

1. For the following, let  $f(x) = x^2 + 3x + 2$ .

(a) Calculate  $f'(0) = 3$

*Handwritten notes:  $f(x) = x^2 + 3x + 2$   
 $f'(0) = 2x + 3$   
 $f'(0) = 3$*

(b) Write the function  $g(x)$  obtained by translating  $f(x)$  to the left by 2 units.

*Handwritten:  $g(x) = f(x+2)$*

(c) Calculate  $g'(0)$  (hint:  $g(x) = f(x+2)$  so you will want to expand and recollect terms to put the polynomial in the usual nice form). Since translation doesn't change slopes, this should be the same as  $f'(2)$  (to be defined later).

*Handwritten:  $g(x) = f(x+2) = (x+2)^2 + 3(x+2) + 2$   
 $= x^2 + 7x + 12$   
 $f'(x) = 2x + 7$   
 $f'(0) = 7$*

2. Calculate  $f'(0)$  for the following functions:

(a)  $1 + 2x + 3x^2 + 4x^3 + 5x^4 + \dots$   $f'(0) = 2$

*Handwritten:  $f'(0) = 2$   
 $f'(x) = 2 + 6x + 12x^2 + 20x^3 + \dots$   
 $f'(0) = 2$*

(b)  $x + 2x^2 + x^3 + 2x^4 + x^5 + \dots$   $f'(0) = 1$

*Handwritten:  $f'(0) = 1$   
 $f'(x) = 1 + 4x + 3x^2 + 8x^3 + 5x^4 + \dots$   
 $f'(0) = 1$*

(c)  $1 + x^4 + x^8 + \dots$   $f'(0) = 0$

*Handwritten:  $f'(0) = 0$   
 $f'(x) = 4x^3 + 8x^7 + \dots$   
 $f'(0) = 0$*

(d)  $|x^2 + x - 12|$   $f'(0) = -1$

*Handwritten:  $f'(0) = -1$   
 $f'(x) = 2x + 1$   
 $f'(0) = 1$   
 negative near 0  $\rightarrow$   $-x^2 - x + 12$   
 $f'(x) = -2x - 1$   
 $f'(0) = -1$*

(e)  $|x + 4|$   $f'(0) = 1$

*Handwritten:  $f'(0) = 1$   
 $f'(x) = 1$   
 positive near 0  $\rightarrow$   $x + 4$   
 $f'(x) = 1$*

(f)  $|x^2 + x + 3|$   $f'(0) = 1$

*Handwritten:  $f'(0) = 1$   
 $f'(x) = 2x + 1$   
 $f'(0) = 1$   
 positive near 0  $\rightarrow$   $x^2 + x + 3$   
 $f'(x) = 2x + 1$*

3. For each of the following functions, express them in the form

$$f(x) = f(0) + f'(0)x + \text{error}(x)$$

(a)  $(x-1)^2 + 3x + 2 = 3 + x + x^2$

*Handwritten:  $x^2 - 2x + 1$   
 $f(0) = 3$   
 $f'(0) = 1$   
 $\text{error}(x) = x^2$*

(b)  $x^{100} - x^{50} = \text{all error}$

*Handwritten:  $\text{all error}$*

(c)  $x^3 + 4x\sqrt{x} - x + 1 = 1 - x + 4x\sqrt{x} + x^3$

*Handwritten:  $f(0) = 1$   
 $f'(0) = -1$   
 $\text{error}(x) = 4x\sqrt{x} + x^3$*

(d)  $x^4 - 3x$

*Handwritten:  $f(0) = 0$   
 $f'(0) = 0$   
 $\text{error}(x) = x^4 - 3x$*