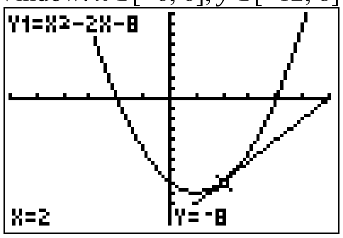
Name: ______________________________ Date: ________________________

## 1.6 Slopes of Tangents and Instantaneous Rate of Change

BLM 1–17

**1.** Consider the graph shown.
Window: $x \in [-6, 6]$, $y \in [-12, 8]$




**a)** Write the coordinates of the tangent point shown.
**b)** Estimate and state the coordinates of another point on the tangent line.
**c)** Determine the slope of the tangent using the points from parts a) and b).
**d)** Draw the tangent to the curve at the point (–1, –5). Estimate another point that is on this tangent line. Find the slope of this second tangent line.
**e)** Interpret the significance of the differences in the values found in parts c) and d).
**f)** Discuss what you predict the values will be of the slopes of tangents drawn at other points on the curve.

**2.** A projectile is shot into the air such that its height, $h$, in metres, after $t$ seconds can be modelled by the function $h(t) = 25t - 4.9t^2$.
**a)** Complete the table.

| Interval | $\Delta h$ | $\Delta t$ | $\frac{\Delta h}{\Delta t}$ |
|---|---|---|---|
| $4 \le t \le 4.1$ | | | |
| $4 \le t \le 4.01$ | | | |
| $4 \le t \le 4.001$ | | | |

**b)** Use the table to estimate the velocity of the projectile after 4 s.

**3.** After $t$ hours, the number of bacteria, $N$, in a culture can be modelled using the function $N(t) = 75\ 000 + 64t^3$.
**a)** Determine the average rate of change of the growth of the number of bacteria with respect to time for the first 6 h.
**b)** Estimate the instantaneous rate of change of the number of bacteria after 6 h.

**4.** The displacement, $s$ , in metres, of a particle moving back and forth in a straight line can be modelled by the function $s(t) = 4t^2 - 10t + 13$ where $t$ is measured in seconds.
**a)** Find the average rate of change of the distance with respect to time from 1 s to 4 s.
**b)** Estimate the instantaneous rate of change of the displacement of the particle after 1 s.
**c)** Sketch the curve and the tangent at $t = 1$.
**d)** Interpret the average rate of change and the instantaneous rate of change for this situation.

**5.** The population, $P$, of a small town is modelled by the function $P(t) = -2t^3 + 55t^2 + 15t + 22\ 000$, where $t = 0$ represents the beginning of this year.
**a)** Write an expression for the average rate of change of population from $t = 10$ to $t = 10 + h$.
**b)** Use the expression in part a) to determine the average rate of change of the population when
**i)** $h = 3$ **ii)** $h = 5$
**c)** Use the expression in part a) to estimate the instantaneous rate of change of the population after 10 years.
**d) Use Technology** Graph $P(x)$.
**e)** Using the graph from part d), would it be justified for a large department store to open 10 years from now in this town? Explain.
**f)** If the store was not opened10 years from now, would it be justified instead to open it 30 years from now? Explain.