Name - _____

Kinetic and Potential Energy

Determine whether the objects in the following problems have kinetic or potential energy. Then choose the correct formula to use:

$$\boldsymbol{KE} = \frac{1}{2}\, mv^2$$

$$\boldsymbol{PE} = mass \times gravitational\ acceleration\ (-9.81\frac{m}{s^2}) \times height \quad \textbf{OR} \quad \boldsymbol{PE} = Weight \times Height$$

$$Energy = J \qquad Weight = N \qquad Mass = kg \qquad Velocity = \frac{m}{s}$$

$$Gravitational\ acceleration = (-9.81\frac{m}{s^2})$$

1.) You serve a volleyball with a mass of $2.1\ kg$. The ball leaves your hand with a speed of $30.\frac{m}{s}$. The ball has ___kinetic___ energy. Calculate it.

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = \frac{1}{2}(2.1)(+30)^2$ $E_k = 945\ J$

2.) A baby carriage is sitting at the top of a hill that is $21\ m$ high. The carriage with the baby weighs $12\ N$. The carriage has ___Potential___ energy. Calculate it.

Answer - $E_p = mgh$ $E_p = (\frac{12}{9.81})(-9.81)(21)$ $E_p = 252\ J$

3.) A car is traveling with a velocity of $40.\frac{m}{s}$ and has a mass of $1120\ kg$. The car has ___kinetic___ energy. Calculate it.

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = \frac{1}{2}(1120)(+40)^2$ $E_k = 896\,000\ J$

4.) A cinder block is sitting on a platform $20.\ m$ high. It weighs $79\ N$. The block has ___Potential___ energy. Calculate it.

Answer - $E_p = mgh$ $E_p = (\frac{79}{9.81})(-9.81)(20)$ $E_p = 1\,580\ J$

5.) There is a bell at the top of a tower that is $45\ m$ high. The bell weighs $190\ N$. The bell has ___Potential___ energy. Calculate it.

Answer - $E_p = mgh$ $E_p = (\frac{190}{9.81})(-9.81)(45)$ $E_p = 8\,550\ J$

6.) A roller coaster is at the top of a $72\ m$ hill and weighs $966\ N$. The coaster (at this moment) has___Potential___ energy. Calculate it.

Answer - $E_p = mgh$ $E_p = (\frac{966}{9.81})(-9.81)(72)$ $E_p = 69\,552\ J$

7.) What is the kinetic energy of a $3.0\ kg$ ball that is rolling at $2.0\frac{m}{s}$?

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = \frac{1}{2}(3.0)(+2.0)^2$ $E_k = 6.0\ J$

8.) Two objects were lifted by a machine. One object had a mass of $2.0\ kg$, and was lifted at a speed of $+2.0\frac{m}{s}$. The other had a mass of $4.0\ kg$ and was lifted at a speed of $+3.0\frac{m}{s}$.

a. Which object had more kinetic energy while it was being lifted?

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = \frac{1}{2}(2.0)(2.0)^2$ $E_k = 4.0\ J$

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = \frac{1}{2}(4.0)(3.0)^2$ $E_k = 18\ J$ <-- More

b. Which object had more potential energy when it was lifted to a distance of $10.\ m$? Show your calculation.

Answer - $E_p = mgh$ $E_p = (2.0)(-9.81)(10.)$ $E_p = 192.20\ J$

$E_p = mgh$ $E_p = (4.0)(-9.81)(10.)$ $E_p = 392.40\ J$

9.) A $3.0\ kg$ briefcase is dropped. If this briefcase reaches the floor at a speed of $3.2\frac{m}{s}$, from what height was it dropped?

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = \frac{1}{2}(3.0)(3.2)^2$ $E_k = 30.72\ J$

$E_k = E_p{}'$ $30.72 = (3.0)(-9.81)h$ $h = 1.04\ m$

10.) A water balloon $(0.250\ kg)$ was dropped from the edge of a $8.0\ m$ cliff. How fast was is moving as it hit the ground?

Answer - $E_p = mgh$ $E_p = (0.250)(-9.81)(8.0)$ $E_p = 19.63\ J$

$E_p = E_k{}'$ $19.62 = (0.5)(0.250)v^2$ $v = 12.53\frac{m}{s}$