1.2 The Slope of a Tangent

1. Simplify the Difference Quotients:

   a. $\dfrac{(8+h)^2-64}{h}$ b. $\dfrac{\dfrac{2}{3+h}-\dfrac{2}{3}}{h}$ c. $\dfrac{3(2+h)^3-24}{h}$ d. $\dfrac{2\sqrt{4+h}-4}{h}$ (hint: conjugate)

2. Determine, and simplify, an expression describing the slope of a secant through the given points:

   a. $P(2,3),\ Q\left(2+h,(2+h)^2-1\right)$

   b. $A(1,\ f(1)),\ B(1+h,\ f(1+h)),$ where $f(x)=2x^3-1$

   c. $R(0,2),\ S\left(h,\sqrt{h+4}\right)$

3. Using a limit on the slope of a secant, determine the slope of the tangent to each curve at the given domain value (Don't forget – a domain value isn't enough info…you need a ***point***!):

   a. $f(x)=-2x^2+5,$ at $x=1$

   b. $g(x)=-2x^2+5x,$ at $x=1$

   c. $h(x)=\sqrt{2x+1},$ at $x=4$

   d. $p(x)=\dfrac{3}{x},$ at $x=2$

4. Determine the ***equation of the tangent*** to the curve $f(x)=2x^2+x+3$ at the point $(2,13)$. (Hint: a tangent is a line and so has an equation with a form like $y=mx+b$. Find *m*!)

5. A young Calculus student managed to lock himself in a room in a tower, 50*m* high. Looking out the window he notices a damsel of rescue and decides to get her attention by throwing a stone at her feet. The stone's height, as a function of time, is described by the function $h(t)=-4.9t^2-t+50$ (*h* is in *m*, and *t* is in seconds). Unfortunately for our student (who, let's face it, isn't very bright) the stone smashes through the windshield of a parked police car. Determine (DON'T BE AFRAID OF DECIMALS!!):

   a. The average velocity of the stone over the time interval $t\in[0,2]$.

   b. The instantaneous velocity of the stone at $t=2$ seconds.

   c. The velocity the stone hits the police car's windshield if the point of impact is 1*m* above ground (hint: you will need the time *t* when *h*(*t*) is 1*m*).

6. Determine the coordinates of the point on the curve $f(x) = -2x^2 + 3x$ where the tangent to $f(x)$ is parallel to the line $y = 5x + 2$ (*slope is your friend…do you see how friendly mathematics is*?!?).

7. Determine the equation of the line that passes through $(2, 2)$ and is parallel to the tangent to the curve $f(x) = -3x^2 - 2x$ at $(-1, 5)$.

Answers to Selected Problems:

1. b. $-\dfrac{2}{3(3+h)}$ d. $\dfrac{2}{\sqrt{4+h}+2}$
2. b. $6 + 6h + 2h^2$
3. b. $m_{\tan} = 1$ d. $m_{\tan} = -\dfrac{3}{4}$
4. $y = 9x - 5$
5. a. $v_{avg} = -10.8 m/s$ b. $v = -20.6 m/\text{s}$ c. $t = 3.3s,\ v = -33.34 m/s$
6. $(-0.5, -2)$
7. $y = 4x - 6$