

A. Select the correct answer for the following multiple choice questions and write your answer in the line next to the question number. (Each question is worth 3 points)

- c 1. Today, the standard kilogram is defined in terms of
d 2. Today, the standard meter is defined in terms of

Answers for 1 & 2

- a. the distance from the earth's equator to the north pole
- b. the electromagnetic waves emitted by cesium atoms
- c. a standard platinum-iridium cylinder
- d. the speed of light
- e. the speed of sound

- d 3. What does a car speedometer measure?
c 4. What does a car odometer measure?

Answers for 3 & 4

- a. average velocity
- b. average speed
- c. distance
- d. instantaneous speed
- e. instantaneous velocity
- f. displacement

- c 5. What is the angle between the vectors A and $-A$ when they are drawn from a common origin?

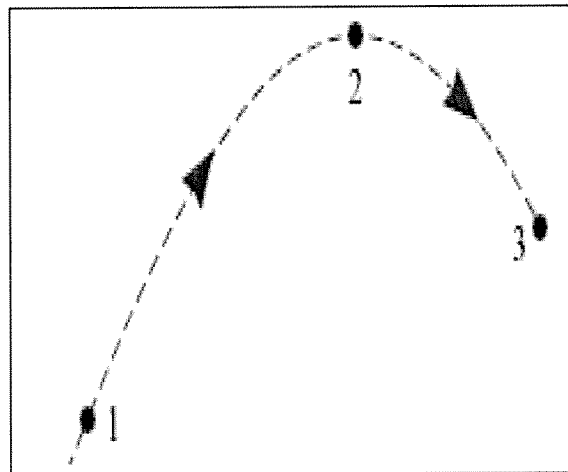
- a. 0^0
- b. 90^0
- c. 180^0
- d. 270^0
- e. 360^0



- d 6. Acceleration is the rate at which _____ changes.
- a. distance
 - b. displacement
 - c. speed
 - d. velocity
 - e. time

- e 7. The slope of the position *versus* time graph gives,
- a. time
 - b. displacement
 - c. acceleration
 - d. position
 - e. velocity

- d 8. The drawing shows projectile motion at three points along the trajectory. The speeds at the points are v_1 , v_2 , and v_3 . Assume there is no air resistance and rank the speeds, largest to smallest.



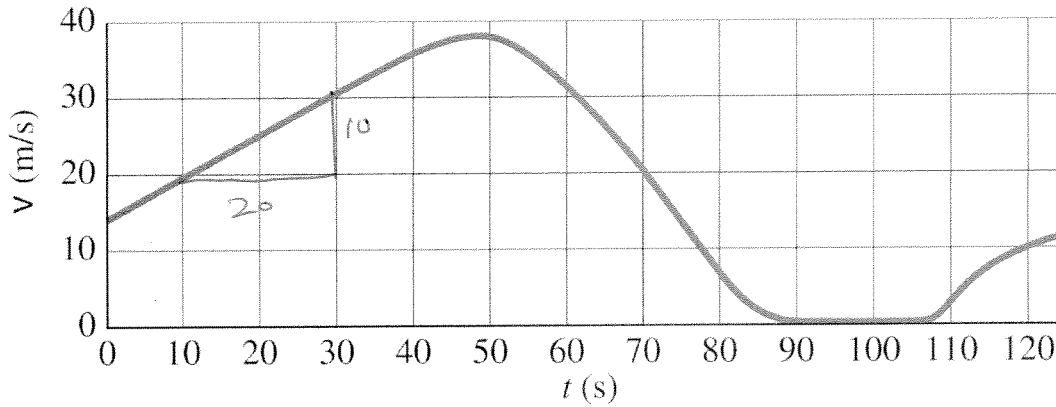
- a. $v_1 > v_2 > v_3$
- b. $v_2 > v_3 > v_1$
- c. $v_3 > v_1 > v_2$
- d. $v_1 > v_3 > v_2$
- e. $v_2 > v_1 > v_3$

- c 9. Car A is traveling east at 60 MPH. Car B is traveling west at 50 MPH. What is the velocity of car A relative to car B?

- a. 60 MPH, east
- b. 50 MPH, west
- c. 110 MPH, east
- d. 110 MPH, west
- e. 10 MPH, east
- f. 10 MPH, west

$V_{AQ} = 60 \text{ MPH} \rightarrow$
 $V_{BQ} = 50 \text{ MPH} \leftarrow$
 $V_{AB} = V_{AQ} + V_{QB}$
 $= \frac{\rightarrow}{60} + \frac{\rightarrow}{50} = \frac{\rightarrow}{110} \text{ MPH}$

10-14) Deal with the one-dimensional motion of an object, which is graphed below.



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b 10. The above graph is,

- a. time *versus* velocity b. velocity *versus* time

c 11. What is the instantaneous velocity of the object at 20 s?

- a. 0 m/s b. 20 m/s c. 25 m/s d. 30 m/s e. 38 m/s

b 12. What is the instantaneous acceleration of the object at 20 s?

- a. 0 m/s^2 b. 0.5 m/s^2 c. 1.0 m/s^2 d. 10 m/s^2 e. 25 m/s^2

e 13. Approximately how far the object travels during the first 100 seconds?

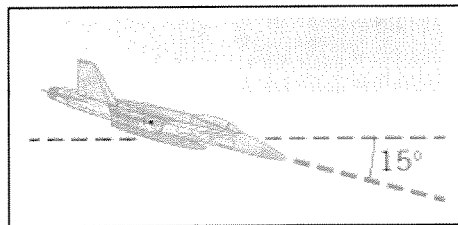
- a. 0 m b. 100 m c. 1000 m d. 1500 m e. 2000 m

b 14. What is happening to the acceleration from 110 to 120 s?

- a. increasing b. decreasing c. stay the same

b 15. A plane is diving as shown below with a velocity of 120 m/s at an angle of 15° below horizontal. What is the vertical component of the plane's velocity?

- a. 31 m/s, up
b. 31 m/s, down
c. 116 m/s, up
d. 116 m/s, down



b 16. Which one of the following is a vector?

- a. Distance b. Displacement c. Speed d. Time e. Mass

B. Equations of Kinematics for constant acceleration are given below:

1.	2.	3.	4.
$y = v_0 + at$	$x = \frac{1}{2}(v + v_0)t$	$x = v_0t + \frac{1}{2}at^2$	$v^2 = v_0^2 + 2ax$

1. Derive the third equation using the first two, starting with 2nd equation.

$$x = \frac{1}{2}(v + v_0)t$$

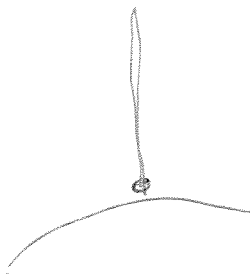
$$x = \frac{1}{2}(v_0 + at + v_0)t$$

$$x = \frac{1}{2}(2v_0 + at)t$$

$$x = (v_0 + \frac{1}{2}at)t$$

$$x = v_0t + \frac{1}{2}at^2$$

2. An astronaut on a distant planet wants to determine its acceleration due to gravity. The astronaut throws a rock straight up with a velocity of + 14.0 m/s and measures a time of 27.6 s before the rock returns to his hand. What is the acceleration due to gravity on this planet?



Time to reach the highest point
 $= \frac{27.6}{2} = 13.8 \text{ s}$

$$v_0 = 14 \text{ m/s}$$

$$t = 13.8 \text{ s}$$

$$v = 0$$

$$a = ?$$

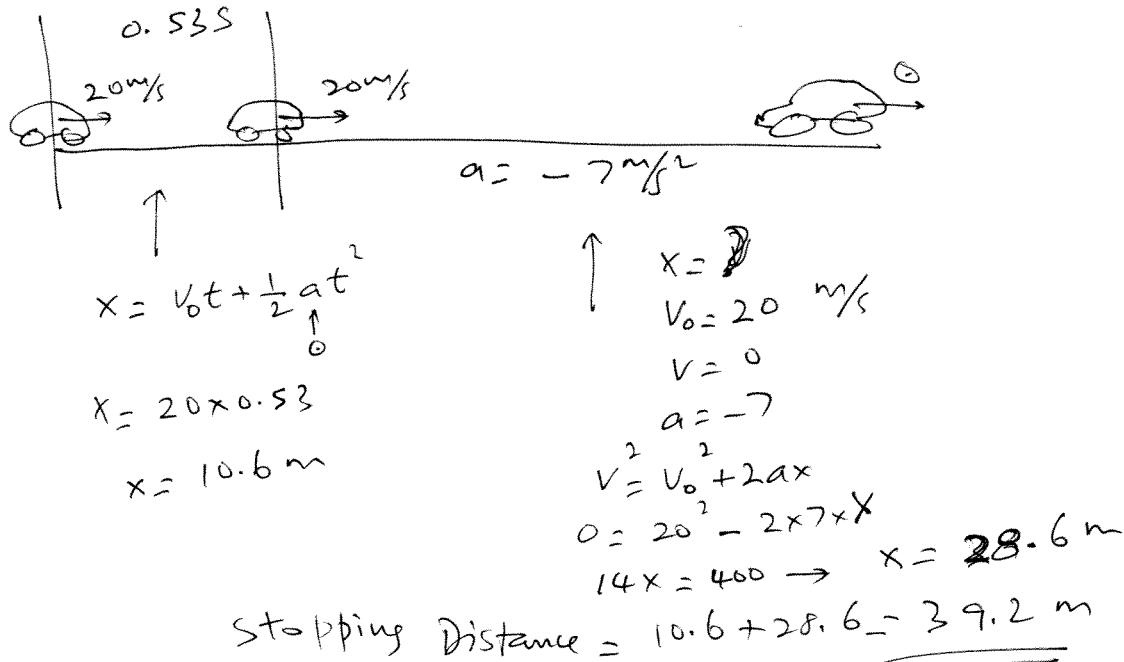
$$v = v_0 + at$$

$$0 = 14 + a(13.8)$$

$$a = -\frac{14}{13.8} = -1.01 \text{ m/s}^2$$

Acceleration due to gravity = 1.01 m/s^2 , down.

3. A car is traveling at 20.0 m/s, and the driver sees a traffic light turn red. After 0.530 s (the reaction time), the driver applies the brakes, and the car decelerates at 7.00 m/s^2 . What is the stopping distance of the car, as measured from the point where the driver first sees the red light?

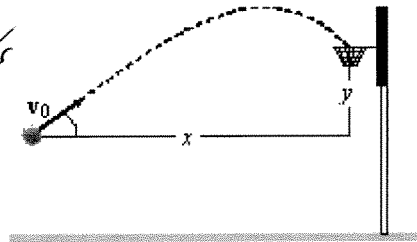


4. A basketball is shot with an initial velocity 8.0 m/s at a launch angle of 40° , which follows the trajectory shown. The ball enters the basket 0.92 s after it is launched.

a. Find the components of the initial velocity, v_{0x} and v_{0y} .

b. Find the distances x and y ? (Acceleration due to gravity = 9.8 m/s^2 , down)

a. $v_{0x} = v_0 \cos 40^\circ = 8 \cos 40^\circ = 6.1 \text{ m/s}$
 $v_{0y} = v_0 \sin 40^\circ = 8 \sin 40^\circ = 5.1 \text{ m/s}$



$\rightarrow v_{0x} = 6.1 \text{ m/s}$
 $t = 0.92 \text{ s}$
 $a_x = 0$
 $x = v_{0x} t + \frac{1}{2} a_x t^2$
 $x = 6.1 \times 0.92 + 0$
 $x = 5.6 \text{ m}$

$\uparrow v_{0y} = 5.1 \text{ m/s}$
 $a_y = -9.8 \text{ m/s}^2$
 $t = 0.92 \text{ s}$
 $y = v_{0y} t + \frac{1}{2} a_y t^2$
 $= 5.1 \times 0.92 - \frac{1}{2} \times 9.8 \times 0.92^2$
 $y = 4.69 - 4.15$
 $y = 0.54 \text{ m}$