Physics Grade 9 — Chapter 2

Kinematics · Tests from supplied DeepSeek notes PDF

Chapter Test 1 — Foundation and Understanding

Instructions:
Section A: 15 MCQs (1 mark each)
Section B: 5 Short Questions (2 marks each)
Section C: 2 Long Questions (5 marks each)
Section D: 3 Numerical Problems (3 marks each)
Total: 40 marks
Section A — Multiple Choice Questions (15 × 1 = 15 marks)
MCQ 1. The study of motion without considering its causes is called:
A. Dynamics
B. Kinematics
C. Mechanics
D. Statics
Correct Answer: B. Kinematics
Explanation: Kinematics is defined as the study of motion without considering its causes.
MCQ 2. An object is said to be at rest if it:
A. Changes its position with time relative to an observer
B. Does not change its position with time relative to an observer
C. Moves in a straight line
D. Moves in a circle
Correct Answer: B. Does not change its position with time relative to an observer
Explanation: An object is at rest if it does not change its position with time relative to an observer.
MCQ 3. The motion of a free-falling apple is an example of:
A. Rotatory motion
B. Rectilinear motion
C. Circular motion
D. Vibratory motion
Correct Answer: B. Rectilinear motion
Explanation: A falling apple moves in a straight line, which is rectilinear motion.
MCQ 4. The length of the path traveled between two positions is called:
A. Displacement
B. Distance
C. Speed
D. Velocity
Correct Answer: B. Distance
Explanation: Distance is defined as the length of the path traveled between two positions.
MCQ 5. Displacement is a:
A. Scalar quantity
B. Vector quantity
C. Base quantity
D. Derived quantity
Correct Answer: B. Vector quantity
Explanation: Displacement has direction and is a vector quantity.

MCQ 6. The SI unit of speed is:
A. Metre (m)
B. Second (s)
C. Metre per second (m/s)
D. Newton (N)
Correct Answer: C. Metre per second (m/s)
Explanation: The SI unit of speed is metre per second (m/s).
MCQ 7. The rate of change of velocity is called:
A. Speed
B. Displacement
C. Acceleration
D. Distance
Correct Answer: C. Acceleration
Explanation: Acceleration is defined as the rate of change of velocity with respect to time.
MCQ 8. The acceleration due to gravity near the Earth's surface is approximately:
A.
B.
C.
D.
Correct Answer: B.
Explanation: The value of is approximately near the Earth's surface.
MCQ 9. The slope of a distance-time graph gives:
A. Acceleration
B. Speed
C. Distance
D. Time
Correct Answer: B. Speed
Explanation: The gradient (slope) of a distance-time curve gives speed.
MCQ 10. The area under a speed-time graph gives:
A. Speed
B. Acceleration
C. Distance
D. Time
Correct Answer: C. Distance
Explanation: The area under a speed-time graph represents the distance traveled.
MCQ 11. Which of the following is a vector quantity?
A. Distance
B. Speed
9.8 m/s
9.8 m/s2
9.8 N
9.8 kg
9.8 m/s2
g 9.8 m/s2
C. Mass
D. Displacement
Correct Answer: D. Displacement
Explanation: Displacement is a vector because it has both magnitude and direction.
MCQ 12. The motion of a spinning top is an example of:
A. Translatory motion
B. Rotatory motion

C. Vibratory motion
D. Random motion
Correct Answer: B. Rotatory motion
Explanation: A spinning top rotates around its own axis, which is rotatory motion.
MCQ 13. The motion of a swinging pendulum is an example of:
A. Translatory motion
B. Rotatory motion
C. Vibratory motion
D. Circular motion
Correct Answer: C. Vibratory motion
Explanation: A pendulum moves back and forth about a mean position, which is vibratory motion.
MCQ 14. When an object moves with uniform velocity, its acceleration is:
A. Positive
B. Negative
C. Zero
D. Infinite
Correct Answer: C. Zero
Explanation: Uniform velocity means constant velocity, so there is no change in velocity, and acceleration is zero.
MCQ 15. A ball is thrown straight up. At the top of its path, the magnitude of its acceleration is:

A. Zero
B.
C.
D.
Correct Answer: B.
Explanation: At the top of its path, the ball momentarily stops, but the acceleration due to gravity is still acting on it.
Section B — Short Questions (5 × 2 = 10 marks)
Q1. Define rest and motion. Explain why they are relative terms.
Answer:
Rest is the state of an object when it does not change its position with the passage of time relative to an observer. Motion is the state when an object changes its position with time relative to an observer. These terms are relative because they depend on the observer's frame of reference. For example, a passenger sitting in a moving bus is at rest relative to the bus (they are not changing position relative to the seats) but in motion relative to a person standing on the road (the passenger is moving past the stationary observer). Without specifying the observer, it is meaningless to say an object is at rest or in motion.
Q2. Differentiate between distance and displacement with examples.
Answer:
Distance is the total length of the path traveled between two positions. It is a scalar quantity and depends on the actual path taken. For example, if a person walks 3 km East and then 4 km North, the total distance traveled is 7 km. Displacement is the shortest straight-line distance from the initial position to the final position, along with the direction. It is a vector quantity and depends only on the starting and ending points. For the same person, the displacement is 5 km North-East. Distance is always greater than or equal to the magnitude of displacement.
Q3. What is acceleration? Write its formula and unit.
Answer:
Acceleration is the rate of change of velocity with respect to time. It is a vector quantity,

meaning it has both magnitude and direction. The formula for acceleration is , where is the final velocity, is the initial velocity, and is the time taken. The SI unit of acceleration is metre per second squared (m/s²). A positive acceleration means the velocity is increasing with time, while a negative acceleration (deceleration) means the
9.8 m/s2
4.9 m/s2
19.6 m/s2
9.8 m/s2
a=
tv −v
f i
v
f v
i t

velocity is decreasing. Acceleration can also occur due to a change in direction, even if the speed is constant.

Q4. What does the slope of a distance-time graph represent? What does a horizontal line on this graph indicate?

Answer:

The slope (gradient) of a distance-time graph represents the speed of the object. A steeper slope indicates a higher speed, while a gentler slope indicates a lower speed. A horizontal line on a distance-time graph indicates that the object is at rest (zero speed). This is because the distance is not changing as time passes, meaning the object is not moving. The slope of a horizontal line is zero, confirming that the speed is zero. This graph is always in the positive XY plane because distance is always positive and time moves forward.

Q5. Explain why a body moving in a circle at a constant speed is said to have a changing velocity.

Answer:

Velocity is a vector quantity that includes both speed and direction. When a body moves in a circle at a constant speed, the magnitude of its velocity (speed) remains constant, but the direction of motion is continuously changing. Since velocity depends on direction, a change in direction means the velocity is changing. This changing velocity means the body is accelerating, even though its speed is constant. This acceleration is called centripetal acceleration and is directed toward the center of the circle. Thus, a body in uniform circular motion has constant speed but variable velocity.

Section C — Long Questions (2 × 5 = 10 marks)

Q1. Describe the three main types of motion with examples.

Answer:

Introduction: Motion is the change in position of an object with time relative to an observer. It is broadly classified into three main types: translatory, rotatory, and vibratory motion.

Translatory Motion: In translatory motion, all points of a moving object move uniformly in the same direction, such that there is no change in the object's orientation. The entire object moves from one place to another. Translatory motion is further divided into three types:

Rectilinear motion: Motion in a straight line path (e.g., a falling apple, a train on a straight track).

Circular (curvilinear) motion: Motion in a curved path (e.g., a car around a bend, a satellite in orbit).

Random motion: Motion with no specific path (e.g., a butterfly flying, clouds moving in the sky).

Rotatory Motion: In rotatory motion, an object rotates or spins around its own axis. The points on the object move in circles around the axis. Examples include a spinning top, a rotating fan blade, and the Earth rotating on its axis.
Vibratory Motion: In vibratory motion, an object moves back and forth repeatedly about a fixed mean position. Examples include a swinging pendulum, a vibrating guitar string, and a child on a swing.
Combination of Motions: An object can have a combination of these motions. For example, a rolling ball has both translatory motion (it moves forward) and rotatory motion (it spins).
Conclusion: Understanding these types of motion helps us describe and analyze the behavior of moving objects in the physical world.
Q2. Explain the graphical analysis of motion using distance-time and speed-time graphs.
Answer:
Introduction: Graphs provide a visual representation of motion, making it easier to understand relationships between physical quantities like distance, speed, and time.
Distance-Time Graph: This graph plots distance on the vertical axis and time on the horizontal axis. The slope (gradient) of the graph represents the speed of the object.
A horizontal line indicates the object is at rest (zero speed).
A straight diagonal line indicates constant speed.
A curve that gets steeper indicates increasing speed (acceleration).
A curve that gets less steep indicates decreasing speed (deceleration).
The gradient is calculated as .
Speed-Time Graph: This graph plots speed on the vertical axis and time on the horizontal axis. It serves two purposes:
1. The slope of the graph gives the acceleration.
2. The area under the graph gives the distance traveled.
A horizontal line indicates constant speed (zero acceleration).
A straight line with a positive slope indicates constant acceleration.
A straight line with a negative slope indicates constant deceleration.
The area under the graph can be calculated using geometric shapes (rectangles, triangles) to find the distance.
$\Delta s/\Delta t$

Importance: Graphical analysis allows us to determine speed, acceleration, and distance without using complex equations. It is especially useful for motion with changing speed, where simple formulas do not apply.
Conclusion: Distance-time and speed-time graphs are powerful tools for understanding and analyzing motion, connecting visual intuition with mathematical description.
Section D — Numerical Problems (3 × 3 = 9 marks)
Q1. A car travels a distance of 150 km in 3 hours. Calculate its average speed in km/h and m/s.
Solution:
Given:
Distance
Time
Required:
Average speed in km/h and m/s
Formula:
Substitution:
Conversion to m/s:
Final Answer:
Verification: . Correct.
Q2. A car accelerates from rest at for 5 seconds. Calculate its final velocity and

the distance traveled.
Solution:
Given:
Initial velocity
s=150 km
t=3 h
V =ave
t
s
V =ave
=3 h
150 km 50 km/h
50 km/h=50× =3600 s1000 m 50× =185 13.89 m/s
V =ave 50 km/h=13.89 m/s
13.89×3.6=50 km/h
2 m/s2
u=0 m/s
Acceleration
Time
Required:
Final velocity and distance
Formula:
Substitution for velocity:
Substitution for distance:
Final Answer:
Verification: Using : . Correct.
Q3. A ball is dropped from a height of 20 m. Calculate the time it takes to reach the ground and the speed with which it hits the ground. (Take)
Solution:
Given:
Initial velocity
Height
Acceleration due to gravity
Required:
Time and final velocity
Formula:
Substitution for time:
a=2 m/s2
t=5 s
v s
v=u+at
s=ut+ at21 2
v=0+(2)(5)=10 m/s
s=(0)(5)+ (2)(5) =21 2 0+ (2)(25)=21 25 m
v=10 m/s
s=25 m
v =2 u+2 2as10 =2 0+2(2)(25) □100=100
g=10 m/s2
u=0 m/s
s=20 m
g=10 m/s2
t v

s=ut+ gt21 2
v=u+gt

Substitution for velocity:
Final Answer:
Verification: Using : . Correct.

Answer Key and Detailed Solutions — Test 1
MCQ Answers
1. B
2. B
3. B
4. B
5. B
6. C
7. C
8. B
9. B
10. C
11. D
12. B
13. C
14. C
15. B

Short Answers
(Provided above in Section B.)
20=0+ (10)t21 2
20=5t2
t =2 4
t=2 s
v=0+(10)(2)=20 m/s
t=2 s
v=20 m/s
v =2 u+2 2gs20 =2 0+2(10)(20) □400=400

Long Answers
(Provided above in Section C.)
Numerical Solutions
(Provided above in Section D.)

Chapter Test 2 — Understanding and Application

Board: FBISE
Class: 9
Subject: Physics
Section A — Multiple Choice Questions (15 × 1 = 15 marks)
MCQ 1. A person walks 3 km East and then 4 km North. What is the total distance traveled?
A. 5 km
B. 7 km
C. 1 km
D. 12 km
Correct Answer: B. 7 km
Explanation: Distance is the total path length, so .
MCQ 2. A person walks 3 km East and then 4 km North. What is the magnitude of their displacement?
A. 5 km
B. 7 km
C. 1 km
D. 12 km
Correct Answer: A. 5 km
Explanation: Displacement is the straight-line distance from start to finish; using the Pythagorean theorem, .
MCQ 3. A car travels 70 km in 1 hour. Its speed is:
A. 70 km/h
B. 70 m/s
C. 35 km/h
D. 140 km/h
Correct Answer: A. 70 km/h
Explanation: Speed = distance/time = .
3 km+4 km=7 km
=3 +42 2 5 km
70 km/1 h=70 km/h

MCQ 4. For straight-line motion in one direction, the magnitude of velocity is:
A. Greater than speed
B. Less than speed
C. Equal to speed
D. Zero
Correct Answer: C. Equal to speed
Explanation: For straight-line motion in one direction, distance equals the magnitude of displacement, so speed equals the magnitude of velocity.
MCQ 5. A car is moving at a constant speed of 60 km/h around a circular track. Its velocity is:
A. Constant
B. Zero
C. Continuously changing
D. Equal to its speed
Correct Answer: C. Continuously changing
Explanation: Since the direction of motion is continuously changing, the velocity is continuously changing even though the speed is constant.
MCQ 6. The average speed is defined as:
A. Total displacement divided by total time
B. Total distance divided by total time
C. Total time divided by total distance

D. Total distance multiplied by total time
Correct Answer: B. Total distance divided by total time
Explanation: Average speed is the total distance covered divided by the total time taken.
MCQ 7. If a car travels 300 km in 5 hours, its average speed is:
A. 60 km/h
B. 50 km/h
C. 70 km/h
D. 1500 km/h
Correct Answer: A. 60 km/h
Explanation: Average speed = .300 km/5 h=60 km/h
MCQ 8. The speed of an object at a specific instant of time is called:
A. Average speed
B. Instantaneous speed
C. Uniform speed
D. Variable speed
Correct Answer: B. Instantaneous speed
Explanation: Instantaneous speed is the speed at any specific instant of time.
MCQ 9. A body in uniform circular motion has:
A. Constant velocity
B. Variable velocity
C. Zero acceleration
D. Constant displacement
Correct Answer: B. Variable velocity
Explanation: The direction of motion is continuously changing, so the velocity is variable.
MCQ 10. The area under a speed-time graph for an object moving with constant speed is represented by a:
A. Triangle
B. Rectangle
C. Circle
D. Parabola
Correct Answer: B. Rectangle
Explanation: For constant speed, the graph is a horizontal line, and the area under it is a rectangle (Area =).
MCQ 11. A car accelerates from rest at for 5 seconds. Its final speed is:
A.
B.
C.
D.
Correct Answer: B.
v×t
2 m/s2
2 m/s
10 m/s
20 m/s
15 m/s
10 m/s
Explanation: Using : .
MCQ 12. A cyclist increases speed from to in 10 s. The acceleration is approximately:
A.
B.

C.
D.
Correct Answer: A.
Explanation: Convert to m/s: , .
.
MCQ 13. A ball is dropped from a tower and reaches the ground in 4 s. The speed of impact is:
A.
B.
C.
D.
Correct Answer: D.
Explanation: Speed = .
MCQ 14. When the slope of a body's displacement-time graph increases, the body is moving with:
A. Increasing velocity
B. Decreasing velocity
C. Constant velocity
D. Zero velocity
Correct Answer: A. Increasing velocity
Explanation: The slope of a displacement-time graph represents velocity. If the slope is increasing, the velocity is increasing.
MCQ 15. The motion of a butterfly is an example of:
A. Rectilinear motion
B. Circular motion
v=u+atv=0+2×5=10 m/s
5 km/h 7 km/h
0.055 m/s2
0.55 m/s2
5.5 m/s2
55 m/s2
0.055 m/s2
5 km/h=1.39 m/s7 km/h=1.94 m/sa=(1.94−1.39)/10=0.055 m/s2
0 m/s
2.45 m/s
19.6 m/s
39.2 m/s
39.2 m/s
g×t=9.8×4=39.2 m/s

C. Random motion
D. Rotatory motion
Correct Answer: C. Random motion
Explanation: A butterfly moves with no specific path, which is random motion.
Section B — Short Questions (5 × 2 = 10 marks)
Q1. Explain why a body moving in a circle at a constant speed has a changing velocity.
Answer:
Velocity is a vector quantity that depends on both speed and direction. When a body moves in a circle at a constant speed, the magnitude of its velocity (speed) remains constant, but the direction of motion is continuously changing. Because velocity includes direction, a change in direction means the velocity is changing. This changing velocity implies that the body is accelerating, even though its speed is constant. This acceleration is called centripetal acceleration and is directed toward the center of the circle. Therefore, uniform circular motion involves constant speed but variable velocity.
Q2. Differentiate between average speed and instantaneous speed.

Answer:
Average speed is the total distance covered by an object divided by the total time taken for the journey. It provides a single value that represents the overall rate of motion, smoothing out any variations in speed during the trip. For example, if a car travels 300 km in 5 hours, its average speed is 60 km/h, even if it traveled at different speeds at different times. Instantaneous speed, on the other hand, is the speed of an object at a specific instant in time. It is the speed shown by a speedometer at any given moment. While average speed gives an overall picture, instantaneous speed tells you exactly how fast you are moving at a particular point in time.
Q3. What is the difference between uniform and variable velocity?
Answer:
Uniform velocity means that an object covers equal displacements in equal intervals of time. This requires both the speed and the direction of motion to be constant. For example, a car moving at a constant 60 km/h on a straight road has uniform velocity. Variable velocity means that the velocity changes over time. This can happen if the speed changes, the direction changes, or both change. For example, a car moving around a circular track at a constant speed has variable velocity because its direction is continuously changing. A satellite in orbit is another example. Uniform velocity requires both constant speed and constant direction, while variable velocity occurs whenever either changes.

Q4. Explain the concept of acceleration due to gravity and its sign convention.
Answer:
Acceleration due to gravity () is the acceleration experienced by an object due to the Earth's gravitational pull. Near the Earth's surface, its value is approximately directed downward, toward the center of the Earth. All freely falling objects experience this same acceleration, regardless of their mass, when air resistance is neglected. The sign convention for depends on the direction of motion. When an object is falling downward (moving with gravity), is taken as positive ( ). When an object is thrown upward (moving against gravity), is taken as negative ( ). This convention is used in the equations of motion to correctly represent the direction of acceleration. For example, a ball thrown upward decelerates at until it stops at the top and then accelerates downward.
Q5. What does the area under a speed-time graph represent? How is it calculated?
Answer:
The area under a speed-time graph represents the distance traveled by the object. This is because the area is the product of speed and time, which is the definition of distance. The area can be calculated by breaking the graph into geometric shapes. For constant speed, the graph is a horizontal line, and the area is a rectangle: Area = . For uniformly changing speed starting from zero, the graph is a triangle, and the area is . For more complex motion, the area under the graph can be found by dividing it into smaller shapes (rectangles, triangles, trapezoids) and summing their areas. This method is especially useful for motion with changing speed, where simple formulas like do not apply.
Section C — Long Questions (2 × 5 = 10 marks)
Q1. Describe the different types of motion with examples from daily life.
Answer:
Introduction: Motion is the change in position of an object with time relative to an observer. It is classified into three main types: translatory, rotatory, and vibratory motion.
Translatory Motion: In translatory motion, all points of a moving object move uniformly in the same direction, with no change in orientation. The entire object moves from one place to another. It is further divided into three types:
Rectilinear motion: Motion in a straight line path. Examples include a falling apple, a

train on a straight track, and a gunshot.
Circular (curvilinear) motion: Motion in a curved path. Examples include a car going around a bend, a satellite orbiting Earth, and a roller coaster.
g
9.8 m/s2
g
g +g
g −g
9.8 m/s2
v×t
×21
t×v
d=vt

Random motion: Motion with no specific path. Examples include a butterfly flying, clouds moving in the sky, and kites flying.
Rotatory Motion: In rotatory motion, an object rotates or spins around its own axis. The points on the object move in circles around the axis. Examples include a spinning top, a rotating fan blade, and the Earth rotating on its axis.
Vibratory Motion: In vibratory motion, an object moves back and forth repeatedly about a fixed mean position. Examples include a swinging pendulum, a vibrating guitar string, and a child on a swing.
Combination of Motions: An object can have a combination of these motions. For example, a rolling ball has both translatory motion (it moves forward) and rotatory motion (it spins). Similarly, a moving car has translatory motion, while its wheels have rotatory motion.
Conclusion: Understanding these types of motion helps us describe and analyze the behavior of moving objects in the physical world.
Q2. Explain the graphical analysis of motion using distance-time and speed-time graphs. How can speed and acceleration be determined from these graphs?
Answer:
Introduction: Graphs provide a visual representation of motion, making it easier to understand relationships between physical quantities like distance, speed, and time.
Distance-Time Graph: This graph plots distance on the vertical axis and time on the horizontal axis. The slope (gradient) of the graph represents the speed of the object. The gradient is calculated as .
A horizontal line indicates the object is at rest (zero speed).
A straight diagonal line indicates constant speed.
A curve that gets steeper indicates increasing speed (acceleration).
A curve that gets less steep indicates decreasing speed (deceleration).
Speed-Time Graph: This graph plots speed on the vertical axis and time on the horizontal axis. It serves two purposes:
1. The slope of the graph gives the acceleration (or deceleration).
2. The area under the graph gives the distance traveled.
A horizontal line indicates constant speed (zero acceleration).
A straight line with a positive slope indicates constant acceleration.
A straight line with a negative slope indicates constant deceleration.
The area under the graph can be calculated using geometric shapes (rectangles, triangles) to find the distance.
Δs/Δt

Determining Speed and Acceleration: From a distance-time graph, the speed is the slope of the line. From a speed-time graph, the acceleration is the slope of the line, and the distance is the area under the line.

Conclusion: Graphical analysis allows us to determine speed, acceleration, and distance without using complex equations. It is especially useful for motion with changing speed, where simple formulas do not apply.

Section D — Numerical Problems (3 × 3 = 9 marks)

Q1. A car travels 120 km in 2 hours and then 180 km in 3 hours. Calculate the average speed for the entire journey.

Solution:

Given:

Distance 1 = , Time 1 =

Distance 2 = , Time 2 =

Required:

Average speed for the entire journey

Formula:

Substitution:

Final Answer:

Verification: . Correct.

Q2. A ball is thrown vertically upward with a velocity of 19.6 m/s. Calculate the maximum height reached and the time taken to reach it. (Take)

Solution:

Given:

Initial velocity

120 km 2 h

180 km 3 h

V =ave

Total time

Total distance

Total distance=120+180=300 km

Total time=2+3=5 h

V =ave

=5300 60 km/h

V =ave 60 km/h

60×5=300 km

g=9.8 m/s2

u=19.6 m/s

Final velocity at top

Acceleration

Required:

Maximum height and time

Formula:

Substitution for height:

Substitution for time:

Final Answer:

Verification: At , . Correct.

Q3. A car accelerates uniformly from 10 m/s to 30 m/s in 5 seconds. Calculate its acceleration and the distance traveled during this time.

Solution:

Given:

Initial velocity

Final velocity

Time

Required:

Acceleration and distance

Formula:
v=0 m/s
a=−g=−9.8 m/s2
h t
v =2 u+2 2as
v=u+at
0=(19.6) +2 2(−9.8)h
0=384.16−19.6h
h= =19.6
384.16 19.6 m
0=19.6−9.8t
t= =9.8
19.6 2 s
h=19.6 m
t=2 s
t=2 sv=19.6−9.8(2)=0
u=10 m/s
v=30 m/s
t=5 s
a s

Substitution for acceleration:
Substitution for distance:
Final Answer:
Verification: Using :
. Correct.

Answer Key and Detailed Solutions — Test 2
MCQ Answers
1. B
2. A
3. A
4. C
5. C
6. B
7. A
8. B
9. B
10. B
11. B
12. A
13. D
14. A
15. C
a=
t
v−u
s= ×2
(u+v) t
a= =530−10
=520 4 m/s2
s= ×2(10+30) 5= ×240 5=20×5=100 m
a=4 m/s2
s=100 m

v =2 u+2 2as30 =2 10 +2 2(4)(100) □900=100+800=
900

Short Answers
(Provided above in Section B.)
Long Answers
(Provided above in Section C.)
Numerical Solutions
(Provided above in Section D.)

Chapter Test 3 — Application, Reasoning, and Exam Preparation

Board: FBISE
Class: 9
Subject: Physics

Section A — Multiple Choice Questions (15 × 1 = 15 marks)

MCQ 1. A body moves 4 km North, then 3 km East, then 4 km South. The magnitude of its total displacement is:
A. 11 km
B. 5 km
C. 3 km
D. 7 km
Correct Answer: C. 3 km
Explanation: The North and South displacements cancel (4 km - 4 km = 0). The net displacement is 3 km East. Magnitude = 3 km.

MCQ 2. A body moves 10 m East, then 10 m West, then 5 m East. The total distance traveled and the magnitude of displacement are:
A. and
B. and
C. and
D. and
Correct Answer: A. and
Explanation: Total distance = . Displacement =
East. Magnitude = 5 m.

MCQ 3. A ball is thrown straight up. What is the magnitude of acceleration at the top of its path?
A. Zero
B.
C.
D.
Correct Answer: B.
Explanation: At the top of its path, the ball momentarily stops, but the acceleration due to gravity is still acting on it.

MCQ 4. A car travels a curvy track of length 800 m in 40 s. The straight path between start and end is 600 m, covered in 36 s. The average speed for the curvy track is:
25 m 5 m
5 m 25 m
25 m 25 m
5 m 5 m
25 m 5 m
10+10+5=25 m 10−10+5=5 m
9.8 m/s2
4.9 m/s2
19.6 m/s2
9.8 m/s2

A.
B.
C.
D.
Correct Answer: A.
Explanation: Average speed = total distance / time = .

MCQ 5. For the same car in MCQ 4, the magnitude of average velocity along the straight path is:

A.
B.
C.
D.
Correct Answer: B.
Explanation: Average velocity = displacement / time = .
MCQ 6. A cheetah accelerates from rest to in 3 s. Its acceleration is:
A.
B.
C.
D.
Correct Answer: A.
Explanation: Using the formula, .
MCQ 7. A ball is thrown upward with a speed of . How long does it take to reach the top? (Take)
A.
B.
C.
D.
Correct Answer: B.
Explanation: At the top, . Using : .
20 m/s
16.67 m/s
15 m/s
25 m/s
20 m/s
800 m/40 s=20 m/s
20 m/s
16.67 m/s
15 m/s
25 m/s
16.67 m/s
600 m/36 s=16.67 m/s
26.8 m/s
9.93 m/s2
26.8 m/s2
3 m/s2
80.4 m/s2
9.93 m/s2
a=(26.8−0)/3=9.93 m/s2
20 m/s
g=10 m/s2
1 s
2 s
3 s
4 s
2 s
v=0 v=u−gt0=20−10t □t=2 s
MCQ 8. A car moves at a constant speed of for . What distance does it cover?
A.
B.

C.
D.
Correct Answer: B.
Explanation: Distance = speed × time = .
MCQ 9. A car decelerates from to rest in . Its deceleration is:
A.
B.
C.
D.
Correct Answer: B.
Explanation: .
MCQ 10. A ball dropped from rest reaches a speed of . How long did it take?
(Take)
A.
B.
C.
D.
Correct Answer: B.
Explanation: .
MCQ 11. A body starts from rest and moves with uniform acceleration. Its velocity after time is . The distance covered in time is:
A.
B.
C.
D.
Correct Answer: B.
15 m/s 10 s
100 m
150 m
200 m
250 m
150 m
15×10=150 m
20 m/s 5 s
−2 m/s2
−4 m/s2
−5 m/s2
−10 m/s2
−4 m/s2
a=(0−20)/5=−4 m/s2
29.4 m/s
g=9.8 m/s2
2 s
3 s
4 s
5 s
3 s
v=gt □29.4=9.8×t □t=3 s
t v t
vt
vt21
2vt

vt2
vt21

Explanation: For uniform acceleration starting from rest, average velocity = .
Distance = average velocity × time = .
MCQ 12. A train moving at applies brakes and comes to rest in . The distance traveled during braking is:
A.
B.
C.
D.
Correct Answer: B.
Explanation: Using .
MCQ 13. A body is thrown vertically upward with a velocity of . The maximum height reached is:
A.
B.
C.
D.
Correct Answer: B.
Explanation: Using with :
.
MCQ 14. A car starts from rest and accelerates uniformly at for . The distance covered is:
A.
B.
C.
D.
Correct Answer: C.
Explanation: Using with : .
MCQ 15. A stone is dropped from a height of . The time it takes to reach the ground is: (Take)
v/2
vt21
20 m/s 10 s
50 m
100 m
200 m
400 m
100 m
s= ×2(u+v) t= ×2(20+0) 10=100 m
19.6 m/s
9.8 m
19.6 m
39.2 m
78.4 m
19.6 m
v =2 u−2 2gh v=00=(19.6) −2 2×9.8×h□h=
19.6 m
4 m/s2 5 s
20 m
40 m
50 m
100 m
50 m
s=ut+ at21 2 u=0s= ×21 4×5 =2 50 m
20 m

g=10 m/s2

A.
B.
C.
D.
Correct Answer: B.
Explanation: Using : .
Section B — Short Questions (5 × 2 = 10 marks)
Q1. A ball is thrown vertically upward. Describe what happens to its velocity and acceleration at the highest point.
Answer:
When a ball is thrown vertically upward, it decelerates due to gravity. At the highest point, its velocity becomes zero momentarily. However, the acceleration due to gravity is still acting on it, with a magnitude of directed downward. This means that even though the velocity is zero at the top, the ball is not in equilibrium; it is still accelerating. After reaching the top, the ball starts to fall back down, and its velocity increases in the downward direction. This illustrates that acceleration can be non-zero even when velocity is zero.
Q2. Explain why a body in uniform circular motion is said to be accelerating even though its speed is constant.
Answer:
Acceleration is the rate of change of velocity. Velocity is a vector that depends on both magnitude (speed) and direction. In uniform circular motion, the speed remains constant, but the direction of motion is continuously changing. Since the direction of velocity is changing, the velocity is changing. Therefore, the body is accelerating. This acceleration is called centripetal acceleration and is directed toward the center of the circle. It is responsible for continuously changing the direction of the velocity vector, keeping the object in its circular path. Thus, uniform circular motion involves constant speed but variable velocity and non-zero acceleration.
Q3. A car is moving with a constant speed along a straight road. Is there any work done on the car? Explain.
Answer:
In physics, work is done when a force causes a displacement in the direction of the force. If a car is moving with a constant speed along a straight road, its kinetic energy is not changing. According to the work-energy theorem, the net work done on the car is equal to its change in kinetic energy. Since the kinetic energy is constant, the net work
1 s
2 s
3 s
4 s
2 s
s= gt21 2 20= ×21 10×t □2 t =2 4□t=2 s
9.8 m/s2

done is zero. This means the forward force from the engine is balanced by the opposing forces of friction and air resistance. The engine does work, but friction and air resistance do negative work, so the net work is zero. Thus, no net work is done on the car when it moves at constant speed.
Q4. Explain how the area under a speed-time graph can be used to find the distance traveled.
Answer:
The area under a speed-time graph represents the distance traveled because the area is the product of speed and time, which is the definition of distance. For a graph with a

constant speed, the area is a rectangle: Area = . For uniformly changing speed starting from zero, the graph is a triangle, and the area is . For more complex motion, the area can be found by dividing the graph into smaller geometric shapes (rectangles, triangles, trapezoids) and summing their areas. This method works because the area under the curve is mathematically equivalent to the integral of speed with respect to time, which gives the total distance.

Q5. A body is thrown vertically upward with a certain velocity. What is the direction of its acceleration during the upward motion and during the downward motion?

Answer:

When a body is thrown vertically upward, it moves against gravity. The acceleration due to gravity always acts downward, toward the center of the Earth. Therefore, during the upward motion, the acceleration is directed downward (opposite to the direction of motion), which causes the body to decelerate. At the highest point, the velocity becomes zero, but the acceleration is still downward. During the downward motion, the body moves in the same direction as gravity, so the acceleration is still downward (in the same direction as motion), causing the body to accelerate. In both cases, the acceleration is directed downward with a magnitude of approximately .

Section C — Long Questions (2 × 5 = 10 marks)

Q1. A stone is dropped from a tower. Another stone is thrown downward with an initial velocity. Compare their motion and explain which will hit the ground first and with what velocity. (Neglect air resistance.)

Answer:

Introduction: When objects fall under gravity, their motion is governed by the same acceleration, regardless of their mass. However, the initial velocity can affect the time of fall and the final velocity.

v×t

×21 t×v

9.8 m/s2

Motion of the Dropped Stone: The first stone is dropped from rest. Its initial velocity . It falls with a constant acceleration of downward. Using the equations of motion, its velocity after time is , and the distance fallen is .

Motion of the Thrown Stone: The second stone is thrown downward with an initial velocity . It also experiences the same acceleration downward. Its velocity after time is , and the distance fallen is .

Comparison: Because the second stone starts with a downward velocity, it covers distance faster than the first stone. For the same height, the thrown stone will reach the ground first. Its final velocity will also be greater because it starts with an initial velocity and gains additional velocity due to gravity. The acceleration of both stones is the same ( ), but the initial conditions differ.

Conclusion: The stone thrown downward hits the ground first and with a greater velocity than the stone dropped from rest, even though both experience the same acceleration. This illustrates that the time of fall and final velocity depend on the initial velocity as well as the acceleration due to gravity.

Q2. A car travels from Peshawar to Islamabad on Motorway M1. It stops for 30 minutes at a rest area. The distance-time graph shows three segments: an upward straight line from Peshawar to the rest area, a horizontal line at the rest area, and another upward straight line from the rest area to Islamabad. Explain what each segment represents and how the speed can be calculated from the graph.

Answer:

Introduction: A distance-time graph plots distance on the vertical axis and time on the horizontal axis. The slope of the graph represents the speed of the object.

Segment 1: Peshawar to Rest Area: This is an upward straight line. The distance is increasing linearly with time, indicating that the car is moving with a constant speed. The slope of this line gives the speed of the car during this segment. The steeper the line, the higher the speed.
Segment 2: At the Rest Area: This is a horizontal line. The distance remains constant while time passes. This means the car is at rest (zero speed). The slope is zero, confirming that the speed is zero.
Segment 3: Rest Area to Islamabad: This is another upward straight line. The car is again moving with a constant speed. The slope of this line gives the speed for this segment. The slope may be different from the first segment, indicating a different speed.
Calculating Speed: The speed for each segment is calculated as the gradient of the line: . For example, if the car travels 100 km from Peshawar to the rest area in 1 hour, the speed is 100 km/h. If it travels 75 km from the rest area to Islamabad in 1.5 hours, the speed is 50 km/h.
u=0 g=9.8 m/s2
t v=gt s=
gt21 2
u>0 g
t v=u+gt s=ut+ gt21 2
9.8 m/s2
v=Δs/Δt

Conclusion: The distance-time graph provides a clear visual representation of the car's motion, showing periods of constant speed and rest. The slope of each segment gives the speed, and the horizontal line indicates the car is stationary.
Section D — Numerical Problems (3 × 3 = 9 marks)
Q1. A body moves 6 km West, then 8 km North. Find the magnitude and direction of its displacement.
Solution:
Given:
Displacement West = 6 km
Displacement North = 8 km
Required:
Magnitude and direction of displacement
Formula:
Using the Pythagorean theorem:
Direction:
Substitution:
Direction: The displacement is at an angle of approximately North of West.
Final Answer:
Direction = North of West
Verification: . Correct.
Q2. A car accelerates uniformly from 15 m/s to 25 m/s in 4 seconds. Calculate its acceleration and the distance traveled.
Solution:
R= (6) +(8)2 2
θ=tan
−1(6
8)
R= =36+64 =100 10 km
θ=tan =−1(6
8) tan (1.33)≈−1 53.1□
10 km 53.1□

R=10 km
53.1□
6 +2 8 =2 36+64=100=102
Given:
Initial velocity
Final velocity
Time
Required:
Acceleration and distance
Formula:
Substitution for acceleration:
Substitution for distance:
Final Answer:
Verification: Using :
. Correct.
Q3. A ball is thrown vertically upward with a velocity of 30 m/s. Calculate the maximum height reached and the total time it takes to return to the ground. (Take)
Solution:
Given:
Initial velocity
Final velocity at top
Acceleration
Required:
Maximum height and total time
Formula:
u=15 m/s
v=25 m/s
t=4 s
a s
a=
t
v−u
s= ×2
(u+v) t
a= =425−15
=410 2.5 m/s2
s= ×2(15+25) 4= ×240 4=20×4=80 m
a=2.5 m/s2
s=80 m
v =2 u+2 2as25 =2 15 +2 2(2.5)(80) □625=225+
400=625
g=10 m/s2
u=30 m/s
v=0 m/s
a=−g=−10 m/s2
h T
v =2 u+2 2as
Substitution for height:
Substitution for time to reach top:
Total time: Since the time to go up equals the time to come down, the total time
.
Final Answer:

Verification: At , . At ,
. Correct.

Answer Key and Detailed Solutions — Test 3

MCQ Answers

1. C
2. A
3. B
4. A
5. B
6. A
7. B
8. B
9. B
10. B
11. B
12. B
13. B

v=u+at
0=(30) +2 2(−10)h
0=900−20h
h= =20
900 45 m
0=30−10t
t=3 s
T=
2×3=6 s
h=45 m
T=6 s
t=3 sv=30−10(3)=0 t=6 ss=30(6)+ (−10)(6) =21 2
180−180=0

14. C
15. B

Short Answers

(Provided above in Section B.)

Long Answers

(Provided above in Section C.)

Numerical Solutions

(Provided above in Section D.)