Study Guide – Work, Power & Machines Name:______________________________

1. **WORK**:
   a. Define *work*:

   b. Work can also be defined as a transfer of _______________.

   c. In order for work to be done, force and displacement must be in the __________________ direction.

   d. Give one example in which work is done:

   e. Give one example in which work is <u>not</u> done:

   f. For the following 3 scenarios, explain why work *is* or *is not* done:
   - A woman preparing for a trip lifts her suitcase from the floor to the bed so that she may pack more easily.

   - A man spends 5 minutes thinking about the most efficient way to decorate his roof with Christmas lights.

   - A student carries his book bag down the hallway.

   g. Identify which of the pairs in each scenario illustrates *more* work being done:
   _____ A boy helps a teacher by lifting a 200-N box of books 1.5 meters from the floor to the desktop.
   _____ The same boy lifts a 500-N box of books the same height.
   <u>Explain your choice:</u>

   _____ A girl throws a 1-kg softball with a force of 50 Newtons a distance of 25 meters.
   _____ The same girl throws the softball with the same force a distance of 17 meters.
   <u>Explain your choice:</u>

   h. The formula for calculating work is ____________________, and the unit for work is the ______________.

2. **POWER:**
   a. Define *power*:

   b. How are power and work related?

   c. Identify which of the pairs in each scenario illustrates *less* power being generated:
   _____ A woman pushes a cart with 95 N of force 3 m in 10 seconds.
   _____ A man pushes a cart with 95 N of force 3 m in 13 seconds.
   <u>Explain your choice:</u>

   _____ A 340-N student climbs the stairs in 14 seconds.
   _____ A 420-N student climbs the stairs in 14 seconds.
   <u>Explain your choice:</u>

   d. The relationship between power, force and velocity is ____.

3. **MACHINES:**
   a. A machine is a device that ____.

   b. The 6 simple machines include:

   c. The 2 simple machines that are a modified version of the inclined plane are ____________________ and ____________________.

d. The work input for a machine is ____, while the output is ______________________________.

e. If work input is not equal to work output for a machine, how does the Law of Conservation of Energy explain this "lost" energy?

f. Why is no machine 100 % efficient, or greater than 100 % efficient?

g. The efficiency of a machine can be calculated by ______________________________________.

h. Calculate the efficiency of the following machines:
   - 1200 N of force are used to push a lever down 1.3 m. The lever raises a 1450-N boulder 0.4 m.

   - A machine that places the caps on plastic soda bottles requires 25 kJ of input work. The output work of the machine is 23 kJ.

i. Define *mechanical advantage*:

j. Fill in the blanks with either IMA (Ideal Mechanical Advantage) or AMA (Actual Mechanical Advantage).
   ___________ the advantage a machine could provide in a perfect world
   ___________ depends on position of the machine's parts
   ___________ depends on forces involved in use of the machine
   ___________ the advantage a machine provides when used in the real world

k. Provide the appropriate formulas for each type of mechanical advantage, and include what the variables mean:

   IMA = ____________________   AMA = ____________________

l. Determine the ***ideal*** and ***actual mechanical advantage*** for each of the following machines:
   - A lever has an effort arm with a length of 2 m and a resistance arm with a length of 0.5 m. When 900 N of force are applied to the lever, a 1750-N load is raised 0.3 m.

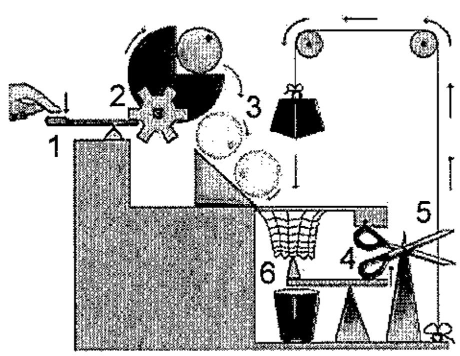
   IMA =   AMA =

   - An engineer is designing a wheelchair ramp for a new school building. She designs a 25-m ramp to help disabled staff and students travel the 3.5 m from the ground to the school's entrance. With her design, a student in his wheelchair with a combined weight of 590 N only has to exert about 90 N of force to climb the ramp.

   IMA =   AMA =

m. Identify and label the different simple machines used in the complex machine to the right:

   1 -
   2 -
   3 -
   4 -
   5 -
   6 –



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