



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION, 2009

ENGINEERING – MATERIALS AND TECHNOLOGY

(Higher level – 300 marks)

THURSDAY 4 JUNE, AFTERNOON 2:00 – 5:00

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.

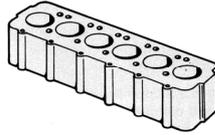
Question 1.

(100 marks)

Section A – 50 Marks

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

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



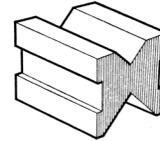
(i) machine screw

(ii) cylinder head

(iii) key

- (b) Outline **two** safety precautions to be observed when using cutting fluids in a machining process.
- (c) Distinguish between metal ore concentration and metal ore extraction.
- (d) Identify **two** factors that influence fatigue failure in metals.
- (e) State the difference between a single-acting cylinder and a double-acting cylinder in pneumatic control.

- (f) Outline **one** use for the vee block shown.



- (g) Define the term *Young's Modulus of Elasticity*.

- (h) Explain the function of a heat sink in electronic circuit assembly.

- (i) Select **any two** of the abbreviations shown and explain their meaning:

(i) PCB (ii) uPVC (iii) SPST switch (iv) H.S.S.

- (j) Describe the importance of the colour coding associated with workshop safety signs.

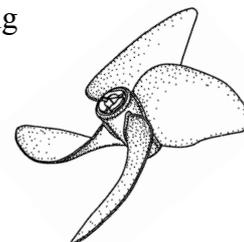


- (k) Describe the term *elastic memory* with reference to thermoplastics.

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

(i) James Dyson (ii) Igor Sikorsky (iii) Chester Carlson.

- (m) Explain *sacrificial protection* as a method of preventing corrosion on the bronze propeller of a boat, as shown.

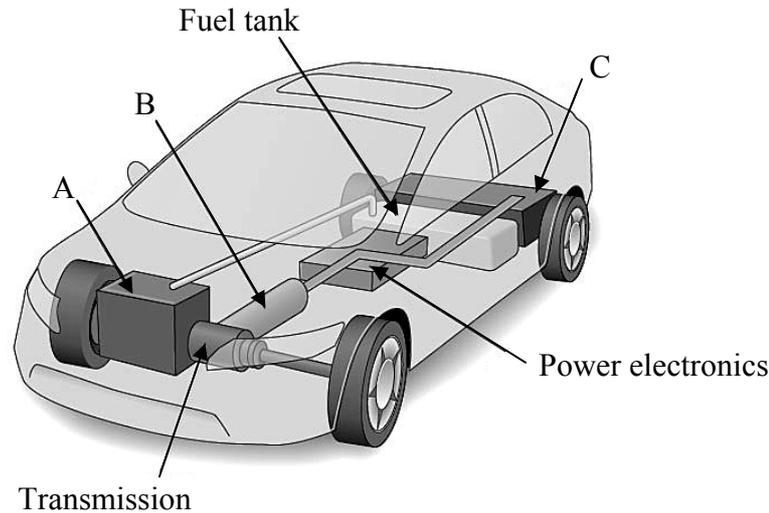


Section B – 50 Marks

Answer **all** of the following:

An increased awareness of both sustainable design and social responsibility has encouraged car manufacturers to develop the more environmentally friendly hybrid vehicle.

(n) A hybrid vehicle is illustrated in the diagram below:

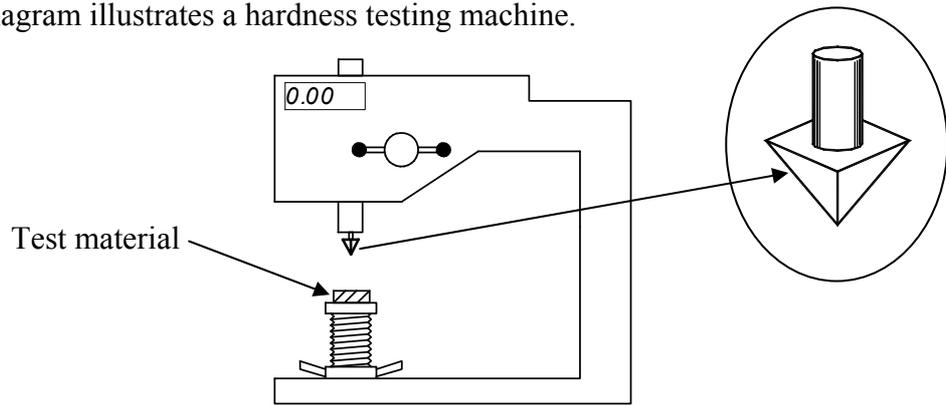


- (i) Identify the parts labelled A, B and C.
 - (ii) Describe the principle of operation of this hybrid vehicle.
- (o) Identify **three** common power sources that may be used to power a hybrid vehicle.
- (p) Describe, in detail, **any three** environmental consequences associated with the use of hybrid vehicles.
- (q) Explain how the running costs of a hybrid vehicle are reduced by the following design elements in hybrid vehicle technology:
- (i) regenerative braking;
 - (ii) battery capacity;
 - (iii) fuel-engine shut down.
- (r) Describe **any two** of the following:
- (i) PHEV;
 - (ii) the incentives to consumers to encourage the use of hybrid vehicle technology;
 - (iii) the difference between *series* hybrid vehicles and *parallel* hybrid vehicles.

Question 2.

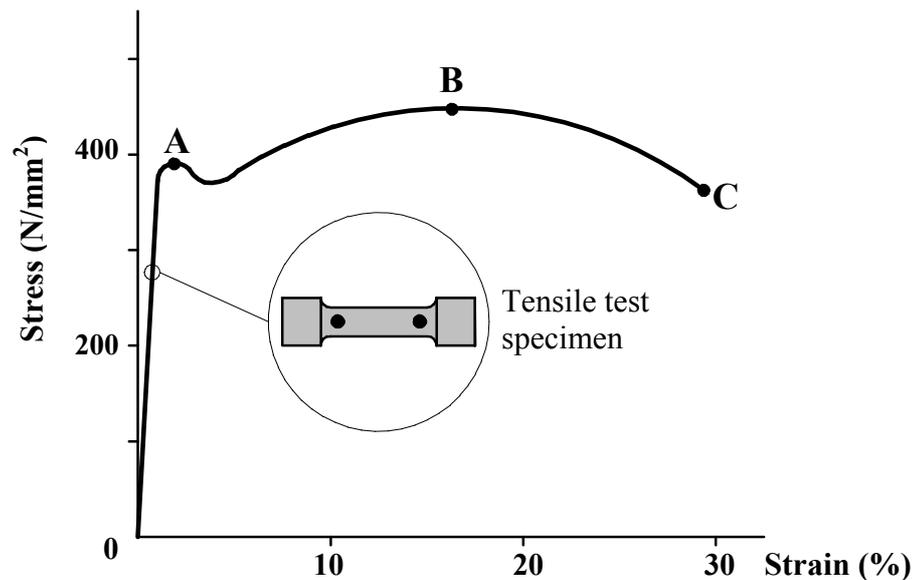
(50 marks)

- (a) The diagram illustrates a hardness testing machine.



- (i) Identify the hardness test shown.
(ii) Describe the main features of this mechanical test.

- (b) The Stress-Strain graph and the test specimen used in a tensile test are shown.



- (i) Identify the points A, B and C on the Stress-Strain graph.
(ii) Describe, with the aid of diagrams, the shape of the test specimen at point B and the shape of the test specimen at point C.
- (c) (i) Outline **two** reasons why non-destructive tests are used in the manufacture of cast motorcycle engines.
(ii) Describe, with the aid of a suitable diagram, a non-destructive test for locating surface flaws on aluminium castings.

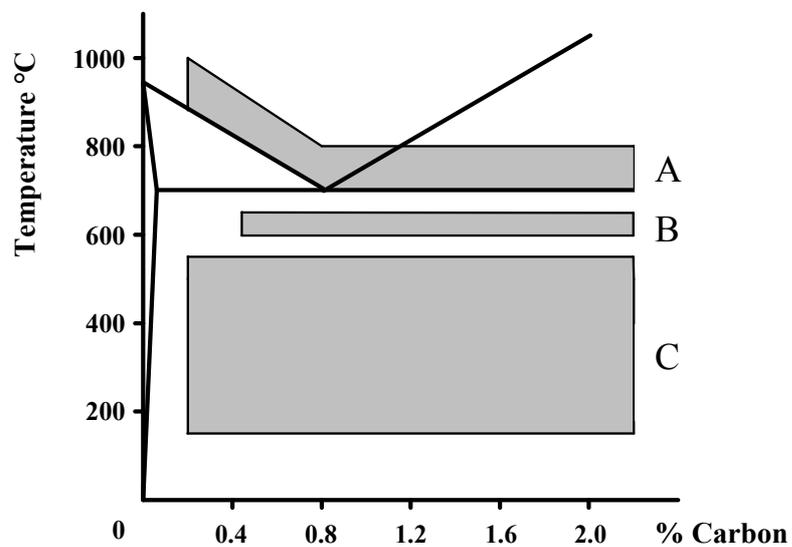
Question 3.

(50 marks)

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

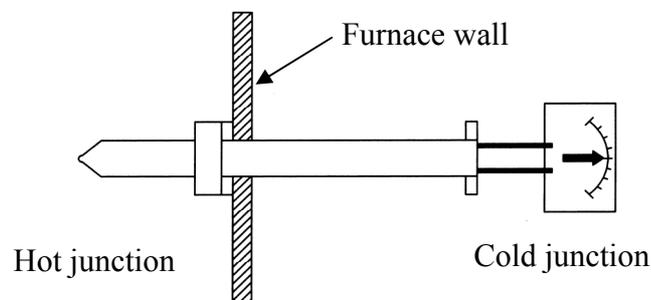
- (i)** Identify **any three** quenching media used in heat treatments;
- (ii)** Discuss the safety hazards associated with the process of case hardening;
- (iii)** Describe the principle of induction hardening;
- (iv)** What is pearlite?

(b) Temperature zones for heat treatment processes are shown:



- (i)** Identify **any two** of the heat treatment processes at A, B or C.
- (ii)** Explain allotropy in carbon steel.

(c) The diagram represents a pyrometer for measuring furnace temperature.



- (i)** Identify this instrument.
- (ii)** Outline the principle of operation for this instrument.

Question 4.**(50 marks)**

- (a) Explain **any two** of the following:
- (i) Crystalline and amorphous structures;
 - (ii) Dendritic growth;
 - (iii) A cooling curve for an alloy;
 - (iv) Brittleness in crystal cells.
- (b) The given table shows the solidification temperatures for various alloys of metal A and metal B. The melting point of metal A is 270°C and metal B is 630°C.

% of metal 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

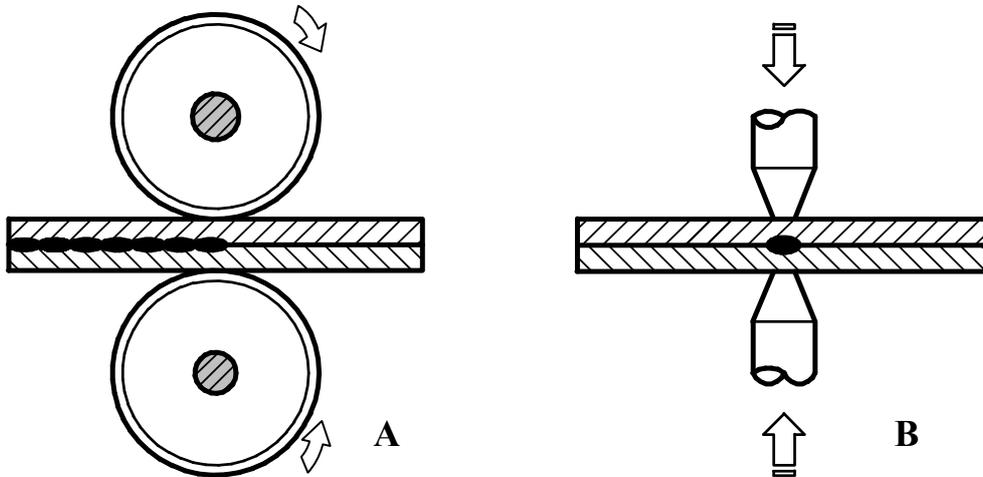
Using the graph paper supplied:

- (i) Draw the equilibrium diagram according to the given data;
 - (ii) Label the diagram and describe the main features;
 - (iii) For the alloy of **50% B** determine, from the diagram, the ratio of phases at **400°C**.
- (c) Distinguish, with the aid of suitable diagrams, between the following crystal defects:
- (i) a dislocation;
 - (ii) a substitute defect.

Question 5.

(50 marks)

(a) Two resistance welding processes are illustrated at **A** and **B** below.



- (i) Name the **two** resistance welding processes.
 - (ii) Describe the principles of operation for **any one** of these resistance welding processes.
- (b) Answer **any three** of the following:
- (i) Distinguish clearly between the applications of MIG welding and the applications of TIG welding;
 - (ii) State **two** functions of the electrode coating in manual metal arc welding;
 - (iii) Describe **two** factors to be considered when installing a welding station in a school workshop;
 - (iv) Describe multi-run welding.
- (c) Describe, with the aid of suitable diagrams, the main features of **one** of the following:
- (i) The transformer circuit used in manual metal arc welding;
 - (ii) Submerged arc welding.

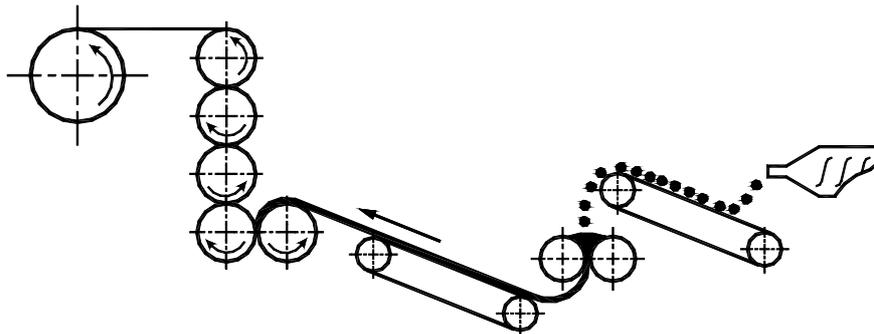
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- (c) (i) Outline the advantages of using pneumatic control to power robots for heavy duty vehicle assembly.
- (ii) Describe the benefits of using robotic control in a hazardous manufacturing environment.

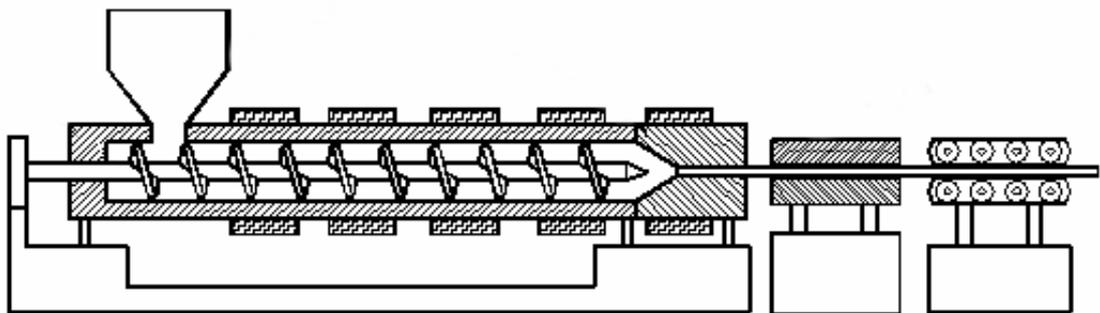
Question 6.

(50 marks)

- (a) Two polymer manufacturing processes are shown at **A** and **B** below.
- (i) Name **both** processes.
 - (ii) Identify **one** component produced by **each** process.
 - (iii) Describe the principle of operation of manufacturing process **A** or of manufacturing process **B**.



Manufacturing process **A**



Manufacturing process **B**

- (b) Identify and describe the type of polymerisation that will produce polyethylene.
- (c) Explain **any three** of the following in relation to polymers:
- (i) Blow moulding;
 - (ii) Elastomer;
 - (iii) Catalyst;
 - (iv) Co-polymer;
 - (v) Thermosetting plastic.

Question 7.

(50 marks)

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

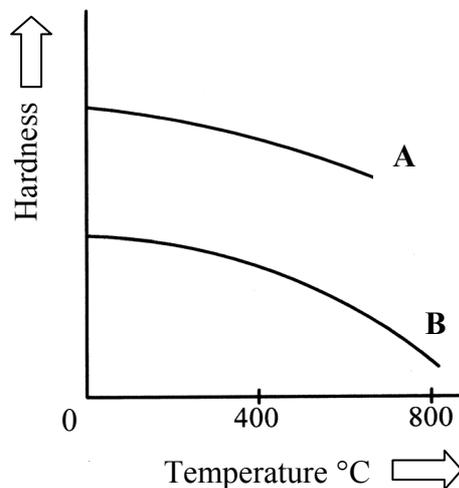
- (i) Identify **one** use for the milling cutter shown;
- (ii) Describe the process of knurling;
- (iii) Identify **two** safety features incorporated into a pedestal grinding machine;
- (iv) Outline **two** advantages of using a height gauge;
- (v) Distinguish between direct and comparative measurements.



(b) Cutting tool materials include high carbon steel, high speed steel and tungsten carbide.

The effect of increased machining temperatures on the hardness of cutting tool materials **A** and **B** is shown below.

- (i) Suggest a suitable cutting tool material for **A** and a suitable cutting tool material **B**.
- (ii) Outline **two** methods of prolonging cutting tool life.



(c) Describe, with the aid of suitable diagrams, the essential features of the horizontal milling machine **or** the vertical milling machine.

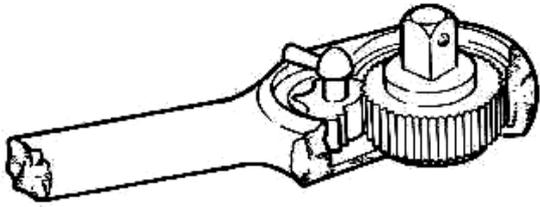
OR

- (c) (i) Distinguish between CAD and CAM.
- (ii) Outline the main safety features of a modern CNC machine.

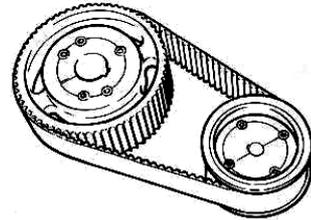
Question 8.

(50 marks)

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



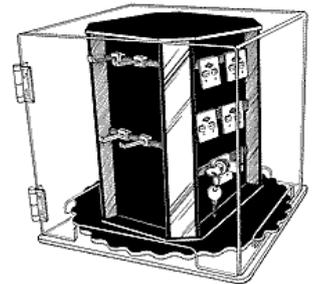
(i)



(ii)

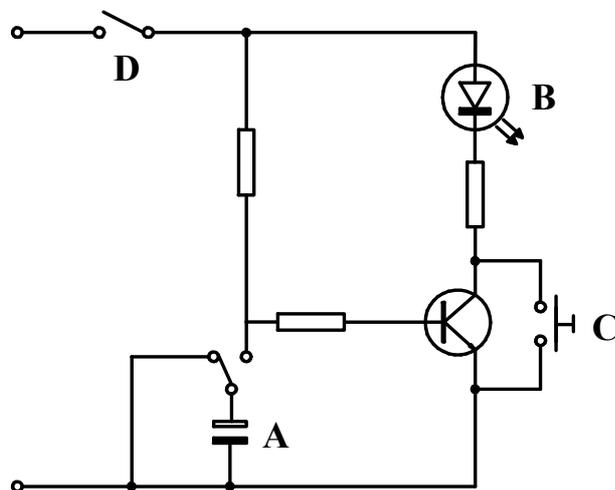
- (b) Explain **any three** of the following:
- (i) The advantages of helical gears;
 - (ii) One method of preventing slip in a pulley-belt system;
 - (iii) Crank and slider mechanism;
 - (iv) Integrated circuit;
 - (v) Solenoid.

- (c) Describe, with the aid of suitable diagrams, a mechanism to activate a rotating jewellery display as shown.



OR

- (c) With reference to the circuit shown:
- (i) Identify the electronic components A, B, C and D.
 - (ii) Describe the function of each of the components A and B.



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