KINETIC AND POTENTIAL ENERGY PROBLEMS:

KE = ½ mv^2 GPE =mgh EPE = ½ kx^2 k=F/x

Section 5-2

Pg. 173

#2

Two bullets have the mass of 3 g and 6 g, respectively. Both are fired with a speed of 40 m/s. Which bullet has more kinetic energy? What is the ratio of their kinetic energies?

1) KE = ½ mv^2 so bullet two has more KE…. KE_1 = ½ (.003)(40)^2=2.4 J

2) KE = ½ mv^2 so bullet two has more KE…. KE_2 = ½ (.006)(40)^2=4.8 J twice as much

#3

Two 3 g bullets are fired with velocities of 40 m/s and 80 m/s respectively. What are their kinetic energies? Which bullet has more kinetic energy? What is the ratio of their kinetic energies?

1) KE = ½ mv^2 so bullet two has more KE…. KE_1 = ½ (.003)(40)^2=2.4 J

2) KE = ½ mv^2 so bullet two has more KE…. KE_2 = ½ (.006)(80)^2=9.6 J four times asmuch

Section 5-2 pg 177

3

A spring with a force constant of 5.2 N/m has a relaxed length of 2.45 m. When a mass is attached to the end of the spring and allowed to come to rest, the vertical length of the spring is 3.57 m. Calculate the elastic potential energy stored in the spring.

K = 5.2 N/m x = 3.57-2.45 =1.12 m EPE = ½ k x^2 = ½ (5.2)(1.12)^2= 3.26 J

4

A 40 kg child is in a swing that is attached to ropes 2 m long. Find the gravitational potential energy associated with the child relative to the child's lowest position under the following conditions:

a) when the ropes are horizontal *h=2, m=40,g=9.8 GPE=mgh=40(9.8)(2)=784J*

b) when the ropes make a 30 degree angle with the vertical. (half off the ground)

h=1, m=40,g=9.8 GPE=mgh=40(9.8)(1)=392J

c) at the bottom of the circular arc.

h=0, m=40,g=9.8 GPE=mgh=40(9.8)(0)=0 J

*** Honors

Section 5-2 pg. 173 # 4

A running student has half the kinetic energy that his brother has. The student speeds up by 1 m/s, at which point he has the same kinetic energy as his brother. If the student's mass is twice as large as his brother's mass, what were the original speeds of both the student and his brother?

KEstart1 = ½ KE start2 $1/2m_1v_1^2 = 1/4m_2v_2^2$

KEfinish1=KEfinish2 $1/2m_1(v_1+1)^2 = 1/2m_2v_2^2$

$m_1=2m_2$

so….. $½ (2\ m_2)\ v_1^2 = 1/4\ m_2v_2^2$ *or* $v_1^2=1/4v_2^2$ *so* $v_1=1/2v_2$ *or* $2v_1=v_2$

$½ (2m_2)(v_1+1)^2 = 1/2m_2v_2^2$ *so* $(v_1+1)^2=1/2v_2^2$

substitution is our friend … so…..

$(v_1+1)^2= ½ (2v_1)^2 = 4v_1^2$ *so* $v_1+1 = 2v_1$, **$v_1=1$, $v_2=2$m/s**

**Honors:

Using Motion Equation # 5, prove that starting gravitational potential energy and ending kinetic energy are equal for a falling object.

For a falling object, v_f= v, vi=0, A = 9.8, D = h

$V_f^2=Vi^2+ 2\ A\ D$ or $V^2=2gh$

$1/2V^2=gh$, $1/2mv^2= mgh$ is KE=GPE! (because work = F*D = mgh=mAD)

Using Motion Equation # 5, Newton's Laws and the definition of work, prove that starting elastic potential energy and ending kinetic energy are equal for an object pulled back on a spring.

Object pulled on spring, vi=0, D=x, Fi=0, Ff=max (NOT constant force, so NOT constant accleration),

$V_f^2=Vi^2+ 2\ A\ D$ or $V^2=2AD$

$1/2V^2=Ax$, $1/2mv^2= mAx$

Favg=ma= (Fi+Ff)/2 so work = FavgD = Ff/2(x)=mAx

For elastic k=Ff/x ,so Ff=kx, so work = FavgD=kx/2*x = ½ k x^2 = mA x

So ½ mv^2 = mAx=1/2kx^2, and GPE = EPE !

Section Review 5-2 pg. 178

1. What forms of energy are involved in the following situations?

a) a bicycle coasting along a level track. ***KE***

b) heating water ***Heat, Kinetic Energy?***

c) throwing a football ***chemical to electrical to mechanical (EPE to KE to GPE)***

d) winding the hairspring of a clock. ***KE to EPE***

2. How do the forms of energy in item 1 differ from another? Be sure to discuss mechanical vs. non-mechanical, kinetic vs. potential, and gravitational vs. elastic.

Movement of an object (force and mass) have to do with mechanical energy…. Spring is elastic potential, and gravity is gravitational potential that can cause an object to move and change to kinetic energy. You get those potential energies from non mechanical such as chemical, hear, electrical, etc…

3. A pinball bangs against a bumper, giving the ball a speed of 42 cm/s. If the ball has a mass of 50 g, what is the ball's kinetic energy in joules?
M = 50g = .05 kg, v=42 cm/s = .42 m/s
KE = ½ mv^2 = ½*(.05)*(.42)^2 = .00441 Joules

4. A spoon is raised 21 cm above a table. If the spoon and its contents have a mass of 30 g, what is the gravitational potential energy associated with the spoon at that height relative to the table?
M = 30 g = .03 kg, h = 21 cm = .21 m, GPE =mgh=.03(9.8)*.21=.06174 J

5. A 65 kg diver is poised at the edge of a 10 m high platform. Calculate the gravitational potential energy associated with the position of the diver. Assume the zero level is the surface of the pool.
GPE = mgh = 65(9.8)(10)=6370 Joules

6. What is the kinetic energy of a 1250 kg car moving at 45 km/hr?
m=1250 kg, v=45 km/hr=45*1000/3600=12.5 m/s
KE = ½ mv^2= ½(1250)*12.5^2=97656.25 J

7. The force constant of a spring is 550 N/m. How much elastic potential energy is stored in the spring if the spring is compressed a distance of 1.2 cm? What is the force being used to compress the spring?
K=F/x = 550 N/m, x =1.2 cm=.012 m EPE = ½ k x^2=1/2(550)(.012)^2=.0396 Joules
550=F/.012 , F =6.6 Newtons

8. a 25 kg falling object strikes the ground with a speed of 12.5 m/s. IF the kinetic energy of the object when it hits the ground is equal to the gravitational potential energy at some height above the ground, what is the height?

KE= ½ mv^2= .5 (35)(12.5)^2= 1953.125 Joules = GPE = mgh = (25)(9.8)(h)
H = GPE/mg = 1953.125/(25*9.8)=7.97 meters=h