Your Name: _____ **PHY203**

Final Exam
5/11/09

Part 1

Solutions

1. Convert the speed of light, $3x10^8$m/s to teramiles/hour:

a. $5.2x10^{-11}$ Tmi/h

b. $6.7x10^{-4}$ Tmi/h

c. $1.7x10^{-3}$ Tmi/h

d. $6.7x10^{+4}$ Tmi/h

e. None of the above

$3x10^8$m/s=$3x10^5$km/s/(1.609km/mi)
x(3600s/hr)/(10^{12})= $6.7x10^{-4}$ Tmi/h

For problems 2-5, Let **A** = 5**i**, **B** = 5**i** - 6**j**, **C** = -2**i** - 3**j**, and **D** = 2**A** + 3**B** – 8**C**

2. Find the magnitude of the vector **A** and the angle that vector **A** makes with the positive x-axis (measured in a counterclockwise direction from the positive x-axis):

a. 2.23, 0^o

b. 5.0, 0^o

c. 2.23, 90^o

d. 5.0, 90^o

e. None of the above

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

$q = 0^o$

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

a. 3.3, 309.8^o

b. 3.3, 320.2^o

c. 7.8, 309.8^o

d. 7.8, 320.2^o

e. None of the above

$B = ((7)^2 + (-10)^2)^{1/2} = 7.8$

$q = 360^o - \tan^{-1}(6/5) = 309.8^o$

4. Find the magnitude of the vector **C** and the angle that vector **C** makes with the positive x-axis (measured in a counterclockwise direction from the positive x-axis):

a. 3.6, 214^o

b. 3.6, 236.3^o

c. 3.6, 303.7^o

d. 3.6, 326.3^o

e. 5.0, 326.3^o

$C = ((-2)^2 + (-3)^2)^{1/2} = 3.6$

$q = 180^o + \tan^{-1}(3/2) = 236.3^o$

5. Find the magnitude of the vector **D**:

a. 36.5

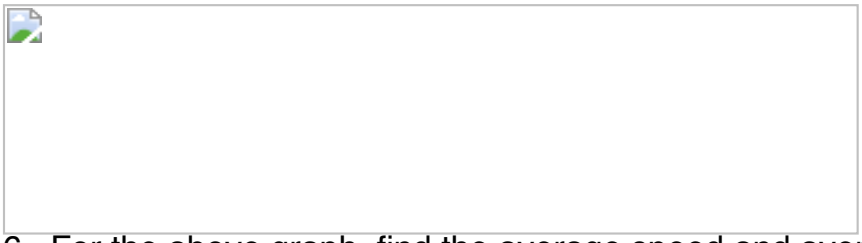
b. 38.7

c. 41.4

D = 2(5**i**)+3(5**i** - 6**j**) - 8(-2**i** - 3**j**) = = 41**i** + 6**j**

$D = ((41)^2 + (6)^2)^{1/2} = 41.4$

d. 42.9
e. None of the above



6. For the above graph, find the average speed and average velocity from positions A to C:

a. 2m/s, -2m/s $speed_{iavg} = Ds/Dt = (40m + 20m))/(10s) = 6.0$ m/s
b. 6m/s, -2m/s
c. 6m/s, +2m/s $v_{iavg} = Dx/Dt = (0 – 20)/(10s) = -2.0$ m/s
d. 6m/s, +6m/s
e. None of the above

7. For the above graph, find the instantaneous acceleration at point B and at point D:

a. 2.0 m/s^2, -4.0 m/s^2 a_{intB} = slope = (30m/s)/(15s) = 2.0 m/s^2
b. 2.0 m/s^2, -1.6 m/s^2
c. 2.0 m/s^2, +1.6 m/s^2 a_{intD} = slope = (-40m/s)/(10s) = -4.0 m/s^2
d. 2.0 m/s^2, +4.0 m/s^2
e. None of the above

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

a. -3.0 m/s^2 $a_{avg} = Dv/Dt = (-10m/s)/(25s) = -0.4$ m/s^2
b. -2.0 m/s^2
c. -1.0 m/s^2
d. -0.4 m/s^2
e. None of the above

A missile on Planet 203-X (with g = 10 m/s^2 exactly) is shot from a cliff with height 250m and initial speed of 60m/s and an angle of 75^O, as shown below.

9. Calculate the time in sec. that it will take for the missile to reach its highest point.

a. 1.2 sec.
b. 1.55 sec.
c. 5.8 sec.
d. 16.8 sec.
e. None of the above

$\mathbf{v_o}$ = 60 m/s(cos75° **i** + sin75° m/s **j**)
= 15.5 m/s **i** + 58.0 m/s **j**
$0 = (58 \text{ m/s}) - (10 \text{ m/s}^2)(t)$
t = 5.8s

10. Calculate the total time from launch for the missile to hit the ground.

a. 3.35 sec.
b. 5.7 sec.
c. 8.8 sec.
d. 14.9 sec.
e. None of the above

$0 = 250\text{m} + 58 \text{ m/s } t + 1/2(-10 \text{ m/s}^2)t^2$
solve quadratic eq.
t = 14.9s

11. Consider a rocket being launched from rest straight up into the atmosphere.
In the first stage, the rocket accelerates at 30m/s^2 for 20s. Then the motor cuts off and the rocket continues to travel upwards for a while. (Use $g=9.81\text{m/s}^2$)

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

$H_1 = 1/2(30 \text{ m/s}^2)20^2$
$H_1 = 6000\text{m}$

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

$v = (30 \text{ m/s}^2)20\text{s}$
$v = 600\text{m/s}$

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

$0 = (600 \text{ m/s})^2 - 2(9.81 \text{ m/s}^2)(DH)$
DH = 18,350m
$H_2 = 6000\text{m} + 18{,}350\text{m} = 24{,}350\text{m}$

d. Find the total time the rocket has been in the air before it stops traveling upwards and begins to descend.

$0 = (600 \text{ m/s}) - (9.81 \text{ m/s}^2)(t_2)$
$t_2 = 61.2\text{s}$

$t = 20s + 81.2s = 81.2s$

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

$0 = 24{,}350m + 0 + 1/2(-9.81\ m/s^2)\ t_3^2$

$t = 70.5s$

$t = 81.2s + 70.5s = 151.7s$

f. Find the speed of the rocket just before it hits the ground.

$v = (9.81\ m/s^2)(70.5s) = 692m/s$