

國立中央大學八十六學年度轉學生入學試題卷

全校

科目:

普通物理

共 2 頁 第 1 頁

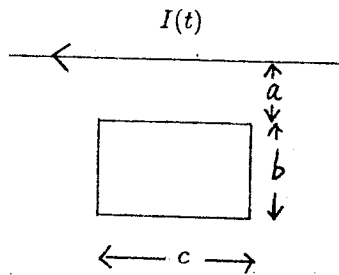
General Physics

Time: 80 minutes

You must show the steps clearly in order to get credits.

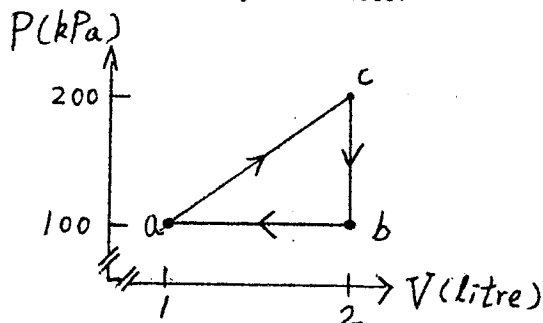
Some useful constants: $h = 6.626 \times 10^{-34}$ Js; $c = 3.0 \times 10^8$ m/s; $\epsilon_0 = 8.854 \times 10^{-12}$ F/m; $e = 1.6 \times 10^{-19}$ C; 1 litre = 10^{-3} m³; 1 kPa = 10^3 N/m²

- (1) A rectangular loop of size $b \times c$ is placed at a distance a from the wire as shown. The current in the wire varies with time as $I(t) = I_0/t$, where $I_0 > 0$. Find
- (8%) the magnetic flux through the rectangular loop;
 - (5%) the direction of the induced emf in the loop;
 - (7%) the induced emf in the loop.



- (2) (10%) A glass lens is coated on one side with a thin film of MgF₂ to reduce reflection from the lens surface. The index of refraction of MgF₂ is 1.38; that of the glass is 1.50. What is the least coating thickness that eliminates (by interference) the reflections at the middle of the visible spectrum ($\lambda = 550$ nm)? Assume the light is approximately perpendicular to the lens surface.

- (3) When a gas undergoes a process depicted as the straight line from a to c in the following figure, the heat flow into the system is 180J.



- (5%) Find the work done from a to c .
- (5%) If $U_a = 100$ J, find U_c .
- (5%) What is the work done by the gas when it returns to a via b (i.e. W_{cba})?
- (5%) What is the heat transfer in the process cba ?

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注：背面有試題

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共 2 頁 第 2 頁

- (4) (10 %) When a metal is illuminated with light of frequency f , the maximum kinetic energy of the photoelectrons is 1 eV. When the frequency is increased by 50%, the maximum kinetic energy increases to 3 eV. What is the threshold frequency for this metal?
- (5) A uranium nucleus (charge= $92 e$, mass= $238 u$) at rest decays to a thorium nucleus and an α -particle (charge= $2 e$, mass= $4 u$). Just after the decay, the particles are at rest and separated by $7.4 \times 10^{-15} m$.
- [a] (5%) What is the charge and mass of the thorium nucleus ?
- [b] (15%) Find the kinetic energy of each decay particle when they are infinitely far apart. Do not assume that the thorium nucleus stays at rest and do this problem non-relativistically.
- (6) Two spheres suspended by vertical cords, initially touch, are shown in the figure. Sphere 1 has a mass $m = 30g$ is pulled to the left to a height $h_1 = 8cm$, and then released. After swinging down, it collides elastically with sphere 2, whose mass $M = 75g$. Find
- [a] (5%) the velocity of sphere 1 just after the collision,
- [b] (5%) the height sphere 1 swing back to the left after the collision,
- [c] (5%) the velocity of sphere 2 just after the collision,
- [d] (5%) the height h_2 that sphere 2 swing to after the collision.

