Mathematics Quote: For a physicist mathematics is not just a tool by means of which phenomena can be calculated, it is the main source of concepts and principles by means of which new theories can be created.
– Freeman Dyson, Mathematics in the Physical Sciences.

1. Reading assignment for Section 1.5:
   (1) Remarks 5.1-5.2.
   (2) Theorem 5.1-5.2.
   (3) Examples 5.1-5.4,5.6.
   (4) Examples from the lecture notes.

   Turn in 2, 4

3. Find the limits without using calculator:
   (i) \( \lim_{x \to \infty} \frac{2x^2 + 1}{x^2 - 1} \)
   (ii) \( \lim_{x \to \infty} \frac{2x + 1}{x^2 - 1} \)
   (iii) \( \lim_{x \to \infty} \frac{2x^3 + 1}{x^2 - 1} \)
   (iv) \( \lim_{x \to -\infty} \frac{2x^3 + 1}{x^2 - 1} \)
   Extra points: (v) \( \lim_{x \to \infty} \frac{-2x + 3}{x^2 - 1} \)

4. State the definition of a vertical asymptote \( x = a \) of the graph of \( f(x) \).
   State the definition of a horizontal asymptote \( y = b \) of the graph of \( f(x) \).

5. Find algebraically each of vertical and horizontal asymptotes of \( f(x) \) if it exists without using calculator.
   (a) (i) \( f(x) = 3e^{-x^2} \) (ii) \( f(x) = 5e^{2x} \)
   (b) (i) \( f(x) = \ln(3 + 2x) \)
   (c) (i) \( f(x) = \frac{2x^2 + 1}{x^2 - 1} \) (ii) \( f(x) = \frac{x^2 + x - 2}{x^2 - 1} \) (iii) \( f(x) = \frac{1-x}{\sqrt{x^2 - 1}} \)
   (d) Extra points: (i) \( f(x) = \frac{1-x}{\sqrt{1-x^2}} \) (ii) \( f(x) = \tan(x) \) (iii) \( f(x) = \tan^{-1}(x) \)

6. Find the following limits algebraically (without using calculator).
   (a) \( \lim_{x \to \infty} xe^{-x} \) (note that \( e^{-x} = \frac{1}{e^x} \))
   (b) (i) \( \lim_{x \to 0} \frac{1 + e^x}{2 + 3e^x} \) (ii) \( \lim_{x \to \infty} \frac{1 + e^x}{2 + 3e^x} \) (iii) \( \lim_{x \to -\infty} \frac{1 + e^x}{2 + 3e^x} \)