

**Math 180****Name (Print):** _____**9/10/2016****NetID:** _____**Time Limit: 20 Minutes**

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-



1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right)$$

$$e^{(\cos x)^2}$$

$$y = \cos x$$

$$y' = -\sin x$$

$$(-\sin x) e^{\cos^2 x}$$

$$2te^{t^2} \Big|_2^{\cos x}$$

$$2\cos x e^{\cos^2 x} - 4e^4$$

$$-\sin x e^{\cos^2 x} - e^4$$



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x} \quad \text{integral test}$$

$f(x)$ is continuous

$f(x)$ is positive

$$f \geq 2$$

$$f'(x) = \frac{-\ln x}{(x \ln x)^2} = \text{decreasing}$$

$$\frac{1}{x \ln x} = \frac{\ln i - \ln j}{\ln i \ln j}$$

product rule

$$\lim_{b \rightarrow \infty} \int_2^b \frac{1}{x \ln x} dx$$

↓
converges



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Sample 1

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-



1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right)$$

$$\int_2^{\cos x} e^{t^2} dt = e^{x^2} \cdot 2x = 2x e^{x^2} \Big|_2^{\cos x}$$

$$2(\cos x) e^{(\cos x)^2} - 2(2) e^4$$

$$\boxed{2 \cos x e^{\cos^2 x} - 4e^4}$$



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$u = \ln x$$

$$du = \frac{1}{x} dx$$

$$\int_2^a \frac{1}{u} du$$

$$\lim_{a \rightarrow \infty} \int_2^a \frac{1}{\ln x} dx$$

$$\lim_{a \rightarrow \infty} \ln u \Big|_{\ln 2}^{\ln a}$$

$$= \ln(\ln a) - \ln(\ln 2) = \infty$$

diverges



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Sample 1

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-



1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right)$$

$$= e^{\cos^2 x} (-\sin x)$$



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$\frac{1}{x} < \frac{1}{x \ln x} < \frac{1}{\ln x} \quad \text{converges}$$

$$\lim_{x \rightarrow \infty} \frac{1}{x \ln x} = \frac{1}{\infty} = 0$$



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Sample 1

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-



1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right)$$

$$f(x) = \int_2^0 e^{t^2} dt + \int_0^{\cos x} e^{t^2} dt$$

$$f(x) = - \int_0^2 e^{t^2} dt + \int_0^{\cos x} e^{t^2} dt$$

$$f'(x) = -e^4 + e^{\cos^2 x} + C$$



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$= \lim_{b \rightarrow \infty} \int_2^b \frac{dx}{x \ln x} = \lim_{b \rightarrow \infty} \int_{\ln 2}^{\ln b} u \, du$$

$$\left(\begin{array}{l} u = \ln x \\ du = \frac{1}{x} dx \end{array} \right)$$

$$= \lim_{b \rightarrow \infty} \left. \frac{u^2}{2} \right|_{\ln 2}^{\ln b}$$

$$= \lim_{b \rightarrow \infty} \left(\frac{(\ln b)^2}{2} - \frac{(\ln 2)^2}{2} \right) = \frac{(\ln \infty)^2}{2}$$

$$- \frac{(\ln 2)^2}{2}$$

$$= \infty - \frac{(\ln 2)^2}{2} = \infty \quad \text{diverges}$$



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Sample 1

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-



1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right)$$

according to the Fundamental Theorem
of Calculus

$$\begin{aligned} f' \left(\int_2^{\cos x} e^{t^2} dt \right) &= e^{(\cos x)^2} \cdot -\sin x \\ &= -e^{\cos^2 x} \sin x \end{aligned}$$



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$\lim_{b \rightarrow \infty} \int_2^b \frac{dx}{x \ln x}$$

$$u = \ln x$$

$$du = \frac{1}{x} dx$$

Diverges!

$$\lim_{b \rightarrow \infty} \int_2^b \frac{1}{u} du$$

$$\lim_{b \rightarrow \infty} \ln|u| \Big|_{\ln 2}^{\ln b} + C$$

$$\ln|\infty| - \ln|2|$$

↓
∞

$$\Rightarrow \ln \left| \frac{\infty}{2} \right|$$

$$\ln|\infty|$$

↙
goes to ∞



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Sample 1

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-



1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right)$$

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

$$\Rightarrow = f(\cos x)$$

$$\begin{aligned} \text{& } (f(\cos x))' &= f'(\cos x) \cdot (-\sin x) \quad \text{chain Rule} \\ &= e^{(\cos x)^2} (-\sin x) \end{aligned}$$

FTC



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$\frac{1}{x \ln x} > \frac{1}{x} \rightarrow \text{diverges}$$

$$\Rightarrow \text{by comparison } \int_2^{\infty} \frac{dx}{x \ln x} \text{ diverges}$$



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Sample 1

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-



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$\Leftrightarrow \sum_{n=2}^{\infty} \frac{1}{n \ln n} \text{ diverges}$$

\Rightarrow diverges by integral test



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Sample 1

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-



1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right)$$

$$= e^{\cos^2 x} \quad (-\sin x) - e^{2^2} \cdot (2t)$$
$$= e^{\cos^2 x} (-\sin x)$$



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$u = \ln x \quad du = \frac{1}{x} dx$$

$$= \int_2^{\infty} \frac{du}{u} = \ln u \Big|_2^{\infty} = \ln \infty - \ln 2 = \infty$$

diverges



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Sample 1

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Sample 1

#9 2 of 4

1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right) = e^{(\cos x)^2} (-\sin x)$$



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$= \int \frac{d}{dx} = \text{scribble} \quad \frac{1}{x} \Big|_2^{\infty} = \frac{1}{\infty} - \frac{1}{2} = -\frac{1}{2} \text{ Converge}$$



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Sample 1

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-



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Sample 1

#10 2 of 4

1. (8 points) Evaluate

$$\frac{d}{dx} \left(\int_2^{\cos x} e^{t^2} dt \right) = \cos x e^{t^2} dt$$



2. (8 points) Determine whether or not the following improper integral converges or diverges. Rewrite the integral as a limit, and evaluate the integral if it converges.

$$\int_2^{\infty} \frac{dx}{x \ln x}$$

$$= \frac{1}{x \ln x} \Big|_2^{\infty} = \frac{1}{\infty} - \frac{1}{2 \ln 2}$$

Converges



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Sample 1

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