Your Name: _____ **PHY203**

Exam #1
Chapters 1-3
Thurs, 10/0109

Solutions

1. A runner runs a marathon (26.2 miles) in 4 hours. What is the average speed in m/s?
a. 2.9×10^{-3} m/s 26.2x(1.609x1000)/(4x3600)=2.9
b. 1.13×10^{-3} m/s
c. 1.13 m/s
d. 2.9 m/s
e. None of the above

2. Add 0.66 kiloliters to 15,000 milliliters:
a. 81 l (0.66x1000)+(15,000x 10^{-3})=660+15=675
b. 6.75×10^{2} l
c. 8.1×10^{2} l
d. 6.6×10^{3} l
e. None of the above

For problems 3 and 4 consider two trains traveling in the same direction on parallel tracks. The measurements start when the fronts of the trains are 500m 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 at a constant speed of 5 m/s. In all cases below, find the x position at which the front of train 2 is side-by-side to the front of train 1:
3. Case 1: Train 2 passes the x= -500m position at t=0 traveling with a constant speed of 3 m/s.
a. 192 m $x_1 = 5t$; $x_2 = -500+3t$
b. 308 m $x_1 = x_2$:5t = 3t -500; 2t=-500
c. 833 m no solution for positive time
d. 1333 m
e. None of the above (never catches up)

4. Case 2: Train 2 passes the x= -500m position at t=0 traveling with a constant speed of 8 m/s.
a. 192 m $x_1 = 5t$; $x_2 = -500+8t$
b. 308 m $x_1 = x_2$:5t = 8t -500; 3t=500
c. 833 m t=167; x=5(167)=833
d. 1333 m
e. None of the above

For problems 5 and 6, a runner runs 1.5 km in the positive x direction, then turns around and runs 1.0 km back in the direction of the starting point. The total time of the run is 15 min.
5. Find the total distance and total displacement of the run.
a. -500m, 2500m distance=1.5km+1.0km=2500m
b. 2500m, -1000m displacement=0.5km-0=500m
c. 500m, 2500m
d. 2500m, -500m

e. 2500m, 500m

6. Find the average speed and average velocity distance of the run.
a. -0.56m/s, 2.78m/s speed=2500m/(15x60)=2.78
b. 2.78m/s, -0.56m/s velocity=500m/(15x60)=0.56
c. 0.56m/s, 2.78m/s,
d. 2.78m/s, 0.56m/s
e. None of the above

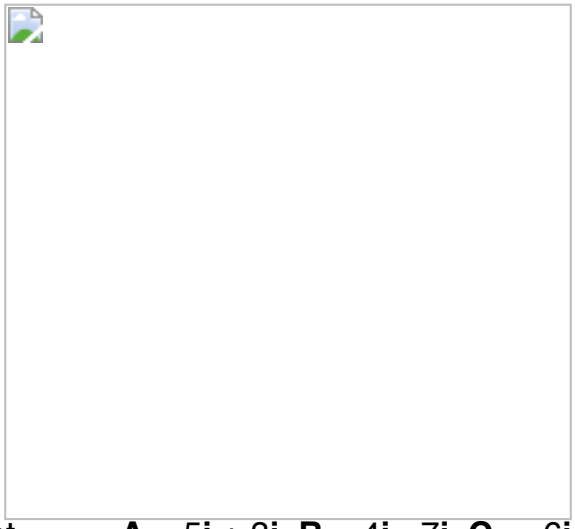
For problems 7-10, on Planet XXX where the acceleration due to gravity is exactly $10 m/s^2$, a soccer ball is kicked from ground level and misses the goal, just clearing the top of the net. The height of the top of the net is 1.5 m and the ball is kicked from a distance of 4 m from the net.

7. Calculate the y-component of the initial velocity.
a. 3.9 m/s $0 = (v_{oy})^2 - 2(10\ m/s^2)(1.5\ m)$
b. **5.48 m/s** $v_{oy}=5.482$
c. 15 m/s
d. 30 m/s
e. None of the above

8. Calculate the time it takes for the ball to just reach the goal.
a. 0.39 sec. $0 = 5.48\ m/s - (10\ m/s^2)\ t$
b. **0.55 sec** $t=0.55s$
c. 1.5 sec.
d. 3.0 sec.
e. None of the above

9. Calculate the x-component of the initial velocity.
a. 1.33 m/s $4m = (v_{ox})0.55s$
b. 2.7 m/s $(v_{ox})=7.27m/s$
c. **7.3 m/s**
d. 10.2 m/s
e. None of the above

10. Calculate the magnitude of the velocity as the ball just crosses the top of the net.
a. 1.33 m/s same answer as previous problem
b. 2.7 m/s
c. **7.3 m/s**
d. 10.2 m/s
e. None of the above



11. Let **A** = 5**i** + 3**j**, **B** = 4**i** - 7**j**, **C** = -6**j**

a. Sketch and clearly label the vectors **A** , **B** , and **C** on the above graph.

b. For the vector **A**, find the magnitude of the vector and the angle the vector makes with respect to the x-axis (measured from the positive x-axis in a counterclockwise direction).

$A = (5^2 + 3^2)^{1/2} = 5.83$

$q = \tan^{-1}(3/5) = 31^o$

c. For the vector **B**, find the magnitude of the vector and the angle the vector makes with respect to the x-axis (measured from the positive x-axis in a counterclockwise direction).

$B = (4^2 + 7^2)^{1/2} = 8.06$

$q = 360^o - \tan^{-1}(7/4) = = 360^o – 60.26^o = 300^o$

d. Write the vector, **D**= **A**-4**B**+3**C**, in vector notation.

D = (5**i** + 3**j**) - 4(4**i** - 7**j**) + 3(- 6**j**) = -11**i** + 13**j**

12. 2 balls are dropped or thrown from a cliff..; Rock a is thrown straight up at t=0 with an initial speed of 20 m/s; rock b is dropped from the cliff at t=3 sec. (Use $g=9.81 m/s^2$)
a. Using the coordinate system given in the figure, write the equation of motion for rock a.

$x_a = 0 - 20(t) + 1/2(9.81)(t)^2$

b. Using the coordinate system given in the figure, write the equation of motion for rock b.

$x_b = 0 + 0 + 1/2(9.81)(t-3)^2$

c. Find the time at which the rocks are side-by-side.

$x_a = x_b = -20(t) + 1/2(9.81)(t)^2 = 1/2(9.81)(t-3)^2$

$= (4.905)(t^2-6t + 9)$

$t = 4.68s$

d. Find the height below the cliff at which the rocks are side-by-side.

$x_b = (4.905)(4.68-3)^2$

$= 13.9m$

e. If the height of the cliff is 500m, find the distance that rock b travels in the last second before hitting the ground.

$500m = 1/2(9.81)(t)^2$ $t = 10.1s$

$H' = 1/2(9.81)(t-1)^2 = (4.905)(9.1)^2 = 405.9m$

$500m - 4.05.9m = 94.1m$

11. Let **A** = -5**i** + 3**j**, **B** = 2**i** + 6**j**, **C** = -8**i**

a. Sketch and clearly label the vectors **A** , **B** , and **C** on the above graph.

b. For the vector **A**, find the magnitude of the vector and the angle the vector makes with respect to the x-axis (measured from the positive x-axis in a counterclockwise direction).

$A = (5^2 + 3^2)^{1/2} = 5.83$

$q = = 180^o - \tan^{-1}(3/5) = 180^o - 31^o = 149^o$

c. For the vector **B**, find the magnitude of the vector and the angle the vector makes with respect to the x-axis (measured from the positive x-axis in a counterclockwise direction).

$B = (2^2 + 6^2)^{1/2} = 6.32$

$q = \tan^{-1}(6/2) = 71.6^o$

d. Write the vector, **D**= **A**-4**B**+3**C**, in vector notation.

D = $(-5\mathbf{i} + 3\mathbf{j}) - 4(2\mathbf{i} + 6\mathbf{j}) + 3(-8\mathbf{i}) = -37\mathbf{i} - 21\mathbf{j}$

12. 2 balls are dropped or thrown from a cliff. Rock a is thrown straight up at t=0 with an initial speed of 25 m/s; rock b is dropped from the cliff at t=4 sec. (Use $g=9.81 m/s^2$)

a. Using the coordinate system given in the figure, write the equation of motion for rock a.

$x_a = 0 - 25(t) + 1/2(9.81)(t)^2$

b. Using the coordinate system given in the figure, write the equation of motion for rock b.

$x_b = 0 + 0 + 1/2(9.81)(t-4)^2$

c. Find the time at which the rocks are side-by-side.

$x_a = x_b = -25(t) + 1/2(9.81)(t)^2 = 1/2(9.81)(t-4)^2$

$= (4.905)(t^2-8t + 16)$

$t = 5.51s$

d. Find the height below the cliff at which the rocks are side-by-side.

$x_b = (4.905)(5.51-4)^2$

$= 11.2m$

e. If the height of the cliff is 400m, find the distance that rock b travels in the last second before hitting the ground.

$400m = 1/2(9.81)(t)^2$ $t = 9.03s$

$H' = 1/2(9.81)(9.03-1)^2 = (4.905)(8.03)^2 = 316.3m$

$400m – 316.3m = 83.7m$