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Simple Machines - Fundamentals

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**Exercise 1**

What is the Mechanical Advantage of a machine if a 30 N force lifts a 20 kg load?

\_\_\_\_\_Convert 20 kg to Newtons \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_20 kg = 200N\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_M A = L/ E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_= 200/ 30\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_= 6.67\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Exercise 2**

Find the effort required to lift a toad of 300 N, if a lever is 1.5 m long. A fulcrum is placed under the lever 300 mm from the load.

Free body diagram.





 

 = 0

 = + 300 + 300 – E x 1200 **MA** \_\_\_\_\_4\_\_\_\_\_\_\_

 E = 90000

 1200

 = 75N MA = L = 300

 E 75

 = 4

**Exercise 3**

If the maximum force resisting shear offered by the sheet metal is 0.85 kN, find the effort required and the mechanical advantage of the system.



 

 = 850 + 40 – E × 165 Effort \_\_\_\_206N\_\_\_\_

 165E = 34000 MA 4.13

 E = 206N ؞

 MA = L/ E L = 850N

 = 850/ 206 = 413 E = 206N

**Exercise 4**

Calculate the force which must be applied to the handle in order to hold the wheelbarrow up in a stationary position. What is the mechanical advantage of the system?

The wheelbarrow+ load= 46 kg.



 M = 46kg.

 F = 46 × 10

 = 460N

 = -460 × .5 + E × 1.25 Force \_\_\_\_\_184N\_\_\_\_\_

 1.25E = 230 MA \_\_\_\_\_2.5\_\_\_\_\_\_\_

 E = 184N

 MA = L/E L = 460N

 = 460/ 184 E = 184N

 = 2.5

**Exercise 5**

A rock, to be raised by a 3 m lever, has a mass of 260.2 kg. If a vertical effort of 425 N is available, calculate: 

1. The mechanical advantage of the system.
2. The distance, x, for the position of the fulcrum. u L = 260.2kg

Disregard the mass of lever. = 2602N MA = L/E

 E = 425N =2602/ 425

 = +2602 × x – 425(3 – x) = 6.1

 = 2602x – 1275 + 425x

2602x + 425x = 1275 MA \_\_\_\_\_6.1\_\_\_\_\_\_\_

 3027x = 1275 Distance \_\_\_\_\_421 mm\_\_\_

 X = 1275/ 3027

 = .421 m

 = 421 mm

**Exercise 6**

Some landscapers use a shovel as a lever to assist in moving rocks.

1. Calculate the force required at E to balance the 5kg rock on the shovel as shown. 

 M = 5kg

 = 50N

 = 50 × .26 – E × 1 Convert mm to m

 E = 13N Force at E: \_\_\_13N\_\_\_

1. Determine the mechanical advantage of the lever system shown in (a) when the shovel is used as shown.

MA = L/ E L = 50N

 = 50/ 13 E = 13N

 = 3.85



**Exercise 7**

The pulley system shown is part of an apparatus attached to a bed-.in hospital to life the leg of patients. 

Determine the VR ·of the system.

Number of ropes supporting the load = 3

 **VR** \_\_\_\_\_3\_\_\_\_\_

**Exercise 8**



**Exercise 9**

