Simple Machines Review

ELF ← levers, what class
3 2 1

7J   .7 × 100%
                        70%

Important Equations:

Work = $F \times D$

(Actual) Mechanical Advantage = $\dfrac{\text{Output force}}{\text{input force}}$ Efficiency = $\dfrac{\text{Output work}}{\text{Input work}} \times 100\%$ 10J

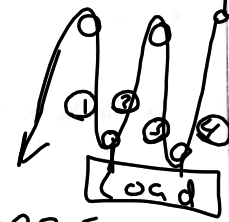Ideal Mechanical Advantage Inclined Plane = $\dfrac{\text{length of ramp}}{\text{height of ramp}}$

Mechanical Advantage Wedge = $\dfrac{\text{length}}{\text{width}}$

Mechanical Advantage Screw = $\dfrac{\text{circumference}}{\text{distance between threads}}$

Mechanical Advantage Lever = $\dfrac{\text{distance } E \leftrightarrow F}{\text{distance } L \leftrightarrow F}$

Mechanical Advantage Wheel and Axle = $\dfrac{\text{radius of wheel}}{\text{radius of axle}}$
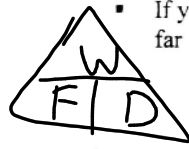
Mechanical Advantage Pulley = # of supporting ropes

Load

- A __machine__ is a device that allows you to do work in a way that is easier or more effective.

.50.
×100%
50%

- __Work__ is done on an object when the object moves in the same direction in which the force is exerted.

You exert a force of 62N to lift a box onto a table that is 0.5 m tall. How much work is done?

31 J $W = F \times D$

with a force of

- If you did 84 Joules of work to push a chair across the living room and the chair weighed 20 N, then how far did you push the chair?

$$D = \frac{W}{F} = \frac{84J}{20N} = 4.2 \text{ m}$$

$\triangle \dfrac{W}{F \mid D}$

- The amount of **work** done is NOT affected by the **time** it takes to do the work. In order to compare work to time, you need to calculate _____ .

EOF 3 ‡ 1

- A machine can make work easier in 3 ways:
  - By changing the __amount__ of force you exert;
  - By changing the __distance__ over which you exert your force; or
  - By changing the __direction__ in which you exert your force.

- A machine's (__actual__) mechanical __advantage__ is the number of times a machine increases a force exerted on it and can be found by comparing the __output force__ to the __input force__.

- If you exert a force of 10 N on a can-opener and the can-opener exerts a force of 30 N on the can, what is the mechanical advantage of this machine?

  $$\frac{30\ N}{10\ N} = 3$$

  in ↗ *out.*

- In the real world, all machines are slowed down by __friction__

- The __efficiency__ of a machine compares the Output Work to the Input Work, and is expressed as a percent.

- You do 250,000 J of work to cut a lawn with a hand mower. If the work done by the mower is 200,000 J, what is the efficiency of the lawn mower?

  $$\frac{OW}{IW} \times 100\% = \frac{200,000\ J}{250,000\ J} \times 100\% = 80\%$$

  OW / E[IW]

- Suppose the efficiency of a manual pencil sharpener is 68%. If the output work needed to sharpen a pencil is 4.8 J, how much input work must you do to sharpen the pencil?

  $$E = \frac{OW}{IW} \qquad IW = \frac{OW}{E} = \frac{4.8\ J}{.68} = 7.06\ J$$

- An __inclined plane__ is a simple machine with a flat, sloped surface that increases the DISTANCE over which your force is exerted and changes the DIRECTION of your force.
  - An example of this type of simple machine is... __a ramp__.

- What is the Mechanical Advantage of an inclined plane with a length of 5 m and a height of 3 m?

  $$1.6\overline{>}$$

- A _wedge_ is a simple machine that is thick at one end and tapers to a point. It is like an inclined plane in motion.

   o   An example of this type of simple machine is... _axe_ .

- What is the Mechanical Advantage of a wedge with a length of 0.75m and a width of 0.2 m?

- A _screw_ is a simple machine that is like an inclined plane wrapped around a cylinder.

   o   An example of this type of simple machine is... _____ .

- What is the Mechanical Advantage of a screw where the length around the threads is 6cm and the length of the screw is 2.5cm?

- A _lever_ is a simple machine that consists of a rigid bar that is free to pivot on a fixed point called a _fulcrum_ .

   o   An example of a First Class Lever is... _____ .

   o   An example of a Second Class Lever is... _____ .

   o   An example of a Third Class Lever is... _____ .

- What is the M.A. of a lever in which the distance from the fulcrum to the input force is 1.2 m and the distance from the fulcrum to the output force is 0.6 m?

- A _wheel & axle_ is a simple machine made of two circular or cylindrical objects fastened together that rotate about a common axis.

   o   An example of this type of simple machine is... _____ .

- What is the M.A. of a wheel-and-axle where the radius of the wheel is 38cm and the radius of the axel is 8cm?

- A _pulley_ is a simple machine made of a grooved wheel with a rope or cable wrapped around it.

   o   An example of this type of simple machine is... _____ .

- What is the M.A. of a pulley that has 3 sections of rope supporting the mass?