



Coimisiún na Scrúduithe Stáit State Examinations Commission

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Innealtóireacht - Ábhair agus Teicneolaíocht

Scrúduithe Ardeistiméireachta, 2007

Gnáthleibhéal

Marking Scheme

Engineering - Materials and Technology

Leaving Certificate Examination, 2007

Ordinary Level



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

Leaving Certificate Examination 2007

Engineering - Materials and Technology

(Ordinary Level – 200 Marks)

Sample Answers and Marking Scheme

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

LEAVING CERTIFICATE EXAMINATIONS
ENGINEERING – MATERIALS and TECHNOLOGY
ORDINARY LEVEL – 200 marks
Marking Scheme 2007

Question 1:	Total - 65 Marks.
Section A – 30 Marks Any six @ 5 marks each.	(Two part answers 3 + 2)
Section B – 35 Marks Any three parts @ 12 + 12 + 11 Marks	(Two part answers 6 + 6 or 6 + 5)

<u>Question 2 Total - 45 Marks.</u> (a) Two parts @ 9 each (18) (b) Three parts @ 4 each (12) (c) Two parts @ 5 each (10) (d) Name @ 5 marks (5)
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<u>Question 3 Total - 45 Marks.</u> (a) Explain @ 9 marks (9) (b) Two parts @ 8 each (16) (c) Two parts @ 7 each (14) (d) Two parts @ 3 each (6) OR (d) Two parts @ 3 each (6)

<u>Question 4 Total - 45 Marks</u> (a) Three parts @ 5 each (15) (b) Three parts @ 4 each (12) (c) Three parts @ 4 each (12) (d) Two parts @ 3 each (6)

<u>Question 5 Total - 45 Marks.</u> (a) Three parts @ 4 each (12) (b) Explanation @ 12 marks Component @ 3 marks (15) (c) Two parts @ 6 each (12) (d) Two parts @ 3 each (6)

<u>Question 6 Total - 45 Marks.</u> (a) Three parts @ 6 each (18) (b) Three parts @ 5 each (15) (c) Two parts @ 6 each (12) OR (c) Two parts @ 6 each (12)
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<u>Question 7 Total - 45 Marks.</u> (a) Two parts @ 7 + 6 (13) (b) Four parts @ 5 each (20) (c) Two parts @ 6 each (12) OR (c) Three parts @ 4 each (12)
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**LEAVING CERTIFICATE EXAMINATION 2007
ENGINEERING MATERIALS AND TECHNOLOGY**

ORDINARY LEVEL

Sample Answers & Marking Scheme

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

QUESTION No. 1 – Total 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

MARKS

- | | | |
|------------|---|--------------------|
| (a) | Ensure a chuck guard is fitted and the work piece is securely clamped. | 3 + 2 Marks |
| (b) | A battery. | 5 Marks |
| (c) | A self locking nut contains a nylon insert which the screw thread cuts into thus holding the nut secure. This prevents loosening due to vibration. | 5 Marks |
| (d) | Alloys are produced to provide materials with desired properties such as low melting temperatures, extra strength or resistance to corrosion. | 5 Marks |
| (e) | A temporary joint describes a joint which can be dismantled.
Mechanical methods such as screw fasteners or compression joints when used allow the fixings to be taken apart. | 5 Marks |
| (f) | A square thread. | 5 Marks |
| (g) | A computer keyboard is an input device. | 3 + 2 Marks |
| (h) | Bevel gears are used to change the axis of rotational motion.
A mechanical hand drill uses bevel gears not only to change the rotary motion through 90 degs. but also, by using different size gears, to increase the output rotational speed. | 3 + 2 Marks |

SECTION B – 35 MARKS

MARKS

(i) Any one:

(i) **Surface Plate:**

The surface plate is used as a datum surface for marking out and also for checking the flatness of other surfaces. The top surface is perfectly flat and accurately finished. The sides are also accurately finished and are at right angles to each other. The surface plate is usually made of best-quality, close-grained cast iron, sometimes with strengthening ribs underneath to prevent any distortion. It stands on three feet so that it is stable in use.

In the school Engineering room the surface plate is commonly used as a small marking out table in conjunction with an angle plate and vernier height gauge.

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

(ii) **Tailstock:**

A tailstock is part of a centre lathe. The tailstock sits on the lathe bed at the opposite end to the lathe headstock. It can be clamped to the bed at any point. The tailstock contains a barrel which slides in the body when you turn the hand wheel. The barrel can be locked in any position. The barrel can accommodate different tools for drilling, reaming, or for supporting long shafts when machining. The tailstock can be moved from side to side on its base, this feature is used for taper turning.

(iii) **Strip Heater:**

A strip heater is used to form straight or small curvature bends in thermoplastic sheet material. An electric element or hot wire is enclosed in a channel which has an opening at the top. Thermoplastic sheet is placed across supports above the opening. By adjusting the height of the supports the width of strip to be heated can be altered. The supports are set to a low height for tight bends. If a more gradual bend is required the heated area is widened by setting the supports higher. Different thicknesses of sheet may be formed by thermostatically controlling the heating temperature.

(j) Any two:

(i) Software:

The programs which direct the operation of a computer i.e. Microsoft Word, Solid Works, Games etc.

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

(ii) 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.

(iii) CDRW:

A compact re-writable disk provides portable memory in the form of a compact disk. Capable of storing very large files it can be written to many times allowing the data to be over written as required.

(iv) Computer simulation:

A computer simulation provides a computer generated animation of a procedure or process. Utilised in many fields from training of aircraft pilots to safety checks on machining operations, CNC software provides a simulation facility to trial run programs before manufacture.

(k)

(i) Conductivity:

The haphazard movement of free electrons in a piece of metal can easily be changed to a movement in one direction if the metal is connected to the terminals of a battery. Metals therefore allow electrons / electricity to pass through easily.

If the end of a piece of metal is heated, the resulting increase in the movement and vibration of the electrons and ions causes nearby electrons and ions to move and vibrate faster. Heat energy is transferred along the piece of metal in this way. Metals are, therefore, very good conductors of heat.

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

(ii) Example:

Gold is an excellent conductor of electricity.

Copper is a very good conductor of heat.

(l) Any two:

(i) Chuck guard:

Due to the dangers of high speed moving parts and / or metal cuttings a chuck guard is put in place before machining to protect the operator from serious injuries.

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

(ii) 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.

(iii) Depth gauge:

A depth gauge can be used to measure the dept of holes, recesses and the distances between surfaces. A depth gauge consists of a blade which is adjustable in its stock.

(iv) Hand Vice:

A hand vice is used for holding metal while it is being drilled. Small work that has to be drilled and which cannot be held in a machine vice i.e. small pieces of sheet or strip is held in a hand vice for safety.

(m)

(i) Rack and Pinion / Drilling machine spindle and feed lever.

(ii) When the pinion is rotated clockwise the rack moves down lowering the drill spindle. Rotary motion is changed to linear motion.

Mechanism
Award 6
Operation
Award 6(5)
Total (12,11)

QUESTION NO. 2

Total 45 Marks

(a) Any Two:

- (i) Basic Oxygen Furnace - Produces Steel
- (ii) Electric Arc Furnace - Produces Steel
- (iii) Blast Furnace - Produces Pig Iron

Name furnace
Award 2 @ 9 Marks
Total (18)

(b) Any three:

- (i) Soft drink cans - Aluminium
- (ii) Hand files - High Carbon Steel
- (iii) Electric wire - Copper
- (iv) Roof flashings - Lead

Materials
Award 3 @ 4 Marks
Total (12)

(c) Any two:

- (i) Brass: - Copper and Zinc
- (ii) Soft Solder: - Lead and Tin
- (iii) Bronze: - Copper and Tin

Metals
Award 2 @ 5 Marks
Total (10)

(d) Non-ferrous metal:

A non-ferrous metal does not contain any Iron.

Explanation
Award 1 @ 5 Marks
Total (5)

QUESTION NO. 3

Total 45 Marks

(a) Any one:

(i) **Annealing:**

Annealing is carried out to soften metal and to relieve internal stresses. The metal is heated to the required temperature and allowed to cool down as slow as possible.

Explanation

Award 1 @ 9 Marks

Total (9) Marks

(ii) **Case hardening:**

Case hardening is a method of making a steel part very hard on the outside while leaving its centre tough. Mild 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, which can be hardened leaving a tough core.

(b)

(i) **Hardened:**

The point of the scriber is first cleaned and polished using emery cloth. The point is then heated to a cherry red and cooled rapidly or quenched in water. The point now becomes very hard and brittle.

Description

Award 2 @ 8 Marks

Total (16)

(ii) **Tempered:**

Tempering removes some of the hardness from the scriber point while improving its toughness. It is done by heating the point of the scriber to a suitable temperature, below the reddening temperature i.e. pale straw and then cooling it in oil or water.

(c) Any two:

(i) **Brittleness:**

A brittle material is very hard and can easily be fractured by an impact. Brittleness is the opposite of toughness. Glass is an example of a brittle material.

Explanation

Award 2 & 7 Marks

Total (14)

(ii) **Ductility:**

Ductility is the ability of a metal to be drawn into wire. A material is ductile when it can be permanently stretched by a tensile force without fracture.

(iii) Malleability:

Malleability is the property of a material which allows it to be extended in all directions by rolling or hammering without rupture. The malleability of most metals is increased by heating.

(d) Any two:

- (i)** Goggles or face shield should be worn to protect the face and eyes.
- (ii)** A leather apron and / or leather gloves should be worn to protect the body and hands.

Award 2 @ 3 Marks
Total (6)

OR

(d) Any two:

- A: -** - Piston
- B: -** - Return Spring
- C: -** - Piston Rod

Parts
Award 2 @ 3 Marks
Total (6)

QUESTION NO. 4

Total 45 Marks

- (a) (i) Oxygen and Acetylene

Any one:

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



Oxydizing Flame – More Oxygen than Acetylene



Carburising Flame – More Acetylene than Oxygen



Three parts
Award 3 @ 5 Marks
Total (15)

- (b) Any three:

- (i) **Oxides**

When metals react with oxygen, oxides are formed on their surface. This oxide layer interferes with the thermal joining process and must be removed by fluxes or by keeping the oxygen away from the joint area.

- (ii) **Flashback arrestor**

The purpose of a flashback arrestor is to prevent the return of the flame through the hose into the regulator or gas cylinder. Flashback arrestors are positioned on both the acetylene and the oxygen supply between the hose and the regulator.

- (iii) **Pressure Gauge**

The pressure gauge indicates the pressure of gas contained inside the cylinder.

Explanation
Award 3 @ 4 Marks
Total (12)

(iv) Welding Torch

Oxygen and acetylene are delivered to the torch through separate hoses. Each gas can be controlled by a valve on the torch. The welding torch mixes the two gases together and after they are ignited they burn at the nozzle.

(c)

- | | | |
|--------------|--------------------------|---------------|
| (i) | Heavy gauge mild steel | - Arc welding |
| (ii) | Acrylic sheet | - Adhesive |
| (iii) | Light gauge copper sheet | - Soldering |

Method Award 3 @ 4 Marks Total (12)

(d) Any two:

- | | |
|-------------|--|
| (i) | Never inhale fumes produced by soldering flux. |
| (ii) | Always replace a hot soldering iron back into its stand when not in use. |

Precautions Award 2 @ 3 Marks Total (6)

QUESTION NO. 5

Total 45 Marks

(a) Name three:

- (i) Vacuum forming
- (ii) Blow Moulding
- (iii) Injection Moulding

Process Award 3 @ 4 Marks Total (12)
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(b)

(i) **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**.

Description Award 1 @ 12 Marks Component Award 1 @ 3 Marks Total (15)

(ii) **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**.

(iii) **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.

(c) **Any two:**

(i) **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.

Types

Award 2 @ 6 Marks

Total (12)

(ii) **Laminating:**

High strength plastics can be produced by impregnating sheets of paper or cloth with a resin. Layers of this material are bonded by allowing the resin to set into a solid structure. Heat and pressure are often used in this process.

(iii) **Thermoplastic:**

Thermoplastics are linear chain type polymers and are relatively soft and flexible, they melt easily and can be repeatedly softened and remoulded.

(d) **Two safety precautions:**

(i) Do not over heat the component for dip coating as this can result in melting the plastic powder causing burns or damage to the surrounding area.

(iii) Wear a face mask to reduce the inhalation of fine particles and / or fumes.

Precautions

Award 2 @ 3 Marks

Total (6)

QUESTION NO. 6

Total 45 Marks

(a) Any three:

- (i)** Parting off
- (ii)** Taper turning
- (iii)** Facing / Surfacing
- (iv)** Knurling

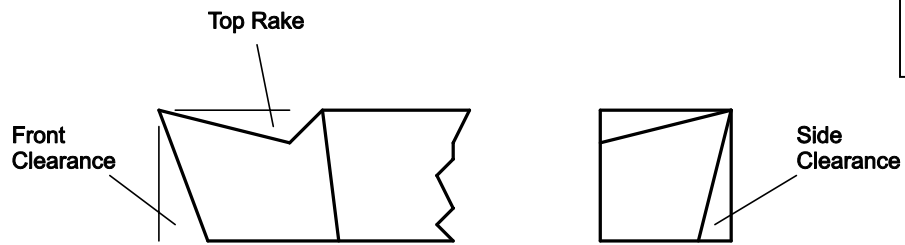
Operations
Award 3 @ 6 Marks
Total (18)

(b) Any three:

- (i) Pilot hole:**
A pilot hole must be drilled before using a large drill. This keeps the large drill central, and it also means that the chisel edge of the drill does not have to do any cutting.
- (ii) Countersink hole:**
A countersink is the tapered enlargement at the mouth of a hole formed to receive the heads of countersunk-head screws and rivets. The enlargement is formed by a countersink cutter.
- (iii) Clearance hole:**
A clearance hole is slightly larger than the machine screw that passes through it. Clearance enables machine screws to be inserted quickly and also allows for the misalignment of drilled holes during assembly.
- (iv) Blind hole:**
This is a hole that does not go all the way through a part. When it is not practical to have a machine screw going through a part, a blind hole can be drilled and tapped and a screw used.

Terms
Award 3 @ 5 Marks
Total (15)

(c) Any two:



Angles
Award 2 @ 6 Marks
Total (12)

OR

(c) Any two:

- (i) CAM: Computer Aided Manufacture
- (ii) CNC: Computer Numerical Control
- (iii) CAD: Computer Aided Drawing / Design

Terms
Award 2 @ 6 Marks
Total (12)

QUESTION NO. 7**Total 45 Marks****(a) Any two:****(i) Interference fit:**

In this assembly there is no space between the parts. The shaft is always made larger than the hole it is intended to fit into. Force is usually required to assemble the parts.

Type of fit

Award 7 + 6 Marks**Total (13)****(ii) Clearance fit:**

In this assembly there is a space between the two parts. The shaft is always smaller than the part it fits into.

(iii) Tolerance:

The tolerance is the amount by which a dimension is allowed to deviate from the nominal size. Tolerance can be obtained by subtracting the lower limit from the upper limit.

(b)**(i)** Nominal diameter of hole: - 32mm**(ii)** Nominal diameter of shaft: - 32mm**(iii)** Lower limit of hole: - $32 - 0.06 = 31.94\text{mm}$ **(iv)** Higher limit of shaft: - $32 + 0.08 = 32.08\text{mm}$

Calculations

Award 4 @ 5 Marks**Total (20)****(c) Any two:****(i)** Plug gauge – for checking the limits of holes**(ii)** Gap / Snap gauge – for checking the limits of shafts**(iii)** Feeler gauges – for checking the gap between two surfaces

Name

Award 2 @ 6 Marks**Total (12)****OR****(c) Any three:****(i)** Light Emitting Diode**(ii)** Switch**(iii)** Buzzer**(iv)** Motor

Symbols

Award 3 @ 4 Marks**Total (12)**

