X1.1 205

PHYS-205(11) (Kaldon-27003) **Name** _____
WMU-Fall 2002
Exam 0 - ~~100,000 points + 20,000 ☆ points~~ **Book Title** ***This is for Topic 1, not your textbook!***
Sample – Not a Real Exam

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
Feel Free to Ask Any Questions ☐☆2a ☐☆2b ☐☆2c ☐☆2e

Now This Car Really Moves! (25,000 points)

1.) In 1997-98, the land speed record is now set past Mach 1, the speed of sound ($v = c_s = 343$ m/s) , using a jet powered car. (a) If the jet car starts at rest and accelerates at $a = +2g$, then how long (time) will it take for the car to reach $v = 400.\ m/s$?

(b) How far (distance) does the jet car travel from rest to the point where it reaches $v = 400\ m/s$? *This can be done with or without the answer to (a) .*

Once the jet car reaches $v = 400.\ m/s$, you have to be very careful when trying to bring it to a stop – hit the brakes too hard and the car will flip out of control, not good at speeds above Mach 1! (c) If the jet car coasts at a constant speed for 10.0 seconds, how much distance will it travel during that time?

(d) If the jet car is slowed down to stop over a distance of 15,000 meters, about 9.3 miles, what is the value of the acceleration of the jet car?

(e) How much time does it take for the jet car to decelerate to a stop? *This can be done with or without the answer to (d).*

Travel Into The Astounding Fifth Dimension (25,000 points)

2.) The motion of an object is determined the following equation. All of the other constants of integration, such as x_0, are zero. $\frac{d^5x}{dt^5} = 5.00\ m/s^5$

☆(a) Find the equation for the acceleration, a, of this object.

☆(b) Find the equation for the speed, v, of this object.

☆(c) Find the equation for the position, x, of this object.

(d) A second object can be described by the following equation. Find the position of the second object at the time t = 5.00 sec.

$$x(t) = 5.00m + 5.00\ m/s\,t + 5.00\ m/s^2\,t^2 + 5.00\ m/s^3\,t^3 + 5.00\ m/s^4\,t^4 + 5.00\ m/s^5\,t^5$$

☆(e) Find the equation for the acceleration, a, of this second object, at the time t = 5.00 sec.

The Bridges to Babylon Rock Concert (25,000 points)

3.) Three boys are standing on a bridge, 3.20 m above a river. They each hold a large rock. At the same time, they each do something with their rocks. Abe will toss his rock straight up at $v_0 = +6.70\ m/s$. Buck will simply release his rock with $v_0 = 0$. Carl will throw his rock straight down at $v_0 = -6.70\ m/s$. In order to find out whose rock would hit the water first, and which rock is traveling the fastest, we would need the following information: (a) Find the time it takes for each rock to reach the water.

(b) How high does Abe's rock reach before it reaches its turning point?

(c) With what velocity will Abe's rock be moving at when it next passes by Abe's hand?

(d) Find the total distance each rock travels from the time they are released to the time they hit the water.

(e) What is the acceleration of each rock from the time they are released to the time they hit the water?

The Spoils Go To The Vectors! (25,000 points)

4.) One vector is described in *standard form* as $\vec{A}$ = 3.21 m @ 167°. Another vector is described as $\vec{B}$ = +4.32 *m* $\hat{i}$ - 6.62 *m* $\hat{j}$. (a) Find the *x*- and *y*-components of the vector A.

Find (b) the magnitude and (c) direction in form of the standard angle, of the vector B.

(d) Find $\vec{A} + \vec{B}$ in standard form.

(e) Find $\vec{A} - \vec{B}$ in standard form.

***"All Aboard!"* (25,000 points)**

5.) One Amtrak train heads east from Los Angeles CA at 12:00 noon PDT[1], starting from rest. At 12:03 it is moving at $v = 52.7\ m/s$ (118 mph). What is its acceleration?

(b) A second Amtrak train heads west from Chicago IL at 12:30pm PDT, starting from rest. It accelerates to $v = 67.0\ m/s$ (150 mph) with an acceleration of $a = 0.100\ g$. How many *kilometers* does it take for this train to get up to speed?

(c) It is 2222 miles (3583 km) from L.A. to Chicago. Ignoring the initial bout of acceleration, so that both trains are moving at their respective constant speeds, and remembering that the first train has a half hour head start, find the distance between the two trains at 12:30pm PDT.

Find out (d) when and (e) where the two trains pass each other. *If you didn't get an answer to (c), use 3583 km as the distance between the two trains at 12:30pm PDT.*

[1] For simplicity's sake, all times are given as Pacific Daylight Time, so you won't have to mess with the difference in time zones.

***" Fore ! ! ! ! "* (25,000 points)**

6.) An object begins its motion at $x_0 = 1.00\ m$, $v_0 = 2.00\ m/s$, $a_0 = 3.00\ m/s^2$ and an initial jerk of $j_0 = 4.00\ m/s^3$. The motion of an object is determined by the following equation:

$$\frac{d^4x}{dt^4} = 4.00\ m/s^4$$

☆(a) Find the equation for the acceleration, a, of this object.

☆(b) Find the equation for the speed, v, of this object.

☆(c) Find the equation for the position, x, of this object.

(d) A second object can be described by the following equation. Find the position of the second object at the time t = 0.400 sec.

$$x(t) = 4.00m + 4.00\ m/s\,t + 4.00\ m/s^2\,t^2 + 4.00\ m/s^3\,t^3 + 4.00\ m/s^7\,t^7 + 4.00\ m/s^8\,t^8$$

☆(e) Find the equation for the velocity, v, of this second object.

Twelve O'Clock High (25,000 points)

7.) Here in 1999, with Iraq and Kosovo, we are so used to "Smart Bombs", that one tends to forget that back in World War II, bombs fell as stupid ballistic objects. Consider a B-17 flying over Germany at an altitude of 3050. meters (10,000 feet) and a speed $v_x = 145$ *m/s* (325 mph). Neglecting air resistance, as usual, find (a) the time it takes for a bomb to fall to the ground.

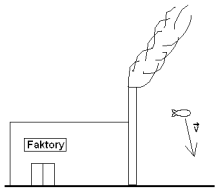
(b) How far is it horizontally from the Release Point (where you drop the bomb), to where the bomb hits the ground? *If you didn't get an answer to (a), use* $t = 22.2$ *sec.*

(c) Find the *y*-component of the velocity, v_y, of the bomb just *before* impact with the ground.

(d) Find the *x*-component of the velocity, v_x, of the bomb just *before* impact with the ground.

(e) Find the final velocity, $\vec{v}$, in standard form of the bomb just *before* impact with the ground. *If you didn't get answers to (c) and (d), use* $v_x = 123$ *m/s and* $v_y = 234$ *m/s.*

"Oops – we missed!"



Vectors and Bugs – Whatta Combination! (25,000 points)

8.) One vector is described in *standard form* as $\vec{A} = 16.3$ m @ 153°. (a) Find the *x*- and *y*-components of the vector A.

(b & c) Another vector is described as $\vec{B} = +4.32\ m\ \hat{i} - 6.62\ m\ \hat{j}$. Find $\vec{A} - \vec{B}$ in standard form. *If you didn't get (a), use* $\vec{A} = 1.85m\,\hat{i} - 22.27m\,\hat{j}$.

(d) A bug is sitting on the edge of an ancient Long Playing Record, radius $r = 0.1525$ *m*. The record spins at 33-1/3 revolution per minute, so each rotation takes $t = 1.80$ *sec*. Find the speed, *v*, that the bug makes as it goes round and round.

(e) Find the centripetal acceleration, a_c, of the bug. *If you didn't get an answer for (d),* $v = 6.25$ *m/s.*