Name Key Hour _____

Energy Notes

Energy: Ability to do work

I) Kinetic Energy (KE)- Energy of motion **Units:** Joule (J)

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

m = mass measured in kg

v = velocity measured in m/s

The units of KE:

$kg \cdot \left(\frac{m}{s}\right)^2 = kg \cdot \frac{m^2}{s^2} = N \cdot m = J$

$1N = 1\,kg \cdot \frac{m}{s^2}$

Example Problem for Kinetic Energy

Cartman (mass 46 kg) is trying to escape his mother who wants him to eat his broccoli. He is running as fast as his short, stubby legs can carry him! If he is traveling at 8 m/s, what is his kinetic energy for those few seconds that he can keep up that speed?

Given: $m = 46\,kg$, $v = 8\,m/s$

Unknown: KE

Equation.: $\frac{1}{2}mv^2$

$\frac{1}{2}(46)(8)^2$

$1472\,J$

II) Gravitational Potential Energy (PE) - Stored energy due to position **Units:** Joule (J)

$PE = m \cdot g \cdot h$

m = mass measured in kg

g = gravity measured in m/s^2

h = height measured in m

The units of PE:

$kg \cdot \frac{m}{s^2} \cdot m = kg \cdot \frac{m^2}{s^2} = N \cdot m = J$

Answer should be positive

- make 9.8 positive
- or make answer positive
- or put height in negative

Example Problem for Potential Energy:

Cartman (mass 46 kg) is now resting on a ledge that is 1.5 meters above the ground. Calculate his potential energy?

Given: $m = 46\,kg$, $h = 1.5\,m$, $g = 9.8\,m/s^2$

Unknown: PE

Equation.: mgh

$46\,kg(9.8\,m/s^2)(1.5\,m)$

$= 676.2\,J$

make answer positive

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III) The Conservation of Energy- means that energy is not lost

It is just converted from 1 form to another.

(initial) total starting energy = (final) total ending energy

Equation: $PE_i + KE_i = PE_f + KE_f$

Or:

$mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$ cancel m out!

$gh_i + \frac{1}{2}v_i^2 = gh_f + \frac{1}{2}v_f^2$

Example Problems for the Conservation of Energy:

1. **You swing a pendulum starting from rest. If it has a velocity of 1.9 m/s at the bottom of its swing from what height was it originally swung?** *The height is defined as zero when it hangs straight down.*

Given: $v_i=0$, $h_f=0$

$h_f=0$
$v_f=1.9\frac{m}{s}$

Unknown: h_i

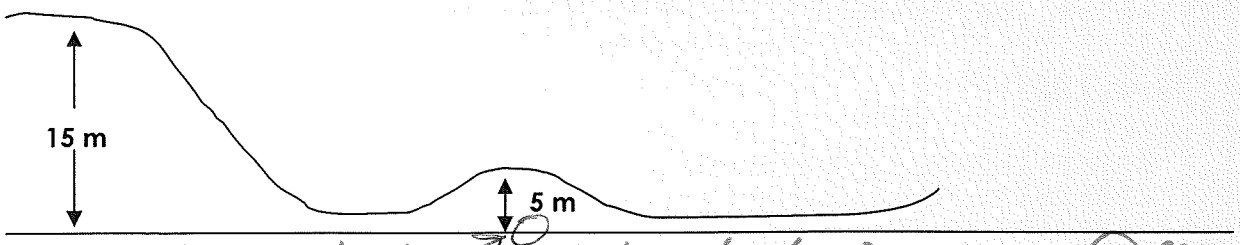
Equation: ~~$mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$~~ (0, 0)

so: $gh_i = \frac{1}{2}v_f^2$

$(9.8)h_i = \frac{1}{2}(1.9\frac{m}{s})^2$

$h_i = 0.18m$

2. **Adam (m=65 kg) went sledding. Find his speed at the top of the second hill.**



$h_i=15$
$h_f=5$
$v_i=0$
$v_f=X$

~~$mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$~~

so: $gh_i = gh_f + \frac{1}{2}v_f^2$

$(9.8)(15) = (9.8)(5) + \frac{1}{2}v_f^2$

(1) subtract: $147 - 49 = 49 - 49 + \frac{1}{2}v_f^2$

$98\frac{m^2}{s^2} = \frac{1}{2}v_f^2$

(2) divide by $\frac{1}{2}$

(3) square root: $\sqrt{196} = \sqrt{v_f^2}$

$v_f = 14\frac{m}{s}$