Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2006

ENGINEERING – MATERIALS AND TECHNOLOGY

(Ordinary level – 200 marks)

MARKING SCHEME

AND

SAMPLE ANSWERS

LEAVING CERTIFICATE ENGINEERING
MATERIALS AND TECHNOLOGY
(Ordinary Level – 200 marks)
Marking Scheme 2006

Answer Question 1, Sections A and B and **Four other questions.**

Question 1 Section A – **30 marks** **Any six @** 5 marks each. (a) **Any two** @ 3 + 2 (b) **Any one** @ 5 (c) 5 (d) 5 (e) 5 (f) **Any two** @ 3 + 2 (g) 3 + 2 (h) **Any one** @ 5	**Question 1 Section B – 35 marks** **Any three @** 12 + 12 + 11. (i) **Any one** @ 12/11 (j) **Any two @** 6 + 6/5 (k) 12/11 (l) **Any two @** 6 + 6/5 (m) **Any one** @ 12/11	**Question 2 – 45 marks** (a) (i) **Name** @ 6 (ii) **Describe** 6 **Diagram** 6 (b) **Any three** @ 4 + 4 + 4 (c) **Any two** @ 5 + 5 (d) **Any one** @ 5
Question 3 – 45 marks (a) (i) 8 (ii) 8 (b) **Any two** @ 7 + 7 (c) 9 (d) **Two precautions** @ 3 + 3 **OR** (d) **Two applications** @ 3 + 3	**Question 4 – 45 marks** (a) (i) 5 (ii) 5 (iii) 5 (b) (i) 4 (ii) **One application for each** @ 4 + 4 (c) (i) 4 (ii) 4 (iii) 4 (d) **Two hazards@** 3 + 3	**Question 5 – 45 marks** (a) (i) **Any one** @ Describe 12 Component 3 (b) (i) 7 (ii) 7 (c) **Two precautions** @ 3 + 3 (d) (i) 5 (ii) 5
Question 6 – 45 marks (a) **Any three** @ 6 + 6 + 6 (b) (i) **Name** @ 5 + 5 (ii) **Purpose: Any one** @ 5 (c) **Any two @** 6 + 6 **OR** (c) **Two precautions** @ 6 + 6	**Question 7 – 45 marks** (a) **Any two** @ 7 + 6 (b) (i) 5 (ii) 5 (iii) 5 (iv) 5 (c) **Name** @ 4 **Identify: any two** @ 4 + 4 **OR** (c) **Any three** @ 4 + 4 +4	

End.

Question 1 **(65 marks)**

Section A – 30 marks

(a) The wearing of safety goggles is essential when operating manufacturing equipment such as a drilling machine, centre lathe or milling machine. **3 + 2**

(b) **(i)** Printed Circuit Boards provide a means of assembling electronic components between pre-etched copper tracks.
(ii) A light emitting diode can be utilised as a power on indicator.
(iii) A switch can make or break the path of current flow in a circuit. **(Any one) 5**

(c) Solder. **5**

(d) To contain the flow of electrical current. **5**

(e) Vacuum forming can be used in the production of baths or car bumper panels. **5**

(f) (i) Car jack (ii) Lathe leadscrew (iii) Quick release vices. **(Any two) 3 + 2**

(g) Keyboard, mouse, microphone, floppy disk or DVD. **3 + 2**

(h) Radius gauge or Feeler gauge. **(Any one) 5**

Section B – 35 marks

(i) Plastic dip coating tank:
Plastic dip coating tank is used to put a more socially acceptable finish on articles made from steel, such as shopping baskets and kitchen utensils etc. The article is heated to 180 degs. C in an oven and dipped into the tank where fluidized power particles of polyethylene melts and adheres to its surface. When removed, the particles fuse together and cool, providing an attractive and protective coating.

Morse taper sleeve:
A morse taper sleeve can be used to hold tools such as taper shank drills and reamers in drilling machines and in lathe tailstocks. The morse taper sleeve is used when the taper shank of a tool is too small for the machine socket in which it is to be used. The shank of the tool is inserted into the sleeve, which is then inserted into the tapered socket of the machine. The morse taper sleeve maintains the frictional drive between the machine spindle and the cutting tool being used.

Vee blocks and clamp:
Vee blocks and clamp are used for holding round material while being marked or drilled. Vee blocks are usually obtained in pairs, because two blocks are required when supporting long bars. The clamp is held in two groves that are cut in the sides of the vee block and when tightened holds the round bar in position. Vee blocks may also be used to support round material vertically on a surface table for marking out. **(Any one) 12/11**

(j) (i) Virus: A program or piece of code that operates by attaching itself to some other program or downloaded file. When this program starts the virus code runs, replicates itself and infects other programs or documents on the PC without the user's knowledge. Written with the deliberate intention of corrupting files, a computer virus can seriously damage or completely destroy files or software on a computer.

(ii) Computer network: A computer network is a collection of computers, printers and other equipment, which are connected together so that they can communicate with each other. The linking of computers by special cables or radio waves known as wireless networks allow data and resources to be shared among users.

(iii) Hard disk: A fixed magnetic disk generally fitted internally in a PC, on which you can store computer data. The term 'hard' is used to distinguish it from a soft, or floppy disk. Hard disks hold more data and are faster than floppy disks.

(iv) USB port: A USB (Universal Serial Bus) port provides a quick an easy way of connecting many different external devices to computers. A single USB port can be used to connect up to 127 peripheral devices, such as mice, keyboards, printers, digital cameras and Mp3 players. **(Any two) 6 + 6/5**

(k) Compressive force: A compressive force occurs when a bar is subjected to a push. If the push on one end results in an equal and opposite push on the other end then the bar is said to be in compression.

Tensile force: A tensile force occurs when a bar is subjected to a pull. If the pull on one end results in an equal and opposite pull on the other end then the bar is said to be in tension. **12/11**

(l) Fuse: A fuse generally consists of a thin wire inside a glass or ceramic tube and is commonly found inside electrical plugs. The fuse prevents too much electricity flowing into the appliance if a fault occurs. It's purpose is to protect the low voltage electronics found inside all electrical appliances. The fuse acts as a deliberate weak link in a circuit. When the fuse 'blows' the thin wire melts and the electricity supply to the appliance is cut off.

Surface plate: A surface plate is used for marking out small pieces of work and can be used as a datum surface for this purpose. The surface plate has an accurately machined flat surface with it's four edges finished square with the top surface and one another. The plate is made from cast iron with the underside ribbed to prevent distortion while supported on three feet to give rigidity.

Voltmeter: A voltmeter is used to measure voltage. It measures the potential difference between two points in a circuit. A voltmeter can be used to measure the voltage drop across the terminals of a bulb or the voltage rise across a battery

Pop rivet: A pop rivet is used for joining light gauge material. A special tool is used to draw a pin through the rivet enlarging one end of the rivet until the pin breaks leaving it's head behind. A pop rivet has an advantage in that it can be used to join hollow sheet metal articles where only one side of the joint is accessible.

(Any two) 6 + 6/5

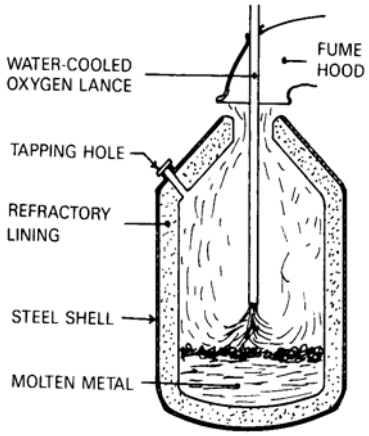
(m) **Diagram on left:** Cam and follower.

Diagram on right: Crank and slider. **(Any one) 12/11**

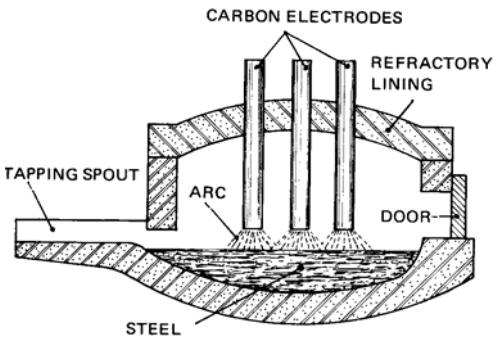
Question 2 **45 marks**

(a) (i) Basic Oxygen furnace or Electrical Arc furnace. **(Name any one) 6**

(ii)



(i) 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.



(ii) 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.

(Any one selected) Describe 6
Diagram 6

(b) **(i)** Stainless steel: Kitchen sinks.
(ii) Copper: Electrical cables.
(iii) Cast Iron: Vices.
(iv) Brass: Door hinges.

(Any three) 4 + 4 + 4

(c) **(i)** **Galvanised steel:**
Steel coated in layers of zinc. When steel is submerged in melted zinc a chemical reaction permanently bonds the zinc to the steel through galvanizing, protecting the steel from corrosion. Galvanised steel is used for outdoor, marine or industrial applications.

(ii) **Bright mild steel:**
Bright mild steel contains up to 0.25% carbon. Used for general engineering fabrication, bright mild steel is cold rolled producing a steel, which is silver in color with a good surface finish which is more accurate in size.

(iii) **Tinplate:**
Steel coated on both sides with a very thin coating of pure tin. Carried out by an electro-deposition process or hot dip tinning. The coating of tin helps to protect the steel from corrosion. **(Any two) 5 + 5**

(d)

(i)	Aluminium:	Bauxite
(ii)	Lead:	Galena
(iii)	Iron:	Haematite/Magnetite

(Any one) 5

Question 3 **45 marks**

(a)

(i) **Cooled quickly:**
High carbon steel at a temperature of 900 degs. C exists as an FCC structure i.e. austinite. When cooled quickly the FCC structure tries to change back to a BCC structure, but does not manage to do so. A new structure is created called martensite, which is extremely hard and brittle. **8**

(ii) Allowed to cool slowly:

When high carbon steel is allowed to cool slowly from a temperature of 900 degs. C the FCC structure has time to change back to it's original BCC structure. The slow cooling produces a soft and stress relieved steel. **8**

(b)

(i) Toughness:

This is the ability of a material to withstand an impact or Hammering load.

(ii) Malleability:

This is the capacity to which a metal can be extended in all directions by hammering or rolling without causing the material to rupture.

(iii) Elasticity:

Elasticity enables a metal to return to it's original shape after external forces which cause distortion are removed. **(Any two) 7 + 7**

(c)

Case Hardening:

Mild steel cannot be hardened, as it does not contain sufficient carbon. Mild steel can be made to absorb carbon which penetrates it's outer skin. This carbon rich skin can then be heat treated to produce a hard case over a soft core. This process is known as case hardening. **9**

(d) Safety precautions include:

- Care must be taken when cooling hot metals in water as the steam produced may cause serious burns to exposed body parts.
- Goggles, face shields, leather aprons and leather gloves should be worn when working with hot metals. **(Two precautions) 3 + 3**

OR

(d) Applications include:

- To provide sufficient air pressure to facilitate spray-painting operations.
- To provide sufficient air pressure to operate pneumatic equipment such as single or double acting cylinders. **(Two applications) 3 + 3**

Question 4 **45 marks**

(a) **(i)** Oxidising flame. **5**

(ii) Carburising flame. **5**

(iii) Neutral flame. **5**

(b) **(i)**

	Soft soldering:	**Manual metal arc welding:**
Temperature range:	183 ºC.	5000 ºC.
Strength:	Weak	Strong
Joint interface:	Alloy based	Fusion takes place.

4

(ii) **One application for each:**

Soldering - Electrical circuit assembly **4**

Manual metal arc welding - Fabrication of steel structures **4**

(c) (i) **Purpose of a flux:**

- To remove oxides from the metal and / or prevent the formation of new oxides.
- To reduce surface tension allowing the solder to flow easily i.e. capillary attraction.
- To assist the alloying action of the solder with the work. **4**

(ii) Passive. **4**

(iii) As a passive flux is non-corrosive it can remain on the electrical joint. **4**

(d) Health hazards include:

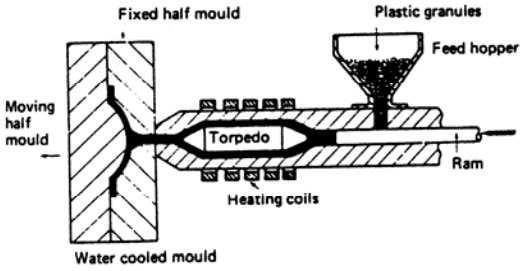
- Burning, which can result form the high temperatures required to achieve the successful fusion of metals.
- Damage to eyes and / or skin caused by UV light. **(Two hazards) 3 + 3**

Question 5 **45 marks**

(a)

(i) Injection Moulding:

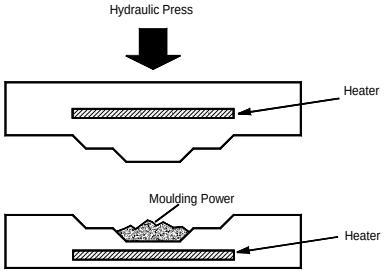
Thermoplastic is softened by heating it inside an injection nozzle. The softened plastic is forced by a plunger into a cold mould where it hardens rapidly and is then ejected. Injection moulding is used for the rapid moulding of components such as **buckets** or the **casings** for a wide range of computer hardware devices.



(ii) Compression Moulding:

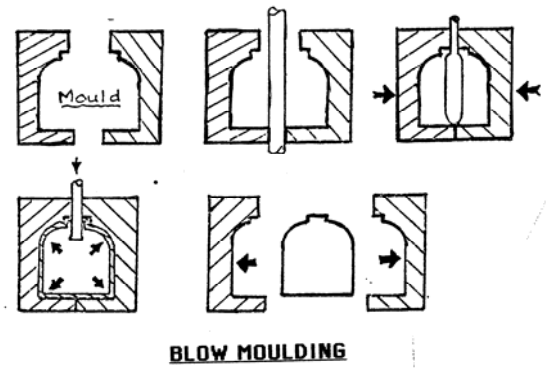
A raw thermosetting plastic, in powder form, is placed in a mould and subjected to heat and pressure for a given period of time, during which the material solidifies (cures). After this stage the mould is opened and the component ejected.

Using this process thermosetting materials can be moulded into **screw top lids**, **plug tops** or **light fittings**.



(iii) 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**.



BLOW MOULDING

(Any one) Describe 12
Component 3

(b) **(i)** Thermoplastic **7**

(ii) Thermosetting **7**

(c) When drilling acrylic:

- Acrylic sheet should never be held in the hand when drilling.
- A machine or hand vice should be used to securely hold the acrylic sheet.
- To reduce the possibility of material distortionand facilitate the safe exit of the twist drill, acrylic sheet should be supported underneath by a suitable material i.e. 'wood'.
- Reduce the pressure on the twist drill when it is breaking through, in case it binds in the hole. **(Two precautions) 3 + 3**

(d) **(i)** Nylon **5**

(ii) Polyethylene **5**

Question 6 **45 marks**

(a)

(i) **Face plate:**
Screwed to the nose spindle the faceplate is used to secure work that is difficult or impossible to hold by other methods. Slots or holes allow the work to be bolted to the faceplate. If the work is off centre balance weights should be used.

(ii) **Three jaw chuck:**
The three jaw chuck is screwed to the headstock spindle and provides a means of securing round or hexagonal material during turning. The three jaws move together when the key is turned in any of the keyholes, so it is easy to set up work in this chuck.

(iii) **Knurling tool:**
The knurling tool provides a means of producing a grip for fingers on hand tools. The tool does not cut but the revolving wheels on the tool are made to press against the work and leave an impression.

(iv) **Four jaw independent chuck:**
The four jaw independent chuck is used to hold square, octagonal or irregular shaped material which cannot be held in the three jaw chuck. Each jaw can be adjusted independently to accommodate the shape of the work. (**Any three) 6 + 6 + 6**

(b) **(i)** A = Rake angle **(Name) 5**

B = Clearance angle. **(Name) 5**

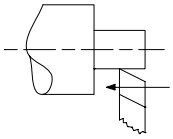
(ii) **A:**Angle 'A' makes it easy for the metal chip to escape.

B:Angle 'B' prevents the front of the cutting tool from rubbing against the work.

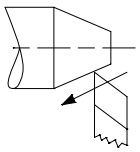
(Purpose: Any one) 5

(c)

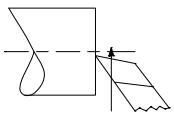
(i) **Parallel turning:**
The cutting tool moves parallel to the axis of rotation of the work and cylindrical forms are produced.



(ii) **Taper turning**.
The cutting tool moves at an angle to the axis of rotation of the work producing conical forms.



(ii) **Facing:**
The cutting tool moves at right angles to the axis of rotation of the work and a flat surface is produced.



(**Any two) 6 + 6**

OR

(c)

- Ensure billet is securely gripped before turning.
- Run a screen simulation to confirm tool path is correct

(Two precautions) 6 + 6

Question 7 **45 marks**

(a) Clearance fit;
Interference fit;
Transition fit. (**Any two) 7 + 6**

(b)

(i)	Nominal Diameter -		=	30mm	**5**
(ii)	Maximum diameter -	30 + 0.06	=	30.06mm	**5**
(iii)	Minimum diameter-	30 – 0.06	=	29.94mm	**5**
(iv)	Tolerance-	30.06 – 29.94	=	0.12mm	**5**

(c) **Name:** Micrometer **4**

Parts:
A = Frame, **B** = Spindle, **C** = Locking nut,
D = Barrel, **E** = Thimble, **F** = Ratchet.

(Identify: Any two) 4 + 4

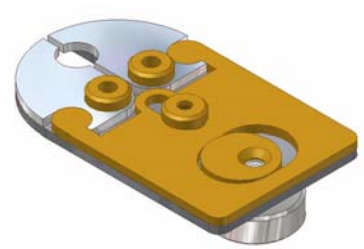
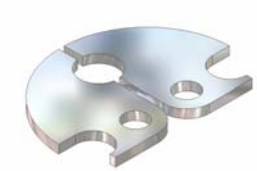
OR

(c) **(i)** Motor;
(ii) Fixed Resistor;
(iii) Battery;
(iv) Light Emitting Diode. (**Any three) 4 + 4 + 4**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Common Level Engineering Practical Marking Scheme 2006

Subjective Grading /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 Practical Examination**		Assembly Function &Finish Subjective Grade 1-20	20	**20**
2	**Part 1**		Marking out	4	**20**
			13mm Slot	4	
			30mm Radius	4	
			4mm Radii	4	
			Drilling	4	
3	**Parts 2**		Marking Out	4	**20**
			30mm Radius	4	
			6mm Radii	4	
			Profile	4	
			Drilling	4	
4	**Part 3**		Marking Out	4	**20**
			24mm Slot	4	
			6mm Radii	4	
			8mm Slot	4	
			Profile	4	
5	**Parts 4, 5, 6, & 7**		Part 4 Lathe Work	4	**20**
			Part 5 Lathe Work	4	
			Part 6 Lathe Work	4	
			Part 7 Lathe Work	4	
			Part 7 Lathe Work	4	

Total: 100 Marks