2) $f(x) = x^4 + 5x^3 + 11x^2 + 15x + 13$

$f(-2) = 3$

$f'(x) = 4x^3 + 15x^2 + 22x + 15$

$f'(-2) = -1$

$f''(x) = 12x^2 + 30x + 22$

$f''(-2) = 10$

$f'''(x) = 24x + 30$

$f'''(-2) = -18$

$f''''(x) = 24$

$$f(x) = f(-2) + \frac{f'(-2)}{1!}\cdot(x+2) + \frac{f''(-2)}{2!}\cdot(x+2)^2 +$$

$$+ \frac{f'''(-2)}{3!}\cdot(x+2)^3 + \frac{f''''(-2)}{4!}\cdot(x+2)^4 =$$

$$= (x+2)^4 - 3\cdot(x+2)^3 + 5\cdot(x+2)^2 - (x+2) + 3$$

3) $f(x) = \frac{1}{2x+3}$

$$\frac{1}{2x+3} = \frac{1}{3}\cdot\frac{1}{1+\frac{2x}{3}} = \frac{1}{3}\cdot\sum_{k=0}^{n}\frac{(-2)^k\cdot x^k}{3^k} + o(x^n) = \frac{1}{3} + \sum_{k=1}^{n}\frac{(-2)^k\cdot x^k}{3^{k+1}} +$$

$$+ o(x^n)$$

4) $$f(x) = \frac{2x+5}{x^2+5x+4} = \frac{1}{x+1} + \frac{1}{x+4} = \sum_{k=0}^{n}(-1)^k x^k + o(x^n) +$$

$$+ \frac{1}{4}\cdot\sum_{k=0}^{n}\frac{(-1)^k x^k}{4^k} + o(x^n) = \sum_{k=1}^{n}(-1)^k x^k + o(x^n) + \frac{5}{4} + \sum_{k=}^{n}\frac{(-1)^k x^k}{4^{k+1}} + o(x^n) =$$

$$= \frac{5}{4} + \sum_{k=1}^{n} \left((-1^k) \cdot x^k \cdot \left(1 + \frac{1}{4^{k+1}}\right)\right) + o(x^n)$$

6) a) $f(x) = \ln(8 - 2x - x^2)$

$f(0) = \ln(8)$

$f'(x) = \dfrac{2 + 2x}{-x^2 - 2x + 8}$

$f'(0) = -\frac{1}{4}$

$f''(x) = \dfrac{2x^2 + 4x + 20}{(-x^2 - 2x + 8)}$

$f''(0) = -\frac{20}{64} = -\frac{5}{16}$

$f'''(x) = \dfrac{4x^3 + 12x^2 + 120x + 112}{(-x^2 - 2x + 8)}$

$f'''(0) = -\frac{112}{512} = -\frac{7}{32}$

$f(x) = \ln 8 - \frac{1}{4}x - \frac{5}{32}x^2 - \frac{7}{192}x^3 + o(x^3)$

b) $f(x) = (2x+1)\sqrt{1-x}$)

$F(0) = 1$

$f'(x) = \dfrac{3 - 6x}{2\sqrt{1-x}}$

$f'(0) = \frac{3}{2}$

$f''(x) = \dfrac{-9 + 6x}{\sqrt{1-x}\,(4 - 4x)}$

$f''(0) = -\frac{9}{4}$

$$f'''(x) = \frac{6x - 15}{8\sqrt{1-x}(1-x)^2}$$

$$f'''(0) = \frac{-15}{8}$$

$$f(x) = 1 + \frac{3}{2}x - \frac{9}{8}x^2 - \frac{5}{16}x^3 + o(x^3)$$