Simple Machines Problem Series

Michael Xie,
Jack Miner Public School,
Grade 8, Professor Gibson

June 20, 2025

Problem set (1)

1. What would the mechanical advantage be of a lever system that can lift 100N with an effort force of only 25N? Use the GRASS method for your calculations.

2. What would the maximum load that a lever could lift if its mechanical advantage is 3 and the effort force applied to the lever is 30N? Use the GRASS method for your calculations.

3. What effort force would be needed to lift a load of 150N with a lever system that has a mechanical advantage of 3.5? Use the GRASS method for your calculations.

4. What is the DE of an inclined plane that is 2 m high and has a mechanical advantage of 0.5? Use GRASS method.

Solutions for Problem set (1)

1. **Given:** Load $= 100\,\text{N}$, Effort $= 25\,\text{N}$
   Required: Mechanical Advantage (MA)
   Analysis:
   $$\text{MA} = \frac{\text{Load}}{\text{Effort}}$$
   Solution:
   $$\text{MA} = \frac{100\,\text{N}}{25\,\text{N}} = 4$$
   Statement: The mechanical advantage is 4.

2. **Given:** MA $= 3$, Effort $= 30\,\text{N}$
   Required: Maximum Load
   Analysis:
   $$\text{Load} = \text{MA} \times \text{Effort}$$

Solution:

$$\text{Load} = 3 \times 30\,\text{N} = 90\,\text{N}$$

Statement: The maximum load is 90 N.

3. **Given:** Load = 150 N, MA = 3.5
   Required: Effort
   Analysis:

$$\text{Effort} = \frac{\text{Load}}{\text{MA}}$$

   Solution:

$$\text{Effort} = \frac{150\,\text{N}}{3.5} \approx 42.86\,\text{N}$$

   Statement: The effort force needed is approximately 42.86 N.

4. **Given:** Height = 2 m, MA = 0.5
   Required: DE (Distance Effort)
   Analysis:

$$\text{MA} = \frac{\text{DE}}{\text{DR}}, \quad \text{DE} = \text{MA} \times \text{DR}$$

   Solution:

$$\text{DE} = 0.5 \times 2\,\text{m} = 1\,\text{m}$$

   Statement: The DE is 1 meter.

Problem set (2)

1. I push with 400 N on a couch. The couch moves 2 m. How much work am I doing?
2. Mr. Oliver moved his desk 2m. He did 150J of work. How much force did he exert?
3. Mrs. Hutchinson exerted 20 N of force to move a rock in her garden. She did 400 J of work. How far did she move the rock?
4. Ms Tilden is exerting 400 N of force on her door, but it won't open. How much work did she do?

Solutions for Problem set (2)

1. **Given:** Force = 400 N, Distance = 2 m
   Required: Work
   Analysis:

$$W = F \times d$$

   Solution:

$$W = 400\,\text{N} \times 2\,\text{m} = 800\,\text{J}$$

   Statement: The work done is 800 J.

2. **Given:** Work = 150 J, Distance = 2 m
   Required: Force
   Analysis:
   $$F = \frac{W}{d}$$
   Solution:
   $$F = \frac{150\,\text{J}}{2\,\text{m}} = 75\,\text{N}$$
   Statement: The force exerted is 75 N.

3. **Given:** Force = 20 N, Work = 400 J
   Required: Distance
   Analysis:
   $$d = \frac{W}{F}$$
   Solution:
   $$d = \frac{400\,\text{J}}{20\,\text{N}} = 20\,\text{m}$$
   Statement: The rock was moved 20 m.

4. **Given:** Force = 400 N, Distance = 0 m
   Required: Work
   Analysis:
   $$W = F \times d$$
   Solution:
   $$W = 400\,\text{N} \times 0\,\text{m} = 0\,\text{J}$$
   Statement: The work done is 0 J.