

Your Name: _____

PHY203

Exam #1

Chapters 1-3

Fri., 2/08/08

Solutions

1. 1 acre is 43560 square feet in area. How many square centimeters is that?

- a. 46.7 cm^2 $43560 \text{ ft}^2 \times (30.48 \text{ cm/ft})^2 = 4.05 \times 10^7 \text{ cm}^2$
 b. $1.43 \times 10^3 \text{ cm}^2$
 c. $1.33 \times 10^6 \text{ cm}^2$
 d. **$4.05 \times 10^7 \text{ cm}^2$**
 e. None of the above

2. Convert 30 m/s to km/h:

- a. 1.8 km/h $30 \text{ m/s} \times (1 \text{ km}/1000\text{m}) \times (1 \text{ h}/3600\text{s}) = 1.08 \times 10^2 \text{ km/h}$
 b. 8.33 km/h
 c. **$1.08 \times 10^2 \text{ km/h}$**
 d. $5.0 \times 10^2 \text{ km/h}$
 e. None of the above

3. How many meters is 56 megakm in correct scientific notation?

- a. $5.6 \times 10^3 \text{ m}$ $56 \text{ megakm} \times 10^6 \times (1000 \text{ m/km}) = 5.6 \times 10^{10} \text{ m}$
 b. $5.6 \times 10^6 \text{ m}$
 c. $5.6 \times 10^9 \text{ m}$
 d. **$5.6 \times 10^{10} \text{ m}$**
 e. None of the above

4. Consider two cars approaching an intersection from different directions. One car, traveling East, starts from rest a distance, d , from the intersection with an acceleration of 3 m/s^2 . The other car, traveling North at a constant speed of 10 m/s , is at the same distance, d , from the intersection when the first car starts. Assuming the cars arrive at the intersection at the same time (and crash), find the distance d :

- a. 1.5m $x_1 = 1/2(3)(t)^2$; $x_2 = 10t$
 b. 25.8m $x_1 = x_2$; $10t = 0.5(3)(t)^2$
 c. 33.3m $10 = 1.5t$; $t=6.67\text{s}$
 d. **66.7m** $x=10\text{m/s}(6.67\text{s}) = 66.7\text{m}$
 e. None of the above

5. Consider balls being dropped or thrown off a cliff on Planet 203X whose gravity is such that $g = 10 \text{ m/s}^2$ exactly:

A lead ball is dropped off a cliff. 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. 1.6 sec. $x_1 = 1/2(10)(t)^2$; $x_2 = 30(t-2) + 1/2(10)(t-2)^2$
 b. 2.0 sec. $x_1 = x_2$; $1/2(10)(t)^2 = 30(t-2) + 1/2(10)(t-2)^2$

- c. **4.0 sec.** $5(t)^2 = 30(t-2) + 5(t-2)^2; (t)^2 = 6(t-2) + (t^2) - 4t + 4$
 d. 10.0 sec. $0 = 6t - 12 - 4t + 4; 0 = 2t - 8; t = 4$
 e. None of the above



6. For the above graph, find the instantaneous acceleration at position B.:
- a. -20.0 m/s^2 $a_{\text{int}} = \text{slope} = (-10\text{m/s})/(2\text{s}) = -5.0 \text{ m/s}^2$
 b. -10.0 m/s^2
 c. **-5.0 m/s^2**
 d. 0 m/s^2
 e. None of the above
7. For the above graph, find the instantaneous acceleration at position D.:
- a. -20.0 m/s^2 $a_{\text{int}} = \text{slope} = 0$
 b. -10.0 m/s^2
 c. -5.0 m/s^2
 d. **0 m/s^2**
 e. None of the above
8. For the above graph, find the average acceleration from A to E.:
- a. **-1.25 m/s^2** $a_{\text{avg}} = \Delta v / \Delta t = (-10\text{m/s})/(8\text{s}) = -1.25 \text{ m/s}^2$
 b. -0.8 m/s^2
 c. 0 m/s^2
 d. 1.25 m/s^2
 e. None of the above

For problems 9 and 10, Let $\mathbf{A} = -5\mathbf{i} + 9\mathbf{j}$, $\mathbf{B} = 3\mathbf{i} - 10\mathbf{j}$, $\mathbf{C} = -2\mathbf{A} + 4\mathbf{B}$

9. Find the magnitude of the vector \mathbf{A} :
- a. 4.0 $A = ((-5)^2 + (9)^2)^{1/2} = 10.3$
 b. 7.5
 c. 14.0
 d. 106
 e. **None of the above (10.3)**
10. Find the angle that vector \mathbf{B} makes with the positive x-axis (measured in a counterclockwise direction from the positive x-axis):
- a. 16.7° $\theta = 360^\circ - \tan^{-1}(10/3) = 287^\circ$

- b. 73.3°
- c. 287°
- d. 343°
- e. None of the above

11. A motorcycle stunt rider rides up a ramp with an initial speed of 20 m/s. The rider wants to clear a barrier with a height of 7.5m with respect to the top of the ramp at a distance, D, from the end of the ramp, as shown below. **Show your work.** (Note: use $g = 9.81 \text{ m/s}^2$).



a. Assuming the rider *just* clears the barrier, calculate the y component of the rider's initial velocity using the coordinate system above.

$$0 = (v_{y0})^2 - 2(9.81 \text{ m/s}^2)(7.5\text{m})$$

$$v_{y0} = 12.1 \text{ m/s}$$

b. Assuming the rider just clears the barrier, calculate the angle the ramp makes with horizontal and the x component of the initial velocity.

$$q = \sin^{-1}((12.1/20)) = 37.2^\circ$$

$$v_{x0} = (20\text{m/s})\cos(37.2^\circ) = 15.9 \text{ m/s}$$

c. Assuming the rider just clears the barrier, calculate the distance, D, from the beginning of the ramp the barrier must have been placed.

$$0 = (v_{y0}) - (9.81 \text{ m/s}^2)(t)$$

$$12.1 = (9.81 \text{ m/s}^2)(t)$$

$$t = 1.23\text{s}$$

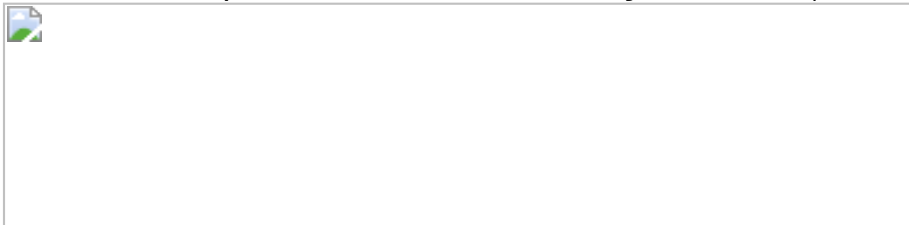
$$D = (15.9 \text{ m/s}) \times (1.23\text{s}) = 19.6\text{m}$$

d. Assuming the rider just clears the barrier, write the velocity, \mathbf{v}_b , of the rider just as the rider crosses over the barrier in vector form using the above coordinate system.

$$\mathbf{v}_b = 15.9 \text{ m/s} \mathbf{i} + 0 \mathbf{j}$$

$$= 15.9 \text{ m/s} \mathbf{i}$$

11. A motorcycle stunt rider rides up a ramp with an initial speed of 25 m/s. The rider wants to clear a barrier with a height of 6.5m with respect to the top of the ramp at a distance, D, from the end of the ramp, as shown below. **Show your work.** (Note: use $g = 9.81 \text{ m/s}^2$).



a. Assuming the rider *just* clears the barrier, calculate the y component of the rider's initial velocity using the coordinate system above.

$$0 = (v_{y0})^2 - 2(9.81 \text{ m/s}^2)(6.5\text{m})$$

$$v_{y0} = 11.3 \text{ m/s}$$

b. Assuming the rider just clears the barrier, calculate the angle the ramp makes with horizontal and the x component of the initial velocity.

$$q = \sin^{-1}((11.3/25)) = 26.9^\circ$$

$$v_{x0} = (25\text{m/s})\cos(26.9^\circ) = 22.3 \text{ m/s}$$

c. Assuming the rider just clears the barrier, calculate the distance, D, from the beginning of the ramp the barrier must have been placed.

$$0 = (v_{y0}) - (9.81 \text{ m/s}^2)(t)$$

$$11.3 = (9.81 \text{ m/s}^2)(t)$$

$$t = 1.15\text{s}$$

$$D = (22.3 \text{ m/s}) \times (1.15\text{s}) = 25.7\text{m}$$

d. Assuming the rider just clears the barrier, write the velocity, \mathbf{v}_b , of the rider just as the rider crosses over the barrier in vector form using the above coordinate system.

$$\mathbf{v}_b = 22.3 \text{ m/si} + 0 \text{ j}$$

$$= 22.3 \text{ m/si}$$