

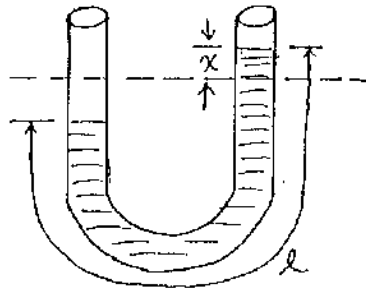
國立中央大學八十七學年度碩士班研究生入學試題卷

所別： 太空科學研究所 不分組 科目：

普通物理

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1. Water fills a length l of a U tube, as shown in the figure. The water is slightly displaced and then (18%) allowed to move freely. (a) Show that the liquid executes simple harmonic motion. (b) What is the period?



2. According to the *van der Waals* equation of state for one mole of a real gas. The pressure P and (12%) volume V at a temperature T are related by

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

where a and b are constants. Obtain an expression for the work done by the gas at a fixed value of T when the volume changes from V_i to V_f .

3. Use the classical expression relating linear momentum to kinetic energy to show that the de Broglie (18%) wave length of an electron with kinetic energy K is given by

$$\lambda = \frac{1.23nm}{\sqrt{K}}$$

where K is in electron volts.

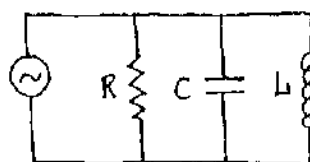
$$(m_e = 9.109 \times 10^{-31} \text{ kg}, \quad h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}, \quad e = 1.602 \times 10^{-19} \text{ C}.)$$

4. What is the distinction between Galileo's principle of relativity and Einstein's principle of (10%) relativity?

5. An electron is orbiting a proton in a hydrogen atom. A weak magnetic field is turned on normal to (18%) the plane of the orbit. Show that if the radius of the orbit is unchanged, the angular velocity changes by

$$\Delta\omega = \pm \frac{eB}{2m}$$

6. A resistor, an inductor, and a capacitor are in parallel with an ac source, as shown in the figure. (a) (18%) What is the relationship between the instantaneous potential differences across the elements? (b) How are the instantaneous currents related? (c) Calculate the impedance Z . (d) What is the resonance frequency at which, in this case, the impedance is a maximum.



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