



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION, 2012

ENGINEERING – MATERIALS AND TECHNOLOGY

(Higher level – 300 marks)

THURSDAY, 7 JUNE

MORNING 9:30 – 12:30

INSTRUCTIONS

- 1.** Answer **Section A** and **Section 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 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) Identify the main processes used to manufacture the metal face guard of the hurling helmet shown.
- (b) Explain the term *allotropy* with reference to carbon steel.
- (c) State the purpose of **any two** of the safety signs shown.



(i)

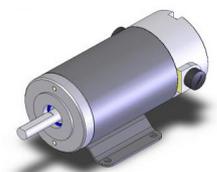


(ii)



(iii)

- (d) Outline **two** issues associated with the disposal of foamed polystyrene cartons.
- (e) Describe the metallic bond, with the aid of a suitable diagram.
- (f) Differentiate between a thermal conductor and an electrical conductor.
- (g) Newbridge Silverware® produced a range of jewellery in silver to mark 2011 as the ‘Year of Craft’ in Ireland. Suggest **two** material properties that make silver suitable for craftwork.
- (h) Explain the term *factor of safety*.
- (i) Distinguish between a single-acting cylinder and a double-acting cylinder in pneumatic control.
- (j) Explain the meaning of **any two** of the following abbreviations:
 - (i) ISP
 - (ii) LDR
 - (iii) RAM
 - (iv) CAD.
- (k) Discuss the contribution that **any one** of the following made to technology:
 - (i) George Devol
 - (ii) Theodore Maiman
 - (iii) Francis Beaufort.
- (l) Describe the importance of the *evaluation* stage in the process of design.
- (m) Describe, with the aid of a suitable diagram, **one** method used to secure a nylon gearwheel to the shaft of the DC motor shown.



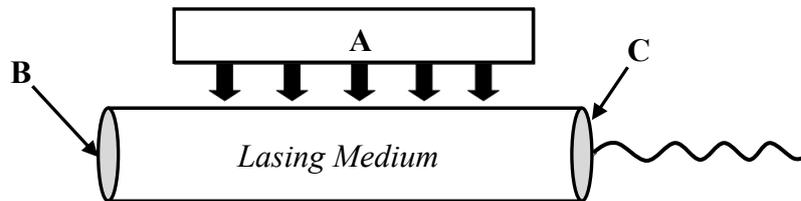
Section B – 50 Marks

Answer **all** of the following:

- (n) Laser (*Light Amplification by Stimulated Emission of Radiation*) technologies are commonplace in modern society. Outline **one** specific example where laser technology is used in **each** of the following:

- (i) Entertainment;
- (ii) Industry.

- (o) The principle of a simple laser is illustrated in the diagram below.



- (i) Name parts **A**, **B** and **C**.
 - (ii) Describe the principle of operation of this laser.
 - (iii) List **any two** sources of energy for this laser.
- (p) Laser light is different from normal light and has the following properties, it is:
- Monochromatic
 - Coherent
 - Directional.

Explain **any two** of these properties.

- (q) *Lasik* is a laser technology used in correcting a range of sight problems by altering the shape of the eye, as shown.

- (i) Describe **two** properties that make laser technology suitable for this application.
- (ii) Discuss the advantages of using laser technology for medical purposes.



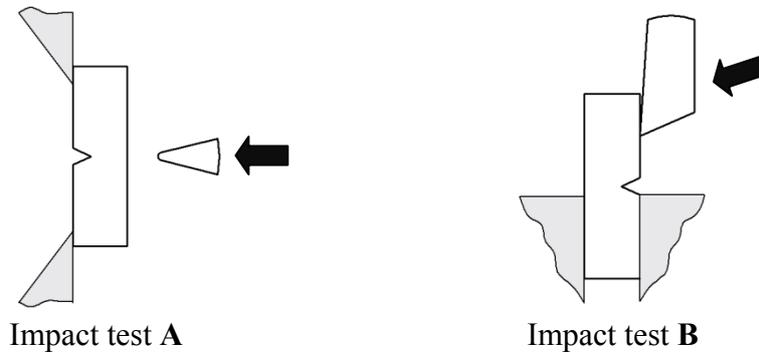
- (r) Explain **any two** of the following:

- (i) The applications of *laser vaporisation cutting* and *laser fusion cutting*;
- (ii) The safety hazards associated with industrial Class IV laser technology;
- (iii) Photon.

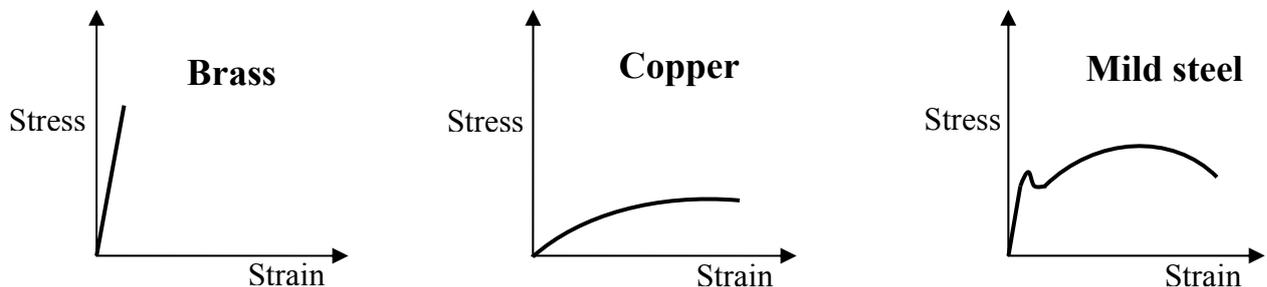
Question 2.

(50 marks)

- (a) (i) Describe the principle of operation of **any one** impact test.
(ii) Compare the two impact tests represented in diagrams A and B.



- (b) The results shown below were obtained from a series of tensile tests on the following metals: **Brass**, **Copper** and **Mild steel**.



- (i) Describe the degree of brittleness in **each** of the metals shown.
(ii) Explain the difference between the elastic state and the plastic state when mild steel is subjected to a tensile test.
- (c) (i) In the manufacture and maintenance of aircraft, a range of non-destructive testing (NDT) is used to check for internal and external flaws.
Identify **two** NDTs that examine surface imperfections and **two** NDTs that detect internal flaws.
(ii) Describe, with the aid of suitable diagrams, **one** non-destructive test used to check for internal faults in welded joints.

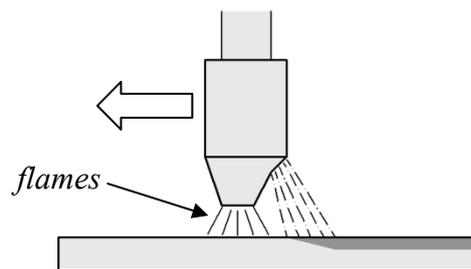
Question 3.

(50 marks)

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

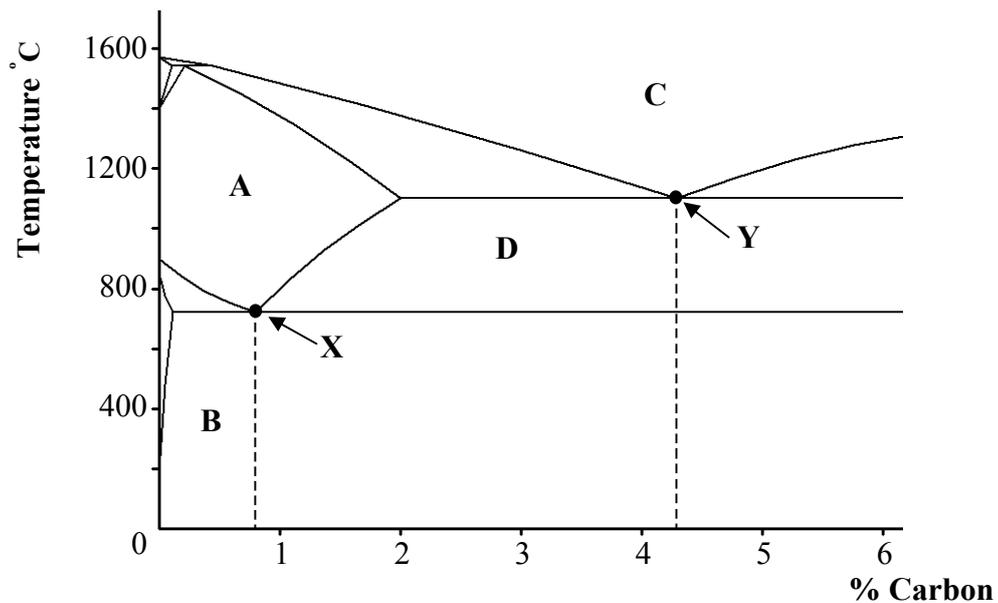
- (i)** Annealing;
- (ii)** Normalising;
- (iii)** Carburising.

(b) A flame hardening process is shown below.



- (i)** Describe the principle of operation of this flame hardening process.
- (ii)** Outline **one** application for this process.

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



- (i)** Name the regions **A**, **B**, **C** and **D** shown.
- (ii)** Identify and describe the points **X** and **Y**.

Question 4.

(50 marks)

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

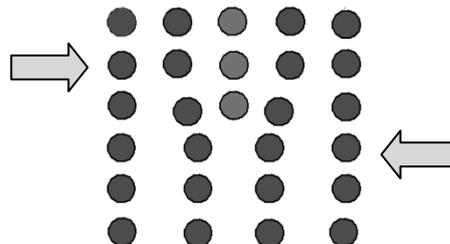
- (i)** The difference between an interstitial solid solution and a substitutional solid solution;
- (ii)** A cooling curve for an alloy;
- (iii)** **One** example of metal refining in Ireland;
- (iv)** The meaning of the term *solvus*.

(b) The table shows the solidification temperatures for various alloys of Cadmium and Bismuth.

% of Cadmium in alloy	0	10	20	30	40	50	60	70	80	90	100
Start of solidification (°C)	268	237	205	175	140	190	235	265	290	310	321
End of solidification (°C)	140	140	140	140	140	140	140	140	140	140	140

- (i)** Using the graph paper supplied, draw the thermal equilibrium diagram according to the given data;
- (ii)** Label and describe the main features of the diagram;
- (iii)** Explain the term *eutectic alloy*.

(c) A diagram of a crystal-lattice line defect is shown.



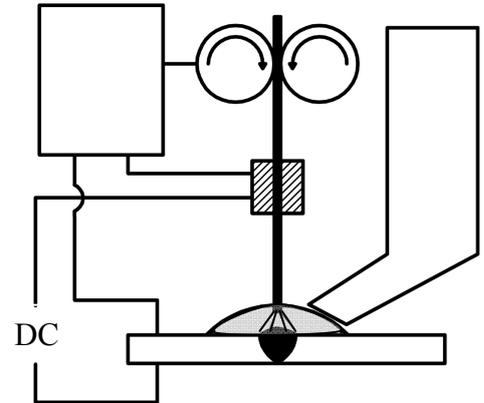
- (i)** Identify and describe this defect.
- (ii)** Outline the impact of a shear force on the defect shown.

Question 5.

(50 marks)

(a) The process of submerged arc welding (SAW) is illustrated.

- (i) Describe the principles of operation of submerged arc welding (SAW).
- (ii) Identify **one** application of SAW.



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

- (i) Describe, with examples, the importance of colour coding in oxyacetylene equipment;
- (ii) Outline **three** safety precautions that should be observed in the preparation of equipment and materials for oxyacetylene welding;
- (iii) Describe multi-run welds;
- (iv) Describe **one** type of welding suitable for the automated welding of steel panels in motorcar manufacture.

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

- (i) Tungsten Inert Gas (TIG) welding;
- (ii) Manual metal arc (MMA) welding.

OR

(c) Resistance spot welding is extensively used in robot controlled engineering manufacture.

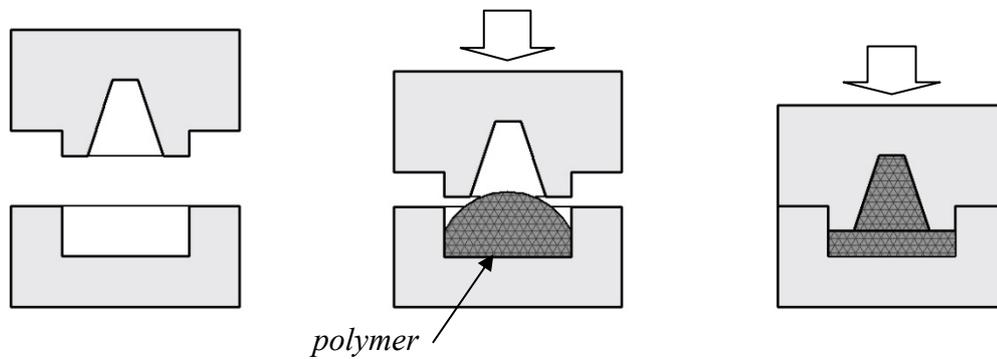
- (i) Explain why resistance spot welding is suitable for robotic control.
- (ii) Identify **two** other industrial processes where robotic control is widely used.



Question 6.

(50 marks)

- (a) With reference to the polymer manufacturing process shown in the diagrams below, answer the following:



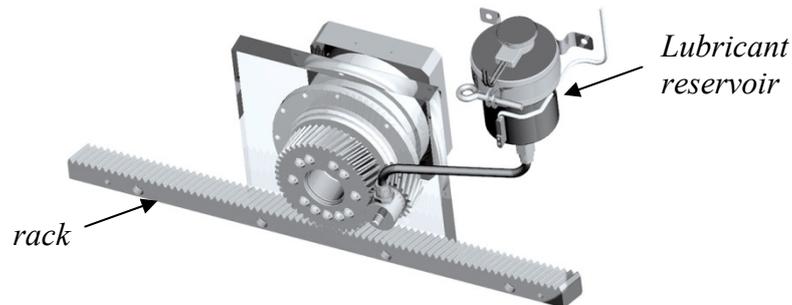
- (i) Name the process **and** describe the principle of operation.
- (ii) State the type of polymer used in this process.
- (iii) Identify **one** component that could be produced using this process.
- (b) Distinguish between *thermoplastics* and *thermoset plastics* using **each** of the following headings:
- (i) Polymerisation process;
- (ii) Chemical bonding;
- (iii) Internal structure;
- (iv) Properties.
- (c) Explain in detail **any three** of the following:
- (i) Elastomer;
- (ii) Catalyst;
- (iii) Blow moulding;
- (iv) GRP;
- (v) Laminate.

Question 7.

(50 marks)

- (a) Answer **any three** of the following:
- (i) Identify **two** benefits of the use of cutting fluids in machining;
 - (ii) Describe the function of a *dividing head* on a milling machine;
 - (iii) Explain the term *tolerance* in engineering measurement systems;
 - (iv) Describe the main factors that influence metal surface finish when parallel turning on the lathe;
 - (v) State **one** advantage and **one** disadvantage of using magnetic chucks on a grinding machine.

- (b) Lubrication is vital to the efficient working of machine parts, such as in the engineering system shown.



- (i) Outline **two** reasons why lubrication is important in machining processes.
 - (ii) Identify **any two** lubricating materials commonly used in engineering machines.
- (c) Outline, with the aid of diagrams, the essential differences between the machining terms in **each** of the following:
- (i) Loading and glazing of grinding wheels;
 - (ii) Forming and generating on the lathe.

OR

- (c) Industrial engineering was one of the earliest areas to use computer technology. Describe **any one** use of computer technology in **each** of the following areas:
- (i) Research;
 - (ii) Product design;
 - (iii) Production techniques.

Question 8.

(50 marks)

- (a) Name and describe the operation of **any one** of the mechanisms shown.



(i)



(ii)

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

- (i) The energy conversion that occurs in a car battery;
- (ii) The function of an idler gear;
- (iii) **One** application of a ratchet and pawl mechanism;
- (iv) The use of a heat sink in an electronic circuit;
- (v) The benefits of using solar panels.

- (c) Describe, with the aid of suitable diagrams, **one** method of providing independent drive to each wheel of the all-terrain surveillance vehicle shown.



OR

- (c) Integrated circuit (IC) microchips are used in many electrical appliances.

- (i) Identify **one** semi-conductive material used in the manufacture of integrated circuits.
- (ii) Outline **two** advantages of using IC microchips rather than building circuits using traditional components.



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