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a. $F(x) = \cos x$

$F(x) = \cos x \rightarrow F(0) = 1$

$F'(x) = -\sin x \rightarrow F'(0) = 0$

$F''(x) = -\cos x \rightarrow F''(0) = -1$

$F'''(x) = \sin x \rightarrow F'''(0) = 0$

$F^{IV}(x) = \cos x \rightarrow F^{IV}(0) = 1$

$F(x) = \cos x$

$= 1 + 0 - \frac{x^2}{2!} + 0 + \frac{x^4}{4!}$

$= -\frac{x^2}{2!} + \frac{x^4}{4!}$

$= \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{(2n)!}$

b. $F(x) = \ln(3+2x)$

$F(x) = \ln(3+2x) \rightarrow F(0) = \ln(3)$

$F'(x) = \frac{2}{3+2x} \rightarrow F'(0) = \frac{2}{3}$

$F''(x) = \frac{-4}{(3+2x)^2} \rightarrow F''(0) = -\frac{4}{9}$

$F'''(x) = \frac{16}{(3+2x)^3} \rightarrow F'''(0) = \frac{16}{27}$

$F^{IV}(x) = \frac{-96}{(3+2x)^4} \rightarrow F^{IV}(0) = \frac{-96}{81}$

$F(x) = \ln(3+2x)$

$= \ln 3 + \frac{2x}{3} - \frac{4x^2}{9 \cdot 2!} + \frac{16x^3}{27 \cdot 3!} - \frac{96 \cdot x^4}{81 \cdot 4!}$

...

c. $F(x) = \frac{1}{x+1}$

$F(x) = \frac{1}{x+1} \rightarrow F(0) = 1$

$F'(x) = \frac{-1}{(x+1)^2} \rightarrow F'(0) = -1$

$F''(x) = \frac{2}{(x+1)^3} \rightarrow F''(0) = 2$

$F'''(x) = \frac{-6}{(x+1)^4} \rightarrow F'''(0) = -6$

$F^{IV}(x) = \frac{24}{(x+1)^5} \rightarrow F^{IV}(0) = 24$

$F(x) = \frac{1}{x+1}$

$= 1 - \frac{x}{1!} + \frac{2x^2}{2!} - \frac{6x^3}{3!} + \frac{24x^4}{4!}$

$= \sum_{n=0}^{\infty} (-1)^n (x)^n$

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2.

a. $F(x) = e^x$, $a = 2$

$F(x) = e^x \rightarrow F(2) = e^2$

$F'(x) = e^x \rightarrow F'(2) = e^2$

$F''(x) = e^x \rightarrow F''(2) = e^2$

$F'''(x) = e^x \rightarrow F'''(2) = e^2$

$F^{IV}(x) = e^x \rightarrow F^{IV}(2) = e^2$

$$F(x) = e^2 + \frac{e^2(x-2)}{1!} + \frac{e^2(x-2)^2}{2!} + \frac{e^2(x-2)^3}{3!} + \frac{e^2(x-2)^4}{4!}$$

$$= \frac{e^2(x-2)}{1} + \frac{e^2(x-2)^2}{2} + \frac{e^2(x-2)^3}{6} + \frac{e^2(x-2)^4}{24} + \ldots$$

$$= \sum_{n=0}^{\infty} \frac{e^2(x-2)^n}{(n)!}$$

b. $F(x) = \frac{1}{x+5}$, $a = 1$

$F(x) = \frac{1}{x+5} \rightarrow F(1) = \frac{1}{6}$

$F'(x) = \frac{-1}{(x+5)^2} \rightarrow F'(1) = -\frac{1}{36}$

$F''(x) = \frac{1}{(x+5)^3} \rightarrow F''(1) = \frac{1}{216}$

$F'''(x) = \frac{-1}{(x+5)^4} \rightarrow F'''(1) = \frac{-1}{1296}$

$F^{IV}(x) = \frac{1}{(x+5)^5} \rightarrow F^{IV}(1) = \frac{1}{7776}$

$$F(x) = \frac{1}{6} - \frac{1}{36}\frac{(x-1)}{1!} + \frac{2(x-1)^3}{216 \cdot 3!} - \frac{6(x-1)^3}{1296 \cdot 3!} + \frac{24(x-1)^4}{7776 \cdot 4!}$$

$$= \sum_{n=0}^{\infty} (-1)^n \frac{(x-1)^n \cdot 1}{(6)^{n+1}}$$

$$= \sum_{n=0}^{\infty} (-1)^n \frac{(x-1)^n}{(6)^{n+1}}$$

c. $F(x) = \frac{1}{x}$, $a = 3$

$F(x) = \frac{1}{x} \rightarrow F(3) = \frac{1}{3}$

$F'(x) = \frac{-1}{(x)^2} \rightarrow F'(3) = -\frac{1}{9}$

$F''(x) = \frac{1}{(x)^3} \rightarrow F''(3) = \frac{2}{27}$

$F'''(x) = \frac{1}{(x)^4} \rightarrow F'''(3) = \frac{-6}{81}$

$F^{IV}(x) = \frac{1}{(x)^5} \rightarrow F^{IV}(3) = \frac{24}{243}$

$$F(x) = \frac{1}{3} - \frac{1}{9}\frac{(x-3)}{1!} + \frac{2(x-3)^2}{27 \cdot 2!} - \frac{6(x-3)^3}{81 \cdot 3!} + \frac{24(x-3)^4}{243 \cdot 4!} \ldots$$

$$= \sum_{n=0}^{\infty} (-1)^n \frac{(x-3)^n}{(3)^{n+1}}$$