

Work and Energy Problem Solving

Objective: Learn to calculate work, power and thermal energy.

Introduction: Energy is the ability to do work. Parts A, B, and C will be completed as a class.

Complete the summary on your own.

Part A Work = Force x Distance

The work done on an object is equal to the force applied to the object multiplied by the distance the object moves. The metric unit for work is the _____

Example: A 20 newton force is required to push a box across the floor. If the box is pushed a distance of 100 meters calculate the work done.

To find the work multiply the force by the distance.

Work = force \times distance

Work = _____ \times _____ = _____ joules

Guided Practice

Find the work done by a person who lifts a heavy box a distance of 2 meters. The box weighs 40 newtons.

Work = force \times distance

Work = _____ \times _____ = _____ joules

Independent Practice

A 100 newton force is required to push a football player backwards. Find the work done if the football player is pushed back a distance of 50 meters.

Work = _____ \times _____ = _____ joules

Part B Power = work / time

Power is the rate that work is done. The metric unit of power is the _____

One watt = one joule per _____, where the joule is the metric unit for _____. Electrical power is measured in watts. For example a 60 watt light bulb uses energy at a rate of _____ watts.

Example

Find the power if 2000 joules of work are done during a time of 10 seconds. Determine the power by dividing the work by the time.

Power = work / time Power = 2000 / 10 = 200 watts

Guided Practice

Find the power if 6000 joules of work are done during a time of 60 seconds.

Power = work / time Power = (_____) / (_____) = _____ watts

Independent Practice

Find the power if 120 joules of work are done during a time of 30 seconds.

Power = work / time Power = (_____) / (_____) = _____ watts

Part C Thermal Energy (Q) = mass x temperature change x specific heat

This is also written: $Q = m \times \Delta T \times C$. Remember: Q is thermal energy or heat, m is mass, ΔT is the temperature change, and C is specific heat ($C = 1$ for water).

Thermal energy (also called heat) is required to change the temperature of an object. Thermal energy must be added to increase the temperature. Thermal energy must be removed to decrease the temperature. The temperature change, (ΔT), is just the difference between the two temperatures (found by subtracting the final temperature from the beginning temperature.)

The specific heat is different for different substances. The specific heat for water is _____ calorie per gram per °C (degrees Celsius). The calorie is the metric unit for _____ energy. (The joule is also a metric unit for work or energy.)

Example

Find the thermal energy required to raise the temperature of 100 grams of water from 20°C up to 90°C.

Use the formula $Q = m \times \Delta T \times C$

To find the thermal energy (Q) use mass (m) times change in temperature (ΔT) times specific heat (C) or $Q = 100 \times (90 - 20) \times 1 = 100 \times 70 \times 1 = 7,000$ calories

Guided Practice

Find the thermal energy required to raise the temperature of 200 grams of water from 10°C up to 90°C.

Formula: $Q = m \times \Delta T \times C$

Calculation: Thermal energy (Q) = _____ x _____ x _____ = _____ calories

Independent Practice

Find the thermal energy required to raise the temperature of 100 grams of water from 20°C up to 80°C.

Thermal energy (Q) = _____ x _____ x _____ = _____ calories

Summary: Describe how to calculate each of the following.

a. Work _____

b. Power _____

c. Thermal Energy (Heat) _____