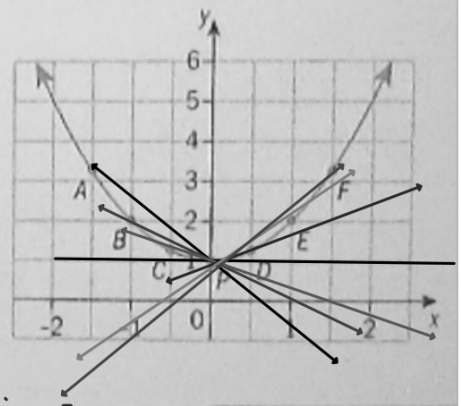
7.2 The tangent line and derivative of x^n

Investigation – secant and tangent lines

Here is the graph of $f(x) = x^2 + 1$



1 Copy the graph to paper and draw lines AP, BP, CP, DP, EP and FP. These lines are called **secant lines** to the graph of $f(x) = x^2 + 1$.

2 Copy and complete the table.

Point	Coordinates	Line	Gradient or slope
P	(0, 1)	—	—
A	(-1.5, 3.25)	AP	-1.5
B	(-1, 2)	BP	-1
C	(-.5, 1.25)	CP	-.5
D	(1.5, 3.25)	DP	.5
E	(1, 2)	EP	1
F	(.5, 1.25)	FP	1.5

secant lines
a line that intersects two points on a curve

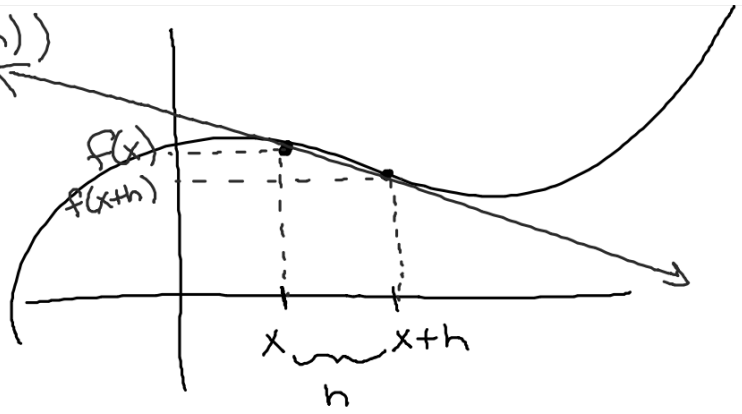
tangent line
a line that touches a curve at one point

Recall that the gra
of a line through t
points (x_1, y_1) and
(x_2, y_2) is $\frac{y_2 - y_1}{x_2 - x_1}$

3 As points on the curve get closer and closer to point P, what value does the gradient of the secant lines seem to be approaching? Approaching a 0 slope

4 Draw the line at point P that has the gradient you found in question 3. This line is called the **tangent line** to the graph of $f(x) = x^2 + 1$ at P

$(x, f(x))$ and $(x+h, f(x+h))$



gradient =

$$\frac{f(x+h)-f(x)}{x+h-x}$$

$$= \frac{f(x+h)-f(x)}{h}$$

difference quotient

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* the definition of the derivative of a function is $\lim_{x \to h} \frac{f(x+h)-f(x)}{h}$