1. [10 pts.] Use the Closed Interval Method to find the absolute extreme values of

$$f(x) = x^4 - 4x^3 + 4x^2$$

on $[-1, 3]$.

2. [7 pts. each] Let $f(x) = \dfrac{x^2}{x^2 - 4}$.

(a) Find the domain and intercepts of f.

(b) Find the asymptotes of f.

(c) Find the critical points of f.

(d) Use the Monotonicity Test to find intervals of increase and decrease, and use either the First Derivative Test or Second Derivative Test to find all local extrema.

(e) Use the Concavity Test to find intervals where f is concave up or down, and identify inflection points.

3. [10 pts.] Find the point P on the line $y = -2x$ that is closest to the point $(-20, 0)$. What is the distance between P and $(-20, 0)$?

4. [15 pts.] An island is 3.5 km from the nearest point on a straight shoreline, and that point is 8 km from a power station. A utility company plans to lay electrical cable underwater from the island to the shore and then underground along the shore to the power station. Assume that it costs $2400 per kilometer to lay underwater cable and $1200 per kilometer to lay underground cable. At what point should the underwater cable meet the shore in order to minimize the cost of the project?
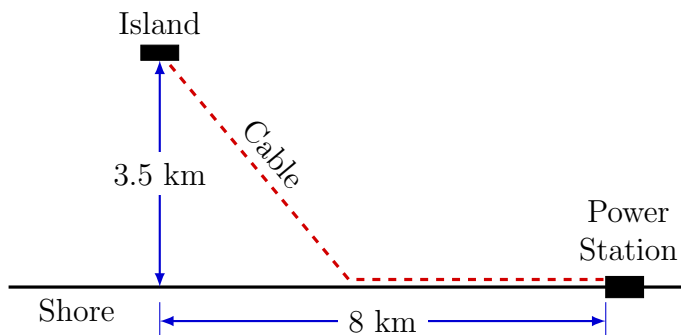
5. [10 pts.] Find the linear approximation to the function $g(t) = \sqrt{2t + 9}$ at the point $t = -4$.

6. [10 pts.] Show that the equation $x^5 + 10x + 3 = 0$ has exactly one real root.

7. 10 pts. each   Use L'Hôpital's Rule to evaluate each limit.

(a) $\lim\limits_{x \to 0} \dfrac{\sin ax}{\sin bx}$, where $a, b \neq 0$

(b) $\lim\limits_{x \to 0} \left(\dfrac{1}{x} - \csc x \right)$

8. 10 pts. each   Determine the following indefinite integrals.

(a) $\displaystyle \int \left(\dfrac{5}{t^2} + 4t^2 \right) dt.$

(b) $\displaystyle \int \left(\sin 2r - \sec^2 9r \right) dr.$