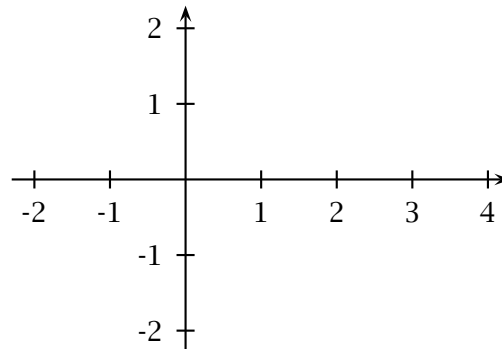


1. A man and a woman are walking toward a right angle intersection along different straight sidewalks. The man is walking at a rate of 4 feet per second and the woman at 5 feet per second. At a given moment, the man is 150 feet away from the intersection and the woman is 100 feet away. At what rate is the distance between them changing at the given moment? (12 points)

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2. Sketch the graph of a function that has relative maxima at  $x = -2$  and  $x = 4$ , a relative minimum at  $x = 2$ , and another critical point at  $x = 0$ . (9 points)



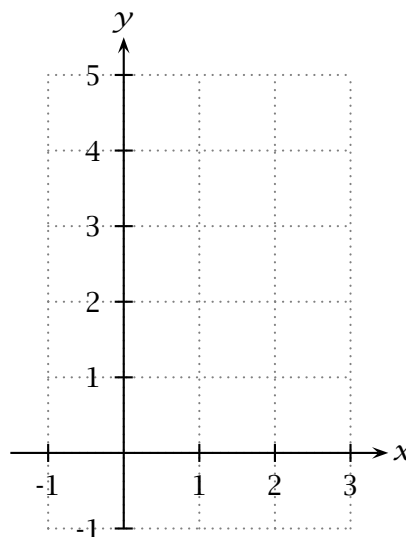
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3. Use calculus to find the absolute extrema of the function  $f(x) = \frac{\ln x}{x}$  on the interval  $[1, 3]$ . Begin by finding the critical points and classifying them according to type. Show the algebraic details. (11 points)

4. Consider the function given by  $f(x) = 3x^{2/3} - 2x$  on the interval  $[-1, 3]$ .

- (a) Use the derivative of  $f$  to find the critical points of  $f$  and the intervals where  $f$  is monotonic. (8 points)

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- (b) Determine the concavity of  $f$ , and determine all of the local extrema of  $f$  (using the first or second derivative test). (8 points)

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- (c) Sketch the graph of  $f$  on the axes given. (6 points)



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- (d) Determine the global extrema (on the interval  $[-1, 3]$ ) for  $f$ . (6 points)

5. Evaluate the limit  $\lim_{x \rightarrow \infty} \frac{e^x}{x^2}$ . Show your work. (9 points)

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6. Evaluate the limit  $\lim_{x \rightarrow \pi} \frac{x - \pi}{\sin x}$ . Show your work. (9 points)

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7. The university wants to design a commemorative mug for its annual calculus festival. Assume the mug will be a 300 cc right circular cylinder with a base but no top (disregard the handle). In order to minimize the cost, the university wants to use the least amount of material to make the mug. Write a function that expresses the total surface area of the cylinder and its base as a function of the base radius, and state the interval over which you would want to minimize the function. [You do not actually need to solve the problem.] (11 points)

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8. Use Newton's method to find an approximation of the root of the equation  $x^3 - 2x^2 + x - 1 = 0$ . For your initial guess,  $x_1$ , use the closest integer to the actual root. Then apply the method to calculate  $x_2$ . (11 points)