

PHYSICS

Short Questions with Answers – Dynamics

Introduction to Dynamics

1. What is Dynamics?

Dynamics is the branch of mechanics that studies the forces which produce changes in the motion of bodies.

2. How is Dynamics different from Kinematics?

Kinematics deals only with the description of motion (position, velocity, acceleration), while Dynamics explains the cause of motion, i.e., the forces producing acceleration.

3. Give examples of forces causing acceleration.

- Earth exerts gravitational force on a falling stone.
 - The engine of a car exerts force that produces acceleration.
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3.1 Concept of Force

4. What is Force?

Force is a push or pull that starts, stops, or changes the magnitude and/or direction of velocity of a body.

5. How does force transfer energy?

Force transfers energy to objects, e.g., a man lifts and pushes a wheelbarrow by applying force.

6. Give examples of forces acting on us.

- Force of gravity pulling downward.
 - Force of friction that allows us to walk.
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Types of Forces

7. What are the two major types of forces?

1. Contact Forces

2. Non-contact Forces

Contact Forces

8. What is a Contact Force?

A contact force is exerted by one object on another at the point of contact.

9. What is Friction?

Friction is the force that resists motion when two surfaces are in contact.

10. What is Drag?

Drag is the resistive force caused by the motion of a body through a fluid (like air or water).

11. What is Thrust?

Thrust is the upward force exerted by a liquid on an object immersed in it. For example, a ship floats because thrust balances its weight.

12. What is Normal Force?

It is the reaction force exerted by a surface on an object lying on it, acting perpendicular to the surface.

13. What is Air Resistance?

It is the opposition offered by air when an object moves through it.

14. What is Tension Force?

It is the force experienced by a rope or string when pulled by a person or load.

15. What is Elastic Force?

It is the restoring force that brings materials like rubber bands, springs, or trampolines back to their original shape after deformation.

Non-contact Forces

16. What is a Non-contact Force?

It is a force that acts between two objects without physical contact, often called field force or action-at-a-distance.

17. What is Gravitational Force?

It is the attractive force that exists between all bodies with mass. Example: Earth attracts an apple falling from a tree.

18. What is Electrostatic Force?

It is the force between charged objects. Like charges repel, unlike charges attract.

19. What is Magnetic Force?

It is the force exerted by a magnet on other magnets or magnetic materials (iron, nickel, cobalt). Like poles repel, unlike poles attract.

20. Name other Non-contact Forces.

Strong nuclear force and weak nuclear force (acting between subatomic particles).

3.2 Fundamental Forces**21. What are the four fundamental forces in nature?**

1. Gravitational Force
2. Electromagnetic Force
3. Strong Nuclear Force
4. Weak Nuclear Force

22. What is the Gravitational Force?

It is the weakest long-range force that exists between all bodies with mass. It keeps planets in orbit and holds the atmosphere and oceans on Earth.

23. What is the Electromagnetic Force?

It is the force between electrically charged particles. It includes electrostatic and magnetic forces, causes chemical reactions, binds atoms and molecules, and is stronger than gravity.

24. What is the Strong Nuclear Force?

It binds protons and neutrons in the nucleus, overcoming the repulsive electromagnetic force between protons. It is a very strong but short-range force.

25. What is the Weak Nuclear Force?

It is responsible for beta decay (radioactive decay) in which a neutron transforms into a proton, electron, and antineutrino. It is stronger than gravity but weaker than electromagnetic force.

26. What is Electroweak Force?

It is the unification of weak nuclear and electromagnetic forces, discovered by Dr. Abdus Salam, Sheldon Glashow, and Steven Weinberg (Nobel Prize 1979).

3.3 Free-Body Diagram**27. What is a Free-Body Diagram?**

It is a diagram that shows the relative magnitudes and directions of all forces acting on an object in a given situation.

28. How is a Free-Body Diagram drawn?

The object is represented by a box, and arrows are drawn from the center showing forces with direction and magnitude.

3.4 Newton's Laws of Motion**29. State Newton's First Law of Motion.**

A body continues its state of rest or uniform motion in a straight line unless acted upon by an external force.

30. What is Inertia?

The property of a body to resist change in its state of rest or motion is called inertia.

31. State Newton's Second Law of Motion.

If a net external force acts on a body, it produces acceleration in the direction of the force. The magnitude of acceleration is directly proportional to force and inversely proportional to mass ($F = ma$).

32. Define Newton (unit of force).

One newton is the force required to produce an acceleration of 1 m/s^2 in a body of mass 1 kg.

33. State Newton's Third Law of Motion.

For every action, there is an equal and opposite reaction.

34. Give examples of Newton's Third Law.

- A gun recoils when it fires a bullet.
- A block on a table experiences equal downward weight and upward reaction from the table.

35. What are the limitations of Newton's Laws of Motion?

They are accurate for everyday motion but not valid for very small particles or objects moving near the speed of light, where Einstein's relativistic mechanics applies.

3.6 Mass and Weight**36. What is Mass?**

Mass is the quantity of matter in a body. It is a scalar, constant everywhere, and measured in kilograms (kg).

37. What is Weight?

Weight is the gravitational force with which Earth attracts a body towards its center. It is a vector and measured in newtons (N).

38. What is Gravitational Field Strength?

It is the gravitational force acting on unit mass, usually $g = 10 \text{ N/kg}$ near Earth's surface.

39. Why does weight vary from place to place but mass remains constant?

Because the value of g (gravitational field strength) changes with location, altitude, and depth, while mass does not change.

40. What instruments are used to measure mass and weight?

- Mass: Mechanical balance, electronic balance.
 - Weight (force): Spring balance or force meter.
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3.8 Friction**41. What is Friction?**

Friction is a resistive force that opposes the relative motion of two surfaces in contact.

42. What is the dissipative effect of friction?

Friction converts useful energy into heat. For example, rubbing hands produces heat.

43. What is Static Friction?

The opposing force that prevents a body from moving when force is applied is called static friction.

44. What is Kinetic Friction?

The friction that acts when a body is sliding over a surface is called kinetic friction.

45. What is Rolling Friction?

The friction that occurs when a body rolls over a surface, e.g., wheels or ball bearings. It is much smaller than sliding friction.

46. What is Terminal Velocity?

It is the constant velocity achieved by a falling object when air resistance balances the downward gravitational force.

47. How can friction be reduced?

- By polishing surfaces.
 - By applying oil or grease.
 - By using wheels or ball bearings.
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