1. In a nuclear fusion reaction two ^{2}H atoms are combined to produce one ^{4}He. (a) Calculate the decrease in rest mass in unified mass units. (b) How much energy is released in this reaction? (c) How many such reaction must take place per second to produce 1 W of power? (15 points)
2. In J.J Thomson's first method, the heat capacity of the beam stopper was about $5X10^{-3}$ cal/°C and the temperature increase was about 2 °C. How many 2000-eV electrons struck the beam stopper? (5 points)
3. (a) The current i due to a charge q moving in a circle with frequency f_{rev} is q f_{rev}. Find the current due to the electron in the first Bohr orbit. (b) The magnetic moment of a current loop is iA, where A is the area of the loop. Find the magnetic moment of the electron in the first Bohr orbit in units A-m^2. This magnetic moment is called a Bohr magneton. (10 points)
4. (a) The scattering angle for 50-eV electrons from MgO I 55.6°. What is the crystal spacing D? (b) What would be the scattering angle for 100-eV electrons? (10 points)
5. Please explain the working principal of pn tunnel diode. You can plot out the I-V curve and the band structure of pn tunnel diode of three regions. (10 points)
6. Please explain the Rayleigh scattering and Raman scattering. (10 points)
7. For electron in an infinite potential quantum well with width L = 1nm, (1) What is the ground state eigen energy of this electron in the unit of (eV) ? (6 points) (2) What is the probability of finding the electron in the interval of $\Delta x = 0.002L$ at (a) x=L/2, (b) x=2L/3 (c) x=L. Since Δx is very small, you do not need to do any integration. (9 points) (m_0=9.11 $\times 10^{-31}$ Kg, $\hbar = 1.05 \times 10^{-34}$J $\cdot$ s , $e_0 = 1.6 \times 10^{-19} Coul$)

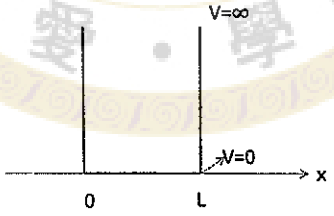

Fig. Q7

8. Consider the circuit shown below for the case with R= 1 kΩ. The power supply V^+ has a dc value of 10 V on which is superimposed a 60 Hz sinusoid of 0.1 V peak amplitude. Calculate both the dc voltage of the diode ($V_{D,dc}$) and the amplitude of the sine-wave signal ($v_{d,sin}$) appearing across the diode ($v_D = V_{D,dc} + v_{d,sin}$). Assume the diode to have a 0.7 V drop around 10 mA, thermal voltage = 25 meV, and n = 2. (10 points)

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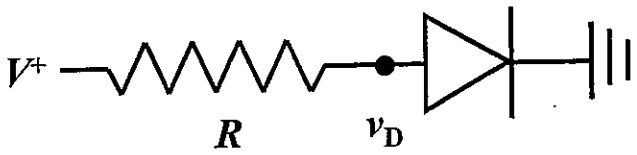

Fig. Q8

9. Choose the correct description(s): (15 points)
（每小題各三分，答錯不倒扣）
(a) MOSFET fabricated on an n-type substrate with p^+ region for the drain and source is called a NMOS transistor.
(b) v_{GS} and v_{DS} is negative of a PMOS transistor.
(c) For a NMOS transistor, current i_D enters the drain terminal and leaves through the source terminal.
(d) For the active mode of BJT, the emitter-base junction is reverse biased, and the collector-base junction is forward biased.
(e) Common-emitter BJT amplifier is also called emitter follower.

Parameters you may need to use:
^{2}H=1875.613 MeV
^{4}He=3727.397 MeV
e=1.602x10^{-19} C
C=3x10^8 m/s^2
h=4.135x10^{-15} eV·s
k=1.38x10^{-23} JK^{-1}
m_e=9.11x10^{-31} kg

試題隨卷繳回