

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2014

Marking Scheme

ENGINEERING –
Materials and Technology

Ordinary Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work. In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

LEAVING CERTIFICATE 2014

MARKING SCHEME

Written Examination and Practical Examination

***ENGINEERING –
MATERIALS AND TECHNOLOGY***

ORDINARY LEVEL

LEAVING CERTIFICATE

ENGINEERING - Materials and Technology

(Ordinary Level – 200 marks)

Written Examination Marking Scheme 2014

Answer Question 1, Sections A and B and Three other questions.

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

Question 2 Total - 45 Marks.

- (a) Three parts @ 4 each (12)
- (b) Three parts @ 3 each (9)
- (c) (i) Two parts @ 4 each
(ii) One part @ 8 marks (16)
- (d) Two parts @ 4 each (8)

Question 3 Total - 45 Marks.

- (a) (i) Two parts @ 4 each
(ii) Three parts @ 3 each (17)
 - (b) Two parts @ 7 each (14)
 - (c) Two parts @ 3 each (6)
 - (d) Two parts @ 4 each (8)
- OR**
- (d) Two parts @ 4 each (8)

Question 4 Total - 45 Marks.

- (a) Three parts @ 5 each (15)
- (b) Three parts @ 4 each (12)
- (c) Three parts @ 4 each (12)
- (d) Two parts @ 3 each (6)

Question 5 Total - 45 Marks.

- (a) (i) Three parts @ 3 marks
(ii) One part @ 12 marks (21)
- (b) One part @ 12 marks (12)
- (c) Two parts @ 3 each (6)
- (d) Two parts @ 3 each (6)

Question 6 Total - 45 Marks.

- (a) Three parts @ 5 each (15)
 - (b) Three parts @ 5 each (15)
 - (c) Three parts @ 5 each (15)
- OR**
- (c) Three parts @ 5 each (15)

Question 7 Total - 45 Marks.

- (a) Two parts @ 5 each (10)
 - (b) Four parts @ 5 each (20)
 - (c) Three parts @ 5 each (15)
- OR**
- (c) Three parts @ 5 each (15)

Sample Answers *and* Marking Scheme

Note: The solutions presented are examples only.
All other valid solutions are acceptable and are marked accordingly.

Question 1

(65 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) (i) Safety glasses must be worn at all times.
(ii) Ensure that long hair is protected to avoid getting caught in moving parts.
- (b) A permanent joint refers to a joining method which will not come apart again, e.g. welding, adhesive or soldering.
- (c) (i) Keyboard. (ii) Mouse.
- (d) A motor. A motor is used to provide rotational movement by converting electrical energy into mechanical energy. A motor can be used in toys, class projects, drilling machines and lathes.
- (e) A plastic bottle is made by the blow moulding process.
- (f) The force exerted on the hacksaw blade shown is a tensile force.
- (g) (i) ISO metric thread.
(ii) A square thread.
- (h) The instrument shown is a vernier calipers (digital). The vernier calipers is used for accurately measuring linear outside, inside or depth measurements i.e. shaft diameters, hole sizes or the depth of drilled holes.

3 + 2 Marks

5 Marks

3 + 2 Marks

3 + 2 Marks

5 Marks

5 Marks

3 + 2 Marks

3+2 Marks

SECTION B – 35 MARKS

(i) Any one:

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

Pop riveting gun:

A pop riveting gun is used to create a pop riveted joint in sheet metal. A pop rivet is placed into the gun and passed through a pre-drilled hole in the metals to be joined. As the handles of the gun are squeezed, a clamping mechanism grips the shaft of the rivet and draws it back. The enlarged end of the shaft causes the remaining part of the rivet to expand thereby clamping the sheet metal together. When the tensile force on the rivet gets too great the shaft breaks off leaving the pop rivet joint behind.

Ratchet and pawl mechanism:

A ratchet and pawl mechanism is used when rotation is required in one direction only. As the ratchet is rotated clockwise the spring loaded pawl pushes outwards as it lifts over the ratchet's teeth. However, if the ratchet tries to rotate anti-clockwise the pawl does not release thereby preventing rotation.

Brazing hearth:

A brazing hearth can be used for heating metals when joining by brazing or soldering. The brazing hearth is equipped with a torch, a compressor and a fire brick lined hearth. The fuel gas is mixed with the air and when ignited a flame burns at the end of the torch. The fire brick lining acts as an insulator to reduce heat loss and ensure rapid heating.

(j) Any two:

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

Computer tablet:

A computer tablet is a portable hand held device which allows the user to complete many of the tasks that a personal computer would. Typically tablets do not have keyboards but use touchscreen control. Tablets also have additional features such as cameras and can download and operate apps.

Scanner:

A scanner is an input device which uses a lamp to capture a copy of an image or document. The scanner then digitises this image into a variety of file formats e.g. jpeg, pdf, tiff etc. These files can then be imported into documents or printed as required.

Streaming media:

Streaming media is video and / or audio data transmitted over a computer network for immediate playback rather than for file download and playback offline. Examples of streaming video and audio include internet radio and television broadcasts, film and corporate webcasts.

3D printer:

A 3D printer is a machine for producing prototype 3D models of design solutions from a variety of different materials. A digital file is sent to the 3D printer in a similar way to that of a normal printer however the resulting print is a physical 3D model. The file may be generated using 3D CAD software or a physical 3D scan of an existing object.

(k)

Malleability:

Malleability is the ability of a material to be flattened out in all directions by rolling or hammering.

Example:

Copper / Lead / Aluminium

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

(l) Any two:

Light dependent resistor (LDR):

A light dependent resistor is a resistor whose resistance varies based on the amount of light falling on it. Bright – low resistance, Dark – high resistance.

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

Compressor:

A compressor is a machine which takes in air from its surroundings and stores it under pressure in a reservoir tank. This air is then used to do work such as powering tools or spray painting.

Engraving:

Engraving refers to the use of sharp tools to cut grooves in metal or any other material. Text or designs may be engraved into the surface of the material. An engraver with a vibrating head can be used to perform the task.

Self-locking nut:

A self-locking nut uses a nylon insert to prevent it from loosening due to vibration. When the nut is tightened onto a machine screw or threaded bar, the thread is cut into the nylon. The nylon grips the bar and will not allow the nut to loosen.

(m)

(i) Stepped pulleys

(ii) Compound gear train.

Name Award 6 + 6 (5) Total (12, 11) Marks

Question 2

(45 Marks)

(a) Suitable materials:

- | | |
|----------------------|------------------|
| (i) Twist drill: | High Speed Steel |
| (ii) Fuel burner: | Cast Iron |
| (iii) Bicycle frame: | Aluminium tube |

Name
Award 3 @ 4 Marks
Total (12) Marks

(b) Any three terms:

(i) Iron Ore:

Iron ore is the rock that iron comes from. Iron ore is smelted in the blast furnace to produce pig iron, which in turn is refined to produce steel.

Good clear description
Award 3 @ 3 Marks
Total (9) Marks

(ii) Galvanised steel:

Steel in its raw state rusts when exposed to moisture. Galvanised steel is steel coated with zinc to prevent the oxygen attacking the surface of the steel and causing it to rust.

(iii) Tuyere:

A tuyere is an air pipe which surrounds the blast furnace. The tuyere allows hot blasts of air to be delivered inside the blast furnace thereby increasing the temperature of the process through the burning of coke.

(iv) Tinsplate:

Tinsplate is thin sheets of steel coated in tin. The tin protects the steel from rusting as well as giving it an attractive appearance. Tinsplate is widely used for food containers as it is non-toxic and easily soldered.

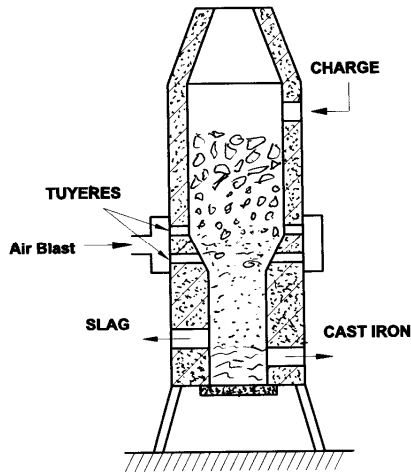
(c) (i) Any two:

- | | |
|-------------------|----------------------|
| Cast iron | Cupola furnace |
| High carbon steel | Electric arc furnace |
| Pig Iron | Blast furnace |

Name
Award 2 @ 4 Marks
Total (8) Marks

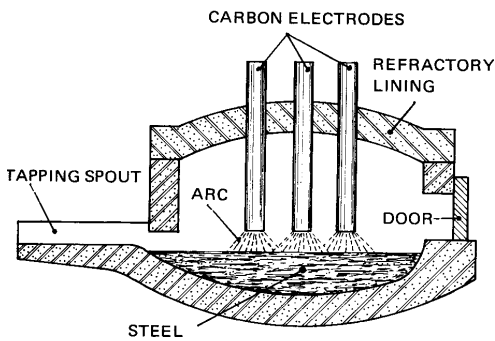
(ii) Any one:

Good clear description
Award 8 Marks
Total (8) Marks



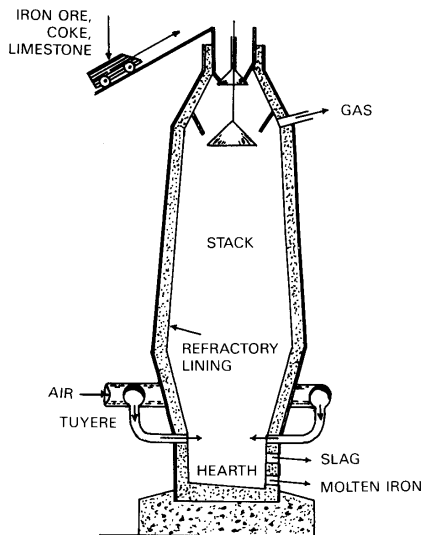
Cupola furnace

Pig iron and scrap steel or cast iron, together with other elements are the raw materials. Similar to the blast furnace, the cupola furnace is coke-fired with limestone acting as a flux to trap the impurities into slag. The molten cast iron is tapped from the bottom of the furnace and cast into moulds of different shapes and sizes as required.



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.



Blast Furnace

Iron ore, coke and limestone provide the charge and are fed in through the top of the furnace. As the coke burns, carbon monoxide is produced, and combines with the oxygen in the ore, leaving iron. The limestone combines with impurities to form slag. The molten iron falls to the bottom of the furnace where it is tapped off from time to time. The slag floats above the molten iron and is tapped off as required.

(d) Any two metal alloys:

- Bronze
- Brass

- Statutes / ornaments
- Door handles / Wood screws

Name
Award 2 @ 4 Marks
Total (8) Marks

Question 3

(45 Marks)

- (a) (i)
- To improve material properties e.g. hardness.
 - To soften metals before cold working e.g. annealing.
- (ii) Hardening, Annealing, Tempering.

(i) Award 2 @ 4 Marks
(ii) Award 3 @ 3 Marks
Total (17) Marks

- (b) **Hardening**
Once the file is manufactured it must be then hardened to prevent/reduce wear. The file is heated to as cherry red colour and is then cooled quickly in water. This ensures that the file is hard but the process makes the file very brittle.

Good Description
Award 2 @ 7 Marks
Total (14) Marks

Tempering

Tempering removes some of the hardness and hence makes the file less brittle. To temper the file it is again heated, but to a lower temperature, which can be judged by its colour. The file is then cooled in water or brine solution.

- (c) **Two reasons:**
Goggles must be worn when heat treating metals to:
- Protect the eyes from hot water splashes or rising steam.
 - Protect the face and or eyes from hot particles that may become air borne.

Reasons
Award 2 @ 3 Marks
Total (6) Marks

- (d) **Any two terms:**

Explanation
Award 2 @ 4 Marks
Total (8) Marks

(i) **Elasticity**

The ability of a material to return to its original shape when freed from a force which was distorting it e.g. rubber.

(ii) **Toughness**

This property enables a material to withstand blows or an impact e.g. steel.

(iii) **Conductivity**

This is the ability of a material to allow heat or electricity to flow through it e.g. copper.

OR

- (d)

Two advantages:

- Robots do not take breaks therefore they can run continuously with little downtime.
- Robotics is used in industry to automate processes and perform repetitive tasks.

Award 2 @ 4 Marks
Total (8) Marks

Question 4

(45 Marks)

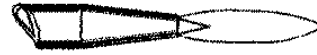
(a) (i) **Oxidising flame**

An oxidising flame contains more oxygen than acetylene. Can be identified as a pointed inner blue cone. Not used when welding steel as the additional oxygen would cause rusting of the joint.

Description

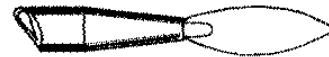
Award 3 @ 5 Marks

Total (15) Marks



(ii) **Neutral flame**

A neutral flame contains equal amounts of oxygen and acetylene. Can be identified by a more rounded inner cone. Can be used for welding steel.



(iii) **Carburising flame**

A carburising flame contains a greater ratio of acetylene than oxygen. Identified by an additional feather, fueled by the acetylene. The additional acetylene may be used to add carbon to a mild steel welded joint to improve hardness.



(b) **Any three:**

(i) **Earth clamp**

The earth clamp is a spring loaded clamp which is clamped onto the material being welded. The earth clamp is connected to the power source / welder. The other lead from the welder is connected to the electrode. When the electrode touches the material, the circuit is complete and an arc is produced.

Explanation

Award 3 @ 4 Marks

Total (12) Marks

(ii) **Welding mask**

A welding mask is used to protect the welder's face and eyes from the intense light & heat generated during the welding process. The tinted glass allows the welder to view the weld with much less intensity of light thereby preventing damage to eyes.

(iii) **Pressure gauge**

The pressure gauge is positioned at the top of the gas cylinders in both oxy-acetylene welding and MIG / TIG welding. The pressure gauge indicates the gas pressure coming from the hose and may be adjusted using the regulator.

(iv) Flashback arrestor

The flashback arrestor is a device fitted on the hose between the tank and the welding torch. It prevents the backflow of the flame, through the hose, from the torch into the gas cylinders, avoiding an explosion.

(c) Any three:

Award 3 @ 4 Marks
Total (12) Marks

- (i)** To initially clean the surfaces of any oxides which would reduce the quality of the soldered joint.
To prevent further oxidation when the parts are heated.
- (ii)** Socket head set screw.
Used when the set screw is to be fitted flush with the surface of a part. A counterbored hole is drilled in advance. The set screw is tightened in position using an allen key.
- (iii)** Wear protective gloves, apron and visor to prevent burning of skin and eyes.
Check that joint is properly assembled to avoid a spark splash.
- (iv)** Spring washer. Used under a plain nut to prevent loosening due to vibration.

(d) Two safety precautions:

Safety Precautions
Award 2 @ 3 Marks
Total (6) Marks

- Wear safety goggles to protect eyes.
- Always replace the soldering iron back into its stand.

Question 5

(45 Marks)

(a) (i)

- A: - Compression moulding
- B: - Vacuum forming
- C: - Injection moulding

Name
Award 3 @ 3 Marks
Total (9) Marks

(ii) Any one process:

Compression moulding

A measured amount of thermosetting polymer, in power form, is placed into the cavity of the mould. Heat from the mould causes the polymer to melt. The mould cavity is shaped to form the outside of the object. The punch is shaped to form the inside of the object. The mould closes dispersing the melted plastic to form the object. Pressure is maintained as crosslinking takes place. Once solidified the mould opens and the part is released.

Compression moulding is used to produce plug sockets / light fittings.

Process
Award 9 Marks
Component
Award 3 Marks
Total (12) Marks

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.

Vacuum forming is used to produce plastic baths / bins / containers.

Injection moulding

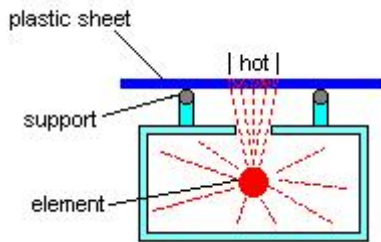
Thermoplastic is softened by heating it inside an injection nozzle. The softened plastic is forced by a plunger into a cold mould where it hardens rapidly. The mould opens and ejects the part.

Injection moulding is used for the rapid moulding of components such as Plastic toys / laptop bodies / remote control cases / lunch boxes.

(b) Any one:

(i) Strip heater

Electricity is passed through a wire strip with high resistance. The electricity causes the wire strip to heat up. A sheet of plastic material is placed over the wire strip ensuring that it is not touching it. Once sufficiently softened, the plastic may be bent to the required shape and held until solidified.



A strip heater is used to form straight or small curvature bends in thermoplastic sheet material.

Description

Award 9 Marks

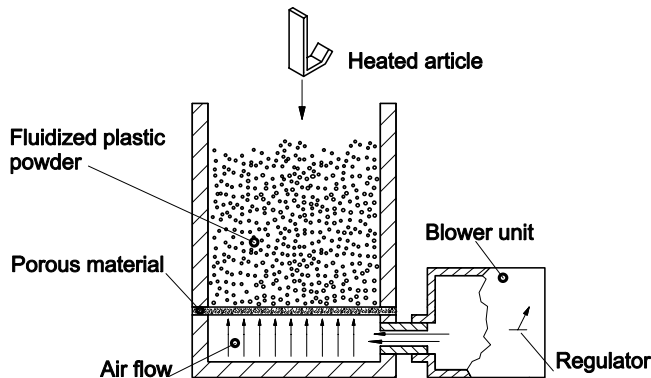
Application

Award 3 Marks

Total (12) Marks

(ii) Plastic dip coating tank

A powder plastic is stored inside a tank. Air is blown through the powder to airate it and cause it to rise. A metal part is heated above the melting temperature of the plastic powder. The hot metal part is then dipped into the airated powder allowing the powder to coat its surface. The part is removed and excess powder is shaken free. The heat from the metal part melts the powder resulting in a plastic coated finish. The part is left to cool normally.



A 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 – provides protection against rusting.

(c) Two safety precautions:

- Always work in a well-ventilated area.
- Wear protective gloves / goggles to protect from adhesive sticking to the skin.

Safety precautions

Award 2 @ 3 Marks

Total (6) Marks

(d) Suitable plastics:

Cavity wall insulation
Gear wheel

Ploystyrene
Nylon

Name

Award 2 @ 3 Marks

Total (6) Marks

Question 6

(45 Marks)

(a) Any three turning operations:

(i) Facing

The cutting tool is moved perpendicular to the axis of the lathe, thereby producing a flat surface on the face of the bar.

(ii) Parallel turning

The cutting tool is moved parallel to the axis of the lathe, thereby reducing the diameter of the bar, producing a cylinder.

(iii) Taper turning

The top slide is rotated to half the included angle of the taper. The cutting tool is fed using the feed handle on the top slide at an angle to the axis of the lathe. A tapered finish is achieved.

(iv) Knurling

A knurling tool is fitted to the tool post of the lathe and set at an angle of 90 deg. to the work piece. The work is rotated at a slow speed and a pair of wheels on the knurling tool is pressed against it. The wheels impress a diamond or straight pattern on the work piece providing a grip on its outer surface.

(v) Drilling

A suitable drill is fitted to the barrel of the tailstock. When the work rotates, the drill is fed into the work piece by turning the hand-wheel on the tailstock. A centre drill is used at the beginning, to ensure that the hole starts on centre

Description Award 3 @ 5 Marks Total (15) Marks
--

(b) Any three terms:

(i) Centre drill

The centre drill is used before drilling on the lathe to ensure the hole starts on centre.

(ii) Rake angle

The rake angle is ground on a cutting tool to provide a sharp edge for cutting. The rake angle allows the swarf to pass over the cutting tool and away from the cutting area.

(iii) Knurling

A knurling tool is used on the centre lathe. Hard serrated rollers are pressed against the surface of a bar. Impressions / patterns are created on the surface of the bar providing grip to the outside of the bar.

(iv) Clearance angle

A clearance angle is ground on a cutting tool to reduce the contact area between the work piece and the cutting tool. This ensures a reduction in friction, heat buildup, longer tool life and better surface finish.

Explanation Award 3 @ 5 Marks Total (15) Marks
--

(c) Centre lathe part:

Centre lathe part
Award 3 @ 5 Marks
Total (15) Marks

- (i) Name:** Tailstock
- (ii) Operations:** Drilling and supporting long bars on the lathe.
- (iii) One safety precaution:** When turning between centres, ensure both levers of the tailstock are locked in place to prevent the bar from coming loose.

OR

(c) (i) Computer Numerical Control.

Award 3 @ 5 Marks
Total (15) Marks

- (ii) Greater accuracy and faster machining time.**
- (iii) Always keep the safety guard closed during operation.**

Question 7

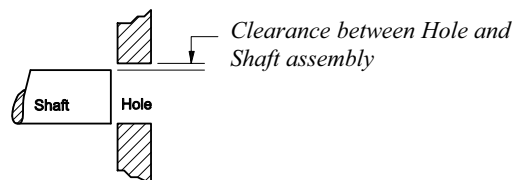
(45 Marks)

(a) Differences:

(i) Clearance fit

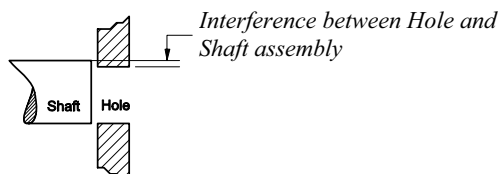
In a clearance fit the shaft size is smaller than the hole size. A gap always exists between both parts. This ensures that the shaft may rotate inside the hole.

Differences
Award 2 @ 5 Marks
Total (10) Marks



(ii) Interference fit

Interference fit results when the size of the shaft is larger than the size of the hole diameter. No clearance exists and a force is required to force the shaft into the hole.



(b)

- | | |
|-------------------------------------|-------|
| (i) Nominal diameter of the hole: | 43.00 |
| (ii) Smallest diameter of the hole: | 42.95 |
| (iii) Largest diameter of the hole: | 43.05 |
| (iv) Tolerance of the hole: | 0.10 |

Calculations
Award 4 @ 5 Marks
Total (20) Marks

(c) Any three:

- | | |
|-----------------------|--|
| (i) Feeler gauge | - for checking the size of required gaps – spark plug |
| (ii) Surface plate | - for accurate marking out using a vernier height gauge. |
| (iii) Go/NoGo gauge | - for checking parts are between specific higher & lower limits. |
| (iv) Adjustable bevel | - for checking angles when bending metal sheet. |

Name & application
Award 3 @ 5 Marks
Total (15) Marks

OR

(c)

- | Name: | Use: |
|----------------------------|--|
| (i) Light emitting diode - | Can be used as a power on indicator in circuits. |
| (ii) Toggle switch - | Used to turn circuits on or off. |
| (iii) Battery - | Provides electrical energy to circuits. |

Name & function
Award 3 @ 5 Marks
Total (15) Marks



Leaving Certificate Engineering Practical Marking Scheme 2014

Subjective Marking 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 Project					Assembly, Function & Finish Subjective Mark 1 – 20		20	20					
2	Parts 1 and 4					Part 1 6 Marks	Marking Out 10 mm Radii M5 Tapped Holes	2	2					
						Part 4 14 Marks	Marking Out 10 mm Radii Ø5.5 mm & 10 mm Holes Ports	2	4	2	6			
3	Part 3					Part 3 20 Marks	Marking Out Drill & CSK 6 mm Radii 14 mm Radii Symmetry of Profile	4	2	4	4	4	6	20
4	Parts 5 and 6					Part 5 × 2 12 Marks	Marking Out Drill & Profile	4	8					
						Part 6 × 2 8 Marks	Marking Out Drill & Profile	4	4	4	20			
5	Parts 2 and 7					Part 2 12 Marks	Mark Out Profile Lathe Work	4	8	8	20			
						Part 7 8 Marks	Lathe Work	8	8	8				

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