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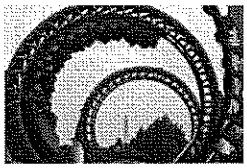


S10 Unit B: Physics: Conservation of Energy

Name: _____

Date: _____

Recall the Energy Eqns:

$E_p = mgh$

$E_k = \frac{1}{2}mv^2$

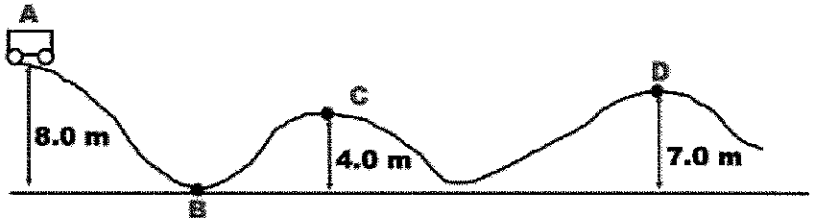
The Conservation of Energy States:

Energy cannot be created or destroyed, only changed in form.

or

The total energy a system is always the same.

ex) A roller coaster (m = 100 kg) starts from rest at point **A**, as shown below.



a) Determine the energy of the roller coaster at point **A**.

$E_p = mgh$
E_p = (100 kg)(9.81 m/s^2)(8.0 m)
E_p = 7848 J
E_p = 7.8 x 10^3 J

At point **A** all of the energy is potential energy as the coaster isn't moving. So we just find the gravitational potential energy.

b) Determine the speed of the roller coaster at point **B**.

$E_k = \frac{1}{2}mv^2$
7.8 x 10^3 J = $\frac{1}{2}$(100 kg)v^2
7.8 x 10^3 J = 50 v^2

156 = v^2

v = 12 m/s

At point **B** all of the energy is kinetic energy, but the total energy stays the same as at point **A** by the conservation of energy. So, the energy is the same as the last part of the question and we just solve for speed.

c) Find the speed at point **C**.

7.8 x 10^3 J = $E_p + E_k$
7.8 x 10^3 J = (100 kg)(9.81 m/s^2)(4.0 m) + $\frac{1}{2}$(100 kg)v^2
7.8 x 10^3 J = 3924 J + 50v^2
3876 J = 50v^2
v = 8.8 m/s

At point **C** the total energy is still equal to 7.8 x 10^3 J (left side of equation), but it is now made up of potential and kinetic energy (right side of equation). So the total energy is equal to the sum of E_p and E_k.

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Conservation of Energy Practice Questions

Show all work to receive full marks.

1. Using the diagram on the previous page, determine the speed of the roller coaster at point **D**. **(2 marks)**

$7.8\times10^3\,J = E_p + E_K$

$7.8\times10^3\,J = mgh + \frac{1}{2}m\vec{v}^2$

$7.8\times10^3\,J = (100kg)(9.81m/s^2)(7m) + \frac{1}{2}(100kg)\vec{v}^2$

$7.8\times10^3 = 6867 + 50\vec{v}^2$

$-6867 \quad -6867$

$933 = 50\vec{v}^2$

$\sqrt{\vec{v}^2} = \sqrt{18.66}$ $\quad \vec{v} = 4.3\,m/s$

2. A baseball is thrown vertically upwards with a speed of 15.0 m/s. How high will the baseball go before it stops? **(2 marks)**

$E_K = E_p$

$\frac{1}{2}m\vec{v}^2 = mgh$

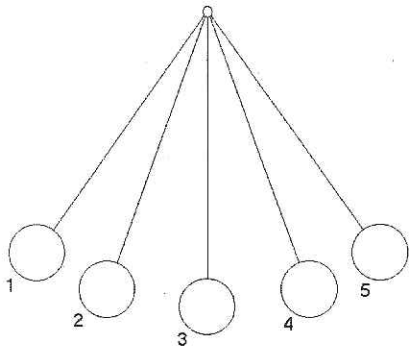
$\frac{1}{2}\vec{v}^2 = gh$

$\frac{1}{2}(15m/s)^2 = (9.81m/s^2)h$

$\frac{112.5}{9.81} = \frac{9.81h}{9.81}$

$h = 11.5m$

3. Describe the energy changes the pendulum to the right goes through as it starts at position 1, moves to position 3 and stops at position 5. **(3 marks)**



① $E_p \rightarrow E_K$

② $E_K \rightarrow E_p$

③ $E_p \rightarrow E_K$

4. Tarzan is running at a speed of 3.5 m/s and grabs a long vine that is hanging vertically from a tree. How high can the ape-man swing? **(2 marks)**

$E_K = E_p$

$\frac{1}{2}m\vec{v}^2 = mgh$

$\frac{1}{2}(3.5m/s)^2 = (9.81m/s^2)h$

$h = 0.62m$