



**Coimisiún na Scrúduithe Stáit  
State Examinations Commission**

**LEAVING CERTIFICATE EXAMINATION, 2007**

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**ENGINEERING – MATERIALS AND TECHNOLOGY**

(Higher Level – 300 marks)

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**FRIDAY, 22 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.

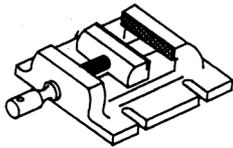
1.

(100 marks)

SECTION A – 50 MARKS

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

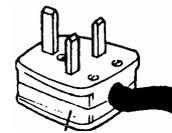
- (a) Outline **two** safety hazards associated with the use of adhesives when joining acrylic sheet.
- (b) Explain the term *Factor of Safety*.
- (c) Identify the main processes used to manufacture **any two** of the items shown:



(i) Drill vice

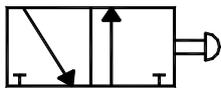


(ii) Hair dryer

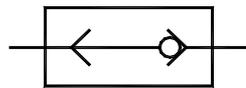


(iii) Plug casing

- (d) Distinguish clearly between the computer terms ROM and RAM.
- (e) Describe the differences between metal *fatigue* and metal *creep*.
- (f) Identify **any one** of the pneumatic symbols shown:

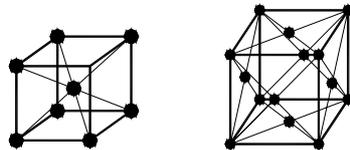


(i)

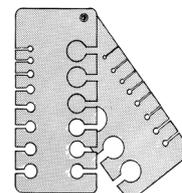


(ii)

- (g) Name **three** methods used in the disposal of used plastic materials.
- (h) Select **any two** of the abbreviations shown and explain their meaning:  
(i) uPVC, (ii) IC, (iii) VDU, (iv) LED.
- (i) Define the term *solvus* with reference to thermal equilibrium diagrams.
- (j) Explain the principle of slip in terms of BCC and FCC crystal structures.



- (k) Identify **two** ore dressing processes that are based on different metal properties.
- (l) What contribution did **any one** of the following make to technology:  
(i) John P. Holland, (ii) Viktor Kaplan, (iii) Eli Whitney?
- (m) Name and suggest a suitable application for the gauge shown.



## SECTION B – 50 MARKS

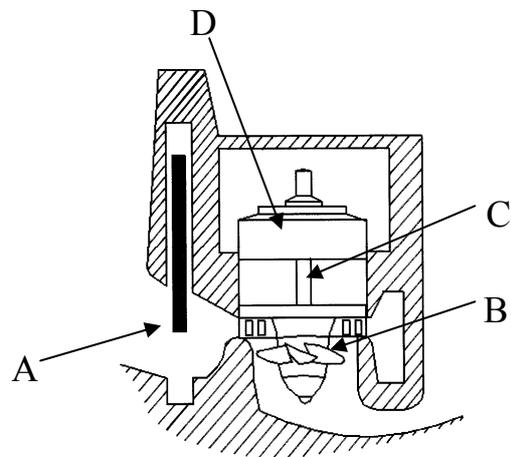
Answer **all** of the following:

- (n) *Solar power may be used to generate electricity through photovoltaic (solar) cells or by thermal electric generators, which produce steam to drive turbines.*

Identify **three** other energy sources, used in the generation of electricity, that may drive a turbine-based system.

- (o) With reference to the diagram of the turbine shown:

- (i) Name the turbine;
- (ii) Describe the principle of operation;
- (iii) Identify **any three** of the components labelled A, B, C and D.



- (p) Describe, with the aid of suitable diagrams, the essential differences between *Impulse* turbines and *Reaction* turbines.
- (q) (i) Distinguish between *pitch control* and *stall control* to avoid damage to a wind turbine.  
(ii) Explain “rated wind speed”.
- (r) Explain **any two** of the following:
- (i) The use of idlers in a multi-level steam turbine;
  - (ii) The main features of a Pelton turbine;
  - (iii) The environmental impact of using renewable sources of energy for electricity generation.

2.

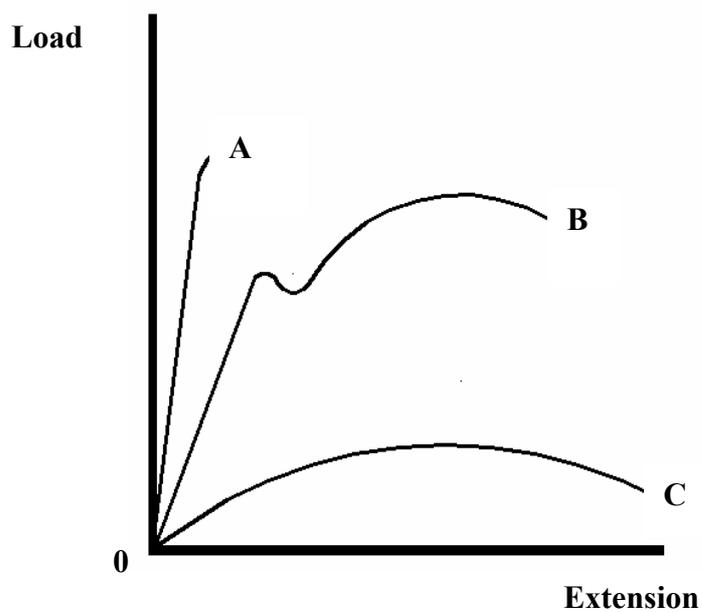
(50 marks)

(a) (i) What are the advantages of mechanical testing?

(ii) Compare Izod and Charpy impact tests.

(b) (i) Identify the basic information that can be obtained from a tensile test.

(ii) With reference to the graph shown below, outline the properties associated with materials A, B and C.



(c) (i) Why are non-destructive tests used in the manufacture of engine parts?

(ii) Describe, with the aid of a diagram, a suitable non-destructive test for assessing welds for internal faults.

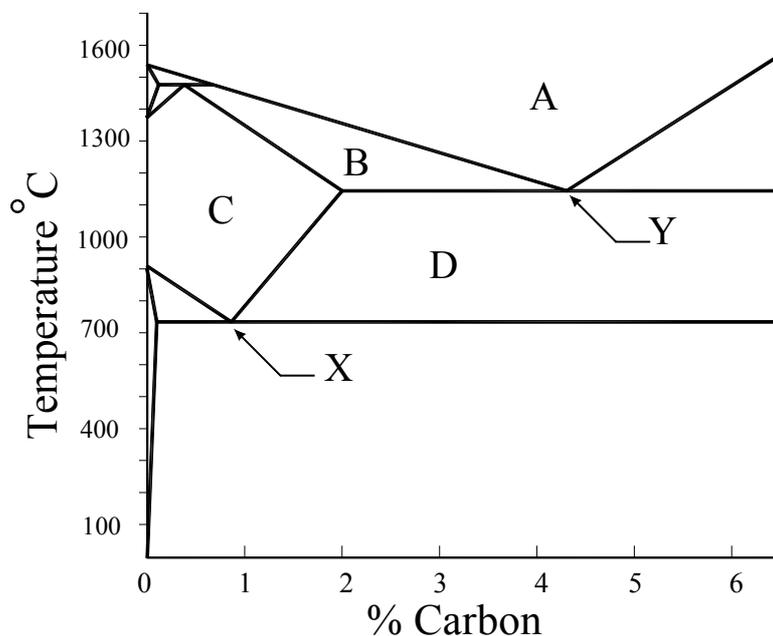
3.

(50 marks)

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

- (i) Identify **two** methods of measuring furnace temperature;
- (ii) Describe the influence of *allotropy* in carbon steel;
- (iii) Explain the term *soaking* in relation to the annealing process;
- (iv) Distinguish between the properties of grey cast iron and white cast iron.

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



- (i) Name the regions A, B, C and D.
  - (ii) Identify and describe the significance of points X and Y.
- (c) (i) The rate of cooling in heat treatment is dependent on the quenching medium. Name **three** quenching media and order them in terms of speed of cooling.
- (ii) Outline, with the aid of a suitable diagram, the principle of induction hardening.

4.

(50 marks)

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

- (i) Crystalline and amorphous structures;
- (ii) The differences between a eutectic alloy and a solid solution alloy;
- (iii) Three crystal point defects;
- (iv) Age hardening.

(b) The given table shows the solidification temperatures for various alloys of metal A and metal B. The melting point of A is 1083°C and B is 1453°C.

| % of metal B in alloy        | 0    | 10   | 20   | 30   | 40   | 50   | 60   | 70   | 80   | 90   | 100  |
|------------------------------|------|------|------|------|------|------|------|------|------|------|------|
| Start of solidification (°C) | 1083 | 1160 | 1220 | 1270 | 1320 | 1350 | 1380 | 1400 | 1430 | 1440 | 1453 |
| End of solidification (°C)   | 1083 | 1080 | 1090 | 1110 | 1140 | 1170 | 1220 | 1270 | 1330 | 1380 | 1453 |

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 50% B determine, from the diagram, the ratio of the phases at 1250°C.

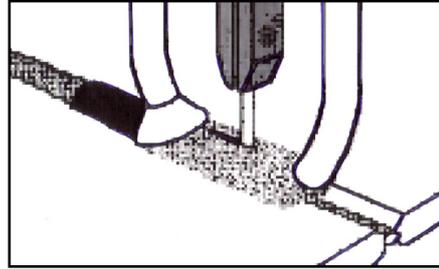
- (c) (i) Outline the relationship between cooling curves and the formation of equilibrium diagrams.
- (ii) Explain, using diagrams, the stages of dendritic growth as a metal solidifies.

5.

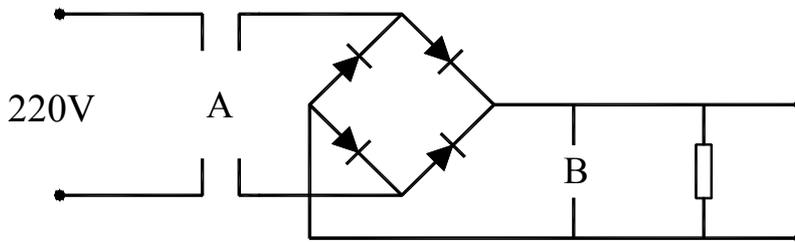
(50 marks)

(a) The diagram illustrates the process of submerged arc welding. Describe the main features of this type of welding making reference to:

- (i) principle of operation;
- (ii) applications.



(b) With reference to manual metal arc welding, answer **any three** of the following:



- (i) Redraw the incomplete welding transformer circuit shown and insert the missing components for A and B;
- (ii) Describe the purpose of the components A and B;
- (iii) What are the advantages of multi-run welds?
- (iv) Outline **three** safety precautions associated with the preparation of materials and equipment for welding.

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

- (i) Resistance seam welding;
- (ii) Electro-slag welding.

**OR**

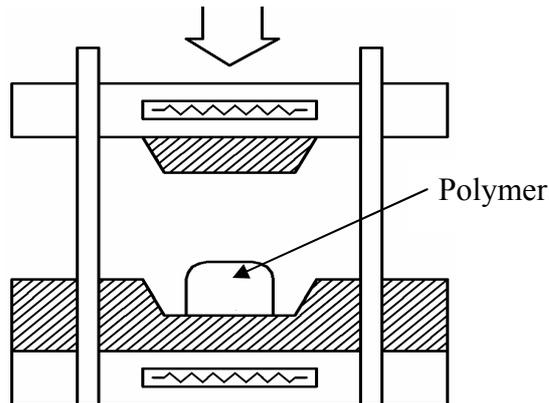
- (c) (i) Describe **two** advantages of using robots in electronic circuit assembly.
- (ii) Identify **two** safety factors to be considered when setting up a robotic welding facility.

6.

(50 marks)

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

- (i) Name the moulding process and describe the principle of operation;
- (ii) Identify **one** component produced.



(b) Polymers are chemically produced and then processed with other materials to improve their properties. State clearly the function of **any two** of the following additives:

- (i) Pigments;
- (ii) Plasticisers;
- (iii) Lubricants.

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

- (i) Condensation polymerisation;
- (ii) Extrusion;
- (iii) Elastomers;
- (iv) Van der Waal's forces;
- (v) Monomer.

7.

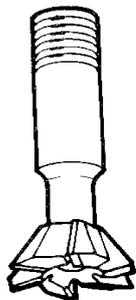
(50 marks)

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

- (i) Identify **three** safety features that should be incorporated into a centre lathe;
- (ii) List **three** reasons for using a cutting fluid when machining;
- (iii) Explain, with reference to metrology, the use of slip gauges;
- (iv) Distinguish between orthogonal and oblique cutting forces;
- (v) Describe how surfaces are machined by forming and generating.

(b) The milling machine is capable of producing a range of cutting operations. Three milling cutters are illustrated below:

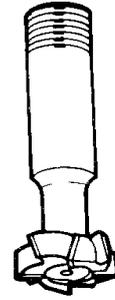
Identify a use for **any two** of the milling cutters shown.



(i)



(ii)



(iii)

(c) Describe, with the aid of a diagram, **any one** of the following:

- (i) Surface grinding;
- (ii) Cylindrical grinding.

**OR**

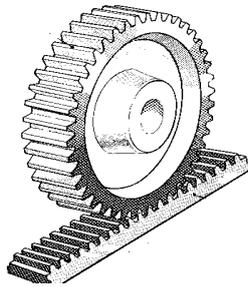
(c) With reference to CNC machining, describe **any three** of the following:

- (i) Safety features on the machine;
- (ii) Canned cycle;
- (iii) G00;
- (iv) Tool park position.

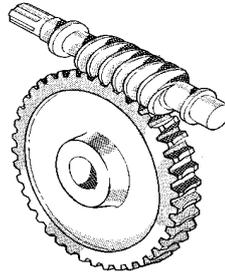
8.

(50 marks)

(a) Name **any one** of the mechanisms shown and describe a suitable application:



(i)



(ii)

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

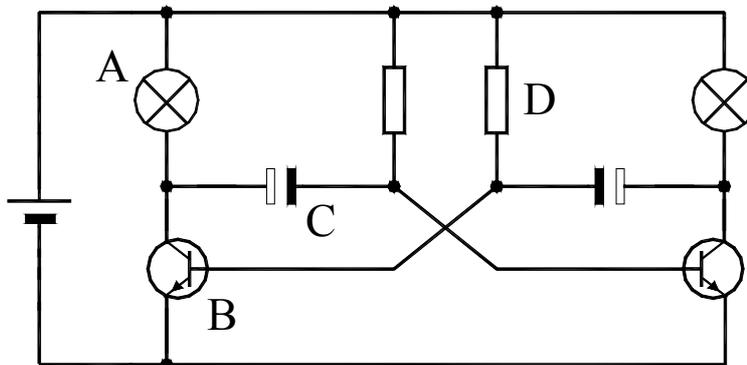
- (i) Idler gears;
- (ii) Universal joint;
- (iii) Solenoid;
- (iv) Pneumatic flow regulator;
- (v) Solar panel.

(c) Describe, with the aid of a diagram, a mechanism that could be used to automatically open a door.

OR

(c) With reference to the circuit shown below:

- (i) Identify the electronic components A, B, C and D;
- (ii) Describe the function of components B and C in the circuit.



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