King Fahd University of Petroleum and Minerals
Department of Physics

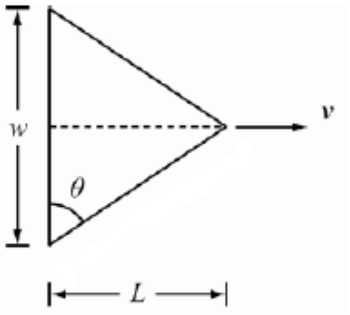
Name: PHYS 204 Final Exam-12/27/2020
ID#: **Due time 10:15 am**

Show detalied solutions using **your hand writing only**, typing or printing will not be accepted. Then, take clear image of your answers and email them to:

watheq@kfupm.edu.sa

Q1 (4 pts.): A diffraction grating has 10000 slits uniformly spaced over 20.000 mm is to be illuminated at normal incidence with red light at wavelength of 632.80 nm and blue light at wavelength of 420.00 nm. On a screen located 1.0000 m from the grating, find the separation (in mm) between the second order red light and blue light fringes?

Q2 (5 pts): An alien spaceship shaped like an isosceles triangle, see figure below, has a width *w* of 20.0 m and a length *L* of 50.0 m. Calculate the angle between the base of the ship and the side of the ship as measured by a stationary observer if the ship is moving past the observer at a speed of 0.400c?



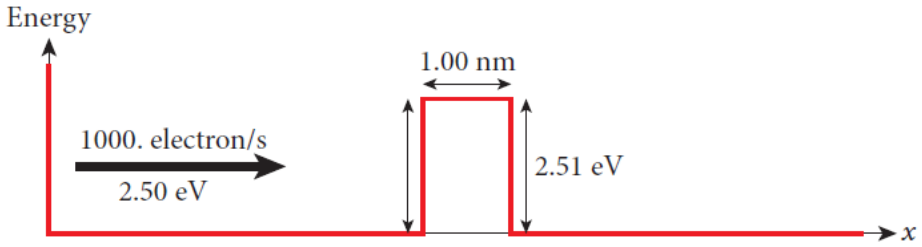
Q3 (5 pts): A small spherical particle of mass 10^{-16} kg and radius 2.50 μm is entrapped in a cubic box of side length 15.0 μm.

(a) Could you know if the particle is at rest or moving? Give scientific argumnet and back it with equations.

(b) Assuming the particle is not at rest, calculate the range of its velocity?

Q4 (4 pts): A beam of electrons moving in the positive x-direction encounters a potential barrier that is 2.51 eV high and 1.00 nm wide. Each electron has a kinetic energy of 2.50 eV, and the electrons arrive at the barrier at a rate of 1000. electrons/s.

(a) What is the rate I_T (in electrons/s) at which electrons pass through the barrier, on average?
(b) Calculate the wavelengths of the electrons before and after they pass through the barrier?



Q5 (4 pts): A sealed box was found which stated to have contained an alloy composed of equal parts by weight of two radioactive metals A and B, with half lives of 12 years and 18 years, respectively.When the container was opened it was found to contain 0.53 kg of A and 2.20 kg of B. Find the age of the alloy.

Q6 (4 pts): It is found that some stars, may begin to fuse two nuclei of ${}^{12}_{6}C$ to one ${}^{24}_{12}Mg$ nucleus.

(a) Calculate energy released in such a reaction.

(b) Calculate the temperature that two carbon nuclei must initially have to allow them to approach each other to within 6.0 fm, center-to-center, so as fusion can occur.

Q7 (4 pts): At room temperature of 300 K, Silicon which has a bandgap of 1.12 eV, has its Fermi level exactly located in the middle of the bandgap. Calculate the the probability that a state located at the top of the valence band is empty?