**2025**

1. (i) A body is acted upon by two equal and opposite forces, that are **NOT** along the same straight line. The body will: **[1]**

(a) remain stationary
(b) have only rotational motion
(c) have only rectilinear motion
(d) have both rectilinear and rotational motion

(iii) What is the correct energy transformation during burning of a candle?

(a) heat → kinetic + potential

(b) heat → chemical + light

(c) chemical → heat + light

(d) mechanical → chemical + heat

(vi) For a lever, a graph is plotted with load on Y-axis and effort on X-axis. Which of the following represents the **slope** of the graph?

(a) Mechanical advantage

(b) Velocity ratio

(c) 1 / Velocity ratio

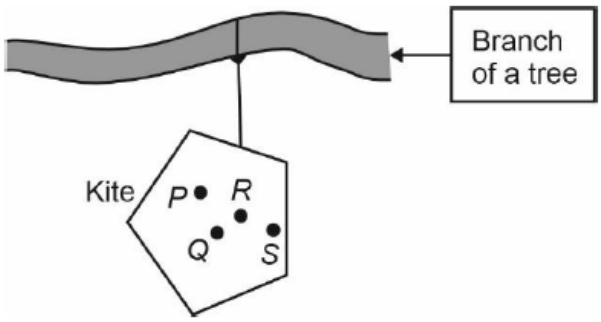
(d) 1 / Mechanical advantage

**Question 2**

(i) Complete the following by choosing the correct answers from the bracket: [6]

(a) In uniform circular motion the **centrifugal force** acts _____ *[towards the centre / away from the centre / along the tangential direction]*.

(ii) A **non-uniform** kite is hanging freely from the branch of a tree as shown. Study the figure and answer the following : **[2]**




(a) Fill in the blank

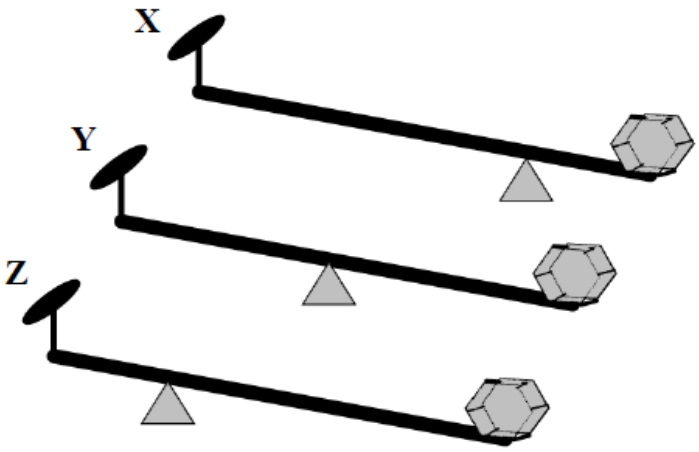
_____ (*P*, *Q*, *R* or *S*) is the most probable position of its centre of gravity.

(b) Support your answer to (a) with a reason.

**Question 6**

(i) Akash takes a **uniform** meter scale and suspends a weight of 2 N at one end **'X'** and a weight of 5 N on the other end **'Y'**. He then balances the ruler horizontally on a knife edge placed at 70 cm from **X**. Draw a diagram of the arrangement and calculate the weight of the ruler. [3]

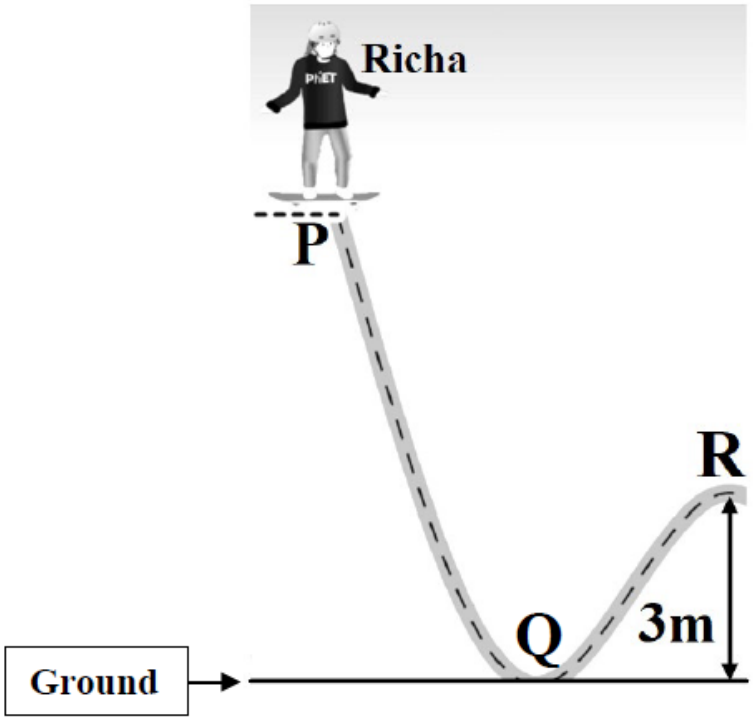
(ii) Three levers **X, Y, Z** of **equal lengths** are shown in the diagram. [3]




(a) Which class of lever do these belong to?

(b) Among these (**X, Y** or **Z**) which one will give the **maximum** mechanical

(iii)




Richa weighing 40 kgf leaves point **P** on her skateboard and reaches point **Q** on the ground with velocity 10 $ms^{-1}$. Calculate:

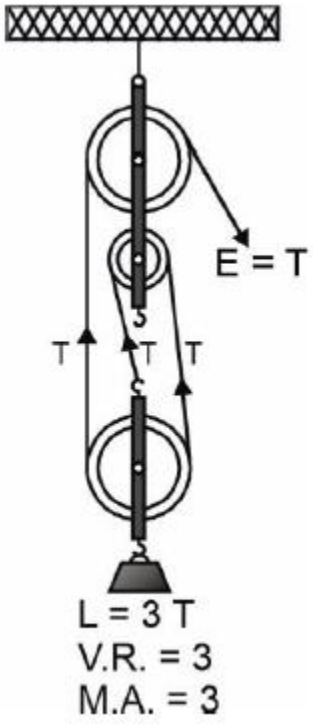
(a) the kinetic energy of Richa at point **Q**.

(b) the vertical height of point **P** above the ground. *(Use **g** as 10 $m/s^2$ and neglect friction)*

(c) the kinetic energy of Richa at point **R.** *(While moving from **Q** to **R**, she loses 500 J of energy against friction.)*

**Question 7**

(i) Draw a block and tackle system of pulleys with **velocity ratio equal to 3**. [3]



**2024**

**Question 1**

Choose the correct answers to the questions from the given options.

(Do not copy the questions, write the correct answers only.)

(i) When a bell fixed on a cycle rings, then the energy conversion that takes place is:

(a) gravitational potential energy to sound energy

(b) kinetic energy to sound energy

(c) sound energy to electrical energy

(d) sound energy to mechanical energy

(ii) A door lock is opened by turning the lever (handle) of length 0.2 m. If the moment of force produced is 1 Nm, then the minimum force required is:

(a) 5 N

(b) 10 N

(c) 20 N

(d) 0.2 N

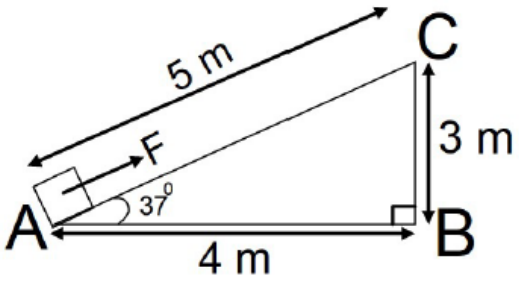
(iii) A force **'F'** moves a load from **A** to **C** as shown in the figure below. For the calculation of the work done, which of these lengths would you use as the displacement?

(a) 3m

(b) 4m

(c) 5m

(d) 7m



(vii) Which of the following is a class III lever?

(a) Pair of scissors

(b) Wheelbarrow

(c) Crowbar

(d) Human forearm

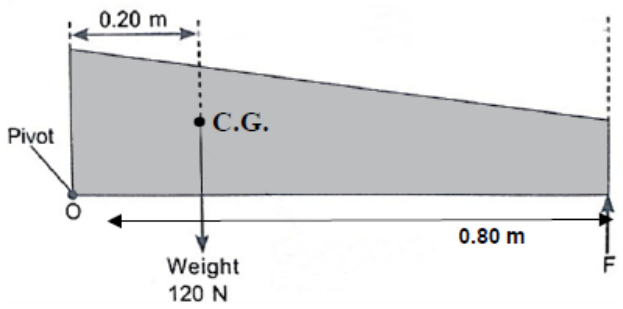
(ii) Fill in the blanks: [2]

(a) When a stone tied to a string is rotated in a horizontal plane, the tension in the string provides _____ force necessary for circular motion.

(b) Work done by this force at any instant is _____.

(iii) A non uniform beam of weight 120 N pivoted at one end is shown in the diagram below. [2]

Calculate the value of **F** to keep the beam in equilibrium.



**2023**

**Question 1**

Choose the correct answers to the questions from the given options.

(Do not copy the questions, write the correct answers only.)

(i) Clockwise moment produced by a force about a fulcrum is considered to be:

(a) Positive

(b) Negative

(c) Zero

(d) None of these

(ii) When the speed of a moving object is *doubled*, then its *kinetic energy*:

(a) remains the same

(b) decreases

(c) is doubled

(d) becomes four times

(iii) The energy conversion in a washing machine is from _____.

(a) magnetic to electrical

(b) electrical to mechanical

(c) electrical to magnetic

(d) magnetic to electrical

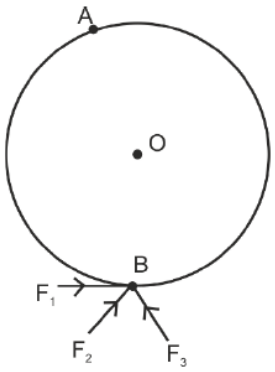
(b) Name a single pulley in which displacement of load and effort is not the same.

(c) State one advantage of this pulley.

(ii) (a) What is the position of centre of gravity of a triangular lamina? [2]

(b) When this triangular lamina is suspended freely from any one vertex, what is the moment of force produced by its own weight in its rest position?

(iii) The diagram shows wheel **O** pivoted at point **A**. Three equal forces $\mathbf{F_1}$, $\mathbf{F_2}$ and $\mathbf{F_3}$ act at point **B** on the wheel. [2]




(a) Which force will produce maximum moment about **A**?

(b) Give a reason for your answer in (a).

(iv) (a) What should be the *angle* between the direction of force and the direction of displacement, for work to be negative? [2]

(b) Name the physical quantity obtained using the formula $\frac{U}{h}$, where $U$ is the potential energy and $h$ is the height.

(v) Calculate the power spent by a crane while lifting a load of mass 2000 kg, at velocity of 1.5 $ms^{-1}$. ($g = 10\ ms^{-2}$) [2]

**Question 6**

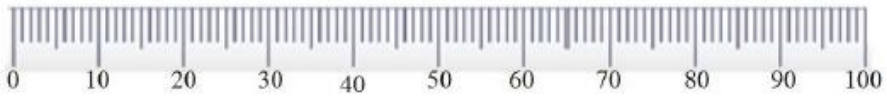
(i) A block and tackle system of pulleys has *velocity ratio* 4. [3]

(a) Draw a labelled diagram of the system indicating clearly, the direction of the load and the effort.

(b) What is the value of the mechanical advantage of the given pulley system if it is an ideal pulley system?

(ii) A **metre** scale of weight 50 gf can be balanced at 40 cm mark without any weight suspended on it. [3]

(a) If this ruler is cut at its centre then state which part [0 to 50 cm or 50 to 100 cm] of the ruler will weigh more than 25 gf.




(b) What minimum weight placed on this metre ruler can balance this ruler when it is pivoted at its centre?

(iii) A car of mass 120 kg is moving at a speed 18 **km/h** and it accelerates to attain a speed of 54 **km/h** in 5 seconds. Calculate: [4]

(a) the work done by the engine.

(b) the power of the engine.

(iv) Meera chose to use a block and tackle system of **'9'** pulleys instead of a single movable pulley to lift a heavy load. [2]

(a) What is the advantage of using a block and tackle system over a single movable pulley?

(b) Why should she connect more number of pulleys in the upper fixed block?

(v) Sumit does 600 J of work in 10 min and Amit does 300 J of work in 20 min. Calculate the ratio of the powers delivered by them. [2]

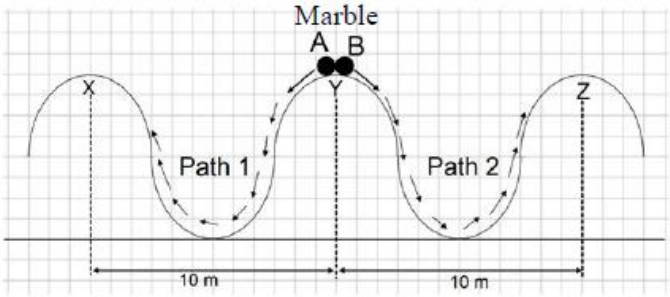
**Question 6**

(i) (a) Define Centre of Gravity. [3]

(b) A hollow ice cream **cone** has height 6 cm.

1. Where is the position of its centre of gravity from the **broad base**?
2. Will its position change when it is filled completely with honey? Write **Yes** or **No**.

(ii)




[3]

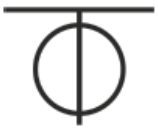
Two identical marbles A and B are rolled down along Path 1 and Path 2 respectively. Path 1 is **frictionless** and Path 2 is **rough**.

(a) Which marble will **surely** reach the next peak?

(b) Along which path/s the **mechanical energy** will be conserved?

(c) Along which path/s is the law of **conservation of energy** obeyed?

(iii) Given are two pulleys. [4]



(a) Copy and complete the labelled diagram connecting the two pulleys with a tackle to obtain Velocity Ratio = 2.

(b) If Load = 48 kgf and efficiency is 80% then calculate:

1. Mechanical Advantage.
2. Effort needed to lift the load.

**2021**

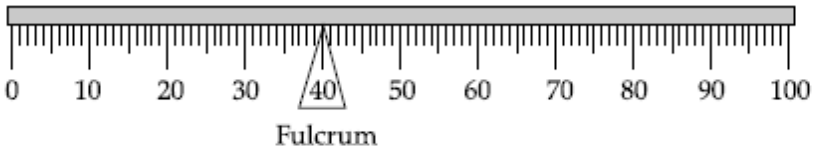
8. **The relation between CGS and S. I. unit of moment of force is** **[1]**
   (a) $1\ \text{Nm} = 10^5$ dyne cm
   (b) $1\ \text{Nm} = 10^5$ dyne
   (c) $1\ \text{Nm} = 10^7$ dyne cm
   (d) $1$ dyne cm $= 10^7$ N m

**10. The energy change during photosynthesis in plants is**

(a) heat to chemical. (b) light to chemical.

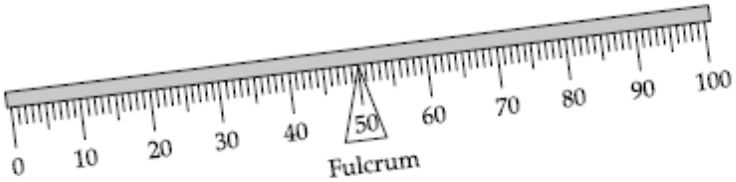
(c) chemical to light. (d) chemical to heat.

**11. The diagram below shows the balanced position of a metre scale.** **[1]**

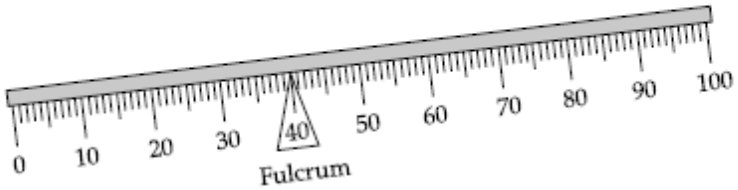



**Which one of the following diagrams shows the correct position of the scale when it is supported at the centre?**

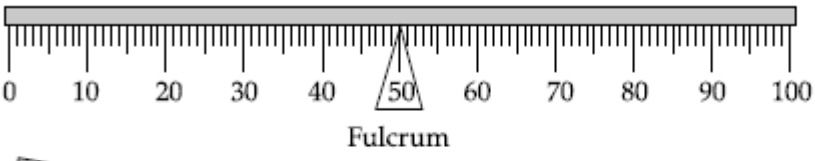
(a)



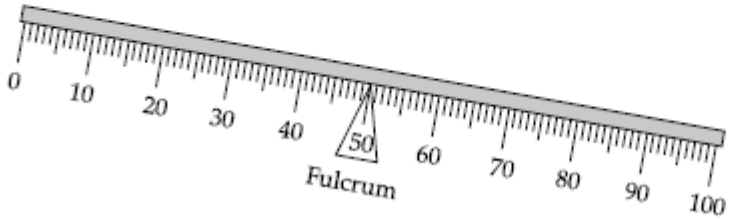

(b)




(c)




(d)



12. **A stone tied at the end of a string is whirled by hand in a horizontal circle with uniform speed.**

(i) **Name the force required for this circular motion** [1]

(a) Centrifugal force.
(b) Centripetal force.
(c) Force of gravity.
(d) Frictional force.

(ii) **What is the direction of the above-mentioned force?** [1]

(a) Towards the centre of the circular path.
(b) Away from the centre of the circular path.
(c) Normal to the radius at a point where the body is present on the circular path.
(d) Direction of this force keeps on changing alternately towards and away from the centre.

13. A body of mass 200 g falls freely from a height of 15 m. [$g = 10\ ms^{-2}$]

(i) When the body reaches 10 m above the ground, its potential energy will be [1]

(a) 20000 J (b) 10 J

(c) 10000 J (d) 20 J

(ii) The gain in kinetic energy of the body when it reaches 10 m above the ground is [1]

(a) 20 J (b) 10 J

(c) 30 J (d) 25 J

(iii) The total mechanical energy it will possess, when it is just about to strike the ground is [1]

(a) 30000 J (b) 20000 J

(c) 30 J (d) 20 J

(iv) The velocity in $ms^{-1}$ with which the body will hit the ground is [1]

(a) 30 (b) 10

(c) $10\sqrt{3}$ (d) $10\sqrt{2}$

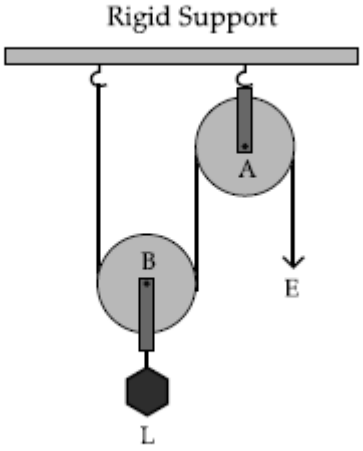
14. A woman draws water from a well using a fixed pulley. The mass of the bucket and the water together is 10 kg. The force applied by the woman is 200 N. The mechanical advantage is ($g = 10\ m/s^2$) [1]

(a) 2 (b) 20

(c) 0.05 (d) 0.5

15. **A single fixed pulley is used because** **[1]**
    (a) it changes the direction of applied effort conveniently.
    (b) it multiplies speed.
    (c) it multiplies effort.
    (d) its efficiency is 100%.

**16. In the diagram shown below, the velocity ratio of the arrangement is [1]**




(a) 1 (b) 2
(c) 3 (d) 0

17. **Which one of the following is the correct mathematical relation?** **[1]**
    (a) Power= Force / Velocity
    (b) Power= Force × Acceleration
    (c) Power= Force / Acceleration
    (d) Power= Force × Velocity

22. 1 joule = _____erg [1]

(a) $10^9$ (b) $10^7$

(c) $10^5$ (d) $10^6$

23. **A light body A and a heavy body B have the same momentum.**

(i) **Choose a correct statement from the given options.** [1]

(a) kinetic energy of body A and body B will be the same.

(b) kinetic energy of body A is greater than kinetic energy of body B.

(c) kinetic energy of body B is greater than kinetic energy of body A.

(d) unless we know the velocity, we cannot find which body has greater kinetic energy.

(ii) **If the ratio of kinetic energies of A and B is 5:2 then which one of the following gives the mass ratio of the bodies respectively?** [1]

(a) 5 : 2 (b) 25 : 4

(c) 2 : 5 (d) 4 : 24

**2020**

**Question 1**

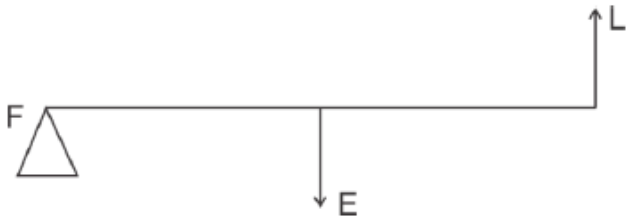
(a) (i) Define moment of force. [2]

(ii) Write the relationship between the SI and CGS unit of moment of force.

(b) Define a kilowatt hour. How is it related to joule? [2]

(c) A satellite revolves around a planet in a circular orbit. What is the work done by the satellite **at any instant**? Give a reason. [2]

(d) (i) Identify the class of the lever shown in the diagram below: [2]




(ii) How is it possible to increase the M.A. of the above lever without increasing its length?

(e) Give one example of each when: [2]

(i) Chemical energy changes into electrical energy.

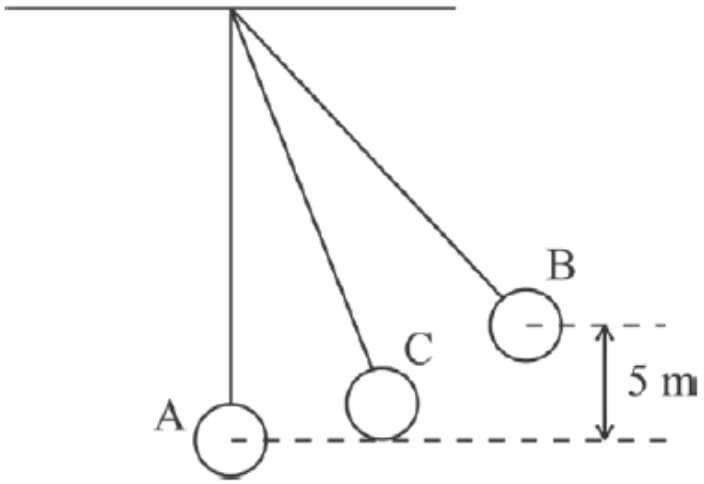
(ii) Electrical energy changes into sound energy.

**Question 2**

(a) A crane **'A'** lifts a heavy load in 5 seconds, whereas another crane **'B'** does the same work in 2 seconds. Compare the power of crane **'A'** to that of crane **'B'**. [2]

**Question 5**

(a) The figure below shows a simple pendulum of mass 200 g. It is displaced from the mean position A to the extreme position B. The potential energy at the position A is zero. At the position B the pendulum bob is raised by 5 m. [3]




(i) What is the potential energy of the pendulum at the position B?

(ii) What is the total mechanical energy at point C?

(iii) What is the speed of the bob at the position A when released from B?

(Take g = 10 $ms^{-2}$ and there is no loss of energy.)

(b) (i) With reference to the direction of action, how does a centripetal force differ from a centrifugal force during uniform circular motion? [3]

(ii) Is centrifugal force the force of reaction of centripetal force?

(iii) Compare the magnitudes of centripetal and centrifugal force.

(c) A block and tackle system of pulleys has velocity ratio 4. [4]

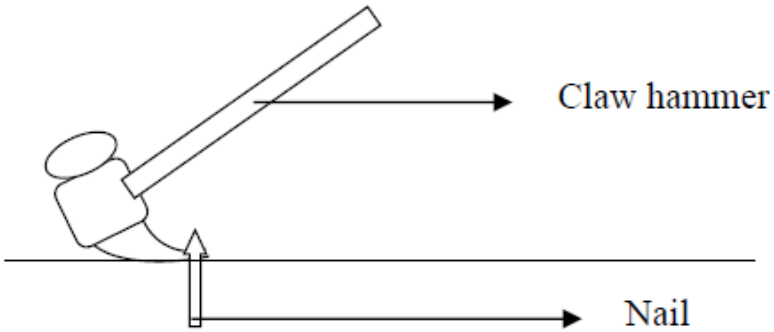
(i) Draw a neat labelled diagram of the system indicating clearly the points of application and direction of load and effort.

(ii) What will be its V.R. if the weight of the movable block is doubled?

**2019**

**Question 1**

(a) The diagram below shows a claw hammer used to remove a nail: [2]




(i) To which class of lever does it belong?

(ii) Give one more example of the **same class** of lever mentioned by you in (i) for which the **mechanical advantage is greater than one**.

(b) Two bodies A and B have masses in the ratio 5:1 and their kinetic energies are in the ratio 125:9. Find the ratio of their velocities. [2]

(c) (i) Name the physical quantity which is measured in calories. [2]

(ii) How is calorie related to the S.I unit of that quantity?

(d) (i) Define couple. [2]

(ii) State the S.I. unit of moment of couple.

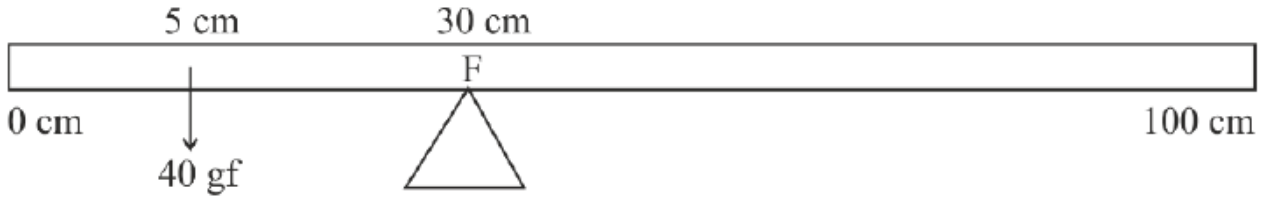
**Question 5**

(a) A body of mass 10 Kg is kept at a height of 5 m. It is allowed to fall and reach the ground. [3]

(i) What is the total mechanical energy possessed by the body at the height of 2 m assuming it is a frictionless medium?

(ii) What is the kinetic energy possessed by the body just before hitting the ground? Take $g = 10\ m / s^2$.

(b) A uniform meter scale is in equilibrium as shown in the diagram: [3]




(i) Calculate the weight of the meter scale.

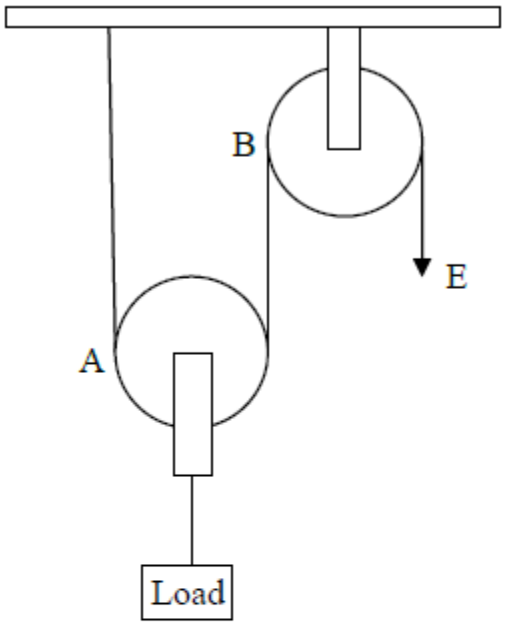
(ii) Which of the following options is correct to keep the ruler in equilibrium when 40 gf wt is shifted to 0 cm mark?

F is shifted towards 0 cm.

or

F is shifted towards 100 cm.

(c) The diagram below shows a pulley arrangement: [4]




(i) Copy the diagram and mark the direction of tension on each strand of the string.

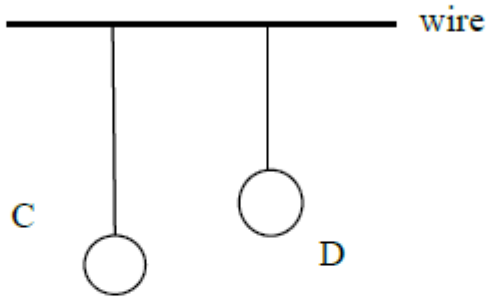
(ii) What is the velocity ratio of the arrangement?

(iii) If the tension acting on the string is T, then what is the relationship between T and effort E?

(iv) If the free end of the string moves through a distance x, find the distance by which the load is raised.

(b) A pendulum has a frequency of 4 vibrations per second. An observer starts the pendulum and fires a gun simultaneously. He hears the echo from the cliff after 6 vibrations of the pendulum. If the velocity of sound in air is 340 m/s, find the distance between the cliff and the observer. [3]

(c) Two pendulums C and D are suspended from a wire as shown in the figure given below. Pendulum C is made to oscillate by displacing it from its mean position. It is seen that D also starts oscillating. [4]




(i) Name the type of oscillation, C will execute.

(ii) Name the type of oscillation, D will execute.

(iii) If the length of D is made equal to C then what difference will you notice in the oscillations of D?

(iv) What is the name of the phenomenon when the length of D is made equal to C?

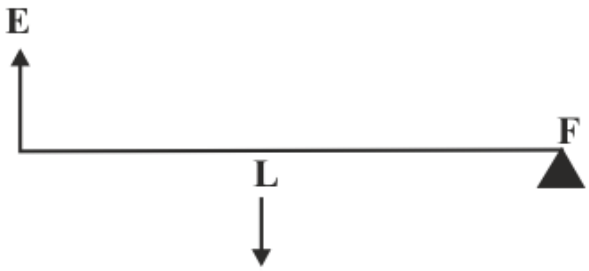
**2018**

**Question 1**

(a) (i) State and define the S.I. unit of power. [2]

(ii) How is the unit horse power related to the S.I. unit of power?

(c) The diagram below shows a lever in use: [2]




(i) To which class of levers does it belong?

(ii) Without changing the dimensions of the lever, if the load is shifted towards the fulcrum what happens to the mechanical advantage of the lever?

(e) (i) Why is the motion of a body moving with a constant speed around a circular path said to be accelerated? [2]

(ii) Name the unit of physical quantity obtained by the formula $\frac{2K}{V^2}$.

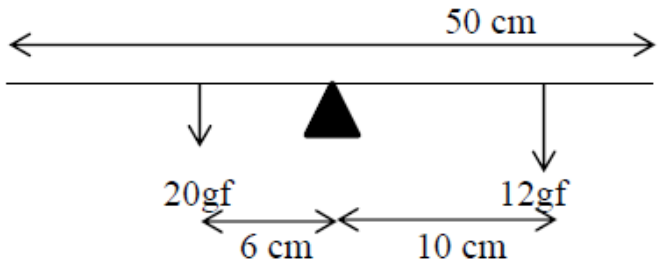
Where K: kinetic energy, V: Linear velocity.

**Question 5**

(a) (i) Derive a relationship between S.I. and C.G.S. unit of work. [3]

(ii) A force acts on a body and displaces it by a distance S in a direction at an angle θ with the direction of force. What should be the value of θ to get the maximum positive work?

(b) A half metre rod is pivoted at the centre with two weights of 20 gf and 12 gf suspended at a perpendicular distance of 6 cm and 10 cm from the pivot respectively as shown below. [3]




(i) Which of the two forces acting on the rigid rod causes clockwise moment?

(ii) Is the rod in equilibrium?

(iii) The direction of 20 gf force is reversed. What is the magnitude of the resultant moment of the forces on the rod?

(c) (i) Draw a diagram to show a block and tackle pulley system having a velocity ratio of 3 marking the direction of load(L), effort(E) and tension(T). [4]

(ii) The pulley system drawn lifts a load of 150 N when an effort of 60 N is applied. Find its mechanical advantage.

(iii) Is the above pulley system an ideal machine or not?

**2017**

**Question 1**

(a) A brass ball is hanging from a stiff cotton thread. Draw a neat labelled diagram showing the forces acting on the brass ball and the cotton thread. [2]

(b) The distance between two bodies is doubled. How is the magnitude of gravitational force between them affected? [2]

(c) Why is a jack screw provided with a long arm? [2]

(d) If the power of a motor be 100 kW, at what speed can it raise a load of 50,000 N? [2]

(e) Which class of lever will always have MA > 1 and why? [2]

**Question 5**

(a) A uniform half metre rule balances horizontally on a knife edge at 29 cm mark when a weight of 20 gf is suspended from one end. [3]

(i) Draw a diagram of the arrangement.

(ii) What is the weight of the half metre rule?

(b) (i) A boy uses a single fixed pulley to lift a load of 50 Kgf to some height. Another boy uses a single movable pulley to lift the same load to the same height. Compare the effort applied by them. Give a reason to support your answer. [3]

(ii) How does uniform circular motion differ from uniform linear motion?

(iii) Name the process used for producing electricity using nuclear energy.

(c) A pulley system with VR = 4 is used to lift a load of 175 kgf through a vertical height of 15 m. The effort required is 50 kgf in the downward direction. [4]

($g = 10\ N\ kg^{-1}$)

Calculate:

(i) Distance moved by the effort.

(ii) Work done by the effort.

(iii) M.A. of the pulley system.

(iv) Efficiency of the pulley system.

(i) A moment of couple has a tendency to rotate the body in an anticlockwise direction. Then the moment of couple is taken as:

(a) positive

(b) negative

(c) maximum

(d) zero

(ii) The kinetic energy of a given body depends on the:

(a) position

(b) centre of gravity of the body.

(c) momentum

(d) displacement

(iv) The adjacent diagram shows the movable block of a block and tackle system with effort in a convenient direction. From the diagram we can conclude that the number of pulleys used in the fixed block are _____.

(a) 1

(b) 3

(c) 2

(d) 4

**Question 2**

(i) Complete the following by choosing the correct answers from the bracket: [6]

(a) A _____ *[class I/class II/Class III]* lever will always have M.A. > 1.

(b) In a block and tackle system, increase in the weight of the movable block _____ *[decreases, does not affect, increases]* the efficiency of the pulley system.

(c) If the mass as well as the velocity of a body is doubled then the kinetic energy of the body _____ *[is doubled/becomes eight times / becomes four times]* the initial kinetic energy.

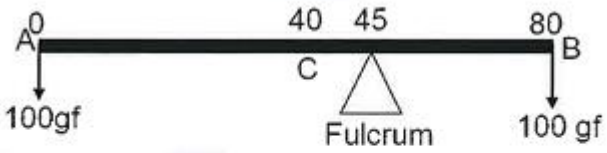
(d) Unit of power used in mechanical engineering is _____ *[watt / horse power / erg per second]*

(e) Two copper wires can have the different _____ *[resistivity / resistance]* but will have same _____ *[resistance / resistivity]*

(ii) Draw a graph of potential energy vs height for a body thrown vertically upwards. [Assume no friction is present.]

**Question 6**

(i)




A metal rod AB of length 80 cm is balanced at 45 cm from the end A with 100 gf weights suspended from the two ends.

(a) If this rod is cut at the centre C, then compare the weight of AC to the weight of BC.

(b) Give a reason for your answer in (a)

**Question 7**

(i) A block and tackle system of pulleys has velocity ratio 4.

(a) Draw a labelled diagram of the system indicating clearly, the direction of the load and effort.

(b) Calculate the potential energy of the load 100 kgf lifted by this pulley to a height 5 m. ($g = 10\ ms^{-2}$)