Find the limit in Problem 1 by applying limit rules step-by-step and labeling each step with the appropriate limit rule.

Problem 1. $\lim_{x\to(-2)} \dfrac{5+2\,x}{x^3} - 3\,x =$

In Problems 2-5, if possible, find the limit carefully showing all your work. Otherwise, explain clearly why the limit does not exist.

Problem 2. $\lim_{h\to 0} \dfrac{\dfrac{1}{h} - 5\,h}{\dfrac{2}{h} + 5\,h} =$

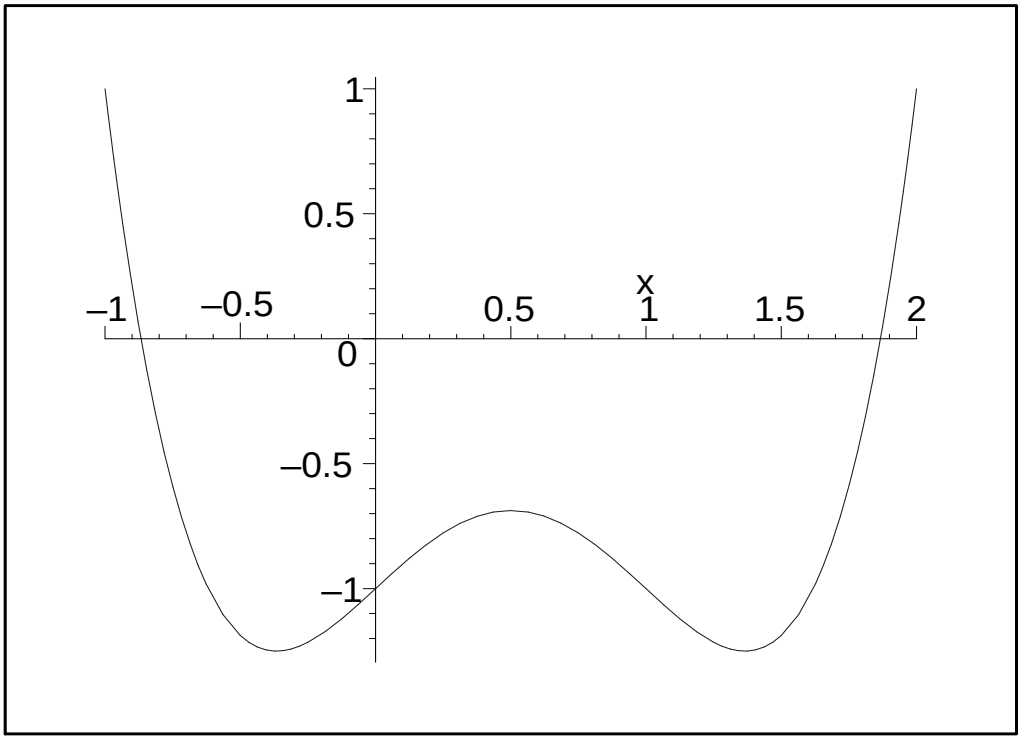
Problem 3. $\lim_{x\to 2} \dfrac{1}{x^2-4} =$

Problem 4. $\lim_{x\to(-4)} \dfrac{2\,x^2+5\,x-12}{x+4} =$

Problem 5. $\lim_{h\to 0} \dfrac{3\,(x\ +h)^2 - 3\,x^2}{h} =$

Problem 6. Find the tangent slope function (derivative) for f(x) and use it to find the tangent lines to the curve at the points x = -0.6, 1.6. Also, accurately graph both tangent lines on the plot below.

$$f(x) = x^4 - 2\,x^3 + x - 1$$



Problem 7. A hot air balloon is ascending at a constant speed of 19 m/s. When it is 33 m above the ground, a care package is released from the balloon.

(a) Specify the position, velocity, and acceleration functions for the motion of the package.

$$s(t) = \frac{1}{2}\,a_0\,t^2 + v_0\,t + s_0$$

(b) How long after being released does it take the package to descend to a height of 45 m? What is the velocity of the package when it descends to this height?

(c) What is the maximum height reached by the package? What is the velocity of the package when it reaches this height?

(d) What is the velocity of the package just before it hits the ground? What is the maximum speed of the package?

Problem 8.

$$f(x) = x^5 - 6\,x^3 + 7\,x$$

Find the zeroes of f: _____

Determine the end behavior of f: _____

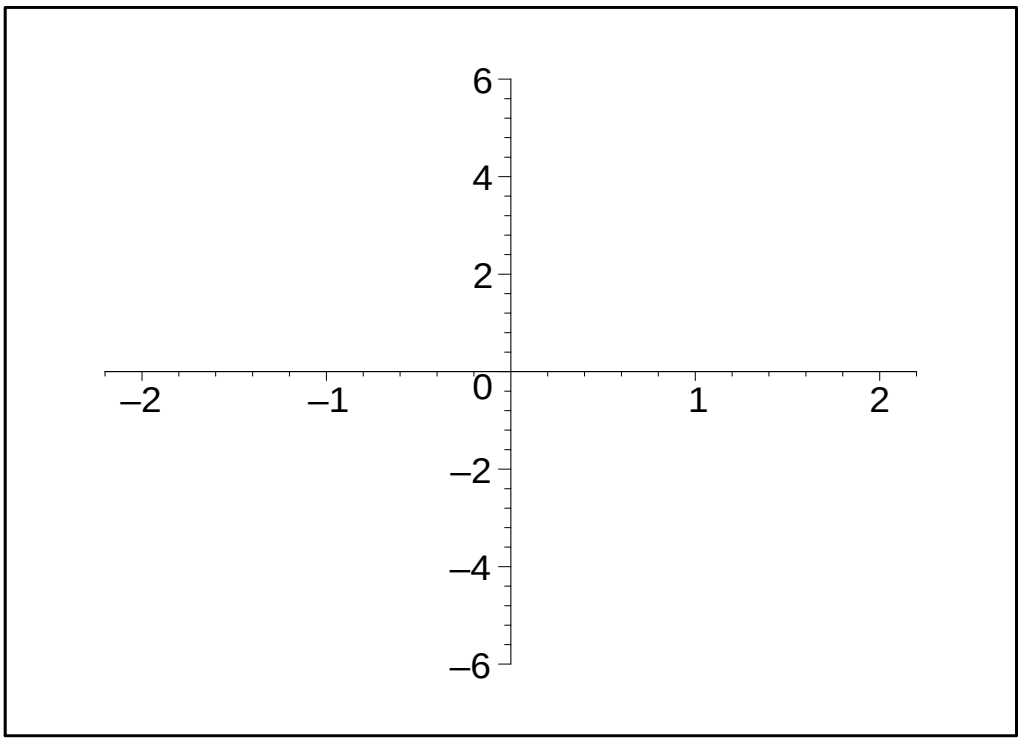
Find the tangent slope function for f: tsf(x) = _____

Find the zeroes of the tsf function: _____

Use the information above to sketch the graph of f and to fill in the information below.

$$x - intercept(s), \quad x \; =$$
$$x - coordinate(s) \; of \; bump(s) \; on \; f, \; x \; =$$

bump1 on f = , *bump2 on f =* , *bump3 on f =*



Problem 9. Compute the limit below for the given function f(x), carefully showing all your work.

$$\mathrm{f}(x) = -2\,x^2 + 5\,x - 1,\ \mathrm{f}\,'(x) = \lim_{h \to 0} \frac{\mathrm{f}(x+h) - \mathrm{f}(x)}{h}$$

Problem 10. Use the Newton-Raphson method to find the real zeroes of f(x), carefully showing all your work.

$$\mathrm{f}(x) = x^5 - 3\,x^4 + 2\,x^2 + 1$$

Problem 11. Compute the derivative using the appropriate D-Rules.

$\mathrm{D}((x^2 + 2\,x - 2)\,(x^3 - 1)) =$

$$\mathrm{D}\left(\frac{(x^2 + 2\,x - 2)^2}{x^3 - 1}\right) =$$

$$\mathrm{D}\left(\left(\frac{\cos(x)}{e^x}\right)^5\right) =$$

$\mathrm{D}\left(e^x + x\ln(x)\right) =$

$\mathrm{D}\left(\ln\left(\dfrac{x}{\sin(x)+1}\right)\right) =$

$\mathrm{D}\left(e^{\cos(x^{-2})} + (x^4 - x^2 + 1)^{-3}\right) =$

Problem 12.

1. Sketch an **accurate** graph of the function f(x),
2. Find all x-intercepts,
3. Compute the derivative,
4. Find the xy-coordinates of all bump points,
5. Find all vertical and horizontal asymptotes,
6. **Label** the graph in 1. with the information in 2., 4. and 5.

$$\mathrm{f}(x) = \frac{3\,x^2 + 2}{5\,x^2 + 9\,x - 1}$$