Name: ____________________ Period: __________

Instructor: Mr. Rodriguez Total Score: ______/40

Final Exam

Conceptual Physics A

Fall 2024

Learning Standard 3.1		
The Law of Conservation of Energy	**Score:** ______ /10	**Grade:**

Multiple Choice: Circle **one** option per question.

1. (2 points) Which of the following statements best describes the law of conservation of energy?

   A. Energy can be created or destroyed, but it cannot change from one form to another.
   B. Energy can be transferred or transformed but is always lost in the process.
   C. Energy cannot be created or destroyed; it can only change from one form to another.
   D. Energy can only be conserved in closed systems, and is always constant in open systems.

2. (2 points) What are the SI (metric) units of energy?

   A. Newtons (N)
   B. kilograms (kg)
   C. Joules (J)
   D. meters per second (m/s)

Fill in the Blank: For each blank space, choose **one** item from the word bank below.

Word Bank

- Chemical
- Electrical
- Elastic
- Gravitational Potential
- Kinetic
- Light
- Sound
- Thermal

3. (3 points) Use the word bank above identify which types of energy are converted into which other types of energy by each machine. Some words may be used more than once; others may not end up used at all.

   (a) A **loudspeaker** converts ________________ energy into ________________ energy.

   (b) A **solar panel** converts ________________ energy into ________________ energy.

   (c) A **car engine** converts ________________ energy into ________________ energy.

   (d) A **flashlight** converts ________________ energy into ________________ energy.

   (e) A **slingshot** converts ________________ energy into ________________ energy.

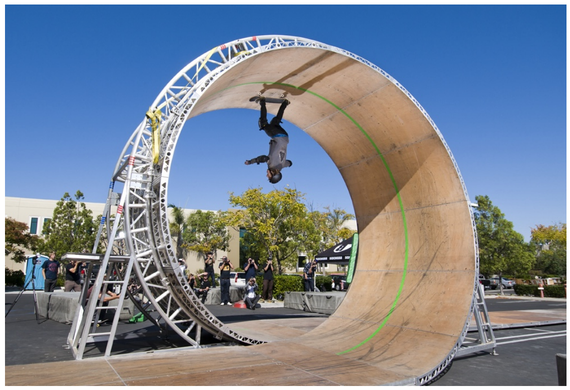
   (f) A **hydroelectric turbine generator** converts ________________ energy into ________________ energy.

Free Response: Answers must be in **complete sentences** to receive full credit.

4. (3 points) Use your knowledge of the law of conservation of energy to explain how *all* energy on Earth actually came from the Sun at one point or another. Make sure to include the following terms in your argument: *solar, plants, animals, chemical energy, humans, fossil fuels.*

Learning Standard 3.2		
Problem Solving via Conservation of Energy	**Score:** ______ /10	**Grade:**

5. (10 points) Tony Hawk is skating on a flat, horizontal surface towards a circular loop, like the one shown in the figure below:



Conservation of energy tells us that the faster Tony is traveling on his skateboard before approaching the loop, the higher he will climb along the loop. Tony wants to find the minimum speed he needs to successfully complete a full circular loop without falling back down. Assume the radius of the loop is $r = 5\,\mathrm{m}$. What is the *minimum* velocity $\mathbf{v}$ that Tony must have at the bottom of the loop to complete the full circle? Assume no friction or air resistance.

Learning Standard 3.3

Power and Generators **Score:** ______ /10 **Grade:**

Relevant Equations

$$PE = mgh \qquad \text{(Potential Energy)}$$

$$P = \frac{\Delta E}{\Delta t} = \frac{\text{(change in energy)}}{\text{(change in time)}} \qquad \text{(Power)}$$

Yosemite Falls, one of the tallest waterfalls in North America, has a total height of approximately 740 m. During peak flow in spring, about 50 000 kg of water flows over the falls every second. Suppose engineers set up a hydroelectric turbine at the base of the falls to capture the energy from the falling water.

6. (2 points) What are the SI (metric) units of power?

7. (3 points) Calculate the gravitational potential energy of the water that falls from the height of Yosemite Falls in one second.

8. (3 points) Calculate the theoretical power generated by the water flow.

9. (2 points) How many 40 W light bulbs could be powered by this hydroelectric turbine?

Learning Standard 3.4

Energy and Automobile Safety **Score:** ______ /10 **Grade:**

Relevant Equations

$$KE = \frac{1}{2}mv^2 \qquad \text{(Kinetic Energy)}$$
$$W = Fd \qquad \text{(Work)}$$

10. (3 points) A car with a mass of 1200 kg is traveling at $v = 12.5\,\text{m/s}$ (about 45 km/h). The driver applies the brakes, and the car comes to a stop due to the friction between the tires and the road.
    (a) Calculate the initial kinetic energy of the car.
    (b) If the brakes apply a constant frictional force of 6,000 N, how far does the car travel before coming to a complete stop?
11. (2 points) If the car was going twice as fast ($v = 25\,\text{m/s}$, which is about 90 km/h), by what factor would the kinetic energy increase?
12. (3 points) At this doubled speed, how much farther would the car travel while applying the brakes to come to a stop?
13. (2 points) Based on your results, explain the relationship between the car's speed and the potential severity of a crash.