

NAME \_\_\_\_\_ PERIOD \_\_\_\_\_ DATE \_\_\_\_\_

WORK, POWER, & ENERGY  
STUDY GUIDE

**INSTRUCTIONS:**

Study Points memo (circle each number as you study)

1=I have started studying this study point

2=I am understanding this study point

3=I have mastered this study point

Darken the  once you understand the study point statements that follow.

Ask someone to read each study point that follows the , and you say the italicized word(s).

**1 2 3** When a force acts on an object to cause a displacement of the object, **work** is done on the object. In order for a force to qualify as having done **work** on an object, there must be a displacement and the force must **cause** the displacement.

- If a force acts on an object parallel to the direction of motion, *work is done.*
- If a force acts on an object perpendicular to the direction of motion, *no work is done.*

**1 2 3** Work (W) can be expressed by the following equation.

$$W = F * d * \cos \theta$$

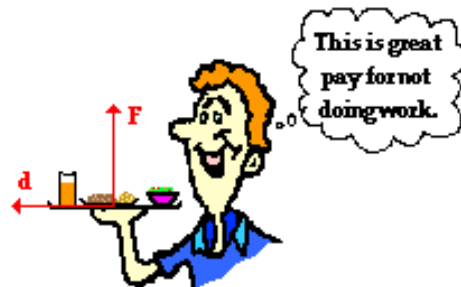
where **F** is the force, **d** is the displacement, and the angle (**theta**) is defined as the angle between the force and the displacement vector.

The **Joule** is the unit of work     $1 \text{ J} = 1 \text{ N} * \text{m}$

**+ Work**       $\frac{d}{F}$      $\theta = 0 \text{ degrees}$

**- Work**       $\frac{d}{F}$      $\theta = 180 \text{ degrees}$

**No Work**     $\frac{d}{F}$      $\theta = 90 \text{ degrees}$



- Work (W) is measured in *Joules.*

Student Notes

---

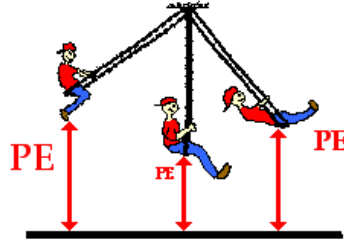
---

---

**1 2 3** Gravitational potential energy  $PE_g$  is the energy stored in an object as the result of its vertical position or height. The **gravitational potential energy** of an object is dependent on two variables - the mass of the object and the height to which the object is raised.

$$PE_g = m \cdot g \cdot h$$

In the above equation, **m** represents the mass of the object, **h** represents the height of the object and **g** represents the gravitational field strength (9.8 N/kg on Earth) - sometimes referred to as the acceleration of gravity.



- Gravitational potential energy ( $PE_g$ ) is measured in **Joules**.
- You decide to run up the stairs to class instead of walking. Your gravitational potential energy on the second floor after running up the stairs is **the same** as if you had walked up the stairs.
- The higher that an object is elevated, the **greater** the gravitational potential energy.
- The gravitational potential energy of an object is equal to the **work done on an object to put it in position**.
- You decide to run up the stairs to class instead of walking. The work you did running up the stairs is **the same** as the work you would have done walking up the stairs.

Student Notes

---

---

---

---

---

---

---

---

**1 2 3** Kinetic energy is the energy of motion. The amount of kinetic energy that an object has depends upon two variables: the mass (m) of the object and the speed (v) of the object. The following equation is used to represent the kinetic energy (KE) of an object.

$$KE = \frac{1}{2} * m * v^2$$

where m = mass of object and v = speed of object

- Kinetic energy (KE) is measured in *Joules*.
- As an object is lifted at constant speed, its kinetic energy *remains the same*.
- The kinetic energy (KE) of an object is equal to *the work done to accelerate the moving object from rest*.
- If the velocity of an object is doubled, the kinetic energy of the object is *quadrupled*.

**Power** is the rate at which work is done. The following equation is used to represent power:

$$Power = \frac{Work}{time}$$

The standard metric unit of power is the Watt. A Watt is equivalent to a Joule/second.

**Power is also equal to force multiplied by speed.  $P = F * v$**



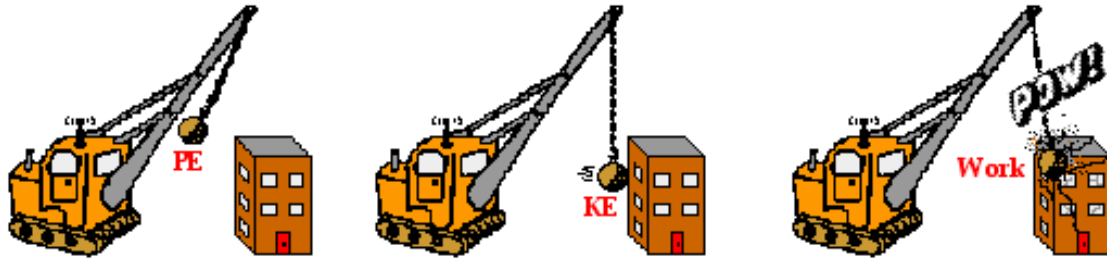
**Rock climbers do a lot of work at a slow rate; their power is small.**

- Power is measured in *Watts*.
- If the speed is halved with no change in force, the power is also *halved*.

**1 2 3**      **Mechanical energy is the energy that is possessed by an object due to its motion or due to its position.** Mechanical energy can be either **kinetic energy** (energy of motion) or **potential energy** (stored energy of position).

**Mechanical Energy is the Ability to Do Work**

An object that has mechanical energy is defined as an object that has the ability to do work. That is, its mechanical energy enables that object to apply a force to another object in order to cause it to be displaced.



**The massive ball of a demolition machine possesses mechanical energy - the ability to do work. When held at a height, it possesses mechanical energy in the form of potential energy. As it falls, it exhibits mechanical energy in the form of kinetic energy. As it strikes the structure to be demolished, it applies a force to displace the structure - i.e., it does work upon the structure.**

- While an object is rising after being thrown upward from the Earth's surface, the object's kinetic energy will *decrease*.
- While an object is rising after being thrown upward from the Earth's surface, the object's gravitational potential energy will *increase*.
- Two objects with different masses that are dropped at the same time and from the same height will have *different* kinetic energies during fall.
- As an object is in free fall towards the Earth's surface, *gravitational potential energy* is converted to *kinetic energy*.

Student Notes

---

---

---

---

---

---