ial Energy, Kinetic Energy, and Conservation of Energy Practice NAME:______________

1. What is the potential energy of a 25kg block which is 15m above the ground?

$$E_p = mgh = 25\,kg \times 9.8\,m/s^2 \times 15\,m$$
$$= 3675\,J \approx 3700\,J$$

2. How much work must be done to lift a 25kg block to a height of 15m above the ground?

$W = Fd$

$F = mg$
$= 25 \times 9.8$
$= 245$

$W = 245 \times 15 = 3675\,J$

This is really the same question

$W = 3700\,J$

3. What is the kinetic energy of a 25 kg block which is moving at 15 m/s?

$$E_K = \frac{1}{2}mv^2 = \frac{1}{2}(25)(15)^2$$
$$= 2800\,J$$

4. ~~What is the kinetic energy of an 85 kg person who is running at 5.3 m/s?~~

How fast is someone running if they are 85 kg and have 1100J of energy?

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

$$v = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2(1100)}{85}} = 5.1\,m/s$$

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850Kg

5. A car increases its velocity from rest to 25.0 m/s.
   a. What is the initial kinetic energy of the car?

0 J

   b. What is the final kinetic energy of the car?

$$E_k = \frac{1}{2}mv^2 = \frac{1}{2}(850)(25)^2$$

$$= 265625J = 2.7\times10^5 J$$

   c. What is ΔE_k?

Final − Initial

$$2.7\times10^5 J - 0J = 2.7\times10^5 J$$

850kg

6. A car increases its velocity from 25.0 m/s to 50.0 m/s.
   a. What is the initial kinetic energy of the car?

$$\frac{1}{2}(850)(25)^2 = 2.7\times10^5 J$$

   b. What is the final kinetic energy of the car?

$$\frac{1}{2}(850)(50)^2 = 1.1\times10^6 J$$

$$= 1062500 J$$

   c. What is ΔE_k?

Final − Initial $= 8.0\times10^5 J$

1062500J − 265625J

d. It takes more energy to speed up from 25m/s to 50m/s.

7. A 25 kg block is dropped from a height of 5.0m. We want to determine how fast it will be moving when it hits the ground.

   a. Method 1: Use kinematics to determine how fast it will be moving when it hits the ground.

Use $v_f^2 = v_0^2 + 2ad$

$d = -5.0m$
$v_0 = 0 \, m/s$
$a = -9.8 m/s$
$v_f = ?$

$v_f = 9.9 m/s$

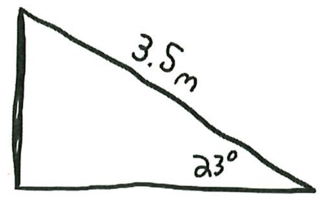
   b. Method 2: Use conservation of energy (kinetic energy at the end will equal potential energy at the start) to determine how fast it will be moving when it hits the ground.

Potential energy $= mgh$
$= 25 \times 9.8 \times 5.0$
$= 1225 \, J$

Kinetic energy $= \frac{1}{2} m v^2$

$$v = \sqrt{\frac{2 E_K}{m}} = \sqrt{\frac{2(1225)}{25}} = 9.9 \, m/s$$

8. A 34 kg block is pushed up a 3.5m long, 23° frictionless incline at a constant velocity. We want to know how much work is needed to push the block up the incline.



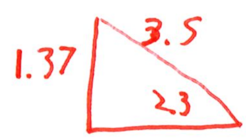
a. Method 1: Determine the force needed to push the block at a constant velocity (this will be equal to $F_{g||}$) and use $W = Fd$ to determine the amount of work needed to push the block 3.5m.

$F_{g||} = \sin 23 \times 34 \times 9.8 = 130.19\,N$

$W = Fd = 130.19 \times 3.5 = 455.67\,J$

$\approx 460\,J$

b. Method 2: Use trigonometry to determine how high the block will be off the ground at the end of the 3.5m incline then use $E_p = mgh$ to determine the work needed to push the block to that height.



$\sin 23 = \frac{O}{3.5}$

$\sin 23 \times 3.5 = 1.3676\,m$

$E_p = 34 \times 9.8 \times 1.3676\,m$

$= 455.67\,J$

$\approx 460\,J$

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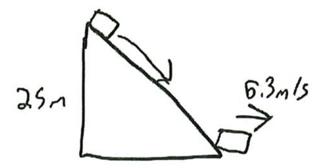
9. A 56kg sled, initially a rest on a 25m high hill, slides down. At the bottom of the hill the sled is moving at 6.3 m/s.



a. What was the potential energy of the sled at the top of the hill?

$E_p = mgh = 56 \times 9.8 \times 25 = 13720\ J$

b. What was the potential energy at the bottom of the hill?

0

c. What was the change in potential energy?

$-13720\ J$

d. What was the kinetic energy of the sled at the top of the hill?

0

e. What was the kinetic energy at the bottom of the hill?

$E_K = \frac{1}{2}mv^2 = \frac{1}{2}(56)(6.3)^2$

$= 1111.32$

f. What was the change in kinetic energy?

$+1111.32\ J$

g. Determine how much heat was generated by friction. (This will be all the potential energy at the start which didn't get transformed into kinetic energy).

$13720 - 1111 = 12609$

$\approx 13000\ J$

$\approx 1.3 \times 10^4\ J$

10. A kid on a krazy carpet slides down a 15.0m tall hill. If the total mass of the kid and the carpet is 19kg and they are moving at 12.0 m/s at the bottom of the hill how much heat was generated?

E_p at start $= mgh = 19 \times 9.8 \times 15$
$= 2793$

E_K at end $= \frac{1}{2}mv^2 = \frac{1}{2}(19)(12)^2$
$= 1368$

Difference: $2793 - 1368 = 1425$

$\approx$ 1400 J of heat was generated

11. A 0.750 kilogram rubber ball is dropped from a height of 150 cm. If 2.0 J of energy is lost during the interaction of the ball with the floor, how high will the ball bounce up from the floor?

E_p at start $= 0.75 \times 9.8 \times 1.5 = \cancel{1.675\,J}$ $11.025\,J$

E_p at end $= \cancel{3.675}\ 11.025 - 2 = \cancel{1.675\,J}$ 9.025

$\cancel{1.675}\ 9.025 = mgh \rightarrow \frac{9.025}{mg} = h \rightarrow \frac{9.025}{0.75 \times 9.8} = \cancel{0.23}\,m$ $1.2\,m$

12. A 65 kg person is running along a gym floor with a speed of 3.5 m/s. She grabs on to a rope hanging from the ceiling of the gym and swings from the end of the rope.

a. Determine the initial kinetic energy of the person.

$$E_K = \frac{1}{2}(65)(3.5)^2 = 398.125\,J$$

$$\approx 4.0 \times 10^2\,J$$

b. Determine how high they will swing if all of their kinetic energy is converted into potential energy.

$$E_p = mgh \rightarrow h = \frac{E_p}{mg}$$

$$h = \frac{398.125}{65 \times 9.8}$$

$$= 0.625$$

$$\approx 0.63\,m$$

13. We wish to determine how far a 50.0 kg object can move along a surface with μ=0.12 at a constant rate using 500.0 J of energy.
    a. Determine the force of friction acting on the object using the formula $F_{fric} = \mu F_N$

$$F_N = F_g = mg = 50 \times 9.8 = 490\ N$$

$$F_{fric} = \mu F_N = 0.12 \times 490 = 58.8\ N$$

    b. Solve for displacement using the formula $W = Fd$.

$$W = Fd \rightarrow d = \frac{W}{F} = \frac{500}{58.8} = 8.5m$$

14. A 12 kg object initially moving at 25 m/s is slowed by friction. μ between the object and the floor is 0.46. We wish to determine how far it will travel before it stops without using kinematics.

    a. Determine the initial kinetic energy of the object.

$$E_K = \frac{1}{2}mv^2 = \frac{1}{2}(12)(25)^2$$

$$= 3750J$$

    b. Determine the force of friction acting on the object.

$$F_{fric} = 0.46 \times 12 \times 9.8 = 54.096\ N$$

    c. All of the initial kinetic energy from the object will be converted to heat by friction. Use $W = Fd$ to determine how far the object will move before stopping.

$$d = \frac{W}{F} = \frac{3750}{54.096} = 69m$$