

CHAPTER – 8

MOTION

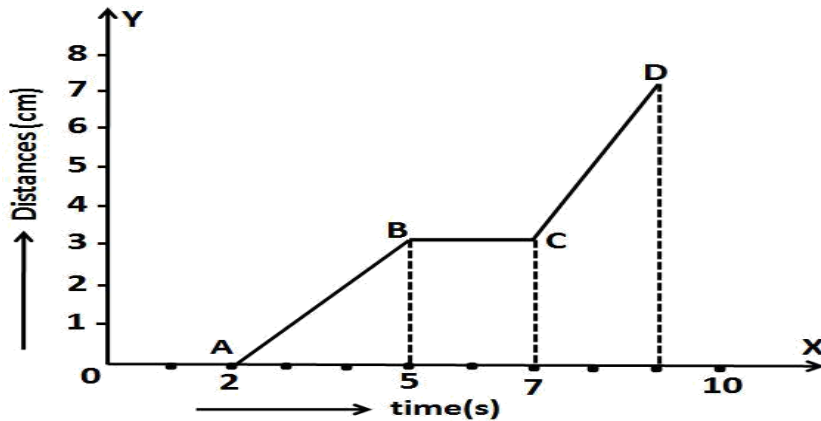
NUMERICALS-I

1. An object travels 16m in 4s and then another 16m in 2s. What is the average speed of the object?
2. In a long distance race, the athletics were expected to take four rounds of the track such that the line of finish was same as the line of start. Suppose the length of the track was 200m.
 - (a) What is the total distance to be covered by the athletics?
 - (b) What is the displacement of the athletics when they touch the finish line?
 - (c) Is the motion of the athletics uniform or non-uniform?
 - (d) Is the displacement of an athletic and the distance covered by him at the end of the race equal?
3. Starting from a stationary position, Bhuvan paddles his bicycle to attain a velocity of 6m/s in 30s. Then he applies brakes such that the velocity of bicycle comes down to 4m/s in the next 5s. Calculate the acceleration of the bicycle in both the cases.
4. Amit is moving in his car with a velocity of 45km/hr. How much distance will he cover
 - i. in one minute and
 - ii. in one second.
5. The odometer of a car reads 2000 km at the start of a trip and 2400km at the end of the trip. If the trip took 8 hr, calculate the average speed of the car in km/hr and m/s.
6. An electric train is moving with a velocity of 120km/hr. How much distance will it move in 30s?
7. A train travels some distance with a speed of 30km/hr and returns with a speed of 45km/hr. Calculate the average speed of the train.
8. A train 100m long moving on a straight level track passes a pole in 5s. Find
 - i. the speed of the train
 - ii. the time it will take to cross a bridge 500m long.
9. A car travels along a straight line for first half time with speed 40km/hr and the second half time with speed 60km/hr. Find the average speed of the car.
10. A body starts rolling over a horizontal surface with an initial velocity of 0.5m/s. Due to friction, its velocity decreases at the rate of 0.05m/s^2 . How much time will it take for the body to stop? A particle is moving in a circle of diameter 10m. Calculate the distance covered and the displacement when it completes 15 revolutions.
11. A body thrown vertically upwards reaches a maximum height 'h'. It then returns to ground. Calculate the distance travelled and the displacement.
12. A body travels a distance of 15m from A to B and then moves a distance of 20m at right angles to AB. Calculate the total distance travelled and the displacement.
13. An object is moving in a circle of radius 'r'. Calculate the distance and displacement
 - a. when it completes half the circle
 - b. when it completes one full circle.

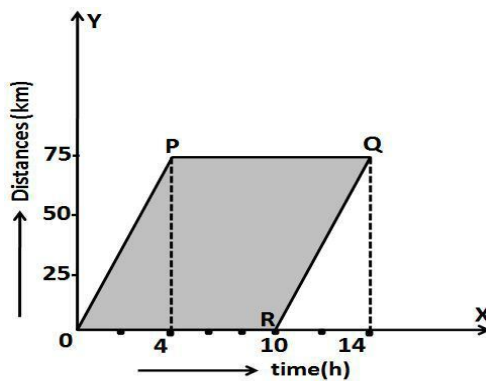
14. A car traveling at 36km/hr speeds upto 70km/hr in 5 seconds. What is its acceleration? If the same car stops in 20s, what is the retardation?
15. A scooter acquires a velocity of 36km/hr in 10seconds just after the start. It takes 20 seconds to stop. Calculate the acceleration in the two cases.
16. On a 120km track, a train travels the first 30 km at a uniform speed of 30 km/hr. How fast must the train travel the next 90 km so as to average 60 km/hr for the entire trip?
17. A train travels at 60 km/hr for 0.52 hr; at 30 km/hr for the next 0.24 hr and at 70 km/hr for the next 0.71 hr. What is the average speed of the train?

NUMERICALS-II

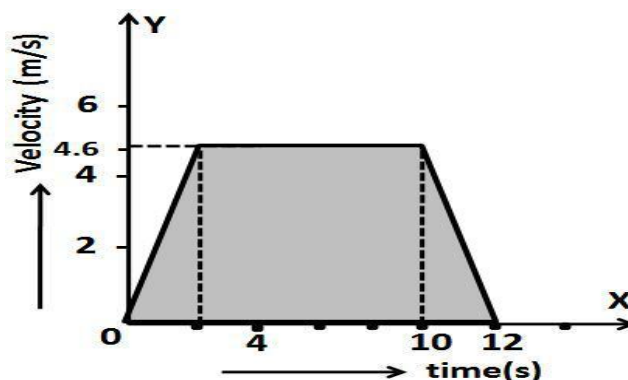
1. The right-sided figure is the distance-time graph of an object. Do you think it represents a real situation? If so, why? If not, why not?



2. The graph in below figure shows the positions of a body at different times. Calculate the speed of the body as it moves from (i) O to P



3. The velocity time graph of an ascending passenger lift is given below. What is the acceleration of the lift: (i) during the first two seconds (ii) between 2nd and 10th second (iii) during the last two seconds.



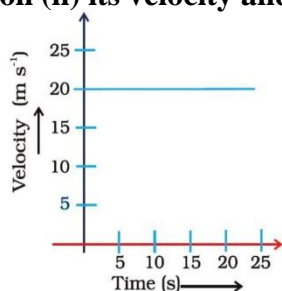
NUMERICALS-III

1. A car increases its speed from 20 km/h to 50 km/h in 10 seconds. What is its acceleration?
2. A ship is moving at a speed of 56km/h. One second later, it is moving at 58km/h. What is its acceleration?
3. A scooter acquires a velocity of 36km/h in 10 seconds just after the start. Calculate the acceleration of the scooter.
4. A racing car has uniform acceleration of 4m/s^2 . What distance will it cover in 10 seconds after start?
5. A car acquires a velocity of 72km/h in 10 seconds starting from rest. Find (a) the acceleration (b) the average velocity (c) the distance travelled in this time.
6. A body is accelerating at a constant rate of 10m/s^2 . If the body starts from rest, how much distance will it cover in 2 seconds?
7. An object undergoes an acceleration of 8m/s^2 starting from rest. Find the distance travelled in 1 second.
8. A moving train is brought to rest within 20 seconds by applying brakes. Find the initial velocity, if the retardation due to brakes is 2m/s^2 .
9. A car accelerates uniformly from 18km/h to 36 km/h in 5 seconds. Calculate (i) acceleration and (ii) the distance covered by the car in that time.
10. A body starts to slide over a horizontal surface with an initial velocity of 0.5 m/s. Due to friction, its velocity decreases at the rate of 0.05 m/s^2 . How much time will it take for the body to stop?
11. A train starting from the rest moves with a uniform acceleration of 0.2 m/s^2 for 5 minutes. Calculate the speed acquired and the distance travelled in this time.
12. A bus was moving with a speed of 54 km/h. On applying brakes, it stopped in 8 seconds. Calculate the acceleration and the distance travelled before stopping.
13. A motor cycle moving with a speed of 5 m/s is subjected to an acceleration of 0.2 m/s^2 . Calculate the speed of the motor cycle after 10 seconds and the distance travelled in this time.
14. The brakes applied to a car produce an acceleration of 6 m/s^2 in the opposite direction to the motion. If the car takes 2 seconds to stop after the application of brakes, calculate the distance it travels during this time.
15. A train starting from rest attains a velocity of 72 km/h in 5 minutes. Assuming that the acceleration is uniform, find (i) the acceleration and (ii) the distance travelled by the train for attaining this velocity.
16. Calculate the speed of the tip of second's hand of a watch of length 1.5 cm.
17. A cyclist goes once round a circular track of diameter 105m in 5 minutes. Calculate his speed.

18. A cyclist moving on a circular track of radius 50m complete revolution in 4 minutes. What is his (i) average speed (ii) average velocity in one full revolution?
19. The length of minutes hand of a clock is 5 cm. Calculate its speed.
20. A car starts from rest and moves along the x-axis with constant acceleration 5m/s^2 for 8 seconds. If it then continues with constant velocity, what distance will the car cover in 12 seconds since it started from the rest?
21. An object is dropped from rest at a height of 150m and simultaneously another object is dropped from rest at a height 100m. What is the difference in their heights after 2 seconds if both the objects drop with same acceleration? How does the difference in heights vary with time?

SHORT ANSWER QUESTIONS

1. The displacement of a moving object in a given interval of time is zero. Would the distance travelled by the object also be zero? Justify your answer.
2. How will the equations of motion for an object moving with a uniform velocity change?
3. A car starts from rest and moves along the x-axis with constant acceleration 5 m/s^2 for 8 seconds. If it then continues with constant velocity, what distance will the car cover in 12 seconds since it started from the rest?
4. A motorcyclist drives from A to B with a uniform speed of 30 km/h and returns back with a speed of 20 km/h. Find its average speed.
5. Draw a velocity versus time graph of a stone thrown vertically upwards and then coming downwards after attaining the maximum height.
6. The velocity-time graph (see below Figure) shows the motion of a cyclist. Find (i) its acceleration (ii) its velocity and (iii) the distance covered by the cyclist in 15 seconds.



LONG ANSWER QUESTIONS

1. An object starting from rest travels 20 m in first 2 s and 160 m in next 4 s. What will be the velocity after 7 s from the start.
2. An object is dropped from rest at a height of 150 m and simultaneously another object is dropped from rest at a height 100 m. What is the difference in their heights after 2 s if both the objects drop with same accelerations? How does the difference in heights vary with time?

.....

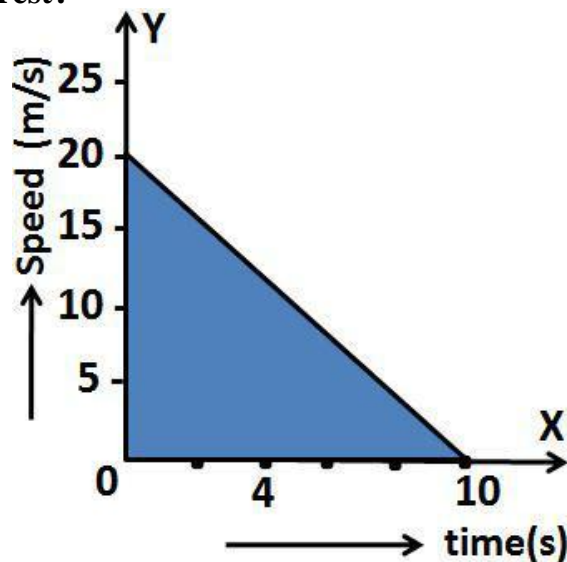
CHAPTER – 9

FORCE AND LAWS OF MOTION

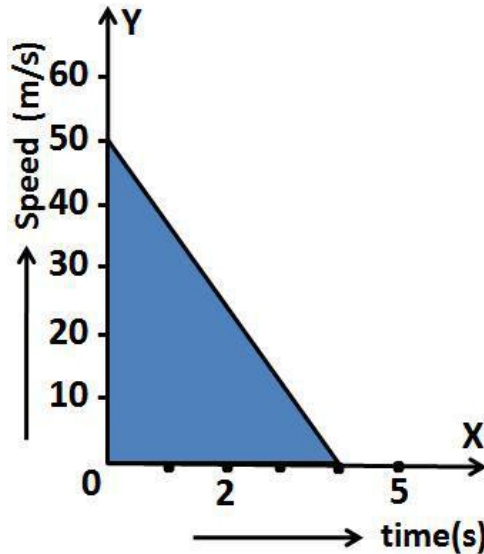
NUMERICALS-I

1. What is acceleration produced by a force of 12 Newton exerted on an object of mass 3 kg?
2. What force would be needed to produce an acceleration of 4m/s^2 on a ball of mass 6 kg?
3. A force of 5 N gives a mass m_1 , an acceleration of 8 m/s^2 , and a mass m_2 , an acceleration of 24 m/s^2 . What acceleration would give if both the masses are tied together?
4. Calculate the force required to impart a car a velocity of 30m/s in 10 seconds. The mass of the car is 1500 kg.
5. A motorcycle is moving with a velocity of 90km/h and it takes 5 seconds to stop after the brakes are applied. Calculate the force exerted by the brakes on the motorcycle if its mass along with the rider is 200kg.
6. What is the momentum of a man of mass 75kg when he walks with a velocity of 2m/s?
7. What would be the force required to produce an acceleration of 2m/s^2 in a body of mass 12 kg? What would be the acceleration if the force were doubled?
8. A man pushes a box of mass 50 kg with a force of 80N. What will be the acceleration of the box? What would be the acceleration if the mass were doubled?
9. A certain force exerted for 1.2 second raises the speed of an object from 1.8m/s to 4.2 m/s. Later, the same force is applied for 2 second. How much does the speed change in 2 second?
10. A constant force acts on an object of mass 5 kg for duration of 2 second. It increases the object's velocity from 3cm/s to 7m/s. Find the magnitude of the applied force. Now if the force were applied for a duration of 5 seconds, what would be the final velocity of the object?
11. A motorcar is moving with a velocity of 108km/h and it takes 4 seconds to stop after the brakes are applied. Calculate the force exerted by the brakes on the motorcar if its mass along with the passengers is 1000 kg.
12. A force of 5 N gives a mass m_1 , an acceleration of 10 m/s^2 , and a mass m_2 , an acceleration of 20 m/s^2 . What acceleration would it give if both the masses were tied together?
13. For how long should a force of 100 N act on a body of mass 20 kg so that it acquires a velocity of 100 m/s?

14. A 150 g ball traveling at 30m/s strikes the palm of a players hand and is stopped in 0.06 sec. Calculate the force exerted by the ball on the hand.
15. A body of mass 1 kg is kept at rest. A constant force of 6.0 N starts acting on it . Find the time taken by the body to move through a distance of 12m.
16. A force of 4 N acts on a body of mass 2 kg for 4 s. Assuming that the body to be initially at rest, find (i) its velocity when the force stops acting (ii) the distance covered in 10 s after the force starts acting.
17. A feather of mass 10 g is dropped from a height. It is found to fall down with a constant velocity. What is the net force acting on it?
18. A hockey ball of mass 200g traveling from west to east at 10m/s is struck by a hockey stick. As a result, then ball gets turned back and now has a speed of 5m/s. If the ball and hockey stick were in contact for 0.2 s, calculate (i) initial and final momentum of the ball (ii) rate of change of momentum of the ball (iii) the force exerted by hockey stick on the ball.
19. A stone of mass 500 g is thrown with a velocity of 20m/s across the frozen surface of a lake. It comes to rest after traveling a distance of 0.1 km. Calculate force of friction between the stone and frozen surface of lake.
20. A body starts from rest and rolls down a hill with a constant acceleration. If its travels 400 m in 20 seconds, calculate the force acting on the body if its mass is 10kg.
21. The velocity time graph of a ball of mass 20g moving along a straight line on a long table is given in below figure. How much force does the table exert on the ball to bring it to rest?



22. The speed time graph of a ball of mass 30g moving along a straight line is shown in below figure. Calculate the opposing force that brings the ball to rest.



- What will be the percentage change in momentum of a body when both its mass and velocity are doubled?
23. A force of 2 N gives a mass m_1 an acceleration of 5m/s^2 and a mass m_2 , an accelerated of 7m/s^2 . What acceleration would be produced if both the masses are tied together?
24. A body of mass 2 kg moving with a velocity of 10m/s is brought to rest in 5 sec. Calculate the stopping force applied.

NUMERICALS-II

1. The velocity of a body of mass 10kg increases from 4m/s to 8m/s when a force acts on it for 2s. (a) What is the momentum before and after the force acts? (b) What is the gain in momentum per second? (c) What is the value of the force?
2. A boy pushes a wall with a force of 20N. What is the magnitude and direction of the force experienced by the body?
3. A 20 g bullet is shot from a 5 kg gun with a velocity of 500m/s . What is the speed of the recoil of the gun?
4. A 10 g bullet is shot from a 5 kg gun with a velocity of 400m/s . What is the speed of the recoil of the gun?
5. When two bodies A and B interact with each other, A exerts a force of 10N on B, towards east. What is the force exerted by B on A?
6. A man weighting 60kg runs along the rails with a velocity of 18km/h and jumps into a car of mass 1 quintal standing on the rails. Calculate the velocity with which car will start traveling along the rails.
7. The car A of mass 1500kg, traveling at 25m/s collides with another car B of amss 1000kg traveling at 15m/s in the same direction. After collision, the velocity of car A becomes 20m/s . Calculate the velocity of car B after collision.

- 8. A bullet of mass 10g is fired from a gun of mass 6 kg with a velocity of 300m.s. Calculate the recoil velocity of the gun.**
- 9. A bullet of mass 50g is fired from a gun of mass 6 kg with a velocity of 400m.s. Calculate the recoil velocity of the gun.**
- 10. A bullet of mass 10g is moving with a velocity of 400m/s gets embedded in a freely suspended wooden block of mass 900g. What is the velocity acquired by the block?**
- 11. A gun of mass 3 kg fires a bullet of mass 30g. The bullet takes 0.003s to move through the barrel of the gun and acquires a velocity of 100m/s. Calculate (i) the velocity with which the gun recoils (ii) the force exerted on gunman due to recoil of the gun.**
- 12. A heavy car of mass 200kg traveling at 10m/s has a head on collision with a sports car B of mass 500kg. If both cars stop dead on colliding, what was the velocity of car B?**
- 13. A machine gun fires 25h bullet at the rate of 600 bullets per minute with a speed of 200m/s. Calculate the force required to keep the gun in position.**

MULTIPLE CHOICE QUESTIONS

1. Which of the following statement is *not* correct for an object moving along a straight path in an accelerated motion?
 - (a) Its speed keeps changing
 - (b) Its velocity always changes
 - (c) It always goes away from the earth
 - (d) A force is always acting on it

2. The forces of action and reaction are
 - (a) always equal only
 - (b) always equal and opposite
 - (c) always equal but in same direction
 - (d) always unequal and opposite.

3. According to the third law of motion, action and reaction
 - (a) always act on the same body
 - (b) always act on different bodies in opposite directions
 - (c) have same magnitude and directions
 - (d) act on either body at normal to each other

4. The action and reaction forces at
 - (a) on different bodies always
 - (b) on some body always
 - (c) on same body, sometimes
 - (d) on different bodies, sometimes

5. A goalkeeper in a game of football pulls his hands backwards after holding the ball shot at the goal. This enables the goal keeper to
 - (a) exert larger force on the ball
 - (b) reduce the force exerted by the ball on hands
 - (c) increase the rate of change of momentum
 - (d) decrease the rate of change of momentum

6. The inertia of an object tends to cause the object
 - (a) to increase its speed
 - (b) to decrease its speed
 - (c) to resist any change in its state of motion
 - (d) to decelerate due to friction

7. Principle of conservation of linear momentum is deduced from
 - (a) Newton's first law
 - (b) Newton's second law
 - (c) Newton's third law
 - (d) none of the above

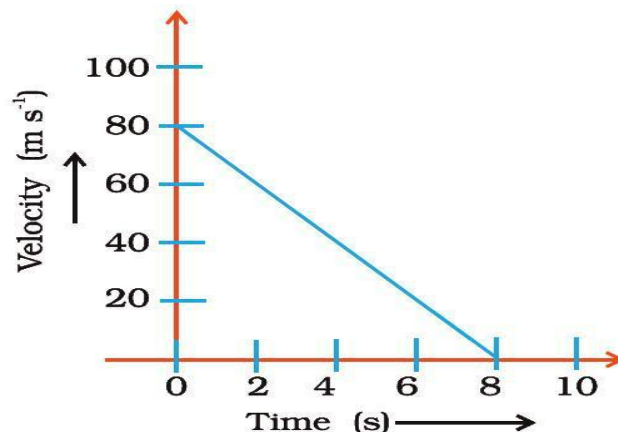
8. The function of mud guards is based on
 - (a) inertia of rest
 - (b) inertia of direction
 - (c) inertia of motion
 - (d) none of the above

9. The force of action and reaction
 - (a) always cancel each other
 - (b) never cancel
 - (c) cancel sometimes
 - (d) cannot say

10. A passenger in a moving train tosses a coin which falls behind him. It means that motion of the train is
- accelerated
 - uniform
 - retarded
 - along circular tracks

SHORT ANSWER QUESTIONS

- There are three solids made up of aluminium, steel and wood, of the same shape and same volume. Which of them would have highest inertia?
- Two balls of the same size but of different materials, rubber and iron are kept on the smooth floor of a moving train. The brakes are applied suddenly to stop the train. Will the balls start rolling? If so, in which direction? Will they move with the same speed? Give reasons for your answer.
- Two identical bullets are fired one by a light rifle and another by a heavy rifle with the same force. Which rifle will hurt the shoulder more and why?
- A horse continues to apply a force in order to move a cart with a constant speed. Explain why?
- Suppose a ball of mass m is thrown vertically upward with an initial speed v , its speed decreases continuously till it becomes zero. Thereafter, the ball begins to fall downward and attains the speed v again before striking the ground. It implies that the magnitude of initial and final momentums of the ball are same. Yet, it is not an example of conservation of momentum. Explain why ?
- Velocity versus time graph of a ball of mass 50 g rolling on a concrete floor is shown in below Figure. Calculate the acceleration and frictional force of the floor on the ball.



- A truck of mass M is moved under a force F . If the truck is then loaded with an object equal to the mass of the truck and the driving force is halved, then how does the acceleration change?
- Why does a gun recoil on firing? Obtain an expression for recoil velocity of gun.
- A rocket can move in air free space, but a jet plane cannot. Why?
- Two friends on roller-skates are standing 5 m apart facing each other. One of them throws a ball of 2 kg towards the other, who catches it, How will this activity affect the position of the two? Explain your answer.

11. Water sprinkler used for grass lawns begins to rotate as soon as the water is supplied. Explain the principle on which it works.

LONG ANSWER QUESTIONS

1. Using second law of motion, derive the relation between force and acceleration. A bullet of 10 g strikes a sand-bag at a speed of 103 m/s and gets embedded after travelling 5 cm. Calculate
 - (i) the resistive force exerted by the sand on the bullet
 - (ii) the time taken by the bullet to come to rest.
2. Derive the unit of force using the second law of motion. A force of 5 N produces an acceleration of 8 m/s^2 on a mass m_1 and an acceleration of 24 m/s^2 on a mass m_2 . What acceleration would the same force provide if both the masses are tied together?
3. State and explain Newton’s third law of motion. How will you prove it experimentally?
4. What is momentum? Write its SI unit. Interpret force in terms of momentum. Represent the following graphically
 - (a) momentum versus velocity when mass is fixed.
 - (b) momentum versus mass when velocity is constant.

.....

CHAPTER – 10 GRAVITATION

NUMERICALS-I

1. The gravitational force between two objects is F. How will this force change when
 - (i) distance between them is reduced to half
 - (ii) the mass of each object is quadrupled?
2. A sphere of mass 40kg is attracted by a second sphere of mass 15kg when their centres are 20 cm apart, with a force of 0.1 milligram weight. Calculate the value of gravitational constant.

3. A body of mass 1 kg is placed at a distance of 2m from another body of mass 10kg. At what distance from the body of 1 kg, another body of mass 5 kg be placed so that the net force of gravitation acting on the body of mass 1 kg is zero?
4. A geostationary satellite is orbiting the earth at a height 5 R above the surface of earth, where R is the radius of earth. Find the time period of another satellite at a height of 2 R from the surface of earth.
5. The distance of planet Jupiter from the sun 5.2 times that of Earth. Find the period of revolution of Jupiter around sun.
6. If the distance of Earth from the Sun were half the present value, how many days will make one year?
7. Two satellites of a planet have periods 32 days and 256 days. If the radius of orbit of former is R, find the orbital radius of the latter.
8. The mass of Earth is 6×10^{24} kg and that of moon is 7.4×10^{22} kg. If the distance between the Earth and the Moon is 3.84×10^5 km, calculate the force exerted by Earth on the Moon. Given $G = 6.7 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$.
9. If the distance between two masses is increased by a factor of 4, by what factor would the mass of one of them have to be altered to maintain the same gravitational force?
10. Two bodies A and B having masses 2kg and 4kg respectively are separated by 2m. Where should a body of mass 1kg be placed so that the gravitational force on this body due to bodies A and B is zero?
11. The mass of Sun is 2×10^{30} kg and mass of Earth is 6×10^{24} kg. If the distance between the centres of Sun and Earth is 1.5×10^8 km, calculate the force of gravitation between them.
12. Two electrons each of mass 9.1×10^{-31} kg are at a distance of 10 \AA . Calculate the gravitational force of attraction between them. Given $1 \text{ \AA} = 10^{-10} \text{ m}$.
13. The gravitational force between two objects is 100 N. How should the distance between these objects be changed so that force between them becomes 50 N?
14. Calculate the force of gravitation between two objects of masses 80kg and 1200 kg kept at a distance of 10 m from each other. Given $G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$.
15. Calculate the force of attraction between the Earth and the Sun, given that the mass of Earth is 6×10^{24} kg and that of sun is 2×10^{30} kg. The average distance between the two is 1.5×10^{11} m.
16. A sphere of mass 25kg attracts another sphere of mass 24kg with a force of 0.1milligram weight. If distance between the centres of two spheres is 20cm, what is the value of G?

NUMERICALS-II

1. Calculate the force of gravity acting on your friend of mass 60kg. Given mass of earth = 6×10^{24} kg and radius of Earth = 6.4×10^6 m.
2. Mass of an object is 10kg. What is its weight on Earth?
3. What is the mass of an object whose weight is 49N?
4. An object weighs 10N when measured on the surface of the earth. What would be its weight when measured on the surface of the Moon?
5. An object is thrown vertically upwards and rises to a height of 10m. Calculate (i) the velocity with which the object was thrown upwards and (ii) the time taken by the object to reach the highest point.
6. A force of 2 kg wt. acts on a body of mass 4.9kg. Calculate its acceleration.
7. A force of 20N acts upon a body weight is 9.8N. What is the mass of the body and how much is its acceleration?
8. A body has a weight of 10 kg on the surface of earth. What will be its mass and weight when taken to the centre of earth?
9. How much would a 70 kg man weigh on moon? What will be his mass on earth and moon? Given g on moon = 1.7 m/s^2 .
10. The Earth's gravitational force causes an acceleration of 5 m/s^2 in a 1 kg mass somewhere in space. How much will the acceleration of a 3 kg mass be at the same place?
11. A particle is thrown up vertically with a velocity of 50m/s. What will be its velocity at the highest point of the journey? How high would the particle rise? What time would it take to reach the highest point? Take $g = 10 \text{ m/s}^2$.
12. If a planet existed whose mass was twice that of Earth and whose radius 3 times greater, how much will a 1kg mass weigh on the planet?
13. A boy on cliff 49m high drops a stone. One second later, he throws a second stone after the first. They both hit the ground at the same time. With what speed did he throw the second stone?
14. A stone drops from the edge of a roof. It passes a window 2m high in 0.1s. How far is the roof above the top of the window?
15. A stone is dropped from the edge of a roof. (a) How long does it take to fall 4.9m ?
(b) How fast does it move at the end of that fall? (c) How fast does it move at the end of 7.9m? (d) What is its acceleration after 1s and after 2s?

MULTIPLE CHOICE QUESTIONS

1. Two objects of different masses falling freely near the surface of moon would
 - (a) have same velocities at any instant
 - (b) have different accelerations
 - (c) experience forces of same magnitude
 - (d) undergo a change in their inertia
2. The value of acceleration due to gravity
 - (a) is same on equator and poles
 - (b) is least on poles
 - (c) is least on equator
 - (d) increases from pole to equator
3. The gravitational force between two objects is F . If masses of both objects are halved without changing distance between them, then the gravitational force would become
 - (a) $F/4$ (b) $F/2$ (c) F (d) $2F$
4. A boy is whirling a stone tied with a string in an horizontal circular path. If the string breaks, the stone
 - (a) will continue to move in the circular path
 - (b) will move along a straight line towards the centre of the circular path
 - (c) will move along a straight line tangential to the circular path
 - (d) will move along a straight line perpendicular to the circular path away from the boy
6. In the relation $F = G M m/d^2$, the quantity G
 - (a) depends on the value of g at the place of observation
 - (b) is used only when the earth is one of the two masses
 - (c) is greatest at the surface of the earth
 - (d) is universal constant of nature
7. Law of gravitation gives the gravitational force between
 - (a) the earth and a point mass only
 - (b) the earth and Sun only
 - (c) any two bodies having some mass
 - (d) two charged bodies only
8. The value of quantity G in the law of gravitation
 - (a) depends on mass of earth only
 - (b) depends on radius of earth only
 - (c) depends on both mass and radius of earth
 - (d) is independent of mass and radius of the earth
9. Two particles are placed at some distance. If the mass of each of the two particles is doubled, keeping the distance between them unchanged, the value of gravitational force between them will be
 - (a) $\frac{1}{4}$ (b) 4 times (c) half times (d) unchanged
10. The earth attracts a body of mass 2 kg on its surface with a force of
 - (a) 9.8 N
 - (b) 19.6 N
 - (c) 6.67×10^{-11} N
 - (d) $2 \times 6.67 \times 10^{-11}$ N

11. A stone dropped from a building takes 4 s to reach the ground. The height of the building is
- 19.6 m
 - 80.4 m
 - 78.4 m
 - 156.8 m
12. The mass of a body on the surface of earth is 12 kg. If acceleration due to gravity on moon is $\frac{1}{6}$ of acceleration due to gravity on earth, then its mass on moon will be
- 2 kgf
 - 72 kg
 - 12 kg
 - Zero
13. The atmosphere is held to the earth by
- gravity
 - wind
 - clouds
 - earth's magnetic field
14. The force of attraction between two unit point masses separated by a unit distance is called
- gravitational potential
 - acceleration due to gravity
 - gravitational field
 - universal gravitational constant
15. The weight of an object at the centre of the earth of radius R is
- zero
 - infinite
 - R times the weight at the surface of the earth
 - $1/R^2$ times the weight at surface of the earth

SHORT ANSWER QUESTIONS

- What is the source of centripetal force that a planet requires to revolve around the Sun? On what factors does that force depend?
- On the earth, a stone is thrown from a height in a direction parallel to the earth's surface while another stone is simultaneously dropped from the same height. Which stone would reach the ground first and why?
- Suppose gravity of earth suddenly becomes zero, then in which direction will the moon begin to move if no other celestial body affects it?
- Identical packets are dropped from two aeroplanes, one above the equator and the other above the north pole, both at height h . Assuming all conditions are identical, will those packets take same time to reach the surface of earth. Justify your answer.
- The weight of any person on the moon is about $1/6$ times that on the earth. He can lift a mass of 15 kg on the earth. What will be the maximum mass, which can be lifted by the same force applied by the person on the moon?
- Calculate the average density of the earth in terms of g , G and R .

7. The earth is acted upon by gravitation of Sun, even though it does not fall into the Sun. Why?
8. Calculate the density of Earth from Newton's law of gravitation.
9. A body weighs more at poles than at the equator of earth. Why?
10. Two particles of equal mass(m) move in a circle of radius (r) under the action of their mutual gravitational attraction. Find the speed of each particle.

LONG ANSWER QUESTIONS

1. How does the weight of an object vary with respect to mass and radius of the earth. In a hypothetical case, if the diameter of the earth becomes half of its present value and its mass becomes four times of its present value, then how would the weight of any object on the surface of the earth be affected?
 2. How does the force of attraction between the two bodies depend upon their masses and distance between them? A student thought that two bricks tied together would fall faster than a single one under the action of gravity. Do you agree with his hypothesis or not? Comment.
-

CHAPTER - 10 **GRAVITATION (CONTINUED)**

THRUST AND PRESSURE

NUMERICALS-I

1. A cube of edge length 10 cm is placed inside a liquid. The pressure at the centre of the face is 15 Pa. Find the force exerted by the liquid on this face.
2. A force of 16 N is distributed uniformly on one surface of a cube of edge 8 cm. Find the pressure on this surface.
3. A force of 100 N is applied on an object of area 2 m^2 . Calculate the pressure.
4. The force on a phonogram needle is 1.2 N. The point has a circular cross-section of radius 0.1mm. What pressure does it exert on the record in (i) Pa (ii) atm ?
5. A force of 15 N is uniformly distributed over an area of 150 m^2 . Find the pressure in pascals.
6. How much force should be applied on an area of 1 cm^2 to get a pressure of 15 Pa?
7. A block weighing 1.0 kg is in the shape of a cube of length 10 cm. It is kept on a horizontal table. Find the pressure on the portion of the table where the block is kept.
8. The pressure due to atmosphere is $1.013 \times 10^5 \text{ Pa}$. Find the force exerted by the atmosphere on the top surface of a table 2.0 m long and 1.0 m wide.

9. Find the thrust acting on the human body due to atmospheric pressure. Take the surface area of a man of middle size to be 1.5 m^2 and atmospheric pressure (1 atm) = $1.013 \times 10^5 \text{ Pa}$.
10. A boy weighing 60 kg f is wearing shoes with heel area of cross section 20 cm^2 while a girl weighing 45 kg f is wearing shoes with heel of area of cross section 1.5 cm^2 . Compare the pressure exerted on ground by their heels when they stand on the heel of one floor.

NUMERICALS-II

1. Calculate the mass of a body whose volume is 2 m^3 and density 0.52 g/cm^3 .
2. A wooden block of dimensions $10 \text{ cm} \times 20 \text{ cm} \times 50 \text{ cm}$ weighs 6.5 kg . Calculate the density of the block.
3. A dining hall has dimensions $50 \text{ m} \times 15 \text{ m} \times 3.5 \text{ m}$. Calculate the mass of air in the hall. Given density of air = 1.30 kg/m^3 .
4. A thread of mercury of 10.2 g is in a tube of uniform cross-section 0.1 cm^2 . Calculate the length of the thread. The density of mercury is 13.6 g/cm^3 .
5. The mass of an empty bucket of capacity 10 litres is 1 kg . Find its mass when completely filled with a liquid of relative density 0.8 .
6. A piece of copper of mass 106 g is dipped in a measuring cylinder containing water at 22 ml mark. The water rises to 34 ml mark. Find (a) volume of the copper piece (b) the density of copper.
7. A bottle weighs 30 g when empty, 53.4 g when filled with a liquid and 48 g when filled with water. Calculate the density of the liquid. Given, density of water at $4^\circ\text{C} = 1000 \text{ kg/m}^3$.
8. An iron cylinder of radius 1.4 cm and length 8 cm is found to weigh 369.6 g . Calculate the density of iron.
9. Calculate the mass of air enclosed in a room of length, breadth and height equal to 5 m , 3 m and 4 m respectively. Density of air = 1.3 kg/m^3 .
10. The mass of a solid rectangular block of iron is 23.6 g and its dimensions are $2.1 \text{ cm} \times 1.2 \text{ cm} \times 1.1 \text{ cm}$. Calculate the density of iron.
11. The mass of an empty 40 litre petrol tank of a vehicle is 8.0 kg . What will be its mass when filled completely with a fuel of density 700 kg/m^3 .
12. A weather forecasting plastic balloon of volume 15 m^3 contains hydrogen of density 0.09 kg/m^3 . The mass of the empty balloon is 7.15 kg . Calculate (a) the mass of hydrogen in the balloon (b) the mass of the balloon filled with hydrogen.
13. The mass of a density bottle is 25 g when empty, 50 g when filled completely with water and 365 g when filled completely with mercury. Find the density of mercury.
14. A bottle can hold 100 g of water at 4°C . What mass of sea water (density = 1030 kg/m^3) can hold it hold?
15. Relative density of silver is 10.8 . The density of water is 1000 kg/m^3 . What is the density of silver in SI?
16. A piece of rock salt weighs 108.2 g in air and 48.2 g in saturated brine of relative density 1.2 . What is the relative density of the rock salt?

17. A silver ornament is suspected to be hollow. Its weight is 250g and it displaces 50 cc of water. If the relative density of silver be 10, find the volume of the cavity.
18. If 100 cc iron of relative density 7.8 floats on mercury of relative density 13.6, what volume of iron is immersed?
19. A coil of wire of cross-section 0.75 mm^2 weighs 125g in air and 115 g in water. Find the length of the coil. (Density of water = 1000 kg/m^3)
20. A cubical block of water is dipped completely in water. Each edge of the block is 1cm in length. Find the buoyant force acting on the block.

CHAPTER - 11

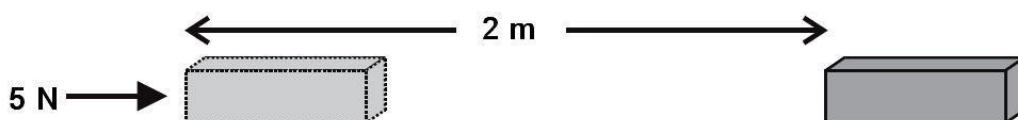
WORK AND ENERGY

NUMERICALS-I

1. A force of 10 N acts on an object. The object is displaced through 12 m, in the direction of the force. If the force acts all through the displacement, find the work done by the force.



2. A porter lifts a luggage of 15 kg from the ground and puts it on his head 1.5 m above the ground. Calculate the work done by him on the luggage.
3. A boy pushes a book by applying a force of 40 N. Find the work done by this force on the book is displaced through 25 cm along the path.
4. A ball of mass 1 kg thrown upwards, reaches a maximum height of 4 m. Calculate the work done by the force of gravity during the vertical displacement. ($g = 10\text{m/s}^2$)
5. Find the amount of work done by a labourers who carrier 'n' bricks of 'm' kg each to the roof of a house 'h' metre high by climbing a ladder.
6. An engine pulls a train 1 km over a level track. Calculate the work done by the train given that the frictional resistance is 5×10^5 N.
7. A man weighing 70 kg carries a weight of 10 kg on the top of a tower 100 m high. Calculate the work done by the man ($g = 10\text{m/s}^2$).
8. A boy of mass 55 kg runs up a flight of 40 stairs, each measuring 0.15m. Calculate the work done by the boy.
9. Calculate the work done in lifting 200 kg of water through a vertical height of 6 metres ($g = 10\text{m/s}^2$).
10. A crane pulls up a car of mass 500 kg to a vertical height of 4 m. Calculate the work done by the crane.
11. A force of 5 N acts on an object. The object id displaced through 8 m, in the direction of the force. If the force acts all through the displacement, find the work done by the force.



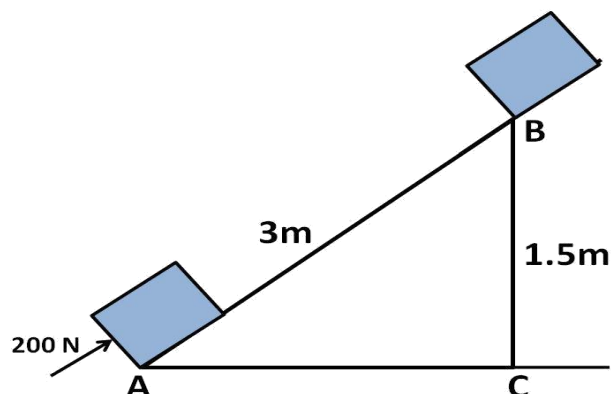
12. A porter lifts a luggage of 15 kg from the ground and puts it on his head 1.5 m above the ground. Calculate the work done by him on the luggage.

NUMERICALS-II

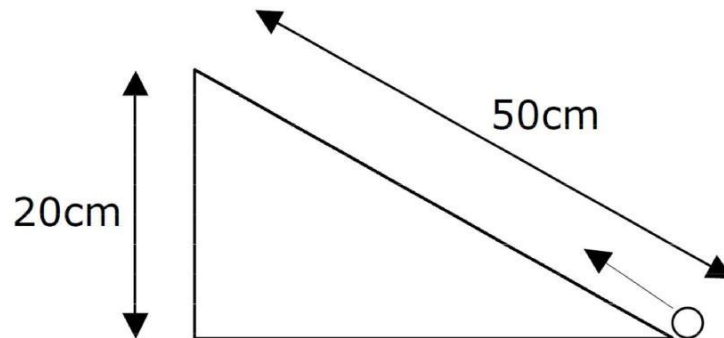
- 1. How far should a man of mass 60 kg run so that his kinetic energy is 750 J?**
- 2. Find the mass of the body which has 5 J of kinetic energy while moving at a speed of 2 m/s.**
- 3. A player kicks a ball of mass 250 g at the centre of a field. The ball leaves his foot with a speed of 10m/s. Find the work done by the player on the ball.**
- 4. A body of mass 5 kg, initially at rest, is subjected to a force of 20 N. What is the kinetic energy acquired by the body at the end of 10 s?**
- 5. A bullet of mass 20g moving with a velocity of 500m/s, strikes a tree and goes out from the other side with a velocity of 400m/s. Calculate the work done by the bullet in joule in passing through the tree.**
- 6. An object of mass 15 kg is moving with a uniform velocity of 4m/s. What is the kinetic energy possessed by the object?**
- 7. What is the work done to increase the velocity of a car from 30 km/hr to 60 km/hr if the mass of the car is 1500kg?**

NUMERICALS-III

1. A body of mass 4 kg is taken from a height of 5m to a height 10m. Find the increase in potential energy.
2. An object of mass 1 kg is raised through a height 'h'. Its potential energy increases by 1 J, find the height 'h'.
3. A 5 kg ball is thrown upwards with a speed of 10m/s. (a) Find the potential energy when it reaches the highest point. (b) Calculate the maximum height attained by it.
4. A 5 kg ball is dropped from a height of 10m. (a) Find the initial potential energy of the ball
(b) Find the kinetic energy just before it reaches the ground and (c) Calculate the velocity before it reaches the ground.
5. A body is thrown up with a kinetic energy of 10J. If it attains a maximum height of 5m, find the mass of the body.
6. A rocket of mass 3×10^6 kg takes off from a launching pad and acquires a vertical velocity of 1 km/s and an altitude of 25 km. Calculate its (a) potential energy (b) kinetic energy.
7. Find the energy possessed by an object of mass 10 kg when it is at a height of 6m above the ground. Given, $g = 9.8 \text{ m/s}^2$.
8. An object of mass 12 kg is at a certain height above the ground. If the potential energy of the object is 480 J, find the height at which the object is with respect to the ground. Given, $g = 10 \text{ m/s}^2$.
9. Calculate the increase in potential energy as a block of 2 kg is lifted through 2m.
10. A ball of mass 1 kg is dropped from a height of 5m. (a) Find the kinetic energy of the ball just before it reaches the ground (b) What is the speed at this instant?
11. A block of mass 30 kg is pulled up by a rope as shown in below figure with a constant speed by applying of 200 N parallel to the slope. A and B are the initial and final positions of the block. Calculate (a) work done by the force in moving the block from A to B. (b) the potential energy gained by the block (c) account for the difference in work done by the force and the increase in potential energy of the block.



12. A body of mass 5 kg falls from height of 5m. How much energy does it possess at any instant?
13. A 800g ball is pulled up a slope as shown in the diagram. Calculate the potential energy it gains.



14. A spring is compressed by a toy cart of mass 150g. On releasing the cart, it moves with a speed of 0.2m/s. Calculate the elastic potential energy of the spring.
15. An object of mass 40 kg is raised to a height of 5 m above the ground. What is its potential energy? If the object is allowed to fall, find its kinetic energy when it is half-way down.
16. A box has a mass of 5.8kg. The box is lifted from the garage floor and placed on a shelf. If the box gains 145 J of Potential Energy (E_p), how high is the shelf?
17. A man climbs on to a wall that is 3.6m high and gains 2268J of potential energy. What is the mass of the man?
18. A bag of wheat weighs 200 kg. To what height should it be raised so that its potential energy may be 9800 joules? (9.8 m/s^2)

NUMERICALS-IV

- Two girls each of weight 400N, climb up a rope through a height of 8m. We name one of the girls A and the other B. Girl A takes 20s while B takes 50s to accomplish this task. What is the power expended by each girl?
- A boy of mass 50kg runs up a staircase of 45 steps in 9s. If the height of each step is 15cm, find his power. Take $g = 10 \text{ m/s}^2$.
- An electric bulb of 60W is used for 6 hr per day. Calculate the 'units' of energy consumed in one day by the bulb.
- A 60 kg person climbs stairs of total height 20 m in 2 min. Calculate the power delivered.
- The work done by the heart is 1 J per beat. Calculate the power of the heart if it beats 72 times/min.
- A man exerts a force of 200 N in pulling a cart at a constant speed of 16m/s. Calculate the power spent by the man.

- 7. Calculate the power of an engine required to lift 10^5 kg of coal per hour from a mine 360m deep.**
- 8. A man does 200 J of work in 10 s and a boy does 100 J of work in 4s. (a) Who is delivering more power? (b) Find the ratio of the power delivered by the man to that delivered by the boy.**
- 9. A boy of mass 40 kg runs up a flight of 50 steps, each of 10cm high in 5s. Find the power developed by the boy.**

CHAPTER - 12

SOUND

NUMERICALS

1. A boy hears an echo of his own voice from a distant hill after 1 s. the speed of sound is 340m/s. What is the distance of the hill from the boy?
2. A boy is standing in front of wall at a distance of 85m produces 2 claps per second. He notices that the sound of his clapping coincides with the echo. The echo is heard only once when clapping is stopped. Calculate the speed of sound.
3. A man stationed between two parallel cliffs fires a gun. He hears the first echo after 1.5 s and the next after 2.5 s. What is the distance between the cliffs and when does he hear the third echo? Take the speed of sound in air is 340 m/s.
4. A man fires a shot and hears an echo from a cliff after 2s. He walks 85m towards the cliff and the echo of a second shot is now heard after 1.4s What is the velocity of sound and how far was the man from the cliff when he first heard the echo?
5. A boy hears an echo of his own voice from a distant hill after 2.5 s. the speed of sound is 340m/s. Calculate the distance of the hill from the boy.
6. A person clapped his hands near a cliff and heard the echo after 5 s. What is the distance of the cliff from the person if the speed of the sound, v is taken as 346 m/s?
7. A child hears an echo from a cliff after the sound of powerful cracker is produced. How far away is the cliff from the child? (Take speed of the sound in air as 340 m/s).
8. An observer standing between two cliffs fires a gun. He hears one echo after 1.5 s and another after 3.5 s. If the speed of sound is 340 m/s, find (a) the distance of the observer from the first cliff and (b) distance between the cliffs.
9. A boy stands 60m in front of a tall wall and claps. The boy continues to clap every time an echo is heard. Another boy finds that the time between the first (1st) and the fifty first (51st) clap is 18s. Calculate the speed of the sound.
10. A person standing between two vertical cliffs and 680m away from the nearest cliff, shouted. He heard the first echo after 4s and the second echo 3s later. Calculate (a) the speed of sound in air and the distance between the two cliffs.
11. A man standing at 51m from a wall fires a gun. Calculate the time after which an echo is heard. The speed of sound is 340 m/s.
12. A man fires a gun towards a hill and hears its echo after 5s. He then moves 340m towards the hill and fires his gun again. This time he hears the echo after 3s. Calculate the speed of the sound.
13. An engine is approaching a hill at constant speed. When it is at a distance of 0.9km, it blows a whistle, whose echo is heard by the driver after 5s. If the speed of sound is 340m/s, calculate the speed of the engine.
14. It takes 2.4a to record the echo of a sonar. If the speed of sound in water is 1450 m/s, find the depth of the ocean floor.

15. A ship which is stationary, is at a distance of 2900 m from the seabed. The ship sends an ultrasound signal to the seabed and its echo is heard 4s. Find the speed of sound in water.
