Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2012

ENGINEERING – MATERIALS AND TECHNOLOGY

(Higher level – 300 marks)

THURSDAY, 7 JUNE **MORNING 9:30 – 12:30**

INSTRUCTIONS

1. Answer **Section A** and **Section B** of **Question 1** and **FOUR** other questions.

2. All answers must be written in ink on the answer book supplied.

3. Diagrams should be drawn in pencil.

4. Squared paper is supplied for graphs, as required.

5. Please label and number carefully each question attempted.

Question 1. **(100 marks)**

Section A – 50 Marks

Give **brief answers** to **any ten** of the following:

(a) Identify the main processes used to manufacture the metal face guard of the hurling helmet shown.

(b) Explain the term *allotropy* with reference to carbon steel.

(c) State the purpose of **any two** of the safety signs shown.

(i)

(ii)

(iii)

(d) Outline **two** issues associated with the disposal of foamed polystyrene cartons.

(e) Describe the metallic bond, with the aid of a suitable diagram.

(f) Differentiate between a thermal conductor and an electrical conductor.

(g) Newbridge Silverware® produced a range of jewellery in silver to mark 2011 as the 'Year of Craft' in Ireland.
Suggest **two** material properties that make silver suitable for craftwork.

(h) Explain the term *factor of safety*.

(i) Distinguish between a single-acting cylinder and a double-acting cylinder in pneumatic control.

(j) Explain the meaning of **any two** of the following abbreviations:

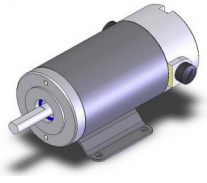
(i) ISP **(ii)** LDR **(iii)** RAM **(iv)** CAD.

(k) Discuss the contribution that **any one** of the following made to technology:

(i) George Devol **(ii)** Theodore Maiman **(iii)** Francis Beaufort.

(l) Describe the importance of the *evaluation* stage in the process of design.

(m) Describe, with the aid of a suitable diagram, **one** method used to secure a nylon gearwheel to the shaft of the DC motor shown.



Section B – 50 Marks

Answer **all** of the following:

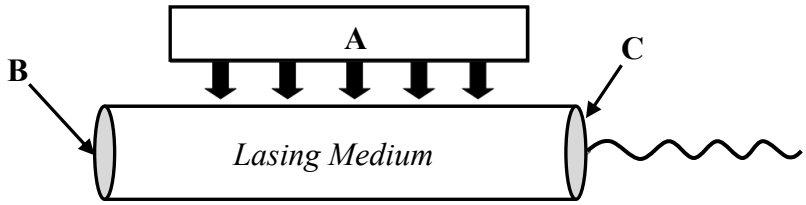
(n) Laser (*Light Amplification by Stimulated Emission of Radiation*) technologies are commonplace in modern society.

Outline **one** specific example where laser technology is used in **each** of the following:

(i) Entertainment;

(ii) Industry.

(o) The principle of a simple laser is illustrated in the diagram below.



(i) Name parts **A**, **B** and **C**.

(ii) Describe the principle of operation of this laser.

(iii) List **any two** sources of energy for this laser.

(p) Laser light is different from normal light and has the following properties, it is:

- Monochromatic
- Coherent
- Directional.

Explain **any two** of these properties.

(q) *Lasik* is a laser technology used in correcting a range of sight problems by altering the shape of the eye, as shown.

(i) Describe **two** properties that make laser technology suitable for this application.

(ii) Discuss the advantages of using laser technology for medical purposes.

(r) Explain **any two** of the following:

(i) The applications of *laser vaporisation cutting* and *laser fusion cutting*;

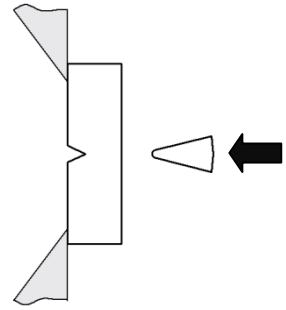
(ii) The safety hazards associated with industrial Class IV laser technology;

(iii) Photon.

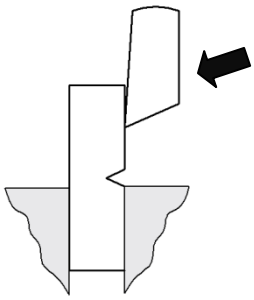
Question 2. **(50 marks)**

(a) **(i)** Describe the principle of operation of **any one** impact test.

(ii) Compare the two impact tests represented in diagrams **A** and **B**.

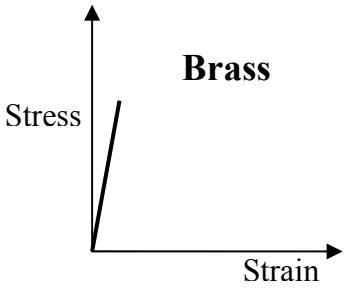


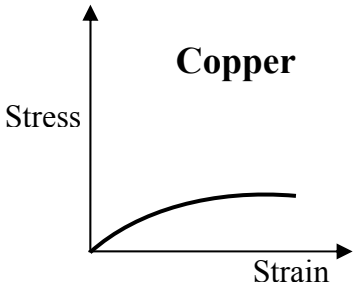
Impact test **A**

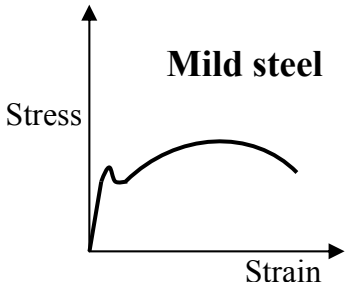


Impact test **B**

(b) The results shown below were obtained from a series of tensile tests on the following metals: **Brass**, **Copper** and **Mild steel**.







(i) Describe the degree of brittleness in **each** of the metals shown.

(ii) Explain the difference between the elastic state and the plastic state when mild steel is subjected to a tensile test.

(c) **(i)** In the manufacture and maintenance of aircraft, a range of non-destructive testing (NDT) is used to check for internal and external flaws.
Identify **two** NDTs that examine surface imperfections and **two** NDTs that detect internal flaws.

(ii) Describe, with the aid of suitable diagrams, **one** non-destructive test used to check for internal faults in welded joints.

Question 3. **(50 marks)**

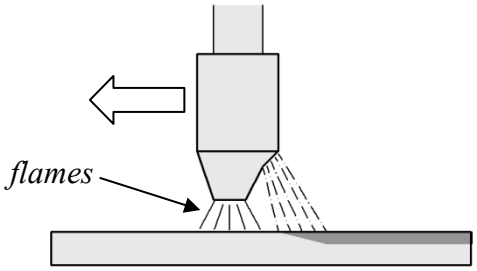
(a) Describe **any two** of the following heat treatment processes:

(i) Annealing;

(ii) Normalising;

(iii) Carburising.

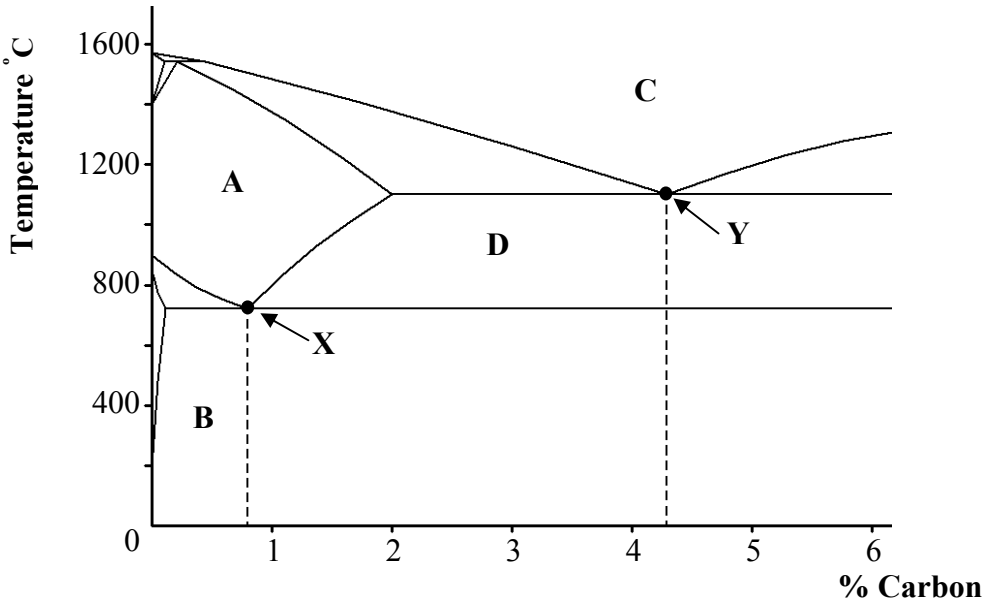
(b) A flame hardening process is shown below.



(i) Describe the principle of operation of this flame hardening process.

(ii) Outline **one** application for this process.

(c) A simplified portion of the iron-carbon equilibrium diagram is shown.



(i) Name the regions **A**, **B**, **C** and **D** shown.

(ii) Identify and describe the points **X** and **Y**.

Question 4. **(50 marks)**

(a) Discuss **any two** of the following:

(i) The difference between an interstitial solid solution and a substitutional solid solution;

(ii) A cooling curve for an alloy;

(iii) **One** example of metal refining in Ireland;

(iv) The meaning of the term *solvus*.

(b) The table shows the solidification temperatures for various alloys of Cadmium and Bismuth.

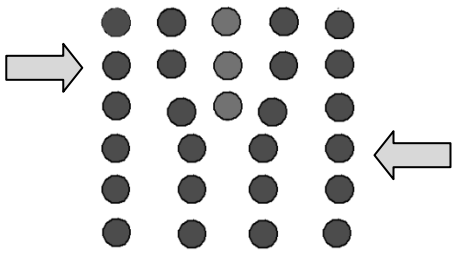
% of Cadmium in alloy	0	10	20	30	40	50	60	70	80	90	100
Start of solidification (˚C)	268	237	205	175	140	190	235	265	290	310	321
End of solidification (˚C)	140	140	140	140	140	140	140	140	140	140	140

(i) Using the graph paper supplied, draw the thermal equilibrium diagram according to the given data;

(ii) Label and describe the main features of the diagram;

(iii) Explain the term *eutectic alloy*.

(c) A diagram of a crystal-lattice line defect is shown.

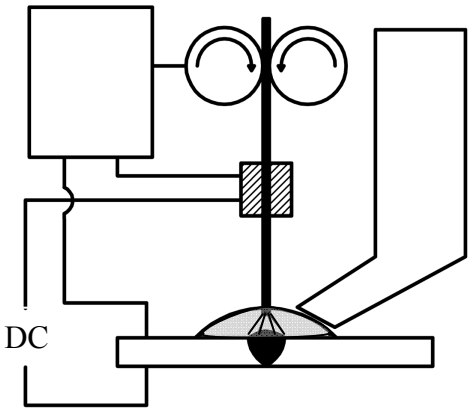


(i) Identify and describe this defect.

(ii) Outline the impact of a shear force on the defect shown.

Question 5. **(50 marks)**

(a) The process of submerged arc welding (SAW) is illustrated.



(i) Describe the principles of operation of submerged arc welding (SAW).

(ii) Identify **one** application of SAW.

(b) Answer **any three** of the following:

(i) Describe, with examples, the importance of colour coding in oxyacetylene equipment;

(ii) Outline **three** safety precautions that should be observed in the preparation of equipment and materials for oxyacetylene welding;

(iii) Describe multi-run welds;

(iv) Describe **one** type of welding suitable for the automated welding of steel panels in motorcar manufacture.

(c) Describe, with the aid of suitable diagrams, the main features of **one** of the following:

(i) Tungsten Inert Gas (TIG) welding;

(ii) Manual metal arc (MMA) welding.

OR

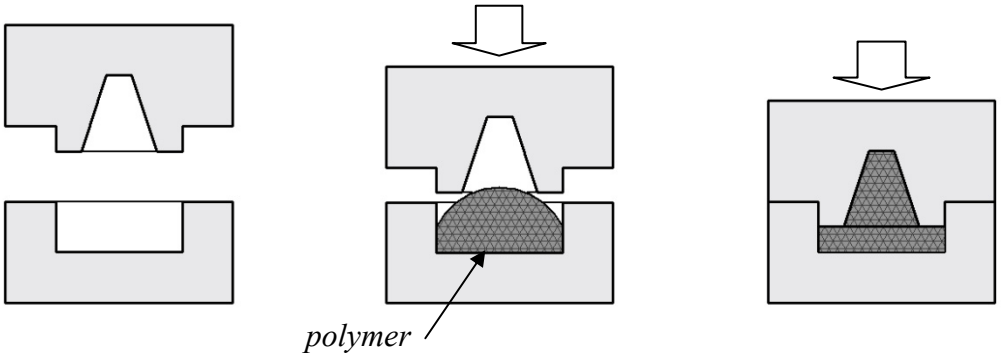
(c) Resistance spot welding is extensively used in robot controlled engineering manufacture.

(i) Explain why resistance spot welding is suitable for robotic control.

(ii) Identify **two** other industrial processes where robotic control is widely used.

Question 6. **(50 marks)**

(a) With reference to the polymer manufacturing process shown in the diagrams below, answer the following:



(i) Name the process **and** describe the principle of operation.

(ii) State the type of polymer used in this process.

(iii) Identify **one** component that could be produced using this process.

(b) Distinguish between *thermoplastics* and *thermoset plastics* using **each** of the following headings:

(i) Polymerisation process;

(ii) Chemical bonding;

(iii) Internal structure;

(iv) Properties.

(c) Explain in detail **any three** of the following:

(i) Elastomer;

(ii) Catalyst;

(iii) Blow moulding;

(iv) GRP;

(v) Laminate.

Question 7. **(50 marks)**

(a) Answer **any three** of the following:

(i) Identify **two** benefits of the use of cutting fluids in machining;

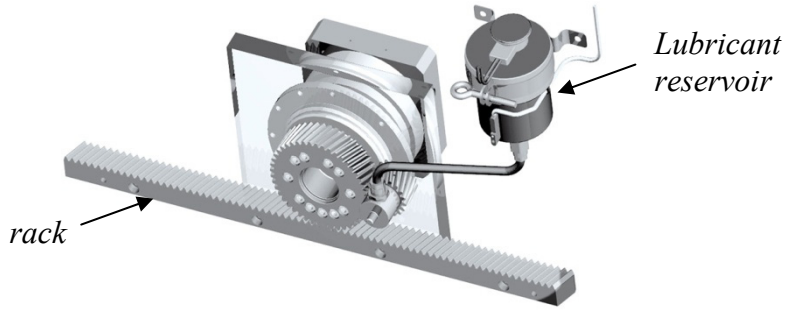
(ii) Describe the function of a *dividing head* on a milling machine;

(iii) Explain the term *tolerance* in engineering measurement systems;

(iv) Describe the main factors that influence metal surface finish when parallel turning on the lathe;

(v) State **one** advantage and **one** disadvantage of using magnetic chucks on a grinding machine.

(b) Lubrication is vital to the efficient working of machine parts, such as in the engineering system shown.



(i) Outline **two** reasons why lubrication is important in machining processes.

(ii) Identify **any two** lubricating materials commonly used in engineering machines.

(c) Outline, with the aid of diagrams, the essential differences between the machining terms in **each** of the following:

(i) Loading and glazing of grinding wheels;

(ii) Forming and generating on the lathe.

OR

(c) Industrial engineering was one of the earliest areas to use computer technology. Describe **any one** use of computer technology in **each** of the following areas:

(i) Research;

(ii) Product design;

(iii) Production techniques.

Question 8. **(50 marks)**

(a) Name and describe the operation of **any one** of the mechanisms shown.

(i)

(ii)

(b) Explain **any three** of the following:

(i) The energy conversion that occurs in a car battery;

(ii) The function of an idler gear;

(iii) **One** application of a ratchet and pawl mechanism;

(iv) The use of a heat sink in an electronic circuit;

(v) The benefits of using solar panels.

(c) Describe, with the aid of suitable diagrams, **one** method of providing independent drive to each wheel of the all-terrain surveillance vehicle shown.

OR

(c) Integrated circuit (IC) microchips are used in many electrical appliances.

(i) Identify **one** semi-conductive material used in the manufacture of integrated circuits.

(ii) Outline **two** advantages of using IC microchips rather than building circuits using traditional components.

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Coimisíun na Scrúdaithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2012

ENGINEERING - PRACTICAL
HIGHER and ORDINARY LEVELS

150 marks

30th APRIL - 11th MAY - MORNING: 10:00 to 1:00
AFTERNOON: 2:00 to 5:00

PLEASE READ CAREFULLY

INSTRUCTIONS

(a) The Examination Number must be clearly stamped or engraved by the **teacher** on the test-piece in the position indicated on the drawing 2012. M74A(L_2). If the test-piece is not assembled, the Examination Number must be indicated on each separate part of the test-piece.

(b) Candidates are not permitted to communicate with or assist one another.

(c) Completed **mild steel** parts **only** must be sprayed with a clear rust preventive aerosol.

From the materials supplied, make the **Lock Mechanism** shown on the drawings to the shape and dimensions specified.

PART	MATERIAL	PROCESS
1	Clear Polycarbonate	Mark out, drill, tap and shape.
2	Brass	Mark out, drill and shape.
3	Brass	Mark out, drill and shape.
4	Aluminium	Mark out, drill and shape.
5	Aluminium	Mark out, drill and shape.

Note: **(i)** Parts 6, 7 and 8 have been made prior to examination day. Using the screws supplied assemble the Lock Mechanism, as detailed on the assembly drawing.
(ii) **Accuracy, finish and function are important.**

Coimisíun na Scrúdaithe Stáit

SCRÚDÚ ARDTEISTIMÉIREACHTA, 2012

INNEALTÓIREACHT - PRAITICIÚIL
ARDLEIBHÉAL agus GNÁTHLEIBHÉAL

150 marc

30 AIBREÁN - 11 BEALTAINE - MAIDIN: 10:00 go dtí 1:00
TRÁTHNÓNA: 2:00 go dtí 5:00

LÉIGH NA TREORACHA SEO GO CÚRAMACH IAD LE DO THOIL

TREORACHA

(a) Ba chóir don **mhúinteoir** Scrúduimhir an Iarrthóra a ghreanadh nó a scríobadh san ionad a thaispeántar ar an líníocht 2012. M74A(L_2). Mura bhfuil an triailphíosa curtha le chéile, ní mór an Scrúduimhir a thaispeáint ar gach páirt ar leith den triailphíosa.

(b) Níl sé de chead ag iarrthóirí caidreamh a bheith acu lena chéile ná cúnamh a thabhairt dá chéile.

(c) Ní mór sprae trédhearcadh aersol chun meirg a chosc a chur ar na páirteanna déanta as **cruach bhog amháin** agus iad críochnaithe.

As na hábhair a sholáthraítear, an **Mheicníocht Ghlasála** a thaispeántar sna líníochtaí a dhéanamh sa chruth agus de réir na dtoisí a shonraítear.

PÁIRT	ÁBHAR	PRÓISEAS
1	Polacharbónáit thrédhearcach	A mharcáil amach, a dhruileáil, a tapa agus a dheilbhiú.
2	Prás	A mharcáil amach, a dhruileáil agus a dheilbhiú.
3	Prás	A mharcáil amach, a dhruileáil agus a dheilbhiú.
4	Alúmanam	A mharcáil amach, a dhruileáil agus a dheilbhiú.
5	Alúmanam	A mharcáil amach, a dhruileáil agus a dheilbhiú.

Nóta: **(i)** Rinneadh páirteanna 6, 7 agus 8 roimh lá an scrúdaithe. Ag baint úsáide as na scriúnna a sholáthraítear, déan an Mheicníocht Ghlasála faoi mar atá sa líníocht cóimeála.
(ii) Tá tábhacht ag baint le cruinneas, le bailchríoch agus le hoibriú.

SCRÚDÚ ARDTEISTIMÉIREACHTA INNEALTÓIREACHT - PRAITICIÚIL

LEAVING CERTIFICATE ENGINEERING - PRACTICAL

2012. M74A(L_1)

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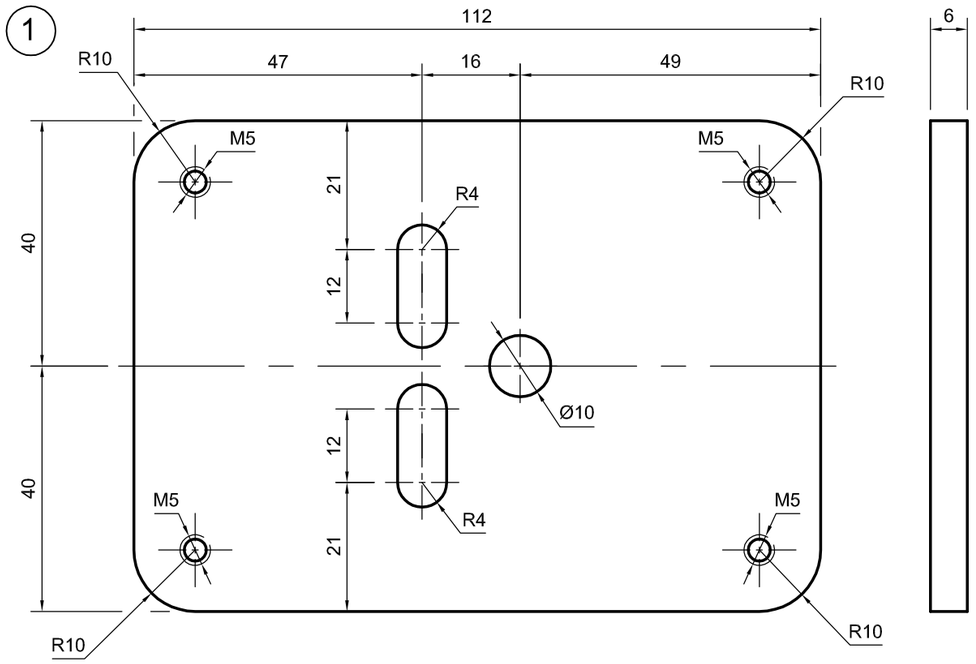

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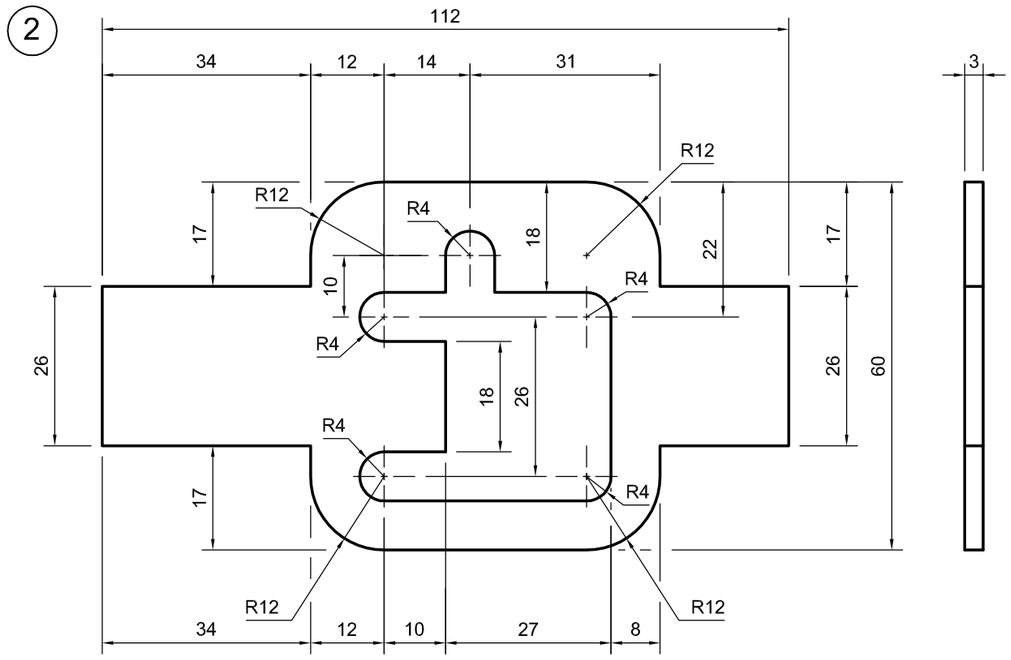

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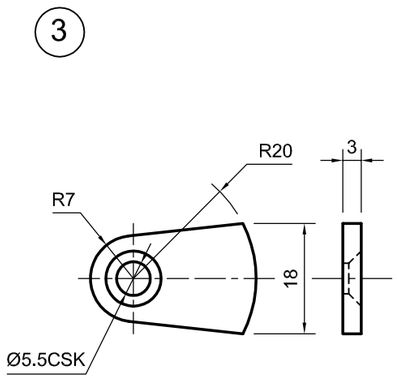

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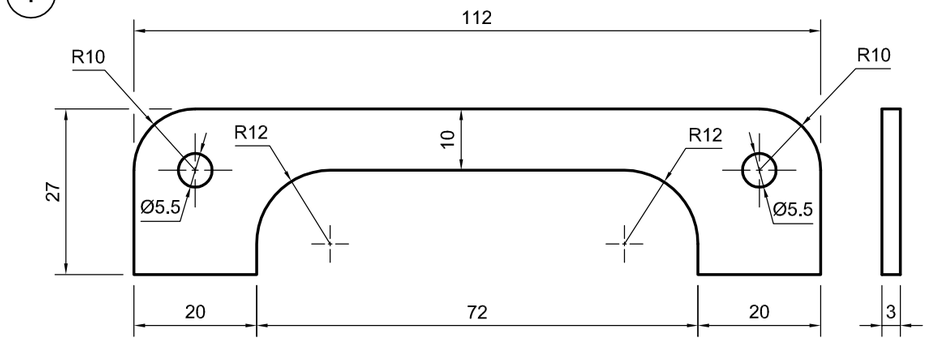

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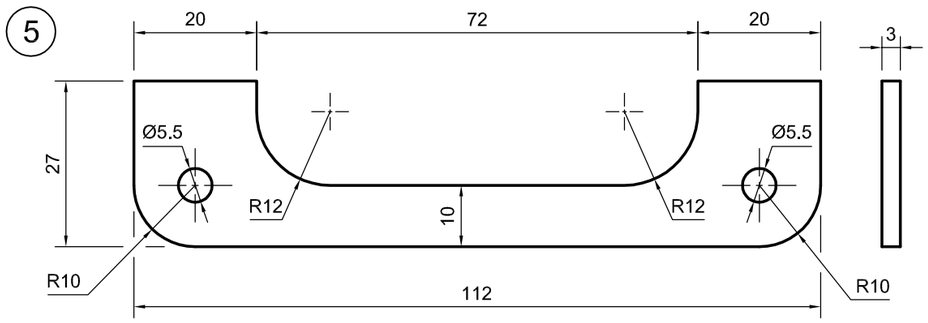

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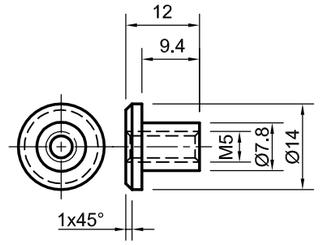

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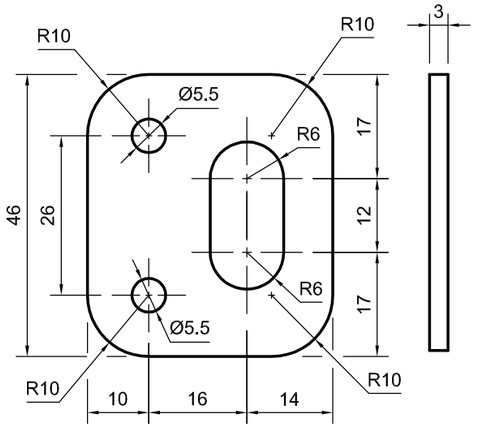

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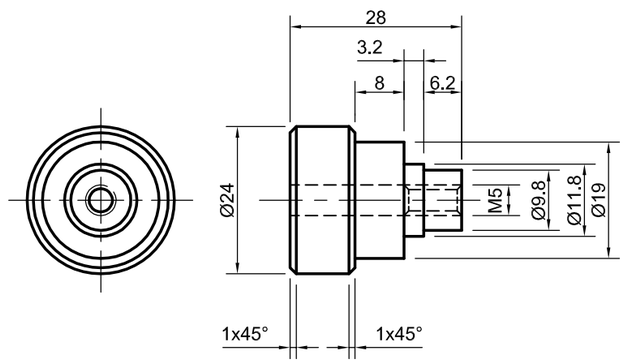
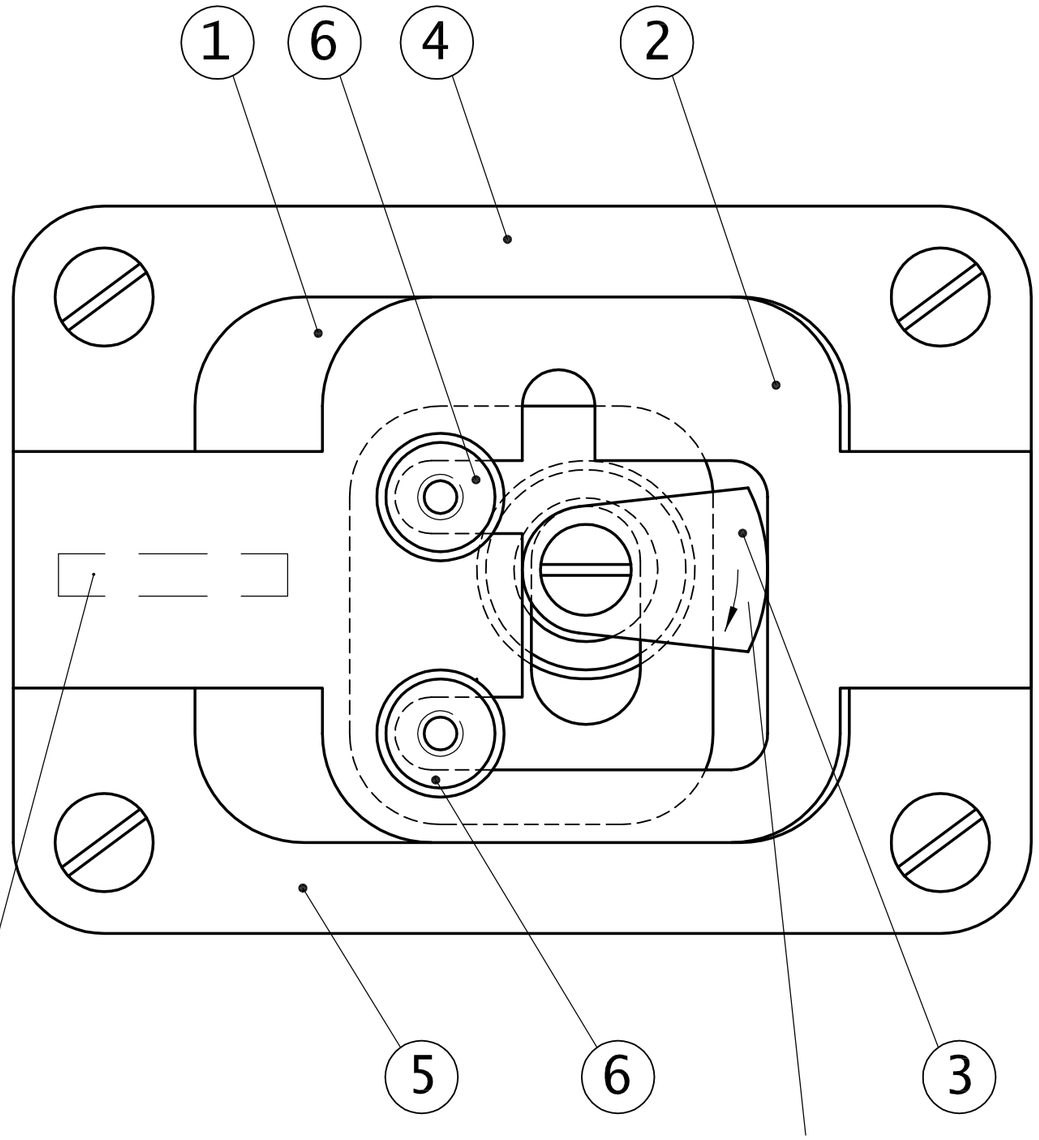


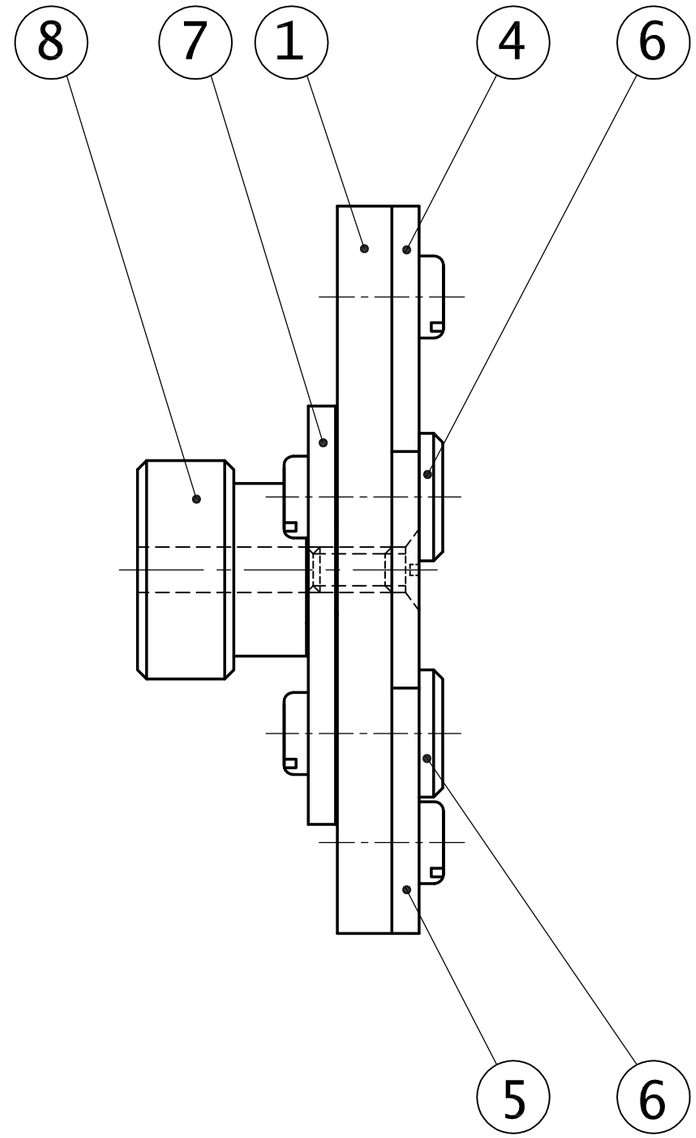
THALL OVER

Coimisiún na Scrúduithe Stáit
State Examinations Commission

2012. M74A(L_2)

SCRÚDÚ ARDTEISTIMÉIREACHTA INNEALTÓIREACHT - PRAITICIÚIL
LEAVING CERTIFICATE ENGINEERING - PRACTICAL





SCRÚDUIMHIR
EXAM NO.

FEIDHM: Ní theastaíonn ach casadh 180° amháin chun an mheicníocht ghlasála a oscailt nó a dhúnadh.
FUNCTION: A revolution of 180° only is required to open or close the lock mechanism.

SONRAÍ CÓIMEÁLA
ASSEMBLY DETAILS