SAFAL EDUCATION ACADEMY
STANDARD – X
PHYSICS
[Force, Work-Energy-Power, Machine]

TIME : 1.0 Hr MARKS : 55
NAME : ______________________ Marks Obtained : ____

Section – 1 (Force) [17]

Q – 1 Multi choice questions [5]

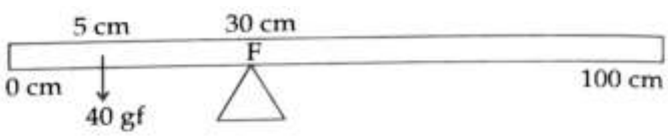
1. A pole vaulter during Tokyo Olympics used a 2.5 m long rod which weighed 10 kg. If the mass of the pole vaulter was 65 kg, calculate the moment of force created by the pole vaulter? [g= 10 N/kg]
   (a) 162.5 kgm, (b) 1625 Nm (c) 16.25 Nm (d) 1625 kgm
2. The weight of a metre scale balanced at 30 cm mark such that two weights one of 30 gf and 10 gf are suspended at 5 cm mark and 40 cm mark respectively is:
   (a) 10 gf, (b) 105 gf, (c) 25 gf, (d) 32.5 gf
3. The maximun force required to open a nut by a spanner of length 50 cm producing a torque of 50 Nm is:
   (a) 10 N, (b) 100 N, (c) 0.1 N, (d) None of these
4. C.G. of a solid and hollow sphere are ________.
   (a) the same, (b) different, (c) almost the same, (d) geometric centre
5. When a body moves in a circular path, outward force is called a _______.
   (a) Pseudo force, (b) Centrifugal force, (c) Centripetal force, (d) Reaction force

Q – 2 Answer the following [6]

1. Define moment of couple. Write its S.I. unit.
2. At which point is the centre of gravity situated in : (a) a triangular lamina and (b)a circular lamina?
3. State two differences between the centripetal and centrifugal force.

Q – 3 Solve the following [6]

1. On a see-saw, two children of masses 30 kg and 60 kg are sitting on one side of it at distances 2 m and 2.5 m respectively from the centre of the see-saw. Find the distance at which a man of mass 75 kg should sit on the other side to balance the see-saw. [2]
2. A force of 2.5 N with its arm 0.5 m long rotates a spanner in clockwise direction. Find the torque.
3. A uniform meter scale is in equilibrium as shown in the diagram: (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



Section – 2 (Work-Energy-Power) [25]

Q – 1 Multi choice questions [5]

1. During free fall the total energy at 3/4n the height is________.
   (a) constant, (b) zero, (c) gravitational potential energy at the top, (d) 3/4th the initial potential energy.
2. In an oscillating pendulum, KE is _________ at extremes.
   (a) zero, (b) negative, (c) positive, (d) variable
3. A parrot flying at a height of 300 m above sea level with a force of 10N _______.
   (a) does no work, (b) does work equal to 3000 J, (c) does negative work, (d) does positive work
4. The bullet weighing 100 g is released from the barrel of an air gun with velocity of 4 m/s. Calculate the Potential energy of the spring.
   (a) 0.8 J, (b) 800J, (c) 8 J, (d) 0.08 J
5. A body possesses a linear momentum of 20 kgm/s and mass of 2 kg. Calculate kinetic energy of the body.
   (a) 10 J, (b) 5J, (c) 100 J, (d) 500 J

Q – 2 Answer the following [10]

1. Define a kilowatt hour. How is it related to joule?
2. Differentiate between watt and watt hour.
3. Differentiate between the potential energy (U) and the kinetic energy (K).
4. What do you mean by degradation of energy? Explain it by taking two examples of your daily life.
5. A body is acted upon by a force. State two conditions when the work done is zero.

Q – 3 Solve the following [10]

1. A ball of mass 0.20kg is thrown vertically upwards with an initial velocity of 20m/s. Calculate the maximum potential energy it gains as it goes up.
2. A block of mass 30 kg is pulled up a slope, as shown in the diagram with a constant speed, by applying a force of 200 N parallel to the slope. A and B are initial and final positions of block. (i) Calculate the work done by force in moving the work from A to B, (ii) Calculate P.E. gained by block. [Take g= 10 ms2]
3. If the power of a motor is 40 kW, at what speed can it raise a load of 20,000 N?
4. A body of mass 0.2 kg falls from a height of 10 m to a height of 6m above the ground. Find the loss in potential energy taking place in the body. [g= 10 m/s]
5. A truck weighing 1000 kgf changes its speed from 36 km/h to 72 km/h in 2 minutes. Calculate the work done by the engine and its power.

Section – 3 (Machine) [13]

Q – 1 Fill in the blanks [5]

1. Mechanical advantage = ___________ × velocity ratio.
2. In class II lever, effort arm is __________ than the load arm.
3. A scissors is a ___________ multiplier.
4. A door is an example of _________ lever.
5. ________ is the unit of Mechanical Advantage.

Q – 2 Answer the following [8]

1. What do you understand by a simple machine?
2. State the principle of an ideal machine.
3. How is mechanical advantage related to the velocity ratio for (i) an ideal machine, (ii) a practical machine?
4. Name the three classes of levers and distinguish between them. Give two examples of each class.

ANSWERS

Section – 1 (Force) [17]

Q – 1 Multi choice questions [5]

1. A pole vaulter during Tokyo Olympics used a 2.5 m long rod which weighed 10 kg. If the mass of the pole vaulter was 65 kg, calculate the moment of force created by the pole vaulter? [g= 10 N/kg] (a) 162.5 kgm, (b) 1625 Nm (c) 16.25 Nm (d) 1625 kgm
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4. C.G. of a solid and hollow sphere are ________. (a) the same, (b) different, (c) almost the same, (d) geometric centre
5. When a body moves in a circular path, outward force is called a _______. (a) Pseudo force, (b) Centrifugal force, (c) Centripetal force, (d) Reaction force

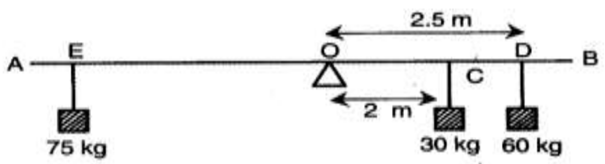
Q – 2 Answer the following [6]

1. Define moment of couple. Write its S.I. unit.
   The moment of a couple is equal to the product of either force and the perpendicular distance between the line of action of both the forces.
2. At which point is the centre of gravity situated in : (a) a triangular lamina and (b)a circular lamina?
   Ans. (a) At the point of intersection of its medians, (b) At the centre of circular lamina
3. State two differences between the centripetal and centrifugal force.

Centripetal force		Centrifugal force	
1	It acts towards the centre of the circle.	1	It acts away from the centre of the circle.
2	It is a real force.	2	It is a fictitious force.

Q – 3 Solve the following [6]

1. On a see-saw, two children of masses 30 kg and 60 kg are sitting on one side of it at distances 2 m and 2.5 m respectively from the centre of the see-saw. Find the distance at which a man of mass 75 kg should sit on the other side to balance the see-saw. [2]



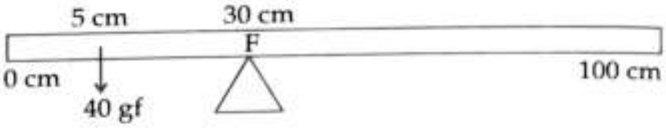
$$\therefore \quad 60 \times 2.5 + 30 \times 2 = 75 \times OE$$
$$75 \times OE = 150 + 60$$
$$OE = \frac{210}{75} = 2.8 \text{ m}$$

2. A force of 2.5 N with its arm 0.5 m long rotates a spanner in clockwise direction. Find the torque.

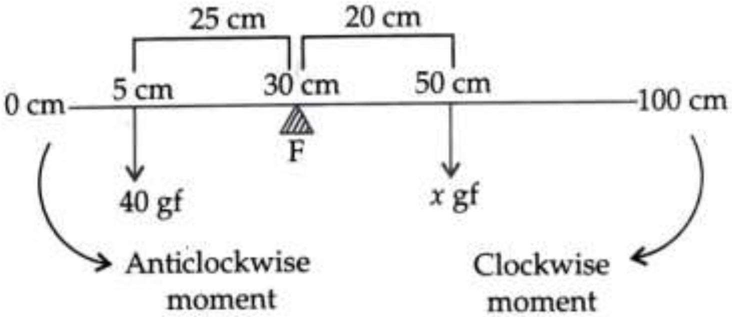
$$\text{Torque } (\tau) = \text{Force (F)} \times \text{Force arm } (d)$$
$$= 2.5 \text{ N} \times 0.5 \text{ m}$$
$$= 1.25 \text{ N m}$$

3. A uniform meter scale is in equilibrium as shown in the diagram: (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



Ans. (i) Let the weight of the meter scale be x gf and it acts at the centre of gravity (*i.e.*, 50 cm mark)



Anticlockwise moment = 40 ×25 gf cm

Clockwise moment = x × 20 gf cm

when the meter scale is balanced,

Clockwise moment = Anticlockwise moment

$$\Rightarrow \quad x \times 20 = 40 \times 25$$

$$\Rightarrow \quad x = \frac{40 \times 25}{20} \text{ gf} = 50 \text{ gf}$$

∴ Weight of meter scale is 50 gf.

(ii) F is shifted towards 0 cm.

<u>**Section – 2 (Work-Energy-Power) [25]**</u>

Q – 1 Multi choice questions [5]

1. During free fall the total energy at 3/4n the height is________. (a) <u>constant</u>, (b) zero, (c) gravitational potential energy at the top, (d) 3/4th the initial potential energy.
2. In an oscillating pendulum, KE is _________ at extremes. (a) <u>zero</u>, (b) negative, (c) positive, (d) variable
3. A parrot flying at a height of 300 m above sea level with a force of 10N _______. (a) <u>does no work</u>, (b) does work equal to 3000 J, (c) does negative work, (d) does positive work
4. The bullet weighing 100 g is released from the barrel of an air gun with velocity of 4 m/s. Calculate the Potential energy of the spring. (a) <u>0.8 J</u>, (b) 800J, (c) 8 J, (d) 0.08 J
5. A body possesses a linear momentum of 20 kgm/s and mass of 2 kg. Calculate kinetic energy of the body. (a) 10 J, (b) 5J, (c) <u>100 J</u>, (d) 500 J

Q – 2 Answer the following [10]

1. Define a kilowatt hour. How is it related to joule?

   One kilowatt hour (1 kWh) is the energy spent (or work done) by a source of power 1 kW in 1 h. i.e.,

1 kilowatt hour (kWh) = 1 kilowatt x 1 hour
= 1000 J s^{-1} x 3600 s
= 3.6 x 10^6 J
= 3.6 MJ

2. Differentiate between watt and watt hour.

Watt		Watt hour	
1	If 1 joule of work is done in 1 second, the power spent is said to be 1 watt.	1	One watt hour (1 Wh) is the energy spent (or work done) by a source of power 1 W in 1 h.
2	Watt (W) is the S.I. unit of power.	2	Watt hour (Wh) is the unit of energy.
3	Its bigger unit is kWh.	3	Its bigger unit are kilowatt (kW), megawatt (MW) and gigawatt (GW).

3. Differentiate between the potential energy (U) and the kinetic energy (K).

Potential energy (U)		Kinetic energy (K)	
1	The energy possessed by a body by virtue of its specific position (or changed configuration) is called the potential energy.	1	The energy possessed by a body by virtue of its state of motion is called the kinetic energy,
2	It is usually denoted by the symbol U.	2	It is usually denoted by the symbol K
3	It is expressed by $K = ½ mv^2$	3	It is expressed by $P = mgh$

4. What do you mean by degradation of energy? Explain it by taking two examples of your daily life.
The gradual decrease of useful energy due to radiation loss, friction, etc. is called the degradation of energy.
(1) When electrical appliances are run by electricity, the major part of electrical energy is wasted in the form of heat energy.
(2) In transmission of electricity from the power generating station, a lot of electrical energy is wasted in the form of heat energy in the line wires used for transmission.

5. A body is acted upon by a force. State two conditions when the work done is zero.
The amount of work done by a force is zero in the following two conditions
(i) when there is no displacement ($S = 0$), and
(ii) when the displacement is normal to the direction of force ($\theta = 90$).

Q – 3 Solve the following [10]

1. A ball of mass 0.20kg is thrown vertically upwards with an initial velocity of 20m/s. Calculate the maximum potential energy it gains as it goes up. (Ans.40J)
2. A block of mass 30 kg is pulled up a slope, as shown in the diagram with a constant speed, by applying a force of 200 N parallel to the slope. A and B are initial and final positions of block. (i) Calculate the work done by force in moving the work from A to B, (ii) Calculate P.E. gained by block. [Take g= 10 ms2]

Ans. (i) Work done in moving the block from A to B,

$= F \times s$

$= 200\ N \times 3\ m = 600\ J$

(ii) Gain in potential energy

$= mgh = 30 \times 10 \times 1{\cdot}5$

$= 450\ J.$

3. If the power of a motor is 40 kW, at what speed can it raise a load of 20,000 N?

Ans. Given : Power = 40 kW = 40,000 W; F = 20,000 N

∴ Power = Force × Average speed

or 40,000 = 20,000 × Average speed

$\therefore$ Average speed $= \frac{40,000}{20,000}$

$= 2\ m/s.$

4. A body of mass 0.2 kg falls from a height of 10 m to a height of 6m above the ground. Find the loss in potential energy taking place in the body. [g= 10 m/s]

Ans. Given, Mass = 0·2 kg

Height, h = 10 m to 6 m

Loss in potential energy

$= mg(h_1 - h_2)$

$= 0{\cdot}2 \times 10 \times (10 - 6) = 8\ J$

5. A truck weighing 1000 kgf changes its speed from 36 km/h to 72 km/h in 2 minutes. Calculate the work done by the engine and its power.

Ans. Weight of truck = 1000 kgf

∴ Mass (m) = 1000 kg

Here, $u = 36\ kmh^{-1} = 10\ ms^{-1}$, $v = 72\ kmh^{-1} = 20\ ms^{-1}$, t = 2 minutes = 2 × 60 s = 120 s

Work done = Increase in kinetic energy

$= \frac{1}{2} m (v^2 - u^2)$

$= \frac{1}{2} \times 1000 \times (20^2 - 10^2)\ J$

$= 500\ (400 - 100)\ J$

$= 500 \times 300\ J = 150000\ J$

$= 1{\cdot}5 \times 10^5\ J$

Power of the engine $= \frac{W}{t}$

$= \frac{150000}{120}$

$= 1{\cdot}25 \times 10^3\ W$

Section – 3 (Machine) [13]

Q – 1 Fill in the blanks [5]

1. Mechanical advantage = ____________ × velocity ratio. (efficiency)
2. In class II lever, effort arm is ___________ than the load arm. (Greater)
3. A scissors is a ____________ multiplier. (speed)
4. A door is an example of _________ lever. (Class II)

5. ________ is the unit of Mechanical Advantage. (No unit)

Q – 2 Answer the following [8]

1. What do you understand by a simple machine?

   A machine is a device by which we can either overcome a large resistive force (or load) at some point by applying a small force (or effort) at a convenient point and in a desired direction or by which we can obtain a gain m speed.
2. State the principle of an ideal machine.

   An ideal machine is a machine whose parts are weightless and frictionless so that which there is no dissipation of energy in any manner. Its efficiency is 100%, i.e. the work output is equal to work input.
3. How is mechanical advantage related to the velocity ratio for (i) an ideal machine, (ii) a practical machine?

   (i) Mechanical advantage = Velocity ratio

   (ii) Mechanical advantage < Velocity ratio
4. Name the three classes of levers and distinguish between them. Give two examples of each class.

   Depending upon the relative positions of the effort, load and fulcrum, there are following three types of levers: (a) Class I levers, (b) Class II levers and(c) Class III levers.

   (a) Class I levers: In these types of levers, the fulcrum F is in between the effort E and the load L. The fulcrum F need not be at the mid-point between the load L and the effort E. Examples: A seesaw, a pair of scissors, crowbar, handle of water pump, claw hammer, a pair of pliers, the beam of a common balance, a spade used for turning the soil, a spoon used to open the lid of a tin can, a catapult and the nodding of the human head are the examples of Class I levers.

   (b) Class II levers: In these types of levers, the load L is somewhere in between the effort E and the fulcrum F. The effort arm is thus always longer than the load arm. Examples: A nut cracker, a bottle opener, a wheel barrow, a lemon crusher, a paper cutter, a mango cutter, a bar used to lift a load, a door, raising the weight of the human body on toes, etc.

   (c) Class III levers: In these types of levers, the effort E is in between the fulcrum F and the load L and so the effort arm is always smaller than the load arm. Examples: Sugar tongs, the forearm used for lifting a load (or action of the bicep muscle), fire tongs, foot treadle, knife, a spade used to lift coal (or soil), fishing rod etc.