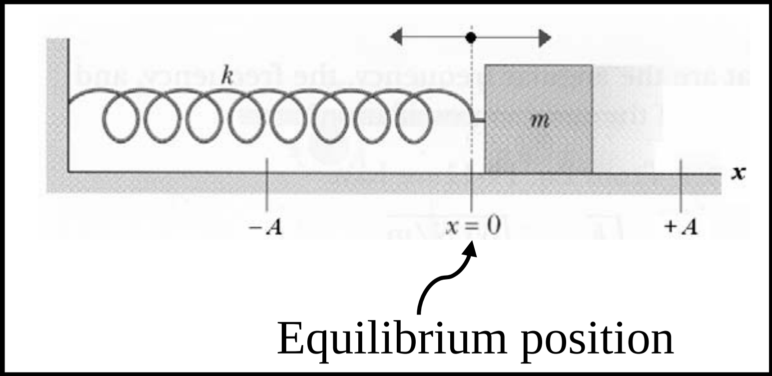
- **Mass on a spring** (a specific case for SHM)



$$\omega = \sqrt{k/m}$$ (Angular frequency)

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k}}$$

$$f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

Note that *T* and *f* do not depend on the amplitude *A*. *T* and *f* depend only on the inertia of the object (represented by *m*) and the stiffness of the spring (represented by *k*).

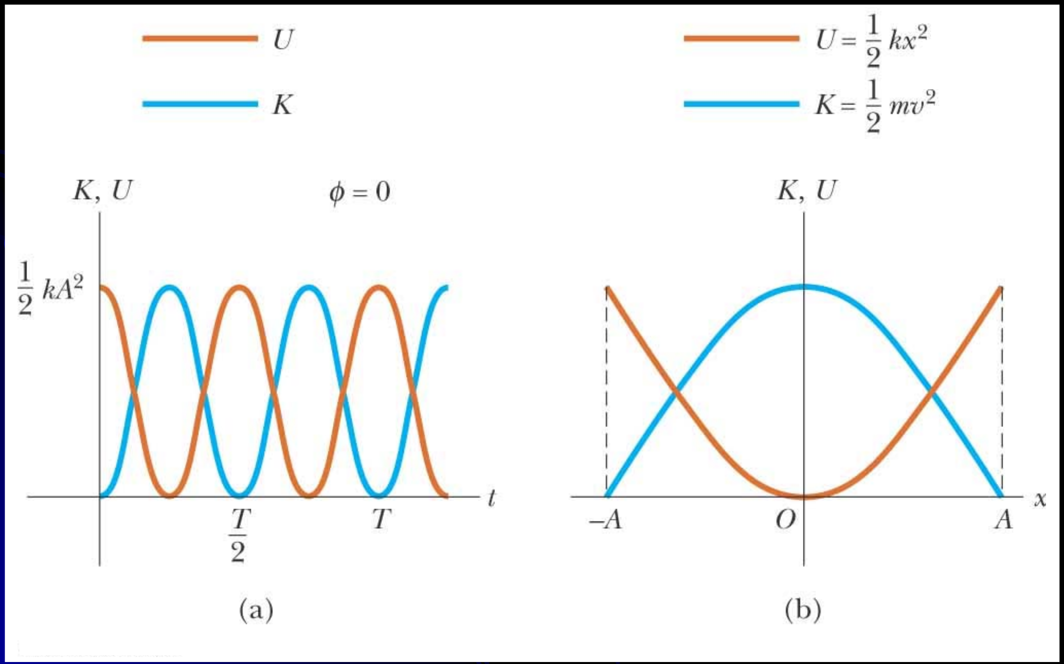
15.3. Energy of the simple harmonic oscillator

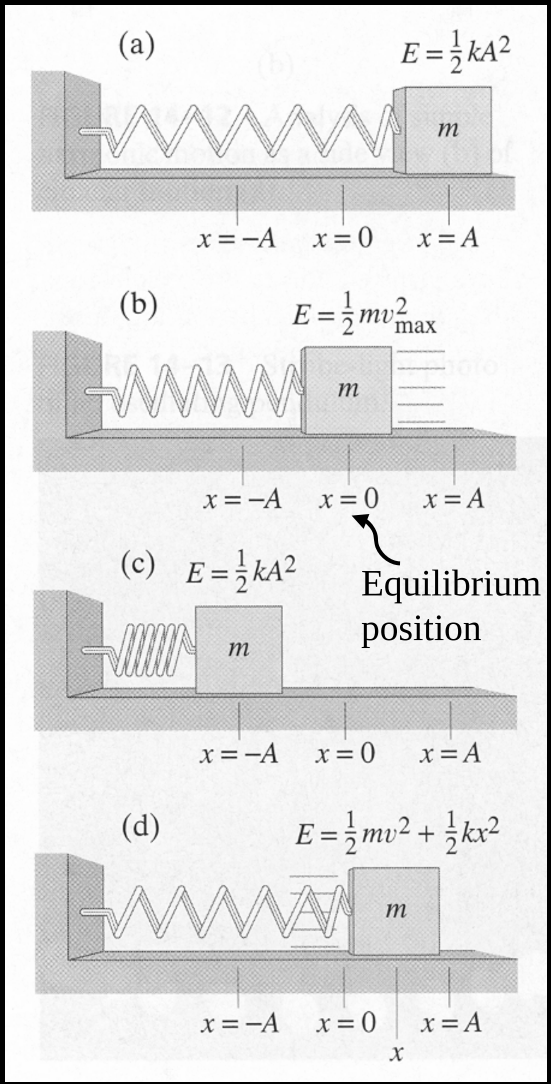
The total mechanical energy is the sum of the kinetic and potential energies,

$$E = K + U = \tfrac{1}{2} mv^2 + \tfrac{1}{2} kx^2 ,$$

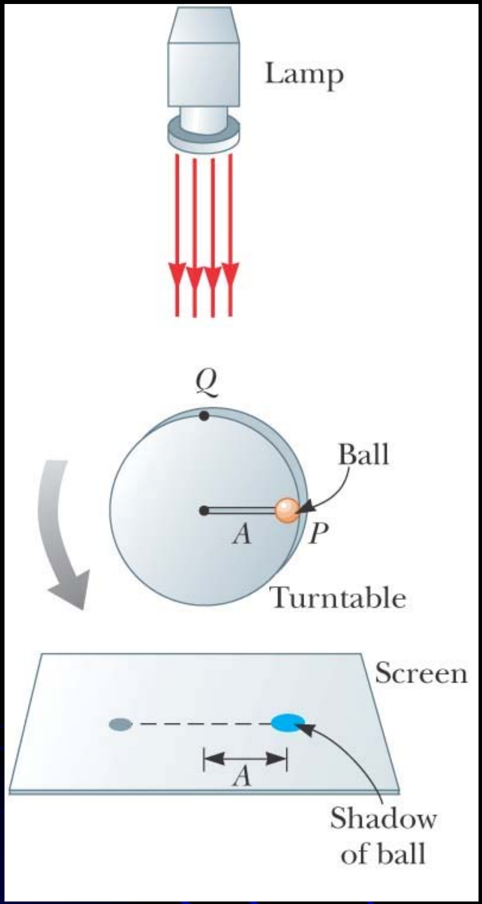
where v is the velocity of the mass m when it is a distance x from the equilibrium position.

- **Conservation of energy**

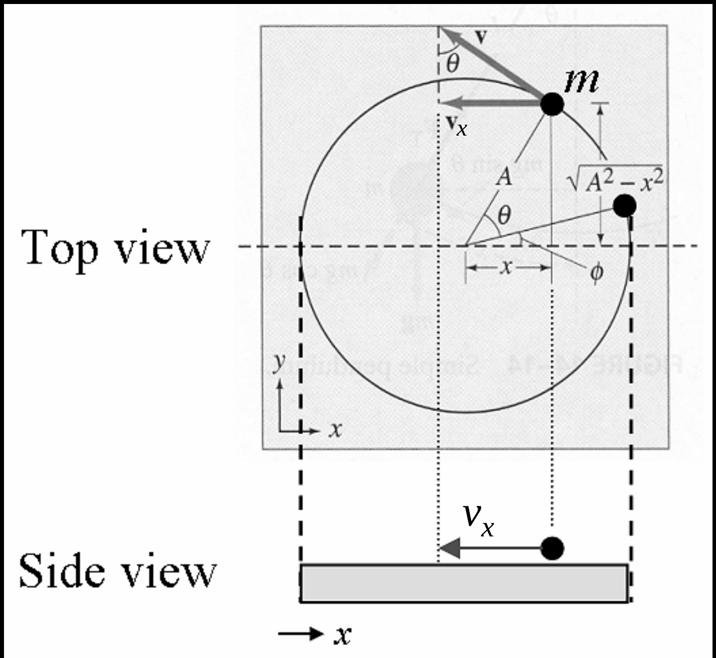




15.4. SHM related to uniform circular motion

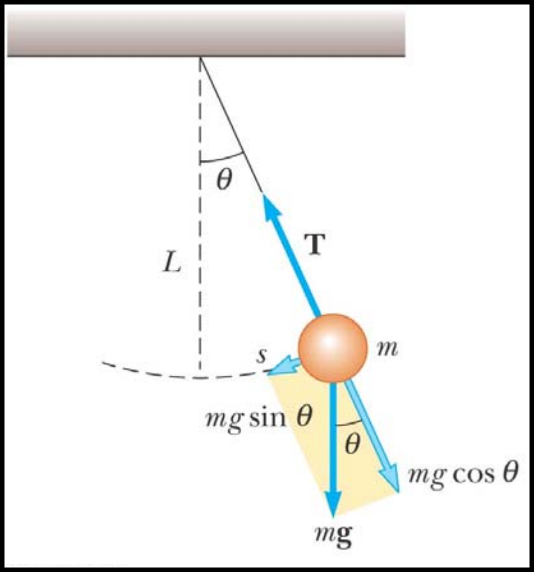


An experimental setup for demonstrating the connection between simple harmonic motion and uniform circular motion. As the ball rotates on the turntable with constant angular speed, its shadow on the screen moves back and forth in simple harmonic motion.



→ SHM is the projection of uniform circular motion on a diameter of the circle in which the circular motion occurs.

15.5. The Simple Pendulum



A simple pendulum is one which can be considered to be a point mass suspended from a string or rod of negligible mass.

$$\omega = \sqrt{\frac{g}{L}}$$

$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$

$$T = \frac{1}{f} = 2\pi\sqrt{\frac{L}{g}}$$

***T* and *f* of a simple pendulum depend only on the length *L* of the string and the acceleration due to gravity. They are independent of the mass *m*.**