

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

5980

FRIDAY, 27 JUNE, 2.00 to 5.00

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

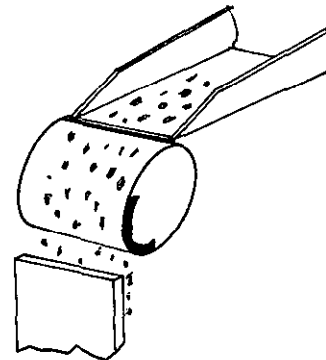
1.

(100 marks)

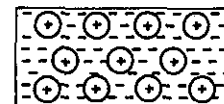
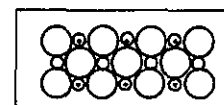
SECTION A - 50 marks

Give brief answers to any ten of the following:



- (a) Explain the systemic effects of toxic materials.
- (b) Describe the method of ore dressing in the sketch shown.
- (c) What causes creep in metals?
- (d) What is meant by Factor of Safety?



- (e) Distinguish between the two types of bond structures shown.
- (f) Explain the term Cathodic Protection.
- (g) Name the processes used to manufacture:



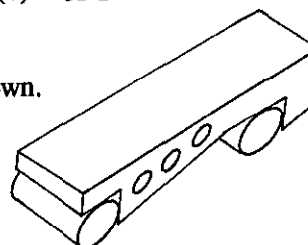
- (i) Electrical wire (ii) Connecting rods (iii) Acrylic sheet.

- (h) Identify the electronic symbols: (i)  (ii) 

- (i) State two disadvantages in using an adhesive for joining.
- (j) Name three methods employed in the disposal of waste plastics.
- (k) Select any three abbreviations and explain their meaning.

- (i) PLC (ii) ALU (iii) PTFE (iv) ROM (v) CPU

- (l) Name and describe the function of the device shown.



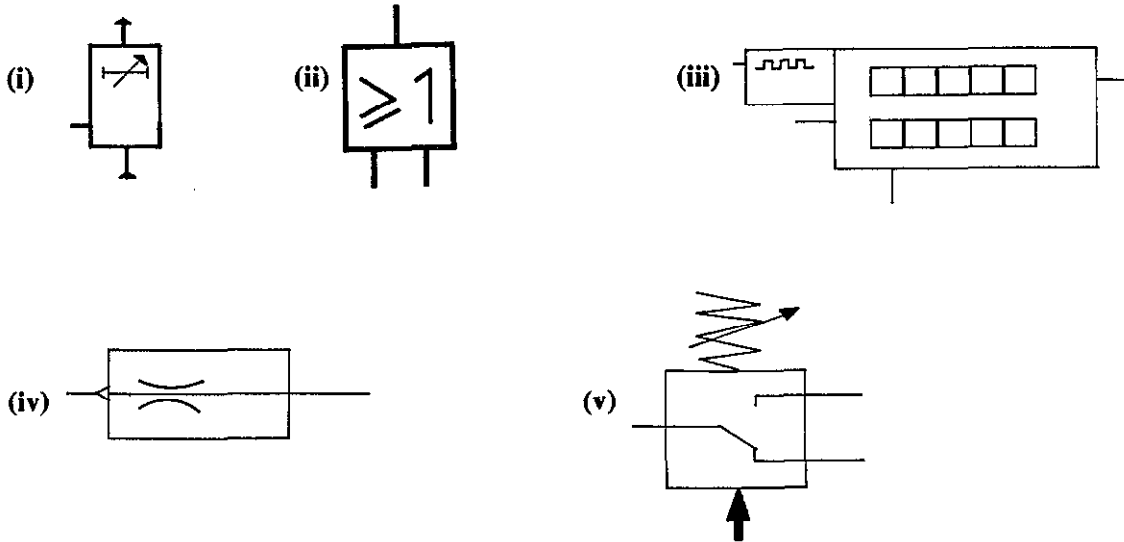
- (m) Outline a contribution to technology by one of the following:

- (i) Victor Popp (ii) Germaine Sommeiller (iii) Blaise Pascal.

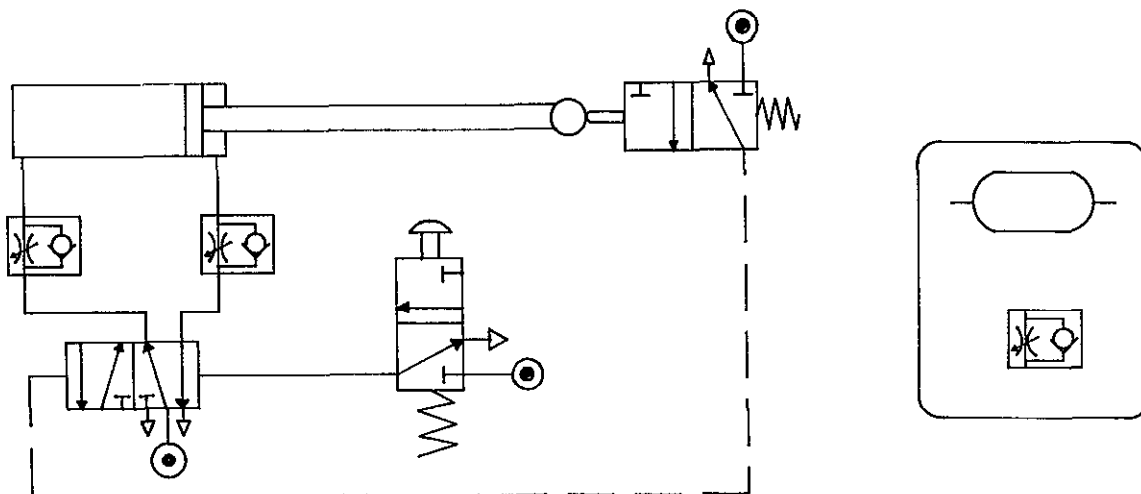
SECTION B - 50 marks

Answer all of the following:

- (n) Explain why time delays are vital in the safe operation of an automated pneumatic system?
- (o) Identify any three of the pneumatic symbols shown and state a specific function for each one.



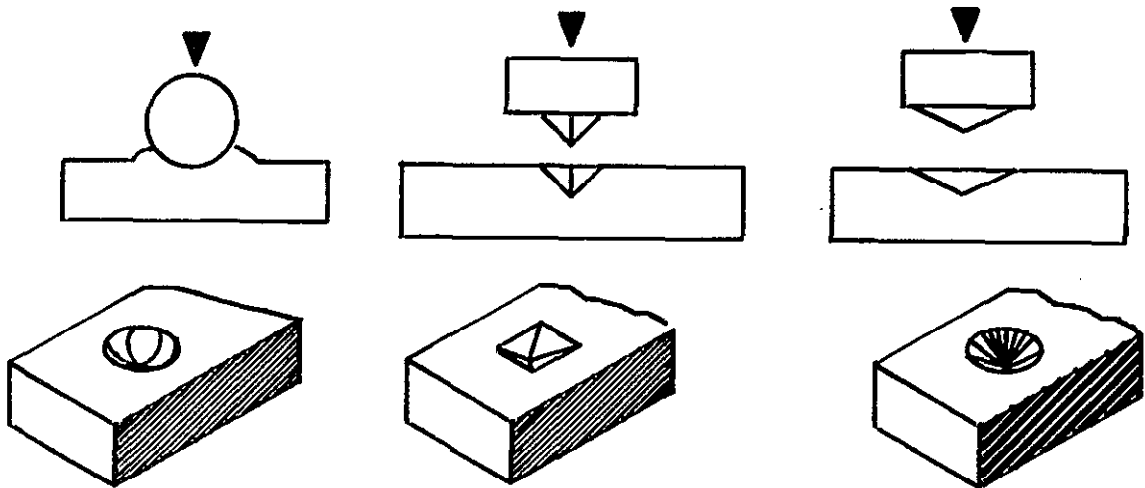
- (p) What role would pneumatic and electronic sensing devices play in creating time delays? Illustrate your answer.
- (q) Describe the two main factors influencing pressure build up in a reservoir.
- (r) Redraw the given circuit diagram in your answer book. The two given pneumatic components (drawn in symbolic form) should be included, in the optimum position, for maximum time delay on instroke of piston. Suggest a practical application for your circuit.



- (a) (i) List three elements of poor design that may contribute to early failure in components.
- (ii) Describe a test procedure based on *Pulse Reflection*.
- (b) Explain the principles of any two of the tests shown below.

Refer in particular to:

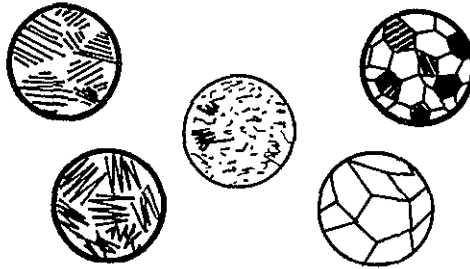
- (i) Basis for results;
- (ii) Specific name of test;
- (iii) Distinguishing features.



- (c) Identify the type of non-destructive test most suitable for each of the following defects.
- (i) Surface cracks in Ferro-Magnetic materials;
- (ii) Internal flaws in welds;
- (iii) Surface cracks in Non-Ferrous materials.

(a) Select the most suitable microstructure shown to illustrate an explanation of the following structures:

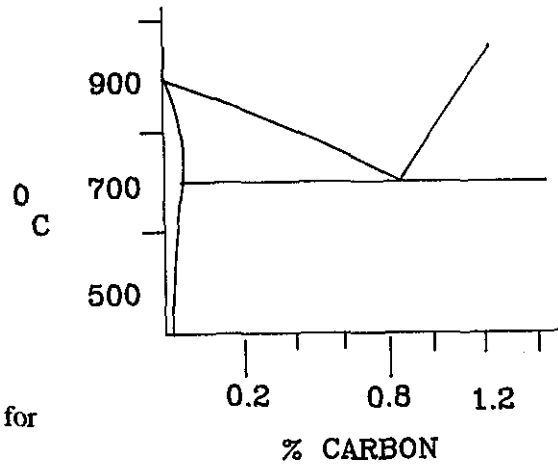
- (i) Martensite;
- (ii) Ferrite and Pearlite;
- (iii) Ferrite;
- (iv) Pearlite and Cementite.



(b) Redraw the given iron - carbon diagram into your answer book.

Define the terms:

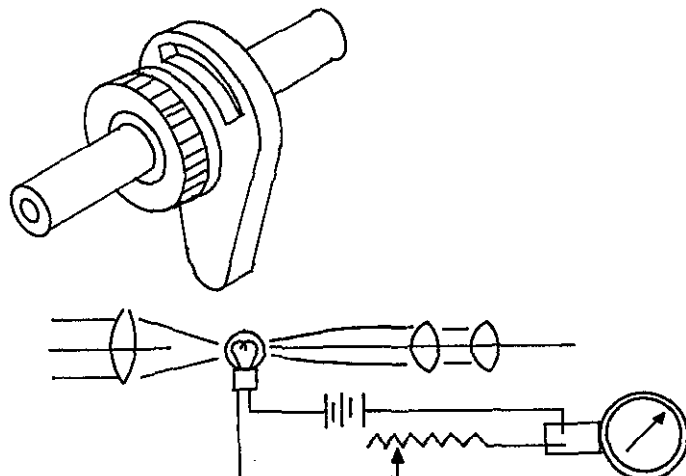
- (i) Stress relieving;
- (ii) Normalising;
- (iii) Annealing.



Indicate the temperature zones for each process on your diagram.

(c) With reference to the instrument shown below, discuss its characteristics under the following headings:

- (i) Name and function;
- (ii) Method of operation;
- (iii) Advantages/Limitations.



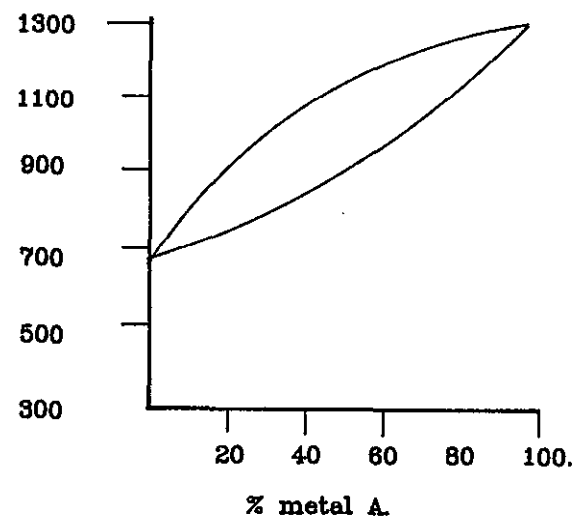
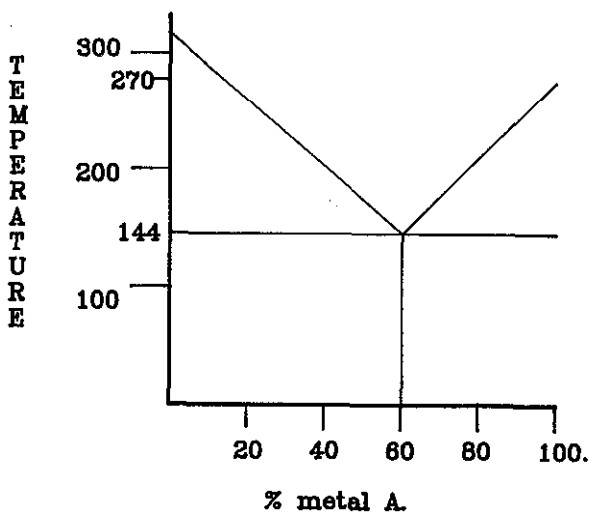
(a) Describe one of the following:

- (i) Age hardening;
- (ii) Slip in crystals.

(b) Simplified thermal equilibrium diagrams for two different Alloy systems are shown.

Copy the given diagrams into your answer book and compare both systems under the following headings:

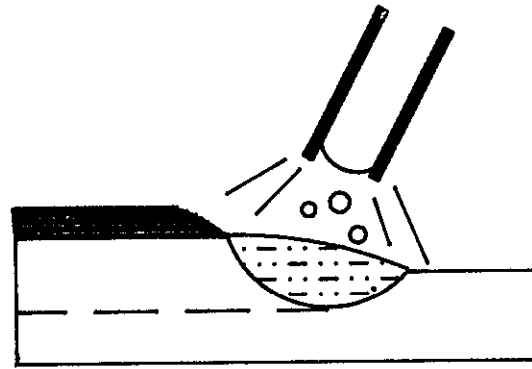
- (i) Degrees of solubility;
- (ii) Regions and features;
- (iii) Typical alloying elements.



(c) With reference to the diagram on the right hand side above, determine for a 40% metal A, the ratio of the phases at 900°.

(a) Explain a function and advantage of the following in relation to metal arc welding.

- (i) Multi runs;
- (ii) Shielded arc;
- (iii) Edge preparation;
- (iv) Slag.



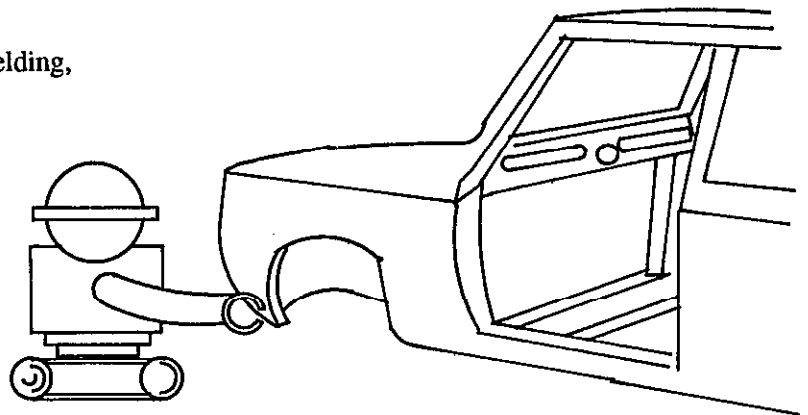
(b) Differentiate clearly between Primary and Secondary combustion in oxy-acetylene welding.

(c) Compare Metal Inert Gas welding with Tungsten Inert Gas welding.

OR

(c) Referring to robotic control in welding, explain the following:

- (i) Yaw or Roll;
- (ii) Machine vision;
- (iii) Working envelope.



6.

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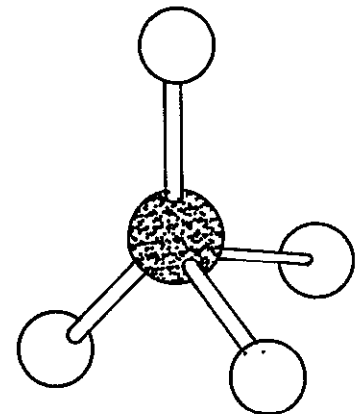
(a) Distinguish between the structure of:

- (i) an amorphous polymer;
- (ii) a crystalline polymer.

Outline the effects of these structures on the properties of plastics.

(b) Explain each of the following terms:

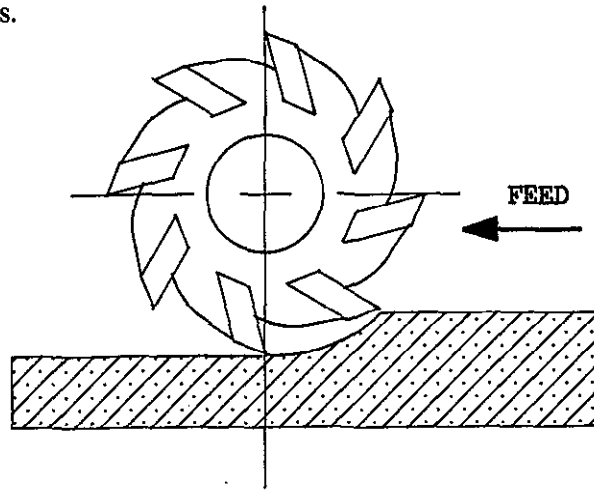
- (i) Vulcanisation;
- (ii) Parison;
- (iii) Secondary bonding;
- (iv) Covalent bonding.



(c) Compare Compression Moulding with Injection Moulding.

- (a) List the positive effects of using cutting fluids.

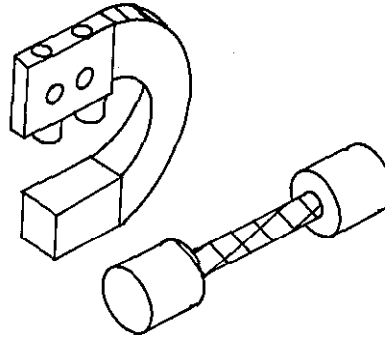
Define the terms: (i) Rancidity; (ii) Irritant.



- (b) Compare Upcut and Downcut milling. Identify the example shown.

- (c) Answer any two of the following:

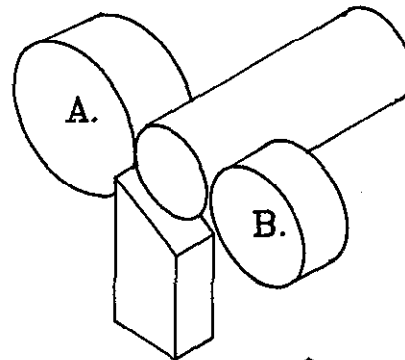
- (i) What are the functions of the two gauges shown and briefly compare direct and comparative measurement.



- (ii) Explain the surface symbol shown.



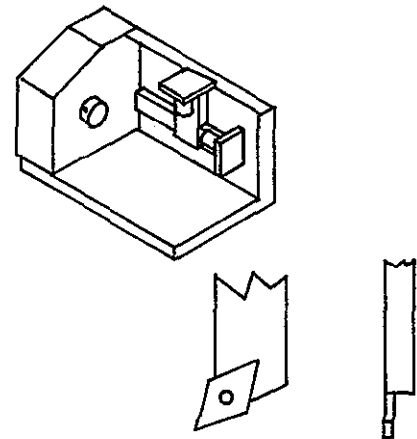
- (iii) Identify and briefly describe the grinding process shown. Name parts A and B.



OR

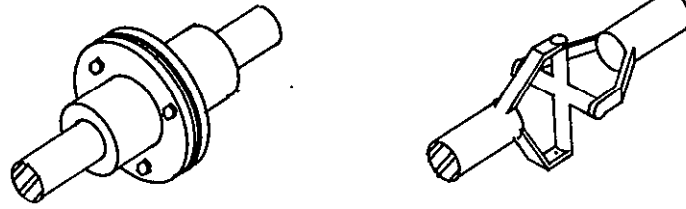
- (c) With reference to CNC machining, answer each of the following:

- (i) Explain the function of a stepper motor;
- (ii) Distinguish between an M99 and a G91 code;
- (iii) Identify the two tools shown and discuss the advantages of carbide inserts.



(a) Answer any three of the following:

(i) Distinguish between the two shaft couplings shown below.



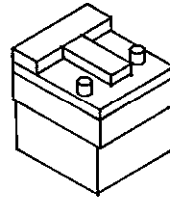
(ii) Compare the two gear systems shown below.



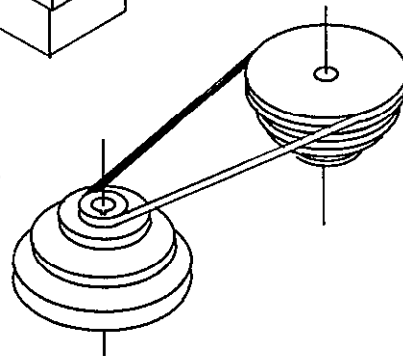
(iii) Describe an application of each thread form shown below.



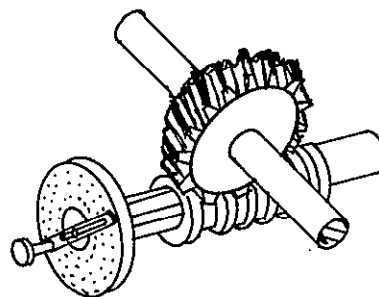
(iv) Identify the energy conversion which occurs in the battery shown.



(b) The diagram shows the pulley belt drive arrangement for a drilling machine. Explain how maximum drill speed is achieved? Suggest how slippage might be reduced.



(c) Describe the operation and function of the mechanism below.



OR

(c) Name the electronic device shown. Explain the terms (i) Monostable; (ii) Bistable.

