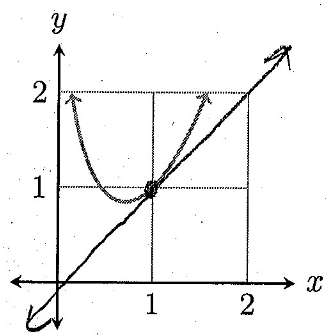
+6

1. Let $f(x) = x^2 - \ln x$. Find an equation of the tangent line in the form $y = mx + b$ at $x = 1$. You can check by sketching on the graph. Hint: No calculator is necessary for this problem.



$f'(x) = 2x - \frac{1}{x}$ +2

$f'(1) = 2 - 1 = 1$ ← slope +1

$f(1) = 1^2 - \ln 1 = 1$, $(1,1)$ ← point +1

$y - y_1 = m(x - x_1)$

$y - 1 = 1(x-1)$

$y - 1 = x - 1$ +2

$y = x$

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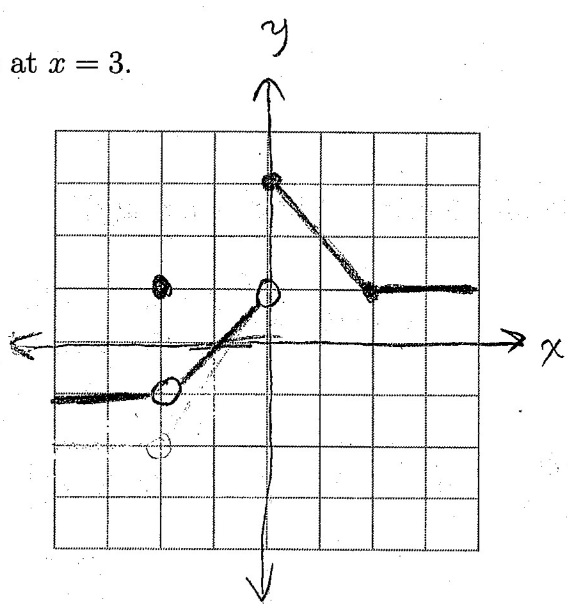
2. On the grid below, sketch a graph of a function $f(x)$ with domain $[-4, 4]$ which has the following properties.

+1 for entire domain

   (a) There is a removable discontinuity at $x = -2$.
   (b) There is an essential discontinuity at $x = 0$.
   (c) $\lim_{x \to 0^-} f(x) = 1$.
   (d) $\lim_{x \to -2^+} f(x) = -1$.
   (e) $f(2) = 1$.
   (f) $f(x)$ is continuous at $x = 3$.



+6

3. Find all local extrema of $f(x) = 2x - 4\sin(x)$ on the interval $[0, \pi]$. You do *not* need to make a sign chart if you know an easier method.

$$f'(x) = 2 - 4\cos(x) = 0$$
$$4\cos(x) = 2$$
$$\cos(x) = \frac{1}{2}$$ +3
$$x = \frac{\pi}{3}$$ +1

$$f''(x) = 4\sin(x)$$
$f''(\frac{\pi}{3}) = 4\sin(\frac{\pi}{3}) = 2\sqrt{3}$, so a local minimum +2

+6

4. Find the derivative of $f(x) = \ln(x^3 e^x)$ by any method. Hint: It might be easier to simplify with rules of logarithms first.

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

+3

5. Consider the following function. What is $\lim_{x \to 2^-} g(x)$?

$$g(x) = \begin{cases} x^2 - 2, & x \le 2, \\ 3x + 5, & x > 2. \end{cases}$$

$$\lim_{x \to 2^-} g(x) = \lim_{x \to 2^-} (x^2 - 2) = 2^2 - 2 = 2$$