1. Pre-calculus review. For the following functions given by their graphs, what are the domain, range, and describe the increasing/decreasing behavior of the function. Assume the function does not go beyond what is shown. Assume any endpoints of curves are closed endpoints.

Domain = \([-2, 2]\) \((-2 \leq x \leq 2)\)
Range = \([-1, 2]\) \((-1 \leq y \leq 2)\)
Increasing on \([-1, 2]\) \((-1 \leq x \leq 2)\)
Decreasing on \([-2, -1]\) \((-2 \leq x \leq -1)\)

Domain = \([-1, 2]\)
Range = \([0, 2]\)
Increasing on \([-1, \frac{1}{2}]\)
Decreasing on \(\left[\frac{1}{2}, 2\right]\)

2. Pre-calculus review. For the following functions given by their formulas, what are their domains?
Your concerns are zero denominators and even roots of negative numbers
(a) \(f(x) = \frac{x-2}{x^2+5x-4}\)  
   Domain is where \(x \neq 4/3\) \((3x - 4 \neq 0)\)
(b) \(g(x) = \sqrt{x - 12}\)  
   Domain is all \(x\) \((\text{no problems with } \sqrt{x})\)
(c) \(h(x) = \frac{17}{\sqrt{x-4}}\)  
   Domain is \(x > 4\) \((\text{need } x - 4 \geq 0 \text{ for } \sqrt{x})\) \((\text{and } x - 4 \neq 0 \text{ for denominator})\)

3. More pre-calculus. Algebra practice:
(a) Expand \((5x - 3)^2\)
   \(= (5x)^2 + 2(-3)(5x) + (-3)^2 = 25x^2 - 30x + 9\)
(b) Simplify by factoring, if possible:
   \(\frac{x^2-4}{x^2+5x+6} = \frac{(x-2)(x+2)}{(x+2)(x+3)} = \frac{x-2}{x+3}\)
(c) Simplify by factoring, if possible:
   \(\frac{x^2+4}{x^2-4} = \frac{x^2+4}{(x-2)(x+4)}\) \(\text{no further simplifications possible}\)
4. Finally, calculus... Let \( f(x) = x^2 + 3x \).

(a) Find the average rate of change of \( f \) over the following time intervals. Simplify your answers.

\[
\frac{f(3) - f(1)}{3 - 1} = \frac{18 - 4}{2} = \frac{14}{2} = 7
\]

\[
\frac{f(2) - f(1)}{2 - 1} = \frac{10 - 4}{1} = 6
\]

\[
\frac{f(1.1) - f(1)}{1.1 - 1} = \frac{(1.21 + 3.3) - 4}{0.1} = \frac{5.1}{0.1} = 51
\]

\[
\frac{f(1+h) - f(1)}{h} = \frac{(1+h)^2 + 3(1+h) - 4}{h} = \frac{1 + 2h + h^2 + 3 + 3h - 4}{h} = \frac{h^2 + 5h}{h} = \frac{h(h+5)}{h} = h + 5
\]

(b) Using the last answer from (a), what is the "instantaneous" rate of change of \( f \) at 1? This is the number that the average rate of change over \( [1, 1+h] \) approaches as \( h \) approaches 0.

As \( h \) approaches 0,
\( h + 5 \) approaches 5.

(c) The answer to (b) may also be interpreted as the slope of the tangent line to the graph of \( y = x^2 + 3x \) at the point at \( x_0 = 1 \). Write an equation of this tangent line.

\[
\text{slope} = 5 \quad \text{y} = 1^2 + 3 \cdot 1 = 4
\]

\[
\text{point} = (1, 4).
\]

Tangent line is
\[
y - 4 = 5(x - 1).
\]