1. Dalton's atomic theory is stated as follows (5%)
   (1) All matter is composed of atoms, indivisible particles that are exceedingly small.
   (2) All atoms of a given element are identical, both in mass and in chemical properties. However, atoms of different elements have different masses and different chemical properties.
   (3) Atoms are not created or destroyed in chemical reactions.
   (4) Atoms combine in simple, fixed, whole-number ratios.

   and is not quite consistent with modern atomic theory. Restate Dalton's theory, taking into account modern discoveries about the atom.

2. In general, can we predict the effect of doubling the concentration of A on the rate of the overall reaction A + B —> C? Can we predict the effect if the reaction is known to be an elementary reaction? (5%)

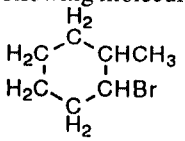
3. In SF_6, the sulfur atom has a share in 12 electrons. Explain why this observation is consistent with the principle behind the octet rule and give the shape of this molecule. (5%)

4. Describe the bonding and calculate the bond order in F_2^+ in terms of its molecular orbital-level diagram. (5%)

5. Explain briefly how you could determine the solubility product of CuI by using an electrochemical measurement. (5%)

6. What experiment supported de Broglie's description of the wave-particle duality? Calculate the wavelength of a proton (mass 1.67×10^{-24} g) having a velocity of 1.80×10^{8} cm·s^{-1}. ($h = 6.626 \times 10^{-34}$ J·s) (5%)

7. Does the following molecule exist as cis and trans isomers? As optical isomers? (5%)



8. Suggest a method for preparing the compound $C_6H_5CO_2H$ from any kind of alcohol. (5%)

9. (a) What raw material would you use to prepare sulfuric acid? (10%)
   (b) What anions are commonly found in metal ores?
   (c) If metalloid X forms a hydride with the formula XH_4, what element is it likely to be?
   (d) How many electrons can occupy a molecular orbital?
   (e) Why do elements in the same group have similar chemical properties?

10. Write a complete, balanced equation for each of the following reactions. (10%)
   (a) Molecular fluorine reacts with sulfur trioxide gas to yield SO_3F_2.
   (b) Magnesium carbonate is heated to drive off carbon dioxide and leave behind a white residue.
   (c) Propene is treated with water in the presence of dilute acid.

(背面仍有題目,請繼續作答)

11. (a) What is the difference between a covalent bond and a coordinate covalent bond? (10%)
(b) Distinguish between low-spin and high spin complex.
(c) Explain why Mn(II) is a much poorer reducing agent than either Cr(II) or Fe(II).
(d) Give the oxidation number and coordination number of the central metal ion in the coordination compound $[Co(NH_3)_5NO_2](NO_3)_2$.

12. Aluminum bronze is an alloy containing Al and Cu and is considered to be a solid solution. A piece of this alloy is reacted with excess NaOH which removes the Al. 0.05559 mol of H_2 is produced. The Cu remaining is filtered off and dried to weigh 9.001 g. The alloy has a density of 7.60 g/mL. Calculate the molarity (M) of Al in this alloy. (Atomic weight: Al 26.9815; Cu 63.546) (10%)

13. A sample of Freon-11 is vaporized at 50.0 °C and 760.0 torr in a flask with only a small opening, then cooled to 0 °C to condensed any Freon-11 vapor remaining in the flask. The flask is then filled with water. The following data were obtained: Mass of flask before Freon-11 was added = 92.3162 g
Mass of flask and condensed Freon-11 = 93.5205 g (10%)
Mass of flask filled with water at 25 °C = 328.0 g
Give the accurate molecular weight of Freon-11. If the composition of Freon-11 is C, 8.74%; Cl, 77.43%; F, 13.83, What is the molecular formula? (Atomic weight: Cl 35.5; F 19.0)

14. The kinetics of the reaction $2I^-_{(aq)} + 2VO_2^+{}_{(aq)} + 4H^+_{(aq)} \longrightarrow I_{2(aq)} + 2VO^{2+}_{(aq)} + 2H_2O_{(l)}$ was studied by the method of initial rates, and the following data were obtained at 25 °C:

Initial concentrations (M)			Initial rate
$[I^-]_o$	$[VO_2^+]_o$	$[H^+]_o$	(M/s)
0.0020	0.010	0.10	2.60×10^{-8}
0.0040	0.010	0.10	5.21×10^{-8}
0.0020	0.020	0.10	5.19×10^{-8}
0.0020	0.010	0.050	6.50×10^{-9}

Deduce the rate law for this reaction. Calculate the rate constant and specify its unit. (10%)