COLEGIO CEMEP

Physics – 6th Grade High School
Project 2 – October 2017
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You'd probably agree that it's hard work to pull a heavy sofa across the room, to lift a stack of encyclopedias from the floor to a high shelf, or to push a stalled car off the road. Indeed, all of these examples agree with the everyday meaning of work—any activity that requires muscular or mental effort. What it means for a force to do work on a body? And how to calculate the amount of work done?

1. **Energy and Work.**

What will you achieve at the end of this purpose?

Synthesize, analyze, interpret, and evaluate qualitative and/or quantitative data; solve problems involving quantitative data; determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory; identify sources of bias and/or error; and suggest improvements to the inquiry to reduce the likelihood of error.

Use appropriate terminology related to energy and momentum, including, but not limited to: work, work energy theorem, kinetic energy, and gravitational potential energy.

Solve problems involving the relationship between power, energy, and time.

Pool of Knowledge: 09/29/2017 **Due Date: 10/02/2017**

Activities:

1.1 Respond the following conceptual questions.

a. Can kinetic energy be negative? Explain.

b. Can a normal force do work? If not, why not? If so, give an example.

c. Cite two examples in which a force is exerted on an object without doing any work on the object.

1.2 Search the meaning of the following concepts.

a. Work.

b. Energy.

c. Power

1.3 Using a diagram, explain the relationship between Work and Energy.

1.4 Solve the following exercises:

a. You push your physics book 1.50 m along a horizontal tabletop with a horizontal push of 2.40 N while the opposing force of friction is 0.600 N. How much work does each of the following forces do on the book: (a) your 2.40-N push, (b) the friction force, (c) the normal force from the tabletop, and (d) gravity? (e) What is the net work done on the book?

b. A worker pushes a wheelbarrow with a horizontal force of 50 N on level ground over a distance of 5.0 m. If a friction force of 43 N acts on the wheelbarrow in a direction opposite that of the worker, what work is done on the wheelbarrow by the worker? **(a) 250 J (b) 215 J (c) 35 J (d) 10 J (e) None of those answers is correct.**

c. **Meteor Crater**. About 50,000 years ago, a meteor crashed into the earth near present-day Flagstaff, Arizona. Measurements from 2005 estimate that this meteor had a mass of about 1.4×10^8 kg (around 150,000 tons) and hit the ground at a speed of 12 km/s. (a) How much kinetic energy did this meteor deliver to the ground? (b) How does this energy compare to the energy released by a 1.0-megaton nuclear bomb? (A megaton bomb releases the same amount of energy as a million tons of TNT, and 1.0 ton of TNT releases 4.184×10^9J of energy.)

d. A sled with mass 8.00 kg moves in a straight line on a frictionless horizontal surface. At one point in its path, its speed is 4.00 m/s; after it has traveled 2.50 m beyond this point, its speed is 6.00 m/s Use the work–energy theorem to find the force acting on the sled, assuming that this force is constant and that it acts in the direction of the sled's motion.

e. A 3.00-kg object has a velocity (16.00 i - 2.00 j) m/s. (a) What is its kinetic energy at this moment? (b) What is the net work done on the object if its velocity changes to (18.00 i + 4.00 j) m/s? (Note: From the definition of the dot product, v^2= vS .vS.)

f. How many joules of energy does a 100-watt light bulb use per hour? How fast would a 70-kg person have to run to have that amount of kinetic energy?

g. A tandem (two-person) bicycle team must overcome a force of 165 N to maintain a speed of 9.00 m/s. Find the power required per rider, assuming that each contributes equally. Express your answer in watts and in horsepower.

2. Thermodynamics

What will you achieve at the end of this purpose?

Synthesize, analyze, interpret, and evaluate qualitative and/or quantitative data; solve problems involving quantitative data; determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory.

Describe the contributions of scientists to the fields under study.

Explain the energy transformations that occur with reference to the laws of thermodynamics.

Pool of Knowledge: 10/06/2017 **Due Date: 10/09/2017**

Activities:

2.1 What states the 1st Law and the 2nd Law of Thermodynamics?

2.2 Search the meaning of the following concepts.

a. Temperature.
b. Heat
c. Specific Heat.
d. Calorimetry.

2.3 Solve the following exercises:

a. Convert the following Celsius temperatures to Fahrenheit: (a) -62.8°C the lowest temperature ever recorded in North America (February 3, 1947, Snag, Yukon); (b) 56.7°C, the highest temperature ever recorded in the United States (July 10, 1913, Death Valley, California); (c) 31.1°C, the world's highest average annual temperature (Lugh Ferrandi, Somalia).
b. The Humber Bridge in England has the world's longest single span, 1410 m. Calculate the change in length of the steel deck of the span when the temperature increases from -5.0°C to 18.0°C.
c. A U.S. penny has a diameter of 1.9000 cm at 20.0°C. The coin is made of a metal alloy (mostly zinc) for which the coefficient of linear expansion is 2.6×10^{5} K^{-1}.What would its diameter be on a hot day in Death Valley (48.0°C)? On a cold night in the mountains of Greenland (-53°C)?
d. You are given a sample of metal and asked to determine its specific heat. You weigh the sample and find that its weight is 28.4 N. You carefully add 1.25×10^{4}J of heat energy to the sample and find that its temperature rises 18.0 C°. What is the sample's specific heat?

3. Electricity.

What will you achieve at the end of this purpose?

Analyze the efficiency and the environmental impact of one type of electrical energy production and propose ways to improve the sustainability of electrical energy production.

Analyse diagrams of series, parallel, and mixed circuits with reference to Ohm's law (V = IR) and Kirchhoff's laws.

Distinguish between alternating current (AC) and direct current, and explain why alternating current is presently used in the transmission of electrical energy.

Pool of Knowledge: 10/13/2017 **Due Date: 10/16/2017**

Activities:

3.1 Answer the following questions:

a. What does it states the Coulomb's Law?

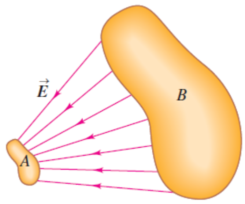
b. What are electric fields?

c. What's the value of the magnitude of charge of a proton or an electron?

d. Your clothing tends to cling together after going through the dryer. Why? Would you expect more or less clinging if all your clothing were made of the same material (say, cotton) than if you dried different kinds of clothing together? Again, why? (You may want to experiment with your next load of laundry.)

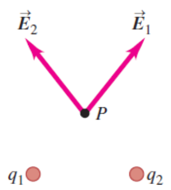
e. Two irregular objects A and B carry charges of opposite sign. Figure Q21.19 shows the electric field lines near each of these objects. (a) Which object is positive, A or B? How do you know? (b) Where is the electric field stronger, close to A or close to B? How do you know?

Figure **Q21.19**



f. The electric fields at point due to the positive charges q1 and q2 are shown in Fig. Q21.22. Does the fact that they cross each other violate the statement that electric field lines never cross? Explain.

Figure **Q21.22**



3.2 Solve the following exercises:

a. Suppose that two point charges, each with a charge of +1.00 Coulomb are separated by a distance of 1.00 meter. Determine the magnitude of the electrical force of repulsion between them.
b. Two balloons are charged with an identical quantity and type of charge: -6.25 nC. They are held apart at a separation distance of 61.7 cm. Determine the magnitude of the electrical force of repulsion between them.
c. Neurons are components of the nervous system of the body that transmit signals as electrical impulses travel along their length. These impulses propagate when charge suddenly rushes into and then out of a part of the neuron called an axon. Measurements have shown that, during the inflow part of this cycle, approximately 5.6×10^{11} Na^{+} (sodium ions) per meter, each with charge +e, enter the axon. How many coulombs of charge enter a 1.5-cm length of the axon during this process?
d. A particle has charge -3.00 nC. (a) Find the magnitude and direction of the electric field due to this particle at a point 0.250 m directly above it. (b) At what distance from this particle does its electric field have a magnitude of 12.0 N/C?

4. Modern Physics- Quantum Mechanics.

What will you achieve at the end of this purpose?

Analyse the development of the two major revolutions in modern physics and assess how they changed scientific thought.

Use appropriate terminology related to quantum mechanics and special relativity, including, but not limited to: quantum theory, photoelectric effect, matter waves, time dilation, and mass–energy transformation.

Describe the experimental evidence that supports a wave model of matter.

Pool of Knowledge: 10/20/2017 **Due Date: 10/23/2017**

Activities:

4.1 Answer the following questions:

a. Explain what's the Wave Fuction?
b. Explain what are microscopic and macroscopic particle in boxes?
c. Explain the Schrödinger Equation?
d. What happens in a particle in a well of finite height?
e. Explain the Tunneling Through a Potential Energy Barrier.
f. What's a nuclear fusion?
g. What's a Scanning Tunneling Microscope?
h. How do the Resonant Tunneling Devices work?
i. How do the Resonant Tunneling Transistors work?
j. If quantum mechanics replaces the language of Newtonian mechanics, why don't we have to use wave functions to describe the motion of macroscopic bodies such as baseballs and cars?
k. If a particle is in a stationary state, does that mean that the particle is not moving? If a particle moves in empty space with constant momentum and hence constant energy $E = p^2/2m$, is it in a stationary state? Explain your answers.

4.2 Draw and name its parts.

a. A Resonant Tunneling Device.
b. A Resonant Tunneling Transistor.
c. A representation of a wave function.
d. A representation of a finite potential well.
e. A representation of Potential barriers and tunneling: