Your Name: _____

PHY203
Final Exam #1
Chapters 1-3
Mon, 5/9/11

Part 1

Solutions

1. An ant crawls north along a wall for 3.0 meters, then turns around and crawls 2.0 meters south back towards the starting point. Find the total distance and the total displacement. (Take north as the positive *x* direction.)

	Distance	Displacement	
a.	1.0 m	+1.0 m	distance = 3.0 m + 2.0 m
b.	1.0 m	-1.0 m	displacement = +3.0 m – 2.0 m
c.	3.0 m	+2.0 m	
d.	5.0 m	+1.0 m	
e.	5.0 m	- 1.0 m	

2. A physics student rides her bike for 30 min covering a distance of 10 km, then returns by a differ route back to the starting point, covering an additional 15 km in an additional 30 min. What was her ave velocity?

a. 0 km/hr same start and end point: avg. vel. = 0
b. 10 km/hr
c. 20 km/hr
d. 25 km/hr
e. 50 km/hr

3. At t = 0, the speed of an object starting at x=0 and y = -10m is 40 m/s. At t=5 sec., the particle is at x= -15m and y= 20m with a speed of 35 m/s.
Find the average velocity over the time interval:

a. 22.9 m/s
b. 37.5 m/s
c. 3 m/s **i** -6 m/s **j**
d. -3 m/s **i** +2 m/s **j** $\mathbf{v_{avg}} = (\mathbf{x_2} - \mathbf{x_1})/ Dt = ((-15\ m\mathbf{i} + 20m\mathbf{j})-(0-10m\mathbf{j}))/5s$
e. -3 m/s i +6 m/s j $(-15\ m\mathbf{i} + 30m\mathbf{j})/5s = -3$ m/s i +6 m/s j

4. A lead ball is dropped off a cliff on Planet XXX where the acceleration due to gravity is exactly 10 m/s^2. 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. 3.0 s $y_1 = 1/2gt^2$; $y_2 = 30(t-2) + 1/2g(t-2)^2$
b. 4.0 s $y_1 = y_2 : 1/2gt^2 = 30(t-2) + 1/2g(t-2)^2$
c. 5.0 s t = 4.0 s
d. 6.0 s
e. None of the above

For problems 5-8, consider a rocket being launched from rest straight up into the atmosphere of Planet XXX where the acceleration due to gravity is exactly 10 m/s^2. In the first stage, the rocket accelerates at 20 m/s^2 for 15 s. Then the motor cuts off and the rocket continues to travel upwards for a while.

5. Find the height of the rocket when the motor cuts off.

a. 75 m
b. 150 m
c. 1125 m
d. 2250 m
e. 4500 m

$H_1 = 1/2(20\ m/s^2)(15\ s)^2$
$= 2250m$

6. Find the speed of the rocket when the motor cuts off.

a. 150 m/s
b. 300 m/s
c. 2250 m/s
d. 4500 m/s
e. None of the above

$v = (20\ m/s^2)(15\ s)$
$= 300m/s$

7. Find the height of the rocket at which it stops traveling upwards and begins to descend.

a. 1125 m
b. 2250 m
c. 3375 m
d. 4500 m
e. 6750 m

$0 = (300\ m/s)^2 + 2(-10\ m/s^2)\ (DH)$
$DH = 4500m$
$H_2 = 2250m + 4500\ m = 6750\ m$

8. Find the total time the rocket is in the air before it hits the ground.

a. 8.8 s
b. 23.8 s
c. 66.2 s
d. 81.7 s
e. 148.5 s

$0 = 2250 + 300\ t_2 + 1/2(-10\ m/s^2)\ t_2^2$
$t_2 = 66.7s$
$t = 15s + 66.7s = 81.7s$

9. Consider two trains running in the same direction on parallel tracks. Train 1 leaves the station at time, t = 0, with a constant speed of 100 m/s. Train 2 leaves the station 10 seconds later than train 1 at an initial speed of 0 m/s
but an acceleration of 20 m/s^2. Find the time, t, at which the trains are exactly side-by-side:

a. 3.8 s
b. 13.1 s
c. 16.2 s
d. 26.2 s
e. 33.0 s

$x_1 = 100t\ ;\ x_2 = 1/2(20)(t-10)^2$
$x_1 = x_2 : 100t = 10(t-10)^2$
$100t = 10(t^2 - 20t + 100);\ t = 26.2\ sec.$

10. Let **A** = 5**i** - 6**j**, **B** = -10**i** + 7**j**, **C** = 2**A** – 3**B**
Write the vector, **C**, in vector notation:

a. 40i - 33j
b. 40**i** - 9**j**
c. -20**i** + 9**j**
d. -20**i** - 33**j**
e. None of the above

C = 2(5**i** - 6**j**) - 3(-10**i** + 7**j**) = = 40**i** - 33**j**

11. A hockey player launches a slap shot at the net from 15 m 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 1.22 m. **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, $\mathbf{v_i}$, of the puck in vector form.

$\mathbf{v_O} = 30\ \text{m/s}(\cos 15^o\ \mathbf{i} + \sin 15^o\ \text{m/s}\ \mathbf{j}) = 29\ \text{m/s}\ \mathbf{i} + 7.8\ \text{m/s}\ \mathbf{j}$

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

$15\text{m} = 0 + 29\ \text{m/s}\ t$
$t = 15/29 = 0.52\ \text{s}$

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.

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

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