Unit 6 Lessons 1 – 5 Study Guide

Unit 6 Lesson 1-5 Vocabulary

Lesson	Term	Definition
1	Chemical Energy	A form of potential energy stored in chemical bonds
1	Electrical Energy	
1	Energy	The ability or capacity to do work
1	Energy Sources	
1	Energy Transformation	The conversion of energy from one form to another
4, 5	Gravitational Potential Energy	
1, 2	Joule	The SI unit that measures energy
3, 4, 5	Kinetic Energy	
1	Law of Conservation of Energy	A law of physics that says that energy cannot be created or destroyed, but it can be transformed
1	Light Energy	
1	Mechanical Energy	The energy of motion and position
1	Nuclear Energy	
4, 5	Potential Energy	Stored energy that is associated with the position of an object
2	Power	
1	Sound Energy	Energy produced when matter vibrates
2	Watt	The SI unit of power (energy per time), equal to one joule per second (1 J/s)
1, 2	Work	
4	Elastic Potential Energy	Energy stored due to a change in shape in a material that tends to return to its original shape
5	Amplitude	A measure of how far the pendulum is offset from a vertical position when it is released
5	Arm	The arm of the pendulum is the string or bar that attaches the bob to the pivot; its length is measured from the pivot to the center of the bob
5	Bob	
5	Period	The time it takes, in seconds, for a pendulum to complete a full swing – moving from one side to the other and back again
5	Pivot	

Lesson 1: Energy

What is Energy?

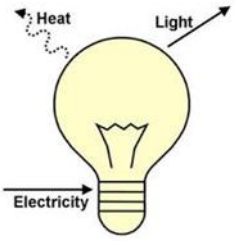
- **Energy** – the ability to do _____
    - Changes in the physical world are possible because of energy: change in speed, change in direction, change in temperature, etc.

Forms of Energy

- **Mechanical Energy** – the energy of motion and position
- **Chemical Energy** – energy stored in chemical bonds
- **Electrical Energy** – associated with electric charges; electrons moving
- **Sound Energy** – caused due to the vibration of objects or matter
- **Light Energy** – a form of electromagnetic energy; vibration of electrically charged particles which sends light energy out into the space around them
- **Nuclear Energy** – when atoms are split during nuclear fission

Conservation of Energy

- **Law of Conservation of Energy** – states that energy can neither be _____ nor destroyed, but can be transformed
    - Energy can be transferred from place to place and can be converted between the different forms of energy
    - When transferred or converted the amount of energy does not change, it is _____



Energy Transformed

- Energy transformations take place when energy _____ from one form to another
    - Example: Gasoline contains chemical energy.
        - When it is burned, it is _____ into heat energy and mechanical energy.
            - ➢ No energy is lost or gained!

Energy Sources

- **Renewable Sources**: can be replaced (in a lifetime);
    - Examples: _____, _____, _____, _____
- **Non-renewable Sources**: cannot be replaced (in a lifetime);
    - Examples: **coal, oil, natural gas, uranium**

Measuring Energy

- **Joule –** is the SI unit for _____; 1 joule (J) = 1 Newton-meter (N-m)
    - one joule of energy is used when a force of one Newton is applied over a distance of one meter
        - called a Newton-meter or a joule (J)

Lesson 2: Work

What is Work?

- **Work** is when a _____ is exerted on an object and the object **moves** a distance in the direction of the force

Work Depends on Force and Distance

- *W* = Fd (Note: the *W* is in italics)
- Work = Force x distance
    - *W* (work) = How much **work** needs to be done to move a book with a force of 10 Newtons a distance of 1 meter?
    - F (Force) = 10 Newtons or 10 N
    - d (distance) = 1 meter or 1 m
        - *W* = 10 N x 1 m
        - *W* = ___ N-m or ___ joules or ___ J

Work and Time

- Work does not take into account the _____ it takes to complete a task: *W* = Fd
- If you do the work of moving a book using 10 N of force a distance of 1 meter in 2 seconds or 10 seconds or 50 seconds, you will still do 10 joules of work.

Power:

- Power = the rate at which work is done
- P = *W*/t
- Power = Work/time
    - Power = How much **power** is needed to cut down a tree if using a hand saw or a chain saw?
        - Both a hand saw and a chain saw will do the same amount of work (joules)
            - The chain saw will do the work faster; faster means more power.

The Watt

- P = W/t which means power is work (joules) divided by time (seconds) or joules per second or J/s
- Joules per second (J/s) is the SI unit of _____, also called **watts** or W (Note: the W is NOT in italics)

Calculating Power

- P = *W*/t
- Power = Work/time
    - P (power) = How much power is needed to move a book using 10 J in 2 seconds?
    - *W* (work) = 10 joules or 10 J
    - t (time) = 2 seconds or 2 s
        - P = 10 J / 2 s
        - P = ___ J/s or ___ watts or ___ W

Power and Energy

- **Power** is the rate at which _____ is done
    - **Work requires energy**
        - Therefore, **power** can also be defined as the rate at which _____ is used

Lesson 3: Kinetic Energy

What is Kinetic Energy?

- Kinetic Energy (KE) is the energy an object has while it is in _____;
  - it is the energy that enables moving objects to perform work on other objects;
  - When a moving object stops moving its kinetic energy is _____.

Kinetic Energy Depends on Mass

- The amount of kinetic energy (KE) of a moving object depends on its _____
  - Consider throwing a baseball versus a ping pong ball at a pyramid of cans –which one will have a greater impact on the cans? The baseball! (More mass!)

Kinetic Energy Depends on Speed

- The amount of kinetic energy (KE) of a moving object depends on _____
  - Consider you throwing a baseball versus a professional pitcher throwing a baseball at a pyramid of cans –which one will have a greater impact on the cans? Pitcher! More speed!

Comparing Kinetic Energies

- **Two cars of the same mass** –Car #1 is moving slowly through town and Car #2 is moving at a high rate of speed on an open highway:
  - Which one has more kinetic energy? _____
- **Two vehicles moving at the same high rate of speed** on an open highway –Vehicle #1 is a small car and Vehicle #2 is a tractor-trailer:
  - Which one has more kinetic energy? _____

Kinetic Energy Equation

- $KE = ½mv^2$
- Kinetic Energy = ½ (mass) $(speed)^2$ …NOTE: v = speed, velocity without direction

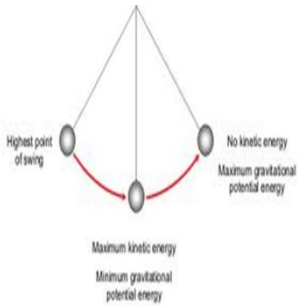
Calculating Kinetic Energy

- $KE = ½mv^2$
- Kinetic Energy = ½ (mass) $(speed)^2$
  - KE (Kinetic Energy) = How much kinetic energy is needed to move a book using 10 J in 2 s?
  - m (mass) = 0.05 kg
  - v (speed) = 2 meters/seconds or 2 m/s
    - $KE = ½ \times 0.05kg \times (2m/s)^2$
    - $KE = 0.025kg \times 4m^2/s^2$
    - KE = _____ J … or _____ joules of kinetic energy

Changes in Kinetic Energy

- Imagine throwing a ball up into the air, when would the kinetic energy –the energy of the ball's motion- be greatest? **Right at the beginning and end of its flight**
- Imagine throwing a ball up into the air, when would the kinetic energy –the energy of the ball's motion- be the least? **At the highest point**

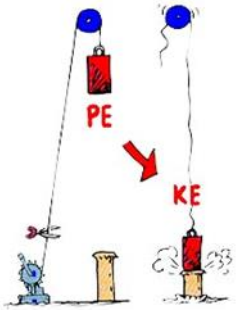
Kinetic Energy of a Pendulum



- Imagine a swinging pendulum (or a child on a swing)…
  - When would the pendulum reach its maximum speed?
    _____ of swing
  - When would the pendulum have its greatest kinetic energy?
    _____ of swing
  - When would the pendulum have no kinetic energy?
    _____ of the swing

Lesson 4: Potential Energy

What is Potential Energy?



- **Potential Energy** - _____ energy an object has due to position or shape; when objects are NOT moving

Elastic Potential Energy

- **Elastic Potential Energy** (EPE) – is stored energy in a _____ object that can be bent, stretched or compressed from its natural shape
- Examples: bow and arrow, mousetrap

Gravitational Potential Energy

- **Gravitational Potential Energy** (GPE) – is stored energy due to an objects _____ and have the potential to fall due to the force of gravity; a property of elevated objects
- Examples: objects that fall!

Gravitational Potential Energy Equation

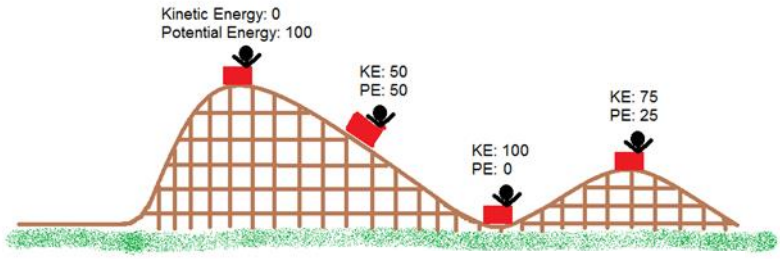
- The amount of GPE an object has depends on the object's weight (N) and height above the floor (m)
- PE = w x h
- Gravitational Potential Energy = weight x height
  - Weight (w) = mg or mass (kg) x acceleration due to gravity (m/s^2)
- Therefore, PE = m x g x h
- Gravitational Potential Energy = mass x acceleration due to gravity x height
  - PE (Potential Energy) = How much potential energy is in a ball with a mass of 0.16kg tossed to a height of 4.0 m above the floor?
  - m (mass) = 0.16 kg
  - g (acceleration due to gravity) = 9.8 m/s^2
  - h (height) = 4 m
    - PE = m x g x h
    - PE = (0.16kg) (9.8m/s^2) (4 m)
    - PE = _____ kg m^2/s^2
    - PE = _____ J

Converting Potential Energy to Kinetic Energy

- **Objects at rest** have **potential energy** due to <u>shape</u> or _____
- A change in shape or position can set the object in _____
- **Objects in motion** have **kinetic energy**
- Therefore, **potential energy** can be _____ into **kinetic energy**

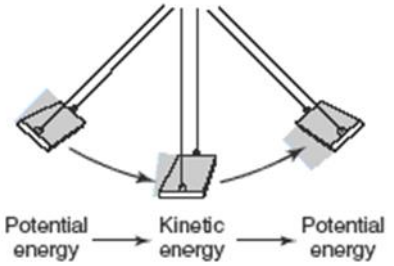
Changes in Potential and Kinetic Energy

- Changes in potential and kinetic energy can be _____
- Imagine a roller coaster, as it CLIMBS a hill
    - The roller coaster is lifted against the force of gravity; **increasing** its potential energy;
    - The roller coaster also has kinetic energy because it is moving, however the kinetic energy is **decreasing** as it climbs the hill
- When the roller coaster reaches the top of the hill, it **stops moving** for a moment
    - Potential Energy is 100 (the max)
    - Kinetic Energy is 0 (the lowest)
- When the roller coaster goes DOWN the hill
    - The Potential Energy _____
    - The Kinetic Energy _____
- The Roller Coaster's potential energy is: elastic or gravitational? gravitational



Potential and Kinetic Energy of a Pendulum

- **Kinetic Energy** increases as the pendulum swings _____ and decreases as it swings upward
    - Kinetic energy is greatest when the pendulum is moving fastest
- **Potential Energy** increases as the pendulum swings upward and decreases as it swings _____
    - Potential energy is greatest when the pendulum's at the highest point



Conservation of Energy

- When Kinetic Energy increases, Potential Energy decreases
- When Potential Energy increases, Kinetic Energy decreases
- **Law of Conservation of Energy** – states that energy can neither be created nor destroyed, but can be _____

Lesson 5: LAB: The Pendulum

What is a Pendulum?

- **Pendulum** – object that moves back and forth in a constant amount of _____

Parts of a Pendulum

- **Pivot** – the point where the pendulum is attached to a non-moving _____
- **Bob** – the mass attached to the bottom of the _____
- **Arm** – the string or bar that attaches the bob to the pivot; the _____ of the arm is measured from the pivot to the center of the bob

Pendulum in Motion

- **Period** – the time it takes, in seconds, for a complete, _____ swing of the pendulum – moving from one side to the other and back again
- **Amplitude** – a measure of how _____ the pendulum is offset from a vertical position when it's released