1. For each function, find its derivative.

   (a) $f(x) = e^x - 7x^2 - 3x + \ln(2)$

   $$f'(x) = e^x - 14x - 3 + 0$$

   ($\ln(2)$ is a constant, just like 5 is, and so $\frac{d}{dx}(\ln(2)) = 0$.)

   (b) $f(x) = x^e - \ln(x) + 3^x$

   $$f'(x) = ex^{e-1} - \frac{1}{x} + \ln(3)3^x$$

   (x^e is not an exponential function, as it isn't in the form

   $$\text{constant}^{\text{variable power}}.$$

   Instead, it's in the form variable$^{\text{constant power}}$, and so it's a power function. Thus we just used the power rule on it.)

   (c) $f(x) = \ln(7)e^x - 3x^{\ln(12)} + 5e^8 - (\ln(3))^x$

   $$f'(x) = \ln(7)e^x - 3\ln(12)x^{\ln(12)-1} - \ln(\ln(3))\ln(3)^x$$

   (Again, $\ln(7)$ is just a constant, so we differentiate $\ln(7)e^x$ the same way we would differentiate $2e^x$ – use the rule that $\frac{d}{dx}(kf(x)) = kf'(x)$. Similarly, $\ln(12)$ is just a fixed number, and so to differentiate $x^{\ln(12)}$ we would use the power rule. $5e^8$ is just a constant, so it's derivative is 0, and while it looks intimidating, $(\ln(3))^x$ is just a routine exponential function, it just so happens that it's base is $\ln(3)$.)

2. Let $f(x) = \ln(x) - \frac{x^2}{20}$. Find the maximum and minimum values of $f(x)$ on the interval $[1, 12]$.

Assuming the graph is smooth, the maximum and minimum values of $f(x)$ on $[1, 12]$ can only occur at stationary points or at the endpoints of the interval.

As usual, to find stationary points we take the derivative of f and set it equal to zero:

$$f'(x) = \frac{1}{x} - \frac{x}{10}$$

$$\begin{aligned} f'(x) = 0 \implies & \frac{1}{x} - \frac{x}{10} = 0 \\ \implies & \frac{1}{x} = \frac{x}{10} \\ \implies & 10 = x^2 \\ \implies & x = \pm\sqrt{10} \end{aligned}$$

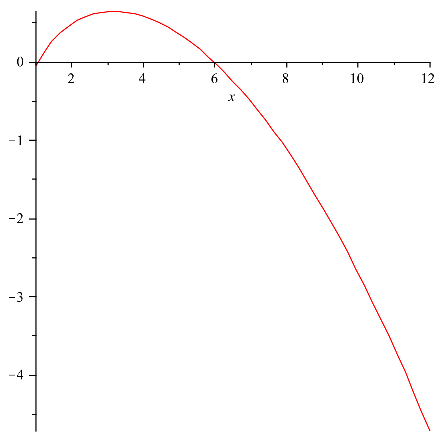
Since $-\sqrt{10} \notin [1, 12]$, the only stationary point in the interval is $\sqrt{10}$.

Thus the maximum and minimum values can only occur at $x = 1$, $x = \sqrt{10}$, and $x = 12$.

x	$f(x)$
1	$-\frac{1}{20}$
$\sqrt{10}$	$\ln(\sqrt{10}) - \frac{10}{20} \approx .65$
12	$\ln(12) - \frac{144}{20} \approx -4.72$

Therefore the maximum value of $\ln(\sqrt{10}) - \frac{1}{2}$ occurs at $x = \sqrt{10}$, and the minimum value of $\ln(12) - \frac{144}{20}$ occurs at $x = 12$.

You can roughly check this by looking at the graph of $f(x)$, either on your graphing calculator or on Maple.


0
−1
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