Calculating Energy Practice

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

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = (0.5)(2.1)(30)^2$ $E_k = 945\ J$

2.) A baby carriage is sitting at the top of a hill that is $21\ m$ high. The carriage with the baby has a mass of $1.2\ kg$. Calculate the energy of the carriage.

Answer - $E_p = mgh$ $E_p = (1.2)(9.81)(21)$ $E_p = 247.21\ J$

3.) A cinder block is sitting on a platform $20.\ m$ high. It weighs $79\ N$. Calculate the energy of the block.

Answer - $E_p = mgh$ $E_p = (8.053)(9.81)(20)$ $E_p = 1580\ J$

$mass = \frac{weight}{gravity}$ $m = \frac{79}{9.81}$ $m = 8.053\ kg$

4.) The potential energy of an apple is $6.0\ J$. The apple is $3.0\ m$ high. What is the mass of the apple?

Answer - Use algebra to rearrange the variables to solve for m.

$E_p = mgh$ $6.0 = (m)(9.81)(3.0)$ $m = 0.20\ kg$

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

Answer - $E_p = mgh$ $E_p = (19.3679)(9.81)(45)$ $E_p = 8550\ J$

$mass = \frac{weight}{gravity}$ $m = \frac{190}{9.81}$ $m = 19.3679\ kg$

6.) A roller coaster is at the top of a $72\ m$ hill and weighs $966\ N$. Calculate the energy of the roller coaster.

Answer - $E_p = mgh$ $E_p = (98.4709)(9.81)(72)$ $E_p = 69552\ J$

$mass = \frac{weight}{gravity}$ $m = \frac{966}{9.81}$ $m = 98.4709\ kg$

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

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = (0.5)(3.0)(2.0)^2$ $E_k = 6.0\ J$

8.) Two objects were lifted by a machine. One object had a mass of $4\ kg$, and was lifted at a speed of $2\frac{m}{s}$. The other had a mass of $2\ kg$ and was lifted at a rate of $3\frac{m}{s}$.

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

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = (0.5)(4)(2)^2$ $E_k = 8\ J$

$E_k = \frac{1}{2}mv^2$ $E_k = (0.5)(2)(3)^2$ $E_k = 9\ J$ ← More E_k

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

Answer - $E_p = mgh$ $E_p = (4)(9.81)(10)$ $E_p = 392.4\ J$ ← More E_p

$E_p = mgh$ $E_p = (2)(9.81)(10)$ $E_p = 196.2\ J$

9.) You are on roller blades on top of a small hill. Your potential energy is equal to $1\,000.0\,J$. The last time you checked your mass was $60.0\,kg$.

a. What is your weight in newtons?

Answer - $weight = mass \times gravity$ $weight = (60.0)(9.81)$ $weight = 588.6\,N$

b. If you start skating down this hill, your potential energy will be converted to kinetic energy. At the bottom of the hill, your kinetic energy will be equal to your potential energy at the top. What will be your speed at the bottom of the hill?

Answer - $E_p\ at\ the\ top = E_k\ at\ the\ bottom$

Use algebra to isolate the v $E_k = \frac{1}{2}mv^2$ $1\,000.0 = (0.5)(60)(v)^2$ $v = 5{,}77\frac{m}{s}$

10.) What is the potential energy of a $3\,kg$ ball that is on the ground?

Answer – zero energy. No height above the ground means no potential energy.

11a.) What is the kinetic energy of a $1\,kg$ ball is thrown into the air with an initial velocity of $30.\frac{m}{s}$?

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = (0.5)(1)(30)^2$ $E_k = 450\,J$

b. How high into the air did the ball travel? Remember $KE = PE$

Answer - $E_p\ at\ the\ top = E_k\ at\ the\ bottom$

Use algebra to isolate the h $E_p = mgh$ $450 = (1)(9.81)(h)$ $h = 45.87\,m$

12.) What is the kinetic energy of a $2\,000.kg$ boat moving at $5.0\frac{m}{s}$?

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = (0.5)(2000.)(5.0)^2$ $E_k = 25\,000\,J$

13.) What is the velocity of a $500.kg$ elevator that has $4\,000\,J$ of energy?

Answer - Use algebra to isolate the v $E_k = \frac{1}{2}mv^2$ $4\,000.0 = (0.5)(500.)(v)^2$ $v = 4.0\frac{m}{s}$

14.) What is the mass of an object that creates $33\,750\,J$ of energy by traveling at $30.\frac{m}{s}$?

Answer - Use algebra to isolate the m $E_k = \frac{1}{2}mv^2$ $33\,750 = (0.5)(m)(30.)^2$ $v = 75\frac{m}{s}$

15.) In a lab investigation, one group of students (group A) measures the speed of a $0.10\ kg$ car at $2.5\frac{m}{s}$ at the bottom of a hill. Another group of students (group B) measures the speed of the car at $3.0\frac{m}{s}$ at the bottom of the hill. The car's starting position at the top of the hill is $1.0\ m$ high.

a.) What is the potential energy of the car at the beginning of the experiment before its speed is measured?

Answer - $E_p = mgh$ $E_p = (0.10)(9.81)(1)$ $E_p = 0.981\ J$

b.) Calculate the kinetic energy of the car for group A using the speed ($2.5\frac{m}{s}$) and mass values above.

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = (0.5)(0.10)(2.5)^2$ $E_k = 0.313\ J$

c.) Calculate the kinetic energy of the car for group B using the speed ($3.0\frac{m}{s}$) and mass values above.

Answer - $E_k = \frac{1}{2}mv^2$ $E_k = (0.5)(0.10)(3.0)^2$ $E_k = 0.450\ J$