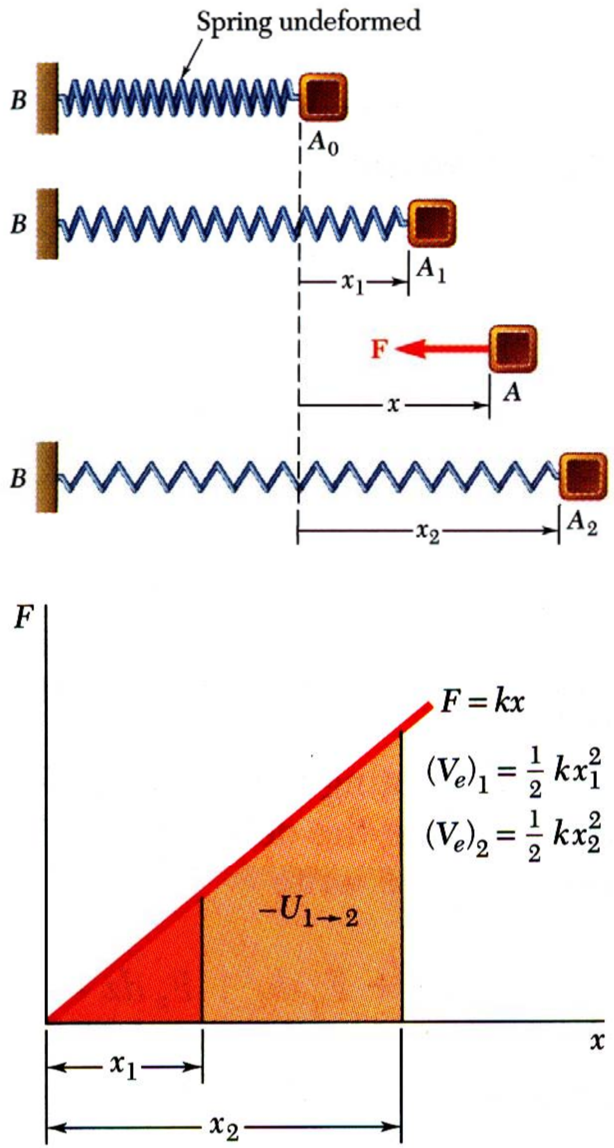
Kinetics of Particles: Energy and Momentum Methods

Preview of 13.5- 13.9

Read p.844 and 845 and summarize below. (At least 10 lines)
(Power and mechanical efficiency ~ motion under a gravitational force)

13.6 Potential Energy



- Work of the force exerted by a spring depends only on the initial and final deflections of the spring,

$$U_{1\rightarrow 2} =$$

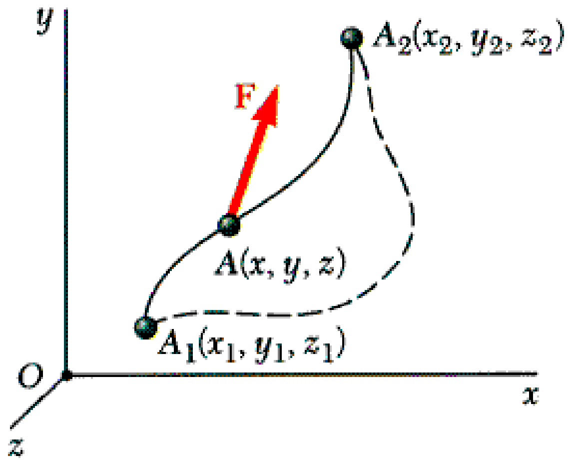
- The potential energy of the body with respect to the elastic force,

$$V_e =$$

$$U_{1\rightarrow 2} =$$

- Note that the preceding expression for V_e is valid only if the deflection of the spring is measured from its **undeformed position**.

13.7 Conservative Forces

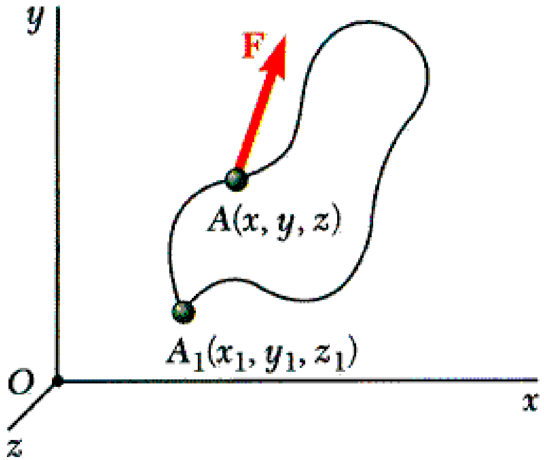


- Concept of potential energy can be applied if the work of the force is independent of the path followed by its point of application.

  $U_{1\to 2} =$

  Such forces are described as *conservative forces*.

- For any conservative force applied on a closed path,



- Elementary work corresponding to displacement between two neighboring points,

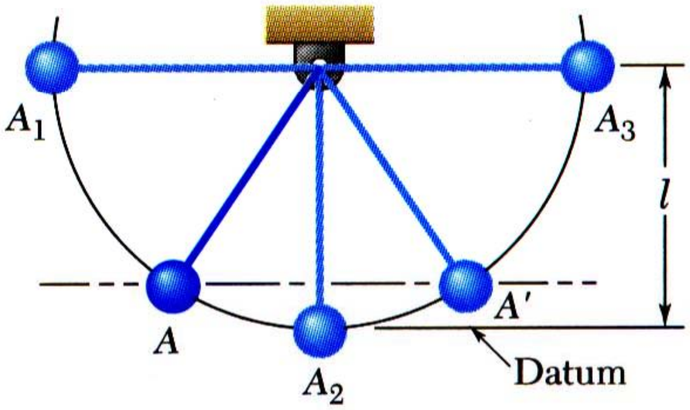
  $dU =$

  $=$

  $F_x dx + F_y dy + F_z dz =$

  $\vec{F} =$

13.8 Conservation of Energy



- Work of a conservative force,

$$U_{1\to 2} = V_1 - V_2$$

- Concept of work and energy,

$$U_{1\to 2} =$$

- Follows that

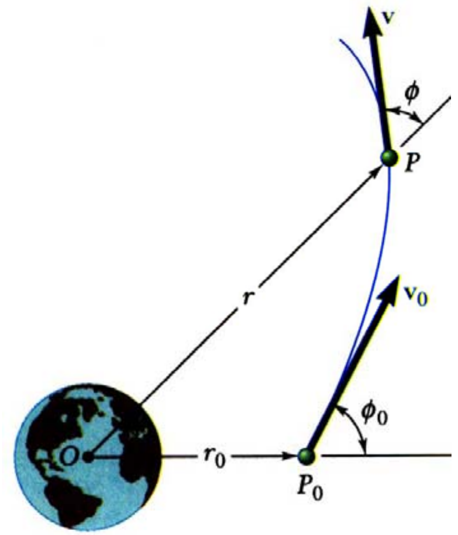
$$E =$$

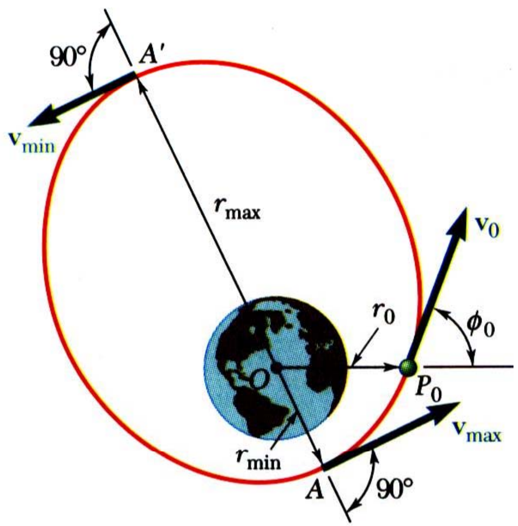
- When a particle moves under the action of **conservative forces**, the total mechanical energy is constant.

- **Friction forces** are not conservative. Total mechanical energy of a system involving friction decreases.

- Mechanical energy is dissipated by friction into energy. Total energy is constant.

13.9 Motion Under a Conservative Central Force





- When a particle moves under a conservative central force, both the principle of

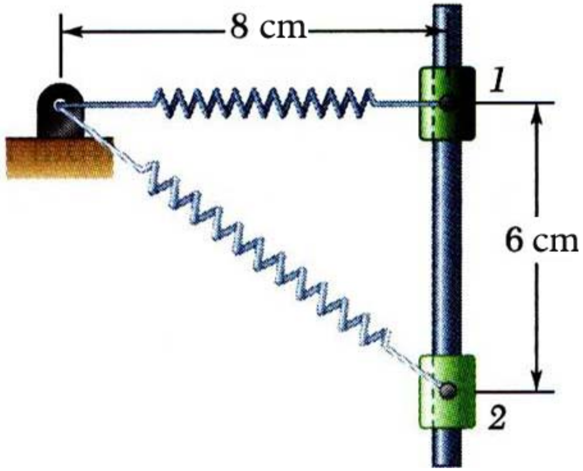
  and the principle of

  may be applied.

- Given r, the equations may be solved for v and φ.

- At minimum and maximum r, $\varphi = 90^o$. Given the launch conditions, the equations may be solved for r_{min}, r_{max}, v_{min}, and v_{max}.

Sample Problem 13.6

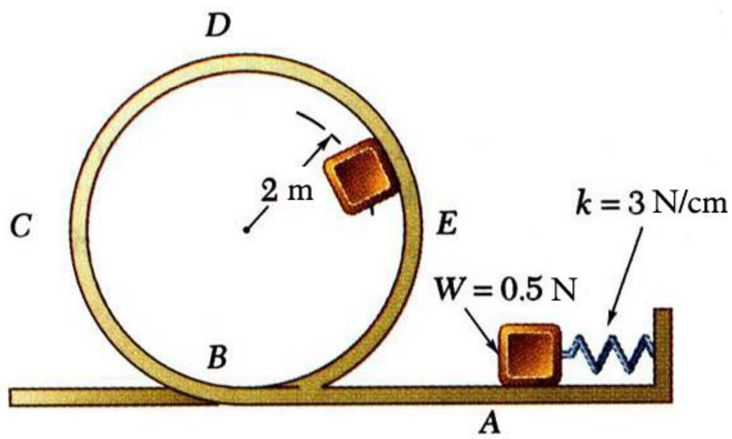


A 20 N collar slides without friction along a vertical rod as shown. The spring attached to the collar has an undeflected length of 4 cm and a constant of 3 N/cm.

If the collar is released from rest at position 1, determine its velocity after it has moved 6 cm. to position 2.

Sample Problem 13.6

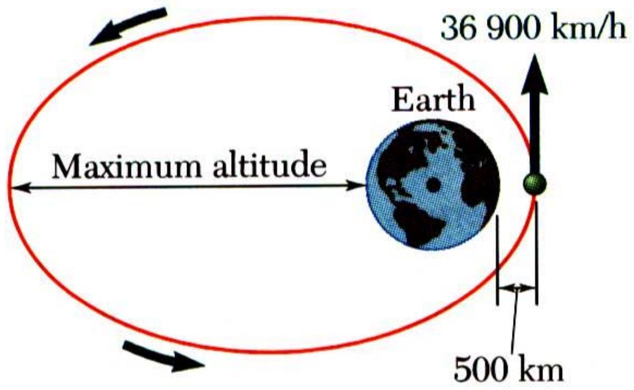
Sample Problem 13.7



The 0.5 N pellet is pushed against the spring and released from rest at *A*. Neglecting friction, determine the smallest deflection of the spring for which the pellet will travel around the loop and remain in contact with the loop at all times.

Sample Problem 13.7

Sample Problem 13.9



A satellite is launched in a direction parallel to the surface of the earth with a velocity of 36900 km/h from an altitude of 500 km.

Determine *(a)* the maximum altitude reached by the satellite, and *(b)* the maximum allowable error in the direction of launching if the satellite is to come no closer than 200 km to the surface of the earth

Sample Problem 13.9