

1. Find any critical points of the following functions, and use the first derivative test to determine whether they constitute local maxima or minima. Identify the maximum and minimum values of the function on the interval, if they exist.
 - (a) $f(x) = -x^2 - x + 2$ $[-4, 4]$
 - (b) $G(x) = (x - 1)^{\frac{2}{3}}$ $[0, 8]$
 - (c) $h(\theta) = \cos \theta \sin \theta$ $[0, \pi]$ (Double-angle trig identities might come in handy.)
 - (d) $z(x) = \frac{x^2 + 1}{x - 4}$ $[-1, 4]$ (Be careful.)
2. Use the fact that a quadratic polynomial with roots r and s can be written in the form $f(x) = A(x - r)(x - s)$ for some constant A for these two proofs.
 - (a) Suppose that quadratic f has roots r and s . Show that $f'(r) + f'(s) = 0$.
 - (b) Show that the critical point of a quadratic occurs midway between its roots.
3. Prove that of all rectangles with given perimeter P , the square has the largest area.
4.
 - (a) Find the closest point on the graph of $f(x) = x^2$ to the point (a, b) .
 - (b) Show that the line connecting $(0, b)$ to the closest point is normal to the graph at that point. (In this context, "normal" means that they meet in a right angle.)