Your Name: _____ **PHY203**
Final Exam
12/14/07

Solutions

For problems 1-3, Let **A** = 6**i** - 5**j**, **B** = -7**i** + 10**j**, **C** = 3**A** – 2**B**

1. Write the vector, **C**, in vector notation:
a. 4**i** - 5**j** **C** = 3(6**i** - 5**j**) - 2(-7**i** + 10**j**) = = 32**i** - 35**j**
b. 4**i** + 5**j**
c. 32**i** + 5**j**
d. 32i - 35j
e. None of the above

2. Find the magnitude of the vector **B**:
a. 3.0 $B = ((-7)^2 + (10)^2)^{1/2} = 12.2$
b. 7.1
c. 12.2
d. 17.0
e. None of the above

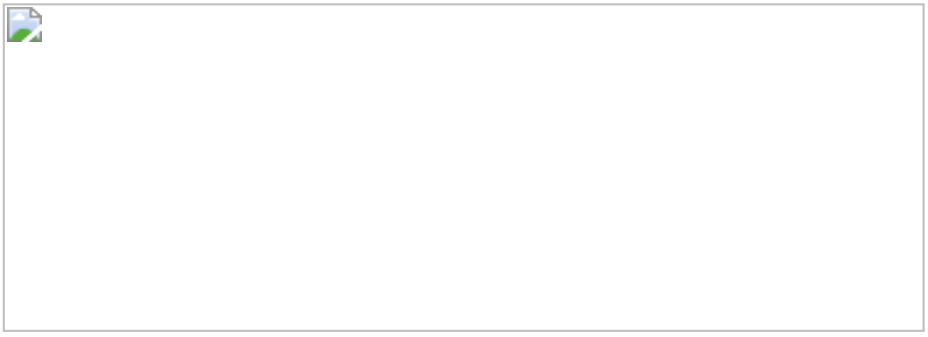
3. Find the angle that vector **A** makes with the positive x-axis (measured in a counterclockwise direction from the positive x-axis):
a. 40^o $q = 360^o - \tan^{-1}(5/6) = 320^o$
b. 50^o
c. 310^o
d. 320^o
e. None of the above

4. A bike rider starts from rest with an acceleration of 0.066 m/s^2. Find how long it takes the bike rider to ride 1.0 km:
a. 2.9 min. $1000m = 1/2(0.066)(t)^2$
b. 5.5 min. $t = 174s/60 = 2.9$ min.
c. 5.8 min.
d. 253 min.
e. None of the above

5. Consider two trains running in the same direction on parallel tracks. Train 1 passes the station at time, t = 0, with a constant speed of 5 m/s. Train 2 passes the station 30 seconds later than train 1 at a constant speed of 6 m/s. Find the time, t, at which the trains are exactly side-by-side:
a. 16.4 sec. $x_1 = 5t$; $x_2 = 6(t-30)$
b. 150 sec. $x_1 = x_2$: $5t = 6t - 180$
c. 180 sec. t = 180 sec.
d. 210 sec.
e. None of the above

6. A police officer gives a burst of the car's siren as the car is traveling towards a wall at a speed of 100 m/s. The officer hears the siren sound reflected from the wall 1.0 sec. later. Find the distance the car was at the time the siren was sounded. (Use 343 m/s as the speed of sound in air):

a. 172 m t =1.0s =d/343m/s + (d-100m/s(1s))/343m/s
b. 221.5 m 343 = d + d-100 = 2d - 100 ; d = 221.5m
c. 243 m
d. 343 m
e. None of the above



For problems 7-10, refer to the plot above:

7. Find the average speed from points C-G:

a. -8.3 m/s average speed = distance/time=500m/ 60 s = 8.33 m/s
b. -1.7 m/s
c. 1.7 m/s
d. 8.3 m/s
e. None of the above

8. Find the average velocity from points A-G:

a. -8.9 m/s $Dv_{avg} = (x_2 – x_1)/ Dt = = (-200m – 0)/90s$
b. -2.2 m/s = -200m m / 90s = -2.22 m/s
c. 2.2 m/s
d. 8.9 m/s
e. None of the above

9. Find the instantaneous velocity at point D:

a. 0 $v_{inst.}$ = slope = -300m/30 s = -10 m/s
b. -6.7 m/s
c. -5 m/s
d. -2.2 m/s
e. None of the above

10. Find the instantaneous acceleration at point F:

a. -6.67 m/s^2 $a_{inst.}$ = slope of v vs. t = 0
b. -5 m/s^2
c. -2.22 m/s^2
d. 0
e. None of the above

11. A boy who is standing on top of a 30m tall building throws a ball at a nearby building that is 100m tall. The initial velocity in the x-direction given to the ball is 30 m/s. When the ball lands on the roof of the second building it is traveling *only* in the horizontal direction. **Show your work.** (Note: use g = 9.81 m/s^2).

a. Calculate the initial velocity of the ball in the y-direction.

$0 = (v_{yo})^2 - 2(9.81\ m/s^2)\ (100m - 30m)$
$v_{yo} = +\ 37\ m/s$

b. Calculate the initial speed of the ball *and* the angle the ball made initially with respect to the horizontal (x-) direction.

$v = (30^2 + 37^2)^{1/2} = 47.7\ m/s$
$q = \tan^{-1}(37/30) = 51^o$

c. Calculate the time it takes for the ball to reach the roof of the second building.

$0 = 37\ m/s - (9.81\ m/s^2)(t)$
$t = 3.8s$

d. Write the velocity of the ball just as it is hitting the roof in vector notation using the coordinate system given above.

$\mathbf{v} = 30\ m/s\ \mathbf{i}$

e. *If the second building were not in the way*, calculate how long it would take for the ball to hit the ground.

$0 = 30m + 37\ m/s\ t + 1/2(-9.81\ m/s^2)t^2$
$t = 8.3s$

PHY203
Crib Sheet
Chapters 1-3

$speed_{AV}$ = (total distance traveled)/Dt

$D\mathbf{x} = \mathbf{x_2} - \mathbf{x_1}$ (displacement)

$\mathbf{v}_{AV} = D\mathbf{x}/Dt$

$\mathbf{a}_{AV} = D\mathbf{v}/Dt$

$\mathbf{v}_{Inst} = d\mathbf{x}/dt$

$\mathbf{a}_{Inst} = d\mathbf{v}/dt$

For constant acceleration:

$x_f = x_o + v_o t + (1/2)at^2$

$v_f = v_o + at$

$V_f^2 = v_o^2 + 2a(x_f - x_o)$

$g = 9.81$ m/s^2, the acceleration due to gravity (on Earth), unless otherwise directed

For a vector **A** with magnitude A and direction q (measured counterclockwise with respect to the x-axis):

$A_x = A\cos(q)$

$A_y = A\sin(q)$

$A = (A_x^2 + A_y^2)^{1/2}$

$\tan(q) = A_y/A_x$

quadratic eq. sol.: If $ax^2 + bx + c = 0$; then $x = [-b \pm (b^2-4ac)^{1/2}]/(2a)$