QUESTIONS ON PAGE 150.

1. Explain why a machine or a mechanism cannot have an efficiency of 100%..

Answer

The efficiency of any machine is not 100% because some of the input work is used to compensate for the work done by friction.

2. If the efficiency of a machine increases, what happens to each of the following? (Use the words "increases," "decreases," or stays the "same" to describe the changes.)

(a) Input work – increases.

(b) Useful output work – increases.

(c) Friction – Friction decreases.

(d) Mechanical advantage – increases.

3. What is the mathematical relationship between efficiency, input work, and useful output work?

$$\text{Efficiency} = \frac{\text{useful output work (Joules)} \times 100\%}{\text{Input work (Joules)}}$$

4. Explain how a lubricant affects the efficiency and the frictional forces of a machine

Answer

When lubricant is added to any two surfaces that rub together, it fills the gaps between the two surfaces making it easier for those surfaces to slide past each other thus reducing the frictional force and therefore reducing frictional force leads to increase in the efficiency of the machine.

5. A student does 25J of work on the handle of a pencil sharpener. If the pencil sharpener does 20J of work on the pencil, what is the efficiency of the sharpener?

Answer

$$\text{Efficiency} = \frac{\text{useful output work (Joules)} \times 100\%}{\text{input work (Joules)}}$$

$$= \frac{20 \times 100}{25}$$

$$= 80\%.$$

6. A force of 900N pushes a wedge 0.10m into a log. If the work done on the log is 50J, what is the efficiency of the wedge?.

Answer

Input work = 900N × 0.10m

= 90Joules.

$$\text{Efficiency} = \frac{\text{useful work done (Joules)}}{\text{Input work (Joules)}} \times 100$$

$$= \frac{50 \times 100}{90}$$

$$= 55.56\%$$

7. Use the data below to rank machines A, B and C from

(a) highest to lowest mechanical advantage

(b) highest to Lowest efficiency.

MACHINE	Input Force (N)	Input distance (M)	output force (N)	output distance (M)
A	5.0	10	20	2.0
B	10	25	50	3.5
C	20	6.0	27	4.0

Answers

(a) Highest to Lowest mechanical advantage

$M.A \text{ of } A = \frac{20}{5.0} = 4.$

$M.A \text{ of } B = \frac{50}{10} = 5.$

$M.A \text{ of } C = \frac{27}{20} = 1.35$

Ranking

B – Highest M.A

A

C Lowest M.A

(b) Highest to Lowest efficiency.

$\text{Efficiency of } A = \frac{(20 \times 2.0) \times 100}{(5.0 \times 10)}$

$= \frac{40 \times 100}{50}$

$= 80\%.$

Efficiency of B $= \frac{(50 \times 3.5) \times 100}{(10 \times 25)}$

$= \frac{50 \times 3.5 \times 100}{250}$

$= 70\%$

Efficiency of C $= \frac{27 \times 4.0 \times 100}{20 \times 6.0}$

$= 90\%$

Ranking

C — Highest efficiency

A

B — Lowest efficiency

QUESTIONS ON PAGE 152-153.

7. To increase the mechanical advantage of a lever should you increase or decrease the length of the out put arm?

Answer

You should decrease the length of the out put arm.

10 A mechanical system is used to pull a tarp over a grass tennis court. On a clear sunny day, the efficiency of the system is 55%. After a rainstorm, the efficiency is measured to be 65%. Explain why there is a difference in the efficiences.

Answer

After rainstorm the surface of grass tennis court was covered with water. Since water is a good lubricant, it reduced the frictional force between tarp and grass tennis court thus reducing frictional force leads to increased in efficiency.

11 Each photograph on the right shows a common tool. Identify the type of simple machine each tool represents.

Answer

Knife - Wedge.

Handle Wheel and ~~axel~~ axle.

12. Plan an experiment to measure the Ideal mechanical advantage of a three hole punch.

(a) What materials would you need?

(b) What procedure would you use?

Answers

(a) What materials would you need?

(i) 3-hole punch.

(ii) Paper to be punched.

(iii) Ruler

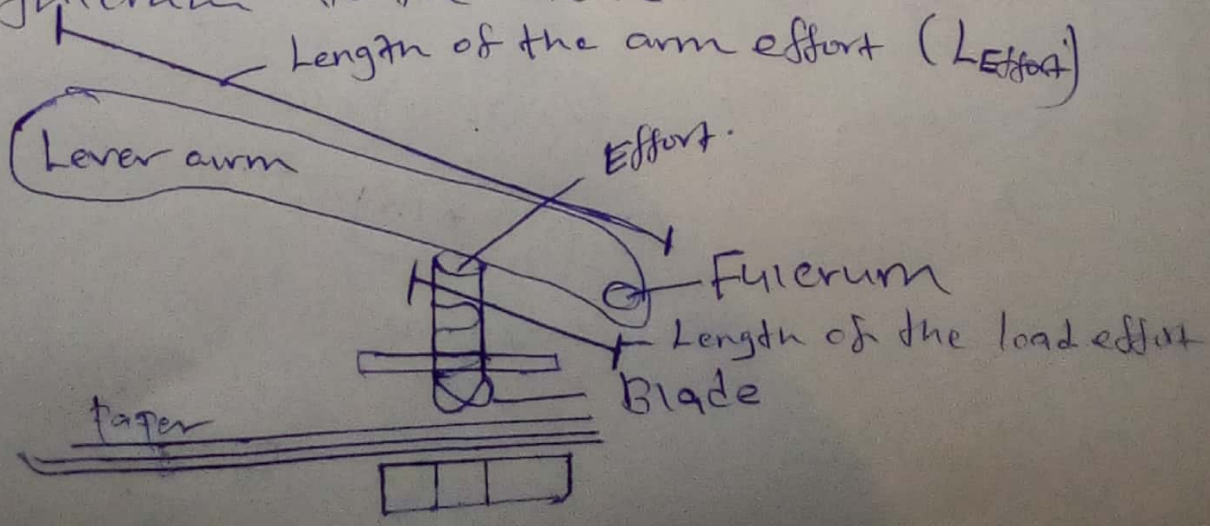
(b) What procedure would you use?

(i) Support the 3-hole punch on a bench.

(ii) Insert the papers to be punched in the 3-hole punch.

(iv) Measure the distance from the fulcrum to effort arm.

(v) Measure the distance (length) from the fulcrum to the load.



(VI) To get the Ideal mechanical advantage of the 3-hole punch will be given by

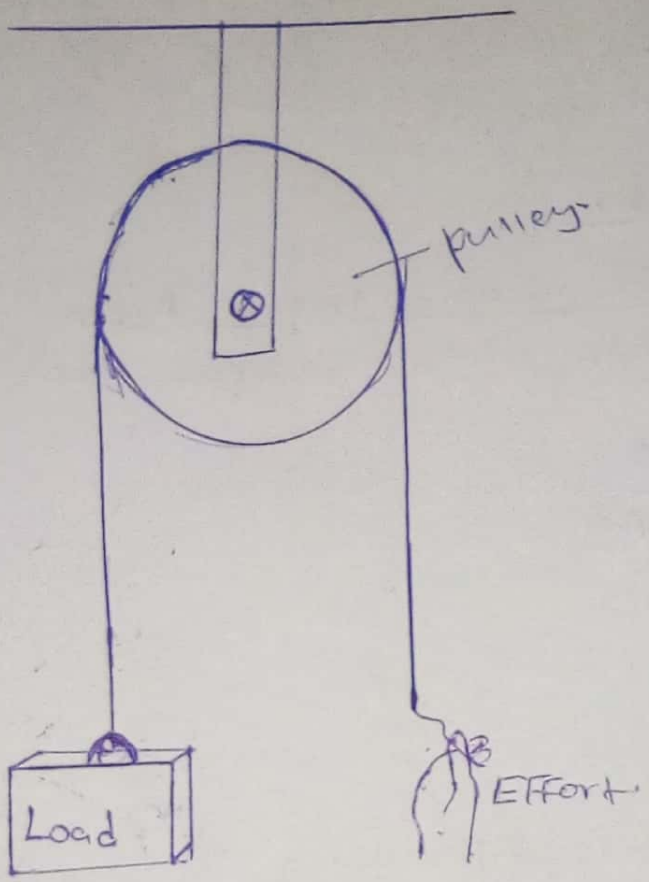
$$\text{Ideal mechanical advantage} = \frac{3 \times \text{Length of Arm effort}}{3 \times \text{Length of load effort}}$$

$$= \left(\frac{3 \times L_{effort}}{3 \times L_{Load}}\right)$$

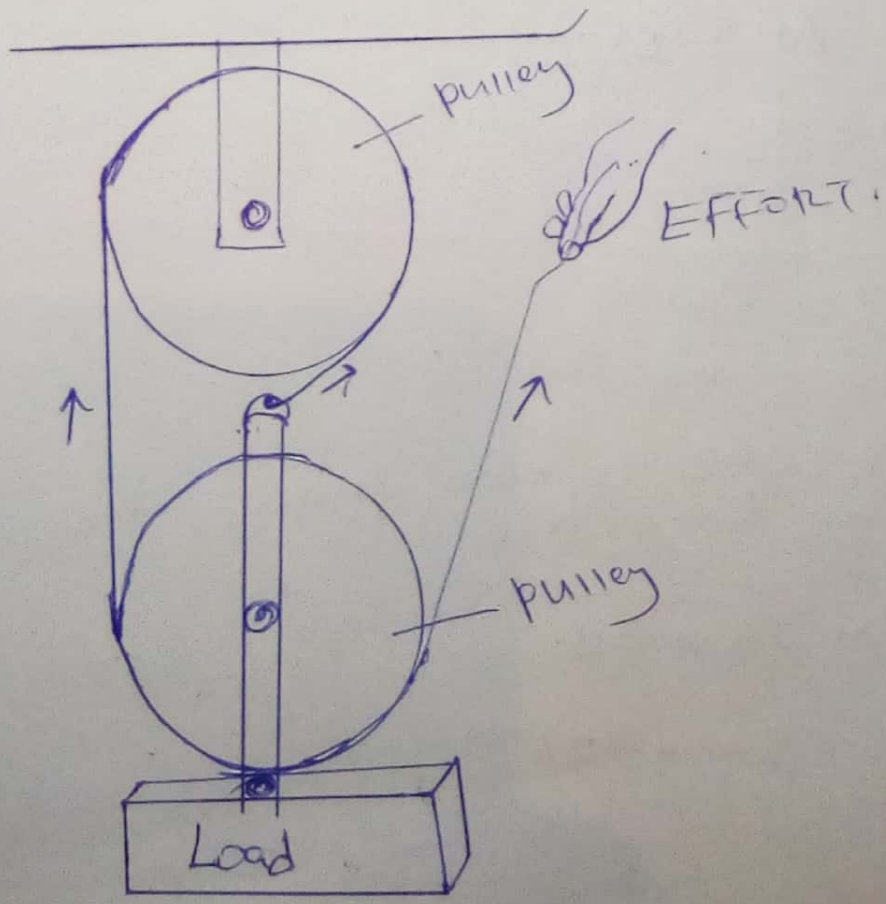
NOTE

We have multiplied by 3 because the punch is punching 3 holes simultaneously.

(a) IMA = 2.



(b) IMA = 3.



16. The handle of a screwdriver has a radius of 3cm. If the shaft of the screwdriver has a radius of 0.5cm, what is the IMA of the screwdriver when used to tighten a screw?

Answer

$$IMA = \frac{\text{Radius of the handle}}{\text{Radius of the shaft.}}$$

$$= \frac{3cm}{0.5cm}$$

$$= 6.$$

17. Wei uses a pulley system to lift a box. She pulls the rope a distance of 3m, using a force of 50N. If the work done on the box is 120J, what is the efficiency of the pulley system?

Answer

$$\text{Efficiency} = \frac{\text{useful output work (Joules)} \times 100\%}{\text{Input work done (Joules)}}$$

$$= \frac{(120 \times 100)}{(3 \times 50)}$$

$$= 80\%.$$