These are solutions to the common version problems. The problems on your personal version should be similar, but usually with different numbers.

We will make use of the formula $f'(x) = 2ax + b$ where $f(x) = ax^2 + bx + c$.

2. If $h(t)$ represents the height of an object above ground level at time $t$ and $h(t)$ is given by $h(t) = -16t^2 + 12t + 1$ find the speed at time $t = 0$.

**Solution:**
The speed at time $t$ is $s'(t) = 2 \cdot (-16)t + 12 = -32t + 12$. The speed at time $t = 0$ is thus $s'(0) = -32 \cdot 0 + 12 = 12$.

3. If $h(t)$ represents the height of an object above ground level at time $t$ and $h(t)$ is given by $h(t) = -16t^2 + 12t + 1$ find the height of the object at the time when the speed is 0.

**Solution:** The speed at time $t$ is $s'(t) = 2 \cdot (-16)t + 12 = -32t + 12$. When is the speed 0? Set $s'(t) = 0$, and solve for $t$: $-32t + 12 = 0$ and so $t = \frac{12}{32} = \frac{3}{8}$. The height at this time is then $s\left(\frac{3}{8}\right) = -16\left(\frac{3}{8}\right)^2 + 12\left(\frac{3}{8}\right) + 1 = 3.25$.

4. Suppose $h(t) = t^2 + 10t + 7$. Find the instantaneous rate of change of $h(t)$ with respect to $t$ at $t = 2$.

**Solution:**
The instantaneous rate of change of $h(t)$ is $h'(t)$,

$$h'(t) = 2t + 10.$$  

To get the instantaneous rate of change of $h(t)$ at $t = 2$ is $h'(2) = 2 \cdot 2 + 10 = 14$.

5. Suppose $G(x) = 6x^2 + x + 4$. Find a number $b$ so that $G'(b) = 7$.

**Solution:**

$$G'(x) = 6 \cdot 2x + 1 = 12x + 1.$$  

Now, $12b + 1 = 7$ and so $b = \frac{1}{2}$.

6. Let $g(x) = 2x^2 + 2x + 1$. Find a value $c$ between 1 and 3 so that the average rate of change of $g(x)$ from 1 to 3 is equal to the instantaneous rate of change of $g(x)$ at $x = c$.

**Solution:**
The instantaneous rate of change of $g(x)$ is

$$g'(x) = 2 \cdot 2x + 2 = 4x + 2$$

and so $g'(c) = 4c + 2$.

Next, $g(3) = 2 \cdot 3^2 + 2 \cdot 3 + 1 = 25$ and $g(1) = 2 \cdot 1^2 + 2 \cdot 1 + 1 = 5$. The average rate of change from 1 to 3 is

$$\frac{g(3) - g(1)}{3 - 1} = \frac{25 - 5}{3 - 1} = 10.$$  

Now $10 = 4c + 2$ and so $c = 2$.  

7. Let \( F(s) = 5s^2 + s + 4 \). Find a value of \( d \) greater than 0 so that the average rate of change of \( F(s) \) from 0 to \( d \) equals the instantaneous rate of change of \( F(s) \) at \( s = 1 \).

**Solution:** The instantaneous rate of change of \( F(s) \) is
\[
F'(s) = 2 \cdot 5s + 1 = 10s + 1
\]
and so the instantaneous rate of change of \( F(s) \) at \( s = 1 \) is \( F'(1) = 10 + 1 = 11 \).

Next, \( F(0) = 4 \) and \( F(d) = 5d^2 + d + 4 \) and so the average rate of change is
\[
\frac{F(d) - F(0)}{d - 0} = \frac{5d^2 + d + 4 - 4}{d} = \frac{(5d + 1)d}{d} = 5d + 1.
\]
Equating the average rate of change with the instantaneous rate of change gives \( 5d + 1 = 11 \) and so \( d = 2 \).

8. Let \( f(x) = x^2 + x + 14 \). What is the value of \( x \) for which the tangent line to the graph of \( y = f(x) \) is parallel to the \( x \)-axis.

**Solution:**
First, the \( x \)-axis has slope equal to zero, and since the tangent line is parallel to the \( x \)-axis, the tangent line must also have slope equal to 0. But the derivative of \( f(x) \) is the slope of this tangent line, and \( f'(x) = 2x + 1 \). Then \( 0 = 2x + 1 \) and so \( x = -\frac{1}{2} \).

9. Let \( f(x) = x^2 + x + 14 \). What is the value of \( f(x) \) for which the tangent line to the graph of \( y = f(x) \) is parallel to the \( x \)-axis.

**Solution:**
First, the \( x \)-axis has slope equal to zero, and since the tangent line is parallel to the \( x \)-axis, the tangent line must also have slope equal to 0. But the derivative of \( f(x) \) is the slope of this tangent line, and \( f'(x) = 2x + 1 \). Then \( 0 = 2x + 1 \) and so \( x = -\frac{1}{2} = -0.5 \).

This tells us where the tangent line is horizontal to the \( x \)-axis. To find the value of \( f(x) \) at this point, plug in \( x = -0.5 \),
\[
f(-0.5) = (-0.5)^2 + (-0.5) + 14 = 13.75.
\]

10. Let \( f(t) = 6t^2 + 4t + 1 \). Find the value of \( t \) for which the tangent line to the graph of \( f(t) \) has slope 1.

**Solution:** The slope of the tangent line is
\[
f'(t) = 12t + 4
\]
and so we set \( 12t + 4 = 1 \) and solve for \( t \) to get \( t = -1/4 \).