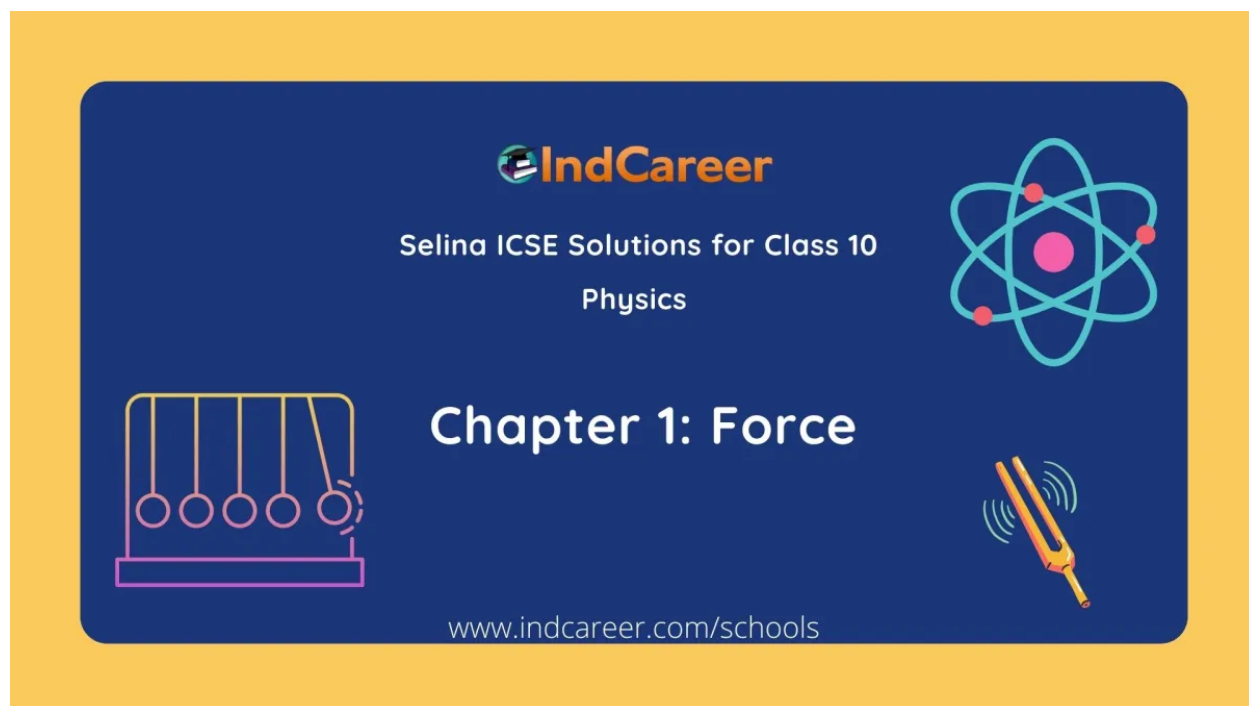


Selina Class 10 ICSE Solutions Physics :

Chapter 1- Force



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Selina Class 10 ICSE Solutions Physics :

Chapter 1- Force

Class 10: Physics Chapter 1 solutions. Complete Class 10 Physics Chapter 1 Notes.

Selina Class 10 ICSE Solutions Physics : Chapter 1- Force

Selina 10th Physics Chapter 1, Class 10 Physics Chapter 1 solutions

Exercise 1(A)

Solution 1.

- (a) When the body is free to move it produces translational motion.
- (b) When the body is pivoted at a point, it produces rotational motion.

Solution 2.

The moment of force is equal to the product of the magnitude of the force and the perpendicular distance of the line of action of force from the axis of rotation.

S.I. unit of moment of force is Newton metre (Nm).

Solution 3.

Moment of a force is a vector.

Solution 4.

Moment of force about a point depends on the following two factors:

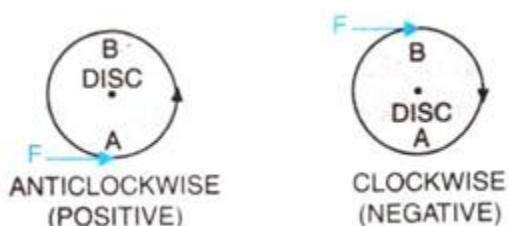
1. The magnitude of the force applied and,
2. The distance of line of action of the force from the axis of rotation.

Solution 5.

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When the body is pivoted at a point, the force applied on the body at a suitable point rotates the body about the axis passing through the pivoted point.

The direction of rotation can be changed by changing the point of application of force. The given figure shows the anticlockwise and clockwise moments produced in a disc pivoted at its centre by changing the point of application of force F from A to B.



Solution 6.

Moment of force about a given axis = force $\times$ perpendicular distance of force from the axis of rotation.

Solution 7.

Moment of force depends on the distance of line of action of the force from the axis of rotation. Decreasing the perpendicular distance from the axis reduces the moment of a given force.

Solution 9.

If the turning effect on the body is anticlockwise, moment of force is called anticlockwise moment and it is taken as positive while if the turning effect on the body is clockwise, moment of force is called clockwise moment and is taken negative.

Solution 10.

It is easier to open a door by applying the force at the free end of it because larger the perpendicular distance, less is the force needed to turn the body.

Solution 11.

The stone of hand flour grinder is provided with a handle near its rim so that it can be rotated easily about the iron pivot at its centre by a small force applied at the handle.

Solution 12.

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It is easier to turn the steering wheel of a large diameter than that of a small diameter because less force is applied on steering of large diameter which is at a large distance from the centre of rim.

Solution 13.

A spanner (or wrench) has a long handle to produce larger turning moment so that nut can easily be turned with a less force.

Solution 14.

(i) We know that,

Moment of force = Force $\times$ Perpendicular distance

Since the perpendicular distance of vector C is least from the point O,

vector C will have the least moment about O.

(ii) We know that,

Moment of force = Force $\times$ Perpendicular distance

Since the perpendicular distance of vector A is greatest from the point O,

vector A will have the greatest moment about O.

(iii) (a) Vectors A and B will produce clockwise moments.

Explanation: If the turning effect on the body is clockwise, moment of force is called clockwise moment and it is taken as negative.

(b) Vector C will produce anticlockwise moment.

Explanation: If the turning effect on the body is anticlockwise, moment of force is called anticlockwise moment and it is taken as positive

(iv) Resultant torque about point O = Sum of torques due to vectors A, B and C

$\therefore$ Resultant torque about point O

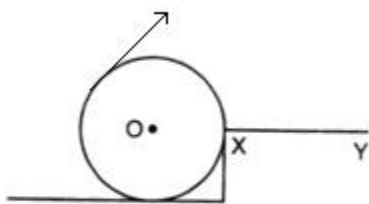
$$= -(4 \times 0.9) - (4 \times 0.8) + (4 \times 0.6) \text{ Nm}$$

$$= -3.6 - 3.2 + 2.4$$

$$= -4.4 \text{ Nm}$$

The negative sign suggests that the resultant torque is in the clockwise direction.

Solution 15.



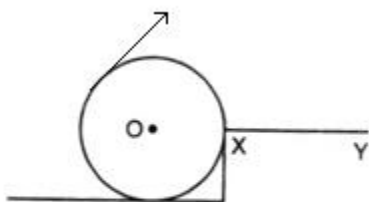
Force F should be provided in the direction as shown in the diagram.

Solution 16.

(a) Resultant force acting on the body = $F - F = 0$ moment of forces = 0 i.e., no motion of the body

(b) The forces tend to rotate the body about the mid-point between two forces, Moment of forces = Fr

Solution 17.



Force F should be provided in the direction as shown in the diagram.

At A and B, two equal and opposite forces each of magnitude F are applied. The two forces rotate the bar in anticlockwise direction.

Solution 18.

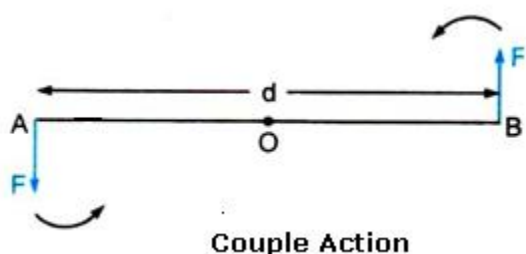
Two equal and opposite parallel forces not acting along the same line, form a couple. A couple is always needed to produce the rotation. For example, turning a key in a lock and turning a steering wheel.

Solution 19.

The moment of a couple is equal to the product of the either force and the perpendicular distance between the line of action of both the forces. S.I unit of moment of couple is Nm.

Solution 20.

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At A and B, two equal and opposite forces each of magnitude F are applied. The two forces rotate the bar in anticlockwise direction. The perpendicular distance between two forces is AB which is called the couple arm.

Moment of force F at the end A

$$= F \times OA(\text{anticlockwise})$$

Moment of force F at the end B

$$= F \times OB(\text{anticlockwise})$$

$$\text{Total moment of couple} = F \times OA + F \times OB$$

$$= F \times (OA + OB) = F \times AB$$

$$= F \times d(\text{anticlockwise})$$

$$= \text{Either force} \times \text{perpendicular distance between the two forces (or couple arm)}$$

$$\text{Thus, Moment of couple} = \text{Force} \times \text{Couple arm}$$

Solution 21.

When a number of forces acting on a body produce no change in its state of rest or of motion, the body is said to be in equilibrium.

Solution 22.

(i) When a body remains in the state of rest under the influence of the applied forces, the body is in static equilibrium. For example a book lying on a table is in static equilibrium.

(ii) When a body remains in the same state of motion (translational or rotational), under the influence of the applied forces, the body is said to be in dynamic equilibrium. For example, a rain drop reaches the earth with a constant velocity is in dynamic equilibrium.

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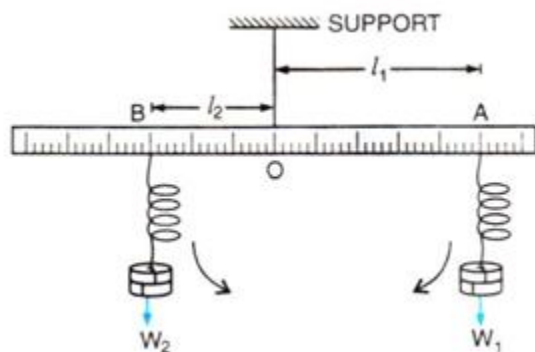
Solution 23.

For a body to be in equilibrium:

1. The resultant of all the forces acting on the body should be equal to zero.
2. The resultant moment of all the forces acting on the body about the point of rotation should be zero.

Solution 24.

According to the principle of moments, if the algebraic sum of moments of all the forces acting on the body about the axis of rotation is zero, the body is in equilibrium. A physical balance (or beam balance) works on the principle of moments.

Solution 25.**Solution 1 (MCQ).**

The moment of a force about a given axis depends on both on the force and its perpendicular distance from the axis.

Hint: Moment of force = Force x Perpendicular distance

Solution 2 (MCQ).

The body will have rotational as well as translational motion.

Numericals**Solution 1.**

Moment of force = force x perpendicular distance of force from point O

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Moment of force = $F \times r$

$$5\text{Nm} = 10 \times r$$

$$R = 5/10 = 0.5 \text{ m}$$

Solution 2.

Length, $r = 10\text{cm} = 0.1\text{m}$

$$F = 5\text{N}$$

$$\text{Moment of force} = F \times r = 5 \times 0.1 = 0.5 \text{ Nm}$$

Solution 3.

Given, $F = 2\text{N}$

Diameter = 2m

Perpendicular distance between B and O = 1m

(i) Moment of force at point O

$$= F \times r$$

$$= 2 \times 1 = 2\text{Nm (clockwise)}$$

(ii) Moment of force at point A = $F \times r$

$$= 2 \times 2 = 4\text{Nm (clockwise)}$$

Solution 4.

Given $AO = 2\text{m}$ and $OB = 4\text{m}$

(i) Moment of force $F_1 (= 5\text{N})$ at A about the point O

$$= F_1 \times OA$$

$$= 5 \times 2 = 10\text{Nm (anticlockwise)}$$

(ii) Moment of force $F_2 (= 3\text{N})$ at B about the point O

$$= F_2 \times OB$$

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$$= 3 \times 4 = 12 \text{ Nm (clockwise)}$$

(iii) Total moment of forces about the mid-point O

$$= 12 - 10 = 2 \text{ Nm (clockwise)}$$

Solution 5.

Given, $AB = 4\text{m}$ hence, $OA = 2\text{m}$ and $OB = 2\text{m}$

Moment of force $F (=10\text{N})$ at A about the point O

$$= F \times OA = 10 \times 2 = 20 \text{ Nm (clockwise)}$$

Moment of force $F (=10\text{N})$ at point B about the point O

$$= F \times OB = 10 \times 2 = 20 \text{ Nm (clockwise)}$$

Total moment of forces about the mid-point O =

$$= 20 + 20 = 40 \text{ Nm (clockwise)}$$

Solution 6.

(i) Perpendicular distance of point A from the force $F = 10 \text{ N}$ at B is 0.5m , while it is zero from the force $F = 10\text{N}$ at A

Hence, moment of force about A is

$$= 10 \text{ N} \times 0.5\text{m} = 5 \text{ Nm (clockwise)}$$

(ii) Perpendicular distance of point B from the force $F = 10 \text{ N}$ at A is 0.5m , while it is zero from the force $F = 10\text{N}$ at B

Hence, moment of force about B is

$$= 10 \text{ N} \times 0.5\text{m} = 5 \text{ Nm (clockwise)}$$

(iii) Perpendicular distance of point O from either of the forces $F = 10\text{N}$ is 0.25 m

Moment of force $F (=10\text{N})$ at A about O = $10\text{N} \times 0.25\text{m}$

$$= 2.5 \text{ Nm (clockwise)}$$

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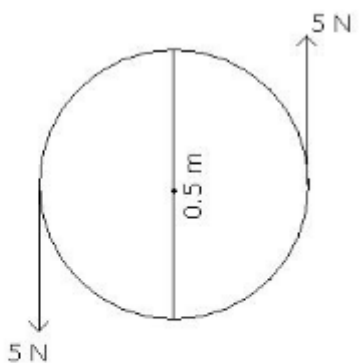
And moment of force $F(=10\text{N})$ at B about O

$$=10\text{N} \times 0.25\text{m}=2.5\text{Nm}(\text{clockwise})$$

Hence, total moment of the two forces about O

$$=0.25 + 0.25=5\text{Nm} (\text{clockwise})$$

Solution 7.



$$\begin{aligned}\text{Moment of couple} &= \text{either force} \times \text{couple arm} \\ &= 5\text{ N} \times 0.5\text{m} \\ &= 2.5\text{ Nm}\end{aligned}$$

Solution 8.

Let the 50gf weight produce anticlockwise moment about the middle point of metre rule .i.e, at 50cm.

Let a weight of 100gf produce a clockwise moment about the middle point. Let its distance from the middle be d cm. Then,

according to principle of moments,

$$\text{Anticlockwise moment} = \text{Clockwise moment}$$

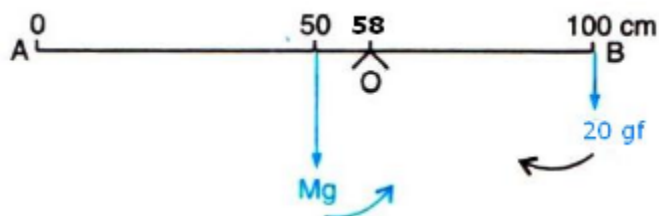
$$50\text{gf} \times 50\text{ cm}=100\text{gf} \times d$$

$$\text{So, } d = \frac{50 \times 50}{100} = 25\text{ cm from the other end}$$

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Solution 9.

(i) Weight mg (W) of rule produces an anti-clockwise moment about the knife edge O . In order to balance it, 20gf must be suspended at the end B to produce clockwise moment about the knife edge O .



(ii)

From the principle of moments,
 Anticlockwise moment = Clockwise moment
 $W \times (58 - 50) = 20\text{gf} \times (100 - 58)$
 $W \times 8 = 20\text{gf} \times 42$
 $W = \frac{20\text{gf} \times 42}{8} = 105\text{gf}$

Solution 10.

Anticlockwise moment = $40\text{gf} \times 40\text{ cm}$

Clockwise moment = $80\text{gf} \times d\text{ cm}$

From the principle of moments,

Anticlockwise moment = Clockwise moment

$40\text{gf} \times 40\text{ cm} = 80\text{gf} \times d$

So, $d = \frac{40\text{gf} \times 40}{80} = 20\text{ cm}$ to the right of point O .

Solution 11.

(i) Anticlockwise moment = $40\text{gf} \times (50 - 10)\text{cm}$

$= 40\text{gf} \times 40\text{cm} = 1600\text{ gf} \times \text{cm}$

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$$\text{Clockwise moment} = 20\text{gf} \times (90 - 50) = 20\text{gf} \times 40\text{cm}$$

$$= 800 \text{ gf} \times \text{cm}$$

Anticlockwise moment is not equal to clockwise moment. Hence the metre rule is not in equilibrium and it will turn anticlockwise.

(ii) To balance it, 40gf weight should be kept on right hand side so as to produce a clockwise moment about the middle point. Let its distance from the middle be d cm. Then,

$$\text{clockwise moment} = 20\text{gf} \times 40\text{cm} + 40\text{gf} \times d \text{ cm}$$

From the principle of moments,

$$\text{Anticlockwise moment} = \text{Clockwise moment}$$

$$40 \text{ gf} \times 40 \text{ cm} = 20\text{gf} \times 40 + 40 \times d \text{ cm}$$

$$1600 - 800 = 40\text{gf} \times d \text{ cm}$$

$$\text{So, } d = \frac{800\text{gf cm}}{40\text{gf}} = 20 \text{ cm (on the other side)}$$

Hence, by placing the additional weight of 40gf at the 70cm mark the rule can be brought in equilibrium.

Solution 12.

From the principle of moments,

$$\text{Anticlockwise moment} = \text{Clockwise moment}$$

$$20\text{kgf} \times 2\text{m} = 40\text{kgf} \times d$$

$$\text{So, } d = \frac{20\text{kgf} \times 2\text{m}}{40\text{kgf}} = 1 \text{ m from the centre on the side opposite to the boy.}$$

Solution 13.

From the principle of moments,
Anticlockwise moment = Clockwise moment
 $100 \text{ gf} \times 40 \text{ cm} = W \times 60 \text{ cm}$
So, weight on the longer pan,
$$W = \frac{100 \text{ gf} \times 40 \text{ cm}}{60 \text{ cm}} = \frac{200 \text{ gf}}{3} = 66.67 \text{ gf}$$

Solution 14.

(i) Total anticlockwise moment about O

$$= 150 \text{ gf} \times 40 \text{ cm} = 6000 \text{ gf cm}$$

(ii) Total clockwise moment about O,

$$= 250 \text{ gf} \times 20 \text{ cm} = 5000 \text{ gf cm}$$

(iii) The difference of anticlockwise and clockwise moment = $6000 - 5000 = 1000 \text{ gf cm}$

(iv) From the principle of moments,

Anticlockwise moment = Clockwise moment

To balance it, 100gf weight should be kept on right hand side so as to produce a clockwise moment about the O. Let its distance from the point O be d cm. Then,

$$150 \text{ gf} \times 40 \text{ cm} = 250 \text{ gf} \times 20 \text{ cm} + 100 \text{ gf} \times d$$

$$6000 \text{ gf cm} = 5000 \text{ gf cm} + 100 \text{ gf} \times d$$

$$1000 \text{ gf cm} = 100 \text{ gf} \times d$$

$$\text{So, } d = \frac{1000 \text{ gf cm}}{100 \text{ gf}} = 10 \text{ cm on the right side of O.}$$

Solution 15.

(i) Anticlockwise moment = $10\text{gf} \times 50\text{ cm} = 500\text{gf cm}$

(ii) From the principle of moments,

Anticlockwise moment = Clockwise moment

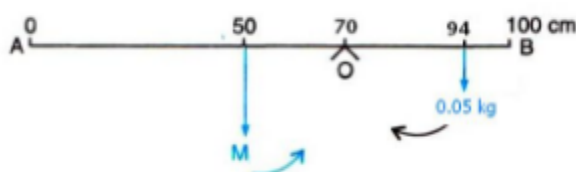
$$10\text{gf} \times 50\text{ cm} = W \times 100\text{cm}$$

$$\text{So, } W = \frac{10\text{gf} \times 50\text{ cm}}{100\text{cm}} = 5\text{gf}$$

By applying a force 5gf upwards at the 100cm mark, rule can be made horizontal

Solution 16.

(a)



(b) From the principle of moments,

Anticlockwise moment = Clockwise moment

$$M \times 20\text{cm} = 0.05\text{kg} \times 24\text{ cm}$$

$$\text{So, } M = \frac{0.05\text{kg} \times 24\text{cm}}{20\text{ cm}} = 0.06\text{kg}$$

Solution 17.

(i) From the principle of moments,

Clockwise moment = Anticlockwise moment

$$100\text{g} \times (50-40)\text{ cm} = m \times (40-20)\text{ cm}$$

$$100\text{g} \times 10\text{ cm} = m \times 20\text{ cm} = m = 50\text{ g}$$

(ii) The rule will tilt on the side of mass m (anticlockwise), if the mass m is moved to the mark 10cm.

(iii) Anticlockwise moment if mass m is moved to the mark 10 cm = $50\text{g} \times (40-10)\text{cm} = 50 \times 30 = 1500\text{g cm}$

Clockwise moment = $100\text{g} \times (50-40)\text{ cm} = 1000\text{g cm}$

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Resultant moment = $1500\text{g cm} - 1000\text{g cm} = 500\text{g cm}$ (anticlockwise)

(iv) From the principle of moments,

Clockwise moment = Anticlockwise moment

To balance it, 50g weight should be kept on right hand side so as to produce a clockwise moment. Let its distance from fulcrum be d cm. Then,

$$100\text{g} \times (50-40)\text{ cm} + 50\text{g} \times d = 50\text{g} \times (40-10)\text{cm}$$

$$1000\text{g cm} + 50\text{g} \times d = 1500\text{ g cm}$$

$$50\text{ g} \times d = 500\text{g cm}$$

$$\text{So, } d = 10\text{ cm}$$

By suspending the mass 50g at the mark 50 cm, it can be balanced.

Exercise 1(B)

Solution 1.

Centre of gravity is the point about which the algebraic sum of moments of weights of particles constituting the body is zero and the entire weight of the body is considered to act at this point.

Solution 2.

Yes, the centre of gravity can be situated outside the material of the body. For example, centre of gravity of ring.

Solution 3.

The position of centre of gravity of a body of given mass depends on its shape i.e., on the distribution of mass in it. For example: the centre of gravity of a uniform wire is at its mid-point. But if this wire is bent into the form of a circle, its centre of gravity will then be at the centre of circle.

Solution 4.

The position of centre of gravity of a

(a) rectangular lamina is at the point of intersection of its diagonals.

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(b) cylinder is at the mid point on the axis of cylinder.

Solution 5.

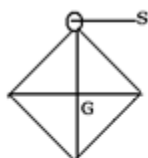
(a) Centre of gravity of a triangular lamina is situated at the point of intersection of its medians.

(b) Centre of gravity of a circular lamina is situated at the centre of circular lamina.

Solution 6.

Centre of gravity of a uniform ring is situated at the centre of ring.

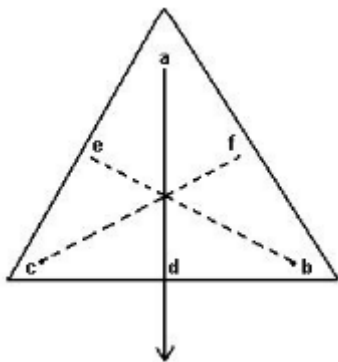
Solution 7.



A square card board in rest position with G as centre of gravity and S as point of suspension.

Solution 8.

Take a triangular lamina. Make three fine holes at a, b, c near the edge of triangular lamina. Now suspend the given lamina along with a plumb line from hole 'a'. Check that the lamina is free to oscillate about the point of suspension. When lamina has come to rest, draw straight line ad along the plumb line. Repeat the experiment by suspending the lamina through hole 'b' and then through hole 'c' for which we get straight lines be and cf respectively. It is noticed that the lines ad, be and cf intersect each other at a common point G which is the position of centre of gravity of triangular lamina i.e. the point of intersection of medians.

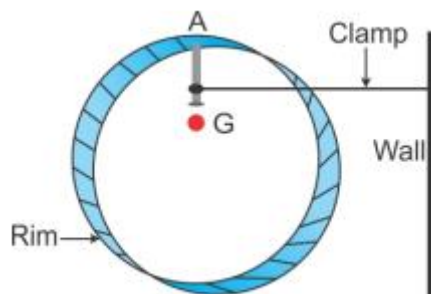
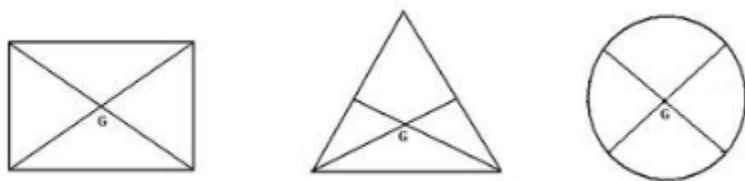


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Solution 9.

(i) False. The position of centre of gravity of a body of given mass depends on its shape i.e., on the distribution of mass in it.

(ii) True.

Solution 10.**Solution 11.****Solution 1 (MCQ).**

At its geometrical centre

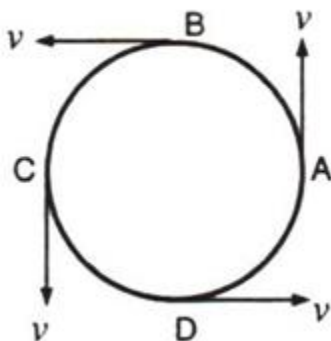
Exercise 1(C)**Solution 1.**

When a particle moves with a constant speed in a circular path, its motion is said to be the uniform circular motion. For example : Revolution of earth around sun is an example of uniform circular motion.

Solution 2.

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Particle moving in a circular path with a constant speed.



Solution 3.

Yes, uniform circular motion has an accelerated motion with a constant speed.

Solution 4.

Motion of a cyclist on a circular track is an example of motion in which speed remains uniform, but the velocity changes.

Solution 5.

When the object moves in a circular path with uniform speed, it means that its magnitude of velocity does not change, only its direction changes continuously. Hence, it is considered as uniformly accelerated motion.

Solution 6.

Uniform linear motion	Uniform circular motion
The body moves along a straight line.	The body moves along a circular path.
Speed and direction both remain constant.	Speed is constant, but direction changes continuously.
It is not an accelerated motion.	It is an accelerated motion.

Solution 7.

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Centripetal force is required for circular motion. It is always directed towards the centre of circle.

Solution 8.

Force acting on a body which is in circular motion is called centripetal force. It acts towards the centre of circular path.

Solution 9.

A planet moves around the sun in a nearly circular path for which the gravitational force of attraction on the planet by the sun provides the necessary centripetal force required for circular motion.

Solution 10.

(a) They act in opposite directions.

(b) No, centrifugal force is not the force of reaction of centripetal force.

Solution 11.

No, centrifugal force is a fictitious force.

Solution 12.

a. On standing outside the disc, we find that the pebble is moving on a circular path. On standing at the centre of the disc, we find that the pebble is stationary placed just in front of us.

Solution 13.

Force of tension in the thread provides the centripetal force.

Solution 15.

(a) False

(b) True

(c) True

(d) False

Solution 1 (MCQ).

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Speed

Hint: Speed is scalar but velocity and acceleration are vector quantities. So, speed remains constant but velocity and acceleration change with the change in direction, and in circular motion the direction of motion changes at every point.



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- Chapter 4- Refraction of Light at Plane Surfaces
- Chapter 5- Refraction through Lens
- Chapter 6- Spectrum
- Chapter 7- Sound
- Chapter 8- Current Electricity
- Chapter 9- Electrical Power and Household Circuits
- Chapter 10- Electro Magnetism
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