Physics 1205 – Fall 2008
Exam #1

Name (Print): Key

My signature below is a statement that all work contained in this exam is my own work. I have not copied work from any other source, or used any material other than one 3 by 5 card and my calculator.

Name (Signature):_____

DO NOT TURN THIS PAGE OVER UNTIL YOU ARE INSTRUCTED TO DO SO.

STOP WORKING ON THIS EXAM AS SOON AS YOU ARE INSTRUCTED TO DO SO.

You will have approximately 1 hour to do this exam

- The following exam consists of 7 multiple-choice questions and 2 worked problems.
  - Point values are assigned to each problem in the exam.
- It is a good idea to first skim through the entire test and begin with the problems that seem most familiar. If you get stuck on a problem, skip to another.
- For the computational problems, please show all problem solving steps and all your work.
  - All work must be done on the pages provided.
  - Please write neatly and put a BOX around your final answer.
  - Use significant figures in your answers.
- Calculators may be used only to do arithmetic. You cannot use your calculator for solving algebraic equations, for graphing, for vectors, etc.

Problem #	Max Points	Score
1	5	
2	5	
3	5	
4	5	
5	5	
6	5	
7	5	
8	35	
9	30	
Total	100	

1. Consider the equation $v = At + Bt^3$ where v is a velocity, t is a time, and A and B are constants. What are the dimensions of A and B?

	A	B
☐	[L]/[T]	[L]/[T]
☐	[L]/[T]	$[L]/[T]^3$
☐	[L]	$[L][T]^2$
☒	$[L]/[T]^2$	$[L]/[T]^4$
☐	$[L]/[T]^2$	$[L]/[T]^3$
☐	[L][T]	$[L][T]^3$

$\frac{[L]}{[T]} = A[T] + B[T]^3$

$\Rightarrow A = \frac{[L]}{[T]^2} \quad B = \frac{[L]}{[T]^4}$

2. An object is dropped from a certain height on the earth and takes a time Δt to hit the ground. (Air resistance can be neglected.) If the same object were dropped from the same height on the moon, where the acceleration due to gravity is 1/6 that of earth, how long would it take the object to hit the moon's surface?

☒ $\sqrt{6}\Delta t$
☐ $6\Delta t$
☐ $36\Delta t$
☐ $\Delta t/\sqrt{6}$
☐ $\Delta t/6$
☐ $\Delta t/36$

want: Δt
same: $v_i = 0$, Δx
know: $a_e = 6 a_m$

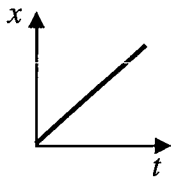
$\Delta x = v_i \Delta t + \frac{1}{2} a t^2$

$\Delta x = \frac{1}{2} a t^2$

$t = \sqrt{\frac{2\Delta x}{a}}$ $\quad \frac{t_m}{t_e} = \sqrt{\frac{a_e}{a_m}} = \sqrt{6}$

3. A stone is dropped from a cliff. If the positive x direction is defined as pointing toward the center of the earth, which graph below best represents the motion of the stone as it falls? Note that the vertical axis is different for the different graphs.

$v = at$ $\quad a$ is constant (slope)



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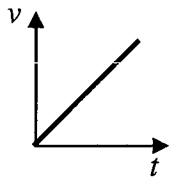

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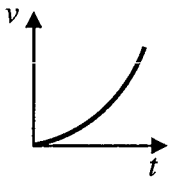

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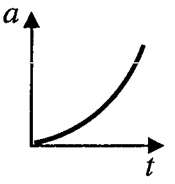

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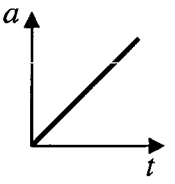


☐

4. You tie a stone to a string and twirl it in a horizontal circle above your head at a constant speed. If you were to double the speed of the stone without changing the length of the string what would happen to the magnitude of the stone's centripetal acceleration?

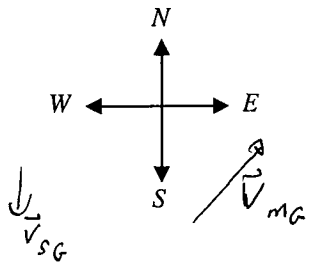
☐ it would be one-fourth as much
☐ it would be half as much
☐ it would be the same
☐ it would be two times greater
☒ it would be four times greater

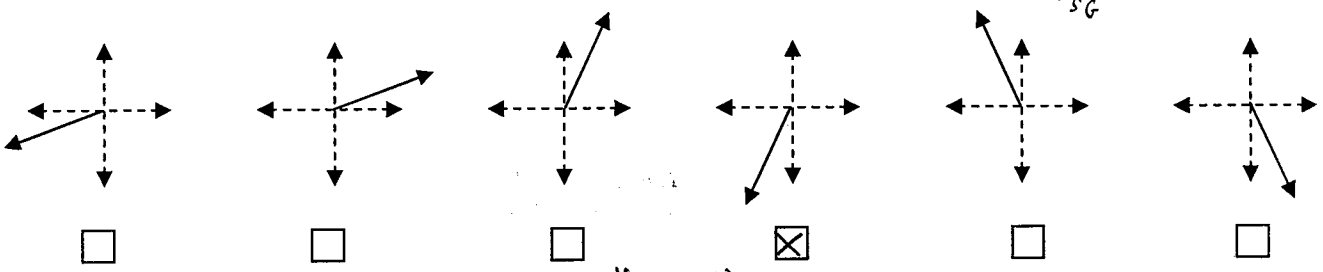
$a_c = \frac{v^2}{r}$

when $v \Rightarrow 2v$

$a_c \Rightarrow 4 a_c$

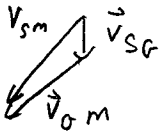
5. Consider the coordinate system shown in the figure to the right. If a sailboat is moving 5 m/s south and a motorboat is moving 10 m/s directly northeast, which vector below (shown as a solid-lined arrow) best represents the velocity of the sailboat relative to the motorboat?





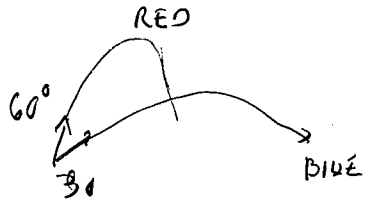
☐ ☐ ☐ ☒ ☐ ☐

$\vec{V}_{SM} = \vec{V}_{SG} + \vec{V}_{GM}$



6. Two balls are thrown with exactly the same speed, but at different angles. A blue ball is thrown at an angle of 30° above the horizontal and a red ball is thrown at an angle of 60° above the horizontal. The blue ball is twice as heavy as the red ball. If you compare the highest point in the trajectory of the blue ball with the highest point in the trajectory of the red ball, which statement below is true about the velocities and accelerations of the balls?

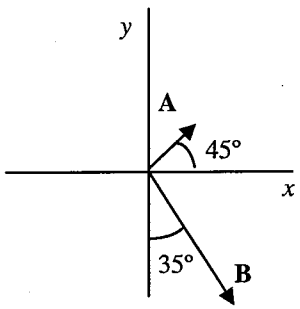
Ball with **greatest velocity** at the apex of their respective flights	Ball with **greatest acceleration** at the apex of their respective flights
☐ blue	blue
☐ red	red
☐ same	red
☒ blue	same
☐ red	same
☐ same	same



$V_{x(30)} > V_{x(60)}$

$a_{BLUE} = a_{red}$

7. In the diagram to the right, the vector **A** has a magnitude of 6.0 and the vector **B** has a magnitude of 15. What is the magnitude of the sum **A** + **B**?



☐ 9.0
☒ 15
☐ 16
☐ 17
☐ 21

$A_x = A\cos 45 = 4.24$

$A_y = A\sin 45 = 4.24$

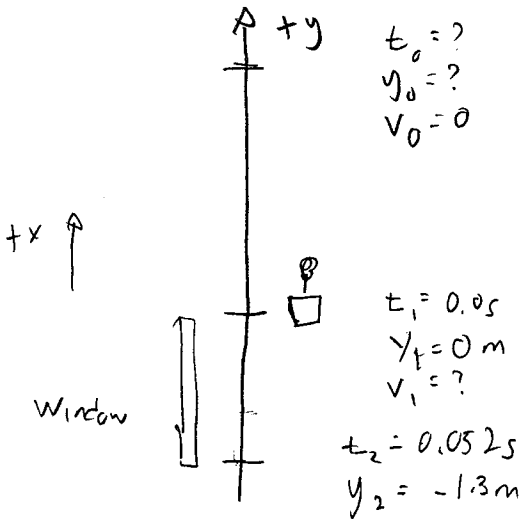
$B_x = B\sin 35 = 8.60$

$B_y = -B\cos 35 = -12.29$

$\vec{A} + \vec{B} = (4.24 + 8.60)\hat{i} + (4.24 - 12.29)\hat{j} = 12.8\hat{i} - 8.05\hat{j}$

$\sqrt{(12.8)^2 + (8.05)^2} = 15$

8. You have a new job with the FBI investigating various crime scenes. Your current case involves an assassination attempt on a foreign official. While this official was walking into a tall building a flower pot came crashing down and nearly hit him on the head. At the same time, a woman on the 12th floor was videotaping her dog doing tricks. Her video tape showed the flower pot fall outside her window, dropping a distance of 1.3 meters in 0.052 seconds. This information should be able to tell you from which floor the flower pot was initially dropped assuming that the flower pot had zero velocity when it was released at some height above the top of the 12th floor window. How far above the top of the 12th floor window was the flower pot dropped? (You may, of course, neglect air resistance.)



$a = -g = -9.80\ m/s^2$

Find V_1

$$y_2 - y_1 = V_1(t_2 - t_1) - \tfrac{1}{2}g(t_2 - t_1)^2$$

$$y_2 = V_1 t_2 - \tfrac{1}{2} g t_2^2$$

$$y_2 + \tfrac{1}{2} g t_2^2 = V_1 t$$

$$V_1 = y_2/t_2 + \tfrac{1}{2} g t_2$$

$$= \frac{(-1.3\ m)}{.0512} + \frac{1}{2}(9.80\ m/s^2)(.0525)$$

$$V_1 = -24.7\ m/s$$

Find y_0

$$V_1^2 = V_0^2 + 2a(y_1 - y_0)$$

$$V_1^2 = +2g y_0$$

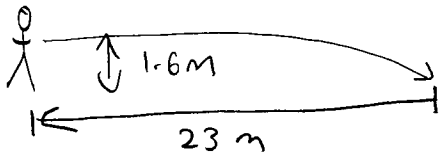
$$y_0 = \frac{V_1^2}{+2g} = \frac{(-24.7\ m/s)^2}{2(9.80\ m/s^2)} = \boxed{31\ m}$$

9. While tossing a baseball around one of your friends boasts that he can throw the ball at a speed of 80 miles/hour. As a physics student who has studied projectile motion, you know how to test this claim. You have your friend throw the baseball so that when it is released it is traveling exactly horizontally. The ball is released from a height of 1.6 meters and travels 23 meters before it hits the ground. How fast was the ball thrown? (Give your answer in miles/hour. 1 mile = 1609 meters, and 1 hour = 3600 seconds.)

(You must solve this problem using the Context-Rich Problem work sheets starting on the next page. Partial credit will be given on this problem for steps performed correctly. For this problem, once a significant mistake is made no more credit will be given for any part of the problem, even if it is done correctly.)

FOCUS the PROBLEM

Draw a Picture Using ALL Given Information



Questions(s)

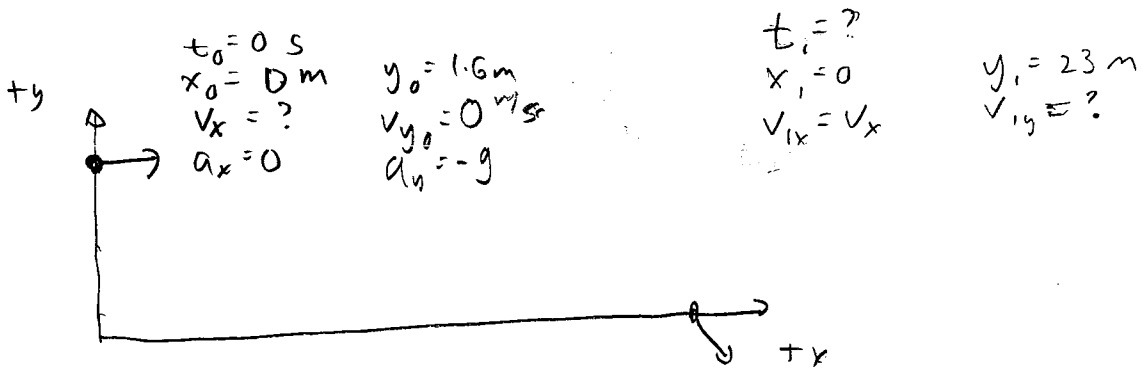
How fast was the ball thrown

Approach

Use kinematic equations with $a_x = 0$ and $a_y = -9.8\ m/s$. Initial velocity in $y = 0$

DESCRIBE the PHYSICS

Diagram(s) and Define Quantities



Target Quantity(ies)

V_x (Since total initial velocity is in "x")

Quantitative Relationships

$$V_1 = V_0 + a(t_1 - t_0)$$

$$x_1 - x_0 = V_0(t_1 - t_0) + \frac{1}{2}a(t_1 - t_0)^2$$

$$V_1^2 = V_0^2 + 2a(x_1 - x_0)$$

PLAN the SOLUTION

Construct Specific Equations (Same Number as Unknowns)

In y

$y_1 - y_0 = \cancel{v_{y0}}^{0}(t_1 - t_0) - \frac{1}{2}g(t_1 - t_0)^2$

$-y_0 = -\frac{1}{2}gt_1^2$

$t_1 = \sqrt{\frac{2y_0}{g}}$ ①

t_1

In x

$x_1 - x_0 = v_x(t_1 - t_0)$

$x_1 = v_x t_1$

$v_x = \frac{x_1}{t_1}$ ②

x_1

Plug ① in ②

$v_x = x_1\sqrt{\frac{g}{2y_0}}$

Check Units

$[L]\sqrt{\frac{([L]/[T])^2}{[L]}} = \frac{[L]}{[T]}$ ok!

EXECUTE the PLAN

Calculate Target Quantity(ies)

$v_x = 23\text{ m}\sqrt{\frac{9.80\text{ m/s}^2}{2(1.6\text{ m})}}$

$= 40\text{ m/s}$

EVALUATE the ANSWER

Is Answer Properly Stated?

No $40\text{ m/s} \times \frac{1\text{ mile}}{1609\text{ m}} \times \frac{3600\text{ s}}{\text{hr}} =$

90 miles/hour

Is Answer Unreasonable?

It is fast, but possible. Your friend can throw an 80 mph fast ball

Is Answer Complete?

Yes

(extra space if needed)