Your Name: _____ **PHY203**

Exam #1
Chapters 1-3
Thurs, 9/30/10

Solutions

1. The world record in swimming for the 1500 m distance is 14 min., 35 sec. What was the average speed in miles per hour?
a. 0.064 mph (1.5km)x(0.6215mi/km)/(875s)x(3600s/h))=3.84
b. 3.84 mph
c. 9.90 mph
d. 38.4 mph
e. None of the above

For questions 2-5, traveling in one direction, a train starts from rest with an acceleration of 5 m/s^2 for 20 s. After 20 s, the train moves at constant speed for 50 s. Finally the train accelerates at -4 m/s^2 until it comes to rest.
2. Find the distance the train travels in the first 20 s.
a. 50 m $x_1 = 1/2(5\ m/s^2)(20s)^2$
b. 100 m
c. 1000 m
d. 2000 m
e. None of the above

3. Find the speed of the train after 20 s.
a. 50 m/s $v = (5\ m/s^2)20s$
b. 100 m/s
c. 200 m/s
d. 1000 m/s
e. None of the above

4. Find the distance the train travels from 20 s to 70 s.
a. 2500 m $x_2 = (100\ m/s)(50s)$
b. 5000 m
c. 10,000 m
d. 50,000 m
e. None of the above

5. Find the distance the train travels from 70 s until it comes to rest.
a. 12.5 m $0 = (100\ m/s)^2 + 2(-4\ m/s^2)(Dx)$
b. 625 m
c. 1250 m
d. 2500 m

e. None of the above

6. 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. 3.2 km $D = (3^2 + 7.5^2)^{1/2} = 8.1$
b. 4.5 km
c. 8.1 km
d. 10.5 km
e. None of the above

7. 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. 29.4 ^{o} $q = \tan^{-1}(8/4.5) = 60.6^o$
b. 40.4 ^{o}
c. 60.6 ^{o}
d. 64.6 ^{o}
e. None of the above

For problems 8-10, on Planet XXX, the acceleration due to gravity is exactly 10 m/s^2. Identical rocks are dropped from the top of a cliff. Find the time, t, at which the rocks are side-by-side.

8. Case1: Rock a is dropped at t = 0; rock b is dropped from the top of the cliff at t = 2 s.

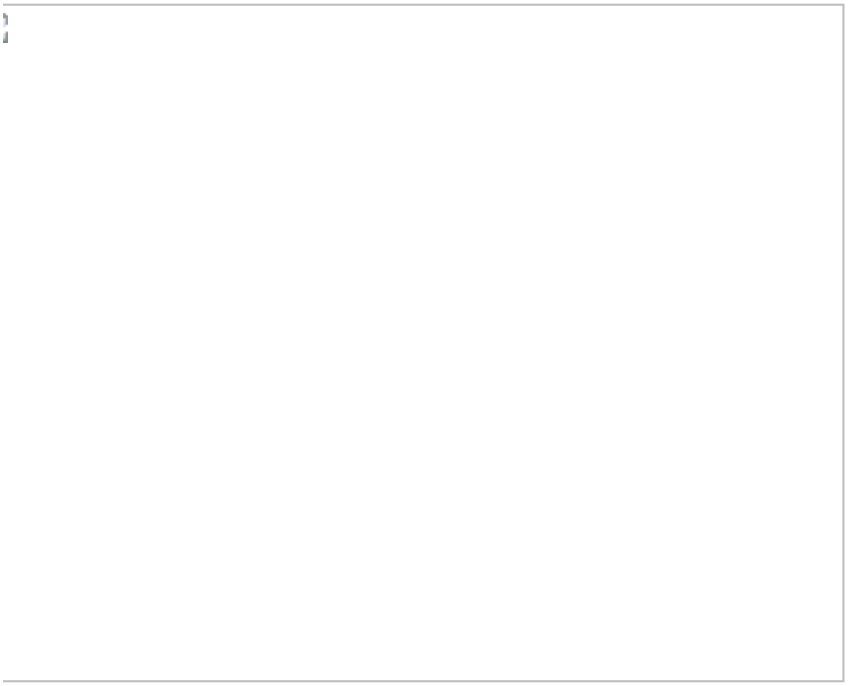
a. 1.0 s rock b can never catch rock a
b. 2.0 s
c. 3.0 s
d. 4.0 s
e. None of the above (never)

9. Case 2: Rock a is dropped at t = 0; rock b is thrown straight down at t = 2 s with an initial speed of 40 m/s.

a. 1.0 s $x_a = 1/2(10)(t)^2$; $x_b = 40(t-2) + 1/2(10)(t-2)^2$
b. 1.67 s $x_a = x_b$; $1/2(10)(t)^2 = 40(t-2) + 1/2(10)(t-2)^2$
c. 3.0 s
d. 5.0 s
e. None of the above

10. Case 3: Rock a is thrown down with an initial speed of 10 m/s at t = 0; rock b is thrown straight down at t = 2 with an initial speed of 40 m/s.

a. 1.2 s $x_a = 10t + 1/2(10)(t)^2$; $x_b = 40(t-2) + 1/2(10)(t-2)^2$
b. 2.0 s $x_a = x_b$
c. 6.0 s
d. 10.0 s
e. None of the above



s

11. First, fill in the plots above for v vs. t and a vs. t.

Show your work below:

a. Find the total distance traveled from points B-H.
distance = 10m + 20m + 10m = 40 m

b. Find the average speed from points B-H.
avg. speed = 40m/6s = 6.67 m/s

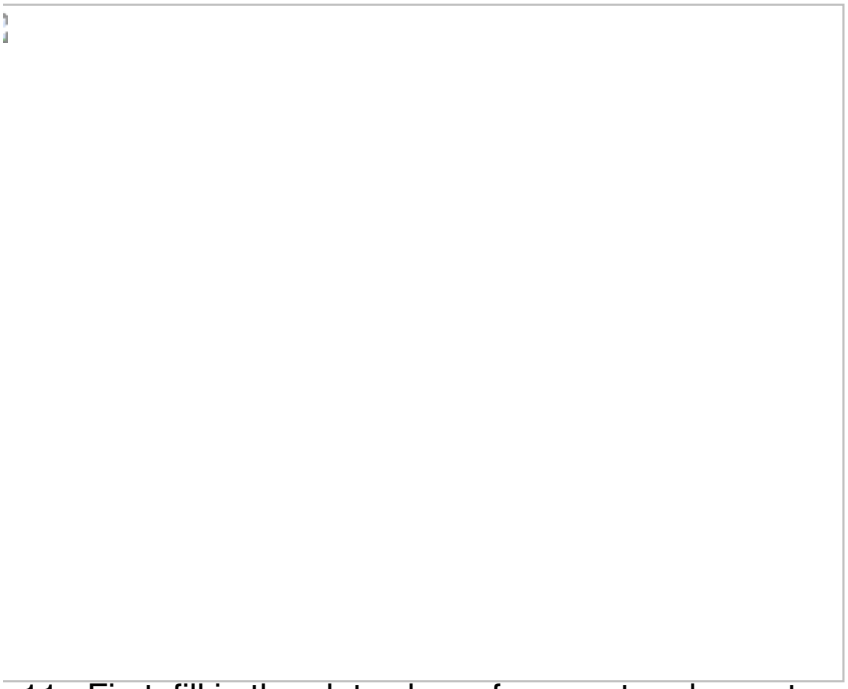
c. Find the average velocity from points B-H.
avg. vel. = (0-0)/6s = 0

c. Find the displacement from points G-I.
displacement = -10m - 10m = -20 m

g. Find the instantaneous velocity at point H.
slope = -10m/s

h. Find the average acceleration from points C-H.

avg. acc. = (-10m/s-(-5m/s))/5s = -1 m/s^2



11. First, fill in the plots above for v vs. t and a vs. t.

Show your work below:

a. Find the total distance traveled from points B-H.

distance = 20m + 40m + 20m = 80 m

b. Find the average speed from points B-H.

avg. speed = 80m/6s = 13.3 m/s

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

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

c. Find the displacement from points E-G.

displacement = -20m - 20m = -40 m

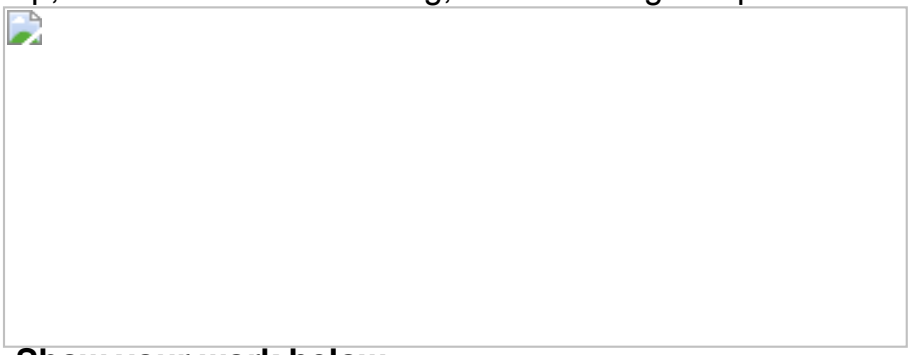
g. Find the instantaneous velocity at point F.

slope = -20m/s

h. Find the average acceleration from points C-F.

avg. acc. = (-20m/s-10m/s)/3s = -10 m/s^2

12. A boy who is standing on top of a 30 m tall building throws a ball at a nearby building that is 100 m tall. The initial velocity in the x-direction given to the ball is 30 m/s. When the ball hits the top, left corner of the building, it is at the highest point of its trajectory. Use g = 9.81 m/s^2.



Show your work below:

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.

$v = (30^2 + 37^2)^{1/2} = 47.6\ m/s$

c. Calculate the angle the ball made initially with respect to the horizontal (x) direction.

$q = \tan^{-1}(37/30) = 51^o$

d. Write the initial velocity in vector notation using the coordinate system shown above.

$\mathbf{v_0}$= (_____30_____ **i** + _____37_____ **j**) m/s

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

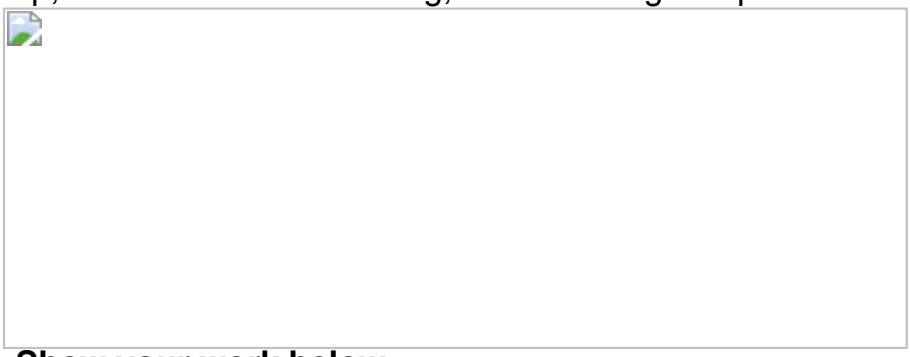
$0 = 37\ m/s - (9.81\ m/s^2)(t)$

$t = 3.8s$

f. Find the velocity of the ball just as it is hitting the roof and write it in vector notation using the coordinate system shown above.

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

12. A boy who is standing on top of a 30 m tall building throws a ball at a nearby building that is 100 m tall. The initial velocity in the x-direction given to the ball is 40 m/s. When the ball hits the top, left corner of the building, it is at the highest point of its trajectory. Use $g = 9.81\ m/s^2$.



Show your work below:

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.

$v = (40^2 + 37^2)^{1/2} = 54.5\ m/s$

c. Calculate the angle the ball made initially with respect to the horizontal (x) direction.

$q = \tan^{-1}(37/40) = 42.8^o$

d. Write the initial velocity in vector notation using the coordinate system shown above.

$\mathbf{v_0}$= (_____40_____ **i** + _____37_____ **j**) m/s

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

$0 = 37 \text{ m/s} - (9.81 \text{ m/s}^2)(t)$
$t = 3.77 \text{ s}$

f. Find the velocity of the ball just as it is hitting the roof and write it in vector notation using the coordinate system shown above.

v = 40 m/s **i**