1. Explain or define the following terms: (15分)

   (a) The SI units.   (b) The work-energy theorem

   (c) A conservative force   (d) The Gauss's law

   (e) The Ampere's law

2. How much work must be done to increase the speed of an electron (a) from rest to $0.5c$? (b) from $0.3c$ to $0.8c$? where c is the speed of light, and the rest mass of electron $m = 9.1 \times 10^{-31}$ kg. (8分)

3. A particle of mass $m = 2$kg is located at $\vec{r} = 3\vec{i} + 8\vec{j}$ (m) with a velocity of $\vec{v} = 5\vec{i} - 6\vec{j}$ (m/s), and the force acting on it is $\vec{F} = -7\vec{i}$ (N). Determine: (a) the angular momentum of the particle $\vec{\ell} = ?$ (b) the torque acts on the particle $\vec{\tau} = ?$ (c) the rate of the angular momentum of the particle changing with time $\frac{d\vec{\ell}}{dt} = ?$ (9分)

4. A circular loop of wire having a radius of 10 cm carries a current of 0.2A. A unit vector parallel to the magnetic dipole moment $\vec{\mu}$ of the loop is given by: $\frac{3}{5}\vec{i} - \frac{4}{5}\vec{j}$. If the loop is located in a magnetic field given by: $\vec{B} = 0.25\vec{i} + 0.3\vec{k}$ (T). Find: (a) the magnetic dipole moment $\vec{\mu}$ of the loop. (b) the torque on the loop. (c) the potential energy of the loop. (9分)

5. One mole of an monatomic gas is caused to go through the cycle shown in figure. (a) How much work is done in expanding the gas from a to c along path abc? (3分)

   (b) what are the change in internal energy
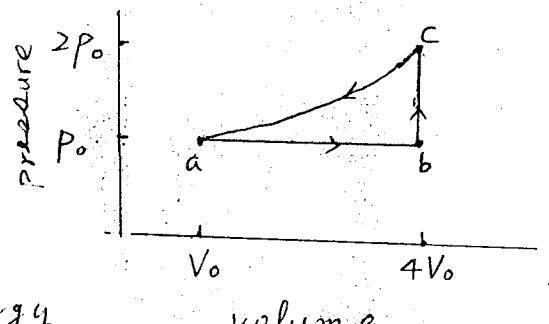
6 Define the following terms : (a) Acid rain (b) Photochemical smog (c) Breeder reactors (d) The second law of thermodynamics (e) Labile complex (活性)

7. Predict the number of unpaired electrons in $[CoCl_4]^{2-}$ complex ion (6%)
($Co-27$)

8 How many of NH_4Cl must be added to 1.0 L of 0.10M $NH_3(aq)$ to form a buffer whose pH is 9.00 ? (NH_3 $K_b=1.8\times10^{-5}$) (10%)

9. Calculate the standard free-energy change ΔG° for the cell reaction
$Cr_2O_7^{-2}(aq)+14H^+(aq)+6I^-(aq)\rightleftharpoons 2Cr^{3+}(aq)+3I_2(s)+7H_2O(l)$. if we have
$2Cr^{3+}(aq)+7H_2O(l)\rightleftharpoons Cr_2O_7^{2-}(aq)+14H^+(aq)+6e$ $E^\circ=-1.33$ V
$I^-(aq)\rightarrow\frac{1}{2}I_2(s)+e$ $E^\circ=-0.54$ V (10%)

10 Predict the product or products formed in each of the following reactions:
(a) $(CH_3)_2C=CHCH_3+HBr\longrightarrow$
(b) $\underset{}{\bigcirc}+CH_3CHClCH_3\xrightarrow{AlCl_3}$
(c) $CH_3CH=CHCH_2CH_3+O_2\xrightarrow{\Delta}$ (9%)