Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination

Technology

Higher Level

Friday, 19 June
Afternoon, 2:00 - 4:30

Section B - Core   *(48 marks)*

*Answer **both** questions.*
Each question in Section B carries 24 marks.

Section C - Options   *(80 marks)*

*Answer **two** of the five options presented.*
All questions in Section C carry 40 marks.

Instructions:

(a)   *Answer these questions in the answerbook provided.*

(b)   *Write your examination number on the answerbook.*

(c)   *Draw all sketches in pencil.*

(d)   *Hand up the answerbook at the end of the examination.*

# Section B - Core - *Answer Question 2 and Question 3.*

Question 2 - *Answer 2(a) and 2(b)*

2(a) The personal safety of elderly people is an important issue in modern society.

    (i)   Describe **two** situations where elderly people may be particularly vulnerable and state why.

    (ii)   In **each** case suggest an application of technology which could contribute to making their environment safer.

2(b) A design for a personal alarm project is shown. The two push-buttons are bought in. All other parts are to be manufactured in the Technology Room.

    (i)   Draw up a Work Breakdown Structure (WBS) for the project.

    (ii)   Suggest a suitable means of joining parts **A** and **B**.

    (iii)   For **each** part, choose a material and describe the steps you would take to manufacture:

        •   The outer casing **A**
        •   The backplate **B**

    (iv)   Describe how the PCB could be produced.
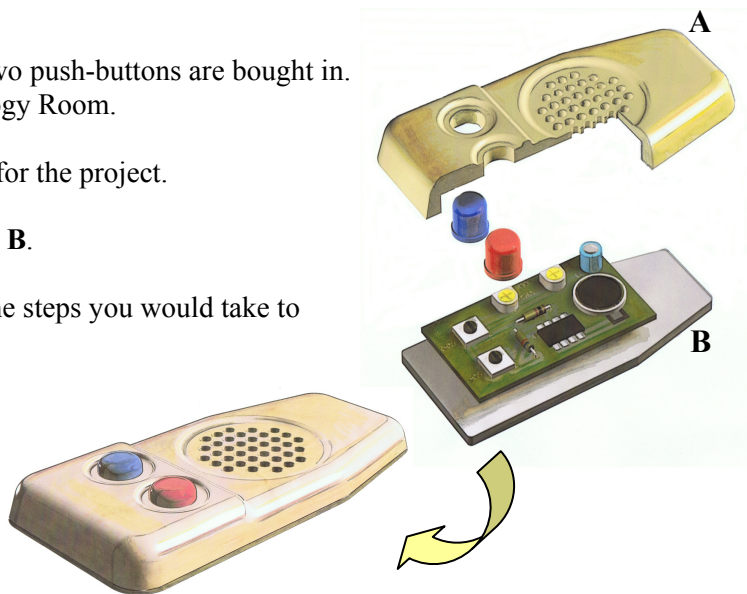
Answer 2(c) or 2(d)

2(c)

    (i)   The personal alarm needs to be easily accessible at all times to the person carrying it.

           Using neat, well-proportioned, annotated sketches propose a design improvement that would address this requirement.

    (ii)   The personal alarm may need to be activated in darkness or in poor visibility.
           Propose a design modification which would make the alarm easier to use in such circumstances.

OR

**2(d)** It is important that the alarm be both reliable and of high quality.

    (i)   Name **three** quality characteristics and specify **three** related quality attributes for the alarm.

    (ii)   Explain how the manufacturing processes and the material choices for the project affect the quality attributes of the alarm.

Question 3 *- Answer 3(a) **and** 3(b)*

3(a) (i) Show using sketches **three** different classes of lever.

(ii) A mechanical lifting device allows a weight of 95 N to be raised using an effort of 10 N on a lever.
If the load moves 1 mm for every 10 mm travel of the lever, calculate the mechanical advantage, velocity ratio and efficiency of the device.

3(b) The graphic shows a student's design of a robotic arm. The arm is powered using a DC motor (**A**) and reduction gear as shown.

(i) The torque available from the motor is 0.6 Nm. The distance from the pivot to the end of the gripper (end effector) is 150 mm. Assuming the robotic arm is balanced when unloaded, calculate the maximum load the arm can lift.

(ii) The robotic arm was found to deflect when used. Using annotated sketches show how the design of the arm could be modified to increase its rigidity.
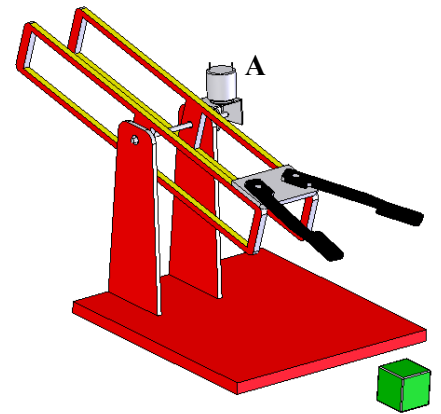
*Answer 3(c) **or** 3(d)*

3(c)

(i) Using annotated sketches show a suitable mechanism for opening and closing the gripper (end effector) of the robotic arm to allow it to pick up the block shown in the graphic.

(ii) In order to achieve equilibrium the gripper must be counterbalanced at the opposite side of the pivot. The gripper exerts a moment of 0.4 Nm about the pivot. Calculate the distance from the pivot to the point at where a counterbalance with a mass of 400 g should be positioned to achieve equilibrium.

OR

3(d)

(i) A circuit is required to control the movement of the motor at **A**. Both forward and reverse motion are required and the circuit should allow the speed of the motor to be varied. Draw the required circuit diagram.

(ii) Propose an appropriate sensor to detect the presence of an object in the jaws of the gripper of the robotic arm. Justify your choice of sensor and describe how it works.

Section C - Options - *Answer **any two** of the Options.*

Option 1 - Applied Control Systems - *Answer 1(a) and 1(b)*

1(a) (i)   Using **three** examples, outline how the use of microprocessors has improved our daily lives.

(ii)   Microcontrollers in the form of Peripheral Interface Controllers (PIC) are widely used for project work. Outline **three** advantages in using PICs for students' projects in Technology.

1(b) A program sequence for a student's steady hand game is shown in the flowchart. When a metal ring touches a wire track a LED illuminates and a buzzer sounds to show that the game is over.
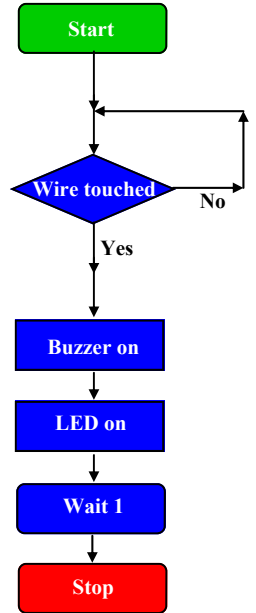
(i)   Draw a modified program flowchart to allow the player **two** touches of the wire track before the game is over.
The LED should illuminate after ONE touch and the buzzer should sound and the game finish after the SECOND touch.

(ii)   Input 2 on the PIC is used to detect when a player has successfully completed the game. Modify the program flowchart to output a simple tune consisting of three tones when this occurs.

(iii)   A transistor driver is required to operate the buzzer.
Draw a circuit diagram to show how the transistor and buzzer are connected to the PIC and explain why the transistor driver is required.

Flowchart:
Start → Wire touched (No → loops back; Yes ↓) → Buzzer on → LED on → Wait 1 → Stop

### Answer 1(c) **or** 1(d)

1(c) Robotic systems are used in many applications in both industry and society.

(i)   Outline **one** application of robotic control in **each** of the following areas:

- Space exploration
- Mechanical assembly

(ii)   A robot is used to spray paint car bodies as part of an assembly line process.
Describe in detail how the robot would be programmed to spray paint the cars.
Explain why accurate and consistent positioning of the car bodies is essential for the spray painting process.
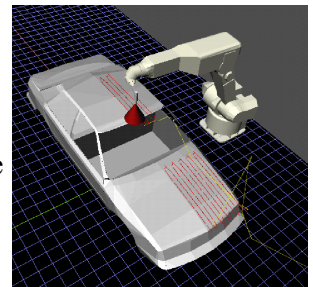
OR

1(d) (i)   Name any **three** of the pneumatic symbols shown below.

A   B   C   D   E
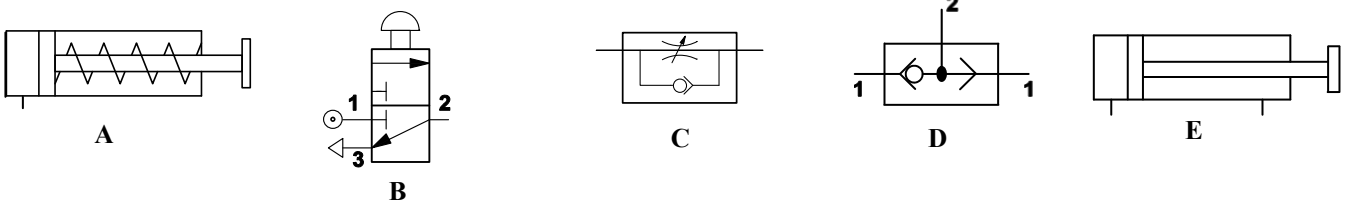
(ii)   By selecting from the given symbols, sketch a pneumatic circuit to achieve the following:

- The cylinder extends fully when the button is pressed
- The cylinder retracts at a controlled rate when the button is released.

Option 2 - Electronics and Control - *Answer 2(a) and 2(b)*

2(a) (i)   Electronic waste is a valuable source of secondary raw materials.
Identify **two** parts of a computer monitor which may be recycled.

(ii)   Many EU countries have banned the disposal of electrical and electronic equipment to landfill.
Outline **two** reasons for the introduction of this ban.

2(b)   The bedside lamp shown stays on for a period of time when the switch is pressed.
The monostable circuit below controls the lamp.
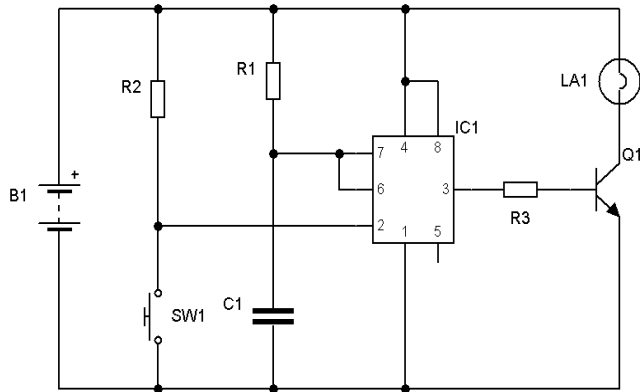
(i)   Name component IC1.

(ii)   Name **two** components in the circuit that control the time delay of the circuit and state how to increase the length of time that the lamp stays on.

(iii)   Explain in detail the sequence of events which occur in the circuit when SW1 is pressed.

(iv)   If the value of C1 is 100μF and the value of R1 is 1MΩ, calculate the delay in seconds.

Answer 2(c) or 2(d)

**2(c)**   The operational amplifier (op-amp) is a versatile and widely used electronic component.

(i)   Describe **two** common configurations for an operational amplifier (op-amp).

(ii)   Sketch a circuit diagram to show how an op-amp can be configured to act as either of the configurations described at (i) above.

OR

2(d)

The graphic shows an alarm system for the seat belt of a car. The alarm is designed to activate for 30 seconds when the ignition is on and the seatbelt is unbuckled.
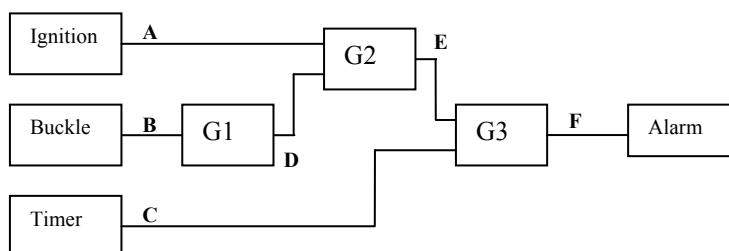
(i)   Identify the logic gates required at G1, G2 and G3.

(ii)   Draw the truth table for output F.

(iii)   Give **three** examples where electronic control is used in automotive safety.

Option 3 - Information and Communications Technology *- Answer 3(a) and 3(b)*

3(a) (i)   The misuse of Communications Technology is of growing concern to many people.
Discuss **two** ways of protecting yourself from the possibility of *'Cyber bullying'* when online.

(ii)   Explain what is meant by the term URL.
Identify **two** elements of the following URL and explain the purpose of **each**.
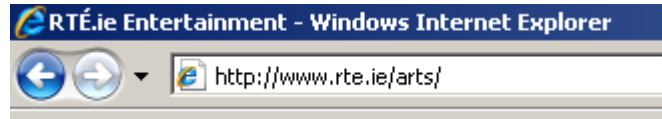
3(b) (i)   State **two** benefits that a company would gain from networking their computer system to form a LAN.

(ii)   Explain the function of **each** of the following in a computer network:

- Network switch
- Network card
- IP address
- File server.

(iii)   The owner of a small transportation company has decided to set up a computer network. At present the company uses one computer for word processing and taking orders. This computer is connected to a printer. It uses another three computers for processing orders and coordinating deliveries.
The company wants to achieve the following:

- All important data to stay on one computer but be available to other computers when needed.
- All computers to be able to use the printer.

    (a) Draw a block diagram of a network to make this possible.

    (b) Describe how the printer can be shared over the network.

Answer 3(c) or 3(d)

3(c) (i)   Distinguish between *bitmap* and *vector* based representations of graphical data and suggest a suitable application for **each**.

(ii)   The graphic shows the logo for a delivery company. The logo is to be used on all printed documents the company uses and on its website. Select a suitable file format for **each** of the following uses of the logo and justify your selection in **each** case:

- Printed on company notepaper and letterheads
- Included in the company's email signature
- On the homepage of the company's website.

OR

3(d) (i)   Distinguish between *shareware*, *freeware* and *trial software*.

(ii)   A sound wave is an analogue signal. Describe how such an analogue signal can be converted to a digital format making reference to *amplitude*, *sampling rate* and *sample format*. Support your answer with a labelled diagram.

Option 4 - Manufacturing Systems - *Answer 4(a) and 4(b)*

4(a) (i)   Why is accelerated testing sometimes used on a product? Describe **two** types of accelerated wear tests.

    (ii)   A hairdryer as shown is designed to have a life of three years before it wears out.
If the average usage is 4 hours per week, calculate the total life in hours required of
the hairdryer.
Suggest a suitable type of accelerated test to measure the life of the hairdryer.

4(b) (i)   Describe **one** main difference between *Quality Control* and *Quality Assurance*.

    (ii)   Draw a diagram to show how the quality costs of conformance and the costs of non-conformance relate to
one another.

    (iii)   A company employs the following people in its production process:

Description	Number	Salary per year
Managers	2	€60,000 each
Customer Service	1	€40,000
Maintenance	2	€45,000 each
Finance	1	€50,000
Quality Assurance	1	€55,000

During the previous year:
- A quarter of one manager's time was spent on quality improvement
- Half of the customer service time was spent dealing with customer complaints
- Half of the maintenance time was spent reworking defective products
- One fifth of the finance time was spent checking for mistakes in billing of customers
- One quarter of the quality assurance time was spent on inspection
- A sales contract worth €40,000 was lost due to a problem with the product.

(a) Evaluate the cost of quality to this company in the previous year.

(b) Propose how the company could make savings by improving their
quality procedures.

Answer 4(c) or 4(d)

4(c) (i) Explain the difference between a process that is *capable* and one that is *not capable.*

(ii) The graphics below show a pen with a removable cap.

Enlarged view of cap

H
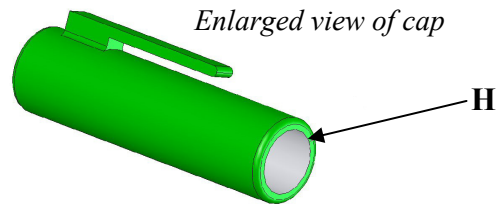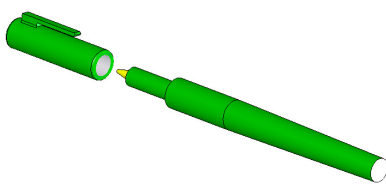
In order to fit the pen properly, the diameter of the hole **H** must lie between 8.05 / 7.95 mm.

The type of plastic used to make the cap affects the accuracy of the hole.

The manufacturer wishes to choose a suitable plastic. Tests were carried out using two different plastics and the sizes of hole **H** were recorded in the table below.

Hole Sizes in mm	
Plastic **A**	Plastic **B**
8.04	7.99
8.02	7.98
8.05	8.02
7.95	7.98
8.04	7.99
8.02	8.01
7.96	8.01
0.0401	**0.0160**

Standard deviation (mm)

(a) Use the information in the table to calculate the process capability index when using each of the plastics **A** and **B**.

(b) Which material should the company choose to make the part? Justify your answer.

OR

4(d) (i) Explain what is meant by a *Break Even Quantity* (BEQ) when choosing between two manufacturing processes for a product.

(ii) A limited edition of 500 pens is to be packaged in presentation boxes.

A decision is to be made whether to package them manually using a skilled operator or to automate the packaging using an automated process.

Skilled labour costs €2.50 per unit to package the pens on a one-off basis.

The automated process costs €0.10 per unit to package the pens.

The setup cost of an automated packaging machine is €1000.

(a) Draw a graph to show the cost of each method of packaging.

(b) Use the graph *or other means* to determine which method is more economical for packaging a batch of 500 pens.

Option 5 - Materials Technology - *Answer 5(a) and 5(b)*

5(a) (i) In the case of **any two** of the following pairs of material categories, outline the differences between the two types of materials listed in them.
Use examples to support your answer.

- Hardwoods *and* softwoods
- Ferrous *and* non-ferrous metals
- Thermoplastics *and* thermosetting plastics.

(ii) Describe *malleability*, *ductility* and *toughness* as properties of metals.

5(b) The use of implant and assistive technologies, such as the arm prosthesis shown, greatly improves the quality of life for many accident victims.

(i) Name **one** material commonly used in implant technology.

(ii) Select suitable materials for the following components used in an arm prosthesis and justify your selection in **each** case:

- Gripper
- Toothed pulley wheels
- Printed Circuit Board.
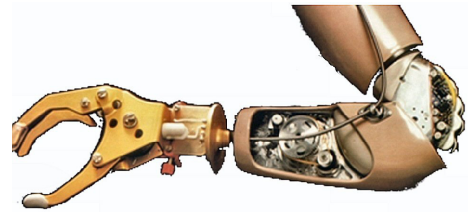
(iii) "Developments in *composite materials* have allowed better prosthetic limbs be designed and built."

(a) What is meant by a *composite material*?

(b) Name a composite material and give an example of a specific use which exploits its main properties.

Answer 5(c) or 5(d)

5(c) (i) Materials can be subjected to different types of stress. Outline what is meant by:
- Compressive stress
- Shear stress
- Torsional stress.

(ii) Describe, with labelled diagrams, **one** of the following material processing tools:
- Bandsaw
- Vacuum former.

Give **two** health and safety guidelines to be observed when using the tool you have described.

OR

5(d) (i) Describe a simple test to compare the hardness of the following materials:
- Oak
- Steel
- Acrylic.

What results would you expect from such a test?

(ii) Explain the advantages of using Computer Aided Manufacture (CAM) techniques in the production of high volume products.

Give an example of such a product and describe a CAM technique which could be used in its manufacture.

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