UNIT 3

DYNAMICS

SHORT QUESTIONS

Q.1 **Define dynamics.** (GRW 2015)

Ans: The branch of mechanics that deals with the study of motion of an object and the cause of its motion is called dynamics.

Q.2 **Define force** (GRW 2013)

Ans: A force moves or tends to move, stops or tends to stop the motion of a body. The force can also change the direction of motion of a body.

Example

We can open the door either by pushing or pulling the door.

A man pushes the cart. The push may move the cart or change the direction of its motion or may stop the moving cart.

A batsman changes the direction of moving ball by pushing it with his bat.

Q.3 **Define inertia. Explain it with examples.** (LHR 2014, 2015)

Ans: Inertia of a body is its property due to which it resists any change in its state of rest or of uniform motion.

It depends on the mass of the body. Greater the mass of the body greater will be the inertia. Therefore, we can say that mass is the direct measure of inertia.

Example 1:

Take a glass cover it with a piece of cardboard. Place a coin on the cardboard. Now kick the card horizontally with a jerk of your finger. The coin does not move with the cardboard with the inertia and falls in to the glass.

Example 2:

Cut a strip of paper. Place it on the table. Stack a few coins at its on end. Pull out the paper strip under the coins with a jerk. We will succeed in pulling out the paper strip under the stacked coin without letting them to fall due to inertia.

Q.4 **What is momentum?** (LHR 2014)

Ans: Momentum of a body is the quantity of motion it possesses due to its mass and velocity. The momentum 'P' of a body is given by the product of its mass m and velocity v. Thus

$P = m \times v$

Quantity

Momentum is a vector quantity.

Unit

SI unit of momentum is kg ms^{-1} or Ns.

Q.5 **State Newton's First law of motion.**

Ans: A body continues in its state of rest or of uniform motion in a straight line provided no net force acts on it.

Q.6 **Why Newton's First law of motion is also called law of inertia?**

Ans: According to Newton's first law of motion "A body continues its state of rest or of uniform motion in a straight line provided no net force acts on it".

The property of a body due to which it resists any change in its state of rest or motion is known as inertia.

On comparing the above two statements we find that statement of Newton's first law of motion is in accordance with statement of inertia. Therefore Newton's first law of motion is known as law of inertia.

Q.7 **State Newton's Second law of motion** **(LHR 2012, GRW 2013)**

Ans: "When a net force 'F' acts upon a body, it produces an acceleration in the body direction of force and the magnitude of acceleration is directly proportional to the force and is inversely proportional to the mass of the body".

Mathematically $F = ma$

Q.8 **What is the unit of force? Define it.** **(GRW 2013)**

Unit of Force

In the System International, the unit of force is newton, which is represented by the symbol **'N'**.

Newton

"One newton is that force which produces an acceleration of 1 ms^{-2} in a body of mass 1 kg".

This unit of force can also be written as,

$$1 \text{ N} = 1 \text{ kg} \times 1 \text{ ms}^{-2}$$
$$1 \text{ N} = 1 \text{ kgms}^{-2}$$

Q.9 **State Newton's Third law of motion**

Ans: "To every Action there is always an equal but opposite reaction".

Q.10 **If a moving body has no acceleration; does it mean that no force is acting on it?**

Ans: According to Newton's second law of motion, we have

$F = ma$

When acceleration = a = 0, we get

$F = m \times 0$

So, $F = 0$

Thus, when acceleration is zero then the net force acting on the body is zero but it does not mean that no force is acting on the body. When body is in motion, some forces be acting on the body but in case of zero acceleration, net (resultant) force should be zero.

Q.11 **What do you know about Momentum?** **(LHR 2015)**

Ans: **Definition**

The Momentum of the moving body is the product of its mass and velocity.

OR

Quantity of motion of the body is determined by a quantity known as Momentum.

Mathematical Form

If a body of mass 'm' is moving with velocity 'v' then mathematically it is written as,

$P = m \times v$

Quantity

Momentum is a vector quantity.

Unit

The SI unit of momentum is (kgms^{-1}). It can also be written as (Ns).

Q.12 **Prove that $1 \text{kgms}^{-1} = 1 \text{Ns}$**

Ans: **L.H.S**

$1 \text{ kgms}^{-1} = 1\text{kg} \times 1\text{ms}^{-1} \times 1\text{s}/1\text{s}$

$\qquad = 1\text{kgms}^{-2} \times 1\text{s}$

As we know that $1\text{kgms}^{-2} = 1\text{N}$

So $1\text{kgms}^{-1} = \text{R.H.S} = 1 \text{ N s}$

OR

R.H.S

1 Ns

As $N = kg\ ms^{-2}$

So $Ns = kg\ ms^{-2} \times s = kg\ ms^{-2} = L.H.S$

So $kg\ ms^{-1} = Ns$

On which quantities, Momentum (quantity of motion) of a body depends?

Ans: Momentum or quantity of the motion of a body depends on two quantities.

    (i) Mass of the body

    (ii) Velocity of the body

Q.13 **What is the relationship of momentum and the force applied on the body?**

Ans: Rate of change of momentum of a body is equal to the applied force on it and the direction of change in momentum is in the direction of the force.

Q.14 **State law of conservation of momentum.**

Ans: The momentum of an isolated system of two or more than two interacting bodies remains constant.

    An isolated system is a group of interacting bodies on which no external force is acting. If no unbalanced or net force acts on a system then its momentum remains constant.

Q.15 **Write down the advantages and disadvantages of friction.**

                                          (LHR 2011, GRW 2011, 2012)

Ans: **Disadvantages**   **(GRW 2013)**

- Friction is undesirable when moving at high speed because it opposes the motion and thus limits the speed of the moving objects.
- Most of our useful energy is lost as heat and sound due to the friction between various moving parts of machines.
- In machines, friction also causes wear and tear of their moving parts.

Advantages

- We write due to presence of friction between paper and pencils.
- Friction enables us to walk on the ground.
- We can tie a knot due to friction
- A nail stays in the wood due to friction.
- Birds can fly, due to air resistance. The reaction of pushed air enables the birds to fly.

Q.16 **Write down the methods to reduce friction.**   **(LHR 2013)**

Ans: The friction can be reduced by:

- Making the sliding friction smooth
- Making the fast moving objects a streamline shape (fish shape) such as car, aeroplanes, etc. this causes the smooth flow of air and thus minimizes air resistance at high speeds.
- Lubricating the sliding surfaces
- Using ball bearings or roller bearings. Because the rolling friction is lesser than the sliding friction.

Q.17 **What is Sliding friction?**

Ans: The frictional force opposing the sliding or dragging of one solid body over another solid body is called sliding friction.

Q.18 **Suppose you are running and want to stop at once. Surely you will have to produce negative acceleration in your speed. Can you tell from where does the necessary force come?**

Ans: While running when we want to stop at once, we press the ground firmly with our feet. Thus friction comes into play due to relative motion of our feet and ground which acts opposite direction to our motion and it reduces our speed and ultimately we come to stop.

Q.19 **Define circular motion.**

Ans: Motion of the body moving in the circular path is known as circular motion. Heavenly bodies have natural tendency to move in curved paths.

Examples

- The motion of the moon around the Earth is nearly in circular orbit.

- The paths of electrons moving around the nucleus in an atom are also nearly circular.

- Motion of the stone tied with the string

Q.20 **Define centripetal force** (GRW 2015, LHR 2015)

A force that keeps a body to move in a circle is known as centripetal force.

Or

A force which compels the body to move in the circular path is known as centripetal force.

$$F_c = \frac{mv^2}{r}$$

Q.21 **Define centripetal acceleration**

The acceleration produced by the centripetal force which is always directed towards the center of the circle is known as centripetal acceleration. It is represented by a_c.

Q.22 **Define and explain centrifugal force. Is it a reaction of centripetal force?**

(LHR 2014)

Ans: **Definition**

The force which compels a body to move away from circular path is known as centrifugal force. This is reaction of centripetal force.

Example

Consider a stone tied with a string moving in a circle. The necessary centripetal force acts on the stone through the string that keeps it in the move in a circle. According to Newton's third law of motion, there exists a reaction to centripetal force. Centripetal reaction that pulls the string outward is sometimes the centrifugal force.

Q.23 **Why outer edge of the road is kept higher than inner edge (banking of road)? Explain.**

(LHR 2013)

Ans: When a car takes a turn, centripetal force is needed to keep it in its curved track. The friction between the tyres and road provides the necessary centripetal force. The car would skid away if the force of friction between the tyres and the road is not sufficient enough particularly when the roads are wet. Banking of a road means that the outer edge of a road is raised. Banking causes a component of vehicle's weight to provide the necessary force while taking a turn. Thus banking of road prevents skidding of vehicle and thus makes the driving safe.

Q.24 **Explain the function of washing machine (dryer).**

Ans: The dryer of a washing machine is basket spinner. They have perforated wall having large numbers of fine holes in the cylindrical rotor. The lid of the cylindrical container is closed after putting wet clothes in it. When it spins at high speed, the water from wet clothes is forced out through these holes due to lack of centripetal force.

Q.25 **Explain the function of cream separator.**

Ans: Most modern plants use a separator to control the fat contents of various products. A separator is a high – speed spinner. It acts on the same principle of centrifuge machine. The bowl spins at very high speed causing the heavier contents of the milk to move outwards in the bowl pushing the lighter contents inwards towards the spinning axis. Cream or butterfat is lighter than other components in the milk. Therefore, skimmed milk, which is denser than cream is collected at outer wall of the bowl. The lighter part (cream) is pushed towards the center from where it is collected through a pipe.

Q.26 **Why a cyclist bend himself toward the inner side of the curved path while taking turn with high speed?**

Ans: A cyclist bend himself toward the inner side of the curved path while taking turn with high speed to provide necessary centripetal force with his weight to take turn in circular path to avoid slipping.

Q.27 **Can a body move with uniform velocity in a circle? If not, why?**

Ans: When a body is moving in circle it may have uniform speed but its velocity is non-uniform because direction of the body is changing at every instant.

Q.28 **Can a body move along a circle without the centripetal force?**

Ans: When a body moves in a circular path, it does so under the action of centripetal force. This force is directed towards the center along the radius of the circle. As the radius is perpendicular to the tangent of the circle, the centripetal force keeps the body in circular path. Thus, in absence of centripetal force, the body cannot move in a circular path.

Q.29 **Moon revolves around the earth, from where it gets necessary centripetal force?**

Ans: The gravitational force between the earth and the moon provides the necessary centripetal force to moon for revolving around the earth.

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