

Name:

Section:

Name of TA:

I: Calculate the limits:

a) (8 points)

$$\lim_{x \rightarrow 0} \frac{\cos x^2 - 1}{x^4} .$$

b) (8 points)

$$\lim_{x \rightarrow 0} \frac{x - \int_0^x e^{-t^2/3} dt}{x^3} .$$

c) (9 points)

$$\lim_{n \rightarrow \infty} n(\sqrt{n^2 + 1} - n)$$

Name:

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II:(25 points) a) Decide which of the following improper integrals exists and compute its values if it exists:

a) (8 points)

$$\int_0^{\infty} e^{-x} x dx ,$$

b) (8 points)

$$\int_2^{\infty} \frac{1}{x \ln(x)^2} dx ,$$

c) (9 points) Does the following integral exist:

$$\int_0^{\infty} \frac{1}{\sqrt{x} + x^2} dx$$

Name:

Section:

Name of TA:

III: a) (11 points) Solve the initial value problem

$$y' + \frac{1}{x}y = 1$$

with initial condition $y(1) = 1$.

b) (14 points) On an arctic expedition food is stored outside at -20°C . At some time the food is brought in a room with temperature 20°C and after two hours the food has a temperature of 0°C . How much does one have to wait until the food has a temperature of 10°C ?

Name:

Section:

Name of TA:

IV: a) (7 points) Does the following series converge?

$$\sum_{n=1}^{\infty} \frac{n-2}{n^3 - n^2 + 3}$$

b) (7 points) Sum the series

$$\sum_{k=2}^{\infty} \frac{2^{k+3}}{3^k} .$$

c) (11 points) Compute the limit

$$\lim_{n \rightarrow \infty} \frac{\sum_{k=1}^n \frac{1}{k}}{\ln n}$$