Section 7-1

What is Work?

Tightly tie a piece of string around your textbook.

Try to lift the book with the string, keeping the string completely parallel to the desk.

Try to lift the book holding the string at a 45-degree angle to your desktop.

Hold the string straight up. Lift the book.

Why did the string's position make a difference in lifting the book?

Work

Work = Force x Distance

newtons x meters = N·m

1 N·m = 1 joule (J)

You need to move five large cans of paint from the basement to the second floor of a house. Will you do more work on the cans of paint if you take them up all at once (if possible) or if you take them up individually? Explain.

If you must exert a force of 4 N on each can and you need to move them 15 meters, how much work is done?

300 J

Section 7-2

Mechanical Advantage and Efficiency

• The Tenth Commandment, meaning and proof verses #33-34. Found on p 17 of your Memory Book.

Work

SCIENCE EXPLORER

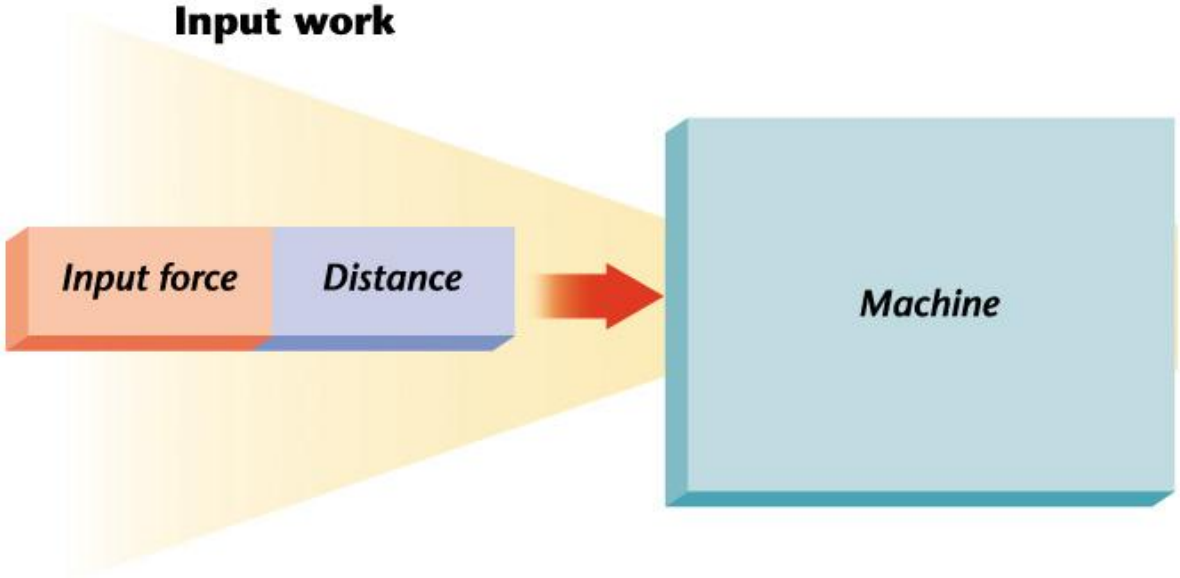
Which of these objects is a machine and which is not a machine?

pliers	corkscrew
eraser	rake
pencil	chalk
knife	paper
can opener	screwdriver
ruler	ball
book	broom

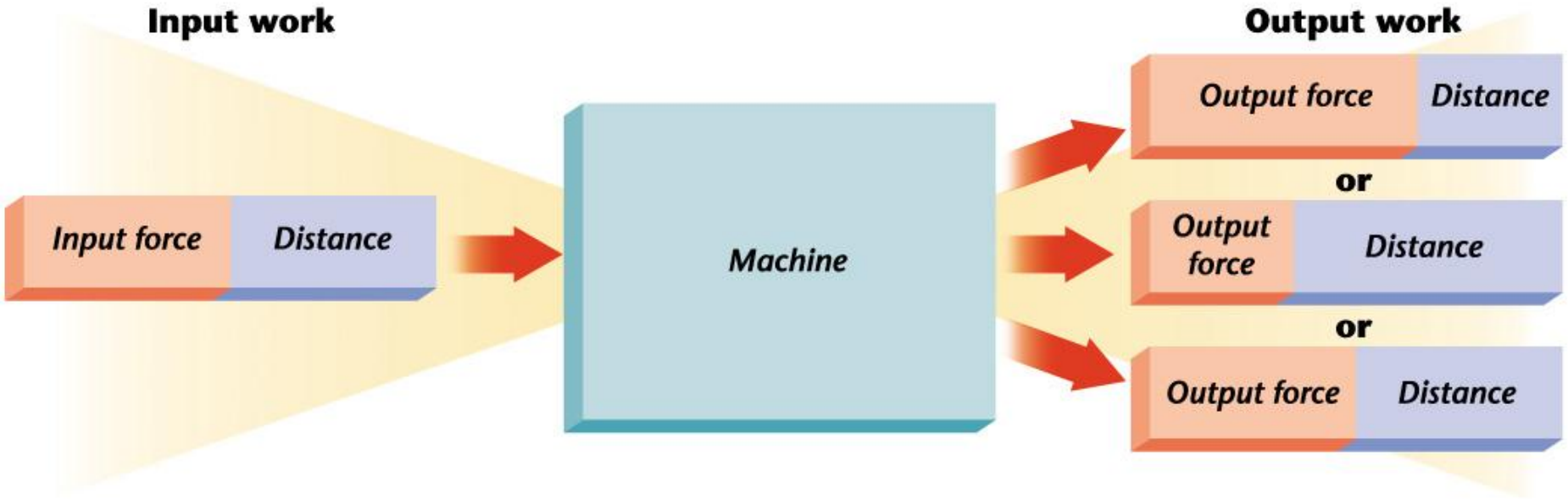
What is a machine?

- A device with which you can do work in a way that is easier or more effective.
- A machine does not change the amount of work required—only the force, distance or direction.

Work



Work



Multiplying Force:

- less force over a longer distance
- ramp

Multiplying Distance:

- exert your input force over a shorter distance
- hockey stick or hand fan

Changing Direction:

- pulley on a flag pole

How Machines Make Work Easier		
Method	**Force needed**	**Distance**
Multiplies force	**Less**	**Longer**
Multiplies distance	**More**	**Shorter**
Changes direction	**Same**	**Same**

Mechanical Advantage:

- **The number of times a force exerted on a machine is multiplied by the machine.**

$$Mechanical\ Advantage = \frac{Output\ Force}{Input\ Force}$$

Mechanical Advantage of Multiplying Force:

- output force is greater than input force
- mechanical advantage is greater than 1

Mechanical Advantage of Multiplying Distance:

- output force is less than the input force
- mechanical advantage is less than 1

Mechanical Advantage of Changing Direction:

- output force equals input force
- mechanical advantage equals 1

Efficiency:

- compares the output work to the input work and is expressed as a percent

$$Efficiency = \frac{Output\ work}{Input\ work} \times 100\%$$

Actual Mechanical Advantage:

- **mechanical advantage a machine provides in a real situation**

Ideal Mechanical Advantage:

- **mechanical advantage of a machine without friction**