2. **Motion in 1-D (30 Points)** A particle of mass $m = 4$ kg moving in one dimension is subject to the force

$$F(x) = \frac{a}{2}x^3 - 2bx$$

where the constants a and b have magnitude $+1$, but have units of $\mathrm{nt/m^3}$ and $\mathrm{nt/m}$ to keep the equation's dimensions correct.

(A) **(15 Points)** Find the potential $U(x)$ which corresponds to this force. Sketch U vs. x and show all of the types of equilibrium points for both positive and negative x. Find numerical values for x at the equilibrium points.

(B) **(5 Points)** Find the frequency of small oscillation at all stable equilibrium points.

(C) **(10 Points)** Sketch a phase diagram (a plot of p_x vs. x) for this system. You don't need to make the diagram "numerically" correct in terms of numerical values of p_x, but it should show the right shape for the trajectory curves around any of the equilibrium points in x. Put arrows on your phase diagram trajectory lines to show which way (in phase space) the particle is moving.