Physics 200 (stapleton) Name: ________________________________

Mid-Term Review: Kinematics

Part 1: Multiple Choice, 1-D Kinematics

1. A particle moves along the x axis from x_i to x_f. Of the following values of the initial and final coordinates, which results in the displacement with the largest magnitude?

A) $x_i = 4$ m, $x_f = 6$ m

B) $x_i = -4$ m, $x_f = -8$ m

C) $x_i = -4$ m, $x_f = 2$ m

D) $x_i = 4$ m, $x_f = -2$ m

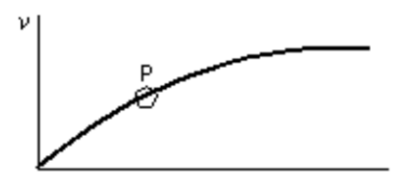
E) $x_i = -4$ m, $x_f = 4$ m

2. A car starts from Hither, goes 50 km in a straight line to Yon, immediately turns around, and returns to Hither. The time for this round trip is 2 hours. The magnitude of the average velocity of the car for this round trip is:

A) 0 B) 50 km/hr C) 100 km/hr D) 200 km/hr

4. The diagram shows a velocity-time graph for a car moving in a straight line. At point P the car must be:

A) moving with zero acceleration
B) climbing the hill
C) accelerating
D) stationary
E) moving at about 45° with respect to the x axis



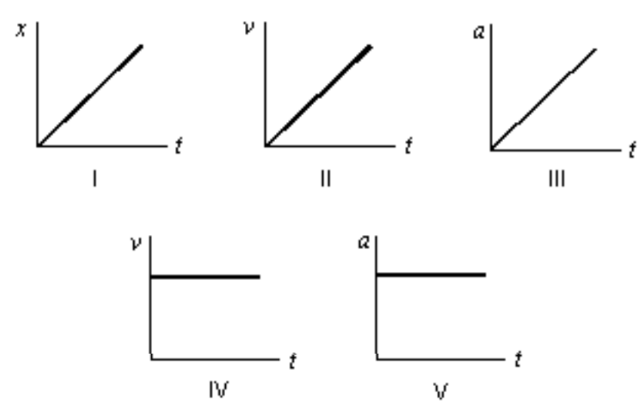
5. A particle moves on the x axis. When its velocity is positive and increasing:

A) its acceleration must be positive
B) its acceleration must be negative
C) its acceleration must be zero
D) it must be slowing down
E) none of the above must be true

6. A car, initially at rest, travels 20 m in 4 s along a straight line with constant acceleration. The acceleration of the car is:

A) 0.4 m/s^2 B) 1.3 m/s^2 C) 2.5 m/s^2 D) 4.9 m/s^2 E) 9.8 m/s^2

7. Consider the following five graphs (note the axes carefully!). Which of these represent(s) motion at constant speed?



A) IV only
B) IV and V only
C) I, II, and III only
D) I and II only
E) I and IV only

8. Velocity can be obtained from:

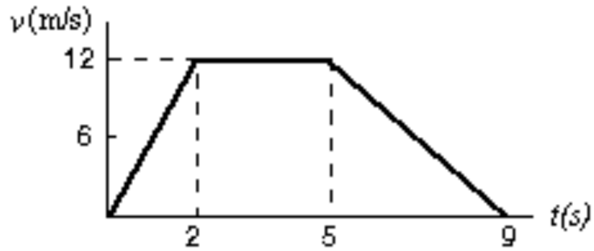
A) the slope of an position-time graph
B) the slope of a velocity-time graph
C) the area under an position-time graph
D) the area under a velocity-time graph

9. A car is moving at the top of a hill at 5 m/s. On the slope of the hill, the car has a constant acceleration of 5 m/s^2. After 5 seconds the car reaches the bottom of the hill. Its speed at the bottom of the hill is:

A) 1 m/s   B) 12.5 m/s   C) 25 m/s   D) 30 m/s   E) 120 m/s

10. The graph represents the straight line motion of a car. How far does the car travel between t = 2 seconds and t = 5 seconds?

A) 4 m
B) 12 m
C) 24 m
D) 36 m
E) 60 m



11. A falling body with no air resistance has a constant acceleration of 10 m/s^2. This means that:

A) the body falls 10 m during each second
B) the body falls 10 m during the first second
C) the speed of the body increases by 10 m/s during each second
D) the acceleration of the body increases by 10 m/s2 during each second
E) the acceleration of the body decreases by 10 m/s2 during each second

12. An object is shot vertically upward. While it is rising:

A) its velocity and acceleration are both upward
B) its velocity is upward and its acceleration is downward
C) its velocity and acceleration are both downward
D) its velocity is downward and its acceleration is upward
E) its velocity and acceleration are both decreasing

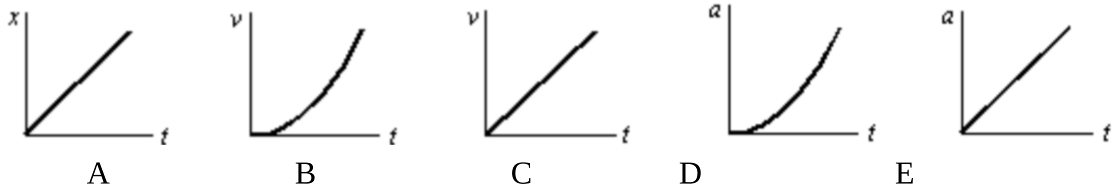
13. An object is thrown straight up from ground level with a speed of 50 m/s. What is its upward speed above ground level 2.0 seconds later? Assume g = 10 m/s^2.

A) 50 m/s   B) 40 m/s   C) 30 m/s   D) 20 m/s   E) 10 m/s

14. An object dropped from a window of a tall building hits the ground in 12.0 s. What is the height of the window above the ground? Assume g = 10 m/s^2.

A) 30 m   B) 60 m   C) 120 m   D) 360 m   E) 720 m

15. A stone is dropped from a cliff. The graph (carefully note the axes) that best represents its <u>speed</u> while it falls is:



Solutions to part 1:
1. E
2. A
4. C
5. A
6. C
7. E
8. A
9. D
10. D
11. C
12. B
13. C
14. E
15. C

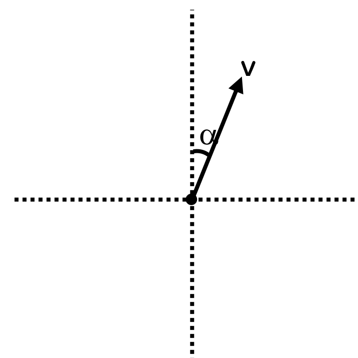
Part 2: Multiple Choice, 2-D Kinematics

1. A vector has a component of 5 m in the +x direction and a component of 12 m in the +y direction. The magnitude of this vector is:
   A) 7 B) 13 C) 17 D) 60 E) 169

2. A vector in the xy plane has an x component of 12 and a y component of 20. The angle it makes with the positive x axis is: A) 26 B) 29 C) 43 D) 59 E) 85

3. If θ is the angle with respect to the positive axis, the y-component of the vector A is given by
   A) $A\cos\theta$ B) $\mu A\cos\theta$ C) $A\sin\theta$ D) $mg - A\sin\theta$

4. Given the diagram to the right, what is the x-component of the vector?
   A) $v\cos\alpha$ B) $v\tan\alpha$ C) $v\sin\alpha$ D) $v\sin^{-1}\alpha$



For #5-8, select A, B or C. Assume no air friction.
Consider only the <u>speed</u> of the projectile (i.e. disregard the + and – signs).
A) <
B) =
C) >

5. v_{xC} _____ v_{xA}

6. v_{yC} _____ v_{yA}

7. v_{xB} _____ v_B

8. a_A _____ a_C

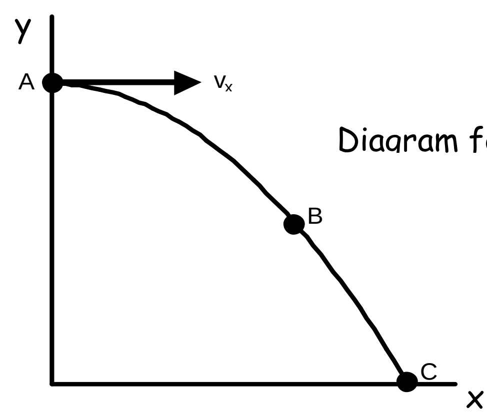


Diagram for #8-

11. A projectile is shot straight upwards with a certain velocity and it reaches a height of 40 m. When the same projectile is shot straight upwards with three times the original velocity, how high with the projectile reach?
   A) 20 m B) 40 m C) 120 m D) 360 m E) 720 m

Solutions to Part 2:
1. B
2. D
3. C
4. C
5. B
6. C
7. A
8. B
11. D

Part 3: Problems with 1-D Kinematics (solutions on website)

1. With full afterburners, the F-16 fighter jet has an acceleration of 12.7 m/s^2. It requires a velocity of 76m/s to take off.

a. How long does it take the F-16 to reach take off speed if it starts from rest?

b. How long does its runway need to be?

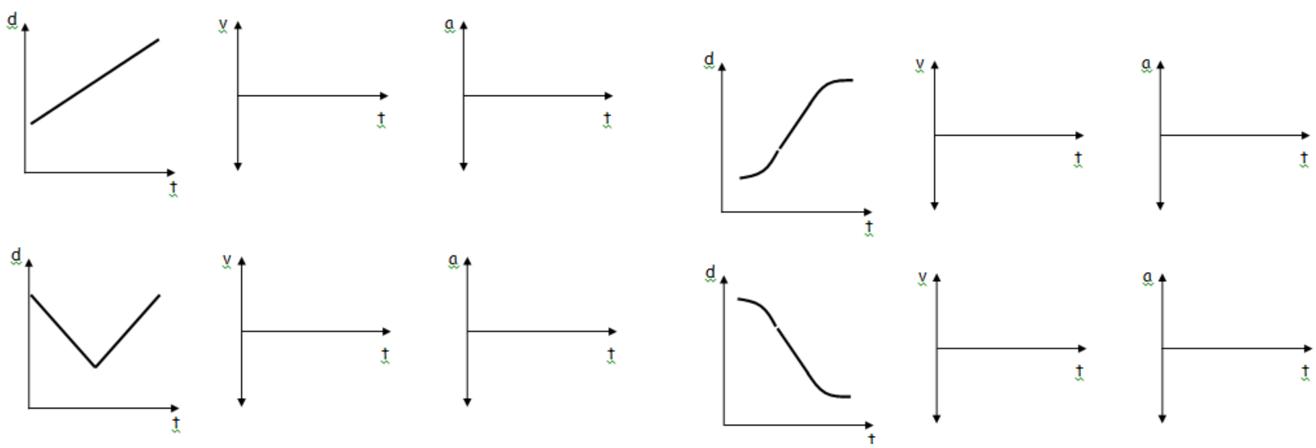
2. A car slows down from a velocity of 40m/s to a velocity of 35m/s over a distance of 25m. What is its acceleration during this time?

3. A runner's velocity is 5m/s at the 50m mark and 8m/s at the 100m mark. Assuming constant acceleration, how long did it take the runner to accelerate from 5m/s to 8m/s?

4. A projectile shot directly upward remained aloft for 6.00 seconds. How high did it go?

Graph Analysis

Using the information provided on the position vs time graph, complete the velocity and acceleration graphs.



Answers to Part 3 (see website for full solutions):

1a. 5.98s 1b. 227m 2. $-7.5m/s^2$ 3. 7.69s 4. 44.1m

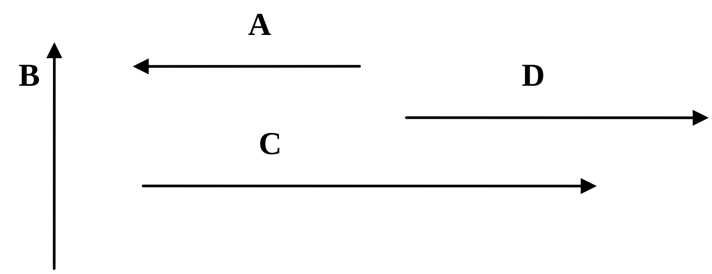
Part 4: Problems with 2-D Kinematics: (solutions on website)

5. A horizontal projectile is shot from desk height (1.0 meters). How long does it take the projectile to hit the ground? Is the time it takes to hit the ground dependent on the horizontal velocity?

6. An arrow is shot from ground level with speed of 35 m/s at an angle 50˚ above the horizontal. What is the vertical component of its velocity at its highest point? What is its total horizontal displacement? How long is it in the air?

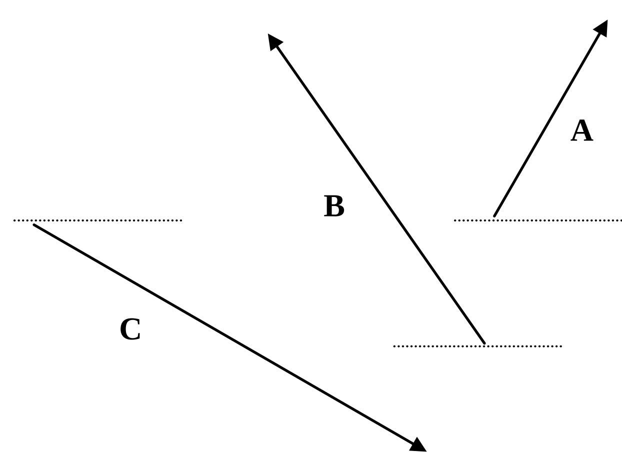
Vectors

7. Find the vector sum of **A + B + C + D**. (6 pts) **A** = 3.0cm, **B** = 3.0 cm, **C** = 6.0cm, and **D** = 4.0cm

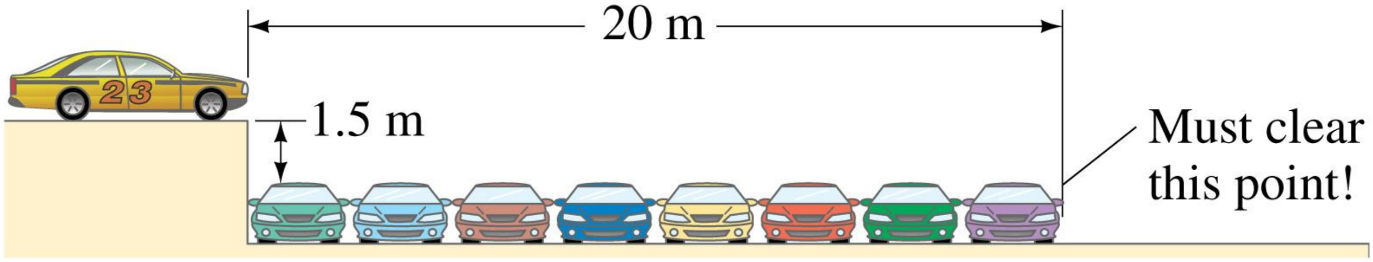


8. Find the vector sum of **A + B + C**. (6 pts)

A = 3.0cm @ 45˚, relative to horizontal.
B = 3.0 cm @ 60˚, relative to horizontal.
C = 6.0cm @ 30˚, relative to horizontal.



9. What minimum speed will car #23 need to make this jump successful? (6 pts)



<u>Answers to Part 4 (see website for full solutions):</u>

5. t=0.45s, no matter what. Fall time is independent of horizontal velocity.
6. 0m/s, 123m, 5.47s
7. 7.6cm, 23°above positive x
8. 6.0cm, 16.3°above positive x
9. 36m/s