

Read directions carefully and *show your work*. Partial credit will be assigned based upon the correctness, completeness, and clarity of your answers.

1. Consider $y(x) = e^e - \ln x + 3 \log_2 x - (e^2)^x - 7 \sin x + \cos(\pi)$, find $\frac{dy}{dx}$.

$$\frac{dy}{dx} = 0 - \frac{1}{x} + 3 \cdot \frac{1}{x \ln 2} - (e^2)^x \ln e^2 - 7 \cos x + 0 \implies \boxed{\frac{dy}{dx} = -\frac{1}{x} + \frac{3}{x \ln 2} - 2e^{2x} - 7 \cos x}$$

2. Consider $f(x) = x^3 - \ln x$. Is f concave up or down at $x = 1$?

$$f'(x) = 3x^2 - \frac{1}{x} = 3x^2 - x^{-1}.$$

$$\text{And so, } f''(x) = 6x + \frac{1}{x^2}.$$

Plug $x = 1$ into f'' to determine the concavity of f :

$$f''(1) = 6 + 1 > 0, \text{ therefore, } \boxed{f \text{ is concave up at } x = 1}.$$