Your Name: _____

PHY203
Exam #1
Chapters 1-3
Thurs., 9/27/07

Solutions

1. You consume a quarter-kilogram piece of beef. By how many slugs have you increased your mass?

a. 0.017 slug 0.25kg/(14.59kg/slug) = 0.017 slug
b. 0.17 slug
c. 3.65 slugs
d. 58.36 slugs
e. None of the above

2. 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 leaves the station 20 seconds later than train 1 at an initial speed of 0 m/s but an acceleration of 1 m/s^2. Find the distance the trains have traveled before they are exactly side-by-side:

a. 50m $x_1 = 5t$; $x_2 = 1/2(1)(t-20)^2$
b. 100m $x_1 = x_2$:$5t = 0.5(t-20)^2$
c. 200m $10t = (t^2 - 40t + 400)$; t=40 sec.
d. 400m x=5m/s(80s) = 200m
e. None of the above

3. A stunt person shoots a gun at a special stunt wall, which explodes upon impact with the bullet. The wall is 100m away and the stunt person hears the sound of the explosion 1.0 sec. after shooting the gun. Find the speed of the bullet. (Use 343 m/s as the speed of sound in air):

a. 57 m/s $t = 1.0s = 100m/v_{bul} + 100m/343m/s = 100m/v_{bul} + 0.29$
b. 77 m/s $0.71 = 100/v_{bul}$; $v_{bul} = 141m/s$
c. 141 m/s
d. 243 m/s
e. None of the above

4. A police officer gives a burst of the car's siren as the car is traveling towards a wall. When the siren burst is sounded, the wall is at a distance of 200m. The officer hears the siren sound reflected from the wall1.0 sec. later. Find the speed of the police car. (Use 343 m/s as the speed of sound in air):

a. 57 m/s t =1.0s =200m/343m/s + (200m-v(1s))/343m/s
b. 93 m/s 343 = 400 – v(1); v = 57m/s
c. 157 m/s
d. 743 m/s
e. None of the above

5. Write 5500 nanoliters in correct SI units:

a. $5.5x10^{-12}$ l 5500 x 10^{-9} liters = 5.5 x 10^{-6} l
b. $5.5x10^{-6}$ l
c. $5.5x10^{6}$ l
d. $5.5x10^{12}$ l

e. None of the above

6. At t = 0, the speed of an object starting from x=5m and y=5m is 45 m/s at an angle of 30^o with respect to the x-axis. At t=10 sec., the particle is at x= -25m and y= 15m with a speed of 25 m/s at an angle of 45^o with respect to the x-axis. Find the average velocity over the time interval:

a. 2.0 m/s
b. 7.0 m/s
c. -2.0 m/s **i** +2.0 m/s **j**
d. 3.0 m/s **i** -1.0 m/s **j**
e. -3.0 m/s i +1.0 m/s j

$\mathbf{Dv_{avg}} = (\mathbf{x_2} - \mathbf{x_1})/ Dt = ((-25\ m\mathbf{i} + 15m\mathbf{j}) - (5m\mathbf{i} + 5m\mathbf{j}))/10s$
$(-30\ m\mathbf{i} + 10m\mathbf{j})/10s = -3.0\ m/s\ \mathbf{i} + 1.0\ m/s\ \mathbf{j}$

7. A bike rider starts from rest with an acceleration of 0.05 m/s^2. Find how far the rider has traveled in 5 min.:

a. 2.25 km $x = 1/2(0.05)(300s)^2 = 2250\ m = 2.25km$
b. 7.5 m
c. 4.5 km
d. 22.5 km
e. None of the above

8. A bike rider starts from rest with an acceleration of 0.075 m/s^2. Find the speed of the rider after 4 min.:

a. 0.3 m/s $v = (0.075)(240s) = 18m/s$
b. 3.0 m/s
c. 18 m/s
d. 180 m/s
e. None of the above

9. A bike rider rides 3 km East and then 7.5 km North. Find the magnitude of the displacement of the rider at the end of the trip:

a. -4.5 km $Dx = (3^2 + 7.5^2)^{1/2} = 8.08km$
b. 4.5 km
c. 8.08 km
d. 10.5 km
e. None of the above

10. A bike rider rides 4.5 km East and then 8.0 km North. Find the angle the displacement of the rider makes with respect to the East direction measured in a counterclockwise direction from the positive East axis at the end of the trip:

a. -60.6^o $q = \tan^{-1}(8/4.5) = 60.6^o$
b. -29.4^o
c. 29.4^o
d. 60.6^o
e. None of the above

11. For the displacement curve of a toy car on a 1D track, plot the corresponding curves for velocity and acceleration below.

Show your work:

a. Find the total distance traveled from points C-F.

distance = 5m + 10m = 15m

b. Find the average speed from points C-F.

avg. speed = 15m/3s = 5m/s

c. Find the average velocity from points B-H.

avg. vel. = (0-0)/6s = 0m/s

d. Find the instantaneous velocity at point H.

slope = $v_{inst.}$ = -10m/s

e. Find the instantaneous speed at point H.

magnitude of slope = $speed_{inst.}$ = 10m/s

12. A hockey player launches a slap shot at the net from 15m away at an angle with the horizontal of 15^o and with an initial speed of 30 m/s. The height of the net is 1.22m. **Show your work.** (Note: use g = 9.81 m/s^2).

a. Calculate the initial x and y components of the hockey puck's initial velocity *and* write the initial velocity, $\mathbf{v_j}$, of the puck in vector form.

$\mathbf{v_O}$ = 30 m/s(cos15^o **i** + sin15^o m/s **j**) = 29 m/s **i** + 7.8 m/s **j**

b. Calculate the time in sec. that it will take for the puck to reach the net.

15m = 0 + 29 m/s t
t = 15/29 = 0.52s

c. Determine whether the puck will enter the net or not-explain briefly why or why not.

at the net, $y = 0 + 7.8\text{m/s}(0.52\text{s}) + 1/2(-9.81\text{m/s}^2)(0.52\text{s})^2$
$y = 2.73\text{m}$

too high-puck goes over the top of the net

d. If the net *were not in place*, calculate the highest point the puck would reach.

$0 = (7.8\text{m/s})^2 - 2(9.81\ \text{m/s}^2)\ H$
$H = 3.1\ \text{m}$

e. If the net *were not in place*, calculate the distance the puck would travel in the horizontal direction before hitting the ice.

$0 = 0 + 7.8\ \text{m/s}\ t - 1/2(9.81\ \text{m/s}^2)t^2$
$0 = 0 + 7.8\ \text{m/s} - 1/2(9.81\ \text{m/s}^2)t$
$t = 1.6\ \text{s}$

$x = 0 + 29\ \text{m/s}\ (1.6\ \text{s}) = 46.4\ \text{m}$