Name Answer Key Date ____________
Honors Physics Energy WS #10H
Period ____________ 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 23.5^0 angle with the horizontal. If he pulls the wagon 10.0 meters, calculate the amount of work he does.

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

2. A worker pushes a 9.45 kilogram box up a frictionless ramp, which is inclined at 15.0^0, at constant speed into a truck. Calculate the amount of force he is exerting.

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

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.

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

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?

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

   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.

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

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

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

   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.

Before	After
P_{before} =	P_{after}
$m_1v_1 + m_2v_2$ =	$(m_1 + m_2)\ v_f$ =
(72 kg)(+3.1 m/s) + (17 kg)(0 m/s) =	(72 kg + 17 kg)(v_f) =
223.2 kg•m/s =	(89 kg) v_f
2.5 m/s =	v_f

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

Use the combined mass because they are traveling together

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

   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?

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

$$W = \Delta E_T = KE_f - KE_i = 0J - 280J = -280J$$

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.

$$k = \frac{F}{x} = \frac{36.7N}{0.557m} = 65.9\,{}^{N}\!/\!_{m}$$

$$PE_{elastic} = \tfrac{1}{2}kx^2 = \tfrac{1}{2}(65.9\,{}^{N}\!/\!_{m})(0.557m)^2 = 10.2J$$

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

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

   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 PE_{spring}

   c. Calculate the spring constant of the spring.

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

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

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

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