



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION, 2004

ENGINEERING - MATERIALS AND TECHNOLOGY

(Higher Level - 300 marks)

THURSDAY, 24 JUNE, AFTERNOON 2.00 - 5.00

INSTRUCTIONS

- 1.** Answer **Question 1, Sections A and B** and **FOUR** other questions.
- 2.** All answers must be written in ink on the answer book supplied.
- 3.** Diagrams should be drawn in pencil.
- 4.** Squared paper is supplied for diagrams and graphs as required.
- 5.** Please label and number carefully each question attempted.

1.

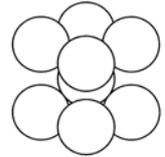
(100 marks)

SECTION A – 50 MARKS

Give **brief answers** to **any ten** of the following:

- (a) Differentiate between pyrometallurgy and hydrometallurgy.
- (b) What contribution did **any one** of the following make to technology:
(i) Gustaf Dahlen , (ii) Wilhelm Roentgen , (iii) Henry Maudsley.

- (c) Identify the crystal structure shown and name **one** metal based on this structure.



- (d) Name **any three** methods employed in the disposal of waste plastic.

- (e) Name and suggest a suitable application for **one** of the thread forms shown.

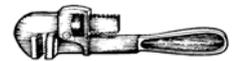


(i)

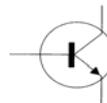
(ii)

- (f) Outline the main properties of a metallic bond.
- (g) Select **any two** of the abbreviations shown and explain their meaning:
(i) LCD (ii) CD-ROM (iii) ISP (iv) DOS .

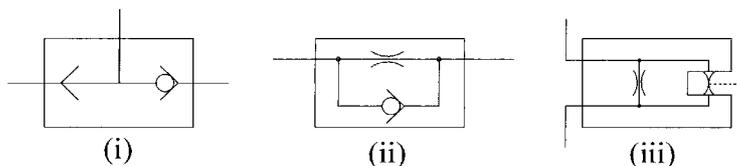
- (h) State the main process used to manufacture the wrench shown.



- (i) Distinguish between crystalline and amorphous structures.
- (j) Identify and state the purpose for the electronic component shown.



- (k) Explain the meaning of the term *soaked* in relation to annealing.
- (l) Outline the difference between generating and forming in machining.
- (m) Identify **any one** of the pneumatic symbols shown.



SECTION B – 50 MARKS

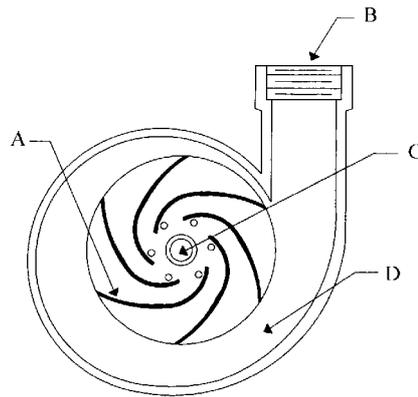
Answer **all** of the following:

(n) Outline the principle of operation of a centrifugal pump.

(o) With reference to the diagram shown below:

(i) Name the components A, B, C and D.

(ii) Describe the function of **any two** components named.



(p) Describe the energy conversion that occurs during the operation of a centrifugal pump.

(q) Differentiate between **any two** of the following:

(i) Radial flow and axial flow;

(ii) Single suction and double suction;

(iii) Open impeller and closed impeller;

(iv) Volute casing and circular casing.

(r) (i) State **two** advantages of using centrifugal pumps.

(ii) Give **two** suitable applications for centrifugal pumps.

2.

(50 marks)

(a) Differentiate between **any two** of the following in relation to materials testing:

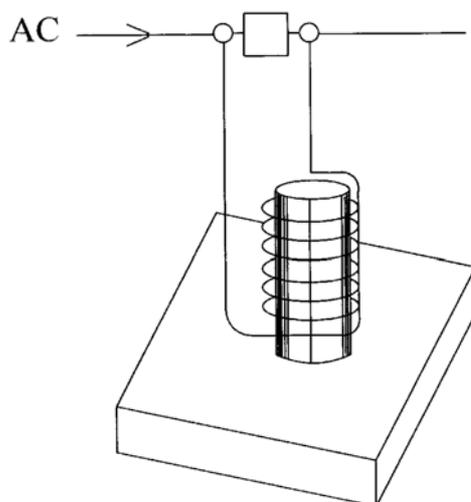
- (i) Ductile fracture and brittle fracture;
- (ii) Macroscopic and microscopic examination of materials;
- (iii) Fatigue and creep;
- (iv) Izod and Charpy.

(b) Describe the Vickers hardness test using the following guidelines:

- (i) The principle of the test;
- (ii) The type of indenter used;
- (iii) An advantage of this test.

(c) A non-destructive test is represented in the drawing below:

- (i) Name the test;
- (ii) Outline the principle of operation;
- (iii) Suggest a suitable application.



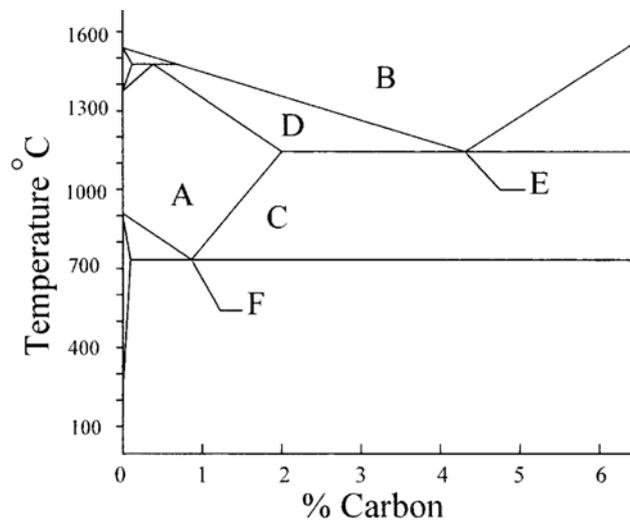
3.

(50 marks)

(a) With reference to the given iron-carbon equilibrium diagram, answer **each** of the following:

(i) Identify the phases represented by A, B, C and D.

(ii) Name points E and F **and** describe what **each** represents.



(b) Describe, with the aid of suitable diagrams, **any two** of the following heat treatment processes:

(i) Induction hardening;

(ii) Flame hardening;

(iii) Carburising.

(c) Outline the significance of allotropy in relation to carbon steel.

4.

(50 marks)

- (a) Answer **any two** of the following:
- (i) Differentiate between a vacancy and a dislocation;
 - (ii) Describe the age hardening process;
 - (iii) Explain why the body-centred cubic structure is mostly associated with brittleness in metals;
 - (iv) What is meant by partial solubility ?
- (b) The given table shows the solidification temperatures for various alloys of cadmium and bismuth. The melting point of cadmium is 321°C and the melting point of bismuth is 268°C .

Amount of cadmium in alloy (%)	10	20	30	40	50	60	70	80	90
Start of solidification ($^{\circ}\text{C}$)	237	205	175	140	190	235	265	290	310
End of solidification ($^{\circ}\text{C}$)	140	140	140	140	140	140	140	140	140

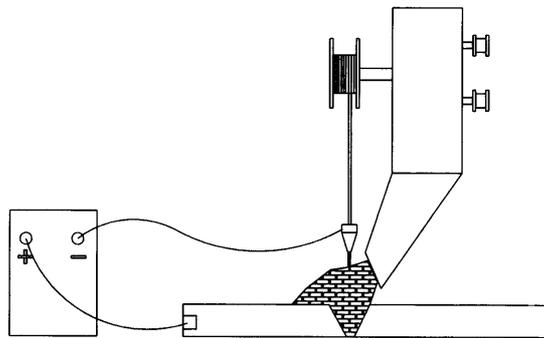
Using the graph paper supplied:

- (i) Draw the equilibrium diagram according to the given data;
 - (ii) Label the diagram and describe the main features;
 - (iii) For the alloy with 75% cadmium determine, from the diagram, the ratio of the phases at 200°C .
- (c) Explain, using diagrams, the various stages of metal solidification during dendritic growth.

5.

(50 marks)

- (a) Answer **any three** of the following:
- (i) Outline **two** ways to protect the weld pool from atmospheric contamination during welding;
 - (ii) Distinguish between an oxidising flame and a carburising flame in oxy-acetylene welding;
 - (iii) Why is tungsten inert gas welding suitable for welding aluminium?
 - (iv) State **three** important safety precautions to prevent electrical hazards associated with manual metal arc welding.
- (b) Describe the welding process shown below using the following guidelines:
- (i) Name;
 - (ii) Method of operation;
 - (iii) Applications.



- (c) Describe, with the aid of a diagram, the main features of metal inert gas welding.

OR

- (c) State **two** important factors that should be considered when designing a robot for welding.

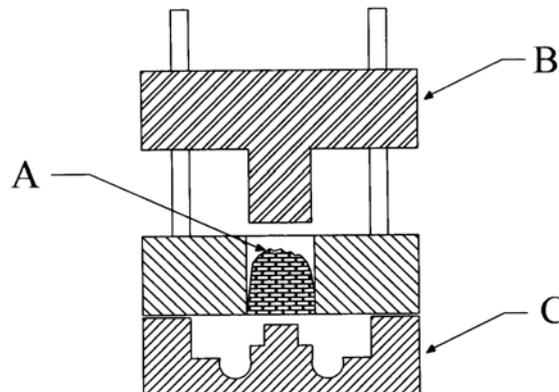
6.

(50 marks)

(a) Describe, with the aid of a diagram, the addition polymerisation process.

(b) Describe the process shown in the diagram below using the following guidelines:

- (i) Name and describe the principle of operation;
- (ii) Identify **one** component produced;
- (iii) Name the parts A, B and C.



(c) Explain **any three** of the following in relation to polymers:

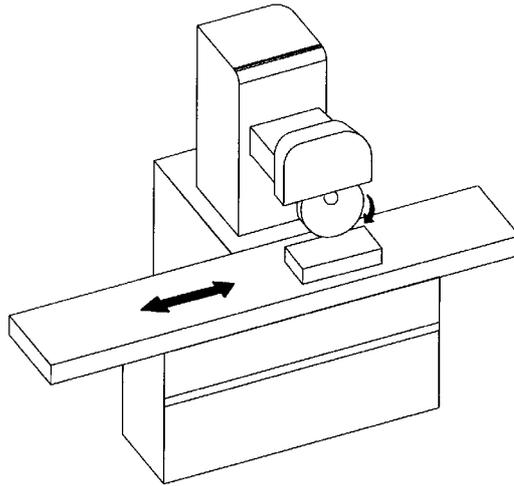
- (i) Van der Waals forces;
- (ii) Crosslinking;
- (iii) Co-polymerisation;
- (iv) Filler;
- (v) GRP.

7.

(50 marks)

(a) With reference to the diagram shown below:

- (i) Name and describe the machining process;
- (ii) Explain a method of workholding;
- (iii) Give **one** suitable application.



(b) Answer **any three** of the following:

- (i) Outline the difference between drilling and reaming;
- (ii) Distinguish between a clearance fit and an interference fit;
- (iii) Describe the purpose of a plug gauge;
- (iv) Name **three** types of chip formed in metal cutting.

(c) Describe, with the aid of a suitable diagram, the main features of peripheral milling **or** face milling.

OR

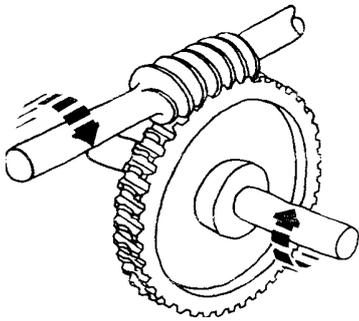
(c) With reference to CNC machining, describe the meaning of **any three** of the following:

- (i) Incremental dimensioning;
- (ii) Time dwell;
- (iii) Canned cycle;
- (iv) CAM.

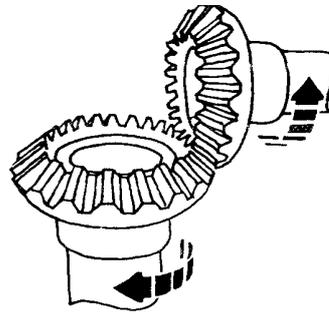
8.

(50 marks)

(a) Name **one** gear system shown and outline a suitable application.



(i)



(ii)

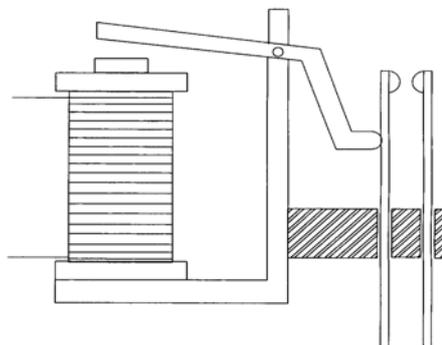
(b) Explain the function of **any three** of the following:

- (i) Ratchet;
- (ii) Toggle mechanism;
- (iii) Universal joint;
- (iv) Throttle valve;
- (v) Solenoid.

(c) Describe the operation and function of a crank and slider mechanism.

OR

(c) Identify the electrical device shown and explain how it operates.



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