X1.0 107

Physics 107 (Kaldon-23825) **Name** _____

WMU - Spring 2000 **Book Title** ***This is for Topic 1, not your textbook!***

Exam 0 - 000,000 points

Sample – Not a Real Exam

Rev. 5/7/00 Su·Mod.9/14/03 Su

State Any Assumptions You Need To Make -- Show All Work -- Circle Any Final Answers
Use Your Time Wisely - Work on What You Can - Be Sure to Write Down Equations
BOLDFACE Variables Are Vectors - Feel Free to Ask Any Questions

"No, officer, I really don't have any idea how fast I was going." (50,000 points)

1.) If highways were marked with signs in the S.I. metric system, instead of m.p.h. or k.p.h, we might see something that looks like the sign at the right. (a) Normally we don't ask you to do conversions between *standard* and *metric*, but this is a practice exam – so what is 30.0 m/s in miles per hour? … kilometers per hour?

(b) How long (time) would it take to travel a distance of 50.0 kilometers (50,000 meters) at the posted speed limit of 30.0 m/s?

Suppose on a trip of some 50.0 kilometers, you travel the first half of the distance at a speed of 25.0 m/s. (c) How far (distance) will you have traveled? (d) How long (time) will it have taken?

(e) How fast would you have to travel in the second half of the distance in order for your trip to take the same time as in part (b)? Would you have been speeding – or not?

***Semper Paratus – Always Prepared* (50,000 points)**

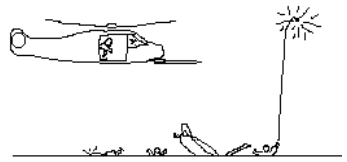
2.) A United States Coast Guard rescue helicopter flies out over Lake Michigan to assist a boat that is in trouble. One of the rescuers is dropped into the water from rest, as the helicopter hovers overhead. (a) If the man falls for 1.33 seconds, how high above the water was the helicopter?

(b) How fast was the man traveling just before he struck the water?

(c) He comes to a stop 2.50 meters below the surface of the water. Assuming that the acceleration is *constant* (which is the only way we do things in PHYS-107, isn't it?), what is the magnitude (value) of his acceleration while coming to a stop?

(d) If we assign +*y* direction to *up* and -*y* direction to *down*, then write down the rescuer's acceleration in the *y* direction for the acceleration in both parts (a) and (c), giving the *correct sign*.

(e) One of the boaters in the water is an idiot, and even though the Coast Guard is there, he fires a flare gun straight up into the air. If the flare starts off with a speed of 50.0 m/s, how high up will the flare go?



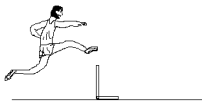
The Following Problem is Brought to You by *Coca-Cola™, Our Proud Sponsor* (50,000 points)

3.) Michael Johnson ran the 200 m at the Atlanta Olympics in something like 19.32 seconds. (a) What is his average speed?

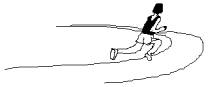
(b) Carl Lewis has run the 100 m in 9.90 seconds. If Mr. Lewis ran like that in the first 100 m of Mr. Johnson's 200 m race, what would Carl's average speed have to be in the second 100 m to tie the race? *Hint: How much time is there left?*

(c) Suppose Ben Johnson of Canada came along and also ran the 200 m in 19.32 seconds, but did so as constant acceleration the whole trip, starting from rest. Find his acceleration, a.

(d) Edwin Moses, running horizontally at 10.0 m/s, jumps over a hurdle with an initial vertical speed, v_{0y}, of 1.00 m/s. How long (time) is Edwin in the air?



(e) [1] Carl Lewis is running on an indoor track, moving at 10.0 m/s through a curve of radius 20.0 m. What is his centripetal acceleration, a_c?



***"Come Josephine In My Fly-ing Machine…!"* (50,000 points)**

4.) An airplane flies east for 15.0 miles at 90.0 miles/hour, then heads north for 15.0 minutes at 120. miles/hour. Find (a) the time spent flying east and (b) the distance traveled north.

Find (c) the total distance and the total time that the airplane flew.

(d) What is the average speed of the airplane based on the path that it took?

The Pythagorean Theorem states that $c = \sqrt{a^2 + b^2}$, where a and b are the sides of a right triangle and c is the hypotenuse. We'll use this a lot shortly, but it won't be on Exam 1. Still, we can do a cool problem if we plug the distance flown to the east as a and the distance flown to the north as b. Then the "straight-line distance that the crow flies" will be c. Use this distance and the time answer to (c) and find (e) the average speed of the airplane based on the beginning and end points. *Which should be larger, (d) or (e)? Why?*

[1] Centripetal Acceleration may or may not be on Exam 1. The equation is: $a_c = v^2/r$, where r is the radius of the circle.

***"Next Stop, High Street – Kensington,"* GREEN LINE – LONDON UNDERGROUND (50,000 points)**

5.) In the movie *Sliding Doors*, Gwyneth Paltrow's character is split along two time paths – one where she misses the subway, and one where she makes it. We've all been there, it's just a matter of seconds difference between the close of the sliding doors in your face, or slipping between them at the last moment. Suppose you hear the train arrive in the station as you are coming down the stairs. The train will be in the station exactly one minute. You are 112 meters from the doors of the train. (a) What is the *minimum* speed that will allow you to make the train?

(b) Alice happens to look on Joe's PHYS-107 exam and sees that for part (a) he has put down 17.1 m/s as the answer. (ALICE – WHY ARE YOU LOOKING ON JOE'S PAPER? – DR. PHIL) Why does Alice know immediately that Joe's answer is WRONG? *You need to give a good Physics answer – but be brief.*

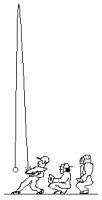
(c) The subway train travels the next station one mile away (1609 meters) in 1½ minutes (90.0 seconds). What is the average speed of the train?

The subway train accelerates from rest to its cruising speed of 23.0 m/s in 20.0 seconds. Find its (d) acceleration and (e) how far it traveled in that time.

History in the Making… (50,000 points) NOTE: this was written in Fall 1998

6.) Mark McGwire's 65th home run this weekend and Sammy Sosa's 63rd home run last week, are quite the achievement. Yet both men miss the ball more than 2/3 of the time they go to the plate. Hitting a major league fast ball has been described as one of the hardest tasks in all of sport – it is about 18.45 meters from the pitcher to home plate (60 ft. 6 inches), and a fast ball travels at about 43.8 m/s (98 m.p.h.). (a) How long does it take for the ball to travel this distance?

(b) The ball makes contact with the bat somewhere in 0.500 m of space on its trip to the catcher. How long is the ball in this space?



(c) Instead of hitting a home run, the batter hits the ball straight up at 45.5 m/s. How high will the ball go? *Assume that y = 0 is where the ball is hit. As usual, we are ignoring things like air resistance and we assume that the ball is going straight up and straight down.*

(d) How long (time) will it take for the ball to get there?

(e) How fast will the ball be going when it gets back down?

Cheetah Hunters of the Serengeti (50,000 points)

7.) A cheetah, initially at rest, is passed by a gazelle, who is running at 35 m.p.h. (15.6 m/s). The cheetah will start running after the gazelle with a constant acceleration of 10.0 m/s². (a) If the final speed of the cheetah is 70 m.p.h. (31.2 m/s), then use the *equation without time* to find out how far the cheetah travels.

(b) How much time does it take for the cheetah to go from zero to 70 m.p.h. (31.2 m/s)?

(c) How far does the gazelle travel in this same time, running at 35 m.p.h. (15.6 m/s)?

(d) What is the average speed of the gazelle?

(e) What is the average speed of the cheetah? Does this make sense?

Steven Seagull – Action Heroes Are For The Birds (50,000 points)

8.) Seagulls like to eat nearly everything, including McDonald's French fries and clams. However, a seagull beak is not strong enough to crack open a clam shell. Imagine a gliding seagull, carrying a clam, suddenly swooping straight up, starting at 10.0 m above the beach (y_0) and an initial speed of +22.2 m/s (v_{0y}). At this point, assume the bird glides straight up, unpowered and with no air resistance. (a) How high does the seagull go?

(b) How much time does it take for the seagull to come to rest at that height?

(c) At the top of its flight, the bird lets the clam go from rest. How fast will the clam be going when it reaches the beach? *Be sure to indicate the direction, too.*

(d) The seagull has dropped the clam onto a rock, and the clam goes from the speed in (c) to rest in a distance of half a centimeter (0.500 cm). What is the acceleration of the clam? *Give answer in m/s².*

(e) How many *gee's* is this? *Hint: what is "g" equal to? That would be 1.00 gee's.*

Dr. Phil doesn't like multiple guess tests, but one problem won't kill us.

"Truth or Dare" (50,000 points) ***Multiple-Guess-Fill-In-The-Bubbles***

mph	sec
25	144.0
30	120.0
35	102.9
40	90.0
45	80.0
50	72.0
55	65.5
60	60.0
65	55.4
70	51.4
75	48.0
80	45.0
85	42.4
90	40.0
95	37.9
100	36.0
105	34.3
110	32.7
115	31.3
120	30.0
125	28.8
130	27.7
135	26.7
225	16.0

9.)(a) It is 8.00 miles from Bill's house to Wackie Weenie World where Bill works. The speed limit on the road that Bill takes is 40.0 m.p.h., which allows him to arrive at work on time. How many seconds does it take to travel this distance? *The handy chart at left may be useful.*

A = 90.0 sec B = 180. sec C = 540. sec D = 720. sec
E = 900. sec F = None of these

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(b) As usual, Bill is four minutes late. How many seconds is 4.00 minutes?

A = 30.0 sec B = 60.0 sec C = 240. sec D = 300. sec
E = 480. sec F = None of these

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(c) How much time is left for Bill to make his trip and still be on time?

A = 30.0 sec B = 60.0 sec C = 240. sec D = 300. sec
E = 480. sec F = None of these

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(d) Approximately how many m.p.h. over the speed limit does Bill have to drive to be on time?

A = 5 mph B = 10 mph C = 15 mph D = 20 mph
E = 25 mph F = None of these

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(e) John & Joan stand on a bridge over a stream. John tosses a rock straight up at $v_0 = 1.0$ *m/s.* What is the acceleration of the rock as it goes up?

A = +9.8 m/s² B = -9.8 m/s² C = +1.0 m/s² D = -1.0 m/s²
E = 0 m/s² F = None of these

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(f) What is the speed *v* of John's rock at the top of its travel?

A = 0.0 m/s B = +1.0 m/s C = -1.0 m/s D = +9.8 m/s E = -9.8 m/s
F = None of these

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(g) What is the speed *v* of John's rock when it passes by him again on the way down?

A = 0.0 m/s B = +1.0 m/s C = -1.0 m/s D = +9.8 m/s E = -9.8 m/s
F = None of these

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(h) When John tosses his rock up, Joan throws a rock straight down with $v_0 = -1.0$ *m/s.* Which rock gets to the stream first?

A = John's B = Joan's C = Bill's D = 720. sec
E = Same time F = None of these

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(i) Which rock is going faster when they hit the stream?

A = John's B = Joan's C = Bill's D = 720. sec
E = Same speed F = None of these

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(j) The kinematic equations describe motion that is:

A: Changing acceleration B: Uniform Jerk C: Circular Motion
D: $a = -jt$ E = All of these F = None of these

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