Your Name: _____ **PHY203**

Exam #1
Chapters 1-3
Fri., 2/06/09

Solutions

1. How many cubic centimeters is a volume of 3 quarts?

a. 5.05×10^{-3} cm^3 3 quarts = 0.75gal x (3.785L/gal)

b. 1.98×10^{2} cm^3 x ($10^3 cm^3/L$) = 2.84×10^{3} cm^3

c. 2.84×10^{3} cm^3

d. 5.05×10^{3} cm^3

e. None of the above

For problems 2-5 consider two trains approaching each other from opposite directions on parallel tracks. The measurements start when they are 200m apart. In all cases below, train 1 is traveling to the right and passes the position x=0 at t=0 traveling in the positive x-direction towards train 2 at a constant speed of 5 m/s. In all cases below, find the x position at which the trains just start to pass each other:

2. Case 1: Train 2 passes the x=200m position at t=0 traveling with a constant speed of 5 m/s.

a. 50m $x_1 = 5t$; $x_2 = 200-5t$

b. 125m $x_1 = x_2$:$5t = 200-5t$

c. 150m 200 = 10t; t=20s

d. 175m x=5m/s(20s) = 100m

e. None of the above (100m)

3. Case 2: Train 2 passes the x=200m position at t=0 traveling with a constant speed of 4 m/s.

a. 22.2m $x_1 = 5t$; $x_2 = 200-4t$

b. 88.9m $x_1 = x_2$:$5t = 200-4t$

c. 111m 200 = 9t; t=22.2s

d. 200m x=5m/s(22.2s) = 111m

e. None of the above

4. Case 3: Train 2 passes the x=200m position at t=10s traveling with a constant speed of 4 m/s.

a. 26.6m $x_1 = 5t$; $x_2 = 200-4(t-10)$

b. 71.1m $x_1 = x_2$:$5t = 200-4t+40$

c. 88.8m 240 = 9t; t=26.6s

d. 133m x=5m/s(26.6s) = 133m

e. None of the above

5. Case 4: Train 2 starts from rest at the x=200m position at t=5s traveling with a constant magnitude of acceleration of 4 m/s^2.

a. 55m $x_1 = 5t$; $x_2 = 200-1/2(4)(t-5)^2$

b. 66m $x_1 = x_2$:$5t = 200-2(t^2-10t+25)$

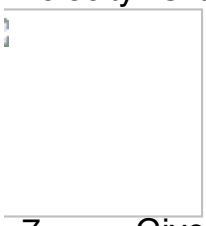
c. 77.6m quad. eq.; t=13.2s

d. 132m x=5m/s(13.2s) = 66m

e. None of the above

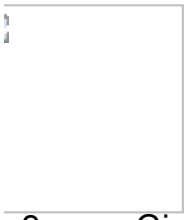
Given the choices above, answer the following questions, 6-10:

6. Given a plot of x vs. t as shown below, which of the graphs above depicts a plot of velocity vs. t: a., **b**., c., d., or e. none of the above?



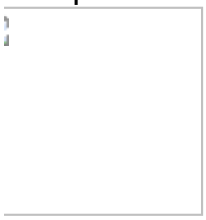
7. Given the same plot of x vs. t as shown in #6, which of the graphs above depicts a plot of acceleration vs. t: a., b., c., d., or **e**. none of the above?

8. Given a plot of velocity vs. t as shown below, which of the graphs above depicts a plot of acceleration vs. t: **a**., b., c., d., or e. none of the above?



9. Given a plot of x vs. t as shown below, which of the graphs above depicts a plot of velocity vs. t: a., b., c., d., or **e**. none of the above?

10. Given a plot of acceleration vs. t as shown below, which of the graphs above depicts a plot of velocity vs. t: a., b., c., **d**., or e. none of the above?



11. A projectile is shot in a direction 30 degrees below the horizontal from a height of 500m and initial speed of 50m/s, as shown above. (Use $g=9.81 m/s^2$)

a. Write the initial velocity vector, $\mathbf{v_O}$, in vector notation, *using the coordinate system given*

above.

$\mathbf{v_o}$ = 50 m/s(cos30^o **i** + sin30^o m/s **j**) = 43.3 m/s **i** + 25 m/s **j**

b. Calculate the time in sec. that it will take for the projectile to hit the ground.

500 m = 0 + 25 m/s t + 1/2(9.81 m/s^2)t^2
0 = -500 m + 25 m/s t + 4.905t^2
Use quadratic equation; t = 7.86 s

c. Calculate the x position at which the projectile will hit the ground (the "range").

x = 0 + 43.3 m/s (7.86 s) = 340.5 m

d. Calculate the final velocity in the x-direction of the projectile just before it hits the ground, *using the coordinate system given above.*

$v_x = v_{xo}$ = +43.3 m/s

e. Calculate the final velocity in the y-direction of the projectile just before it hits the ground, *using the coordinate system given above.*

v_y = 25 m/s + (9.81 m/s^2)(7.86 s) = + 102.1 m/s

f. Calculate the final speed (just before hitting the ground).

v = (43.3^2 + 102.1^2)$^{1/2}$ = 111 m/s

g. Calculate the final angle the projectile makes with respect to the x-axis (just before hitting the ground) (measured in a clockwise direction).

q = tan^{-1}((102.1/43.3) = 67^o

11. A projectile is shot in a direction 60 degrees below the horizontal from a height of 500m and initial speed of 50m/s, as shown above. (Use g=9.81m/s^2)

a. Write the initial velocity vector, $\mathbf{v_o}$, in vector notation, *using the coordinate system given above.*

$\mathbf{v_o}$ = 50 m/s(cos60^o **i** + sin60^o m/s **j**) = 25 m/s **i** + 43.3 m/s **j**

b. Calculate the time in sec. that it will take for the projectile to hit the ground.

500 m = 0 + 43.3 m/s t + 1/2(9.81 m/s^2)t^2
0 = -500 m + 43.3 m/s t + 4.905t^2
Use quadratic equation; t = 6.6 s

c. Calculate the x position at which the projectile will hit the ground (the "range").

$x = 0 + 25 \text{ m/s } (6.6 \text{ s}) = 165 \text{ m}$

d. Calculate the final velocity in the x-direction of the projectile just before it hits the ground, *using the coordinate system given above.*

$v_x = v_{xo} = +25 \text{ m/s}$

e. Calculate the final velocity in the y-direction of the projectile just before it hits the ground, *using the coordinate system given above.*

$v_y = 43.3 \text{ m/s} + (9.81 \text{ m/s}^2)(6.6 \text{ s}) = + 108 \text{ m/s}$

f. Calculate the final speed (just before hitting the ground).

$v = (25^2 + 108^2)^{1/2} = 111 \text{ m/s}$

g. Calculate the final angle the projectile makes with respect to the x-axis (just before hitting the ground) (measured in a clockwise direction).

$q = \tan^{-1}((108/25) = 77^o$