



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION, 2003

ENGINEERING – MATERIALS AND TECHNOLOGY

(Higher level – 300 marks)

THURSDAY, 19 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.

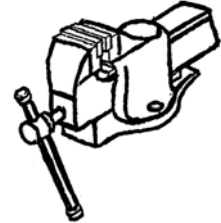
SECTION A – 50 marks

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

(a) Distinguish between the narcotic and irritant effects of toxic materials.

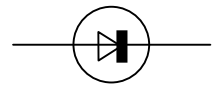
(b) Name **two** properties of materials used to facilitate ore dressing.

(c) Identify the main process used to manufacture the vice shown.



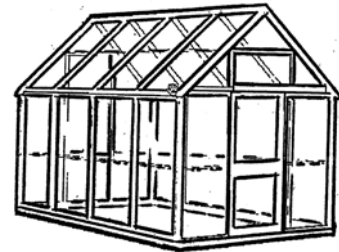
(d) Differentiate between ionic and covalent bonding in solids.

(e) Identify and state a purpose for the electronic component shown.



(f) Explain the function of the flashback arrestors used in oxyacetylene welding.

(g) State a suitable material for manufacturing the greenhouse shown and give **three** reasons why this material is suitable.

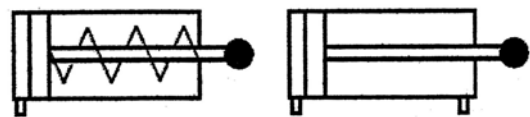


(h) What environmental factors affect the corrosion rate of metals?

(i) Outline the advantages of using pneumatic power over electrical power.

(j) What is meant by *factor of safety*?

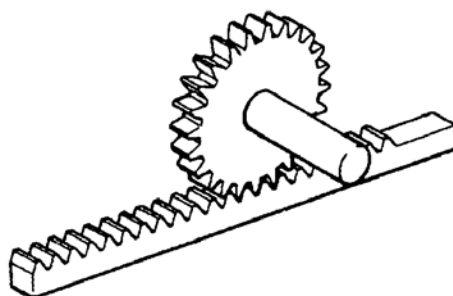
(k) Distinguish between the **two** pneumatic cylinders shown.



(l) What contribution did **any one** of the following make to technology:

(i) German Sommeiller, (ii) Jack Kilby, (iii) Chester Carlson.

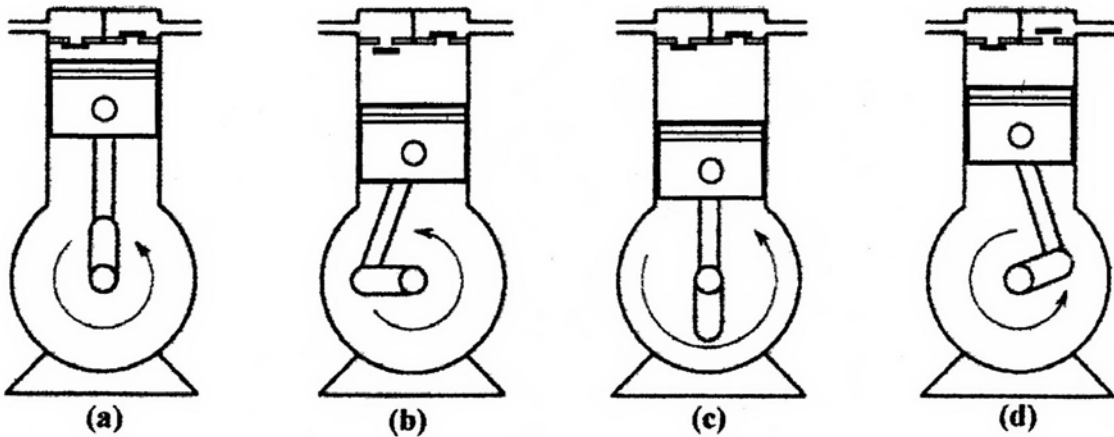
(m) Identify the mechanism shown below and outline **two** suitable applications.



SECTION B – 50 MARKS

Answer **all** of the following:

- (n) Outline the function of a compressor in a refrigeration system.
- (o) Name **three** types of compressors commonly used in refrigeration.
- (p) (i) Identify the compressor system shown in the diagrams below.
(ii) Utilising the diagrams, describe the principle of operation of this compressor system.



- (q) Explain the meaning of non-positive displacement in a compressor system.
- (r) With reference to compression cycle refrigerators:
 - (i) Name **two** parts located in the low pressure side.
 - (ii) Name **two** parts located in the high pressure side.

2.

(50 marks)

- (a) (i) Explain the term *creep* with reference to metals.
- (ii) State **two** factors that affect the behaviour of *creep* in metals.

- (b) A tensile test on a specimen material gave the following results:

Stress (N/mm²)	44	110	220	264	300	330	340	352
Strain (x 1000)	0.50	1.25	2.50	3.00	3.75	5.00	5.75	7.50

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

- (i) The 0.2% proof stress;
- (ii) Young's Modulus of Elasticity for the material.
- (c) (i) Name **two** non-destructive tests used to detect internal flaws in metals.
- (ii) Describe, with the aid of a diagram, **one** of these tests.

3.

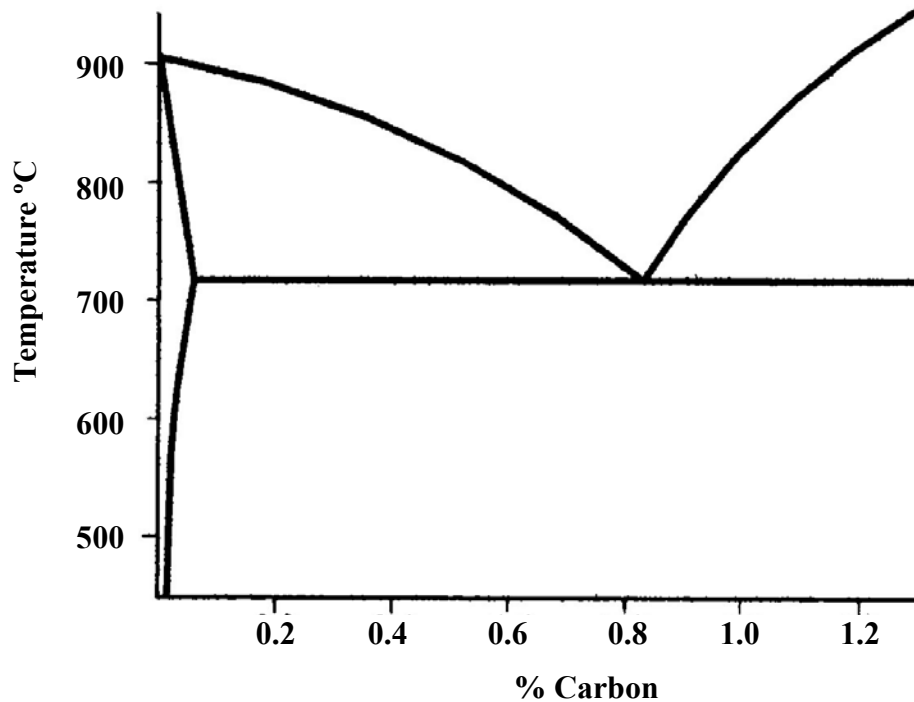
(50 marks)

(a) Explain **any two** of the following terms used in the heat treatment of steel.

- (i) Ferrite;
- (ii) Cementite;
- (iii) Martensite;
- (iv) Tempering;
- (v) Normalising.

(b) Copy the simplified iron-carbon equilibrium diagram into your answer book. With reference to the diagram, describe how 0.5% carbon steel may be heat treated to produce:

- (i) A soft condition;
- (ii) A tough condition.



- (c) (i) Name **two** methods of measuring furnace temperature.
- (ii) Describe the principle of operation and give a suitable application for **one** method.

4.

(50 marks)

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

- (i) Interstitial solid solution and substitutional solid solution;
- (ii) Crystalline and amorphous structures;
- (iii) Solvus and solidus;
- (iv) Body centred cubic and face centred cubic;
- (v) Simple eutectic and a 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:

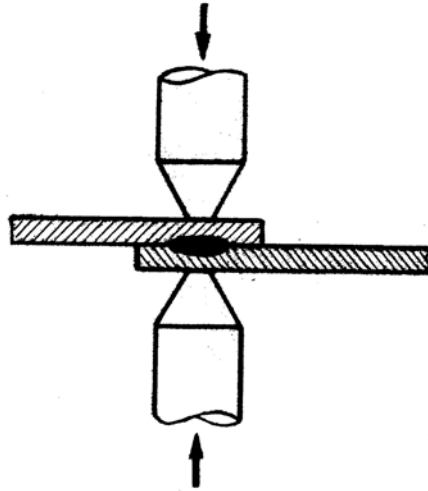
- (i) Draw the equilibrium diagram according to the given data;
 - (ii) Label the diagram and describe the main features;
 - (iii) For the alloy of 60% B determine, from the diagram, the ratio of the phases at 450°C.
- (c) (i) Describe, with the aid of a diagram, a dislocation defect.
- (ii) Suggest **one** method of restricting the movement of a dislocation.

5.

(50 marks)

(a) Describe the welding process shown below using the following guidelines:

- (i) Name;
- (ii) Method of operation;
- (iii) Applications.



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

- (i) State **two** safety precautions associated with oxy-acetylene welding;
- (ii) Outline **two** functions of the electrode coating in manual metal arc welding;
- (iii) What are the benefits of multi-run welds over single-run welds?
- (iv) Compare primary and secondary combustion in the oxy-acetylene flame.

(c) Describe, with the aid of a diagram, the main features of a transformer used in manual metal arc welding.

OR

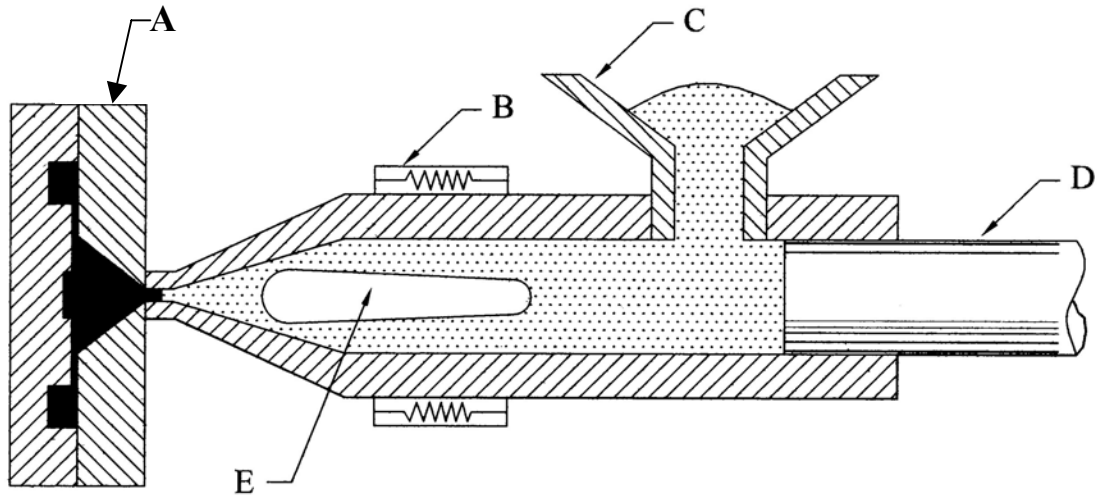
(c) Outline **two** advantages of the use of robotic control in welding.

6.

(50 marks)

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

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



(b) Explain **any two** of the terms:

- (i) Parison;
- (ii) Monomer;
- (iii) Vulcanisation;
- (iv) Catalyst.

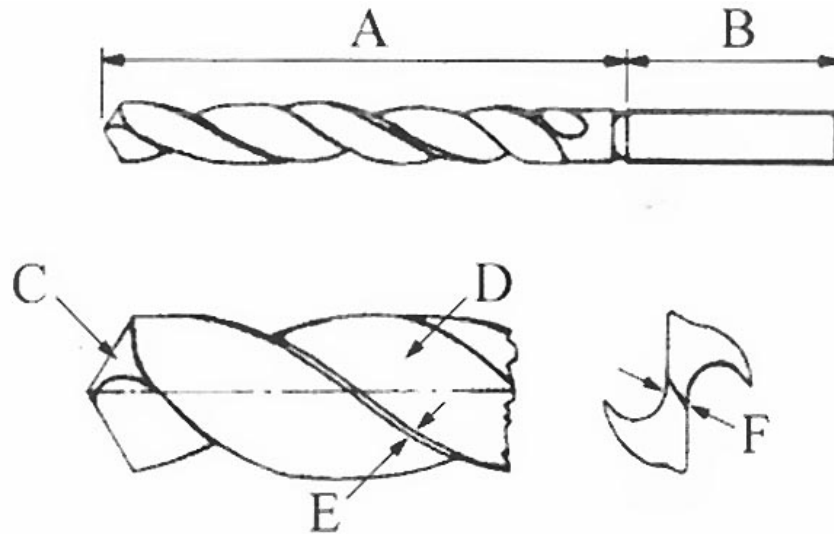
(c) Discuss the **three** main polymer groups with reference to the following:

- (i) Chemical bonding;
- (ii) Internal structure;
- (iii) Properties.

7.

(50 marks)

- (a) With reference to the drill shown below, describe **any three** of the parts A, B, C, D, E and F.



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

- (i) Outline the benefits of using cutting fluids when machining;
- (ii) Describe the purpose of a sine bar;
- (iii) Suggest **two** different ways of mounting cutters on a milling machine;
- (iv) Describe **one** use of the dividing head.

- (c) Compare **three** different types of machine tool for machining flat surfaces using the following guidelines:

- (i) Names;
- (ii) Methods of operation;
- (iii) Applications.

OR

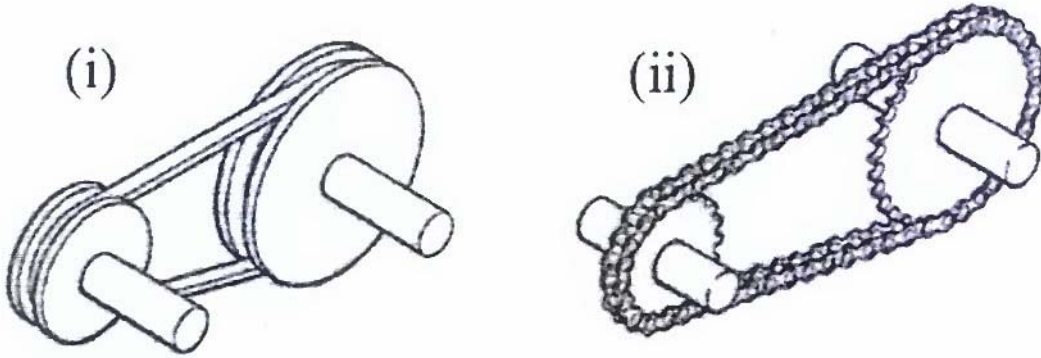
- (c) With reference to CNC machining, describe the meaning of **any three** of the following terms:

- (i) Linear interpolation;
- (ii) Canned cycle;
- (iii) Rapid traverse;
- (iv) Continuation code;
- (v) Stepper motor.

8.

(50 marks)

- (a) Name one drive mechanism shown and outline a suitable application.



- (b) Explain the function of any two of the following:

- (i) Electrical relay;
- (ii) Rectifier;
- (iii) Transistor;
- (iv) Shuttle valve;
- (v) Clutch.

- (c) Describe the operation and function of a quick-return mechanism.

OR

- (c) Describe the operation of the circuit shown and outline an application for its use.

