Coimisiún na Scrúduithe Stáit
State Examinations Commission

Scéimeanna Marcála *Scrúduithe Ardteistiméireachta, 2004*

Innealtóireacht – Ábhair agus Teicneolaíocht *Gnáthleibhéal*

Marking Scheme *Leaving Certificate Examination, 2004*

Engineering – Materials and Technology *Ordinary level*

LEAVING CERTIFICATE EXAMINATION 2004
ENGINEERING MATERIALS AND TECHNOLOGY

ORDINARY LEVEL

Solutions & Marking Scheme
Required: Answer Question 1 and 3 others

QUESTION No. 1 - 65 MARKS **Marks**

SECTION A - 30 MARKS **6 parts @ 5 marks each**
For two part answers award 3 + 2

SECTION B - 35 MARKS **2 parts @ 12 marks each**
1 part @ 11 marks
Award 6 + 6 or 6 + 5 as Appropriate

SECTION A – 30 MARKS

(a) Provide adequate ventilation against the effects of gases and fumes. Wear standard visor for eye and face protection. **3 + 2 Marks**

(b) Motor. **5 Marks**

(c) The ability of a metal to allow heat or electricity to flow through it. **5 Marks**

(d) Lead and Tin **3 + 2 Marks**

(e) (i) A Micrometer.
(ii) To measure the diameter of a shaft to an accuracy of 0.01mm. **3 + 2 Marks**

(f) (i) Acme thread.
(ii)Buttress thread. **3 + 2 Marks**

(g) (i) Worm and wheel mechanism.
(ii) To reduce speed while increasing torque output between a drive shaft and the driven shaft. **3 + 2 Marks**

(h) (i) Automatic welding (ii) Spray painting on car assembly lines. **3 + 2 Marks**

SECTION B – 35 MARKS (continued)

MARKS

(i) Any one:

(i) **Scanner:** A piece of hardware connected to the computer, used to scan text and graphics to software packages.

(ii) **Reamer:** A reamer is used to enlarge an existing hole making it round, smooth and accurate in size. For the most part reamers are parallel with a slight taper at the leading end, have many more flutes than drill bits and are available as hand reamers or machine reamers.

Good clear description
Award 12 (11) Marks
Total (12,11)

(iii) **Bevel gauge:** A bevel gauge is used for checking inclined faces and marking out lines at given angles. It can be set to the required angle by means of a setting protractor and locked in position by a clamping screw.

(j) Any two

(i) **Output device:** Any device that takes information from the computer and makes it available to the user in a human understandable form such as a: Visual Display Unit, Printer, Plotter, CNC Machine/Lathe or Robot.

(ii) **Downloading:** Bringing text, pictures or files, etc. to your computer through an on-line connection.

Good clear description
Award 6+6(5) Marks
Total (12,11)

(iii) **Computer Control:** Computer is used to operate a CNC lathe, Robot or any external device i.e. traffic lights.

(iv) **Firewall:** A firewall is a hardware and/or software barrier between two or more networks. The firewall controls who and how, information can be accessed behind the firewall.

(k) (i) The ability of a metal to be hammered or rolled into thin sheets.

(ii) Gold, Aluminium are malleable metals.

Definition
Award 6
Example
Award 6(5)
Total (12,11)

(l) **Any two**

(i) **Engraving:** In engraving, designs are cut into metal surfaces with sharp tools. Power tools are often used for engraving letters and numbers on ornamental objects.

(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.

Good clear description
Award 6 + 6(5)
Total (12,11)

(iii) **Dip coating:** Dip coating is the application of plastic coating by dipping the heated article into a tank of fluidised thermoplastic powder and allowing the powder to fuse and adhere to the surface.

(vi) **Bimetal strip:** A Bimetal strip is made of two dissimilar strips of metal i.e. Copper and Steel riveted together. At room temperature both strips are the same length. When heat is applied the copper will expand to a greater extent than steel. The result is that the bimetal strip bends. A bimetal strip can be used as a thermostat or in fire alarms. If heat is applied to the strip it will bend upwards closing contacts causing an electrical bell to ring.

(m) (i) Chain and sprocket (ii) Gear

For names
Award 6 +6(5)
Total (12,11)

QUESTION NO.2 Total 45 Marks

(a) (i) Basic Oxygen furnace.
(ii) Blast furnace.
(iii) Electrical Arc furnace.

Name furnaces
Award 3 @ 6 Marks
Total (18)

(b) (i) Simple line drawing showing any part.
(ii) (i) Oxygen 'blow' (ii) Coke combustion (iii) Electric Arc.
(iii) (i) Steel (ii) Pig Iron (iii) Steel

For furnace selected
Award 3 @ 3
Total (9)

(c)

(i)	Aluminium:	Cooking foil.
(ii)	Mild Steel:	Gates, girders.
(iii)	Copper:	Water tubing.

Materials
Award 2 @ 6 Marks
Total (12)

(d) An alloy is a combination of metals or other elements.

Explanation
Award 1 @ 6 Marks
Total (6)

QUESTION NO. 3 Total 45 Marks

(a) (i) **Hardening:** Hardening produces a brittle metal which resists wear, indentation and scratching.

(ii) **Annealing:** Annealing is carried out to soften metal and to relieve internal stresses.

Difference
Award 2 @ 6 Marks
Total (12)

(b) **Case Hardening:**

Low carbon steel does not contain sufficient carbon to enable it to be hardened in the normal way. Steel with a small percentage of carbon (mild steel) is first 'carburised'.

The component is then heated 850 degrees centigrade and quenched in water, this produces a hard outer skin.

Name
Award 1 @ 8 Marks
Total (8)

(c) (i) **Part A:**

Annealing:
Annealing involves heating the center punch to a temperature above its upper critical point and allowing the material to cool very slowly in a furnace or some insulating material.

Part B:

Hardening:
Part B of the center punch is hardened by heating to a cherry red colour, 750 degrees to 850 degrees centigrade and immediately quenching in a container of oil, brine or tepid water.

Good description
A:
Award 1 @ 5 Marks
B:
Aware 3 + 2 Marks
Total (10)

Tempering:
Part B is then polished to show up the oxide colours. Heat is then applied well back from the point. When the required colour reaches the point (Brown) the center punch is quenched in water.

(ii) The center punch is annealed so that its head will be as tough as possible to sustain hammer blows when in use. The point of the center punch is hardened and tempered so as to remove some of its brittleness while enabling the punch to retain the correct point angle while marking softer material.

Good description
Award 1 @ 5 Marks
Total (5)

(d) (i) **<u>Oil</u>** is less drastic than water in quenching and presents less risk of distortion and cracking. Oil gives better control of hardening with slightly less brittleness. Care needs to be taken in its use as fumes are given off by the oil.

Difference
Award 2 @ 5 Marks
Total (10)

(ii) **<u>Water</u>** causes the component to lose heat much quicker than if it were quenched in oil. This results in the steel having an increased hardness. Care needs to be taken in its use as distortion can occur.

<u>OR</u>

(d) A: 3 port 2 stage valve.
B: Shuttle valve ("OR" Block).
C: Single Acting Spring return cylinder.

Name
Award 2 @ 5 Marks
Total (10)

QUESTION NO. 4 Total 45 Marks

(a) (i) A Carburising flame: Excess acetylene is supplied to the neutral flame.

(ii) An Oxidizing flame: Additional oxygen is supplied to the neutral flame.

(iii) A Neutral flame: Equal quantities of oxygen and acetylene.

Identify three
Award 3 @ 5 Marks
Total (15)

(b) (i) A Flux is used to remove oxides from the surface of the parts being soldered facilitating capillary action, allowing "wetting" of the joining surfaces. A Flux also helps to prevent further oxidation when the parts are heated.

(ii) (a) A passive flux is non-corrosive, resin based which prevents oxidation during soldering. Suitable for electrical work and other applications where it is not possible to wash the joint afterwards.

(b) An active flux is corrosive and will remove oxides from the surfaces and prevent further oxidation during soldering. Zinc chloride or 'killed spirits' is an active flux and when used the joint must be thoroughly washed afterwards.

Good descriptions
(i) Award 1 @ 4 Marks
(ii) Award 2 @ 3 Marks
Total (10)

(c) (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 degs. C. Suitable for welding light gauge material with the filler rod fed in by hand.

(ii) **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 degs. C. and is suitable for welding heavy gauge material.

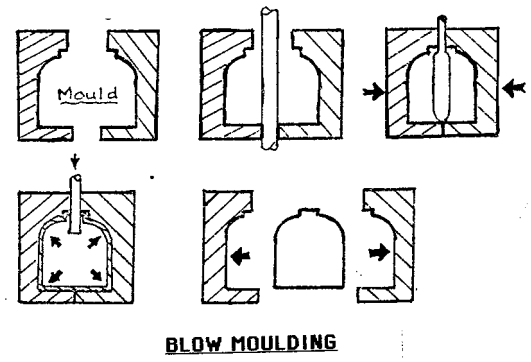
Identify process
(i) Award 2 @ 3 Marks
Describe differences
(ii) Award 2 @ 2 Marks
Total (10)

(d) (i) Wear protective clothing.
(i) Ensure correct temperatures are reached.

Two precautions
Award 2 @ 5 Marks
Total (10)

QUESTION NO. 5 **Total 45 Marks**

(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 it out against the wall of the mould. The component is allowed to cool before being removed from the opened mould.



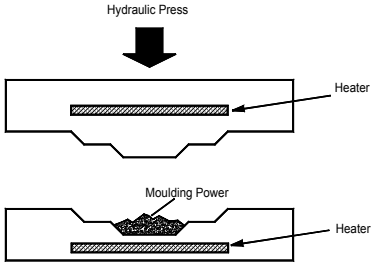
BLOW MOULDING

Process
Award 6+6 Marks
Component
Award 3 Marks
Total (15)

Using this process thermoplastic materials like polythene can be moulded into **bottles** and **drums**.

OR

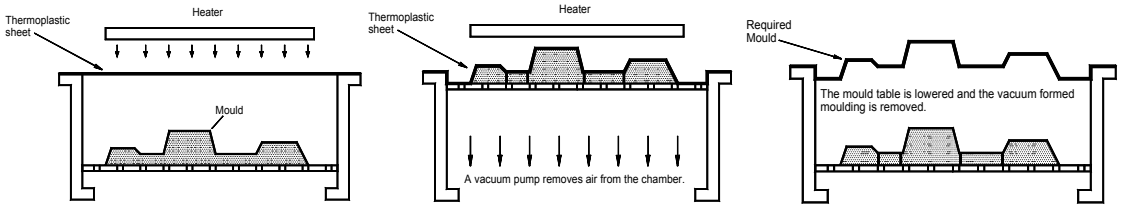
Compression Moulding:
A raw thermosetting plastic in powder form is placed in a mould and subjected to heat and pressure for a given period of time, during which the material solidifies (cures). After this stage the mould is opened and the component ejected.



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

OR

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 vacuumed 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)

(i) **Thermoplastic:**
Thermoplastics are linear chain type polymers and are relatively soft and flexible, they melt easily and can be repeatedly softened and remoulded.

(ii) **Thermosetting:**
Thermosetting plastics are three dimensional in structure with strong cross-links between molecules. They are therefore rigid and hard, they cannot be reset once they have hardened in the mould.

Good description
Award 2 @ 7 Marks
Total (14)

(c)

(i) 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.

Good description
Award 1 @ 10 Marks
Total (10)

(ii) A strip heater is used to bend thermoplastic strip or sheet material. The strip heater heats the sheet in a line and the sheet can be quickly bent along the line. A former is often used to ensure a uniform bend.

(d) Polystyrene - Used to provide thermal insulation.

Name
Award 1 @ 6 Marks
Total (6)

QUESTION NO. 6 Total 45 Marks

(a)
(i) Parallel turning
(ii) Drilling
(iii) Taper turning
(iv) Knurling

Name
Award 3 @ 6 Marks
Total (18)

(b) (i) **Coolant:** Cools the cutting tool and the workpiece. Helps to reduce friction between the cutting tool and workpiece reducing wear and improving surface finish.

(ii) **Clearance angle:** This ensures that only the cutting edge of the tool comes into contact with the work. Without clearance the tool would just rub against the work without cutting.

(iii)**Depth of cut:** The amount by which the cutting tool is engaged in the workpiece. In turning it is the distance from the diameter being reduced to the new diameter.

(iv)**Cutting speed:** Refers to the relative speed between the cutting tool and the work. In turning, the cutting speed is the surface speed of the work and is measured in meters/minute.

Good description
Award 5 + 4 Marks
Total (9)

(c) Name; 4 Jaw Independent chuck.

Methods; (i) 3 Jaw self-centering chuck (ii) Face plate.

Name
Award 1 @ 6Marks
Methods
Award 2 @ 6 Marks
Total (18)

OR

(i) **Simulation:** The production of a part is simulated by computer graphics and shown on the monitor. This is to check for correct programming and off set any dangers that may occur during machining.

(ii) **Safety switch:** Located on CNC lathes to check if the safety guard is in the correct position before manufacturing. The CNC lathe will not start if the guard is opened.

(iii)**G Codes:** Determine the tool path. The cutting tool will move in a particular way depending on the number following the letter G. G01, for example, will cause the tool to travel in a straight line.

Good description
Award 3 @ 6 Marks
Total (18)

(iv) **CAD/CAM**: Stands for Computer-Aided-Design and Computer-Aided-Manufacture. Such a system enables us to draw the part on the computer screen, with the aid of a mouse, and then by selecting the appropriate command the computer will write the part program.

QUESTION NO. 7 Total 45 Marks

(a) (i) **Interference fit:**
An interference fit results where the lower limit on the shaft is always greater than the upper limit on the hole

(ii) **Clearance fit:**
A clearance fit results in the assembly of a shaft and hole where the upper limit of the shaft is smaller than the lower limit of the hole.

Good description
Award 7 + 6 Marks
Total (13)

(iii) **Transition fit:**
This fit can either be a clearance or interference fit.

(b)

(i)	Nominal Diameter -	50mm	
(ii)	Upper Limit -	50 + 0.04 =	50.04mm
(iii)	Lower Limit-	50 – 0.04 =	49.96mm
(iv)	Tolerance-	50.04 – 49.96 =	0.08mm

Calculations
Award 4 @ 5 Marks
Total (20)

(c) Name:- Vernier calipers.

Measurement: - A: Outside measurement.
B: Inside measurement.

Name
Award 6 Marks

Measurement
Award 2 @ 3 Marks
Total (12)

OR

(c) (i) The circuit shown could be used as a continuity tester.

(ii) A: Battery.
B: Fixed resistor.
C: Buzzer.

Function
Award 6 Marks
Name
Award 2 @ 3 Marks
Total (12)