Student #: _____ Student Name: _____

Physics 11 Homework Unit 5: Energy Transformation

(Plus questions from Unit 4)

1. Match each word with the most appropriate choice by filling in the correct number.

_____ power	1. metric unit of power
_____ energy	2. light energy from electromagnetic waves
_____ watt	3. total energy of particles withi n a substance
_____ elastic	4. rate at which work is done
_____ thermal	5. the ability to do work
_____ radiant	6. type of energy stored when a spring is stretched

2. What is the difference between renewable and non-renewable energy resources? Give one example of each. State one advantage and disadvantage of each example you give.

3. How can a $\$10$ compact fluorescent light bulb (15 W) be an overall money saver compared to an incandescent light bulb (60 W) that costs only $\$0.50$?

4. How can you determine the efficiency with which the mechanical energy of a pendulum is conserved?

5. If equal amounts of heat are added to equal masses of silver and copper, both at the same initial temperature, which will reach the higher final temperature? Explain your answer. The specific heat capacity of silver is 0.235 J/g °C and that of copper is 0.385 J/g °C.

6. A 20.0 kg block is being pushed forward on a flat surface with a force of magnitude 45.0 N against a frictional force of 13.0 N.
   (a) Draw a free-body diagram of the block.
   (b) What is the net force acting on the block?
   (c) What is the change in kinetic energy after the force has pushed the block for 4.0 m?
   (d) How much work would it take to stop the block?

7. A 55 kg motorcyclist is flying through the air at 72 km/h at the apex of the jump 8.3 m above the ground. Find his landing speed assuming energy is conserved.

8. An unknown metal has a mass of 50.0 g and absorbs 220.0 J of heat when its temperature increases by 120.0 °C. What is the specific heat capacity of this metal?

9. Your friend comes across a “good deal” to purchase a silver ring. She asks you for advice and for you to test the ring. The ring has a mass of 4.540 g. When you heat the ring with 13.97 J of energy, its temperature rises from 23.05 °C to 47.55 °C. Would you advise your friend that she is getting a good deal? Explain. The specific heat capacity of silver is 0.240 J/g °C.

10. A 450 ml cup of coffee is too hot to drink at 91 °C, so 100.0 ml of cold water at 6.5 °C is added to cool it off.
    (a) What is the final temperature of the drink?
    (b) What assumptions did you have to make when solving this problem?

11. A large nuclear power plant is powered by enriched uranium (3 % U-235). If the thermal power in the reactor core is 4200 MW and 1300 MW of electricity is generated,
    (a) What is the efficiency of the nuclear reactor?
    (b) If each fission event generates 2.0×10^8 eV, and $1\,\text{eV} = 1.6 \times 10^{-19}$ J, find the rate that the atoms are splitting.

12. A swimming pool hold 1.10×10^8 kg of water. First thing in the morning, the temperature of the pool was 20.0 °C. When the temperature was checked in the afternoon, it has risen to 23.0 °C. How much energy was required to raise the temperature of the water?

13. Washing the evening dishes required 55.5 kg of water. Tap water is at a temperature of 10.0 °C and the dishwater's preferred water temperature is 45.0 °C. Find the amount of energy that is required to heat the water. Calculate the electrical cost if Toronto Hydro charges $\$0.132$ per kilowatt-hour during evening "mid-peak" hours. $1.0\,\text{kW h} = 3.6 \times 10^6$ J)

14. A small well-insulated shed is heated by a single 100 W light bulb.
    (a) If the shed has 10.4 kg of air, how long, in minutes, would it take the light bulb to raise the air temperature from –8 °C to 2 °C Assume that 100 % of the bulb's energy is converted to thermal energy.
    (b) Is your answer to (a) reasonable? What assumption could you improve?

____ 15. A boy pushes on a car to slow it down while the car is rolling horizontally down the road. If the boy pushes backwards on the car with 10 N of force as the car rolls forward 3.0 m, the amount of work done by the boy is:
    (a) –30 J
    (b) 0 J
    (c) 3.3 J
    (d) 30 N m
    (e) 300 J

____ 16. What is the speed of a 5.0 kg ball if its kinetic energy is 40 J?

(a) 2.8 m/s
(b) 4 m/s
(c) 8 m/s
(d) 16 m/s
(e) 200 km/h

____ 17. A 300 N force is applied horizontally to a 50 kg crate, originally at rest, pushing it 2 m. The friction force between the crate and the floor is 200 N. The final kinetic energy of the crate is:

(a) 0 J
(b) 200 J
(c) 400 J
(d) 600 J
(e) 300 000 J

____ 18. A small rocket engine generates a thrust of 21.0 N vertically to a 0.500 kg toy rocket. Assuming that the force of air resistance ("drag") is negligible for the first 50.0 cm of flight, ind the kinetic energy gained by the rocket in the first 50.0 cm of takeoff.

(a) 4.0 J
(b) 8.05 J
(c) 10.5 J
(d) 21 J
(e) 32 J

____ 19. If a 1000 kg car accelerates from 10 m/s to 20 m/s, the amount of work done is:

(a) 112 500 J
(b) 10 000 J
(c) 150 000 J
(d) 5000 J
(e) 0 J

____ 20. If mechanical energy is conserved, then

(a) the sum of the kinetic energy and gravitational potential energy remains constant.
(b) the amount of kinetic energy is constant.
(c) thermal energy losses due to friction are constant.
(d) the amount of gravitational potential energy is constant.
(e) none of the above.

____ 21. The amount of energy required to raise a 12 kg toddler onto a high chair 1.25 m off the ground is approximately:

(a) 30 J
(b) 7.8 N
(c) 15 J
(d) 150 J
(e) 0 J (no work is done)

____ 22. A professional cyclist during a bike race has 6.4 kJ of kinetic energy. If the combined mass of the bicycle and cyclist is 82 kg, he is travelling at a speed of:

(a) 100 km/h
(b) 45 km/h
(c) 12.5 km/h
(d) 156 m/s
(e) 0 m/s

____ 23. The rated power output of an engine is 10 hp (horse power) which is approximated to be 7460 W. How much energy would it produce in 10 minutes?

(a) 0 J
(b) 100 J
(c) 74 600 J
(d) 4.5 MJ
(e) 746 MJ

____ 24. An electrical hair dryer consumes 90 kJ in one minute. What is the power used by this hair dryer?

(a) 90 W
(b) 100 W
(c) 1500 W
(d) 5.4 kW
(e) 1 hp

____ 25. A solar panel is exposed to 55 W of sunlight and produces 590 J of electrical energy in 1 minute. What is the efficiency of this panel?

(a) 100 %
(b) 93 %
(c) 18 %
(d) 10 %
(e) 9.3 %

____ 26. Which of the following samples has the highest specific heat capacity?

(a) 100 kg of “material A” requires 13 000 J to increase its temperature by 1 K
(b) A 50 g sample of “material B” releases 1050 J as it cools by 5 °C1050 J
(c) A 2 kg sample of “material C” receives 2340 J of thermal energy as it warms from 20 °C to 23 °C
(d) All the samples above have the same specific heat
(e) It is impossible to compare the specific heat of the materials from the information given

_____ 27. The temperature 273.15 K is equivalent to:

(a) absolute zero
(b) 0 °C
(c) 20 °C
(d) 273 °C
(e) 273 °F

_____ 28. Which of the following energy transformations best describes the operation of a solar powered battery charger? (Radiant energy is the energy of electromagnetic wave.)

(a) electrical energy $\longrightarrow$ thermal energy $\longrightarrow$ kinetic energy
(b) nuclear energy $\longrightarrow$ potential energy $\longrightarrow$ chemical energy
(c) thermal energy $\longrightarrow$ elastic potential energy $\longrightarrow$ electrical energy
(d) radiant energy $\longrightarrow$ electrical energy $\longrightarrow$ chemical potential energy
(e) radiant energy $\longrightarrow$ thermal energy $\longrightarrow$ electrical energy