Chapter 7: Motion, force and work

Question 1. Fill in the blanks with the proper words from the brackets: (stationary, zero, changing, constant, displacement, speed, acceleration, magnitude, stationary but not zero, increases)

(1) If a body traverses a distance in direct proportion to the time, the speed of the body is **constant**
(2) If a body is moving with a constant velocity its acceleration is **zero**
(3) **Speed** is a scalar quantity.
(4) **Velocity** is the distance traversed by a body in a particular direction in unit time.
(5) When an object comes back to the point of origin, its displacement is **zero**.

Question 2. State whether the following statements are true or false :
(1) When a body performs uniform circular motion, its acceleration remains constant.
Answer: False
(2) Displacement of a body and distance covered by the body in a given time interval have always the same magnitude.
Answer: False
(3) The direction of acceleration can be opposite to that of velocity.
Answer: True
(4) Acceleration can be perpendicular to velocity.
Answer: True
(5) Deceleration has magnitude and direction.
Answer: True
(6) The average velocity of a body can be zero.
Answer: True

Question 3. Find the odd one out:

• Acceleration, force, velocity, speed.

Answer: Speed (It is a scalar quantity, while others are vectors)

Question 4. From the groups B and C, choose the proper words, for each of the words in group A:

A	B	C
Work	**Newton**	**Erg**
Force	**Metre**	**cm**
Displacement	**Joule**	**dyne**

Answer:

A	B	C
Work	Joule	Erg
Force	Newton	dyne
Displacement	Metre	cm

Question 5. Answer the following questions in one sentence each:

(1) State the quantities that must be specified to describe force.

Answer: Force is described by its magnitude and the direction in which it is applied.

(2) What happens when a force is applied in the direction of motion of a body?

Answer: When a force is applied in the direction of motion, the body speeds up or accelerates.

(3) What happens when a force is applied in the direction opposite to that of motion of a body?

Answer: When a force is applied in the opposite direction of motion, the body slows down or decelerates.

Question 6. Define the following terms and write the SI and CGS units for the same :

(1) Distance:

Definition: The total length of the path covered by a moving object, irrespective of direction.

SI Unit: Meter (m)

CGS Unit: Centimeter (cm)

(2) Velocity:

Definition: The rate of change of displacement of an object in a specific direction.

SI Unit: Meter per second (m/s)

CGS Unit: Centimeter per second (cm/s)

(3) Speed:

Definition: The rate at which an object covers distance, regardless of direction.

SI Unit: Meter per second (m/s)

CGS Unit: Centimeter per second (cm/s)

(4) Acceleration:

Definition: The rate of change of velocity of an object with respect to time.

SI Unit: Meter per second squared (m/s^2)

CGS Unit: Centimeter per second squared (cm/s^2)

Question 7.

(1) A bird sitting on a wire, flies, circles around and comes back to its perch. Explain the total distance it traversed during its flight and its eventual displacement.

Answer: The total distance the bird traversed is the entire length of its flight path. However, the bird's displacement is zero because it returned to its starting point, meaning the net change in position is zero.

(2) What is the direction of velocity of a particle performing uniform circular motion?

Answer: The velocity of a particle in uniform circular motion is always tangent to the circle at any point on its path.

(3) Explain the following concepts in your own words with everyday examples: force, work, displacement, velocity, acceleration, distance.

Answer:

- Force: A push or pull on an object, like pushing a shopping cart.
- Work: When force moves an object, like lifting a bag of groceries.
- Displacement: The shortest straight line between start and end points, like walking directly across a park.
- Velocity: Speed in a specific direction, like driving 60 km/h north.
- Acceleration: A change in velocity, like a car speeding up at a green light.
- Distance: The total length of the path traveled, like running 5 km around a track.

(4) A ball is rolling from A to D on a flat and smooth surface. Its speed is 2cm/s. On reaching B, it was pushed continuously up to C. On reaching D from C, its speed had become 4cm/s. It took 2 seconds for it to go from B to C. What is the acceleration of the ball as it goes from B to C?

Answer:

Given:

- Initial speed at B: u=2 cm/s
- Final speed at C: v=4 cm/s
- Time taken from B to C: t=2 seconds

To find:

- Acceleration a of the ball from B to C.

Formula:

- $a = \frac{v-u}{t}$

  where:
  - a is the acceleration
  - v is the final speed
  - u is the initial speed
  - t is the time taken

Calculation:

$a = \frac{v-u}{t}$

a = $\frac{4\ cm/s - 2\ cm/s}{2\ seconds}$

a = $\frac{2\ cm/s}{2\ seconds}$

a = 1cm/s^2

Answer:

The acceleration of the ball as it goes from B to C is 1 cm/s^2

(5) Observe the figure and answer the questions :

Sachin and Sameer started on a motorbike from place A, took the turn at B, did a task at C, travelled by the route CD to D and then went on to E. Altogether, they took one hour for this journey. Find out the actual distance traversed by them and the displacement from A to E. From this, deduce their speed. What was their velocity from A to E in the direction AE? Can this velocity be called average velocity?

Answer:

Given:

- A -> B (3 km)
- B -> C (4 km)
- C -> D (5 km)
- D -> E (3 km)

To find:

- Total Distance
- Total Displacement
- Speed
- Velocity
- Average velocity.

Formula:

- Distance : Actual Path Covered
- Displacement: Minimum Distance between start and end points
- Speed = Distance / Time
- Velocity = Displacement / Time

Calculation:

Total distance = 3 + 4 + 5 + 3 = 15km

Total displacement = 3 + 3 + 3 = 9km

Speed = Distance/Time = 15km / 1hr = 15 km/hour
Velocity = Displacement/Time = 9km/1 hr = 9km/hour
The velocity from A to E is 15km/hour which can be called the average velocity

Question. 8. Distinguish between :
(1) Distance and Displacement:
Answer:

Distance	Displacement
The total length of the path traveled.	The shortest straight line between the initial and final points.
It is scalar	It is vector
Walking 5 km around a park.	Walking 3 km directly east from home.

(2) Speed and Velocity:
Answer:

Speed	Velocity
The rate at which an object covers distance.	The rate at which an object changes its position in a specific direction.
It is scalar	It is vector
A car moving at 60 km/h.	A car moving at 60 km/h north.

Question. 9. Give scientific reasons:
(1) Distance and displacement are different concepts. (HOTS)
Answer: Distance measures the total path traveled, regardless of direction, while displacement measures the shortest straight line from the starting to the end point, considering direction. For example, if you walk in a circle and return to the start, your distance is the total length of the path, but your displacement is zero.

(2) When a body falls freely to the ground, its motion has a uniform acceleration.

Answer: A freely falling body experiences uniform acceleration due to gravity, which is constant at approximately 9.8 m/s². This means its velocity increases at a steady rate as it falls, regardless of its mass or initial speed.

Question. 10. Use your brain power! (Textbook page 48)

(1) The unit of acceleration is m/s². Verify this.

Answer: Acceleration is the rate of change of velocity with respect to time. Velocity has units of meters per second (m/s), and time is measured in seconds (s). The formula for acceleration is: a = $\frac{v-u}{t}$ Where (v-u) is the change in velocity (m/s) and t is the change in time (s). Therefore, the unit of acceleration is: $\frac{m/s}{s}$ = m/s^2

(2) Acceleration is a vector quantity. Is force a vector quantity, too? (HOTS) (Textbook page 4)

Answer: Yes, force is also a vector quantity. This is because force has both magnitude and direction. According to Newton's second law of motion, force is the product of mass and acceleration (F=ma), and since acceleration is a vector, force must also have direction and magnitude, making it a vector quantity.

Question. 11. Solve the following problems:

(1) A force of 1000N was applied to stop a car that was moving with a constant veloc The car stopped after moving through 10m. How much is the work done?

Solution: Here the direction of force and displacement are opposite to each other.

That means,

F = 1000 N and

s = -10 m

:.W=Fxs

= 1000 × (-10 m) = - 10000 J

Answer: The work done W= -10000J

(2) A cart with mass 20 kg went 50m in a straight line on a plain and smooth road when a force of 2N was applied to it. How much work was done by the force?

Given:

- Mass of the cart: $m=20\ \text{kg}$
- Distance traveled: $d=50\ \text{m}$
- Force applied: $F=2\ \text{N}$

To find:

- Work done by the force.

Formula:

- $W=F\times d$

  where:
  - W is the work done
  - F is the force applied
  - d is the displacement

Calculation:

- $W=2\ \text{N}\times 50\ \text{m}$
- $W=100\ \text{J}$

Answer:

The work done by the force is 100 Joules.

(3) A person travels a distance of 72 km in 4 hours. Calculate the average speed in m/s.

Given:

- Distance traveled: $d=72\ \text{km}=72{,}000\ \text{m}$
- Time taken: $t=4\ \text{hours}=14{,}400\ \text{seconds}$

To find:

- Average speed in m/s.

Formula:

- $v_{avg}=\frac{d}{t}$

  where:
  - v_{avg} is the average speed
  - d is the distance
  - t is the time taken

Calculation:

- $v_{avg}=\frac{72{,}000\,m}{14{,}400\,seconds}$
- $v_{avg}=5$ m/s

Answer:

The average speed is 5 m/s.

(4) The velocity of a moving body increases 10 m/s to 20 m/s in 5 seconds. Find its acceleration.

Given:

- Initial velocity: u=10 m/s
- Final velocity: v=20 m/s
- Time taken: t=5 seconds

To find:

- Acceleration a.

Formula:

- $a=\frac{v-u}{t}$

  where:
  - a is the acceleration
  - v is the final velocity
  - u is the initial velocity
  - t is the time taken

Calculation:

- $a=\frac{v-u}{t}$
- $a=\frac{20\,m/s-10\,m/s}{5\,seconds}$
- $a=\frac{10\,m/s}{5\,seconds}$
- $a=2$ m/s^2

Answer:

The acceleration is 2 m/s^2.