AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA

LEAVING CERTIFICATE EXAMINATION, 2002

ENGINEERING – MATERIALS AND TECHNOLOGY

(Higher level – 300 marks)

THURSDAY, 20 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.**

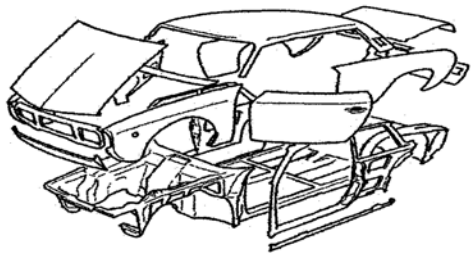
1. **(100 marks)**

SECTION A – 50 marks

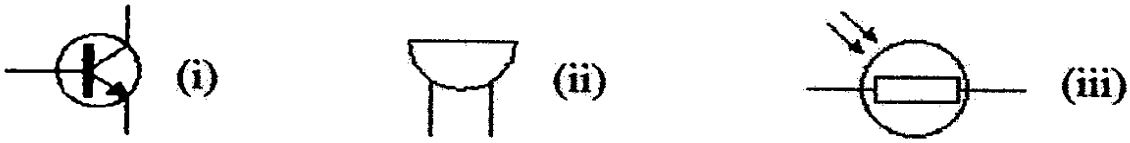
Give brief answers to any ten of the following.

(a) Describe **any one** defect in metal crystals.

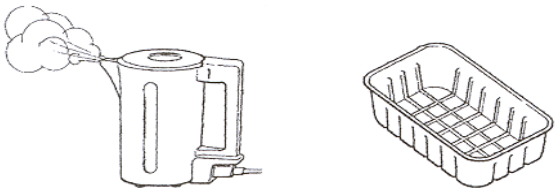
(b) Outline **any three** main processes used in the manufacture of the motor vehicle shown.



(c) Identify and state the purpose of **any one** of the electronic components shown.



(d) Name a suitable manufacturing process for **one** of the plastic items below.

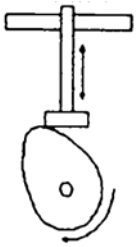


(e) What is dendritic growth?

(f) Explain the term allotropic.

(g) Describe the metallic bond and how the structure affects the properties of metals.

(h) Outline the function of the mechanism shown opposite.



(i) Why are non-metals important in electronics?

(j) Describe the purpose of **any one** safety symbol shown.

(k) Describe how the dovetail shown opposite is checked for dimensional accuracy.

(l) What contribution did **any one** of the following make to technology:
(i) Theodore Maiman, (ii) Charles Parsons, (iii) Eli Whitney.

(m) Briefly outline the function of (i) a pneumatic sequencer or (ii) a pneumatic programmable logic controller.

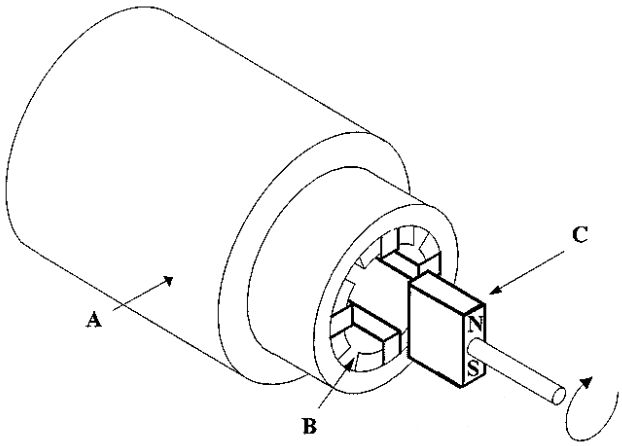
SECTION B – 50 MARKS

Answer **all** of the following:

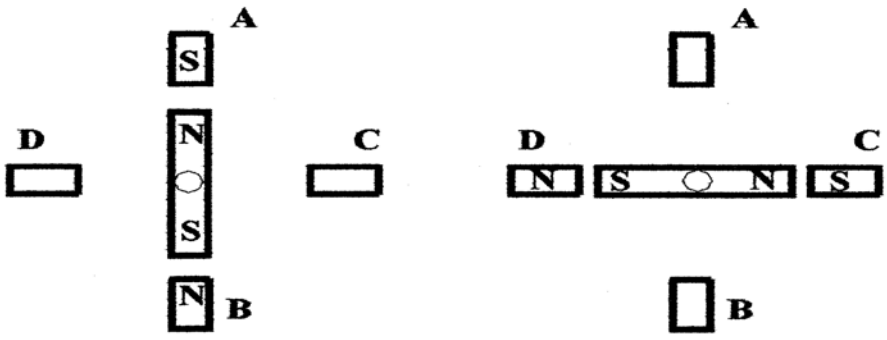
(n) (i) What characteristics of magnets make them suitable to the operation of a stepper motor.

(ii) Explain electromagnetism as it applies to the operation of a stepper motor in terms of current flow and polarity of magnets.

(o) Identify the components A, B and C shown below.



(p) Utilising the given diagrams describe how ninety degrees of movement is achieved.



(q) (i) What is meant by holding torque?

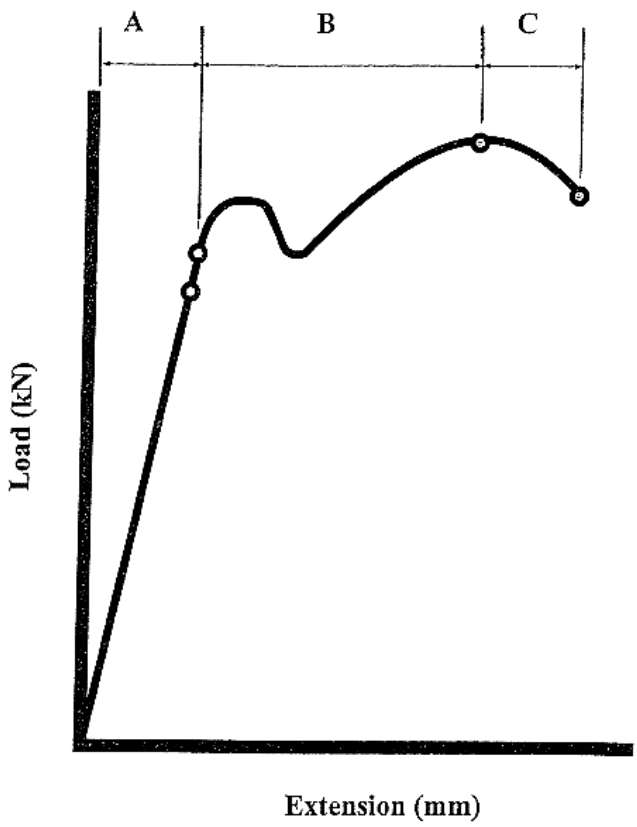
(ii) What is the relationship between stator coils and rotor segments?

(r) (i) Name **two** types of stepper motor.

(ii) List **three** advantages and **three** disadvantages in the use of stepper motors.

2. **(50 marks)**

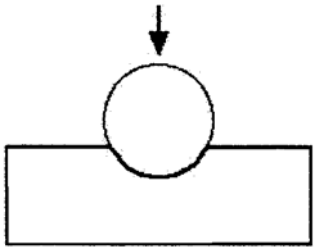
(a) (i) In the Load-Extension graph below describe the ranges A, B and C.



(ii) What is fatique failure?

(b) Explain **<u>any test</u>** based on the diagram below using the following guidelines:

(i) Name and purpose of test;
(ii) Test procedures;
(iii) Expected results.



(c) Describe the principles and applications of **<u>any two</u>** of the following tests:

(i) Ultrasonic;
(ii) Radiographic;
(iii) Magnetic.

3. **(50 marks)**

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

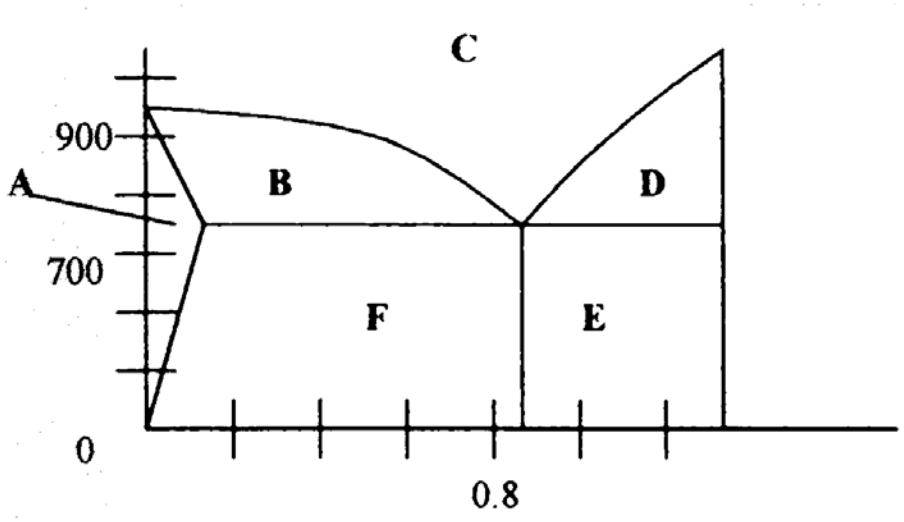
(i) Recalescence;
(ii) Annealing;
(iii) Critical range;
(iv) Martensite.

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

(i) Flame hardening and induction hardening;
(ii) Ferrite and pearlite;
(iii) Grey cast iron and white cast iron;
(iv) Eutectic and eutectoid.

(c) The diagram represents a simplified equilibrium diagram for iron and carbon.

(i) Name the regions labelled;
(ii) Redraw the given diagram into your answer-book and highlight the temperature zones for hardening and stress relieving;
(iii) For a structure containing 0.6% carbon at 870°C, distinguish between the effects of rapid cooling and slow cooling.



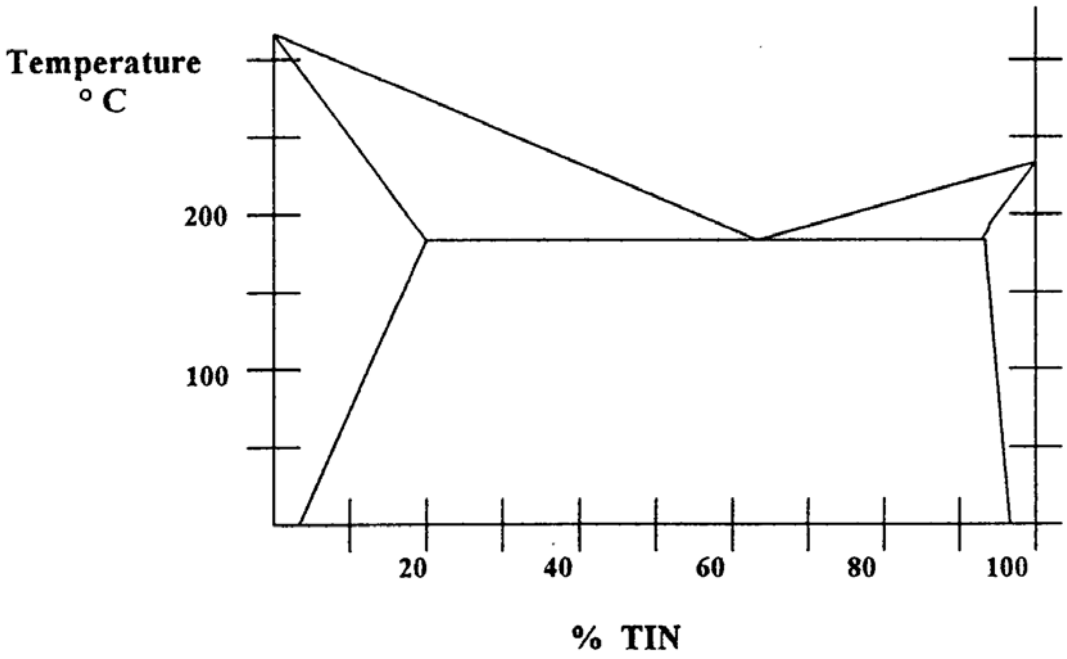
4. **(50 marks)**

(a) With reference to aluminium, answer **any four** of the following:

(i) Name the ore used to manufacture aluminium;
(ii) How is aluminium refined?
(iii) Describe its resistence to oxidation;
(iv) Outline **five** important properties of aluminium;
(v) Where in Ireland is aluminium refined?
(vi) Outline age hardening in the Y-alloy.

(b) Distinguish between a solid solution and a simple eutectic.

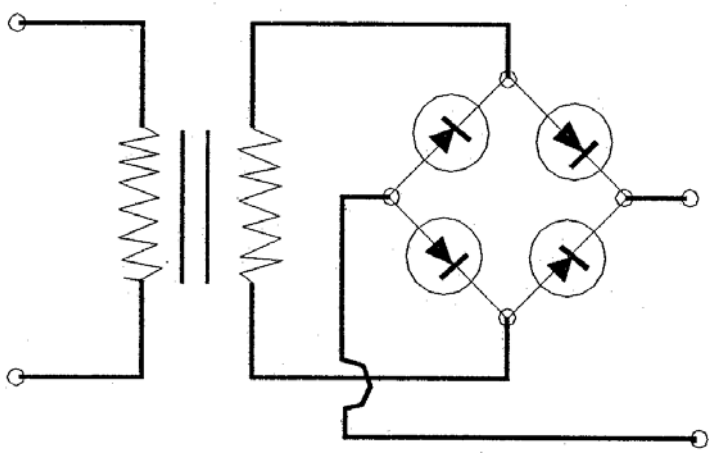
(c) Copy the given lead-tin diagram into your answer book.
Identify (i) liquidus, (ii) solidus and (iii) solvus on your diagram and explain clearly what each term represents.



5. **(50 marks)**

(a) Describe the circuit diagram shown using the following guidelines:

(i) Component names;
(ii) Method of operation;
(iii) Applications.



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

(i) State **two** functions of the electrode coating in manual metal arc welding;
(ii) Distinguish between spot welding and seam welding;
(iii) Outline the advantages multi-runs have over single-runs;
(iv) Why is it more difficult to weld aluminium than mild steel?

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

(i) Submerged arc welding;
(ii) Oxyacetylene welding.

OR

(c) Outline a welding process that is most suited to robotic control and suggest an application.

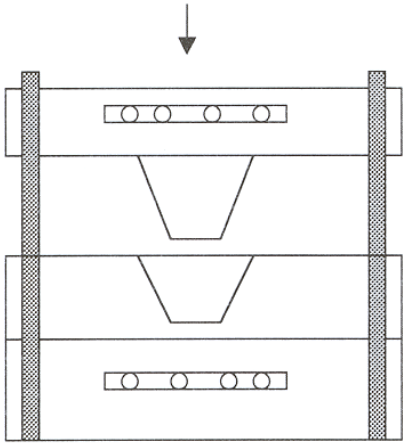
6. **(50 marks)**

(a) State the function of **<u>any three</u>** of the following in relation to polymers.

(i) Stabilisers;
(ii) Catalysts;
(iii) Promoters;
(iv) Inhibitors.

(b) Identify and describe the polymer manufacturing process shown below using the following guidelines:

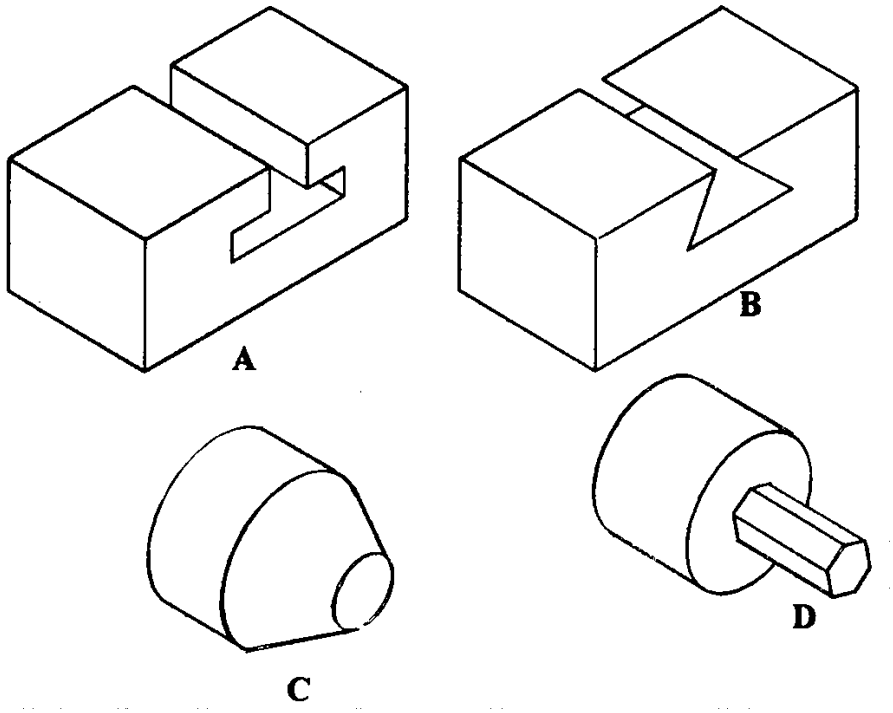
(i) Name and applications;
(ii) Operational process.



(c) Distinguish between addition polymerisation and co-polymerisation.

7. **(50 marks)**

(a) Outline a suitable machining process for **each** of the following sections:



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

(i) With reference to grinding distinguish between loading and glazing;
(ii) Outline the difference between generating and forming;
(iii) Describe the types of material that result in a continuous and discontinuous chip being formed;
(iv) Explain the terms gang milling and straddle milling;
(v) What are the essential differences between direct and comparative measurements?

(c) Outline the effects of altering the rake angle on the shear plane.

OR

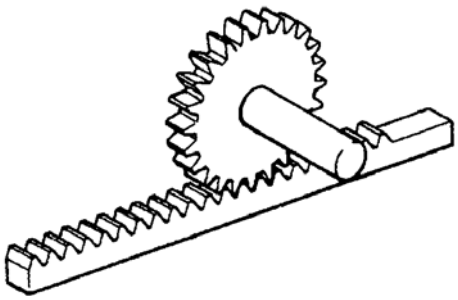
(c) Explain each line in the part CNC program shown in the table.

N	G	M	X	Z	I	K	F	S
200	00		15	1				
210	01			-20			75	
220	01		25	-25			75	
230	00	05	30	10				
240		02						

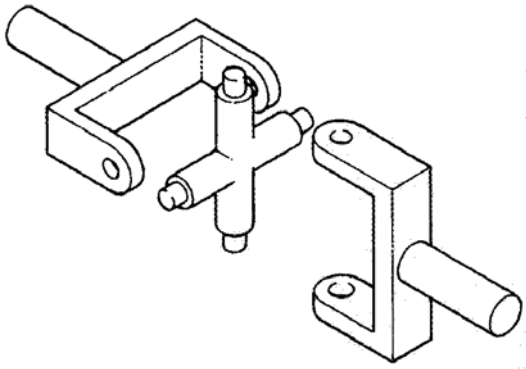
8. **(50 marks)**

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

(i)



(ii)

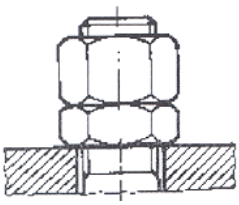


(b) Describe the principal function of **any three** of the following:

(i) Heat pump;
(ii) Ratchet mechanism;
(iii) Flywheel;
(iv) Rectifier;
(v) A non-return valve.

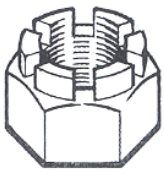
(c) Distinguish between the **three** types of nut shown and outline an application for each selected.

(i)



(ii)

(iii)



OR

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