PHYSICS 107 (KALDON)
WMU - APRIL 1912
FINAL EXAM (SAMPLE) - 200,000 POINTS

NAME ____

☐ YOU MUST GO THROUGH "CHECK-OUT" WITH DR. PHIL

SECTION: 10A (A TO C) 10B (D TO F) 10C (G TO K) 10D (L TO N) 10E (O TO R) 10F (S TO Z)

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
MOST PARTS ARE NOT NEARLY AS HARD AS YOU THINK — FEEL FREE TO ASK ANY QUESTIONS

TITANIC — DENSITY AND WATER (50,000 POINTS) --- FINAL EXTRA VERSION ---

$\rho_{sea\ water} = 1030\ kg/m^3$

1.) If the mass of *Titanic* was 60,000,000 kg (that would correspond to a displacement of about 66,000 tons), then find (a) the weight of the ship…

… and (b) the mass of the water displaced by the ship.

(c) *RMS Titanic* was about 800 feet long (245 meters) and according to the numbers painted on the bow of the ship, she was drafting about 37 feet (11.3 meters) – that means that 11.3 meters of the ship was below the water. Assume that the part of the ship under the water is a rectangular box with these dimensions – what is the width of this box – and hence the width of the ship?

"Take her to sea, Mr. Murdoch. Let's stretch her legs."

The wreck of the *Titanic* lies 3821 meters below the surface of the Atlantic Ocean – about two and a half miles. The Мир Один (Mir One) submersible that visited the wreck keeps the air pressure inside the sub at 101,300 Pa (the same as at the surface) for the people inside. Find (d) the gauge pressure of the water down there and …

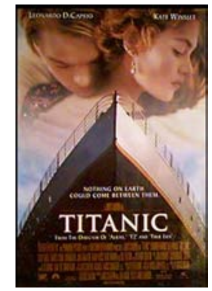
… (e) the speed that water would pour into the submersible if one of the nine inch thick glass windows were to develop a crack.

TITANIC — KINEMATICS, ENERGY AND MOTION (50,000 POINTS)

knot – A unit of speed, one nautical mile per hour, approximately 1.85 kilometers (1.15 statute miles) per hour

2.) *RMS Titanic* was going at approximately 23 knots (42,55 km/hour = 11.82 m/s) when it hit the iceberg. (a) How long would it take for the length of the ship to pass a stationary iceberg – if it kept at a constant speed?

(b) What is the kinetic energy of the *Titanic* at 23 knots (42,55 km/hour = 11.82 m/s)?



The next two parts may require more than one step, so don't assume it's just one plug-in! If it took four minutes to bring the *Titanic* to a complete stop, find (c) the force being applied to the ship to slow it down and …

… (d) the power required to bring the ship to a complete stop.

(e) The *Titanic* was steaming due west 23 knots (42,55 km/hour = 11.82 m/s) – that's to the left. The iceberg is 30.0 seconds ahead. To miss the iceberg, it has to add an additional velocity component to the south, such that it will move 60.0 m in the 30.0 seconds. Find the total vector velocity, $\vec{v}$, in standard form.

Titanic – Ballistics and Modern Physics (50,000 points)

3.) White phosphorus flare rockets are fired straight up into the air, as *Titanic* slowly sinks. They reach their maximum height in 6.00 seconds. Assuming that they almost instantly reach their maximum velocity, v_0, then their entire flight would be a *ballistic* problem that we can solve with the kinematic equations (or other equations developed in this course). Find the initial *vector* velocity, $\vec{v}_o$, of the rocket, giving in standard form (a) the magnitude and (b) the direction of the vector. *Don't tell me that the initial velocity is zero – we are assuming that the rocket has finished firing and the rocket is now moving at its maximum speed at time zero.*

(c) How high does the rocket travel? *Note: this can be solved with or without the answer to part (a).*

(d) One of the phosphorus atoms in the burning flare is hydrogenic. Find the frequency of the emitted photon for an electron dropping between from the $n = 5$ and the $n = 3$ orbits for a hydrogenic phosphorus ion.
– *Hint: this is a two-step problem.*

(e) The Binding Energy of the phosphorus nucleus can be estimated by taking the difference between the sum of Z protons plus N neutrons and the atomic weight value from the periodic table. Give Binding Energy in Joules.

^1_0n neutron 1.008665 amu, ^1_1H proton 1.007825 amu, 1 amu converts to 1.49×10^{-10} J

Titanic – Heat & Physical Attraction (50,000 points)

4.) On a ship of *Titanic*'s size, all lit up at night, there must be something like 40,000 light bulbs. If each bulb is 100 watts, and the voltage is 125 volts, (a) what is the resistance of each bulb?

(b) What is the effective resistance of *all* the light bulbs in the circuit? *Hint: Are they going to be in series or in parallel?*

Rose DeWitt DuBukater (m = 58 kg) and Jack Dawson (m = 64 kg) are one foot apart (r = 0.305 meters). So find the force of the (c) gravitational attraction and (d) the electric attraction between them. *There is an assumption you have to make.* $G = 6.67 \times 10^{-11}\ N{\cdot}m^2/kg^2$ and $k = 9 \times 10^9\ N{\cdot}m^2/C^2$.

(e) If the *Titanic* was 245.000 meters long at 68°F (20°C, 293 K), then what was the length of the ship at time of its sinking, assuming that the temperature was the freezing point of water?

$\alpha_{iron} = 12 \times 10^{-6}$ °C^{-1}

This was an actual final exam for PHYS-107.
White space has been compressed to 4 pages.