



Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE 2008

MARKING SCHEME

**ENGINEERING -
MATERIALS AND TECHNOLOGY**

ORDINARY LEVEL



Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE 2008

MARKING SCHEME

Written Examination and Practical Examination

ENGINEERING - MATERIALS AND TECHNOLOGY

ORDINARY LEVEL

LEAVING CERTIFICATE EXAMINATIONS
ENGINEERING – MATERIALS and TECHNOLOGY
ORDINARY LEVEL – 200 marks

Written Examination - Marking Scheme 2008

Required: Answer Sections A and B of Question 1 and any three other questions.

<p>Question 1.</p> <p>Section A – 30 Marks Any six @ 5 marks each.</p> <p>Section B – 35 Marks Any three parts @ 12 + 12 + 11 Marks</p>	<p style="text-align: center;">Total - 65 Marks.</p> <p style="text-align: right;">Two part answers 3 + 2</p> <p style="text-align: right;">Two part answers 6 + 6 or 6 + 5</p>
--	--

<p>Question 2. Total - 45 Marks</p> <p>(a) Two parts @ 6 each One @ 8 (20)</p> <p>(b) Three parts @ 4 each (12)</p> <p>(c) Three parts @ 3 each (9)</p> <p>(d) Name @ 4 marks (4)</p>
--

<p>Question 3. Total - 45 Marks</p> <p>(a) Two parts @ 8 marks (16)</p> <p>(b) Two parts @ 6 each (12)</p> <p>(c) Two parts @ 4 each (8)</p> <p>(d) One part @ 9 (9)</p> <p style="text-align: center;">OR</p> <p>(d) One part @ 9 (9)</p>
--

<p>Question 4. Total - 45 Marks</p> <p>(a) Four parts @ 4 each (16)</p> <p>(b) Three parts @ 5 each (15)</p> <p>(c) Three parts @ 3 each (9)</p> <p>(d) One part @ 5 (5)</p>

<p>Question 5. Total - 45 Marks</p> <p>(a) Two parts @ 5 each (10) Explanation @ 10 marks Component @ 3 marks (13)</p> <p>(b) Two parts @ 3 each (6)</p> <p>(c) One part @ 7 One part @ 3 (10)</p> <p>(d) Two parts @ 3 each (6)</p>

<p>Question 6. Total - 45 Marks</p> <p>(a) Three parts @ 6 each (18)</p> <p>(b) One part @ 9 each Two parts @ 3 each (15)</p> <p>(c) Two parts @ 6 each (12)</p> <p style="text-align: center;">OR</p> <p>(c) Two parts @ 6 each (12)</p>

<p>Question 7. Total - 45 Marks</p> <p>(a) Two parts @ 5 each (10)</p> <p>(b) Four parts @ 5 each (20)</p> <p>(c) Three parts @ 5 each (15)</p> <p style="text-align: center;">OR</p> <p>(c) Three parts @ 5 each (15)</p>
--

ENGINEERING - MATERIALS AND TECHNOLOGY
ORDINARY LEVEL

Written Examination - Solutions & Marking Scheme 2008

Required: Answer **Sections A and B** of **Question 1** and **any three** other questions.

QUESTION No. 1 – Total 65 MARKS

SECTION A - 30 MARKS

Any 6 parts @ 5 marks each
For two part answers award 3 + 2

SECTION B - 35 MARKS

2 parts @ 12 marks each
and 1 part @ 11 marks
(Award 6 + 6 or 6 + 5 as Appropriate)

SECTION A – 30 MARKS

		MARKS
(a)	- Always wear protective clothing - select the correct working temperature	3 + 2 Marks
(b)	The value of a resistor can be calculated using its colour bands.	5 Marks
(c)	- Copper and Tin produce Bronze, -Copper and Zinc produce Brass.	3 + 2 Marks
(d)	A rack and pinion can be used in the steering mechanism of a car or on a pillar drilling machine to raise or lower the table.	5 Marks
(e)	The shaft is always smaller than the hole allowing the shaft to move freely.	5 Marks
(f)	Square thread, Acme thread, Buttress thread.	3 + 2 Marks
(g)	Computer Numerical Control is where a machine is controlled by a computer program based on numbers. CNC lathes are examples of such machines.	5 Marks
(h)	Name: Vernier calipers. Application: a precision measuring instrument used for external and internal measurements i.e. shafts and holes.	3 + 2 Marks

SECTION B – 35 MARKS

MARKS

(i) Describe the function and operation of **any one**:

▪ **Four Jaw Independent Chuck:**

The four jaw independent chuck can be used for eccentric turning and for gripping square, round, rectangular and irregular shapes. The four jaw independent chuck allows the work to be centred more accurately than a three jaw, but takes longer.

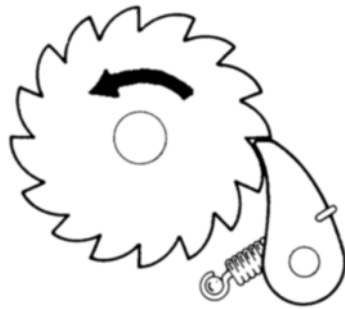
The jaws can be moved independently of one another, each being actuated by its own screw. The jaws are also reversible and therefore only one set is required.

(i) Description
Award 12 (11) Marks
Total (12, 11) Marks

▪ **Ratchet and pawl mechanism:**

Ratchet and pawl mechanisms are used in ratchet spanners, fishing reels, ratchet screwdrivers, micrometers and winding machines etc.

A ratchet and pawl mechanism is used to allow a shaft, axle or pin to rotate in one direction only. The teeth on the ratchet wheel are so shaped that the pawl slides over them in one direction and engages with them so as to restrict movement in the other direction.



▪ **Feeler gauge:**

Feeler gauges are used for checking the gap between two surfaces i.e. spark plug gap or car tappets.

Feeler gauges are used to estimate, by sense of touch, the clearance between two separate components by inserting different blades or combination of blades until the thickness is found that will just go between the surfaces.

(j) Explain any two:

▪ **Network:**

A computer network consists of a collection of computers, printers and other equipment that is connected together so that the equipment can share information, share resources and communicate with other equipment on the network.

▪ **Memory stick :**

Memory sticks are solid state storage devices which operate from a computer's USB port. They can be fitted and removed with ease. Based on flash memory technique memory sticks can be used to store large files for transfer between computers. They are physically very small, very light and provide faster access than other portable memory device.

▪ **Scanner:**

A hardware device connected to a computer. Scanners can be used to copy / scan text and or graphics to software packages. Scanners can also be used as a fax machine.

▪ **DVD:**

Digital Versatile Disc or Digital Video Disk is a type of CD-ROM which holds a minimum of 4.7GB of data., enough for a full length movie. A DVD player or drive is required to read the contents of a DVD.

(j) Explanations
Award 6+6(5) Marks
Total (12, 11) Marks

(k)

Tensile strength:

The ability of a metal to withstand a pulling force is know as it's tensile strength.

Application:

Fishing line / a tow bar requires a high degree of tensile strength as does a crane hook.

(k) Definition
Award 6
Application
Award 6(5)
Total (12, 11) Marks

(l) Explain any two:

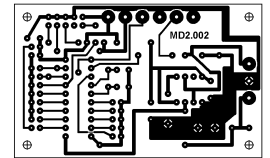
(l) Explanations
Award 6 + 6(5)
Total (12, 11) Marks

▪ **Pulley drive:**

A pulley drive is used to transmit motion and force from one shaft to another by way of pulleys and belts. Household machines such as sewing machines, spin driers and washing machines are often driven by round grooved pulleys and round rubber belts. Machine tools such as drilling machines and lathes use vee pulleys and vee belts.

▪ **Printed Circuit Board (PCB):**

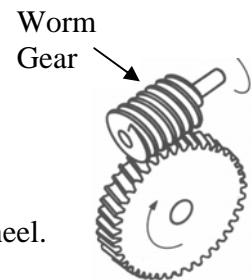
A PCB is usually a plastic board about 1.6mm thick with a thin layer of copper on one side. Unwanted portions of the copper are routed or etched away to leave pads and strips which form electrical connections between the components. The components are soldered to the pads, allowing the strips to connect the components together.



▪ **Worm Gear:**

A worm gear is a single toothed gear. When used with a worm wheel will provide a large speed reduction coupled with increased torque output.

A worm and worm wheel arrangement also transmits rotary motion through an angle of 90 degrees. A worm and worm wheel drive will only allow input and out rotation in one direction only i.e. worm to worm wheel.



▪ **Plug gauge:**

A plug gauge is used to compare the size of holes against a set of pre-determined limits identified by the GO and NO GO parts of the gauge.

(m)

- (i) Cam and follower.
- (ii) A is the follower and B is the CAM.

(m) Name: Award 6
Part: Award 6(5)
Total (12, 11) Marks

QUESTION NO.2

Total 45 Marks

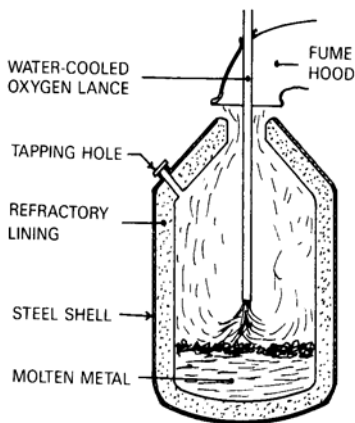
(a)

(i) Basic Oxygen Furnace and Electric Arc Furnace.

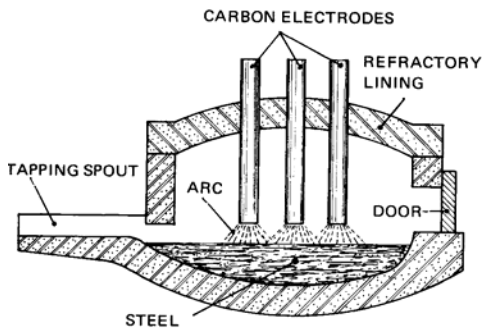
(i) Name furnace
Award 2 @ 6 Marks

(ii) Any one:

(ii) Sketch & Operation
Award 8 Marks
Total (20) Marks



Mild Steel is produced in the **Basic Oxygen Furnace**. The charge consists of scrap iron and steel together with lime and molten pig iron. Oxygen is blown at the surface of the molten charge from a water cooled lance which is lowered through the mouth of the furnace. Impurities in the charge are oxidized and form a slag on the surface. At the end of the blow, the steel is poured off through a tapping hole followed by emptying the slag through the mouth of the furnace.



High Carbon Steel is produced in the **Electric Arc Furnace**. Cold scrap iron or steel make up the majority of the charge together with small amounts of lime and carbon. Heat for this furnace is by an electric arc created between carbon electrodes and the charge. The lime combines with impurities producing slag. When the correct composition of steel is achieved the slag is removed and the steel tapped from the furnace.

(b) Any three:

- | | |
|--------------------|---------------------|
| (i) Door bolt | - Steel / Brass |
| (ii) Machine Vice | - Steel / Cast Iron |
| (iii) Kitchen sink | - Stainless Steel |
| (iv) Tap | - High Carbon Steel |

Materials
Award 3 @ 4 Marks
Total (12) Marks

(c) **Any three:**

- | | | |
|-------|------------|---------------|
| (i) | Steel: | - Ferrous |
| (ii) | Aluminium: | - Non-ferrous |
| (iii) | Cast Iron: | - Ferrous |
| (vi) | Copper | - Non-ferrous |

Classification of Metals
Award 3 @ 3 Marks
Total (9) Marks

(d) **Protective coating:**

Chrome / Zinc / Tin

Explanation
Award 1 @ 4 Marks
Total (4) Marks

QUESTION NO. 3

Total 45 Marks

- (a) (i) The high carbon steel will become hard and brittle i.e. hardened. Wear ability is improved but the high carbon steel will break if subjected to blows or shocks.

Description
(i) 8 marks
(ii) 8 Marks
Total (16)

- (ii) The high carbon steel will become soft and relieved of any internal stresses i.e. Annealed / Normalised. Malleability and toughness is improved, allowing the material to be machined and to better survive blows or shocks.

(b)

- (i) The head of the cold chisel should be soft i.e. annealed.
(ii) The cutting edge of the cold chisel should be hard i.e. hardened

Heat treatments
(i) 6 Marks
(ii) 6 Marks
Total (12)

(c) **Any two:**

- Ensure good ventilation to allow fumes dissipate
- Hold the component securely

Safety precautions
Award 2 @ 4 Marks
Total (8)

(d)

Case hardening:

Case hardening is a method of making low carbon steel very hard on the outside while leaving its centre tough. Low carbon steel may be case hardened by first increasing the amount of carbon in the outer surface by 'carburising'. The steel part will now have a skin or 'case' rich in carbon. The part is then heated to a cherry red and quenched, producing a hardened skin with a tough core.

OR

(d)

Operation:

Push button A operates a 3 port two stage valve. When pressed, compressed air is allowed to flow from port 1 through to port 2 and into the top of the single acting spring return cylinder. The compressed air forces the piston down against the spring stamping the box beneath. When the push button is released port 1 is closed. The return spring pushes the piston back up the cylinder exhausting the air through ports 2 and 3.

(d) or (d) Description
Award 9 Marks
Total (9) Marks

QUESTION NO. 4

Total 45 Marks

(a) Any two:

(i) Gas welding

In Oxy-Acetylene welding the heat source is a flame of acetylene burning in an atmosphere of pure oxygen. This produces a flame whose temperature can reach 3250°C. Suitable for welding light gauge material with the filler rod fed in by hand. Materials are melted and allowed to solidify as one – gas welding is a fusion process.

(ii) Application: Joining of light gauge steel pipes

(i) Adhesive bonding

Adhesives can be used to join similar or dissimilar materials e.g. metal to metal or metal to plastics by surface attachment. Adhesives are supplied in liquid, paste, solid or powder form. Joints, which can be air or water tight, are quick and economical to make. Adhesives can be applied to the surface by hand and allowed to harden. Methods of hardening include the use of a hardener, heat, pressure and the evaporation of a solvent. The use of adhesives is a bonding process.

(ii) Application: Car break pads to steel shoes.

(i) Electric Arc welding

In Electric Arc welding the heat source is produced by an electrical discharge between the electrode (filler rod) and the work piece. The electric arc has a temperature of about 4000°C. and is suitable for welding heavy gauge material. Materials are melted and allowed to solidify as one – arc welding is a fusion process.

(ii) Application: Table / chair frames made from steel box section.

Differences

(i) Award 2 @ 4 Marks

Application

(ii) Award 2 @ 4 Marks

Total (16) Marks

(b)

- (i) Neutral Flame – Equal amounts of Oxygen & Acetylene



- (ii) Carburising Flame – More Acetylene than Oxygen



- (iii) Oxidising Flame – More Oxygen than Acetylene



Three parts
Award 3 @ 5 Marks
Total (15)

(c) Any three:

- (i) **Tinning**

Tinning refers to coating each of the materials to be joined with a thin layer of solder before joining. Tinning supports the production of a successful joint by allowing the solder on both parts to unite when melted.

- (ii) **Flux**

A flux is used to remove oxides from the surface of the parts being soldered and to prevent further oxidation when the parts are heated. A flux can be active or protective.

- (ii) **Capillary action**

Capillary action refers to the solder being drawn into a joint. The parts to be joined are cleaned fluxed and heated. If the work is hot enough and the gap between metals correct the solder will be drawn into the joint, completely filling it.

- (iv) **Oxides**

Oxides are formed when the oxygen in the air reacts with the surface of metals producing a thin skin on the surface of the metal. Iron oxide or rust is an example of an oxide.

Explanation
Award 3 @ 3 Marks
Total (9)

- (d) It is necessary to wear protective clothing when welding to guard against UV light, hot metal particles and or high temperatures.

Award 5 Marks
Total (5) Marks

QUESTION NO. 5

Total 45 Marks

(a) (i) The plastic molding processes shown:

- A - Blow Moulding
- B - Vacuum forming

(ii)

(A) Blow Moulding:

In blow moulding a heated thermoplastic tube called a parison is extruded between the two halves of a split mould. The mould closes around the parison and air is blown into it forcing the parison out against the wall of the mould. The component is allowed to cool before being removed from the opened mould. Using blow moulding thermoplastic materials like polythene can be moulded into **bottles** and **drums**.

(B) Vacuum Forming:

Vacuum forming is used to make articles from thermoplastic sheet. The sheet is clamped and a heater raises the temperature of the sheet until it becomes soft and flexible. The mould table is raised and air is removed from beneath the sheet allowing atmospheric pressure to push down, forcing the sheet to take up the shape of the mould. When the mould table is lowered the vacuum formed sheet can be removed for finishing. Using this process thermoplastic sheet can be formed into **baths, interior panels of lorry cabs** or for **biscuit tin liners**.

(b) **Two safety precautions:**

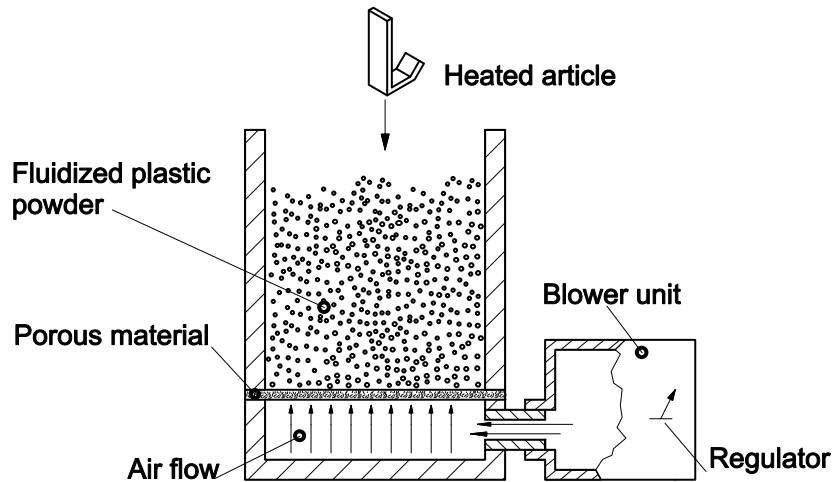
- Ensure the acrylic sheet is held and supported correctly
- Select the correct coarseness of blade before cutting.

(i) Name
Award 2 @ 5 Marks
(ii) Describe Process
Award 1 @ 10 Marks
Component
Award 1 @ 3 Marks
Total (23)

Precautions
Award 2 @ 3 Marks
Total (6) Marks

(c) (i) Operation

A plastic dip coating tank consists of a fluidizing unit and an air supply unit. A means of regulating the air flow must also be provided. The fluidizing unit has two compartments which are separated from each other by a porous material. The upper compartment contains the plastics powder and the air supply is connected to the lower one. Air passes up through the porous material and causes the plastics powder to act like a fluid. This allows the heated article to sink into the powder and receive an even coating all over.



(i) Describe operation
Award 7 Marks
(ii) Application
Award 3 Marks
Total (10) Marks

(ii) Application:

Articles made from steel, such as shopping baskets, kitchen utensils and dish washer holding trays are all plastic dip coated for protection.

- (d) (i) Lunch Box - Thermoplastic
(ii) Saucepan handles - Thermosetting

Award (i) 3 Marks
(ii) 3 Marks
Total (6)

QUESTION NO. 6

Total 45 Marks

(a) Identify any three:

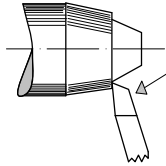
- (i) Tailstock
- (ii) 3 Jaw self centering chuck
- (iii) Centre drill
- (iv) Lathe fixed steady

Award 3 @ 6 Marks

Total (18)

(b) (i) Describe, using diagrams, any one:

Taper turning:



- (ii) -Top slide set to correct angle
- Cutting tool set correctly

(i) Describe operation

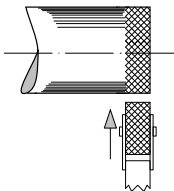
Award 9 Marks

(ii) Safety precautions

Award 2 @ 3 Marks

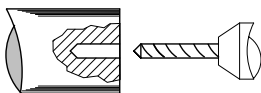
Total (15)

Knurling:



- (ii) -Knurling tool set to correct height
-Use a lubricant to ease knurling

Drilling:



- (ii) -Select the correct speed to suit
drill diameter
-With draw drill periodically to remove swarf

(c) **Reasons:**

- (i) To establish the correct tool geometry for cutting
- (ii) To ensure the cutting tool removes all material when facing / surfacing.

Reasons Award 2 @ 6 Marks Total (12)
--

OR

(c) **CNC Terms:**

- (i) **Emergency stop**
If an error occurs during machining the emergency stop can be used to immediately cancel and stop all operations on a CNC lathe.
- (i) **Simulation:**
This is a means of checking out the CNC program. The machining of the component can be simulated on the computer screen. It can detect errors thus avoiding lathe damage and waste of material.
- (ii) **Stepper Motor:**
A stepper motor is an electric motor designed to rotate incrementally in steps subject to signals received from a computer. Used to move the cutting tool on CNC lathes.

CNC Terms Award 2 @ 6 Marks Total (12)
--

QUESTION NO. 7

Total 45 Marks

(a) **Any two:**

- Vernier calipers
- Micrometer

Measuring instruments
Award 2 @ 5 Marks
Total (10)

(b)

- (i) Nominal diameter of hole: - 20mm
- (ii) Largest diameter of the shaft: - 20.08mm
- (iii) Smallest diameter of the hole: - 19.95mm
- (iv) Type of fit: - Interference fit

Calculations
Award 4 @ 5 Marks
Total (20)

(c) **Any three:**

- (i) Surface plate – for marking out and checking flat surfaces
- (ii) Bevel gauge – for checking and / or marking out angles
- (iii) Vee block – for holding round bars when marking out or drilling
- (iv) Height gauge – for accurate marking out of components

Name
Award 3 @ 3 Marks
Application
Award 3 @ 2 Marks
Total (15)

OR

(c) **Any three:**

- A:** - Battery
- B:** - Motor
- C:** - LED
- D:** - Fixed resistor

Electronic symbols
Award 3 @ 5 Marks
Total (15)



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Engineering Practical, Common Level, Marking Scheme 2008

Subjective Grading: 1 - 20

17 - 20 Excellent

13 - 16 Very Good

9 - 12 Good

5 - 8 Poor

1 - 4 Very Poor

Section	Part Number	Pictorial Sketch / Description	Concept	Mark	Mark	
1	All Parts of Mechanism		Assembly Function & Finish Subjective Grade 1-20	20	20	
2	Part 1		Marking Out	5	20	
			10mm Radii	4		
			9mm Slots	6		
			Drill & Tap M5	2		
			Drill 6mm Holes	2		
			Drill 10mm Hole	1		
3	Part 3		Marking Out	5	20	
			24mm Slot	5		
			Dovetail	4		
			Profile	4		
			Drill 3mm Holes	2		
4	Parts 2, 4 & 5		Part 2	Marking Out	2	20
				Dovetail Slot	6	
				Drill 6mm Holes	2	
			Parts 4 & 5	Marking Out	2	
				28mm x 8mm Recesses	4	
				10mm Radii	2	
				5mm CSK Holes	2	
5	Parts 6, 7, 8 & 9		Part 6 Bench Work	5	20	
			Part 7 Lathe Work	6		
			Part 8 Bench Work	5		
			Part 9 Lathe Work	2		
			Part 9 Lathe Work	2		

100 Marks (× 1.5 = 150 Total)

