Key

MECHANICAL ADVANTAGE WORKSHEET

Calculate the mechanical advantage in the problems with the equation:

$MA = \frac{\text{Resistance Force}}{\text{Effort Force}}$ OR $MA = \frac{\text{Length of Effort Arm}}{\text{Length of Resistance Arm}}$

1. You apply a force of 18 N on to the end of a lever to open a paint can lid. The resistance of the lid is 9 N. Calculate the MA.

$MA = \frac{9}{18} = .5$

2. You apply a force on a crowbar to open a stuck door. The effort length of the crowbar is 26 cm long and the resistance length is 4 cm. Find the MA of the crowbar.

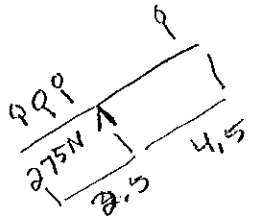
$MA = \frac{26\text{cm}}{4\text{cm}} = 6.5$

3. A worker uses a board that is 4 m long to pry up a boulder. A small rock is used for a fulcrum and is placed 0.5 m from the resistance end of the lever. Calculate the MA of the board.

$MA = \frac{3.5}{.5} = 7$

BOARD ——————
4m 3.5 .5

4A. Three of your friends are all sitting on one end of a seesaw. The combined weight is 275 N. The length from the fulcrum to your friends is 2.5 m. The rest of the seesaw (from the fulcrum to you) is 4.5 m. What is the MA? What effort force is needed to lift your friends?

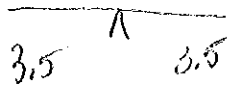


$MA = \frac{4.5}{2.5} = 1.8$

$1.8 = \frac{275\text{N}}{E}$

$E = 152.8\text{ N}$

4B. You want to see if you can lift your three friends when each side of the seesaw is equal in length (3.5 m). What is the MA? What effort force is needed to lift them?



$MA = 1$

$1 = \frac{275}{E}$

$E = 275\text{ N}$

Mechanical Advantage of an Inclined Plane

IMA= $\frac{\text{length}}{\text{Height}}$ AMA = $\frac{\text{output force}}{\text{input force}}$

1. A 5-meter ramp lifts objects to a height of 0.75 meters. What is the mechanical advantage of the ramp?

$IMA = \frac{5m}{.75m} = 6.7$

2. A 10-meter long ramp has a mechanical advantage of 5. What is the height of the ramp?

$IMA = \frac{L}{h}$ $5 = \frac{10m}{h} \cdot h$ $\frac{10}{5} = 2m$

3. A ramp with a mechanical advantage of 8 lifts objects to a height of 1.5 meters. How long is the ramp?

$IMA = \frac{L}{h}$ $8 = \frac{L}{1.5}$ $L = 12\ m$

4. A child makes a ramp to push his toy dump truck up to his sandbox. If he uses 5 Newton's of force to push the 12-newton truck up the ramp, what is the mechanical advantage of his ramp?

$AMA = \frac{12}{5} = 2.4$

5. A ramp with a mechanical advantage of 6 is used to move a 36-newton load. What input force is needed to push the load up the ramp?

$6 = \frac{36}{n} \cdot n$ $n = \frac{36}{6} =$ input = 6N

6. Gina wheels her wheelchair up a ramp using a force of 80 N. If the ramp has a mechanical advantage of 7, what is the output force?

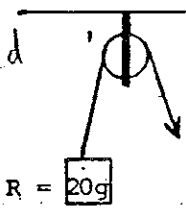
$7 = \frac{\text{output}}{80N}$ 560N

CONCEPT MODULE: FORCE

IMA = R/E

Pulleys Worksheet - after Activity #10

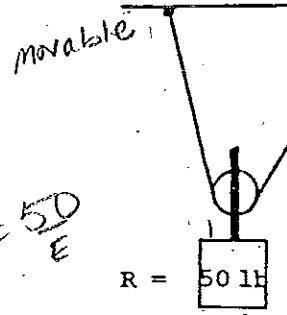
1.



E = 20

IMA = 1

2.

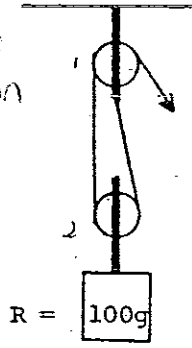


E = 25

IMA = 2

2 = 50/E

3.

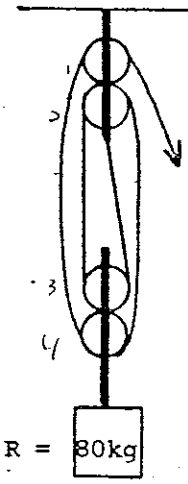


E = 50

IMA = 2

2 = 100/E

4.

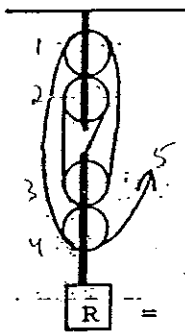


E = 20

IMA = 4

4 = R/E =

5.

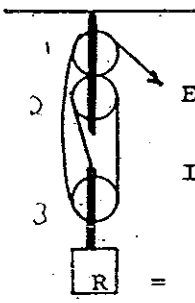


E = 55 kg

IMA = 5

= 275

6.



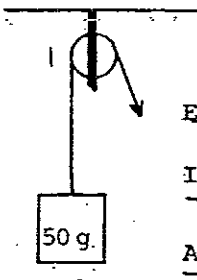
E = 1.5 kg

IMA = 3

= 4.5

AMA = output F / input F

7.



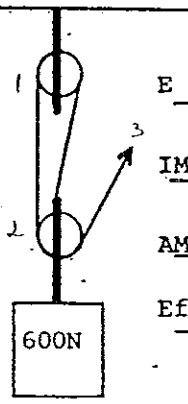
E = 54 g

IMA = 1

AMA = 50/54 = .93

50/1 Efficiency = 93%

8.



E = 250 N

IMA = 3

AMA = 200/250 = .8

Eff. = 80%

AMA = Output / Input

600/3 = 200

Name: Key

LEVER HOMEWORK

MA = $\frac{\text{length of effort arm}}{\text{length of resistance arm}}$

MA = $\frac{\text{resistance force}}{\text{effort force}}$

1. A worker uses an iron bar to raise a manhole cover weighing 65N. The effort arm of the lever is 60 cm long. The resistance arm is 25 cm long. What is the mechanical advantage of the bar?

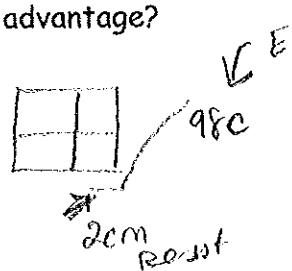
$MA = \frac{60}{25} = 2.4$

2. A crowbar has an effort arm of 76 cm. The resistance arm is 22 cm. What is the mechanical advantage of the crowbar?

$MA = \frac{76}{22} = 3.45$

3. You are prying open a stuck window using a crowbar that is 100 cm long. When you put the end of the crowbar under the window, the distance between the window and the sill is 2 cm and the distance between the sill and the spot where the bar will be pushed is 98 cm. What is the mechanical advantage?

$\frac{98\text{ cm effort}}{2\text{ cm resist.}} = 49$



4. In order to move a large log at camp we use a long pole. The mechanical advantage of the pole is 8. If the log weighs 156 newtons, what effort force is needed to lift the log?

$8 = \frac{156}{E}$ $\frac{156}{8} = 19.5$