Date _____

Name <u>Answer Key</u> Honors Physics Period _____

Energy WS #10H Mrs. Nadworny

Energy Review

Directions: Solve the following problems using the GUESS method and proper significant figures. Be sure to show ALL work.

1. A child is pulling a wagon by the handle. He exerts 37.8 newtons of force along the handle, which makes a 23.5° angle with the horizontal. If he pulls the wagon 10.0 meters, calculate the amount of work he does.

 $F_x = F \cos \theta = 37.8N \cos(23.5^\circ) = 34.7N$ forward $W = F_x d = (^+34.7N)(^+10.0m) = ^+347J$

2. A worker pushes a 9.45 kilogram box up a frictionless ramp, which is inclined at 15.0°, at constant speed into a truck. Calculate the amount of force he is exerting.

$$\begin{split} F_g &= mg = 9.45 kg(-9.81 \frac{m}{s^2}) = 92.7N \text{ down} \\ F_{parallel} &= F_g \sin \theta = (-92.7N)(\sin 15.0^\circ) = 24.0N \text{ downhill} \\ F_{app} &= -F_{g||} = 24.0N \text{ uphill} \end{split}$$

3. An engine does work at a rate of 8510 watts while exerting a force of 610 N on a vehicle. Calculate the speed of the vehicle.

 $v = \frac{P}{F} = \frac{8510W}{610N} = 14\frac{m}{s}$

4. During the Personal Power Lab, a student weighing 522 newtons takes 12.38 seconds to climb a flight of stairs 30.4 meters high. Calculate her vertical power output.

$$P = \frac{Fd}{t} = \frac{522N(30.4m)}{12.38s} = 1280W$$

- 5. A 0.591kilogram pumpkin sits atop a building 100. meters high.
 - a. What potential energy does the pumpkin possess relative to the ground?

 $PE = mgh = (0.591kg)(9.81\frac{m}{c^2})(100.m) = 580.J$

b. Bill Igor Gan decides to push the pumpkin off the building one windy day. If it is traveling at 39 m/s when it strikes the ground, calculate the kinetic energy of the pumpkin just before it strikes the ground.

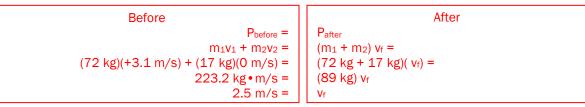
$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(0.591kg)(39\frac{m}{s})^2 = 450J$$

c. How much mechanical energy was "lost" as the pumpkin fell?

$$\Delta E_{T \text{ lost}} = E_f - E_i = KE_{bottom} - PE_{top} = 450J - 580.J = -130J$$

- d. Where did this "lost" energy go?
 - Overcoming air resistance
 - The internal energy increased due to friction with the air

- 6. Amanda B. Reckendwyth, a very mischievous 72 kilogram girl, runs down the hall with a speed of 3.1 meters per second. She jumps onto a stationary 17 kilogram lab cart.
 - a. Calculate the speed of the cart once Amanda has jumped onto it.



b. Calculate the kinetic energy of the Amanda - cart combo.

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(89kg)(2.5\frac{m}{s})^2 = 280J$$

Use the combined mass because they are traveling together

c. She then reaches a carpeted section. Friction exerts 92 newtons of force to bring the cart to rest. How much work is done by friction?

$$W = \Delta E_{\tau} = KE_{f} - KE_{i} = 0J - 280J = -280J$$

The work is negative because force and displacement are in opposite directions.

7. A hypnotist uses a pendulum that is 0.35 meters long. Calculate the period of the pendulum while she is putting somebody into a trance.

$$T = 2\pi \sqrt{\frac{L}{g}} = 2\pi \sqrt{\frac{0.35m}{9.81\frac{m}{s^2}}} = 1.2s$$

8. It takes a force of 36.7 newtons to hold a spring stretched a distance of 0.557 meters. Calculate the elastic potential energy of the spring in this position.

$$k = \frac{F}{x} = \frac{36.7N}{0.557m} = 65.9 \, \text{M}_{m} \qquad PE_{elastic} = \frac{1}{2} \, kx^{2} = \frac{1}{2} \, (65.9 \, \text{M}_{m}) (0.557m)^{2} = 10.2J$$

- 9. A 0.560 kilogram block is held 1.25 meters above a spring. When the block is dropped <u>the</u> <u>gravitational potential energy is transferred to the spring</u> causing it to compress 0.140 meters.
 - a. Calculate the gravitational potential energy of the block when it was held above the spring.

 $PE = mgh = (0.560 kg)(9.81 \frac{m}{c^2})(1.25m) = 6.87J$

b. What is the potential energy stored in the spring when it is compressed?

$$E_{i} = E_{f}$$
$$PE_{spring} = PE_{grav} = 6.87J$$

All of the gravitational PE is transferred into the spring and becomes $\mbox{PE}_{\mbox{spring}}$

c. Calculate the spring constant of the spring.

$$k = \frac{2PE}{x^2} = \frac{2(6.87J)}{(0.140m)^2} = 701\frac{N}{m}$$

d. Calculate how much force was exerted to compress the spring.

 $F = kx = (701 \frac{N}{m})(0.140m) = 98.1N$ down

Answers in size order: 1.2, 2.5, 6.87, 6.87, 10.2, 14, 24.0, 98.1, 130, 280, 280, 347, 450, 580., 701, 1280