Simple Machines

ACADs (08-006) Covered

1.1.2.4.2 1.1.2.6.2

Keywords

Levers, gears, cams, pulleys, physics terms, units, mechanical principles, efficiency, machine

Description

This PowerPoint presentation can be used to train people about the basics of simple machines. The information on the slides is the minimum information that should be explained. The trainer notes for each slide provide more detailed information, but it is up to the trainer to decide how much of this information is presented in class. The notes are intended to be made available for homework reading on this subject.

Supporting Material

Objectives

Explain and use physics terms, units, mechanical principles, mechanical definitions and basic concepts

Learning Outcomes:

1. Explain the mechanical principles:

Including the functions of simple machine individual components

- Such as: Levers, Gears, Cams & Pulleys
- Energy efficiency opportunities

Simple Machines

What are “simple machines”?

- A device for increasing or decreasing the amount of applied force in opposition to a resisting force
- The “applied force” is called effort or effort force, labeled: F_e
- The “resistive force” is called resistance , labeled:

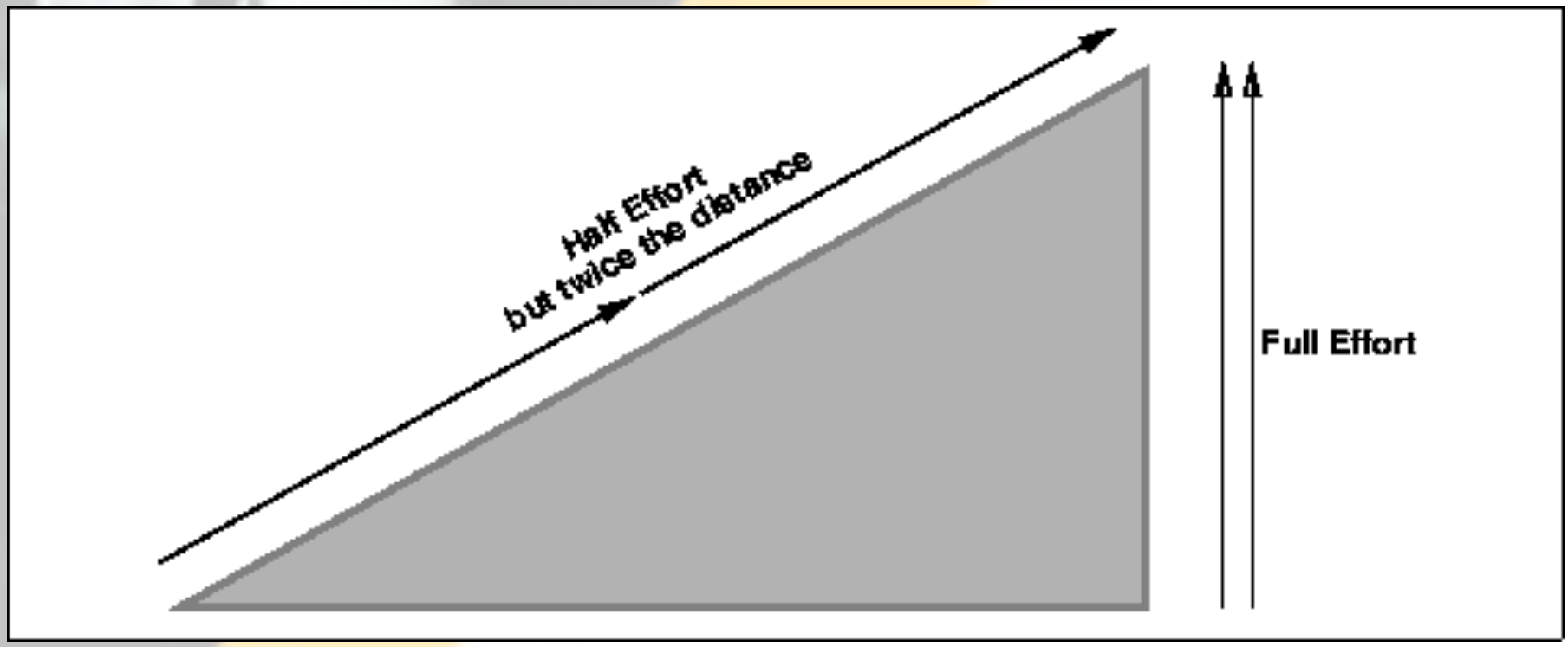
F_r

Force NOT Energy

Important to note the definition uses:

- *FORCE* not *ENERGY*
- The energy, or work, out can not exceed the energy input
- Something must be sacrificed for the simple machine to change the amount of effort required

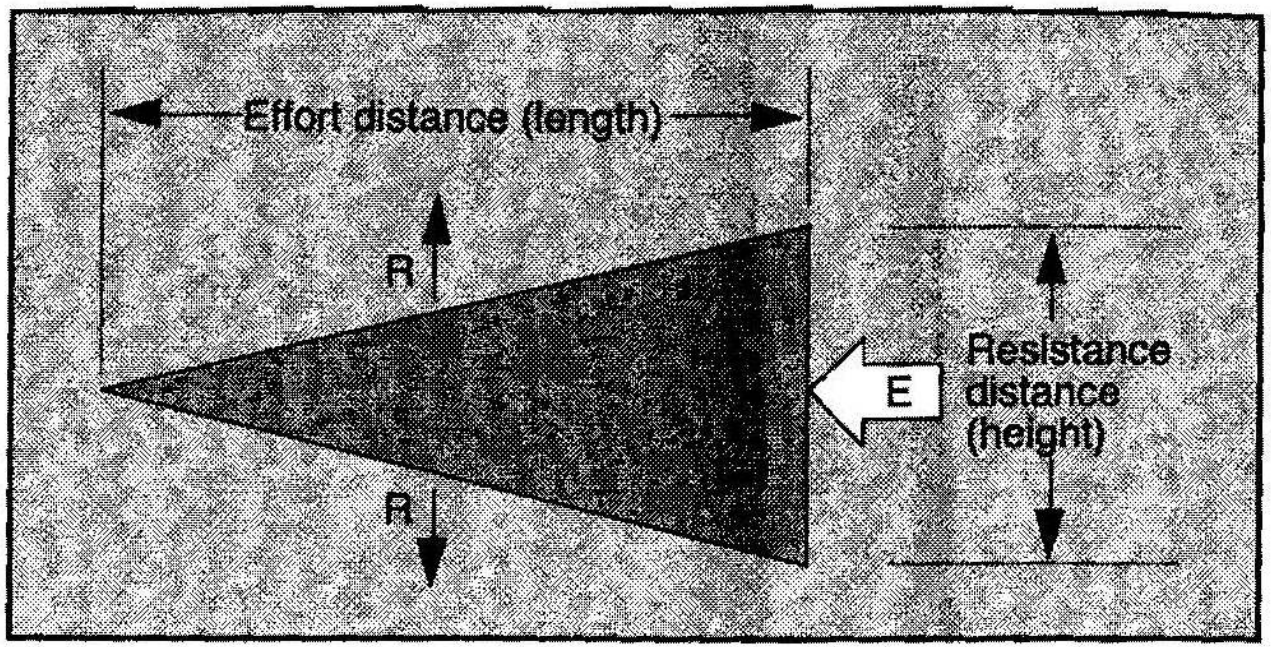
Inclined Plane



Exchanges more distance or speed for less effort

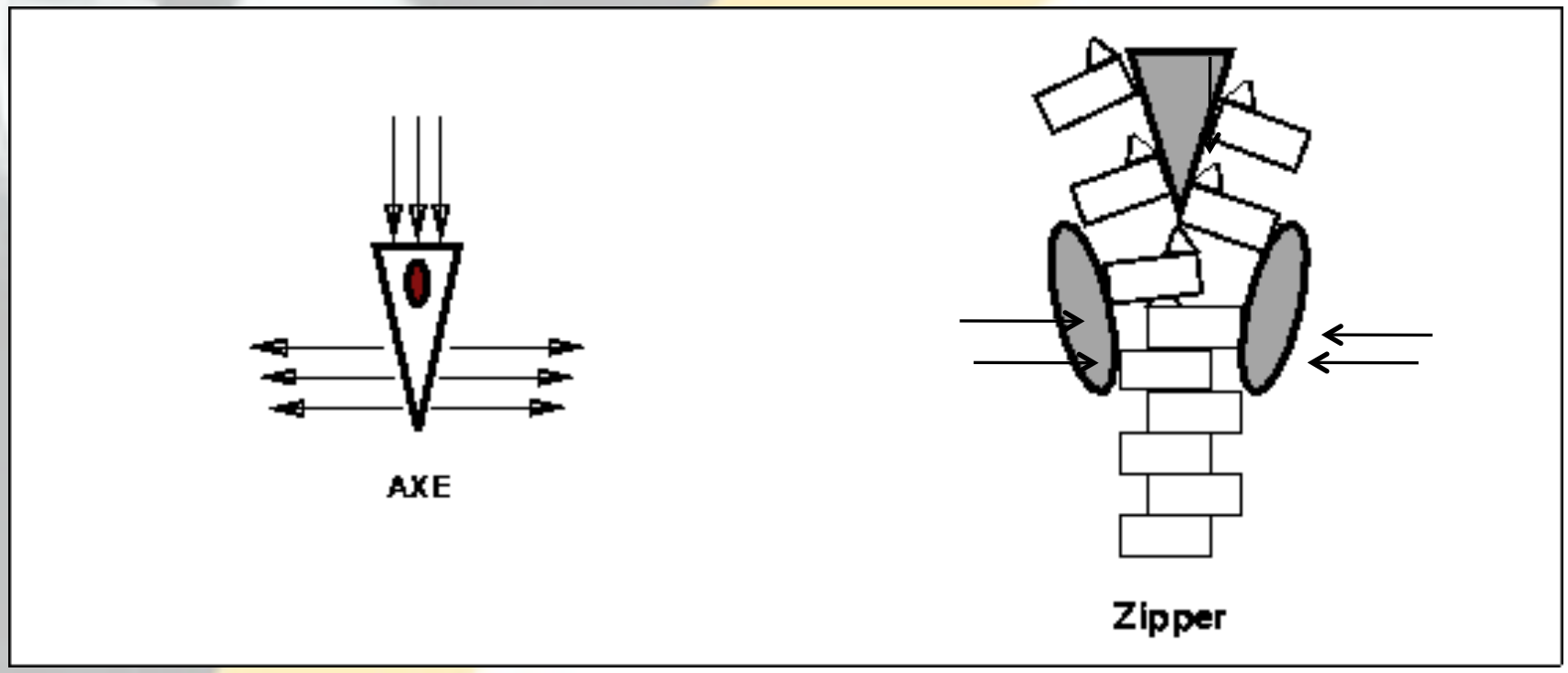
Wedge

{ Dual Inclined Plane }



Exchanges *more* distance for less effort

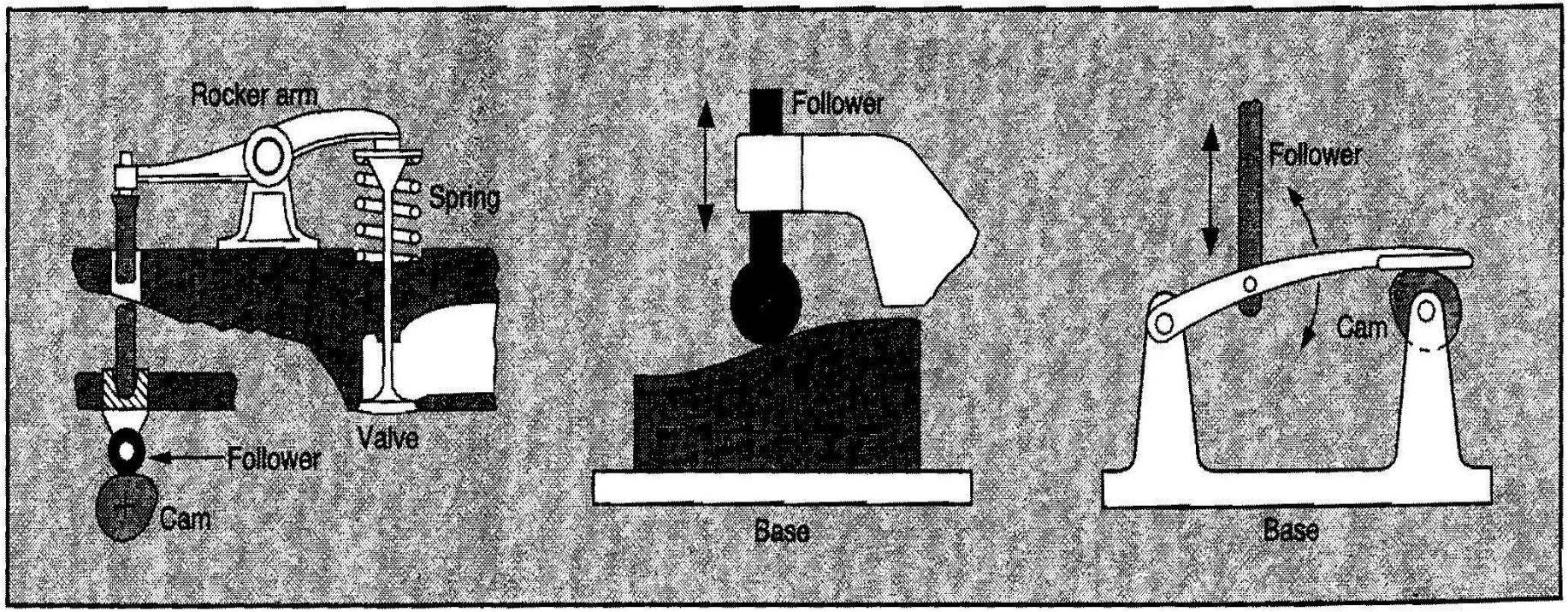
Zipper-The Plane at Work



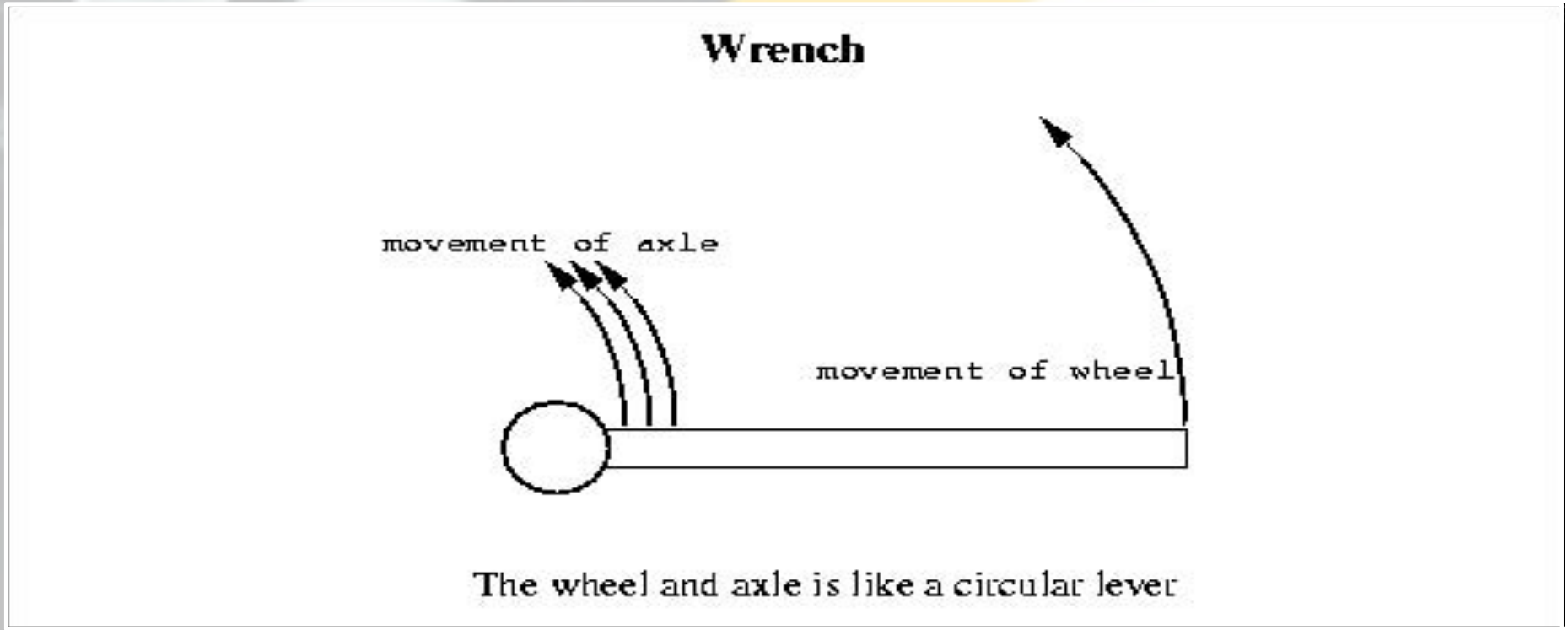
Wedges for opening and closing

Wedges Applied—Cam and Follower

Fig. 1-11. Cam-and-follower mechanisms



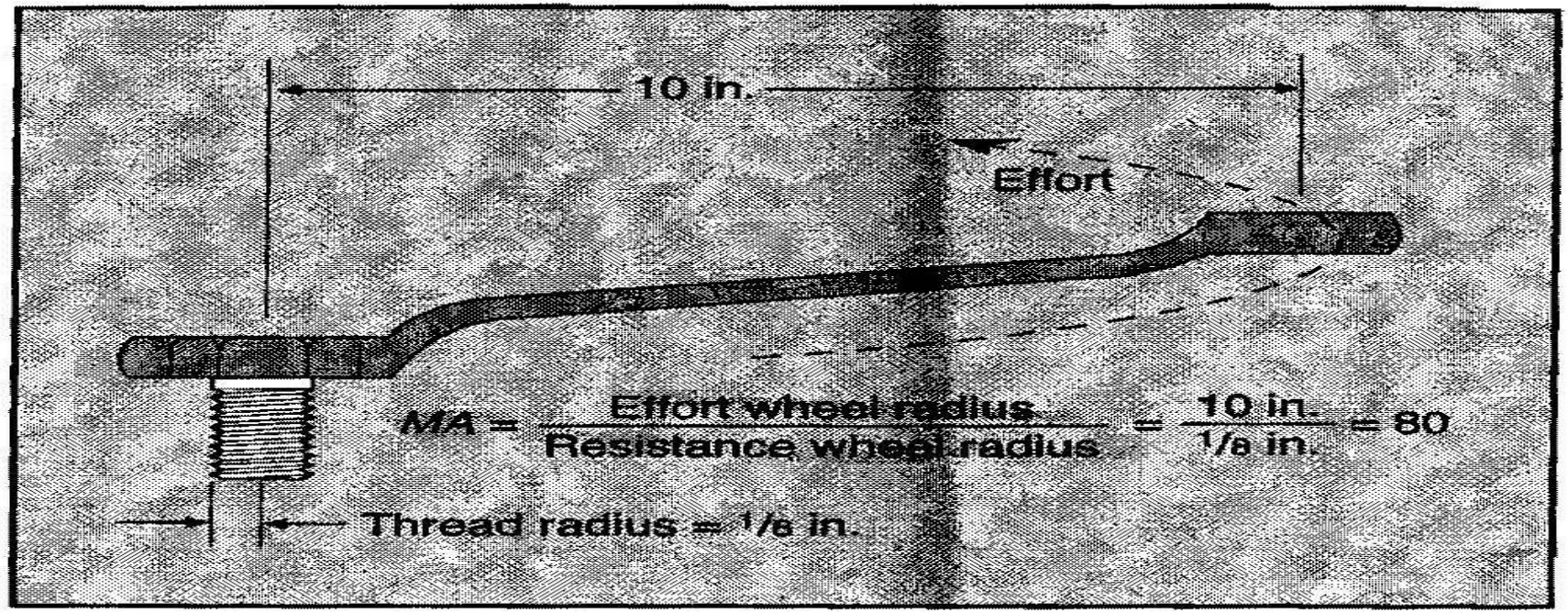
The Wrench –Wheel and Axle



$$\frac{R}{r} = \frac{D}{d} = \frac{C}{c}$$

The Wrench –Wheel and Axle

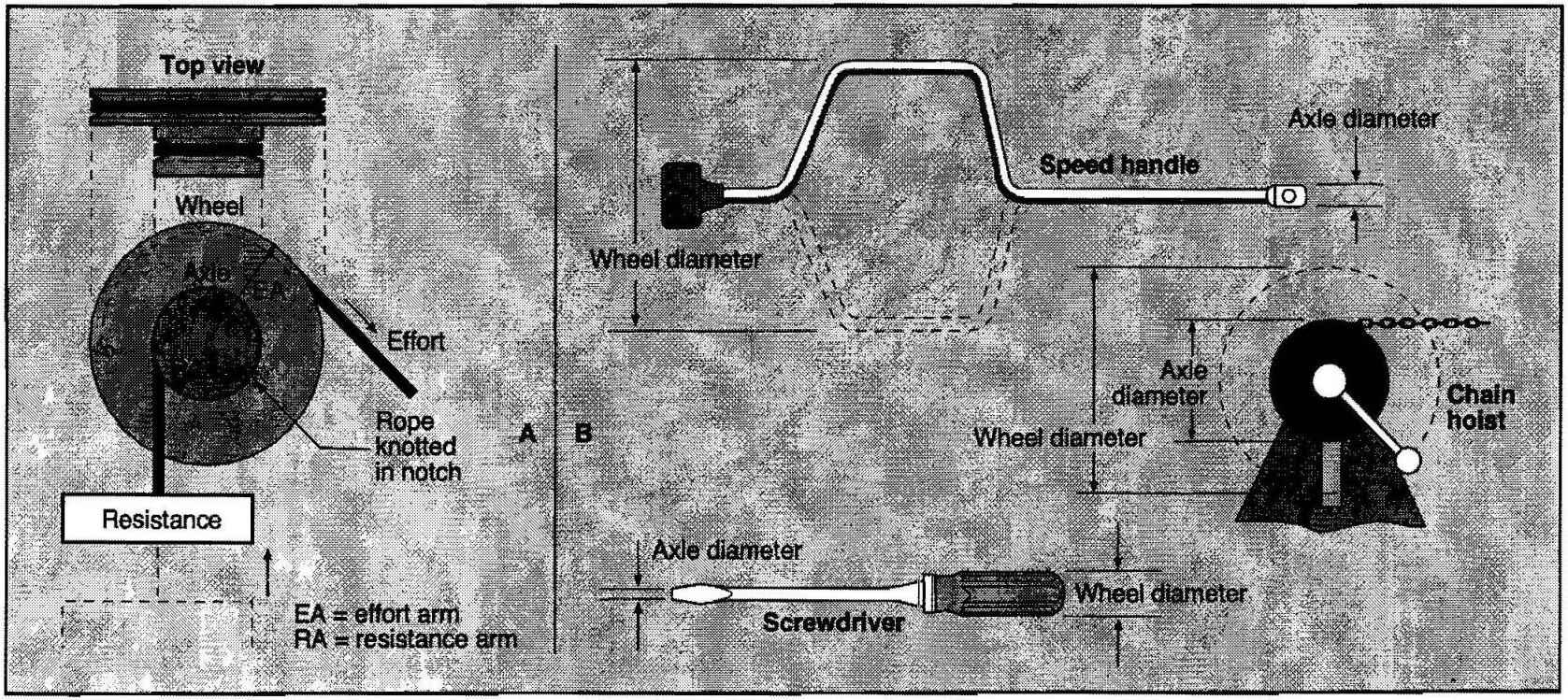
Fig. 1-6. Ideal mechanical advantage of a box wrench



$$\frac{R}{r} = \frac{D}{d} = \frac{C}{c}$$

The Wrench –Wheel and Axle

Fig. 1-5. Wheel and axle machines



Wheel --shorter but more powerful movement at the axle

Gears

Convert rotational motion by

- changing direction
- trading speed for torque.

Gears can be meshed together to

•Multiply force **or** speed and distance

Speed is gained at the expense of effort

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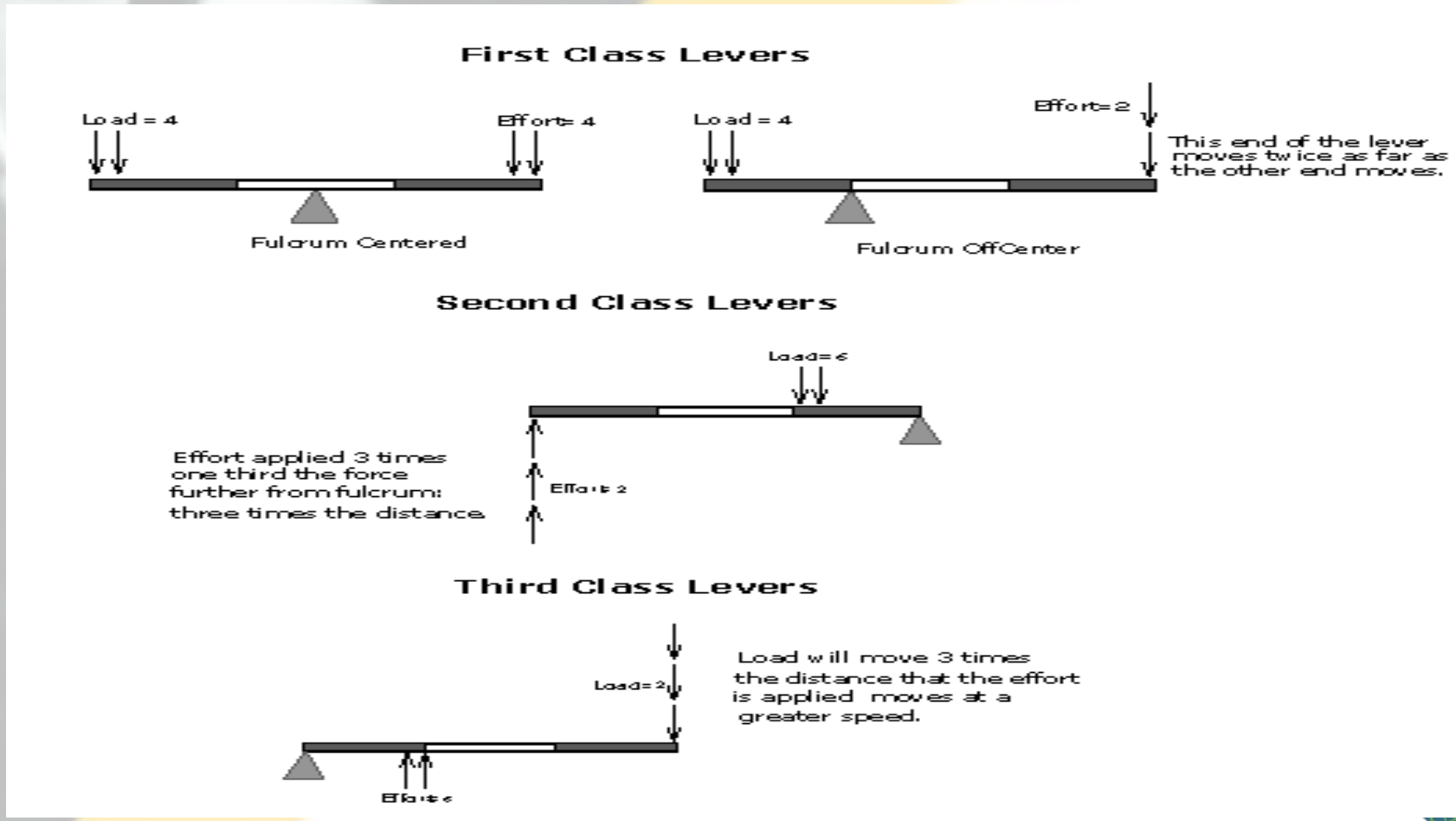
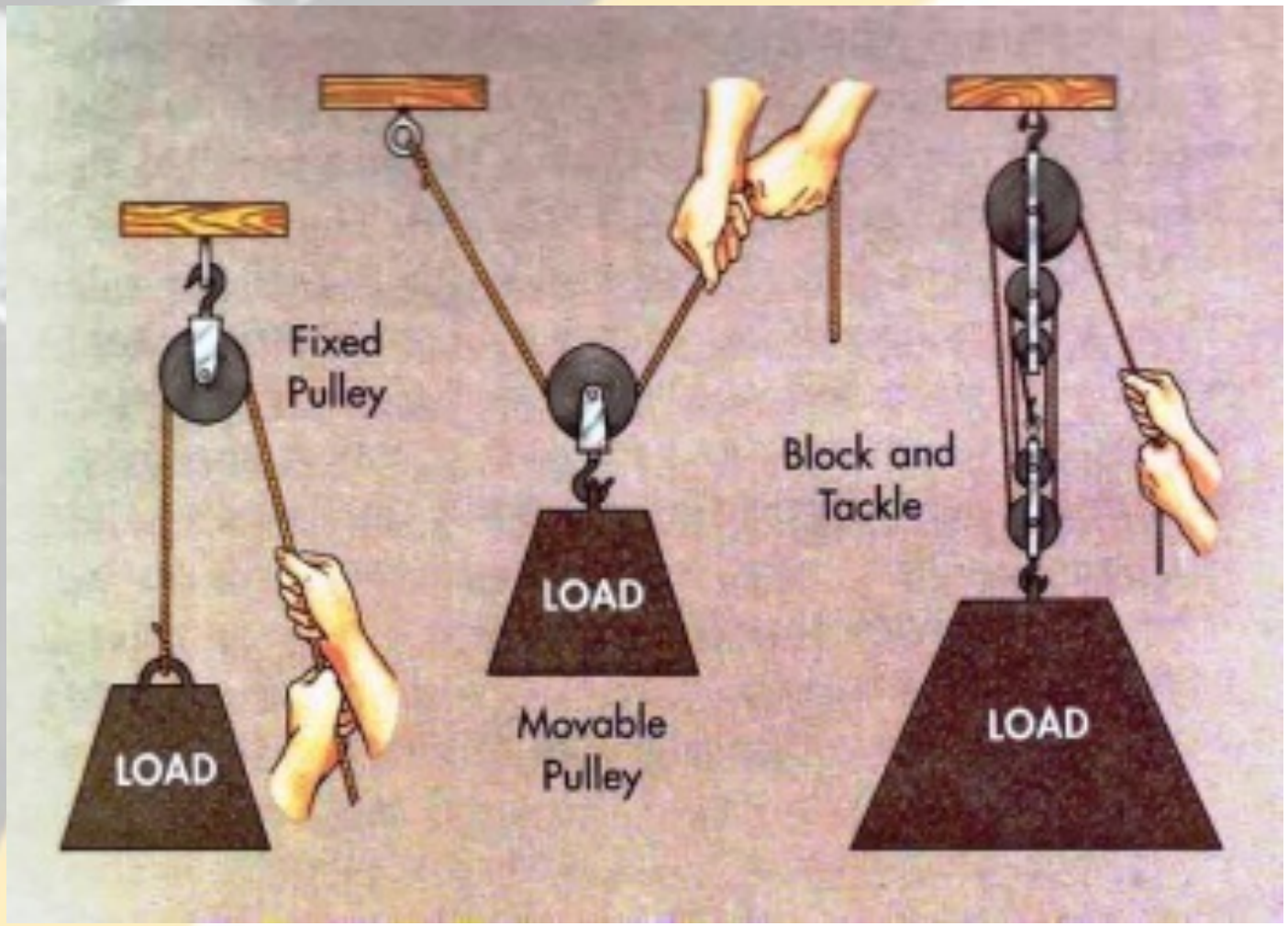
Levers

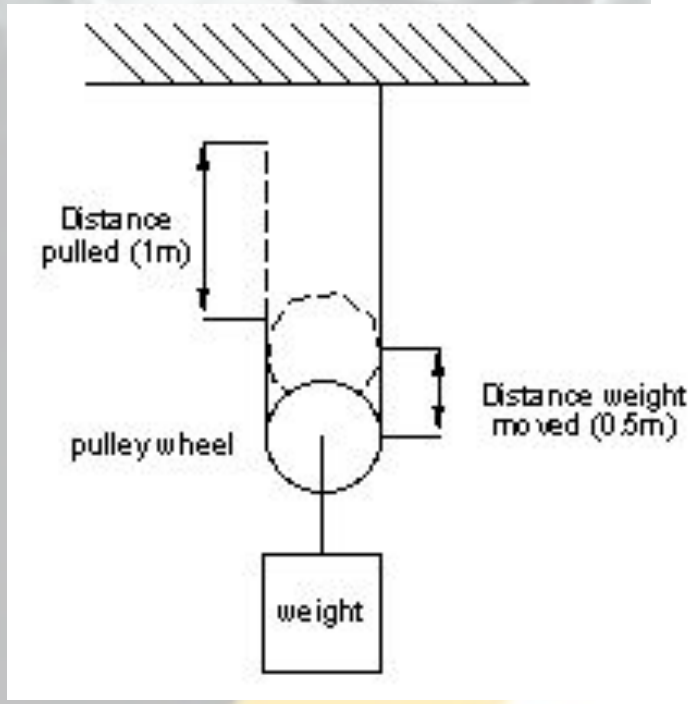

First Class Levers
Load = 4
Effort= 4
Fulcrum Centered
Load = 4
Effort= 2
This end of the lever moves twice as far as the other end moves.
Fulcrum OffCenter
Second Class Levers
Effort applied 3 times one third the force further from fulcrum: three times the distance
Third Class Levers
Load will move 3 times the distance that the effort is applied moves at a greater speed.

Pulleys

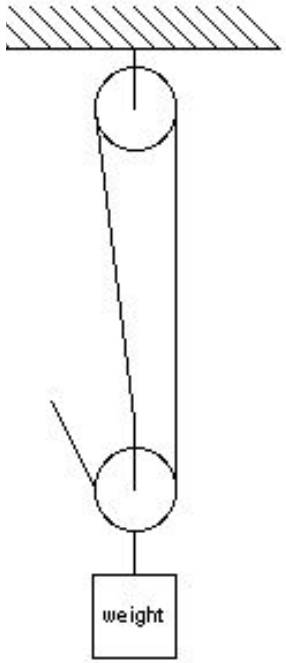

Fixed
Pulley
LOAD
LOAD
Movable
Pulley
Block and
Tackle
LOAD

Pulley – Block and Tackle

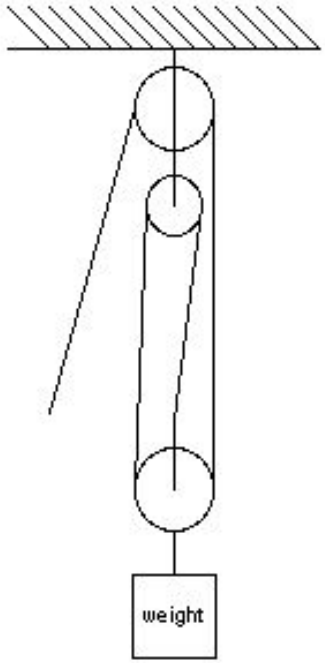
MA = 2



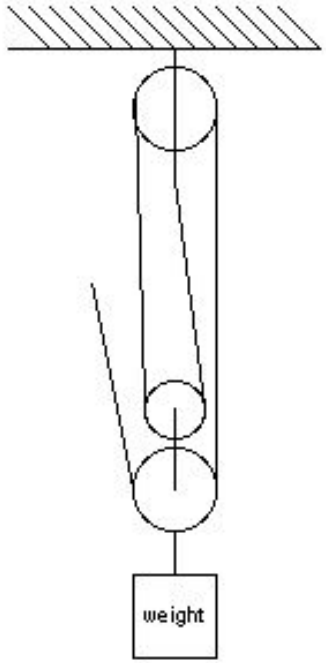
MA = 3



MA = 3



MA = 4



Simple Machines of Everyday

Where are the “simple machines” in your life?

- Scissors
- Wrenches
- Can openers
- Car jacks
- Wheelbarrows
- Car starter motors

Complex Machines of Everyday

Where are the “simple machines” in your life?

Activity - simple-machines

Power tools and other complex machinery
- made up of combinations of “simple machines”

Mechanical Efficiency

- Very few machines ever work in an ideal fashion
- Actual resistance by the actual effort applied, you find the actual mechanical advantage
- Part of your effort goes into overcoming the internal friction of the machine

Mechanical Efficiency

- By reducing friction you can improve the mechanical efficiency of any machine
- You will never be able to eliminate friction entirely
- Although simple machines are all less than perfect in this respect, using them properly will make your work much easier

What Did We Learn?

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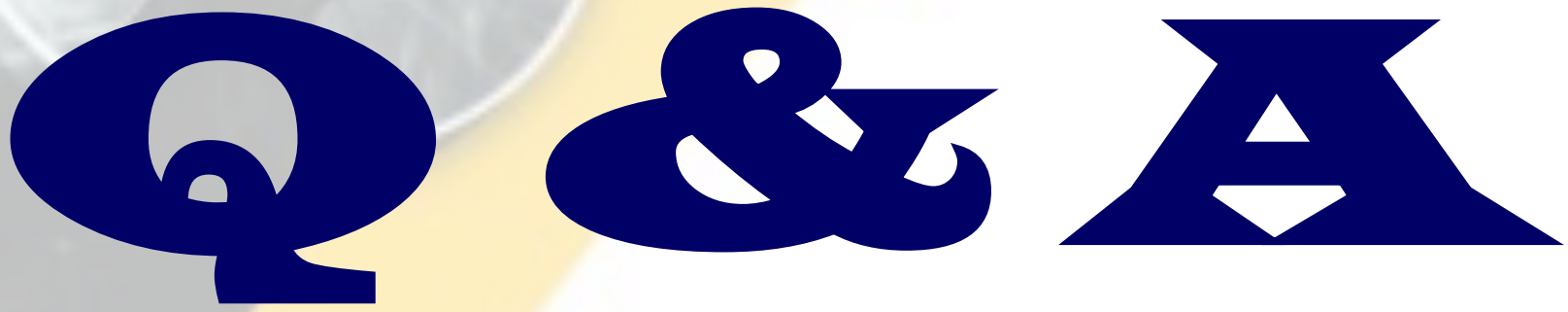
Simple Machines



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