Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2008

ENGINEERING – MATERIALS AND TECHNOLOGY

(Higher level – 300 marks)

FRIDAY, 20 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.

Question 1. **(100 marks)**

SECTION A – 50 MARKS

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

(a) State the purpose of **any one** of the safety symbols shown.

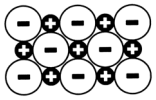
(i) 

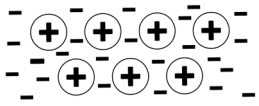
(ii) 

(b) State **any two** aspects of design that will minimise the corrosion of metal products.

(c) Differentiate between pyrometallurgy and hydrometallurgy.

(d) Identify the bond structures represented below:

(i) 

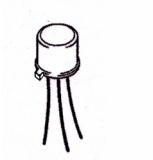
(ii) 

(e) Outline **any two** safety precautions required to avoid the narcotic effects of toxic materials.

(f) Distinguish between amorphous and crystalline structures.

(g) What contribution did **any one** of the following make to technology?
(i) Christopher Cockerell, **(ii)** Theodore Maiman, **(iii)** Charles Parsons.

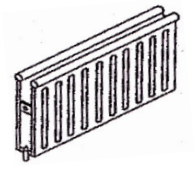
(h) Identify and outline the function of **any one** of the electronic components shown:

(i) 

(ii) 

(i) State **any two** benefits of using compressed air systems in industry.

(j) Identify the main processes used to manufacture **any two** of the items shown:

(i) 

(ii) 

(iii) 

(k) Select **any two** of the abbreviations shown and explain their meaning:
(i) CPU **(ii)** LAN **(iii)** IC **(iv)** CD-RW.

(l) Identify **one** automatic welding process.

(m) Describe the use of *tolerance* in precision measurement.

SECTION B – 50 MARKS

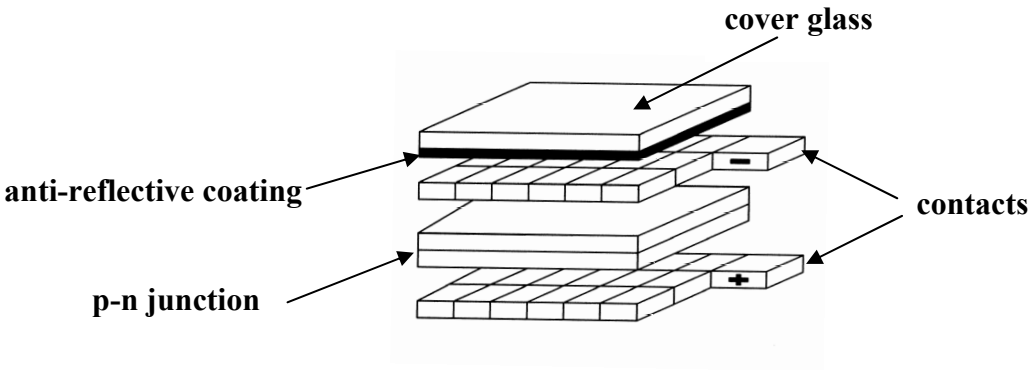
Answer **all** of the following:

(n) Identify **any three** applications where the photovoltaic cell is commonly used.

(o) **(i)** Distinguish between an electrical *conductor* and an electrical *semiconductor*.

(ii) Explain the advantages of using photovoltaic systems in developing economies.

(p) The basic structure of a photovoltaic cell is illustrated below:



(i) Describe the process of current flow at the junction of the P-type and N-type silicon layers.

(ii) Explain the function of the anti-reflective coating.

(q) Outline **any two** reasons for the necessity of using supplemental fuels, such as oil or gas, with solar generating stations.

(r) Explain **any two** of the following:

(i) The environmental impact of using solar cells;

(ii) Photovoltaic module;

(iii) The difference between *on-grid* and *off-grid* use of solar power.

Question 2. **(50 marks)**

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

(i) Distinguish between microscopic and macroscopic examination of metals;

(ii) With reference to metals, explain the term *creep*. Identify **two** factors that influence *creep*;

(iii) Compare the indenters used in both the Brinell and the Vickers hardness tests.

(b) The following data were obtained from a tensile test on a specimen of an aluminium alloy.

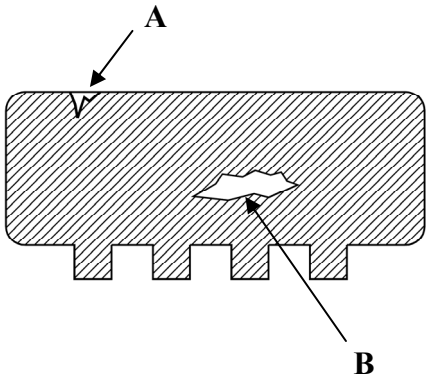
Stress (N/mm^2)	50	125	195	260	300	330	350	352
Strain (x1000)	0.60	1.40	2.20	3.00	3.70	5.00	7.00	8.50

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

(i) The 0.1% proof stress;

(ii) Young's Modulus of Elasticity for the specimen.

(c) The iron casting illustrates two defects at A and B.



(i) Identify suitable non-destructive tests to determine the defects shown at A and B.

(ii) Describe, with the aid of a diagram, the test identified to locate the defect at B.

Question 3. **(50 marks)**

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

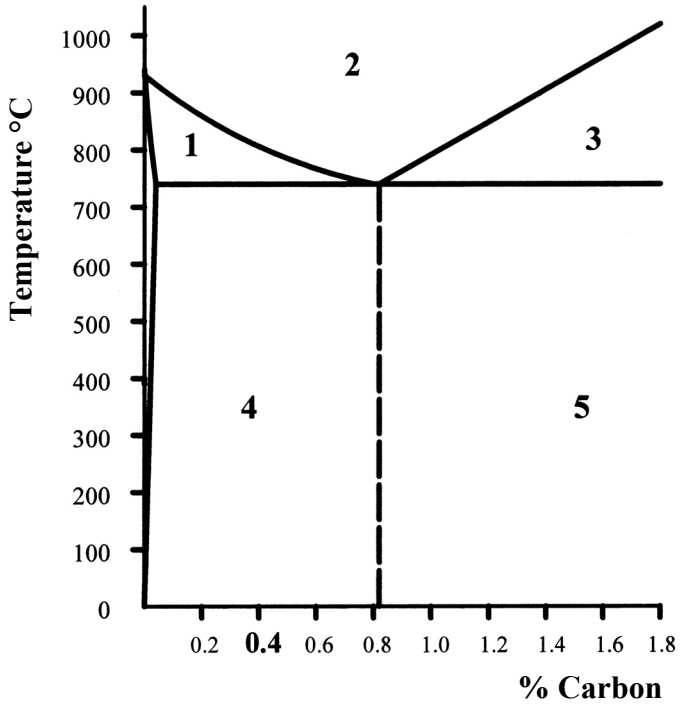
(i) Differentiate between the eutectic point and the eutectoid point;

(ii) Describe **one** method of measuring furnace temperature;

(iii) Compare the microstructures of martensite and ferrite;

(iv) Explain the term recrystallisation in terms of heat treatments.

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



(i) Name the regions represented at 1, 2, 3, 4 and 5.

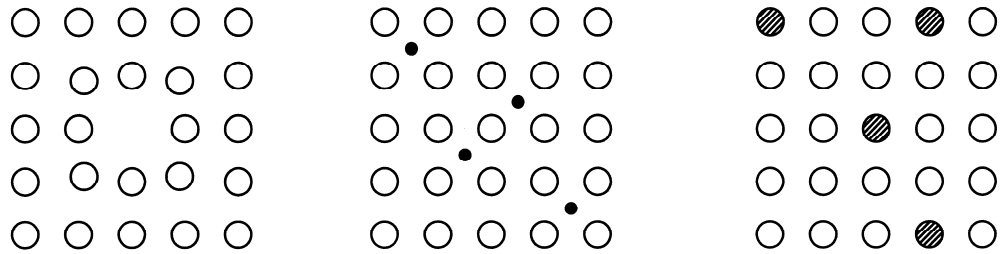
(ii) Describe the structural changes that occur in **0.4%** carbon steel as it cooled slowly from 900 °C.

(c) **(i)** Describe the principle of pack carburising.

(ii) Outline, with the aid of a suitable diagram, the process of flame hardening.

Question 4. **(50 marks)**

(a) Describe **any two** of the crystal defects shown below.



(i) **(ii)** **(iii)**

(b) The table shows the temperatures at which solidification starts and ends as the alloys of cadmium and zinc are cooled from liquid to solid.

Amount of zinc %	0	10	14	20	30	40	50	60	70	80	90	100
Solidification start °C	321	290	266	275	293	310	328	345	362	380	401	410
Solidification end °C	266	266	266	266	266	266	266	266	266	266	266	266

(i) Using the graph paper supplied, draw the thermal equilibrium diagram.

(ii) Label the diagram and describe the main features.

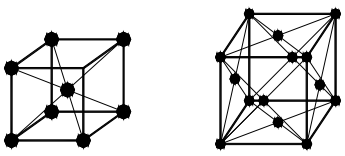
(c) Explain **any two** of the following:

(i) Solvus line;

(ii) Solid solution;

(iii) The stages of metal solidification from the liquid phase;

(iv) The difference between BCC and FCC crystal structures.



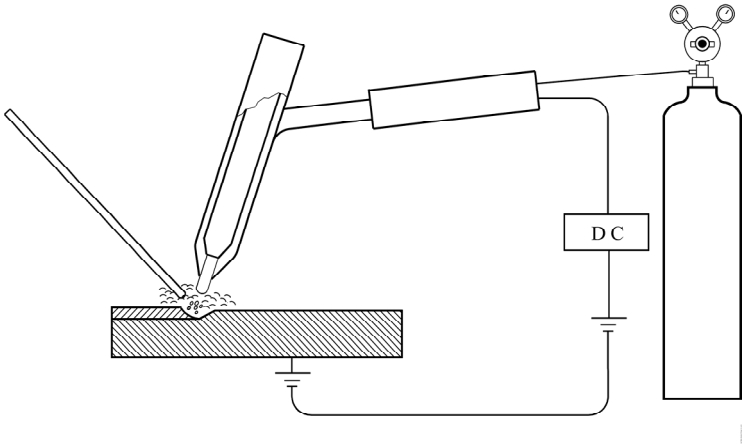
Question 5. **(50 marks)**

(a) Describe the welding process shown below under the following headings:

(i) Name;

(ii) Method of operation;

(iii) Applications.

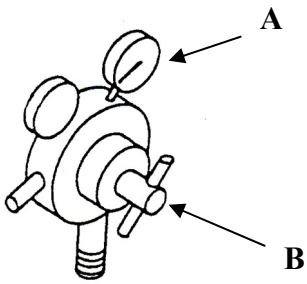


(b) With reference to oxy-acetylene welding answer **any three** of the following:

(i) Identify **two** safety features incorporated in oxy-acetylene equipment;

(ii) Explain the functions of part A and of part B;

(iii) Describe the term *dissolved acetylene*;



(iv) Distinguish clearly between oxidising and carburising flames.

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

(i) Resistance spot welding;

(ii) Metal inert gas welding.

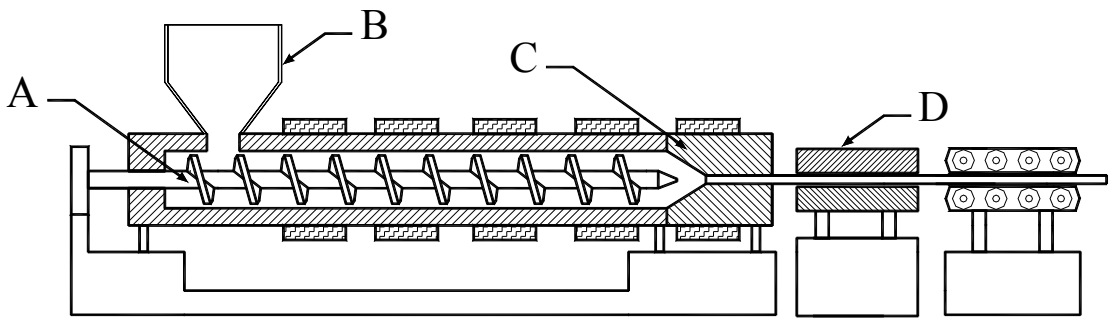
OR

(c) **(i)** Identify **two** industrial applications where robotic control is used.

(ii) Outline the advantages of using stepper motors in the control of robotic movement.

Question 6. **(50 marks)**

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



(i) Name and describe the principle of operation;

(ii) Identify the function of **any three** of the parts A, B, C and D;

(iii) Identify **one** component produced by this process.

(b) Distinguish between thermoplastics and thermosetting plastics making reference to **each** of the following:

(i) Chemical bonding;

(ii) Polymerisation process;

(iii) Properties.

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

(i) Transfer moulding;

(ii) GRP;

(iii) Cross linking;

(iv) Laminate;

(v) Polymer filler materials.

Question 7. **(50 marks)**

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

(i) Name **three** types of chip formed in metal cutting;

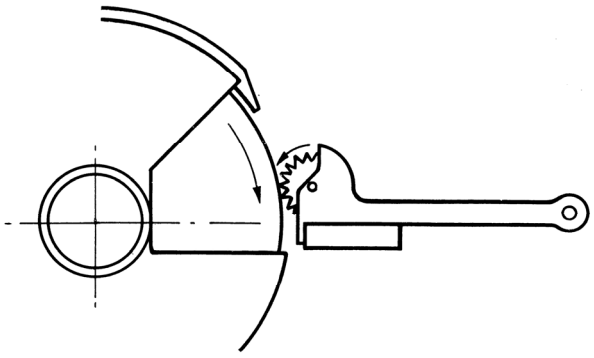
(ii) Describe the function of a *reamer*;

(iii) Outline **two** factors that influence the amount of heat generated in a machining operation;

(iv) Identify **two** safety issues associated with machining mild steel;

(v) Distinguish between a *clearance* fit and an *interference* fit.

(b) The process of grinding wheel dressing is illustrated below:



(i) Outline the reasons for wheel dressing a grinding wheel;

(ii) Differentiate between the *loading* and *glazing* of a grinding wheel.

(c) Describe, with the aid of suitable diagrams, the differences between *up-cut* milling and *down-cut* milling.

OR

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

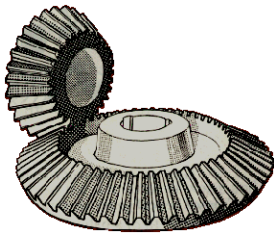
(i) **Two** features that reduce machining cycle time;

(ii) The contrast between CNC machining and conventional lathework;

(iii) The factors that make CNC machining safe.

Question 8. **(50 marks)**

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



(i)

(ii)

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

(i) Electrical relay;

(ii) Clutch;

(iii) Shuttle valve;

(iv) Rack and pinion;

(v) Capacitor.

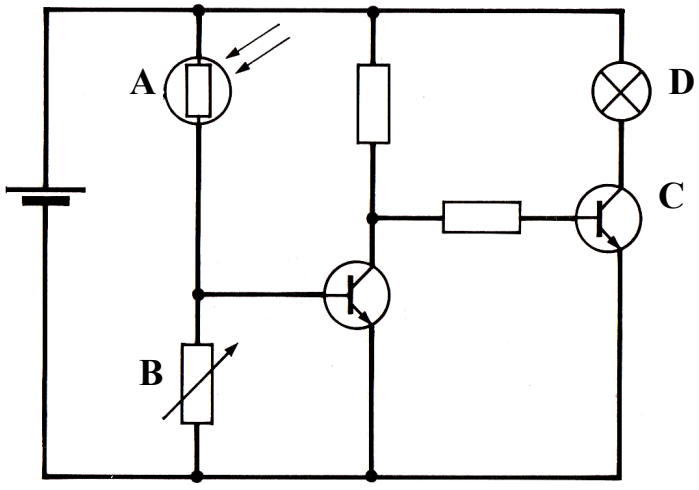
(c) Describe, with the aid of appropriate diagrams, a mechanised system that will safely elevate heavy loads.

OR

(c) With reference to the circuit shown below:

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

(ii) Describe the function of A and the function of B.



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