**Physics 11 Kinematics Final**

**True/False**

*Indicate whether the statement is true or false.*

\_\_\_\_ 1. In a chosen coordinate system, the position of an object in motion can have negative values.

\_\_\_\_ 2. Acceleration is the rate at which an object’s speed changes.

\_\_\_\_ 3. Acceleration is a vector quantity.

\_\_\_\_ 4. A fly riding on the blade of a fan spinning at a constant speed is not accelerating.

**Multiple Choice**

*Identify the choice that best completes the statement or answers the question.*

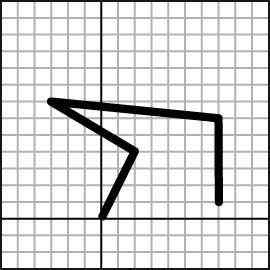
\_\_\_\_ 5. The final position minus the initial position is the

|  |  |  |  |
| --- | --- | --- | --- |
| a. | average velocity. | c. | time interval. |
| b. | motion diagram. | d. | displacement. |

\_\_\_\_ 6. The magnitude of a vector represents its \_\_\_\_\_.

|  |  |  |  |
| --- | --- | --- | --- |
| a. | velocity | c. | size |
| b. | direction | d. | color |

\_\_\_\_ 7. A bird flutters around in a tree in a path described by the dark line:



Which vector represents the average velocity of the bird?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

\_\_\_\_ 8. A racehorse is running with a uniform speed of 69 km/hr along a straightaway. What is the time it takes for the horse to cover 400 meters?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 21 seconds | c. | 0.35 hours |
| b. | 2.1 minutes | d. | 27.6 hours |

\_\_\_\_ 9. The change in velocity during a measurable time interval, divided by the time interval, is the \_\_\_\_\_.

|  |  |  |  |
| --- | --- | --- | --- |
| a. | instantaneous velocity | c. | instantaneous acceleration |
| b. | average velocity | d. | average acceleration |

\_\_\_\_ 10. Which formula represents final velocity of an object with average acceleration?

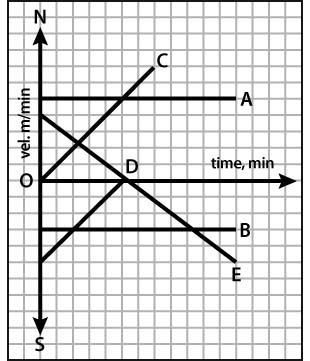
|  |  |  |  |
| --- | --- | --- | --- |
| a. | vi = vf + at | c. | vf = vi  at |
| b. | vf = vi  at | d. | vf = vi + at |

\_\_\_\_ 11. The acceleration due to Earth’s gravity is:

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 9.8 m/s2 | c. | 9.8 ft/s2 |
| b. | 98 m/s2 | d. | 9.8 mi/s2 |

\_\_\_\_ 12. “Free fall” is the condition in which

|  |  |
| --- | --- |
| a. | the motion of a body is due to gravity alone, when air resistance is applicable. |
| b. | the motion of a body is due to velocity alone, when air resistance is negligible. |
| c. | the motion of a body is due to gravity alone, when air resistance is maximized. |
| d. | the motion of a body is due to gravity alone, when air resistance is negligible. |



\_\_\_\_ 13. Line D represents movement that starts out toward the south, slows down, and stops. Why is the slope of the line positive?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | The velocity is positive. | c. | The acceleration is negative. |
| b. | The velocity is negative. | d. | The acceleration is positive. |

\_\_\_\_ 14. The rate at which an object’s velocity changes is called its \_\_\_\_\_.

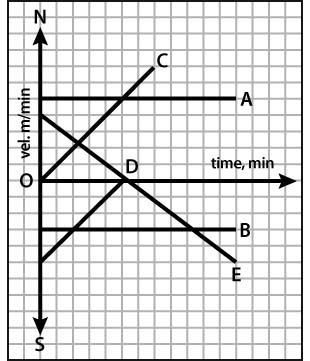
|  |  |  |  |
| --- | --- | --- | --- |
| a. | acceleration | c. | displacement |
| b. | average velocity | d. | scalar magnitude |

**Short Answer**

15. Define average velocity.

16. Mohinder leaves home and rides his bike north at 40 km/hr for 6 km. He stops at the store and spends 5 minutes buying a magazine. He gets back on his bike and rides south for 2 km at a speed of 45 km/hr. He stops at the bank and spends 10 minutes doing his banking.

Construct a position-time graph that shows each leg of Mohinder’s progress from home to the bank. What is his average velocity?



17. What is the main difference between line A and line B?

18. When throwing a baseball, why is the maximum range obtained from releasing the ball at an angle 45o to the horizontal?

19. A shot put with a mass of 10 kg and a bowling ball with a mass of 8 kg are placed on a table. The balls are rolled simultaneously along the table with an initial velocity of 1.5 m/s. If they are allowed to roll off the table, predict which will hit the floor first, and which will land farther away from the table.

**Problem**

20. The velocity-time graph of the motion of a particle is shown below. Calculate the total displacement of the particle from 0 to 29 seconds.



21. A ball is thrown vertically upward with a speed of 1.86 m/s from a point 3.82 m above the ground. Calculate the time in which the ball will reach the ground.

22. A car accelerates from rest at 5 m/s2 for 5 seconds. It moves with a constant velocity for some time, and then decelerates at 5 m/s2 to come to rest. The entire journey takes 25 seconds. Plot the velocity-time graph of the motion.

23. A boy throws a ball vertically upward with a speed of 19 m/s. Calculate the speed of the ball when it is at a height equal to 0.77 times (or 77%) the maximum height reached by the ball.

24. A roadrunner is running along a straight desert road at a constant velocity of 25 m/s. If a certain coyote wants to capture the roadrunner using a net dropped from an overpass that is 10m high, how far away from the overpass is the roadrunner when the coyote drops the net?

25. Sky divers jump out of a plane at an altitude of 4000 m. How much time will pass until they deploy their parachutes at an altitude of 760 m? Assume that air resistance is negligible.

26. A gazelle is running in a straight line with a constant velocity of 1340 m/min. A cheetah can accelerate from 0 m/min to 1820 m/min in 3 seconds. SUPER HARD QUESTION

If the cheetah is hiding in the brush 100 m away from the path of the gazelle, and it wants to intercept the gazelle on a  angle, how far away will the gazelle be when the cheetah begins his attack?

27. A human cannonball is launched from a cannon at 20 m/s at 143 above the horizontal. How long does it take for the guy to hit the water and how fast is he moving when he does?

28. A paintball is shot horizontally from a paintball marker 1.75 m above the ground. The initial velocity of the paintball is 270 m/s. How long will it take for the bullet to hit the ground?

**Physics 11 Kinematics Final**

**Answer Section**

**TRUE/FALSE**

1. ANS: T

The position of a moving object in a selected coordinate system is the position of the object relative to the zero of the coordinate system. The sign depends upon the object’s position relative to zero.

PTS: 1 DIF: Bloom’s Level 2 REF: Page 33

OBJ: 2.2.2 Recognize that the chosen coordinate system affects the sign of objects' positions.

NAT: B.4 | UCP.1

TOP: Recognize that the chosen coordinate system affects the sign of objects' positions.

KEY: Position MSC: 2

NOT: /T/ Correct! /F/ The sign of an object's position depends upon its position with respect to the zero of the coordinate system. The position of an object can also be negative.

2. ANS: F

Acceleration is the rate at which an object’s *velocity* changes. Velocity is a vector quantity. Speed is scalar.

PTS: 1 DIF: Bloom's Level 2 REF: p. 59

NAT: B.4

3. ANS: T

Acceleration has both magnitude and direction. Therefore, it is a vector.

PTS: 1 DIF: Bloom's Level 2 REF: pp. 59-60

NAT: B.4

4. ANS: F

Because acceleration is defined as a change in the velocity, the fly must be accelerating because its direction is constantly changing. Velocity is composed of both speed and direction.

PTS: 1 DIF: Bloom’s Level 2 REF: p. 153

NAT: B.4

**MULTIPLE CHOICE**

5. ANS: D

Displacement is the vector difference between initial and final positions.

PTS: 1 DIF: Bloom's Level 1 REF: p. 36

NAT: B.4

6. ANS: C

A vector’s magnitude represents the vector’s size.

PTS: 1 DIF: Bloom's Level 1 REF: p. 35

NAT: B.4

7. ANS: A

Choice A represents the head-to-tail sum of the vectors of the bird’s motion.

PTS: 1 DIF: Bloom's Level 3 REF: p. 35

NAT: B.4

8. ANS: A

(400 m)(1 km/1000 m) = 0.4 km

(0.4 km)(1 hr/69 km)(60 min/1 hr)(60 s/1 min) = 20.86 s = 21 s

PTS: 1 DIF: Bloom's Level 4 REF: p. 44

NAT: B.4

9. ANS: D

The average acceleration of an object is defined as the change in velocity during a measurable time interval, divided by the time interval.

PTS: 1 DIF: Bloom's Level 1 REF: p. 59

NAT: B.4

10. ANS: D

vf = vi + at

The final velocity of an object is its initial velocity, plus the product of the average acceleration and the time interval.

PTS: 1 DIF: Bloom's Level 2 REF: p. 65

NAT: B.4

11. ANS: A

The acceleration due to Earth’s gravity is 9.8 m/s2

PTS: 1 DIF: Bloom's Level 1 REF: p. 72

NAT: B.4

12. ANS: D

Free fall is the motion of a body due to gravity alone, when air resistance is negligible.

PTS: 1 DIF: Bloom's Level 2 REF: p. 72

NAT: B.4

13. ANS: D

This is a velocity-time graph. The slope of a velocity-time graph is acceleration. The slope of line D is positive because it represents an object with positive acceleration.

PTS: 1 DIF: Bloom's Level 4 REF: pp. 58-59, 62-63

NAT: B.4

14. ANS: A

The rate at which an object’s velocity changes is called its acceleration.

PTS: 1 DIF: Bloom's Level 1 REF: p. 59

NAT: B.4

**SHORT ANSWER**

15. ANS:

Average velocity of an object is defined as the change in position of the object moving along a straight line, divided by the time during which the change occurred. In symbolic form, the average velocity

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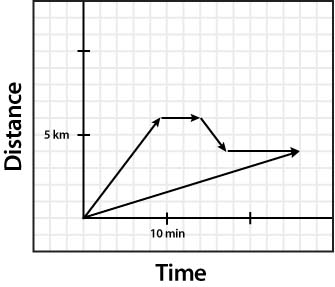
PTS: 1 DIF: Bloom’s Level 2 REF: Page 44

OBJ: 2.4.1 Define velocity. NAT: B.4 TOP: Define velocity.

KEY: Average velocity MSC: 2

16. ANS:

Mohinder’s total displacement is represented by the resultant vector of the legs of his journey.



The slope of the resultant is the average velocity:

4 km / 26 min 40 sec = 0.15 km/min = 9 km/hr

PTS: 1 DIF: Bloom's Level 5 REF: pp. 38-40, 43

NAT: B.4

17. ANS:

Line A represents velocity to the north at zero acceleration; line B represents velocity to the south at zero acceleration.

PTS: 1 DIF: Bloom's Level 3 REF: pp. 58-59

NAT: B.4

18. ANS:

The range of a projectile depends upon the x-component of its initial velocity, vxi, and the time that the projectile is in the air: Range = vxit

The initial velocity in the x-direction is found by vxi = vi cos 

The time is determined by setting the y distance to zero: 0 = 0 + vyit  1/2 gt2 , where vyi = vi sin Solve for t:

0 = 0 + vyit  1/2 gt2

t = 2viy/g

vyi = vi sin 

t = 2(vi sin /g

Range = vxit

Range = vi cos  [2(vi sin /g]

2\*cos sin sin(2

Range = [(vi2sin(2)]/g.

For a given vi, the range has its maximum value when sin(2 has its maximum value of 1. This happens when 2= 90o, or = 45o.

PTS: 1 DIF: Bloom's Level 4 REF: p. 150

NAT: B.4

19. ANS:

Both objects will hit the floor at the same time, and the same distance away from the table. Mass is not a factor in projectile motion.

PTS: 1 DIF: Bloom’s Level 5 REF: pp. 148-149

NAT: B.4

**PROBLEM**

20. ANS:

532.5 m

PTS: 1 DIF: Bloom’s Level 3 REF: Page 65

OBJ: 3.2.1 Interpret position-time graphs for motion with constant acceleration.

NAT: B.4 TOP: Interpret position-time graphs for motion with constant acceleration.

KEY: Position-time graph MSC: 3

NOT: The area under the graph gives the distance traveled.

21. ANS:

1.093 s

PTS: 1 DIF: Bloom’s Level 3 REF: Page 72

OBJ: 3.3.2 Solve objects involving objects in free fall. NAT: B.4

TOP: Solve objects involving objects in free fall. KEY: Free fall

MSC: 3

NOT: The total time is the sum of the time taken by the ball to reach its topmost point and the time to come down from the topmost point to the ground.

22. ANS:



PTS: 1 DIF: Bloom’s Level 3 REF: Page 59

OBJ: 3.1.3 Create velocity-time graphs. NAT: B.4 TOP: Create velocity-time graphs.

KEY: Velocity-time graph MSC: 3

NOT: The velocity-time graph is a straight line making an acute angle with the positive x-axis for accelerated motion, a horizontal line for uniform motion, and a straight line making an obtuse angle with the positive x-axis for decelerated motion.

23. ANS:

9.1 m/s

PTS: 1 DIF: Bloom’s Level 3 REF: Page 72

OBJ: 3.3.1 Define acceleration due to gravity. NAT: B.4

TOP: Define acceleration due to gravity. KEY: Acceleration due to gravity

MSC: 3

NOT: Calculate the maximum height reached and then use the starting point as the highest point.

24. ANS:

It will take the net 1.4 seconds to fall, so the coyote should drop the net when the roadrunner is 35m away.

Time to fall: df = di + vitf + 1/2atf2



vi = 0





df = 1/2atf2

10 m = 1/2(9.8 m/s2)t2

t = 1.4 s

Distance of roadrunner = 25 m/s  1.4 s = 35 m

PTS: 1 DIF: Bloom's Level 6 REF: p. 72

NAT: B.4

25. ANS:

df = di + vitf + 1/2atf2

760 m = 4000 m + 0 m/s (t ) + 1/2(9.80 m/s2)(t)2

3240 m = 1/2(9.80 m/s2)(t)2

t = 26 s

PTS: 1 DIF: Bloom's Level 6 REF: p. 72

NAT: B.4

26. ANS:

The acceleration of the cheetah is 1820 m/min / 3 s = 30.33 m/s / 3s = 10.1 m/s2.

df = di + vitf + 1/2atf2

100 = 0 m + 0 m/s (*tf*) + 1/2(10.1 m/s2)(*tf*)2

t = 4.4 s for the cheetah to get to the intercept point.

The gazelle is running at 1304 m/min = 21.7 m /s

21.7 m /s  4.4 s = 95 m

PTS: 1 DIF: Bloom's Level 6 REF: p. 68

NAT: B.4

27. ANS:

Do this yourself

PTS: 1 DIF: Bloom’s Level 3 REF: p. 150

NAT: B.4

28. ANS:

The only force acting on the paintball to cause it to hit the ground is gravity. The time that it will take for a fired paintball to hit the ground is the same as if it were dropped vertically from the same height. There is no initial velocity downwards.

df = di + vitf + 1/2atf2

1.75 m = 0 m + 0(t) + 1/2(9.8 m/s2)(t)2

t = 0.60 s

PTS: 1 DIF: Bloom's Level 4 REF: pp. 148-149

NAT: B.4