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University of Saskatchewan
Department of Electrical Engineering

EE372 Electronic Materials and Devices
Midterm Examination

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Welcome to the EE372 Midterm. The examination has two parts. Part A consists of questions that test knowledge of basic concepts, and part B requires more involved calculations. Part A is closed book and closed notes. When you finish part A, hand it in (raise your hand) and then proceed to part B. Part B is open book; you may refer to your textbook (Kasap, any edition) but not to any other material such as notes or other books. You may also use a calculator for both parts. The examination lasts **1:30** hour.

Each problem is weighted equally but subparts may be differently weighted.. Show your work if the question involves more than a simple answer; credit will be given only if the steps leading to the answer are **clearly** shown. Partial credit will be given for partially correct answers but only if correct intermediate steps are shown. Write your answers on these pages.

For part A, answer all 3 questions.

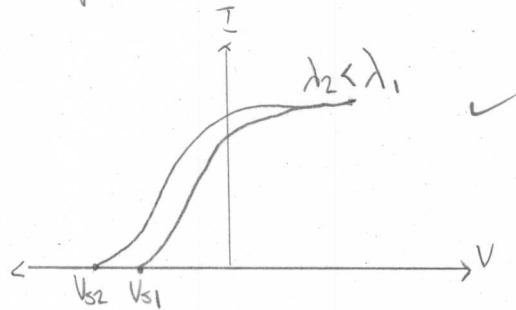
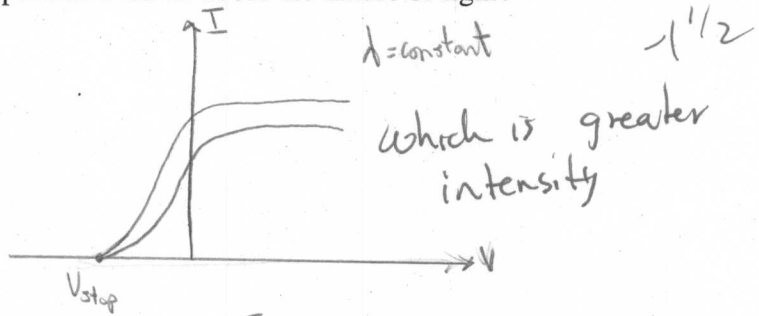
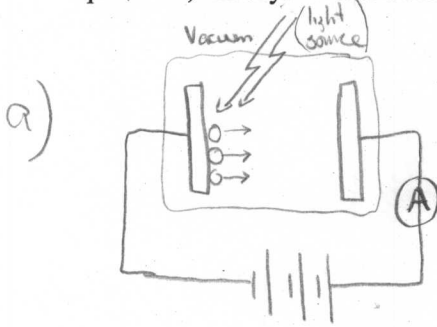
1. 4 1/2
2. 10
3. 10
4. _____

total 24 1/2 / 30

1. Photoelectric Effect

a) Sketch the apparatus used to measure the photoelectric effect and draw typical I-V curves for two different wavelengths of light and two different intensities. Indicate which is the longer wavelength and which is the greater intensity.

b) Explain what is surprising about the I-V curves from the viewpoint of classical (pre-quantum) theory. What does the experiment tell us about the nature of light?



$4^{1/2}$

b) Classical: -increase in Energy means Increase in Intensity

-however an increase in wave length means a lower Energy? X
relate to I-V curves ~~4~~ -4

$$I = \frac{1}{2} c \epsilon_0 E$$

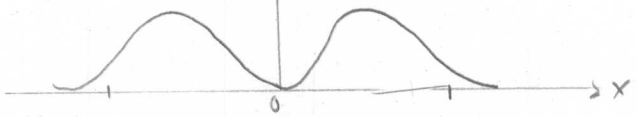
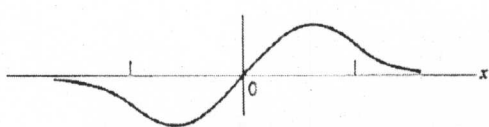
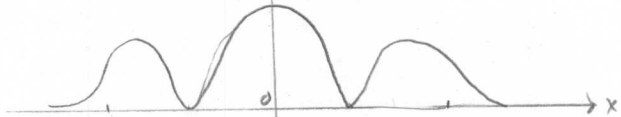
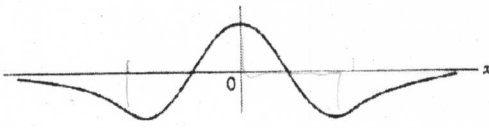
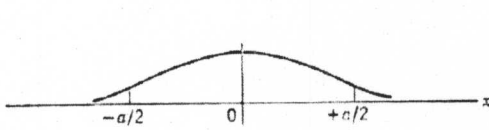
* This experiment shows the Particle like nature of light. ✓

2. Quantum Mechanics

a) In the quantum mechanical solution of an electron in the infinite square-well potential and the Coulomb potential, we found that the electron's energy is quantized. Explain what is meant by a quantized energy.

* quantized energy means that the energy can only have discrete states (non-continuous) values. ✓

b) A solution of Schrödinger's equation yielded the following wavefunctions. Sketch the probability density for the electron for each wavefunction.



c) Two wavefunctions are degenerate. What does that mean?

* It means that the two wave functions can have the same energy. ✓

