# Unit 7.1: Work and Power

**Notes for/from class**

**Further Reference: 13.1 Work, Power, and Machines**

**WHAT IS WORK?**

1. Work is:
   1. Motion of the object must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as the force for work to be done
   2. If there is no motion, work equals \_\_\_\_\_\_\_\_\_\_\_\_\_
2. Work Equation:

In words In symbols

**BODYBUILDER EXAMPLE:**

1. Is the body builder doing work when he is lifting the barbell?
2. Is the body builder doing work as he holds the barbell above his head for 3 seconds?

**DORA EXAMPLE:**

1. Is Dora doing work on the bag when she lifts her backpack?
2. Is Dora doing work on the bag when she runs out the door with the backpack on?

**HINTS:**

1. What are some words that generally mean work is being done?
2. What are some words that generally mean no work is being done?
3. Any exceptions to those hints?

**WORK = FORCE \* DISTANCE**

**Notes for/from class**

1. The SI unit for work is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( \_\_\_)
   1. 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. You do 1 joule of work when you \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Practice Problems:** Show the formula. Show your work. Show your units.

1. A father plays with his daughter by lifting her in the air. How much work does he do on the child if he lifts her 2 meters and exerts an average of 190N?
2. A bicycle’s brakes apply 125N of frictional force to the wheels as the bike moves 14 meters. How much work do the breaks do on the wheel?

**POWER**

1. Power is:
2. Power Equation:

In words In symbols

1. What are the SI Units for Power? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_)

**Practice Problems:** Show the formula. Show your work. Show your units.

1. While rowing across the lake during a race, John does 3,960 joules of work on the oars in 60s. What is the rower’s power output?
2. Lifting an elevator 18 meters takes 100 kilojoules. If doing so takes 20 seconds, what is the average power of the elevator during the process? (*hint: convert to joules*)
3. If a person pushes a lawn mower with a force of 500N over a distance of 20m in 120s, what was the power required to push the lawnmower?

# Unit 7.2: Energy

**Further Reference: 13.3 What is Energy and 13.4 Conservation of Energy**

**ENERGY AND WORK**

1. Energy is “the ability \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,” or ability to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. Energy is measured in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_)
2. Each of the 7 types of energy have forms of kinetic and potential energy
   1. Potential = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Kinetic = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**The 7 Types of Energy**

|  |  |  |
| --- | --- | --- |
| Energy Type | Description | Example |
|  |  |  |
| 2. |  |  |
| 3. |  |  |
| 4. |  |  |
| 5. |  |  |
| 6. |  |  |
| 7. |  |  |

Which of these 7 types of energy have Potential forms of Energy?

So knowing that, are potential and mechanical energy acceptable answers when you are asked to list one of the 7 types of energy?

**POTENTIAL ENERGY**

**Notes for/from class**

1. Define Potential Energy (PE):
2. 2 Types:
   1. Elastic Potential Energy:
      1. Give 2 examples:
   2. Gravitational Potential Energy (GPE):
      1. Give 2 examples:
3. Gravitational Potential Energy (GPE) Equation:

In words In symbols

1. Being that GPE is a form of energy, the SI units for GPE are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Practice Problems:** Show the formula. Show your work. Show your units.

1. A 65kg rock climber ascends a cliff. What is the climber’s gravitational potential energy at a point 35m above the base of the cliff?
2. A 1.5kg baseball is traveling 8m above the ground at 14m/s. What is the gravitational potential energy of the baseball?

Q1 – What does GPE depend on?

Q2 – What does NOT affect GPE?

**KINETIC ENERGY**

1. Kinetic Energy (KE):
2. Kinetic energy depends upon \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ :
3. Kinetic Energy (KE) Equation:

In words In symbols

What are the SI Units for Kinetic Energy (KE)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Notes for/from class**

* 1. 1 joule = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

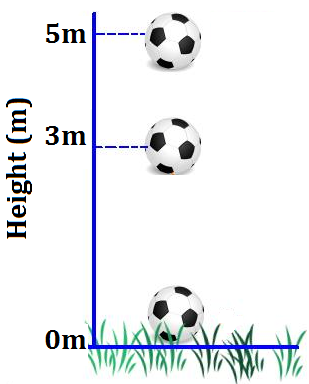
**Practice Problems:** Show the formula. Show your work. Show your units.

1. What is the kinetic energy of a 44kg cheetah running at 31 m/s?
2. A 1.5kg baseball is traveling 8m above the ground at 14m/s. What is the kinetic energy of the baseball?

**ENERGY TRANSFORMATIONS**

1. Law of Conservation of Energy: energy can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Energy can only \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the total amount of energy in a system
   2. The total or net energy of the system must \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when energy changes forms.

**SOCCER BALL EXAMPLE: Law of Conservation of Energy**

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Soccer ball = 4kg.

1. Before the Drop @ 5 meter height:
   1. GPE = \_\_\_\_\_\_\_\_\_\_\_\_\_ because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. KE = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Mid Drop @ 3 meter height
   1. GPE = \_\_\_\_\_\_\_\_\_\_\_\_\_ because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. KE = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. At Impact with Ground @ 0 meter height
   1. GPE = \_\_\_\_\_\_\_\_\_\_\_\_\_ because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. KE = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. For an object that is simply going to fall, GPE at the \_\_\_\_\_\_\_\_\_\_\_\_ will be equal to KE \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. Because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ROLLER COASTER: Law of Conservation of Energy**

**Notes for/from class**

1. The initial energy of the car is stored as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at the top of the hill.
   1. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ changes into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as the car travels downhill.
   2. At the bottom of the lowest hill, the car has the most \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the least \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. As it travels back up the hill, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turns into \_\_\_\_\_\_\_\_\_\_\_\_\_
2. But this is NOT a PERFECT TRANSFORMATION
   1. Each time a roller coaster car moves, energy is converted into \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, in addition to the GPE and KE.

**Practice Problems:** Energy Transformations

In every energy transformation, there is a form of energy that the item starts with and a different form (or more than 1 form) of energy that the item ends with. Tell me the starting energy, and the ending energy that shows up after the transformation

A Lightbulb Starts with: \_\_\_*electrical*\_\_\_ Desired Energy: \_\_\_\_\_*light* \_\_\_\_\_\_ “Waste” Energy: \_\_\_*heat* \_\_\_

A Fan Starts with: \_\_\_\_\_\_\_\_\_\_\_\_\_ Desired Energy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ “Waste” Energy: \_\_\_\_\_\_\_\_\_

A Battery Starts with: \_\_\_\_\_\_\_\_\_\_\_\_\_ Desired Energy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ “Waste” Energy: \_\_\_\_\_\_\_\_\_

A Fire Starts with: \_\_\_\_\_\_\_\_\_\_\_\_\_ Desired Energy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ “Waste” Energy: \_\_\_\_\_\_\_\_\_

A Glowstick Starts with: \_\_\_\_\_\_\_\_\_\_\_\_\_ Desired Energy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ “Waste” Energy: \_\_\_\_\_\_\_\_\_

# Unit 7.3: Nuclear Energy (Fission, Fusion, Uses, and Problems)

**Notes for/from class**

**Further Reference: 10.2 - Nuclear Fission and Fusion and 10.3 Radiation Today**

**NUCLEAR STABILITY**

1. The stability of a nucleus depends on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ forces that hold the \_\_\_\_\_\_\_\_\_\_\_ together. These forces act between \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_
   1. Nuclei are held together by a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force.
   2. This force causes \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_ in the nucleus to \_\_\_\_\_\_\_\_\_\_ one another.
2. Nuclei with too many \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_ are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. If an atom is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, it will try to become stable by

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**FISSION**

1. Fission is the process where:
   1. The nucleus must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for this to happen. Ex: \_\_\_\_\_\_\_\_\_
2. Draw the equation starting with:
   1. 23592U + \_\_\_\_\_\_\_\_\_ 🡪 \_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_ + ENERGY
3. Fission is done in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are used as bullets to break apart \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. The 3 products of a fission reaction are:
      1. .
      2. .
      3. .
5. **Chain Reaction:** The Neutrons released by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can start a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a different U-235 nucleus.
   1. This process may be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (ex: nuclear power plants / subs)
   2. This process may be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (ex: nuclear weapons)
6. They (Hahn and Strassman) found that the overall mass \_\_\_\_\_\_\_\_\_\_\_\_\_\_ after the reaction. The missing mass must have been changed into \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   1. This process is explained by the special theory of relativity (*E = mc2*)

**NUCLEAR FUSION**

1. Fusion is the process where:
2. Fusion starts with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Fusion ends with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Fusion occurs in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. A large amount of \_\_\_\_\_\_\_\_\_\_\_\_\_ is needed to start a \_\_\_\_\_\_\_\_\_\_\_\_, because all nuclei are \_\_\_\_\_\_\_\_\_\_\_ charged and \_\_\_\_\_\_\_\_\_\_\_\_ each other.

**WHAT/WHERE IS RADIATION?**

**Notes for/from class**

1. Radiation is:
   1. Background radiation is:
   2. We are continually exposed to radiation from \_\_\_\_\_\_\_\_\_\_, such as \_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_.
   3. More than \_\_\_\_\_\_\_ of the background radiation comes from \_\_\_\_\_\_\_\_\_\_\_.

**Nuclear Energy Day 2 Information: Uses, Pros, and Cons:**

1. Nuclear Medicine is:
   1. List 2 pros for nuclear medicine:

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* 1. List 2 cons for nuclear medicine:

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1. Nuclear Weapons are an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fission reaction
2. Nuclear reactors are a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fission reaction
   1. In nuclear power plants, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are used to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fission by \_\_\_\_\_\_\_\_\_\_ the chain reaction.
3. Explain, in 3 general steps, how a nuclear power plant converts nuclear energy into electrical energy:

1 –

2 –

3 –

4 –

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the energy produced in the United States is Nuclear Energy.
   1. In South Carolina, nuclear accounts for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of our energy.
2. List 4 Benefits of Nuclear Power Plant Energy:
3. List 4 Negatives to Nuclear Power Plant Energy: