theorem for improper integrals to determine whether the following integral converges or diverges

$$\int_1^{\infty} \frac{x}{\sqrt{1+x^6}} dx$$

Clearly indicate any inequalities you are using and give reasons for your answer.