



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION, 2005

ENGINEERING – MATERIALS AND TECHNOLOGY

(Higher Level – 300 marks)

FRIDAY, 24 JUNE, MORNING 9.30 – 12.30

INSTRUCTIONS

- 1.** Answer **Sections A and B of Question 1** 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.

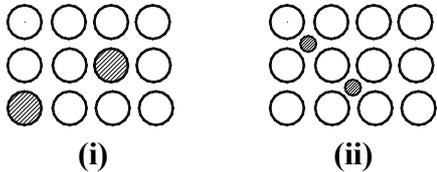
1.

(100 marks)

SECTION A – 50 MARKS

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

(a) Distinguish between the crystal point defects shown.



(b) Explain the significance of **any one** of the following in electronics:
(i) heat sink, (ii) breadboard.

(c) Describe sacrificial protection with respect to corrosion prevention.

(d) What safety factors should be considered when joining materials using adhesives.

(e) Give **two** possible systemic effects of toxic materials.

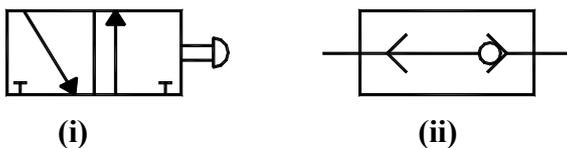
(f) Define the term *allotropy*.

(g) Describe the method of ore dressing in the diagram shown.



(h) State a typical end product for **any two** of the following:
(i) Drop forging, (ii) Calendering, (iii) Casting.

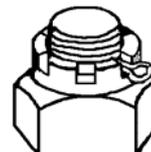
(i) Identify **any one** of the pneumatic symbols shown.



(j) Differentiate between an ionic bond and a metallic bond.

(k) Outline the function of a *parison* in manufacturing with polymers.

(l) Name and suggest a suitable application for the nut shown.

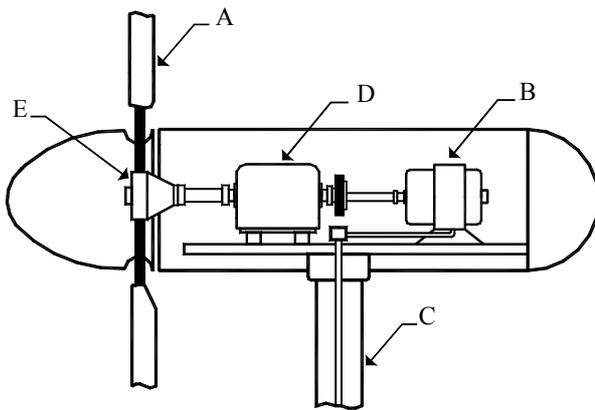


(m) What contribution did **any one** of the following make to technology:
(i) Henry Maudslay, (ii) Simon Stevins, (iii) Michael Faraday.

SECTION B – 50 MARKS

Answer **all** of the following:

- (n) Describe the principle of operation of an aero-generator.
- (o) With reference to the diagram shown below:
- Name the components A, B, C, D and E;
 - Describe the function of **any three** components named.



- (p) Answer **any two** of the following:
- Explain **one** method employed to ensure the safety of an aero-generator in extreme weather conditions;
 - Distinguish between pitch controlled and stall controlled wind turbines;
 - What is the function of the nacelle in an aero-generator ?
- (q) (i) State **one** appropriate reason for installing large wind turbines.
- (ii) List **two** advantages of wind-generated electricity.
- (r) Define **any two** of the following terms:
- Stall;
 - Lift;
 - Wind farm;
 - Anemometer.

2.

(50 marks)

(a) With reference to impact testing, describe **each** of the following:

- (i) Testing procedure;
- (ii) Izod method;
- (iii) Charpy method.

(b) A tensile test on a specimen gave the following results.

Stress (N/mm ²)	68	135	200	275	308	325	338	350
Strain (x 1000)	0.75	1.50	2.25	3.25	4.00	4.75	5.50	7.25

Using the graph paper supplied, plot the stress-strain diagram and determine:

- (i) The 0.2% proof stress;
- (ii) Young's Modulus of Elasticity for the material.

(c) Describe the non-destructive tests most suitable for **each** of the following defects:

- (i) Surface flaws in non-ferrous materials;
- (ii) Internal flaws in welds.

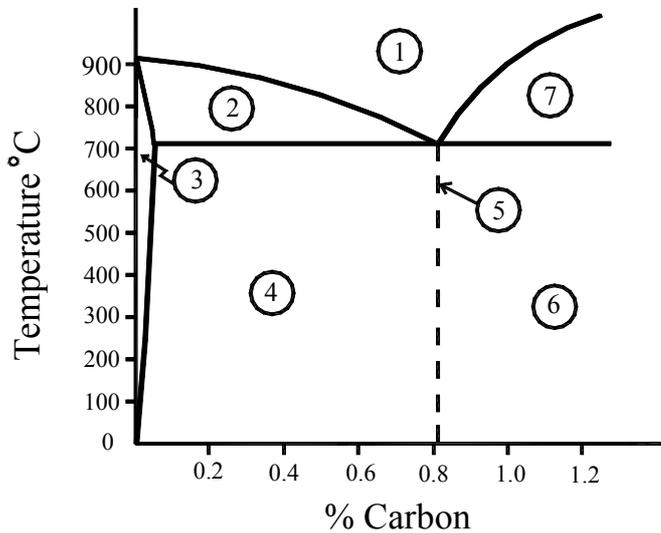
3.

(50 marks)

(a) Answer **any two** of the following:

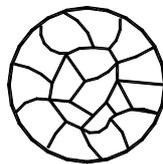
- (i) Compare eutectic and eutectoid reactions, stating any temperature and structural changes;
- (ii) Describe **one** method of measuring temperature in heat treatment furnaces;
- (iii) Differentiate between grey and white cast iron;
- (iv) Explain the term recrystallisation in relation to heat treatment.

(b) A simplified portion of the iron-carbon equilibrium diagram is shown.

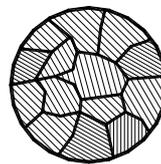


(i) Name the regions 1, 2, 3, 4, 5, 6 and 7.

(ii) Identify the region most suited to each of the microstructures shown below.



A



B

(c) Describe **any two** of the following heat treatment processes:

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

4.

(50 marks)

(a) With reference to thermal equilibrium diagrams, explain **any two** of the following:

- (i) Solvus line;
- (ii) Simple eutectic solutions;
- (iii) Cooling curve;
- (iv) Latent heat of fusion;
- (v) Substitutional solid solution.

(b) The given table shows the solidification temperatures for various alloys of two metals A and B. The melting points of A and B are 270°C and 630°C respectively.

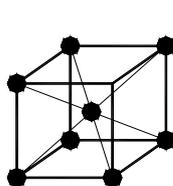
Amount of B in alloy (%)	0	10	20	30	40	50	60	70	80	90	100
Start of solidification (°C)	270	332	400	445	492	524	552	580	603	618	630
End of solidification (°C)	270	272	280	300	318	340	368	404	449	510	630

Using the graph paper supplied:

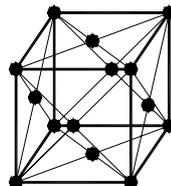
- (i) Draw the equilibrium diagram according to the given data;
- (ii) Label the diagram and describe the main features;
- (iii) For the alloy of 50% B determine, from the diagram, the ratio of the phases at 400°C.

(c) (i) Identify the unit cell structures shown below.

(ii) Explain why structure B is mostly associated with ductility.



A



B

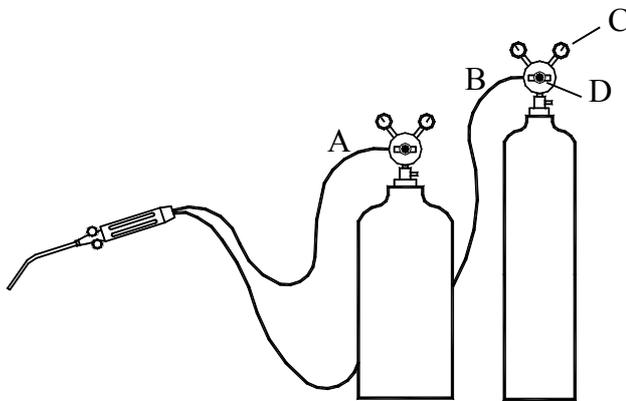
5.

(50 marks)

(a) Describe, with the aid of a diagram, the main features of **one** of the following:

- (i) Electro-slag welding;
- (ii) Seam welding.

(b) With reference to oxy-acetylene welding, answer **any three** of the following:



- (i) Name the colour coding used for hose A and hose B;
- (ii) Identify and explain the function of components C and D;
- (iii) State **three** important safety precautions to be observed when using oxy-acetylene equipment;
- (iv) What is meant by dissolved acetylene?
- (v) Distinguish between an oxidising flame and a carburising flame.

(c) Outline the function of the following in manual metal arc welding:

- (i) Bridge rectifier;
- (ii) Transformer.

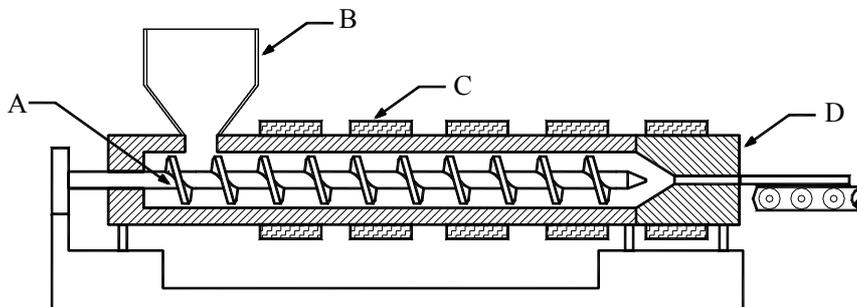
OR

- (c) (i) Identify **one** welding process suitable for robotic control.
- (ii) State **two** industrial applications for robotic controlled welding.

6.

(50 marks)

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



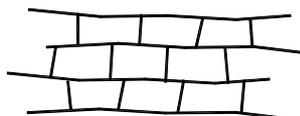
- (i) Name and describe the principle of operation;
- (ii) Identify **one** component produced;
- (iii) Name parts A, B, C and D.

- (b) Differentiate between **any two** of the following:

- (i) Thermoplastic and thermosetting polymers;
- (ii) Crystalline polymer and amorphous polymer;
- (iii) Natural and synthetic rubber;
- (iv) Condensation polymer and co-polymer.

- (c) With reference to the internal polymer structure shown , answer **all** of the following:

- (i) Identify the structure;
- (ii) Explain the chemical bonding;
- (iii) State **two** properties of a polymer having this structure.



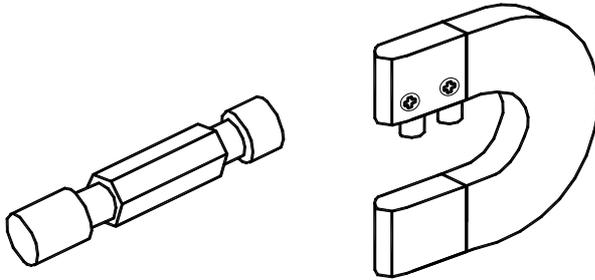
7.

(50 marks)

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

- (i) Distinguish between countersinking and counterboring when drilling;
- (ii) Identify **two** safety hazards associated with the use of cutting fluids;
- (iii) State **two** factors which influence the surface finish during parallel turning;
- (iv) Explain the function of the bond in a grinding wheel;
- (v) Differentiate between orthogonal cutting and oblique cutting.

(b) (i) Name and state the function of **one** of the gauges shown below.



- (ii) Identify **two** reasons why precise measurements could be inaccurately taken.

(c) Outline the difference between the items in **any one** of the following:

- (i) Up-cut and down-cut milling;
- (ii) Peripheral milling and face milling.

OR

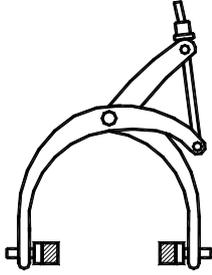
(c) With reference to CNC machining answer **any two** of the following:

- (i) State **two** safety features incorporated in a CNC lathe;
- (ii) Distinguish between a G-code and an M-code;
- (iii) Compare conventional machining with computer numerical control machining.

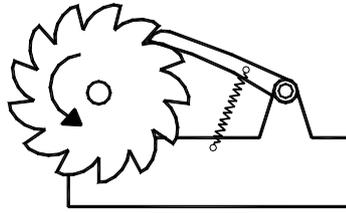
8.

(50 marks)

(a) Describe the operation and outline a suitable application for **one** of the mechanisms shown.



(i)



(ii)

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

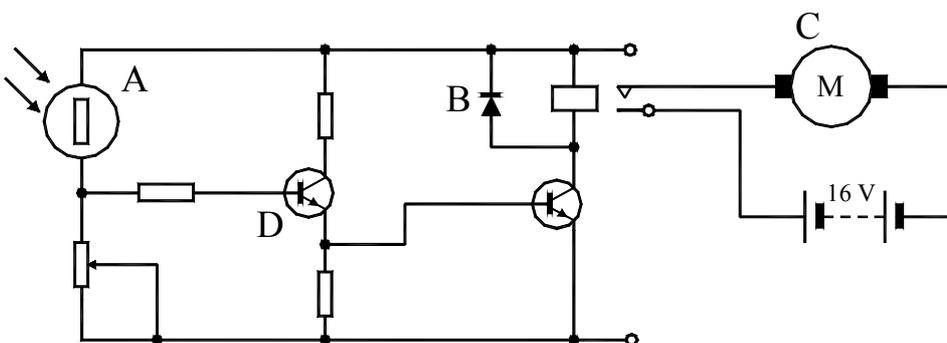
- (i) A capacitor;
- (ii) A non-return valve;
- (iii) An idler gear;
- (iv) Dividing head;
- (v) Solar panel.

(c) Outline clearly the difference between a quick return mechanism and a slider crank mechanism.

OR

(c) With reference to the circuit shown below:

- (i) Identify the electronic components A, B, C and D.
- (ii) Explain the operation and suggest an application for the circuit.



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