1. Expand in Taylor Series about $x=0$ up to quadratic terms

a) $e^x \simeq e^0 + \frac{x-0}{1!} e^0 + \frac{(x-0)^2}{2!} e^0$

$e^x \simeq 1 + x + \frac{1}{2}x^2$

b) $xe^{-x^2} \simeq 0 + \frac{x}{1!} e^0(1-0) + \frac{x^2}{2!}(0)$

$xe^{-x^2} \simeq x$

c) $\cos x \simeq \cos 0 + x(-\sin 0) + \frac{x^2}{2}(-\cos 0)$

$\cos x \simeq 1 - \frac{x^2}{2}$

d) $\ln(1+x) \simeq \ln(1) + \frac{x}{1}\left(\frac{1}{1+0}\right) + \frac{x^2}{2} \frac{-1}{(1+0)^2}$

$\ln(1+x) \simeq x - \frac{1}{2}x^2$

e) $\sqrt{1+x^2} \simeq \sqrt{1} + \frac{x}{1} \frac{0}{\sqrt{1+0}} + \frac{x^2}{2}\left(\frac{1}{\sqrt{1+0}} + \frac{0}{(1+0)^{3/2}}\right)$

$\sqrt{1+x^2} \simeq 1 + \frac{1}{2}x^2$

f) $x^4 - x^2$: this is already in series form, but expanding to quadratic order:

$x^4 - x^2 \simeq (0^4 - 0^2) + \frac{x}{1}(4\cdot 0^3 - 2\cdot 0) + \frac{x^2}{2}(12(0)^2 - 2)$

$x^4 - x^2 \simeq -x^2$