1. Using carbonate ion as an explain (a) how resonance structures are used to describe the structure of carbonate ion, (b) write formal charges of this ion. (5 points)

2. The N_2^+ ion can be prepared by bombarding the N_2 molecule with fast-moving electrons. Predict the following properties of N_2^+: (a) molecular orbital configuration (b) bond order (c) magnetic character, and (d) bond length is longer or shorter than the bond length of N_2. (10 points)

3. Deduce to which AX_nE_m type each of the following molecules belongs, and hence predict the shape: (a) PCl_3 (b) SiH_4 (c) BF_3 (d) BeH_2. (10 points)

4. Name five compounds, which show semiconducting property (5 points)

5. Show that the following magnetic susceptibility data for Ni fit the Curie-Weiss Law:

T(K)	800	900	1000	1100	1200
$\chi \times 10^{-5}$	3.3	2.1	1.55	1.2	1.0

Evaluate T_c (Curie temperature) or θ (weiss constant) and C (Curie constant). (10 points).

6. What is the " laser"? What are the general requirements for a solid material that is to be used as a laser source? (10 points)

7. Polymer industry classifies polymers in several different ways. Please explaining the terms and give an example of each of the following: (5 points)
   (a) Thermoplastics (such as ?)
   (b) Thermosetting (such as ?)
   (c) Addition polymers (such as?)
   (d) Condensation polymers (such as?)
   (e) Liquid crystalline polymers (such as?)

8. Please **draw** the monomer formula and gives abbreviation (PE for polyethylene, for example) of the following addition polymers (6 points)
   (a) Polypropylen
   (b) Polyacrylonitrile
   (c) Polystyrene
   (d) Poly(vinyl acetate)
   (e) Poly (methyl methacrylate)
   (f) Polytetraflouroethylene

9. Saran is a copolymer of 1,1-dichloroethene and chloro-ethene (vinyl chloride). **Draw** a possible structure for this copolymer (4 points).

10. Polymeric materials are characterized by two major types of transition tempertures- the crystaline melting temperature Tm and the glass transition temperature Tg. Please
(a) give physical descriptions of the two transitions.
(b) Will Tg always lower than Tm?
(c) What factors in polymers affected Tg
(d) What factors in polymers affected Tm?
(e) Give at least two methods (and explain briefly) in determining the two temperatures. (10 points)

Please use one sentence to answer each of the following four questions.

11. The following are data obtained on the rate of product formation of an enzyme-catalyzed reaction:

TEMPERATURE (∘)	RATE OF PRODUCT FORMATION (M/s)
10	0.0025
20	0.0048
30	0.0090
35	0.0086
45	0.0012

Comment on the dependence of **rate** on **temperature**. (5 points)

12. If untreated, fevers of 42℃ or **higher** may lead to **brain damage. Why?** (5 points)

13. What is the sequence of a **mRNA** molecule produced from a DNA template strand with the following composition? **5'-ATTGCTCAGCTA-3'** (5 points)

14. In repeated attempts to synthesize the dipeptide **Val-Leu**, aspiring peptide chemist Chen Min performs each of the following operations. **Explain what, if anything, is wrong with each procedure.**
(a) The cesium salt of **leucine** is allowed to react with chloromethylated polystyrene (Merrifield resin). The resulting derivative is treated with Boc-Val and DCC, then with liquid HF. (5 points)
(b) The cesium salt of **Boc-Leu** is allowed to react with the Merrifield resin. The resulting derivative is then treated with Boc-Val and DCC, then with liquid HF. (5 points)