XF.10b 107

Physics 107 (Kaldon) **Name** _____

WMU - Fall 1999 ☐ **You Must Go Through "Check-Out" With Dr. Phil**

Final Exam (L) - 200,000 points 12/05/1999•Rev.6e1

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
Short Answers Should Be Short! – Feel Free to Ask Any Questions

"Last Chance" (50,000 points) ***Multiple-Guess-Pick-The-Best-Answer-Fill-In-The-Bubbles***

1.) In parts (a)-(d), select which Newton's Law or Conservation Law best applies.

(a) If there is a net external force, then it is equal to the change in the momentum divided by the change in time.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E = Energy F = None of these
Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(b) The Second Law of Thermodynamics is a statement about…
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E = Energy F = None of these
Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(c) This is the only one that does not involve vectors.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E = Energy F = None of these
Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(d) For every action, there is an equal and opposite reaction – acting upon the other body.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E = Energy F = None of these
Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

In parts (e)-(h), select which speed best represents the situation described.

(e) *"Don't you walk away from me, young lady. I'm your father – I'm talking to you! Do you hear me?"*
A = 2.0 m/s B = 8.0 m/s C = 30. m/s D = 270 m/s E = 610 m/s
F = 22,000 m/s
Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(f) *"So we flew United on this 767 right over the Grand Canyon – it was awesome."*
A = 2.0 m/s B = 8.0 m/s C = 30. m/s D = 270 m/s E = 610 m/s
F = 22,000 m/s
Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(g) *"The last signal from NASA's Mars Polar Lander was just before it entered the red planet's atmosphere."*
A = 2.0 m/s B = 8.0 m/s C = 30. m/s D = 270 m/s E = 610 m/s
F = 22,000 m/s
Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(h) *"Thief! Thief! He snatched my purse! Look – he's getting away!"*
A = 2.0 m/s B = 8.0 m/s C = 30. m/s D = 270 m/s E = 610 m/s
F = 22,000 m/s
Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

In parts (i)-(j), select the answer that best fills in the blank.

(i) A bells rings with $f = 480\ Hz$. A second bell, with a higher pitch, has a wavelength _____ the first bell.
A = more than B = less than C = the same as
D = None of these
Ⓐ Ⓑ Ⓒ Ⓓ

(j) An electron jumps from $n = 4$ orbit to the $n = 1$ orbit in hydrogen. The strength of the Coulomb electric force between the electron and the proton is now _____ it was. *Ignore the minus sign due to attraction.*
A = more than B = less than C = the same as
D = None of these
Ⓐ Ⓑ Ⓒ Ⓓ

Hi. My name is Dave Thomas and I used to work for the real Colonel Sanders. (50,000 points)

2.) (a) In a recent Wendy's Old Fashioned Hamburgers commercial, it was suggested that their Hot Spicy Chicken Sandwich was *so* hot that it could melt all the ice in a hockey skating rink. That's stupid. In reality, you've got perhaps ¼ pound of chicken ($m = 0.227\ kg$), which went into the grill while it was still cold, 40°F (4.44°C). To be properly cooked, one sources suggests that the chicken be heated to 160°F (71.1°C). Assume that the chicken meat is mostly water, and therefore has a specific heat of $c_{water} = 4180\ J/kg{\cdot}°C$, how much energy did it take to heat the chicken?

(b) The chicken was on the grill for 8.00 minutes. Find the power in Watts that was used to heat the bird. *If you didn't get an answer to (a), use $Q = 50{,}000\ J$.*

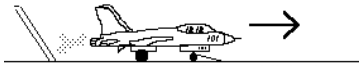
(c) If the grill runs at 1350 W, what is the efficiency of cooking the chicken? In other words, what percentage of the total power actually went into cooking the turkey? *If you didn't get an answer to (b), use $P = 511\ W$.*

If this was an electric grill, plugged into a 220 volt outlet, find (d) the current I and…

(e) … the resistance R of the oven? *Note: This does not depend on (d).*

"The Navy calls their pilots aviators – says they're better than pilots." THE RIGHT STUFF **(50,000 points)**

3.) The United States Navy spends some $6,000,000 to train a naval aviator. Aboard the aircraft carrier *USS John F. Kennedy*, a 187,000 N (19,100 kg) Navy F/A-18 Hornet jet fighter has two engines with a total of 142,000 N thrust. (a) Find the acceleration of the F/A-18 by its engines alone.



The flight deck of an aircraft carrier doesn't make a very long runway, so planes are launched into the air by brute force with a steam catapult. The F/A-18 goes from rest to 160 m.p.h. (71.6 m/s) [1] minimum flying speed while accelerating at 5.00 *g*'s.

(b) How much time does this launch take? *g = 9.8 m/s², of course.*

(c) How far does the plane travel while it was being launched? *Note: this can be solved without knowing the answer to (b).*

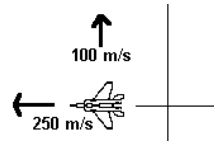
(d) Find the force supplied by the steam catapult during the launch, assuming that the engines are running at their full thrust, 142,000 N.

(e) Assuming that the jet was at rest on the carrier's deck to begin with, find the total change in mechanical energy when the F/A-18 is finally cruising at Mach 1.81 (c_s = 331 m/s) and 60,000 ft (18,300 m). *Note: Set $h_1 = 0$.*

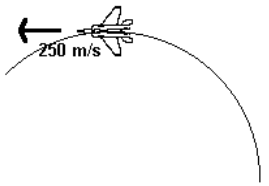
[1] For Naval Aviation purists, we are neglecting the fact that the carrier is steaming into the wind. Treat the plane at rest, $v_0 = 0$. And yes, Dr. Phil knows that his sketches are more like F-14's – I had to change the problem from Monday morning, OK?

Odds & Ends – Mostly Odd (50,000 points)

4.) (a) On the return flight to the aircraft carrier, the F/A-18 in the previous problem is pointed due West and traveling at 250. m/s. They encounter a 100. m/s crosswind headed due North. Find the velocity vector, $\vec{v}$, the total direction and speed of the F/A-18, using due East as our standard angle reference of 0°.



(b) The jet goes into a very tight turn, pulling *9 g*'s ($a_c = 88.2\ m/s^2$). What is the radius of this circle? *Assume the pilot does not lose consciousness.*



(c) It's midnight on 31 December 1999 and a champagne cork flies with $v_{0y} = 8.00\ m/s$. How high does the cork go?

(d) What gauge pressure inside the bottle is needed for the champagne to come out with $v_{0y} = 8.00\ m/s$? *If you need it, consider outside air pressure as 101,300 Pa. This is cheap champagne, consider it to be like water.*

(e) These are numbers that you should know – *for 2000 points each, is this your Final Answer?*

1. This is the acceleration due to gravity on Earth: …… _____ m/s².
2. This is the density (mass-to-volume ratio) of water: …….. _____ kg/m³.
3. This is the boiling point of water: …….. _____ °C.
4. This is the freezing point of water: …… _____ K.
5. This is the total number of points that were available in PHYS-107: ……. _____ points.