Practical No. 5: Determine mechanical advantage and velocity ratio of Simple screw jack for different load and effort.

I. Practical Significance

There is often a need to lift loads and different lifting machines are used depending on the type of load, intensity of the load and other site conditions. A simple screw jack is used to lift heavy loads in confined spaces. After carrying out this experiment, a qualified engineer is able to assess the suitability of a screw jack based on the given load lifting situation.

II. Industry/Employer Expected Outcomes

Apply the principles of engineering mechanics to analyze, design and automation the prototypes and equipment's of various industries

III. Course Level Learning Outcome(s)

CO1-Select the suitable machine under given loading condition.

IV. Laboratory Learning Outcome(s)

Verify law of machine under the given condition.

V. Relevant Affective Domain related Outcome(s)

a. Follow safety practices and precautions.
b. Demonstrate working as a leader/a team member.
c. Maintain tools and equipment.

VI. Relevant Theoretical Background

Simple Screw Jack: A screw jack is a simple device which is used to lift heavy loads such as large vehicles. It mainly consists of three parts. A nut attached to a pedestal or stand, a large screw fitted within the nut and lever attached to the head of the screw.

The weight which is to be lifted is placed on either on the head of the screw or on the platform attached to the screw. Sometimes a wheel is fixed at top and effort is applied tangentially to the circumference of the wheel. A screw thread is cut just like an inclined plane. The distance which the screw advances in one tum is called lead distance and distance measured between two consecutive threads is called pitch distance. The screw jack works on the principle similar to that of an inclined plane.

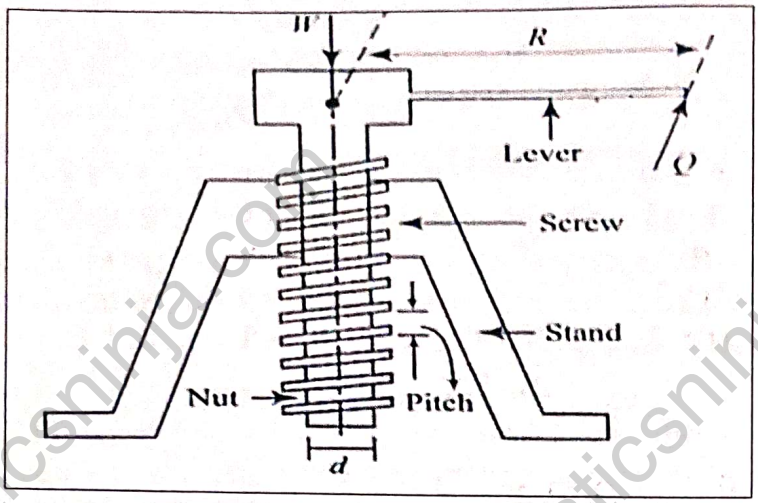
$$\text{Velocity Ratio (V.R.)} = \frac{2\pi R}{p}$$

Where,

R = Length of arm or Radius of wheel

p = Pitch of the screw

VII. Actual diagram used in laboratory with equipment specifications.



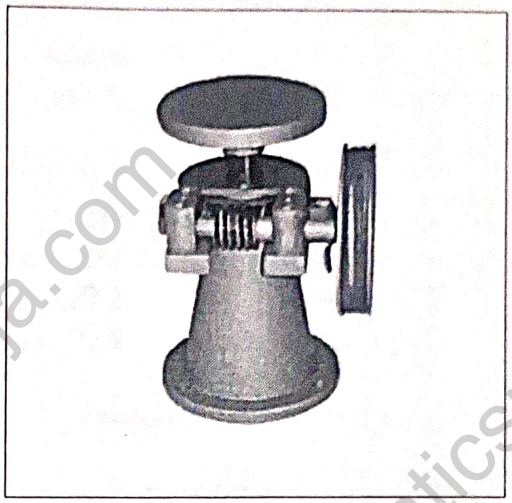


Fig. 5.1 Simple Screw Jack

VIII. Requires Recourses/Apparatus/Equipment with Specifications

Sr. No.	Particulars	Broad Specifications	Quantity	Remarks (If Any)
1	Simple Screw Jack	Table mounted Metallic body, screw with a pitch of 5 mm carrying a double flanged tum table of20 cm diameter.	01 for Group of 4 to 5 students.	

IX. Precautions to be followed

1. Effort must be applied gradually

X. Procedure

1. Observe the machine carefully and identify the various components of machine.
2. Set the machine and check the reversibility of machine
3. Calculate friction in the machine at zero load.
4. Apply the load starting with smaller magnitude.
5. Apply the effort for each corresponding load.
6. Record the observations of load and effort in observation table. Take at least five readings.
7. Determine M.A., V.R., Efficiency, Ideal effort and Effort lost in friction for given screw jack.
8. Plot graphs load against effort and load against efficiency.

Observations and Calculations

1. R = ..92..... mm
2. p = ..10..... mm

$$V.R. = \frac{2\pi R}{p} = \frac{2 \times \pi \times 92}{10} = 57.80$$

$$= 58.$$

XI. Observations Table

Sr. No.	Load W (N)	Effort P (N)	M.A.	Velocity Ratio	Efficiency η (%)	Ideal Effort Pi (N)	Effort Lost in Friction Pf (N)
1	100	30	3·30	5·8	5·74	1·72	28·28
2	150	40	3·75		6·46	2·58	37·42
3	200	50	4		6·89	3·44	46·56
4	250	60	4·1		7·08	4·31	55·69
5	300	70	4·2		7·24	5·17	64·83

Sample Calculations

$$M.A. = \frac{\text{Load}}{\text{Effort}} = \frac{W}{P} = \frac{100}{30} = 3.33$$

$$\text{Efficiency } (\eta) = \frac{M.A.}{V.R.} \times 100\% = \frac{3.33}{58} \times 100 = 3.74\%$$

$$P_i = \frac{W}{V.R.} = \frac{100}{58} = 1.72$$

$$P_f = P - P_i = 30 - 1.72 = 28.28$$

Law of Machine is P = mW + C

Where,

$$M = \text{Slope} = \frac{P2-P1}{W2-W1} = \frac{90-30}{150-100} = \frac{10}{50} = 0.2$$

C = Y intercept (i.e. Machine Friction) = 10 N

XII. Results

1. The law of machine is P = (..0.2.....) W + (...10.....) N
2. The average efficiency of machine is = 6..67... %

XIII. Interpretation of results

Machine is ...non reversible

Friction loss is (i.e. Y – intercept = ..10.....) reduced by ....10..... the machine.

The graph between load and effort is a straight line which indicates.....

The graph between load and efficiency is a curve which indicates.....

.....

XIV. Conclusions and Recommendations

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XV. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. Define is pitch?
2. On which principle screw jack is works?
3. Write four field applications of screw jack.
4. Differentiate between the jack used in actual practice and in the lab.
5. Explain self-locking condition is achieved? Is it advantageous?

Space for answers

Q. 1 ⟶ ?

Ans:- (a) To lift a heavy load the car

(b) To horizontal stalizer of our the craft:

(c) To Support for heavy ~~parts~~ load:

(d) To lift the heavy parts in the industry:

Q. 2 ⟶ ?

Ans:- Maximum load lifting capacity of the screw take 20 to n

Q. 3 ⟶ ?

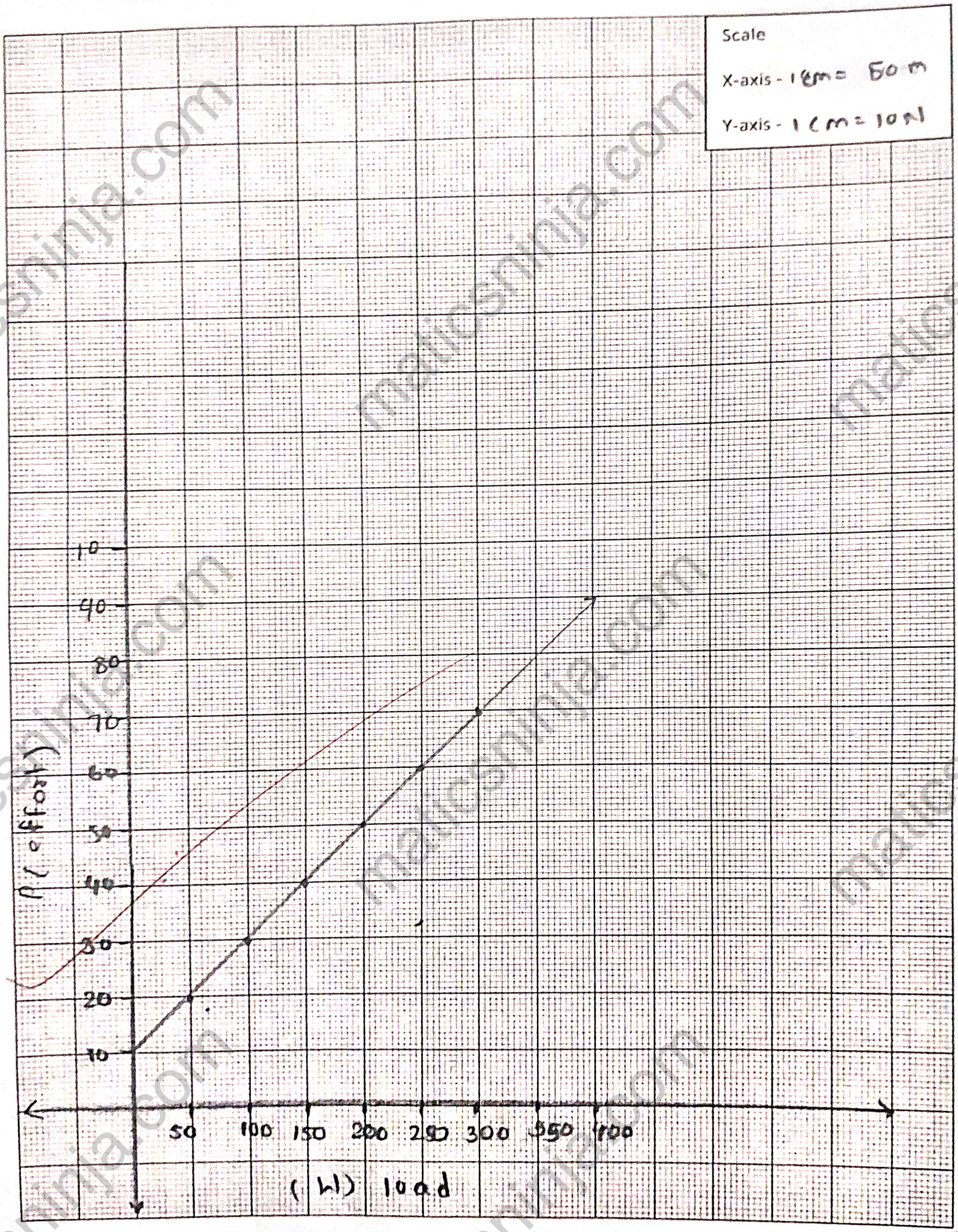
Ans:- yes

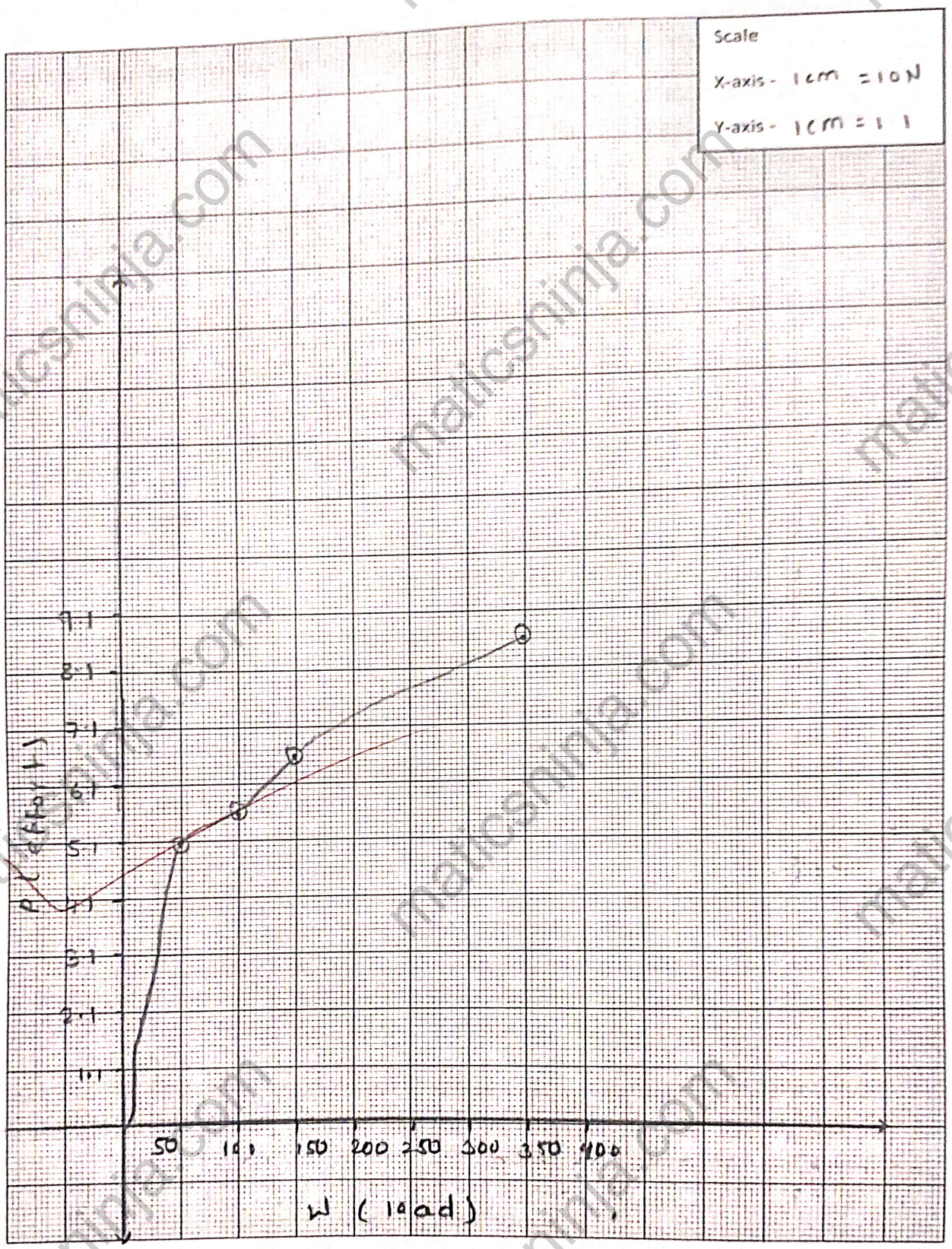
Q. 4 →

Ans non-reversible because the efficiency of screw Jack is the always less than 50%.

XVI. References/Suggestions for further Reading

Sr. No.	Link	Description
1	https://www.engineersrail.com/simple-lifting-machine/	Introduction of simple lifting machine
2	https://www.youtube.com/watch?v=kNypk8GReqM	Law of machine and types of machines useful in industry.
3	https://www.indiamart.com/proddetail/screw-jack-7184285530.html	Simple Screw Jack
4	http://nitttrc.edu.in/nptel/courses/video/112106286/L01.html	Introduction to engineering mechanic


Scale
X-axis - 1cm = 50 N
Y-axis - 1 cm = 10 N
10
40
80
70
60
50
40
30
20
10
50
100
150
200
250
300
350
400
(W) load


Scale
X-axis - 1cm = 10 N
Y-axis - 1cm = 1 1
9-1
8-1
7-1
6-1
5-1
4-1
3-1
2-1
1-1
50
100
150
200
250
300
350
400
W (load)