1. Light of wavelength 310 nm and intensity 1 W/m^2 is directed at a lithium surface with the work function of 2.5 eV. (4%) (a) Find the maximum kinetic energy of the photoelectrons (b) If 1% of the incident photons produce photoelectrons, how many are emitted per second if the lithium surface has an area of 1 cm^2? (4%)

2. Consider a moving electron with energy of 20-MeV experiences a magnetic field of 100 gauss perpendicular to its moving direction. What is the approximate radius of the path of this electron in this magnetic field? (8%)

3. Considering two stars in the universe, surface temperature of star A and star B are 3000 K and 6000 K respectively. And power radiated by star A is 100 times higher than that by star B. What is the size ratio of star A and star B? (8%)

4. Considering an excited quantum dot emits a photon with the wavelength of 600 nm within 1 ns following excitation. What is the minimum uncertainty in (a) energy (4%), and (b) wavelength of the emitted photon? (5%)

5. Calculate the expectation value for the first excited state of a harmonic oscillator. (7%)

6. A particle limited to the x axis has the form of $\Psi = \cos\frac{\pi x}{2}$ between x= -1 to +1. $\Psi = 0$ elsewhere. (1) Please find the probability that particle can be found between x=-0.4 to 0.6. (5%)　(2) Find the expectation value of $\langle x \rangle$ of the particle's position (-1 to 1). (5%)

7. For 3D confinement like a Quantum dot, an electron in box with size of 1nm, please find the permitted lowest energy (10%) . Infinite barrier assumption

8. Zeeman effect: The magnetic field will split energy state for $l \neq 0$. With 0.3T magnetic field (1) What is the energy separation of Zeeman components? (5%)

9. (1) Please write down the Plank radiation formula. (5%)　(2) at 1000K blackbody. What is the "photon number density" at 6000k for photon energy $h\nu = 2eV$ in the unit of $1/m^3/eV$. (5%)

C= 3×10^8 m/s
Electron mass= 9.1×10^{-31} kg
Electron charge= 1.6×10^{-19} C
Planck's constant= 6.626×10^{-34} Js

10. Consider the bipolar junction transistor (BJT) circuit shown in Fig. 1.
(a) (5%) Compare the i_c-V_{CE} characteristics (for different V_{BE}) with and without the Early effect (draw the curves on the same figure).
(b) (5%) Explain the physical origin of the Early effect in details.

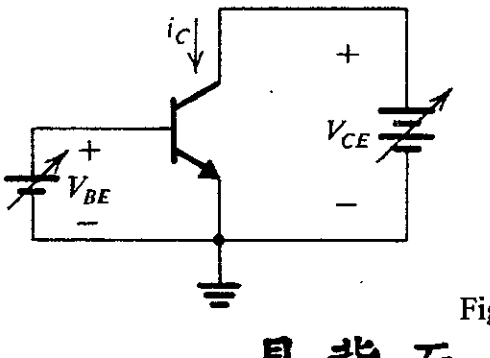

Fig. 1

見背面

11. For the circuit shown in Fig. 2, $\mu_n C_{ox} = 20\ \mu A/V^2$, $\mu_p C_{ox} = 5\ \mu A/V^2$, $V_{tn} = 1$ V, $V_{tp} = -1$ V, $W = 100\ \mu m$ and $L = 1.6\ \mu m$. Where μ_n and μ_p are the electron mobility and hole mobility, respectively. C_{ox} is the capacitance per unit area. V_{tn} and V_{tp} are the threshold voltages of n-channel and p-channel devices, respectively. W and L are the channel width and length, respectively.

(a) (8%) Find I_1 and V_2 in Fig. 2(a). Neglect the channel length modulation effect.

(b) (7%) Consider the circuit in Fig. 2(b). Find the small-signal voltage gain. Assume $V_{DD} = 10\ V$, $I_{REF} = 100\ \mu A$, $V_{An} = 80\ V$ and $|V_{Ap}| = 120\ V$, and Q_2 and Q_3 are matched. Where V_{An} and V_{Ap} are the Early voltages of n-channel and p-channel devices, respectively. v_i and v_o are the input and output voltages, respectively.

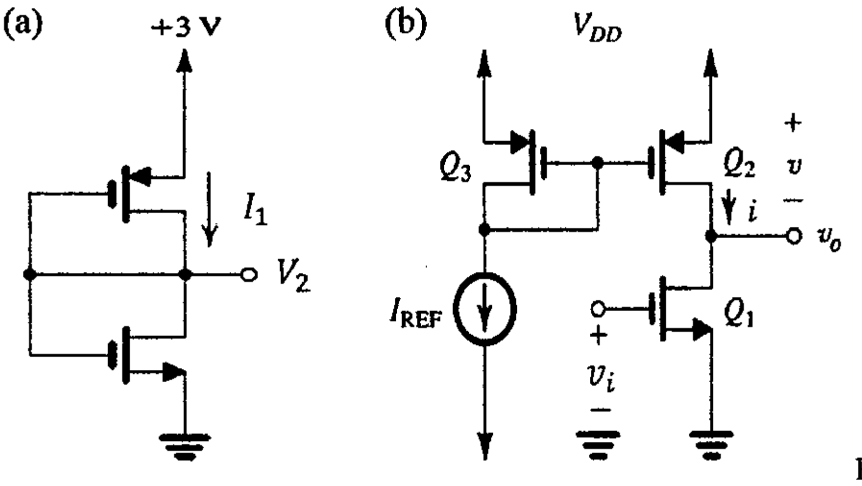

Fig. 2

試題隨卷繳回