

Your Name: _____

PHY203

Final Exam
5/11/09

Part 1

Solutions

1. Convert the speed of light, $3 \times 10^8 \text{ m/s}$ to teramiles/hour:

- a. $5.2 \times 10^{-11} \text{ Tmi/h}$ $3 \times 10^8 \text{ m/s} = 3 \times 10^5 \text{ km/s} / (1.609 \text{ km/mi})$
b. $6.7 \times 10^{-4} \text{ Tmi/h}$ $\times (3600 \text{ s/hr}) / (10^{12}) = 6.7 \times 10^{-4} \text{ Tmi/h}$
 c. $1.7 \times 10^{-3} \text{ Tmi/h}$
 d. $6.7 \times 10^{+4} \text{ Tmi/h}$
 e. None of the above

For problems 2-5, Let $\mathbf{A} = 5\mathbf{i}$, $\mathbf{B} = 5\mathbf{i} - 6\mathbf{j}$, $\mathbf{C} = -2\mathbf{i} - 3\mathbf{j}$, and $\mathbf{D} = 2\mathbf{A} + 3\mathbf{B} - 8\mathbf{C}$

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

- a. 2.23, 0° $A = ((5)^2)^{1/2} = 5$
b. 5.0, 0°
 c. 2.23, 90° $q = 0^\circ$
 d. 5.0, 90°
 e. None of the above

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

- a. 3.3, 309.8° $B = ((7)^2 + (-10)^2)^{1/2} = 7.8$
 b. 3.3, 320.2°
c. 7.8, 309.8° $q = 360^\circ - \tan^{-1}(6/5) = 309.8^\circ$
 d. 7.8, 320.2°
 e. None of the above

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

- a. 3.6, 214° $C = ((-2)^2 + (-3)^2)^{1/2} = 3.6$
b. 3.6, 236.3°
 c. 3.6, 303.7° $q = 180^\circ + \tan^{-1}(3/2) = 236.3^\circ$
 d. 3.6, 326.3°
 e. 5.0, 326.3°

5. Find the magnitude of the vector \mathbf{D} :

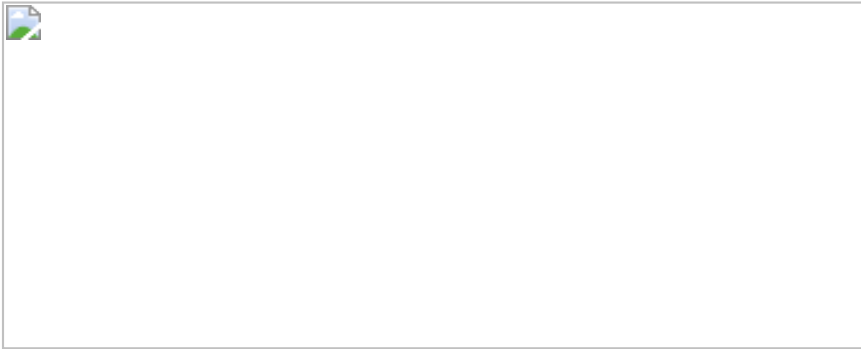
- a. 36.5 $\mathbf{D} = 2(5\mathbf{i}) + 3(5\mathbf{i} - 6\mathbf{j}) - 8(-2\mathbf{i} - 3\mathbf{j}) = 41\mathbf{i} + 6\mathbf{j}$
 b. 38.7
c. 41.4 $D = ((41)^2 + (6)^2)^{1/2} = 41.4$

- 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 $\text{speed}_{i\text{avg}} = Ds/Dt = (40\text{m} + 20\text{m})/(10\text{s}) = 6.0 \text{ m/s}$
- b. 6m/s, -2m/s**
- c. 6m/s, +2m/s $v_{i\text{avg}} = Dx/Dt = (0 - 20)/(10\text{s}) = -2.0 \text{ m/s}$
- 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/s², -4.0 m/s²** $a_{\text{intB}} = \text{slope} = (30\text{m/s})/(15\text{s}) = 2.0 \text{ m/s}^2$
- b. 2.0 m/s², -1.6 m/s²
- c. 2.0 m/s², +1.6 m/s² $a_{\text{intD}} = \text{slope} = (-40\text{m/s})/(10\text{s}) = -4.0 \text{ m/s}^2$
- d. 2.0 m/s², +4.0 m/s²
- e. None of the above

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

- a. -3.0 m/s² $a_{\text{avg}} = Dv/Dt = (-10\text{m/s})/(25\text{s}) = -0.4 \text{ m/s}^2$
- b. -2.0 m/s²
- c. -1.0 m/s²
- d. -0.4 m/s²**
- e. None of the above

A missile on Planet 203-X (with $g = 10 \text{ m/s}^2$ exactly) is shot from a cliff with height 250m and initial speed of 60m/s and an angle of 75° , 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. $\mathbf{v_0} = 60 \text{ m/s}(\cos 75^\circ \mathbf{i} + \sin 75^\circ \mathbf{j})$
 b. 1.55 sec. $= 15.5 \text{ m/s } \mathbf{i} + 58.0 \text{ m/s } \mathbf{j}$
 c. **5.8 sec.** $0 = (58 \text{ m/s}) - (10 \text{ m/s}^2)(t)$
 d. 16.8 sec. $t = 5.8\text{s}$
 e. None of the above

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

- a. 3.35 sec. $0 = 250\text{m} + 58 \text{ m/s } t + 1/2(-10 \text{ m/s}^2)t^2$
 b. 5.7 sec. solve quadratic eq.
 c. 8.8 sec. $t = 14.9\text{s}$
 d. **14.9 sec.**
 e. None of the above

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.

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

$$DH = 18,350\text{m}$$

$$H_2 = 6000\text{m} + 18,350\text{m} = 24,350\text{m}$$

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

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

$$t_2 = 61.2\text{s}$$

$$t = 20\text{s} + 81.2\text{s} = 81.2\text{s}$$

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

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

$$t = 70.5\text{s}$$

$$t = 81.2\text{s} + 70.5\text{s} = 151.7\text{s}$$

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

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