Ch5. No 37. pp119

(a) If the mass of the skier is 150 Kg, what is the gravitational potential of the skier at the beginning? $PE = mgy$ $y = 2\cos\theta$
(b) What is the normal force on the skier while sliding on the slope? $n = mg\cos\theta$
(c) What is the frictional force? $f = \mu\cos\theta$
(d) What is the work done against friction when he reaches the bottom? $W = f\cos 180 - fd$ $W = fx$
(e) What is the kinetic energy of the skier when he reaches the bottom? $KE = PE - W$
(f) What is the velocity when he reaches the bottom? $\frac{1}{2}mv^2 = KE$
(g) Will he still be moving when he reaches the bottom? yes
(h) What is the normal force on the skier when he is on the level snow? mg
(i) If he slides a distance x on the level snow, what is the work done against friction on the level snow? $W = \mu \cdot mg \cdot x$
(j) What happened to the kinetic energy that he had when he was at the bottom of the hill? working against friction
(k) Find x $\frac{1}{2}mv^2 = \mu mg(x)$

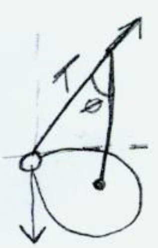
Ch5. No 64. pp 122

(a) What is the initial KE of the object? 0
(b) What is the original PE of the spring before the object moves? $PE = 0$ (not stretched)
(c) What is the normal force on the object? $n = mg\cos\theta$
(d) If the object moves a distance x, how much work is done against friction? $W = fx$ (force)(distan
(e) When the object comes to rest, what is the spring PE $= \frac{1}{2}kx^2$ $W = (\mu mg\cos\theta)(x)$
(f) Where does the PE for the spring come from? gravitational PE
(g) How much gravitational PE is lost? (g) $mgy_1 - mgy_2$ $PE = mgh$
(h) Find the coefficient of kinetic friction $x\sin\theta$

$mg(y_1 - y_2) = mgx\sin\theta$

(h) $\frac{1}{2}kx^2 = mgx\sin\theta - \mu mg\cos\theta$

Ch 7. No 48. pp 172



W=mg

(a) Call T the tension in the string. Find the horizontal component of T $T_y = T\cos\theta$
(b) Find the vertical component of T $\frac{mv^2}{r}$ $T_x = T\sin\theta$
(c) What is the centripetal force on the ball?
(d) Vertical component of T should be equated to ------. $mg = T\cos\theta$
(e) Horizontal component of T should be equated to ------ $\frac{mv^2}{r} = T\sin\theta$
(f) Find the speed of the ball
(g) Find the radius of the circle that the ball is making $2\pi r$
(h) How long will the ball take to make one complete circle $t = \frac{d}{v}$
(i) What is the period of the ball? $\frac{2\pi r}{v} = T$
(j) What is the frequency of the ball?

$f = \frac{1}{T}$

(f) $\frac{\cancel{m}g}{\frac{\cancel{m}v^2}{r}} = \frac{\cancel{T}\cos\theta}{\cancel{T}\sin\theta}$

$\frac{rg}{v^2} = \frac{\cos\theta}{\sin\theta}$

- Solve for V

Example 8.9 (With a hoop instead of a solid ball)

(a) What is the linear KE of the hoop at the top?
(b) What is the PE of the hoop at the top?
(c) What is the rotational KE of the hoop at the top
(d) What is the total energy of the hoop at the top
(e) What is the linear KE of the hoop at the bottom?
(f) What is the rotational KE of the hoop at the bottom? $\frac{1}{2} I\omega^2$
(g) What is the PE of the hoop at the bottom?
(h) What is the total energy of the hoop at the bottom?
(i) Find velocity of the hoop at the bottom.

(a) $mgh = \frac{1}{2}mv^2 + \frac{1}{2}\boxed{I}\omega^2$
$+ \frac{1}{2}mr^2\omega^2$
$mgh = \frac{1}{2}mv^2 + \frac{1}{2}mr^2\left(\frac{v}{r}\right)^2$
$mgh = mv^2$
$v = \sqrt{gh}$

* Brianna * Lodner *

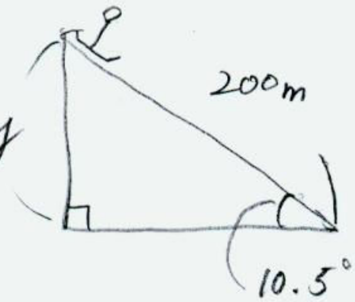
Ch 11. No. 23. pp294.

(a) What is the heat gain of ice changing from -78 C to 0 C?
(b) What is the heat gain of ice during the phase change from 0 C ice to 0 C water?
(c) What is the heat gain for the ice(after melting) going from 0 C water to T C water?
(d) What is the heat loss for the copper clorimeter?
(e) What is the heat gain for the water in the clorimeter?
(f) Find the final temperature of the mixture.

Ch 8. No. 20. pp 197.

(a) Call the tension in the rope T. What is the x-component of T — $T_x = T\cos\theta$
(b) What is the y-component of T? — $T_y = T\sin\theta$
(c) Take the left end of rod as axis of rotation, find the torque due to Tx.
(d) Find the torque due to Ty
(e) Find the torque due to the floodlight.
(f) Find T by using the condition for rotational equilibrium — $T = -wd$
(g) Find the horizontal and vertical forces on the beam by the pole — $T_y = T_y d$

Ch 5 No. 37 p119

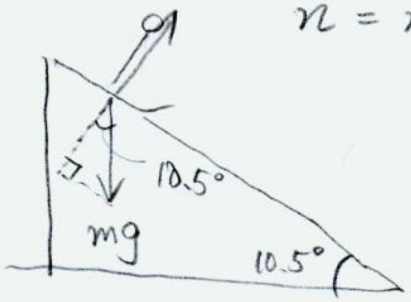


$\mu = 0.075$

(a) $PE = mgy = 150kg \cdot g \cdot (200m) \sin 10.5°$

$= 5.36 \times 10^4$ (J)

(b)



$n = mg\cos 10.5° = 150 \cdot 9.8 \cdot \cos 10.5°$

$= 1.46 \times 10^3$ (N)

(c) $f = \mu n = \mu mg \cos 10.5° = 0.075 \cdot 150 \cdot 9.8 \cdot \cos 10.5°$

$= 108$ (N)

(d) $W = f d \cos \phi$ (ϕ is the angle between f and d vectors.)

$= 108 \cdot 200 \cdot \cos 180°$

$= -2.16 \times 10^4$ (J)

(e) Use Work-energy theorem (W-E theorem).

$TE_f - TE_i = W$

$\Rightarrow (KE_f + PE_f) - (KE_i + PE_i) = W$

(e) continued.

$$(KE_f + \underbrace{\cancel{PE_f}}_{0}) - (\underbrace{\cancel{KE_i}}_{0} + PE_i) = W$$

$$KE_f - PE_i = W$$

$$KE_f = W + PE_i$$

(f) Use the result in (e), and plug in.

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

$$W = -fd$$

$$PE_i = mgy$$

Thus

$$\frac{1}{2}mv^2 = -fd + mgy$$

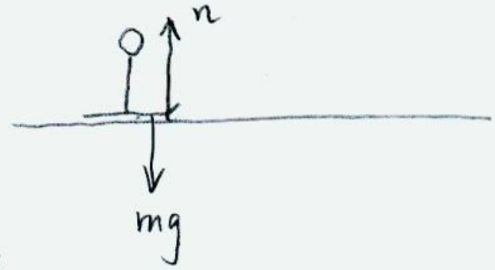
$$\Rightarrow \quad mv^2 = 2(-fd + mgy)$$

$$\Rightarrow \quad v^2 = \frac{2(-fd + mgy)}{m}$$

$$\Rightarrow \quad v = \sqrt{\frac{2(-fd+mgy)}{m}} = 20.7\,(m/s)$$

(g) From (f), yes.

(h) $n = mg$



(i) $W = \mu n \cos 180° \cdot x$

$$= -\mu mg \cdot x$$

$$= -0.075 \cdot 150 \cdot 9.8 \cdot x$$

$$= -110x\,(J)$$

(j) The KE is absorbed by the work done by friction, then v becomes zero.

(k) Use W-E theorem.

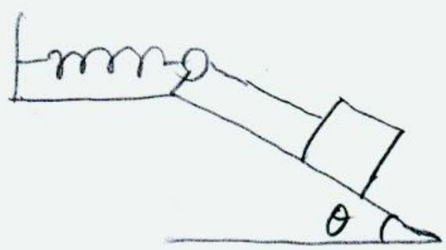
fin. total energy   ini. total energy   work by friction

$$(0 + 0) - \left(\frac{1}{2}mv^2 + 0\right) = -\mu m g x$$

$$\Rightarrow \frac{1}{2}mv^2 = \mu m g x$$

$$\therefore x = \frac{\frac{1}{2}mv^2}{\mu m g} = \frac{v^2}{2\mu g}$$

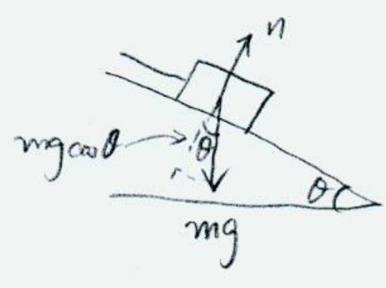
Ch 5 No. 64 p 122



(a) KE = 0
(∵ not moving)

(b) PE of spring = 0 (∵ not stretched).

(c) $n = mg\cos\theta$



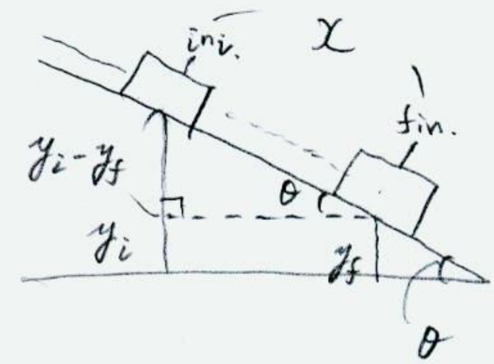
(d) frictional force : $f = \mu n$
work by friction : $W = \mu n x$

Thus, $W = \mu mg\cos\theta \cdot x$

(e) Spring PE when stretched $= \frac{1}{2}kx^2$

(f) The spring is stretched by gravity; namely, gravitational PE.

(g)



$$\text{GPE lost} = mgy_i - mgy_f$$
$$= mg(y_i - y_f)$$

From the small right-angle triangle,

$$y_i - y_f = x \sin\theta$$

Therefore, $\text{GPE lost} = mgx\sin\theta$

(h) Use W-E theorem.

$$\underbrace{(KE_f + GPE_f + SPE_f)}_{\text{fin total E}} - \underbrace{(KE_i + GPE_i + SPE_i)}_{\text{ini. Total E}} = \underbrace{W}_{\text{work by friction}}$$

$KE_f \to 0$, $GPE_f \to GPE_f$, $SPE_f \to \frac{1}{2}kx^2$, $KE_i \to 0$, $GPE_i \to GPE_i$, $SPE_i \to 0$, $W \to -\mu mg\cos\theta \cdot x$

$$\Rightarrow \quad \frac{1}{2}kx^2 - \underbrace{(GPE_i - GPE_f)}_{\text{GPE lost in (g)}} = -\mu mg\cos\theta \cdot x$$

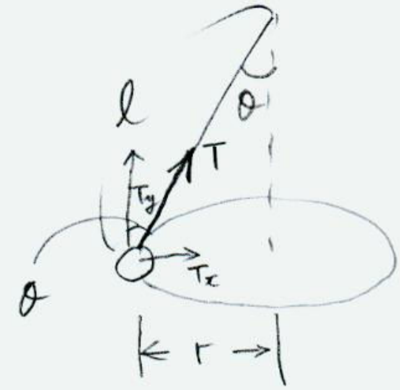
$$\Rightarrow \quad \frac{1}{2}kx^2 - mgx\sin\theta = -\mu mg\cos\theta \cdot x$$

$$\Rightarrow \quad \mu mg\cos\theta \cdot x = mgx\sin\theta - \frac{1}{2}kx^2$$

$$\Rightarrow \quad \mu = \frac{mgx\sin\theta - \frac{1}{2}kx^2}{mgx\cos\theta}$$

$$= \tan\theta - \frac{kx}{2mg\cos\theta}$$

Ch 7 No 48 P172



(a) $T_x = T \sin\theta$

(b) $T_y = T\cos\theta$

(c) $F_c = \frac{mv^2}{r}$

(d) $T_y = mg$

$\Rightarrow T\cos\theta = mg$ — ①

(e) $T_x = \frac{mv^2}{r}$

$\Rightarrow T\sin\theta = \frac{mv^2}{r}$ — ②

(f) from ①, Solve for T

$T = \frac{mg}{\cos\theta}$ and plug it in ②

$$\Rightarrow \frac{\cancel{m}g\sin\theta}{\cos\theta} = \frac{\cancel{m}v^2}{r}$$

$$\Rightarrow \frac{v^2}{r} = \frac{g\sin\theta}{\cos\theta}$$

$$\Rightarrow v^2 = \frac{rg\sin\theta}{\cos\theta}$$

$$\Rightarrow v = \sqrt{\frac{rg\sin\theta}{\cos\theta}} \quad \text{or} \quad = \sqrt{rg\tan\theta}$$

(g) $r = l\sin\theta$

and the circumference is $2\pi r = 2\pi l \sin\theta$

(h) time is given by distance ÷ velocity.

$$\rightarrow \quad t = \frac{d}{v}$$

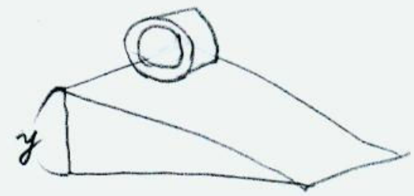
(i) The above d can be replaced by circumference, and t becomes T (period).

$$T = \frac{2\pi r}{v}$$

(j) The frequency is reciprocal of period.

$$f = \frac{1}{T}$$

Example 8.9 (with a hoop instead of a solid ball)



(a) $KE^{l}_{i} = 0$

(b) $PE_{i} = mgy$

(c) $KE^{r}_{i} = 0$

(d) $TE_{i} = KE^{l}_{i} + PE_{i} + KE^{r}_{i} = 0 + mgy + 0 = mgy$

(e) $KE^{l}_{f} = \frac{1}{2}mv^2$

(f) $KE^{r}_{f} = \frac{1}{2}I\omega^2$

(g) $PE_{f} = 0$

(h) $TE_{f} = KE^{l}_{f} + KE^{r}_{f} + PE_{f} = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

(i) Before finding the velocity, recall following:

$$I_{hoop} \text{ (moment of inertia)} = mr^2 \quad \text{—— ①}$$

$$\omega \text{ (anglar velocity)} = \frac{v}{r} \quad \text{—— ②}$$

Use the law of conservation of energy:

$$TE_f = TE_i$$

Take the results from (d) and (h)

$$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgy$$

Plug ① & ② into the above.

$$\frac{1}{2}mv^2 + \frac{1}{2}mr^2\left(\frac{v}{r}\right)^2 = mgy$$

$$\rightarrow \frac{1}{2}mv^2 + \frac{1}{2}mv^2 = mgy$$

$$\rightarrow \cancel{m}v^2 = \cancel{m}gy$$

$$\rightarrow v = \sqrt{gy}$$