Your Name: ________________________

PHY203
Exam #1
Chapters 1-3
Fri., 2/08/08

Solutions

1. 1 acre is 43560 square feet in area. How many square centimeters is that?

a. 46.7 cm^2 $43560\ ft^2 \times (30.48\ cm/ft)^2 = 4.05\times10^7\ cm^2$
b. $1.43\times10^3\ cm^2$
c. $1.33\times10^6\ cm^2$
d. $4.05\times10^7\ cm^2$
e. None of the above

2. Convert 30 m/s to km/h:

a. 1.8 km/h $30\ m/s \times (1\ km/1000m) \times (1\ h/3600s) = 1.08\times10^2\ km/h$
b. 8.33 km/h
c. 1.08×10^2 km/h
d. 5.0×10^2 km/h
e. None of the above

3. How many meters is 56 megakm in correct scientific notation?

a. 5.6×10^3 m 56 megakm x $10^6 \times (1000\ m/km) = 5.6\times10^{10}$ m
b. 5.6×10^6 m
c. 5.6×10^9 m
d. 5.6×10^{10} m
e. None of the above

4. Consider two cars approaching an intersection from different directions. One car, traveling East, starts from rest a distance, d, from the intersection with an acceleration of 3 m/s^2. The other car, traveling North at a constant speed of 10 m/s, is at the same distance, d, from the intersection when the first car starts. Assuming the cars arrive at the intersection at the same time (and crash), find the distance d:

a. 1.5m $x_1 = 1/2(3)(t)^2$; $x_2 = 10t$
b. 25.8m $x_1 = x_2$:$10t = 0.5(3)(t)^2$
c. 33.3m $10 = 1.5t$; $t=6.67s$
d. 66.7m $x=10m/s(6.67s) = 66.7m$
e. None of the above

5. Consider balls being dropped or thrown off a cliff on Planet 203X whose gravity is such that **g = 10 m/s^2** exactly:
A lead ball is dropped off a cliff. 2 seconds later an identical lead ball is thrown straight down from the same cliff with an initial speed of 30 m/s. Find the time measured from when the first ball was released at which the balls are exactly side-by-side:

a. 1.6 sec. $x_1 = 1/2(10)(t)^2$; $x_2 = 30(t-2) + 1/2(10)(t-2)^2$
b. 2.0 sec. $x_1 = x_2$; $1/2(10)(t)^2 = 30(t-2) + 1/2(10)(t-2)^2$

c. 4.0 sec. $5(t)^2 = 30(t-2) + 5(t-2)^2$; $(t)^2 = 6(t-2) + (t^2) - 4t + 4$
d. 10.0 sec. $0 = 6t - 12 - 4t + 4$; $0 = 2t - 8$; $t = 4$
e. None of the above

6. For the above graph, find the instantaneous acceleration at position B.:

a. -20.0 m/s^2 a_{int} = slope = (-10m/s)/(2s) = -5.0 m/s^2
b. -10.0 m/s^2
c. -5.0 m/s^2
d. 0 m/s^2
e. None of the above

7. For the above graph, find the instantaneous acceleration at position D.:

a. -20.0 m/s^2 a_{int} = slope = 0
b. -10.0 m/s^2
c. -5.0 m/s^2
d. 0 m/s^2
e. None of the above

8. For the above graph, find the average acceleration from A to E.:

a. -1.25 m/s^2 a_{iavg} = Dv/Dt = (-10m/s)/(8s) = -1.25 m/s^2
b. -0.8 m/s^2
c. 0 m/s^2
d. 1.25 m/s^2
e. None of the above

For problems 9 and 10, Let **A** = -5**i** + 9**j**, **B** = 3**i** - 10**j**, **C** = -2**A** + 4**B**

9. Find the magnitude of the vector **A**:

a. 4.0 $A = ((-5)^2 + (9)^2)^{1/2} = 10.3$
b. 7.5
c. 14.0
d. 106
e. None of the above (10.3)

10. Find the angle that vector **B** makes with the positive x-axis (measured in a counterclockwise direction from the positive x-axis):

a. 16.7° q = 360° - $\tan^{-1}(10/3)$ = 287°

b. 73.3^o
c. 287^o
d. 343^o
e. None of the above

11. A motorcycle stunt rider rides up a ramp with an initial speed of 20 m/s. The rider wants to clear a barrier with a height of 7.5m with respect to the top of the ramp at a distance, D, from the end of the ramp, as shown below. **Show your work.** (Note: use g = 9.81 m/s^2).

a. Assuming the rider *just* clears the barrier, calculate the y component of the rider's initial velocity using the coordinate system above.

$$0 = (v_{yo})^2 - 2(9.81\ m/s^2)\ (7.5m)$$
$$v_{yo} = 12.1\ m/s$$

b. Assuming the rider just clears the barrier, calculate the angle the ramp makes with horizontal and the x component of the initial velocity.

$$q = \sin^{-1}((12.1/20) = 37.2^o$$

$$v_{xo} = (20m/s)\cos(37.2^o) = 15.9\ m/s$$

c. Assuming the rider just clears the barrier, calculate the distance, D, from the beginning of the ramp the barrier must have been placed.

$$0 = (v_{yo}) - (9.81\ m/s^2)\ (t)$$
$$12.1 = (9.81\ m/s^2)\ (t)$$
$$t = 1.23s$$

$$D = (15.9\ m/s) \times (1.23s) = 19.6m$$

d. Assuming the rider just clears the barrier, write the velocity, $\mathbf{v_b}$, of the rider just as the rider crosses over the barrier in <u>vector form</u> using the above coordinate system.

$$\mathbf{v}_b = 15.9\ m/s\,\mathbf{i} + 0\,\mathbf{j}$$
$$= 15.9\ m/s\,\mathbf{i}$$

11. A motorcycle stunt rider rides up a ramp with an initial speed of 25 m/s. The rider wants to clear a barrier with a height of 6.5m with respect to the top of the ramp at a distance, D, from the end of the ramp, as shown below. **Show your work.** (Note: use g = 9.81 m/s^2).

a. Assuming the rider *just* clears the barrier, calculate the y component of the rider's initial velocity using the coordinate system above.

$0 = (v_{yo})^2 - 2(9.81\ m/s^2)\ (6.5m)$
$v_{yo} = 11.3$ m/s

b. Assuming the rider just clears the barrier, calculate the angle the ramp makes with horizontal and the x component of the initial velocity.

$q = \sin^{-1}((11.3/25) = 26.9^o$

$v_{xo} = (25m/s)\cos(26.9^o) = 22.3$ m/s

c. Assuming the rider just clears the barrier, calculate the distance, D, from the beginning of the ramp the barrier must have been placed.

$0 = (v_{yo}) - (9.81\ m/s^2)\ (t)$
$11.3 = (9.81\ m/s^2)\ (t)$
t = 1.15s

D = (22.3 m/s) x (1.15s) = 25.7m

d. Assuming the rider just clears the barrier, write the velocity, $\mathbf{v}_b$, of the rider just as the rider crosses over the barrier in vector form using the above coordinate system.

$\mathbf{v}_b$= 22.3 m/s**i** **+** 0 **j**
= 22.3 m/s**i**