1. \( f'(-2) \) is positive, and \( f'(2) \) is negative, so the former is larger. We have \( f(1) > f(2) > f'(1) > f'(2) \). (Positive, less positive, 0, negative.)

2. The difference quotient is the slope of the line joining \((2,3)\) to \((3,4/3)\), which is 

\[
\frac{3 - 4/3}{2 - 3} = \frac{5}{3}
\]

The following graph shows the secant line whose slope is \(-5/3\) and that passes through the points \((2,3)\) and \((3,4/3)\).

3. We must find the value of \(\lim_{x\to2} \frac{f(x) - f(2)}{x-2} = \lim_{x\to2} \frac{12/x^2 - 3}{x-2} = \lim_{x\to2} \frac{12-3x^2}{x^2(x-2)} = \frac{3(2-x)(2+x)}{x^2(x-2)} = -\frac{3(2x+3)}{x^2} = -12/4 = -3\).

4. \( f(x) = 3x^2 + 2x \). The derivative \( f'(x) = \lim_{h\to0} \frac{f(x+h) - f(x)}{h} = \lim_{h\to0} \frac{3(x+h)^2 + 2(x+h) - (3x^2 + 2x)}{h} = \lim_{h\to0} \frac{3x^2 + 6xh + 3h^2 + 2x + 2h - 3x^2 - 2x}{h} = \lim_{h\to0} \frac{h(6x + 3h + 2)}{h} = \lim_{h\to0} (6x + 3h + 2) = 6x + 2.

The average value of this function on \([0,2]\) is \( \frac{f(2) - f(0)}{2-0} = \frac{16-0}{2} = 8 \).

5. Here is the graph of a function \(g\) that satisfies the requirements of the problem:
6) $C'(r)$ has units (output unit)/(input unit), or dollars/(% rate of interest). $C'(4)$ is the instantaneous rate of change of the total cost of the loan with respect to the interest rate at the interest rate value of 4%. The sign of this quantity is positive, since an increase in the interest rate from 4% to $(4 + \Delta r)$ % will cause an increase in the total cost of the loan.

7. Find the following derivatives:
   a. $(7x^5 + 4/x^2)' = (7x^5 + 4x^{-2})' = 35x^4 - 8x^{-3}$
   b. $(\sin(\ln(3x)))' = \cos(\ln(3x)) * (\ln(3x))' = \cos(\ln(3x)) * (1/(3x)) * 3 = \frac{\cos(\ln(3x))}{x}.
   c. $\left(3x^2 + 5\right)^4 = 4 \left(3x^2 + 5\right)^3 (6x) = 24x \left(3x^2 + 5\right)^3$
   d. $\left(\cos(x)\right)' = \frac{\cos(x)' \cdot 7^x - \cos(x) \cdot 7^x}{7^x} = \frac{-\sin(x) \cdot 7^x - \cos(x) \cdot 7^x \ln(7)}{7^x}$
   e. $\sqrt{3^2 + x^2} = \left(\left(3^2 + x^2\right)^{1/2}\right)' = \left(3^2 + x^2\right)^{1/2} \cdot (1/(1 + 2x^2)) \cdot (1 + 2x^2)' = 2x \arctan(2x) + \frac{2x^2}{1 + 4x^2}$
   f. $(\arctan(2x))' = (2x) \arctan(2x) + \frac{1}{1 + (2x)^2} \cdot (2x)' = 2x \arctan(2x) + \frac{2x}{1 + 4x^2}$

8. Relation $x^2 + y^2 = 2$. Think $y = f(x)$ and differentiate both sides with respect to $x$: $2x + 2y' + 2y = 0$, so $y' = \frac{-2x}{\sqrt{x^2 + 4}}$.
   At the point $(1,1)$, $y' = -2/3$, so the equation of the tangent line at $(1,1)$ is $y - 1 = (-2/3)(x - 1)$.

9. The population satisfies $p(t) = Ce^{kt}$, with $p(2) = 600$ and $p(8) = 75000$.
   a. Find the initial population: $\frac{75000}{600} = 125 = \frac{p(8)}{p(2)} = \frac{Ce^{8k}}{Ce^{2k}} = e^{6k}$, so $6k = \ln(125)$, or $k = \ln(125)/6 = .804719$. Therefore, $600 = Ce^{.804719 \cdot 2}$, so $C = \frac{600}{e^{1.609438}} = 120$.
   b. Find the function $p(t)$: $p(t) = Ce^{kt} = 120e^{.804719t}$.
   c. Find $p(5)$ and $p'(5)$, which we know is equal to $k \cdot p(5)$. $p(5) = 120e^{.804719 \cdot 5} = 6708.21$.
      $p'(5) = (.804719) p(5) = (.804719)(6708.21) = 5398.22$. The units of $p'(5)$ are in bacteria/hour.
   d. When will the population reach 200000? Solve the equation $p(t) = 200000$ for $t$: We get $120e^{.804719t} = 200000$, so $e^{.804719t} = \frac{200000}{120} = \frac{5000}{3}$; therefore, $t = \frac{\ln(5000/3)}{.804719} = 9.21885$ hours.

10. Estimate the value of the following expressions (reading the values of the functions and the derivatives approximately from
the graphs):

a. \( h(3) = g(f(3)) = g(3) = 0. \)

b. \( h'(3) = g'(f(3)) \cdot f'(3) = g'(3) \cdot f'(3) = (-1)(6) = -6 \) (approx).

c. \( j(-1) = 3 f(-1) + 2 = 3(0) + 2 = 2. \)

d. \( j'(-1) = 3 f'(-1) = 3(5) = 15 \) (approx).