ICSE CLASS 10 EXAMINATION

PRACTICE QUESTION PAPER

PHYSICS

Chapter 3 : MACHINES

(Mechanical Advantage, Velocity Ratio and Efficiency · Levers · Pulley Systems)

Maximum Marks: 40 **Time allowed: One hour**

1. Answers to this Paper must be written on the paper provided separately.

2. You will not be allowed to write during the first 5 minutes. This time is to be spent in reading the question paper.

3. The time given at the head of this Paper is the time allowed for writing the answers.

*4. **Section A** is compulsory. Attempt **all** questions from Section A and **any two** questions from Section B.*

5. The intended marks for questions or parts of questions are given in brackets [ ].

6. Show all working clearly. Take g = 10 m s^{-2} and treat strings and levers as weightless unless stated.

SECTION A (20 Marks)

(Attempt all questions from this Section.)

Question 1

Choose the correct answers to the questions from the given options. *(Do not copy the question, write the correct answers only.)* **[8]**

(i) The mechanical advantage of a lever is equal to:

(a) load arm ÷ effort arm (b) effort arm ÷ load arm

(c) load × effort (d) effort × load arm

(ii) A machine whose velocity ratio is less than 1 is:

(a) a wheelbarrow (b) a single movable pulley

(c) the forearm lifting a load on the palm (d) a bottle opener

(iii) The velocity ratio of an ideal single movable pulley is:

(a) 2 (b) 1

(c) ½ (d) 4

(iv) The efficiency of a practical machine is always:

(a) more than 1 (b) equal to 1

(c) zero (d) less than 1

(v) Assertion (A): A single fixed pulley is used to lift a load even though its mechanical advantage is only 1.

Reason (R): A fixed pulley changes the direction of the effort to a convenient direction.

(a) (A) is true and (R) is false.

(b) (A) is false and (R) is true.

(c) Both (A) and (R) are true, and (R) is the correct explanation for (A).

(d) Both (A) and (R) are true, but (R) is not the correct explanation for (A).

(vi) The ideal mechanical advantage of a block and tackle system having 6 pulleys is:

(a) 3 (b) 6

(c) 12 (d) 5

(vii) A machine of efficiency 75% has a mechanical advantage of 3. Its velocity ratio is:

(a) 4 (b) 2.25

(c) 3.75 (d) 0.25

(viii) Raising the weight of the body while standing on toes is an example of a:

(a) class I lever (b) class II lever

(c) class III lever (d) single movable pulley

Question 2

(a) Define the efficiency of a machine. Write the relation connecting mechanical advantage, velocity ratio and efficiency. **[2]**

(b) Fig. 1 shows a weightless rod AB of length 1.5 m, supported at F, with a load of 24 kgf at A and an effort E applied at B. **[3]**

(i) To which class of lever does it belong? **[1]**

(ii) Calculate its mechanical advantage. **[1]**

(iii) Calculate the effort E needed to lift the load. **[1]**

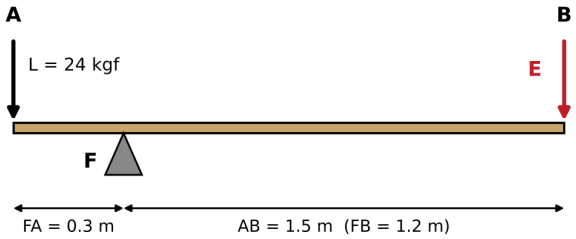


Fig. 1

(c) Which one of mechanical advantage, velocity ratio and efficiency does **not** change when friction is present in a machine of given design? **[1]**

Question 3

(a) A crowbar 1.2 m long is used to lift a load of 150 kgf. The crowbar rests on a fulcrum placed 20 cm from the load, and the effort is applied at the other end. Calculate (i) the load arm and the effort arm, (ii) the mechanical advantage, and (iii) the effort required. **[3]**

(b) Fig. 2 shows a pair of fire tongs holding a piece of coal of weight 1.2 kgf at its free end L. The effort E is applied at 12 cm from the fulcrum F; the coal is 36 cm from F. **[3]**

(i) Name the class of lever. **[1]**

(ii) Find the mechanical advantage of the tongs. **[1]**

(iii) Find the effort needed to hold the coal. **[1]**

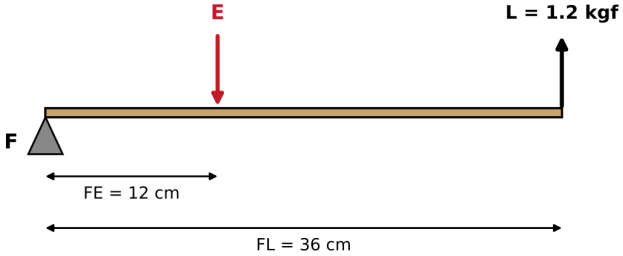


Fig. 2

SECTION B (20 Marks)

(Attempt any two questions from this Section.)

Question 4

(a) In a pair of scissors the cloth is cut at 12 cm from the rivet and the fingers apply the effort at 6 cm from the rivet. (i) Name the class of lever and find its mechanical advantage. (ii) If the effort applied is 10 kgf, find the force exerted on the cloth. (iii) Is the scissors used here as a force multiplier or a speed multiplier? Give a reason. **[3]**

(b) Derive the relation M.A. = V.R. × η between the mechanical advantage, the velocity ratio and the efficiency of a machine. **[3]**

(c) Fig. 3 shows a movable pulley A used together with a fixed pulley B to raise a load of 90 N by applying an effort of 50 N. **[4]**

(i) What is the purpose of the pulley B? **[1]**

(ii) Find the velocity ratio and the mechanical advantage of the system. **[1]**

(iii) Calculate its efficiency. **[1]**

(iv) Assuming no friction in the pulleys and the string being light, find the weight of the pulley A. **[1]**

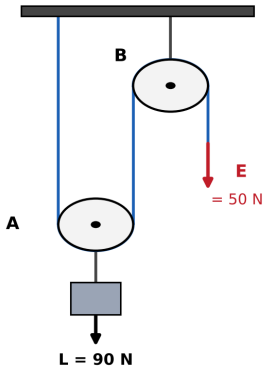


Fig. 3

Question 5

(a) A boy uses a single fixed pulley to raise a bucket of mass 12 kg through a height of 6 m in 8 s by applying an effort of 150 N. Calculate (i) the mechanical advantage, (ii) the velocity ratio and the efficiency of the pulley, and (iii) the power developed by the boy. **[3]**

(b) Fig. 4 shows a block and tackle system of four pulleys in which a load of 400 N is raised by an effort of 125 N applied downwards. **[3]**

(i) Find its mechanical advantage and velocity ratio. **[1]**

(ii) Find its efficiency. **[1]**

(iii) When the load rises through 2 m, calculate the distance moved by the effort and the work done by the effort. **[1]**

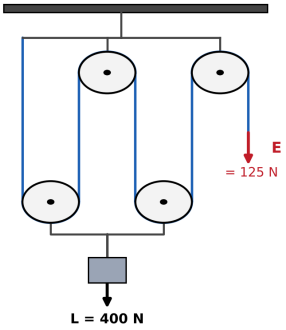


Fig. 4

(c) Fig. 5 shows two movable pulleys A and B and a fixed pulley C used to lift a load of 200 N. Assume the pulleys and strings are weightless and frictionless. **[4]**

(i) Find the tensions T_1 in the string passing under A and T_2 in the string passing under B. **[2]**

(ii) Find the effort E, the mechanical advantage and the velocity ratio. **[1]**

(iii) If the efficiency of the system is 80%, find the effort needed. **[1]**

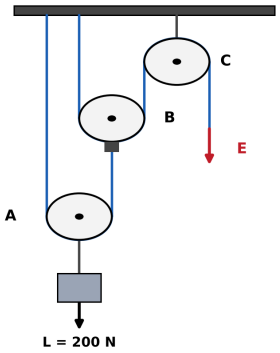


Fig. 5

Question 6

(a) Name the class of lever formed in the human body when (i) the head nods, (ii) the weight of the body is raised on the toes, and (iii) a load kept on the palm is raised by the forearm. Mention where the fulcrum is in case (iii). **[3]**

(b) State three differences between a single fixed pulley and a single movable pulley. **[3]**

(c) Fig. 6 shows a wheelbarrow carrying a load of 45 kgf at A. B is the centre of the wheel, and the horizontal distances are BA = 30 cm and BC = 90 cm. **[4]**

(i) Name the class of lever and the position of the fulcrum. **[1]**

(ii) Write the load arm and the effort arm. **[1]**

(iii) Find the mechanical advantage. **[1]**

(iv) Find the minimum effort required at C to just lift the leg off the ground. **[1]**

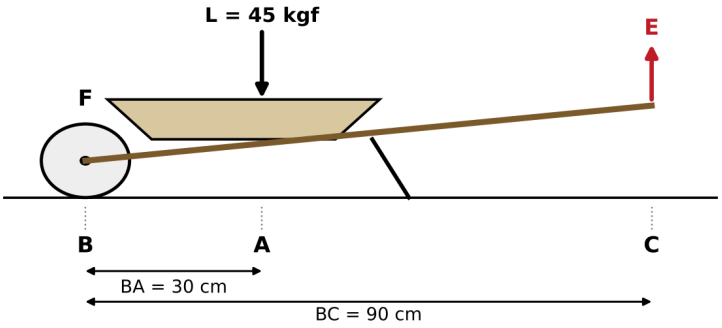


Fig. 6

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