3. A small particle of mass m moves in such a way that the potential energy $U = ur^2$, where a is a constant and r is the distance of the particle from the origin. Assuming Bohr's model of quantization of angular momentum and circular orbits, find the radius of nth allowed orbit.

The force at a distance r is $f = -dU/dr = -2ur$.

Suppose r be the radius of nth orbit. Then, the necessary centripetal force is provided by the above force. Thus,

$$\frac{mv^2}{r} = 2ur \tag{i}$$

Further, the quantization of angular momentum gives

$$mvr = \frac{nh}{2\pi} \tag{ii}$$

Solving Eqs. (i) and (ii) for r, we get

$$r = \left(\frac{n^2 h^2}{8um\pi^2} \right)^{1/4} \tag{iii}$$