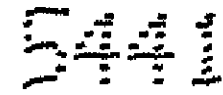


ENGINEERING - MATERIALS AND TECHNOLOGY
(Higher Level - 300 marks)



FRIDAY, 26 JUNE, AFTERNOON 2.00 to 5.00

Answer Question 1, Sections A and B, and Four other questions.

1.

(100 marks)

SECTION A - 50 marks

Give brief answers to any ten of the following:

- (a) Describe the toxic hazards associated with:

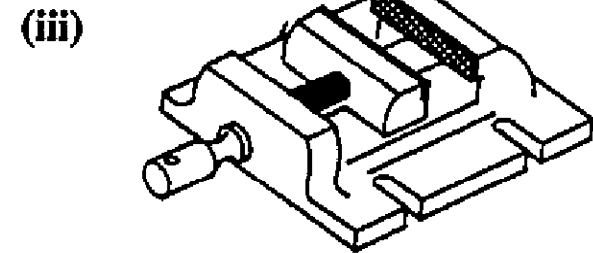
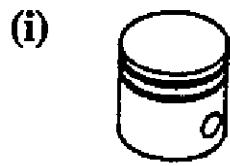


- (i) adhesives and
(ii) cutting fluids.

- (b) Distinguish between Pyrometallurgy and Hydrometallurgy.

- (c) Give an example of any quality control used in industry.

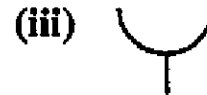
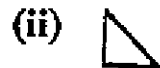
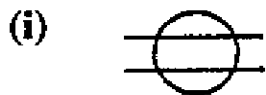
- (d) State the process used to manufacture any two of the following:



- (e) What is age hardening?

- (f) Describe electrical conduction in the metallic bond.

- (g) Identify any two of the weld symbols:



- (h) Distinguish between electronic circuit construction using breadboard or veroboard.

- (i) What is sacrificial protection of metals?

- (j) What is meant by metal *fatigue*?

- (k) Distinguish between crystalline and amorphous polymers.

- (l) Explain any two of the computer terms below:

- (i) address (ii) peripheral units (iii) digitizer.

- (m) Suggest an inventor associated with the development of one of the following;

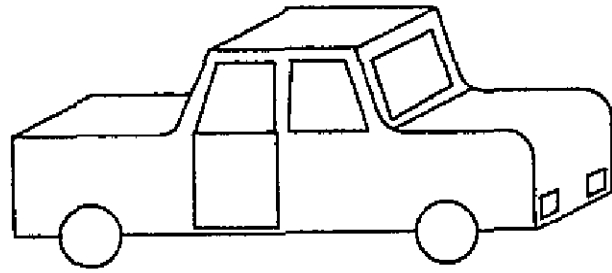
- (i) wind tunnel (ii) computer (iii) transistor.

SECTION B - 50 marks

Answer **all** of the following:

(n) Compare the aerodynamic characteristics of the following design models:

(i)



(ii)



Briefly describe the function and operation of a wind tunnel.

(o) Select and compare **any two** of the following modelling categories:

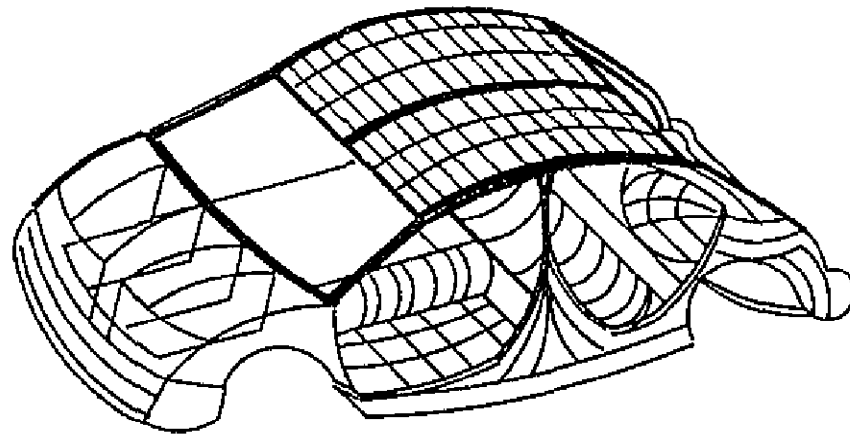
(i) Sales models;

(ii) Test models;

(iii) Layout models;

(iv) Aesthetic/Ergonomic models.

(p) State **two** advantages of using 3D computer aided design in modelling as shown.



(q) Distinguish between Qualitative and Quantitative types of test model.

(r) Select **any three** terms below relating to the development and testing of prototypes and models and explain their meaning:

(i) Development Hacks;

(ii) Ultraviolet ray exposure;

(iii) Endurance tests;

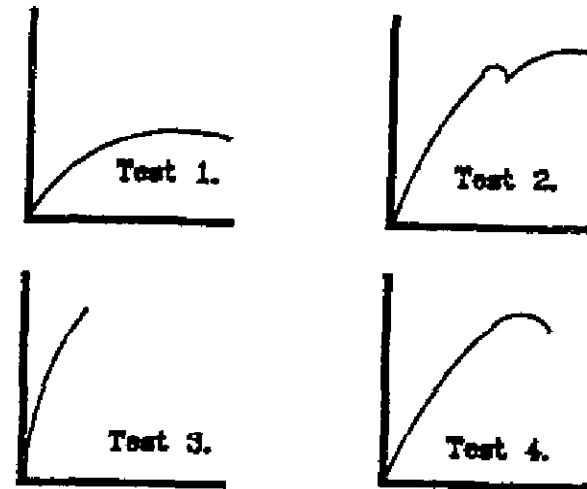
(iv) Deflection tests;

(v) Rolling road tests;

(vi) Simulated assembly;

(vii) Clay models or Balsa wood.

- (a) The results of four separate tensile tests are shown in graphical form. Discuss the results using the following guidelines:
- properties of each sample tested;
 - type of materials.



- (b) Compare two toughness tests referring to:
- test arrangement;
 - energy utilised.
- (c) (i) A non-destructive test is represented diagrammatically in Fig. 2. Outline the principles of the test and suggest a suitable application.

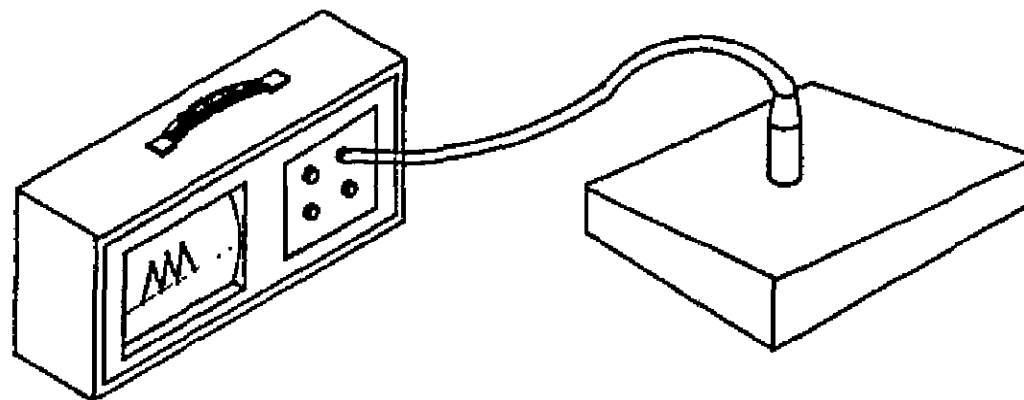


FIG. 2

- (ii) Compare eddy current testing with the magnetic particles test. Suggest a suitable application for each test.

3.

(50 marks)

- (a) The microstructures of grey and white cast iron are shown. Distinguish between the two. Reference must be made to microstructures, properties and uses.

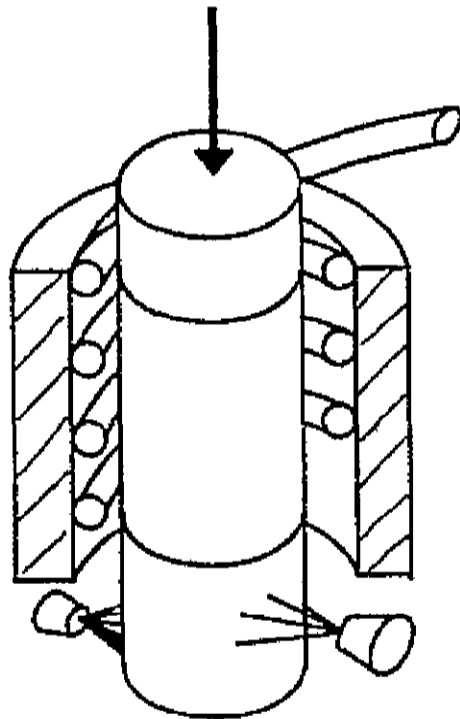


- (b) With reference to the cubic form of crystallisation, discuss:
- (i) The two common forms;
 - (ii) Characteristics and properties;
 - (iii) Slip planes.

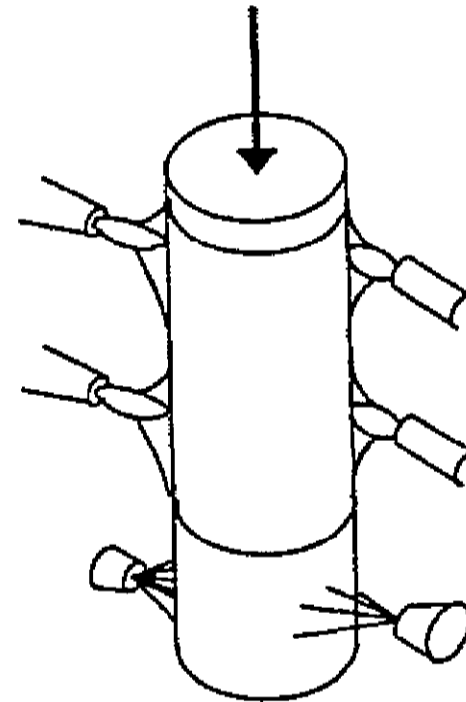
In the normal crystal structure of metals what is the *ability to exist in two forms* called?

- (c) Select one of the heat treatment processes shown and describe it.

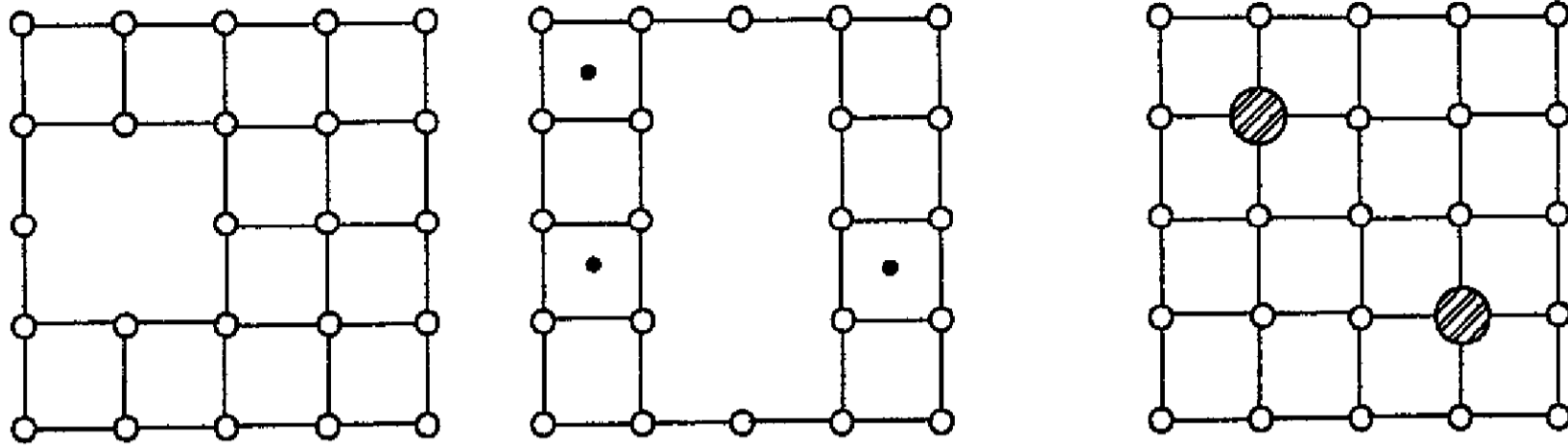
(i)



(ii)

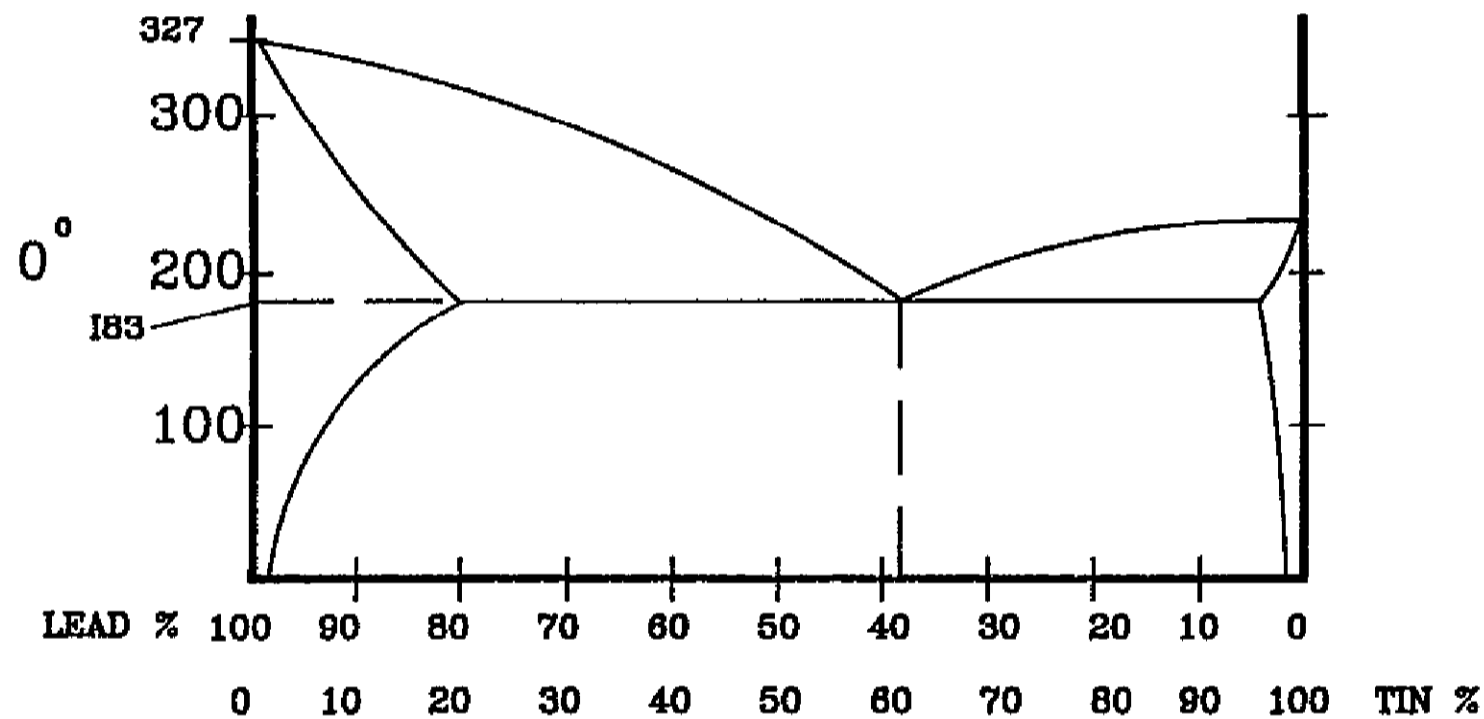


(a) Name any three crystal defects shown below:



Suggest how one defect is used to maximum advantage.

(b) Copy the given equilibrium diagram into your answer book and answer each of the questions below:

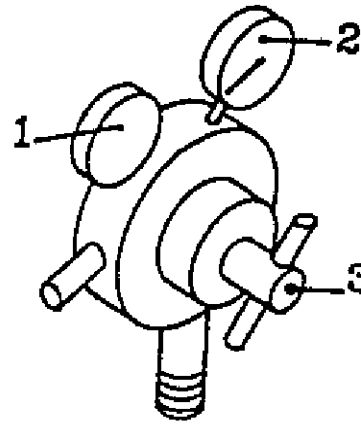


- (i) Identify and explain the liquidus, solidus, solvus and the eutectic points;
- (ii) Referring to the diagram identify tinmans solder and state its melting temperature.
- (c) For an alloy with 30% tin, determine from the diagram the following:
- (i) the composition of the phase at 250°C;
- (ii) the ratio of the phases at 250°C.

5.

(50 marks)

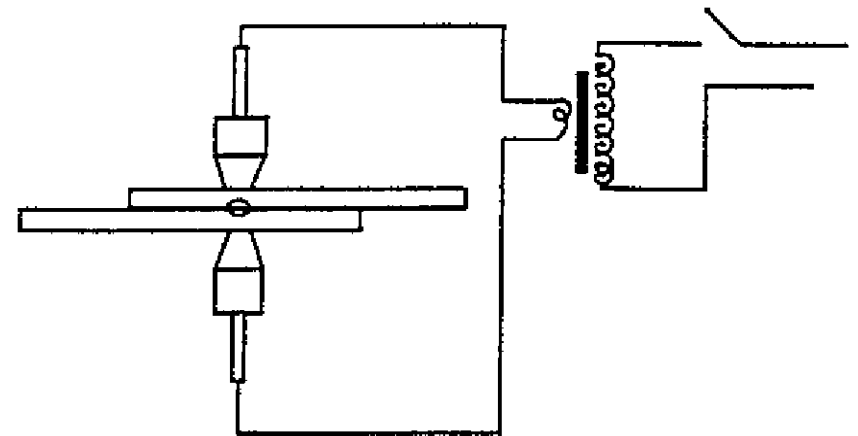
- (a) Explain the function of each numbered item shown on the welding regulator.



- (b) Briefly describe the following defects in manual metal arc welding and suggest a cause and a remedy in each case:

- (i) slag inclusions;
- (ii) porosity;
- (iii) lack of penetration.

- (c) Discuss the principles, function and applications of the welding process shown.



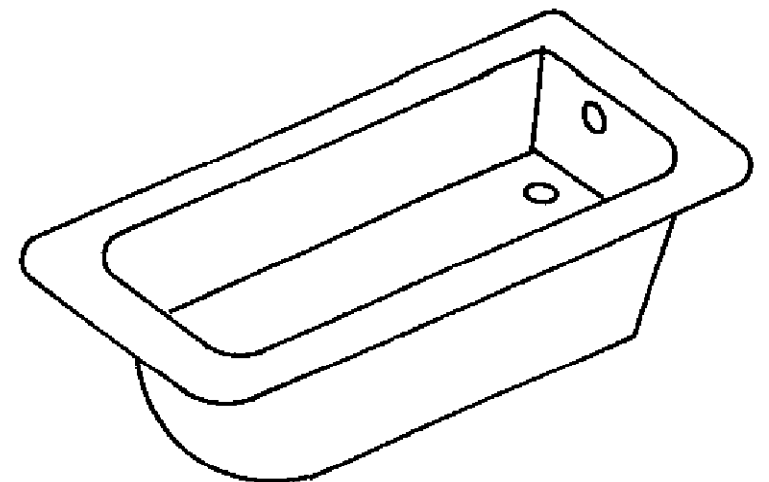
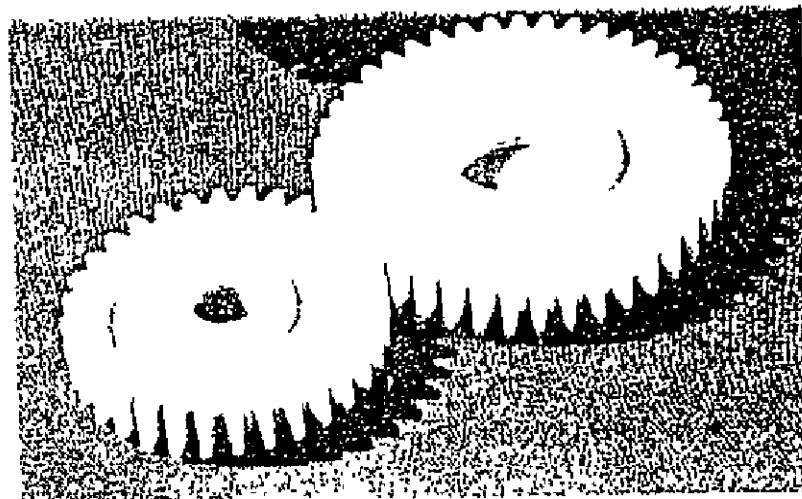
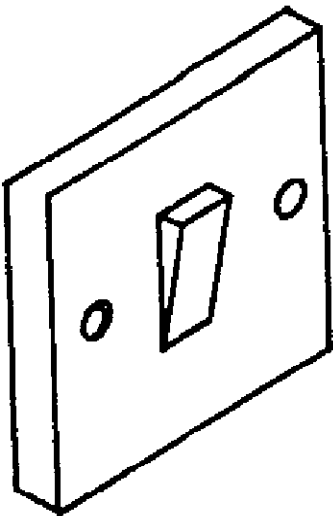
OR

- (c) (i) State four advantages of robotic control in welding and briefly describe an application suited to this type of control;
- (ii) Explain the meaning of the "Lead through" method of robot programming.

6.

(50 marks)

- (a) Select any two plastic items below:



Describe each selected in terms of (i) polymer type used (ii) properties and (iii) manufacturing process.

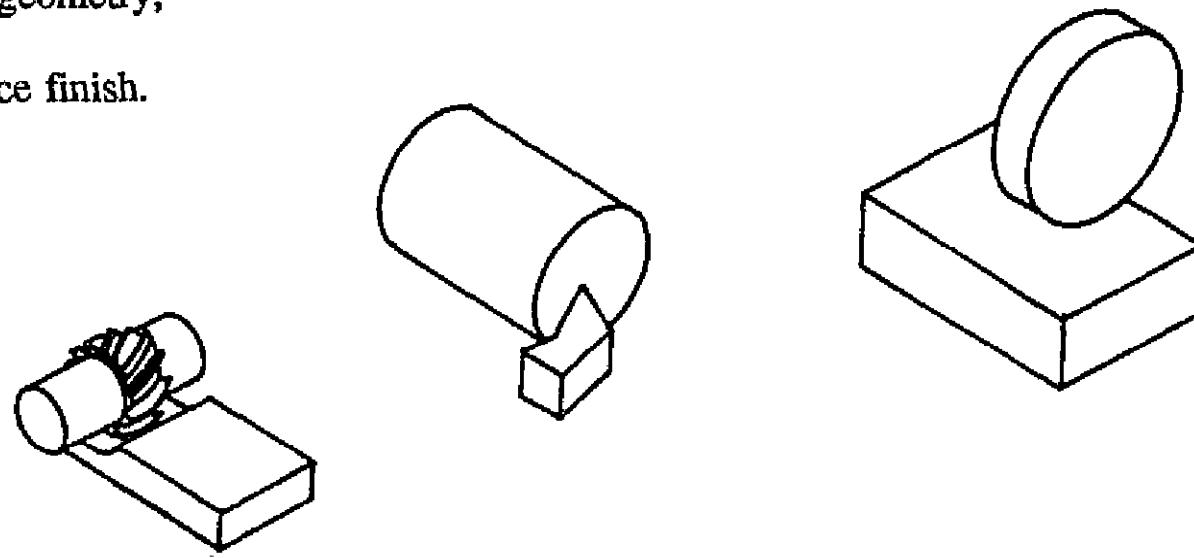
- (b) Choose any four of the terms below and explain their meaning:

(i) cross linking; (ii) laminate; (iii) elastomeric; (iv) GRP; (v) dielectric; (vi) calendaring.

- (c) Describe the *addition polymerization* process.

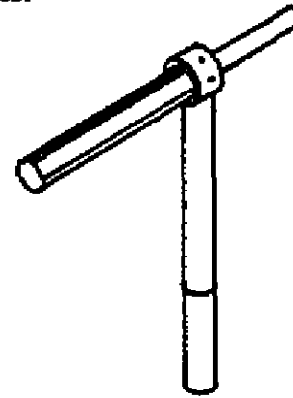
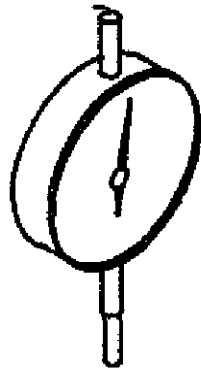
- (a) Flat surface machining may be carried out by any one of the methods shown. Compare any two using the following headings;

- (i) Tool geometry;
(ii) Surface finish.



- (b) Answer any two of the following:

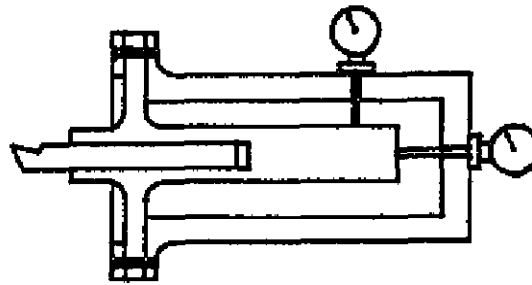
- (i) Describe one function for each gauge shown:



- (ii) Compare the effects of negative rake tool geometry with positive rake angles, as shown, when cutting;



- (iii) Explain the function and operation of the simplified Dynamometer shown.



- (c) Distinguish clearly between forming and generating.

OR

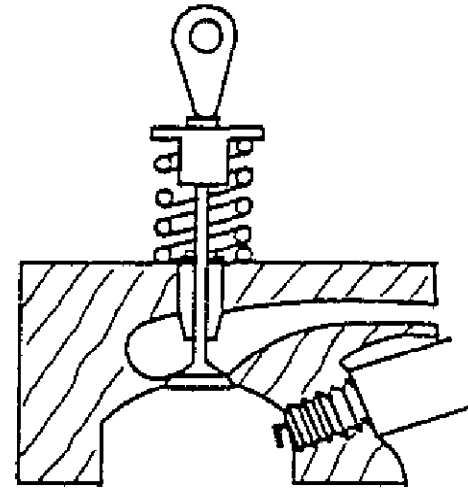
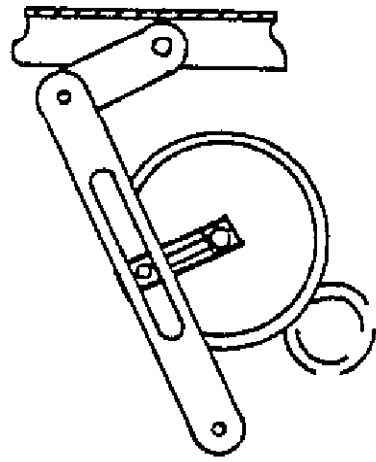
- (c) Compare conventional machining with computer numerical controlled machining.

8.

(50 marks)

(a) Select one mechanism below and answer each of the following:

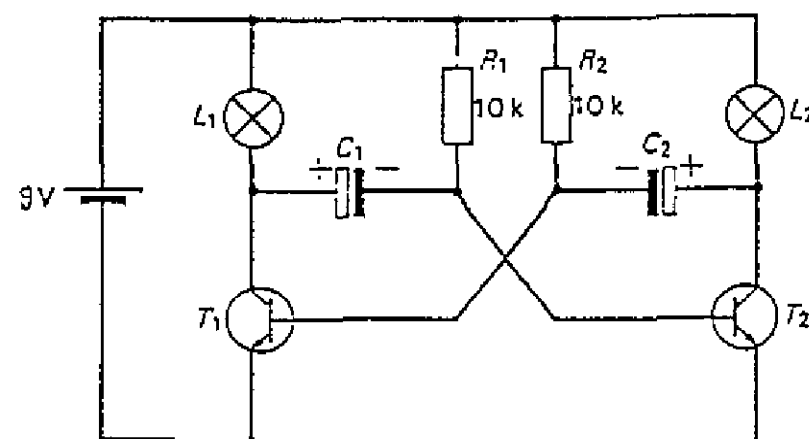
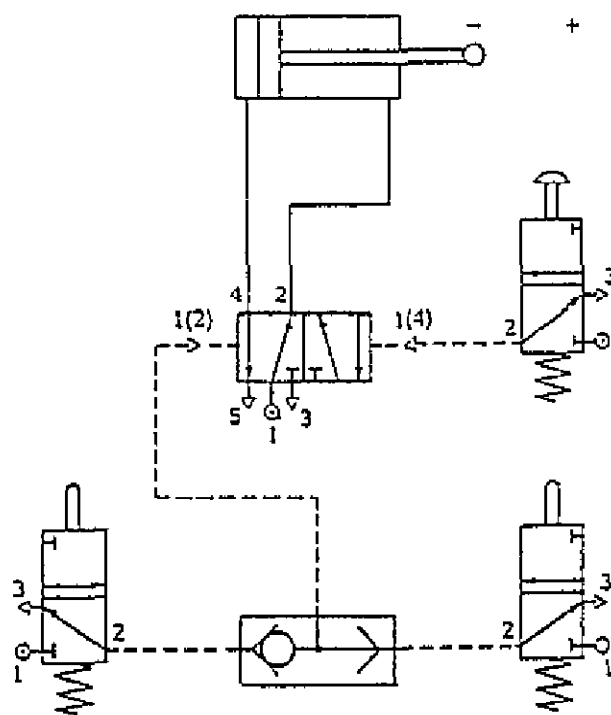
(i) mechanism name; (ii) operation; (iii) application.



(b) Describe the principle function of any three of the following:

- (i) compound gear train;
- (ii) mechanical clutch;
- (iii) solenoid;
- (iv) programmable logic controller;
- (v) pneumatic sequencer.

(c) Explain the operation and suggest an application for the pneumatic circuit or the electronic circuit shown below:



OR

(c) Explain how any machine tool slide may be operated automatically.