Exam 1
Phys 220
Spring 2014

Name: Solution Lab group: _____

Fill out the scantron sheet for problems 1 – 16 (3.5 points each)

1. Rank in order, from the most to the fewest, the number of significant figures in the following numbers: A. 520 B. 520.0 C. 0.520 D. 5.200×10^5
   2 4 3 4
   a. B>C = A>D
   b. D>C>B=A
   c. D=B>C>A
   d. B>D=C>A

2. If an object has a positive velocity and a negative acceleration, it means the object will
   a. slow to a stop.
   b. speed up.
   c. slow down, turn around and speed up in the other direction
   d. remain at a constant speed

3. When a ball is thrown up into the air with an initial velocity of 5 m/s, what is its velocity at the top of its flight?
   a. $v = 0$ m/s
   b. $v = -5$ m/s
   c. $v = 5$ m/s
   d. Not enough information is given.

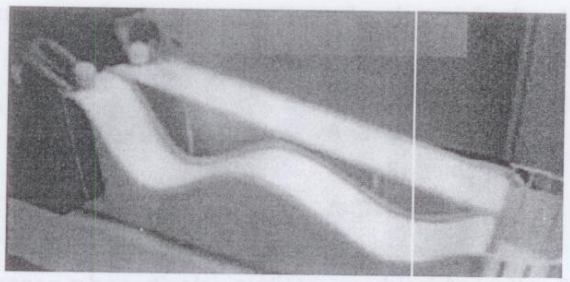
4. When a ball is thrown up into the air, what is its acceleration at the top of its flight?
   a. $a = 0$ m/s^2
   b. $a = -9.8$ m/s^2
   c. $a = 9.8$ m/s^2
   d. Not enough information is given.

5. Which of the following quantities does NOT include direction?
   a. displacement
   b. velocity
   c. speed
   d. acceleration
   e. more than one of the above

6. A dog is running in circles trying to catch his tail. If he's traveling at a constant speed of 1.5 m/s and the circle he makes has a radius of 0.9 meters, what is his acceleration?
   a. 0 m/s^2
   b. 1.5 m/s^2
   c. 1.7 m/s^2
   d. 2.5 m/s^2
   e. 9.8 m/s^2

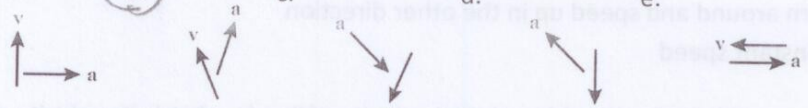
$v^2/r = \frac{(1.5\ m/s)^2}{.9\ m} = 2.5\ m/s^2$

7. Two balls are released at the same time on the two tracks shown below. Which ball wins?
   a. The ball on the low road
   b. The ball on the high road
   c. They tie



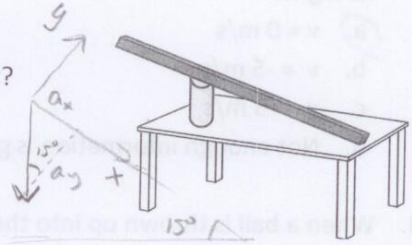
8. Shown here are the velocity and acceleration vectors for an object in several different types of motion. In which case is the object speeding up and turning to its right?

a. b. c. d. e.

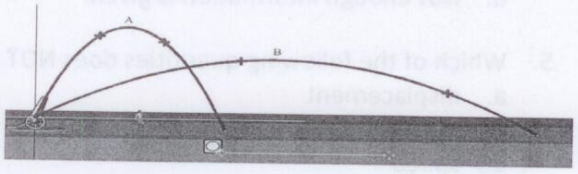


9. A cart is rolling down the ramp shown (inclined to 15° above the horizontal). What is the magnitude of the acceleration of the cart?
   a. 9.8 m/s^2
   b. 0 m/s^2
   c. 2.5 m/s^2
   d. 4.1 m/s^2
   e. 9.4 m/s^2

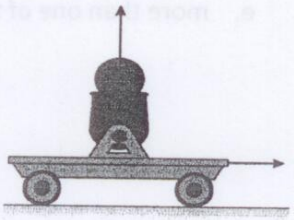
$a_x = 9.8 \sin 15^\circ$
$= 2.5\ m/s^2$



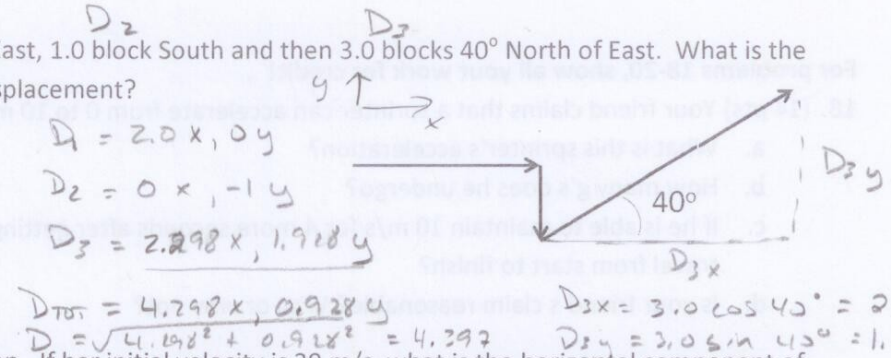
10. Two pumpkins are fired at different angles (ignore air resistance). Which one is in the air longer?
    a. A
    b. B
    c. Same time
    d. Not enough information



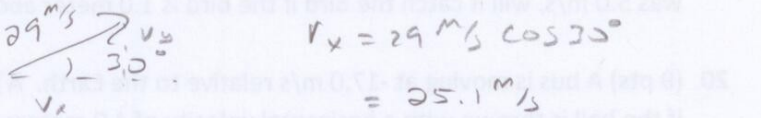
11. What will happen if the cart rolls at a constant velocity and then shoots a ball straight up?
    a. The ball will land behind the cart
    b. The ball will land in the cart.
    c. The ball will land in front of the cart.
    d. Depends on the initial velocity of the cart.



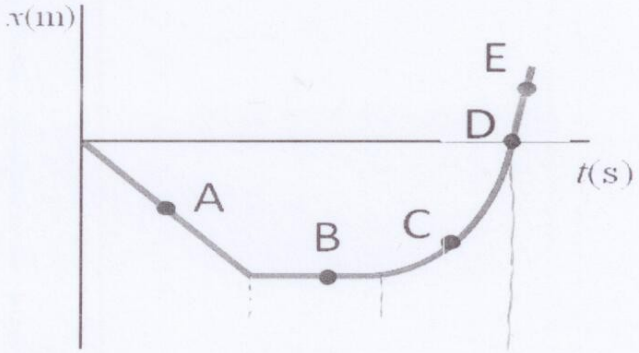
12. A person walks 2.0 blocks East, 1.0 block South and then 3.0 blocks 40° North of East. What is the magnitude of their total displacement?
    a. 1.9 blocks
    b. 2.3 blocks
    c. 4.3 blocks
    d. 4.4 blocks
    e. 6.0 blocks



13. A biker jumps off a 30° ramp. If her initial velocity is 29 m/s, what is the horizontal component of her velocity?
    a. 4.9 m/s
    b. 9.8 m/s
    c. 25 m/s
    d. 14.7 m/s
    e. 29 m/s



Questions 14 –17 The plot to the right shows the position of an object as a function of time. The letters A-E represent particular moments of time.

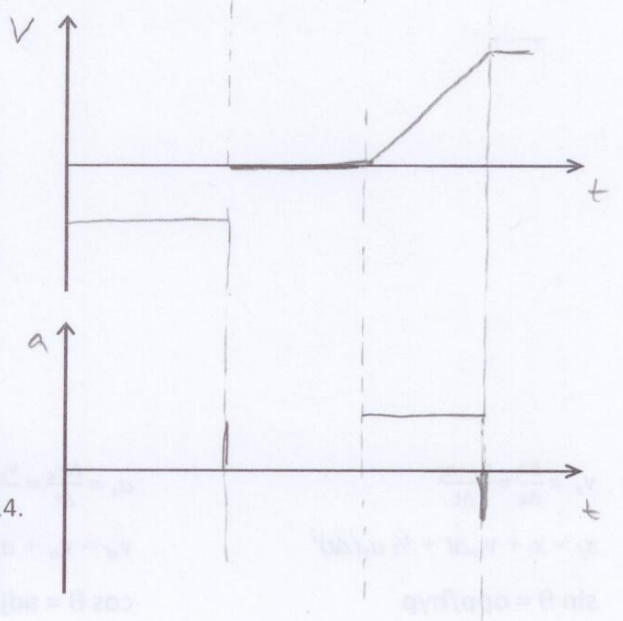


14. What does the slope of this graph represent?
    a. Position
    b. Velocity
    c. Acceleration

15. At which of the following moments is the speed of the object negative?
    a. A
    b. B
    c. C
    d. E
    e. More than one of the above

16. At instant C the velocity of the object is
    a. positive
    b. negative
    c. zero
    d. Not enough info

17. (7 pts) Sketch the corresponding velocity vs. time and acceleration vs. time graphs for the graph in #14. Use dashed lines to indicate where the graphs line up with each other.



For problems 18-20, show all your work for credit!

18. (14 pts) Your friend claims that a sprinter can accelerate from 0 to 10 m/s in 0.25s.
    a. What is this sprinter's acceleration?
    b. How many g's does he undergo?
    c. If he is able to maintain 10 m/s for 4 more seconds after getting up to speed, how far will he travel from start to finish?
    d. Is your friend's claim reasonable? Why or why not?

19. (14 pts) A cat leaps to catch a bird. If the cat's jump was at 60.0° off the ground and its initial velocity was 5.0 m/s, will it catch the bird if the bird is 1.0 meter above the ground?

20. (9 pts) A bus is moving at -17.0 m/s relative to the Earth. A passenger throws a football to his friend. If the ball is thrown with a horizontal velocity of 4.0 meters per second relative to the bus, what is its velocity relative to the Earth? Use the symbolic notation for relative velocity to solve this problem.

$v_x = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t}$

$a_x = \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{\Delta t}$

$a = \frac{v^2}{r}$

$f = \frac{1}{T}$

$x_f = x_i + v_{xi}\Delta t + \frac{1}{2} a_x(\Delta t)^2$

$v_{xf} = v_{xi} + a_x\Delta t$

$v_{xf}^2 = v_{xi}^2 + 2a_x(\Delta x)$

$\sin\theta$ = opp/hyp

$\cos\theta$ = adj/hyp

$\tan\theta$ = opp/adj

$a^2 + b^2 = c^2$

1609 meters = 1 mile

3600 seconds = 1 hour

18. $x_i = 0m$
$x_f = ?$
$v_i = 0 m/s$
$v_f = 10 m/s$
$a = ?$
$\Delta t = 0.25s$

a) $v_f = v_i + a\Delta t$

$10 m/s = 0 m/s + a\ 0.25s$

$\frac{10 m/s}{0.25s} = \boxed{40 m/s^2}$

b) $\frac{40 m/s^2}{9.8 m/s^2} = 4.08 g's = \boxed{4.1 g's}$

c) Must work in 2 parts because $a = 40 m/s^2$ for 0.25s and $a = 0 m/s^2$ for 4.0 seconds.

Part 1

$x_i = 0m$
$x_f = ?$
$v_i = 0 m/s$
$v_f = 10 m/s$
$a = 40 m/s^2$
$\Delta t = 0.25s$

$x_f = x_i + v_i\Delta t + \frac{1}{2} a \Delta t^2$

$x = 0m + 0 m/s\,\Delta t + \frac{1}{2}\, 40 m/s^2 (0.25s)^2$

$= 1.25m$

Part 2

$x_i = 1.25m$
$x_f = ?$
$v_i = 10 m/s$
$v_f = 10 m/s$
$a = 0 m/s^2$
$\Delta t = 4s$

$x_f = x_i + v_i\Delta t + \frac{1}{2} a \Delta t^2$

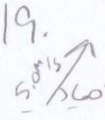
$x_2 = 1.25m + 10 m/s\ 4s +$

$= 41.25m$

$= \boxed{41 m}$

d) 4.1 g's is a lot! Pretty unlikely. Also think about sprinters or any race. 0.25s is probably before the second foot has time to push off.

19.



$V_x = 5.0\,m/s \cos 60°$
$= 2.5\,m/s$

$V_y = 5.0\,m/s \sin 60°$
$= 4.33\,m/s$

$x_i = 0m$	$y_i = 0m$
$x_f = ?$	$y_f =$
$V_{xi} = 2.5\,m/s$	$V_{yi} = 4.33\,m/s$
$V_{xf} = 2.5\,m/s$	$V_{yf} = ?$
$a_x = 0\,m/s^2$	$a_y = -9.8\,m/s^2$
$\Delta t = ?$	$\Delta t = ?$

I want to find how high the cat jumps to see if it makes it to at least 1.0m.

At the top of his flight his $V_y = 0\,m/s$

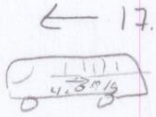
$$V_{yf}^2 = V_{yi}^2 + 2a\Delta y$$

$$\frac{V_{yf}^2 - V_{yi}^2}{2a} = \Delta y$$

$$\frac{0^2 - (4.33\,m/s)^2}{2(-9.8\,m/s^2)} = 0.957m$$

The cat does not quite jump 1.0m

20.



$V_{BE} = -17.0\,m/s$

$V_{FB} = 4.0\,m/s$

B = Bus
E = Earth
F = Football

$V_{FE} = V_{FB} + V_{BE}$

$= 4.0\,m/s + -17.0\,m/s$

$= -13\,m/s$