1. Answer the following:
   (a) What do you understand by the term inertia?
   (b) What determines the inertia of a body?
   (c) Define two kinds of inertia. Support your answer with one example each.

Ans:

(a) The tendency of a body to continue in its state of rest or uniform motion in a straight line, even on the application of external force is called inertia.

(b) The mass of body determines its inertia i.e. inertia is directly proportional to the mass of body.

(c)

(i) Inertia of rest:
The tendency of a body to continue in its state of rest, even on the application of external force is called inertia of rest.
Example: A rider sitting on a horse back falls backward, if the horse gallops off suddenly. It is because when the horse suddenly sets itself in motion, the rider on account of inertia of rest, tends to continue in the state of rest. Thus, the rider is left behind the horse and hence falls.

(ii) Inertia of motion:
The tendency of a body to continue in its state of uniform motion, even on the application of external force is called inertia of motion.
Example: The passengers in a running bus fall in the forward direction, when brakes are applied suddenly. It is because when the bus suddenly comes to rest, the passengers on account of inertia of motion, tend to continue to move in forward direction and hence fall forward.

2. Answer the following:
   (a) What do you understand by the term momentum?
   (b) State two factors which determine momentum of a body?

Ans:

(a) The force possessed by a moving body at some particular instant during its course of motion is called momentum.

(b) (1) Momentum is directly proportional to the mass of body.
(2) Momentum is directly proportional to the velocity of body.

3. Show that rate of change of momentum is the product of mass and acceleration.

Ans:

Consider a body of mass 'm' initially moving with a velocity 'u'.
Let the body be acted upon by a force 'F' for time 't' (in seconds), such that its final velocity is 'v'.
∴ Initial momentum of body = mu.

Final momentum of body = mv.

∴ Change in momentum in time t = mv – mu

∴ Rate of change of momentum $= \frac{m(v - u)}{t}$

But $a = \frac{m(v - u)}{t}$, where a is acceleration

∴ Rate of change of momentum = ma.

According to Newton's second law.

Rate of change of momentum ∝ force (F)

∴ F ∝ ma

Or F = Kma, [where K is constant of proportionality]

If there be a body of unit mass, having a unit acceleration, such that force possessed by the body is also unit, then:

$1 = K \times 1 \times 1$

K = 1.

∴ F = ma.

4. Answer the following:
   (a) State Newton's law of gravitation.
   (b) Derive mathematical expression for the gravitational force based on universal law of gravitation.

Ans:

(a) Everybody in this universe attracts every other body with a force which is directly proportional to the products of masses and inversely proportional to the square of distance between their centers.

(b) Consider two bodies A and B of mass M and m respectively, such that d is the distance between their centers and F is the mutual force of attraction.

Then, according to Newton's law of gravitation.

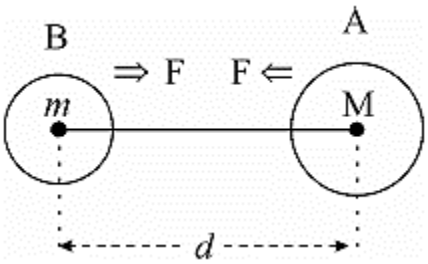
$F \propto M \times m$ ... (1)

$F \propto \frac{1}{d^2}$

Combining (1) and (2)

$F \propto \frac{M \times m}{d^2}$

$F = G.\frac{M \times m}{d^2}$



Where, G is the constant of proportionality, commonly called gravitational constant.

5. If the distance between two bodies is increased 4 times, by which factor, should the mass of one body be altered, so that gravitational force between them remains same.

Ans:

Let F be the force of attraction between the two bodies of mass M and m, where 'd' is the distance between them.

$\therefore F = G.\frac{M.m}{d^2}$ ... (1)

when d becomes 4d, let m = x.

$\therefore F = \frac{Mx}{(4d)^2} = \frac{GMx}{16\ d^2}$ ... (2)

Comparing (2) and (1)

$\frac{GMx}{16\ d^2} = \frac{GMm}{d^2}$

$\therefore x = 16m$

Thus, mass of one body be increased by 16 times.

6. Answer the following:
   (a) What do you understand by the term "force of gravitation"?
   (b) Is the force of gravitation attractive or repulsive force?
   (c) Does the force of gravitation exist at all places in the universe? Explain your answer.

Ans:

(a) The mutual force of attraction between any two bodies is called force of gravitation.

(b) Force of gravitation is always attractive, irrespective of shape, size or location of bodies.

(c) Force of gravitation exists throughout the universe. It is this force which gives rise to galaxies, solar system etc., in the universe

7. What do you understand by the statement that gravitational constant is $6.67 \times 10^{-11}\ Nm^2\ kg^{-2}$?

Ans.

From the above statement, it implies that when two bodies of mass 1 kg each are separated by a distance of 1 m as measured from their centres, then the force of attraction between them is 6.67×10^{-11} N.

8. Two bodies A and B are of mass m and 5 m and their velocities are 5v and v respectively. Assuming bodies are moving with uniform velocities, compare their
   (a) Inertia
   (b) Momentum
   (c) Force required to stop them.

Ans:

(a) Inertia of a body is directly proportional to its mass.

$\therefore$ Ratio of inertia of A and B = m: 5m = 1: 5

(b) Momentum of a body is equal to product of mass and velocity.

$\therefore$ Momentum of A: momentum of B

$= m \times 5v: 5\ m \times v$

$= 1: 1.$

9. A body having a velocity of 200 ms^{-1} has a momentum of 5 Ns. Find the mass of body.

Ans:

m = ?; v = 200 ms^{-1}; p = 5 Ns

Now, p = mv

5 Ns = m × 200 ms^{-1}

$\therefore$ m = 0.025 kg

10. A force of 50 kgf acts on a body of mass $\frac{1}{2}$ t. Find the acceleration produced in the body.

[Take g = 10 N kg^{-1}]

Ans:

F = 50 kgf = 50 (kg) × 10 (N kg^{-1}) = 500 N

$m = \frac{1}{2}t = \frac{1}{2} \times 1000 \text{ kg} = 500 \text{ kg}$

$\therefore$ Acceleration (a) $= \frac{F}{m} = \frac{500(N)}{500(kg)} = 1 \text{ ms}^{-2}$