Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2023

Marking Scheme

Technology

Higher 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.

The table below contains information about annotations used for marking throughout the examination paper.

Annotation	Use	Marks (if applicable)
	Valid information	1
	Valid information	2
	Valid information	3
	Valid information	4
	Valid information	6
	Valid information	8
	Surplus information seen by examiner	N/A
	Incorrect answer	0
	Page seen by examiner/ information not valid	N/A

Section A - Core

72 marks

1. In 2021, five 'Robot City Trees' were installed in Cork city centre, the trees use *IoT* technology and natural moss to reduce air pollution in the surrounding areas.

(i) Explain the term IoT.

IoT - Internet of Things/devices that connect and exchange data over the internet.

(ii) Outline **one** other method of reducing air pollution in our cities.

Planting significant numbers of new trees, using electric vehicles, reducing, or eliminating sources of pollution e.g., diesel/petrol vehicles, use public transport etc.

(6 marks, 3 + 3)

2. Copperfish is an award-winning business, based in Co. Wicklow, creating lighting products from salvaged and storm-fallen timber.

(i) Outline **two** benefits of using copper piping as a material when manufacturing the table lamp shown.

Copper has an attractive colour, is ductile and easily shaped, it can polish to a shiny metallic finish, the metal will not degrade, fittings are readily available to create bends, etc.

(ii) Describe **one** advantage of using salvaged timber for this table lamp.

Salvaged timber is often sourced from old buildings, bridges, or other structures that have been demolished or dismantled, by using this material, it reduces wastage of natural resources, cheaper, better for environment etc.

(6 marks, 4 + 2)

3. The operating voltage of a shower pump motor is 240 V and the current it draws is 11 amps. The power output of the motor is 2400 watts. Calculate the efficiency of the motor (expressed as a %).

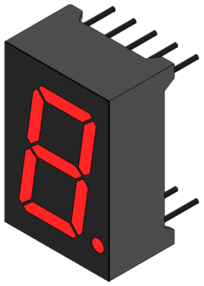
Calculation:
Efficiency = (Output power / Input power) x 100%
where Output power = 2400 watts, Input power = Voltage x Current

Input power = 240 V x 11 A = 2640 watts

Efficiency = (2400 / 2640) x 100%
Efficiency = 0.909 x 100%
Efficiency = 90.9%

(6 marks)

4. An electronic output component is shown.



(i) Name the component shown.

7 segment led display.

(ii) Suggest **two** applications for this component.

digital calculators, electronic meters, digital clocks, odometers, lifts, clock radios, etc

(6 marks, 2 + 4)

5. An elevator with mass of 2000 kg is raised 15 meters in 20 seconds.
The elevator has a *factor of safety of 5* in its design specification.

(i) Calculate the work done and the power required to raise the elevator.
(Assume g = 9.81 m/s^2)

Calculation:
work = force x distance where force = 2000 kg x 9.81 m/s² = 19620 N
work = force x distance = 19620 N x 15 m = 294300 J

power required = work / time = 294300 J / 20 s = 14715 W = 14.7 kW.

(ii) Explain what is meant by the term factor of safety of 5.

A factor of safety of 5 means that the system is designed to withstand loads or stresses that are five times greater than the maximum expected load or stress.

(6 marks, 4 + 2)

6. The image shows a drill with its chuck mounted at 90° to the motor in the body.

(i) Name **one** type of gear system which could be used in the drill to transmit motion through 90°.

Bevel gears, worm and wheel

(ii) Outline, with annotated sketches, a means of securing a gear to a cylindrical drive shaft to prevent slippage when the motor is in use.

Suggestion:
Gear is attached using a grub screw.

(6 marks, 2 + 4)

7. Ergonomic keyboards, similar to that shown, have become popular in recent times.

(i) Explain what is meant by the term *ergonomic*.

Ergonomics is the science of designing and arranging objects, equipment, and environments in a way that optimises human performance, safety, and well-being. Ergonomics takes into account factors such as body posture, movement and comfort, as well as the physical and mental demands of the task being performed.

(ii) Outline **two** reasons for the use of ergonomically designed office products.

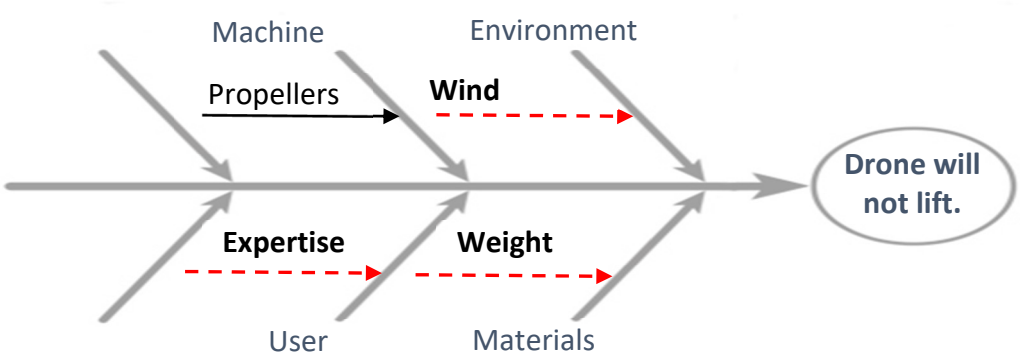
Improved Comfort and Health: Office workers often spend long hours seated in front of a computer, which can lead to various physical health problems.
Ergonomically designed office products can also help increase productivity. By reducing physical discomfort and stress, workers can focus more effectively on their work and are less likely to suffer from fatigue and burnout.
By reducing the risk of injury and improving employee health and well-being, ergonomically designed office products can help reduce costs associated with absenteeism.

(6 marks, 2 + 4)

8. Complete the cause and effect diagram below by suggesting **three** factors to analyse the performance of a drone that fails to lift off the ground. One has been completed for you.

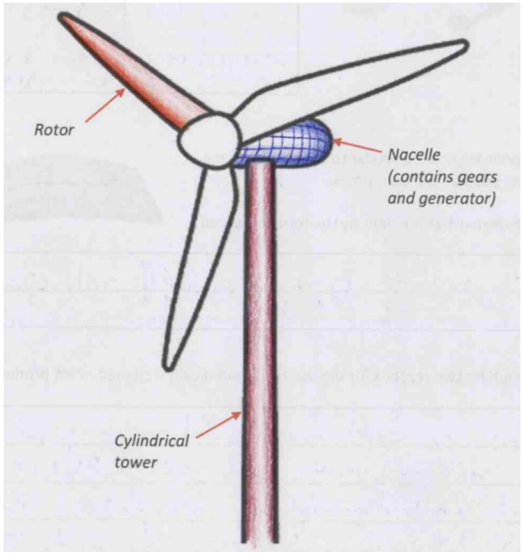
Three appropriate factors selected.

Suggested solution:



(6 marks, 2 + 2 + 2)

9. Use graphical techniques to enhance the profile shape of **each** wind turbine part labelled on the line drawing below.

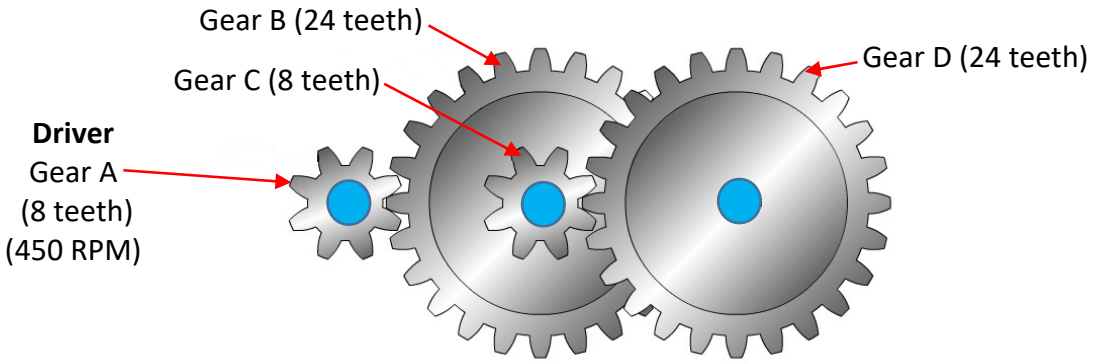


Enhancement techniques such as:

rendering, shading, blending, colouring etc.

(6 marks)

10. Calculate, using the given data, the output speed of the compound gear train shown.



Calculation:

		Driver/Driven x Driver/Driven				
Ratio	**=**	**A/B X C/D**	**= 8/24 X 8/24**	**=**	**1/9**	
Output speed	**=**	**450 RPM x 1/9**		**=**	**50 RPM**	

(6 marks)

11. A cycle helmet and attached camera with protective case, is shown in the image. The camera is powered by a rechargeable internal battery.

(i) State **two** design requirements for the cycle helmet.

The helmet should be comfortable to wear,
It should absorb and dissipate impact energy,
The helmet should be lightweight to prevent strain,
Aerodynamics to reduce wind resistance and drag, allowing for greater speed and efficiency.

(ii) Give **two** environmental benefits of using rechargeable batteries to power portable products.

Reduction in battery waste.
Lower consumption, the production of rechargeable batteries requires fewer resources compared to disposable batteries.
The use of rechargeable batteries reduces the need to produce and transport disposable batteries, which helps to lower carbon emissions.
Decreased toxic waste from batteries.

(6 marks, 4 + 2)

12. The gold and sterling silver used by award-winning Irish jewellers, Juvi, is recycled from jewellery, giftware, and electronics.

(i) State **two** material properties of gold that make it suitable for jewellery manufacture.

Gold does not tarnish or corrode, malleable metal, alloys with silver or copper to become more durable, has an attractive colour that reflects light, rare metal, etc.

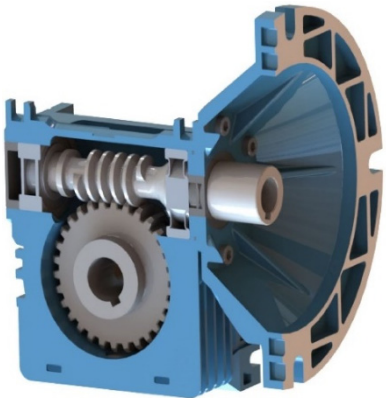
(ii) Distinguish, with an example in each case, between recycling and upcycling.

Recycling is the process of taking waste materials and turning them into new products eg recycling plastic bottles to create plastic bags.

Upcycling involves taking waste materials and transforming them into new products that are of higher value than the original eg turning old bicycle tires into stylish belts or wallets.

(6 marks, 2 + 4)

13. A cutaway model of a mechanism for a hoist is shown.



(i) Name and describe the operation of the mechanism.

Name: **Worm and gearwheel**

Operation: **One turn of worm moves wheel 1 tooth.**

(ii) Give **two** reasons for using this mechanism in the hoist.

Gives a very precise movement,
Can be used to prevent slippage,
Compact and strong, speed reduction etc.

(6 marks, 4 + 2)

14. Vacuum forming machines can be used to form intricate hollow thermoplastic objects.

(i) Outline **two** safety hazards to be aware of when using a vacuum forming machine.

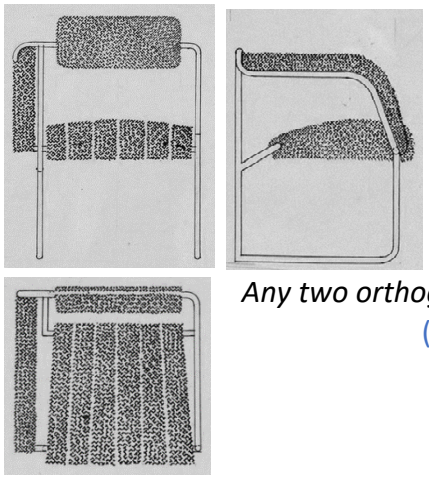
Risk of burns, the plastic sheet is heated to form the shape.
The sheets need to be locked into place as the vacuum pump could cause the sheets to collapse.
Fumes/smells from heated plastic, clamping of fingers etc.

(ii) Describe **one** safety feature integrated into a vacuum forming machine.

Heat is regulated by a thermostatic control which turn off the heater.
Timer/alarm to alert you when required heating time has elapsed.

(6 marks, 4 + 2)

15. Sketch **two** orthographic views of the 'non-conformist chair' designed by Irish innovator, Eileen Gray in 1926.



Any two orthographic views

(6 marks 3 + 3)

Section B - Core

48 marks

Question 2 - *Answer 2(a)* ***and*** *2(b)* *(a) - 8 marks, (b) - 10 marks, (c) OR (d) - 6 marks*

2(a) (i) Give **one** advantage and **one** disadvantage of using a personal drone.

Advantages: personal devices capture aerial photographs and videos, versatile use for a wide range of applications including search and rescue, surveillance, crop monitoring and mapping. Easy to use. Relatively inexpensive.

Disadvantage: There are strict regulations governing the use of personal drones, including restrictions on where and when they can be flown. Personal drones can be used for surveillance, which raises concerns about privacy and security. Most personal drones have limited battery life.

(ii) Explain what is meant by *pre-programmed* flight paths for a drone.

Pre-programmed flight paths for a drone refer to a set of instructions or commands that are programmed into the drone's software prior to take-off, which dictate its movement and behaviour during the flight. These pre-programmed flight paths can be customised and adjusted to suit specific tasks.

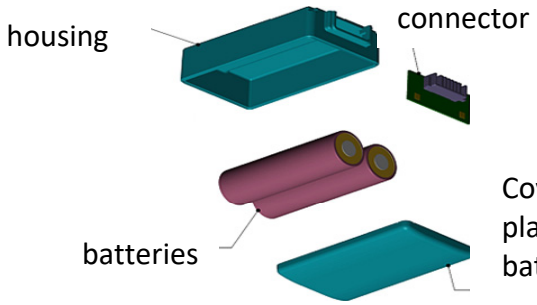
(8 marks, 4 + 4)

2(b) (i) Outline **two** design requirements of the 3D printed casing to ensure that the drone is fit for purpose.

Lightweight, toughness (impact resistance) of selected material, use of design features to stiffen the structure (ribbing of thin materials, etc.), propellers safely integrated into housing etc.

(ii) Outline, with annotated sketches, a means of allowing the battery pack to be changed easily.

Suggested solution:



(iii) Describe what is meant by Bluetooth and give **two** examples of its use

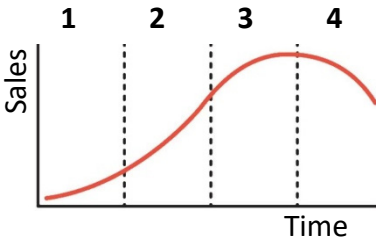
Bluetooth is a wireless communication Technology that allows devices to connect or exchange data over a short distance. PAN, personal area network.

Uses: Connect phone to car audio/Bluetooth speakers/ headphones etc

(10 marks, 2 + 4 + 4)

*Answer 2(c) **or** 2(d)*

2(c) (i) Describe the **four** stages of a typical product.
Lifecycle graph as shown.



1 - Introduction: After all research and development is complete, the product is launched. The product may have few competitors and sales may remain low and it may take time for the market to accept the new product.
2 - Growth: The market has accepted the product and sales begin to increase. The company may want to make improvements to the product to stay competitive.
3 - Maturity: Sales will reach their peak. Other competitors enter the market with alternative solutions and increasing competition.
4 - Decline: Sales begin to decline as the product reaches its saturation point. Most products are phased out of the market at this point due to the decrease in sales and because of competitive pressure. The market will see the product as old and no longer in demand.

(ii) Outline the possible impact of these concerns on the product lifecycle of the Pixy drone.

Product maturity is likely to be impacted due to the critical deficiencies of poor battery life and limited flying time. Decline will happen sharply with inadequate company support and reduced advertising drive by the company.

(6 marks, 4 + 2)

OR

2(d) Describe, with examples, **each** of the following smart materials:

Shape memory materials:
Are a class of materials that have the ability to "remember" their original shape and return to it when subjected to certain stimuli, such as changes in temperature, light or stress**.**

Examples: Nitinol is used for medical devices, shape memory plastics are used in textiles, surgical tools, prosthetics, aerospace etc.

Piezoelectric materials:
These materials have the ability to generate an electric charge in response to mechanical stress or deformation.

Examples: Quartz is the most common example, pressure sensors, or miniature actuators etc

(6 marks, 3 + 3)

Question 3 - *Answer 3(a) **and** 3(b)* *(a) - 8 marks, (b) - 10 marks, (c) OR (d) - 6 marks*

3(a) (i) Explain what is meant by the term autonomously.

A vehicle capable of sensing its environment and operating without human involvement. A human passenger is not required to take control of the vehicle at any time, nor is a human passenger required to be present in the vehicle at all.

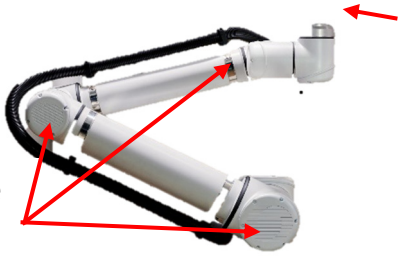
(ii) Outline **two** factors which limit the use of electric vehicles in Ireland.

Availability of charging infrastructure, battery life limitations on driving range, cost price and availability of electric vehicles, etc.

(8 marks, 4 + 4)

3(b) (i) Describe, using annotated sketches, a mechanism that could raise the robot arm to the charging point on the car.

Suggested solution:



Alternative solutions acceptable: Servo motors, gearbox system etc.

(ii) Suggest suitable materials for the robot casing **and** the robot arm. Justify your selections.

Robot casing: **Polypropylene, ABS: easy to mould into shape, thermoplastic (can recycle), good impact resistance, etc.**
Robot arm: **aluminium tubing: light, strengthened with tube profile, machines quickly, etc.**

(iii) Distinguish between the use of cameras and laser sensors to position robots.

Cameras are beneficial for capturing visual information, object recognition, and tracking.
Laser sensors excel in accurate distance measurement, mapping, and obstacle detection.

(10 marks, 4 + 4 + 2)

*Answer 3(c) **or** 3(d)*

3(c) **(i)** LED technology has a wide range of uses such as the cluster on the robot display. If an LED has a forward voltage of 2 V and draws a current of 25 mA, calculate the value of a protective resistor required when powered by a 12 V supply.

R = Vs – Vf / I LED
R = V / I = 12-2 / 0.025 = 400 Ω

(ii) A common semiconductor material for light emitting diodes (LEDs) is gallium arsenide. Describe, with another example and application, the term *semiconductive* material.

A semiconductive material, also known as a semiconductor, is a type of material that exhibits electrical conductivity between that of a conductor and an insulator.

Semiconductors have properties that make them essential in various electronic devices, including transistors, diodes, integrated circuits, and solar cells.

Examples of common semiconductor materials include silicon (Si) and germanium (Ge).

(6 marks, 3 + 3)

OR

3(d) Describe **each** of the following steps in carrying out a risk assessment for the manufacture of circuits.

Identify the hazards. Potential hazards that may pose risks to the assembly process of circuits are examined; an example of risk is the generation of potentially harmful fumes while soldering.

Assess the risks. An evaluate the level of risk associated with each hazard. Risk assessment involves determining the likelihood of an incident occurring and the potential severity of its consequences. The example of dealing with fumes would assess the danger to health of fumes generated, volume of fumes generated and if such can be mitigated.

Put control measures in place. These measures aim to reduce the likelihood of incidents occurring or minimize their potential consequences. For example, fumes may be ventilated, a limit to soldering irons can be put in place to reduce the volume of fumes, etc.

(6 marks 2 + 2 + 2)

Section C - Options *Answer **any one** of the five optional questions.* **40 marks**

Option 1 - Applied Control Systems

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

*Answer 1(a) **and** 1(b)*

1(a) (i) Distinguish between Virtual Reality (VR) and Augmented Reality (AR).

Virtual Reality provides a fully immersive experience by creating a virtual environment that replaces the real world.

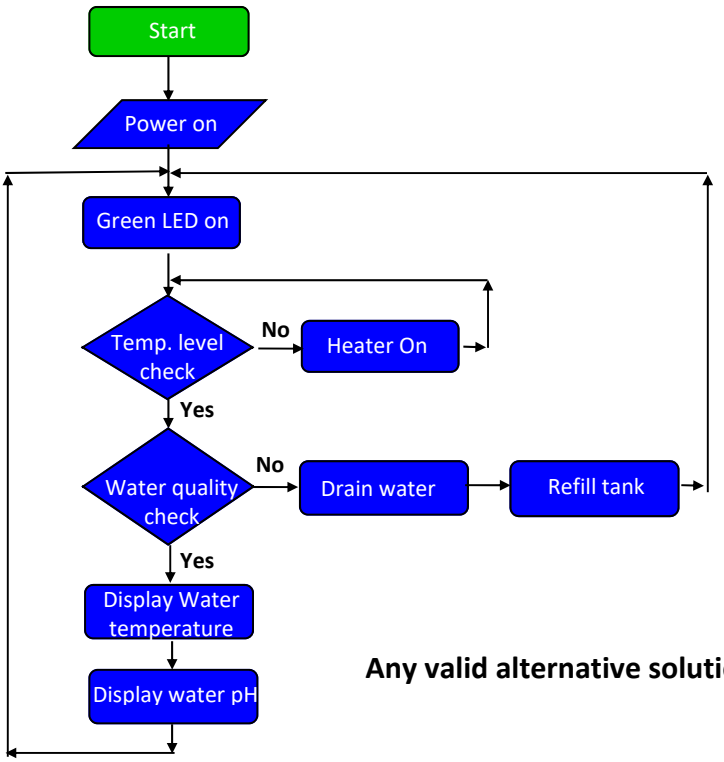
Augmented Reality enhances the real world by overlaying virtual elements onto it. AR integrates virtual content into the user's physical environment, allowing for interaction with both real and virtual elements.

(ii) Suggest **two** applications for immersive technology.

Simulation training for medical applications, remote collaboration for teams, virtual theme parks and gaming, industrial skills development, interior design visualisation, virtual tourism, etc.

(10 marks, 6 +4)

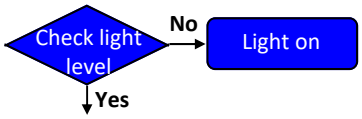
1(b) (i) Draw a flowchart for the operating sequence of the iBowl.



Any valid alternative solution accepted.

(ii) Suggest a modification to the flowchart to support automated lighting and darkness.

Add light sensor check with light switching option.



(iii) Outline **two** benefits of having an option to enable Wifi control for the iBowl.

Operations can be remotely monitored, necessary modifications can be implemented quickly, systems can update quickly with new upgrades to software, etc.

(16 marks, 8 + 4 + 4)

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

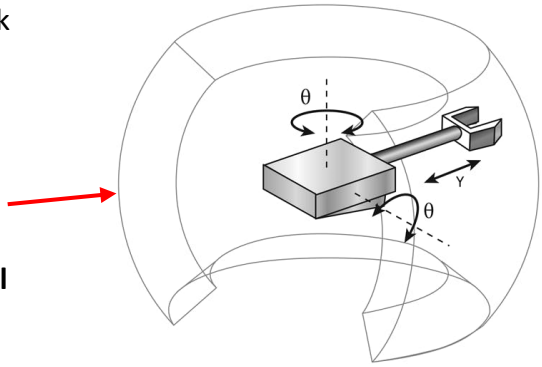
1(c) **(i)** Describe a typical configuration, with an application, for a polar robot.

A typical configuration for a polar robot involves a robotic arm mounted on a polar coordinate system. The polar coordinate system consists of a rotating base and a radial arm, allowing the robot to move in a circular motion and extend radially. This configuration provides flexibility in reaching various positions within a defined workspace. Pick and place robot operations in compiling electronic circuits is an example.

(ii) Describe, with annotated sketches, a work envelope for a polar robot.

The work envelope is the space around the robot, that it can reach.

The work envelope is a partial sphere with an inner limit for a polar robot.



(14 marks, 8 + 6)

OR

1(d) **(i)** Outline **two** advantages of using pneumatic control rather than electronic control for industrial robots in automobile assembly.

Can be used in hazardous and explosive environments, pneumatic control is usually more powerful, pneumatic sequential control is very effective, pneumatic systems are usually more robust and reliable, etc.

(ii) Describe **two** air treatment processes for pneumatic air leaving a compressor.

Filtration: Involves removing contaminants such as water vapor, oil, and solid particles from the compressed air stream.
Drying: Removes moisture from the compressed air.
Lubrication: Oil is often added to the air to lubricate moving parts, the oil is released as a fine mist into well dried air.

(14 marks, 8 + 6)

Option 2 - Electronics and Control

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

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

2(a) (i) Suggest **two** advantages and **two** disadvantages of using photovoltaic systems in Ireland.

Advantages:

Renewable source of clean energy, reduces dependency on fossil fuels, excess energy generated can be fed back into grid to generate extra income, energy can be stored for later use, cost saving over time, etc.

Disadvantages:
Reduced generation at night and during the winter, significant set-up costs, not as convenient as having full access to power, etc.

(ii) Outline the operation of a photovoltaic system making reference to components, sensors, and energy conversions.

A solar photovoltaic (PV) system converts sunlight directly into electricity using solar panels made of photovoltaic cells.

- **Solar panels** consist of multiple photovoltaic cells made of semiconductor materials, such as silicon. When sunlight hits the solar panels, photons from the sunlight excite electrons in the semiconductor material, creating a flow of electricity.
- **An inverter** converts the DC electricity into alternating current (AC) electricity.

- Sensors:
  Solar irradiance sensors measure the intensity of sunlight to determine the energy available for conversion.
  Temperature sensors monitor the temperature of the solar panels to prevent overheating and optimize performance.
  Energy meters track the amount of electricity generated by the system and provide data for monitoring and billing purposes.

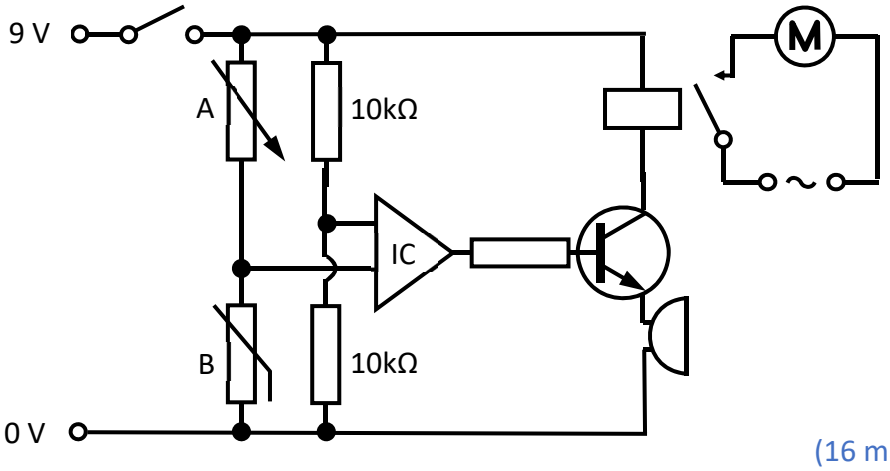
- **Energy Conversion:** Solar power/light is converted to electrical power.

(10 marks, 4 + 6)

2(b) (i) Name the components labelled **A** and **B** in the 9 V circuit shown.
A = Variable Resistor **B** = Thermistor

(ii) Describe the operation of the circuit making reference to the IC and switching components.
The basic principle of this circuit is to compare the voltages at the Op-Amp IC. The potential divider at R1(10kΩ) and R2(10kΩ) provides a reference voltage of4.5V at the IC input. The thermistor and variable resistor provide a potential divider circuit with the voltage from junction AB feeding into the Op-Amp. As heat level changes, the resistance of the thermistor changes. When the voltage from junction AB into the Op-Amp rises above the reference voltage of 4.5V, the output of the IC turned on.

(iii) Show how the given circuit could be modified to provide an output for a 220 V fan.



(16 marks, 6 + 6 + 4)

Answer 2(c) ***or*** *2(d)*

2(c) **(i)** Distinguish between a ceramic capacitor and an electrolytic capacitor making reference to capacitance value, polarisation, and applications.

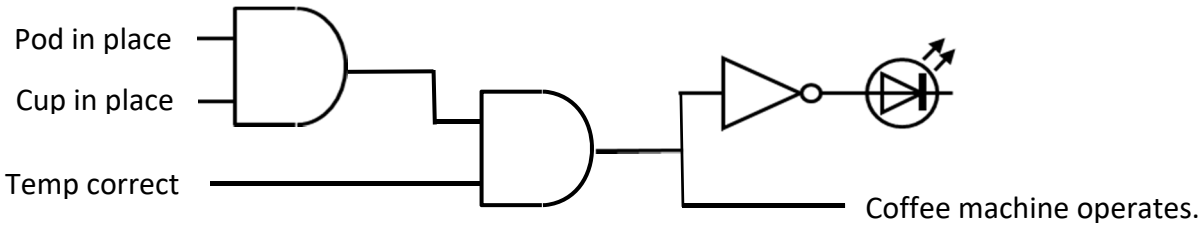
Ceramic capacitors have a range of values from picofarads (pF) to microfarads (µF), they are non-polarised and are used for timing circuits, radio frequency filtering and are suitable for AC and DC circuits.
Electrolytic capacitors typically exhibit larger capacitance values ranging from microfarads (µF) to farads (F), they are polarised and are commonly used where higher capacitance values are used such as power supply filtering, audio amplify, etc.

(ii) Outline the role of induction in the operation of a wireless charging device.
When an electric current flows through a wire, it creates a magnetic field around it. Induction enables wireless charging by using magnetic fields to transfer power from a transmitter coil in the charging pad to a receiver coil in the device being charged. This allows for convenient and cordless charging of devices by utilizing the principles of electromagnetic induction.

(14 marks, 8 + 6)

OR

2(d) **(i)** Draw a logic gate circuit to represent the operation of the coffee machine.



(ii) Suggest sensor components to detect the coffee cup is in place and the water temperature is correct.

Detect the cup: **motion sensor, push to make switch, LDR, Optical sensor, weight sensor, QTC etc.**
Water temperature: **thermistor, thermostat etc.** (14 marks, 8 + 6)

Option 3 - Information and Communications Technology

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

Answer 3(a) and 3(b)

3(a) (i) Describe the function of web servers and data centres.

Web servers: the main function is to deliver content to internet users, web servers host websites, enable communication with clients, manage content, security and access control, etc.

Data centres: provide a secure and controlled environment for data storage, processing, networking, and related operations.

(ii) State **two** challenges of recycling obsolete computer parts.

A wide range of materials is used making them difficult to separate, small quantities of valuable metals are used, technology develops quickly making parts obsolete and circuits less reusable, etc.

(10 marks, 6 + 4)

3(b) (i) Outline the importance of **each** of the following specification elements for a laptop to run CAD programmes, giving appropriate units and indicative sizes:

Processor, brain of the computer. carries out all calculations etc **64-bit**
Installed memory (RAM), memory that is used to temporarily store data that the computer needs to access quickly. **16GB**
Graphics: important for delivering smooth and high-quality graphics performance. Nvidia RTX or AMD Radeon are recommended certified graphics cards.

(ii) Explain the use of *voice over internet protocol (VoIP), screen sharing and breakout rooms* as a design team works remotely to develop a product.

Voice over internet protocol (VoIP) enables team members to communicate with each other in real-time using internet-connected devices. It allows for voice and video calls, as well as instant messaging, fostering seamless and efficient communication among team members**.** VoIP platforms, include Skype, Zoom, Microsoft Teams etc.
Screen sharing allows team members to present design concepts, edit ideas and share feedback.
Breakout rooms allows collaboration among smaller groups with the opportunity to return with deliberations to the full team.

(iii) Describe the importance of a *heat sink* in the operation of a laptop computer.

A heat sink will dissipate heat away from components or systems that generate a high processing temperature. This ensures that devices or systems do not overheat, laptops are susceptible to overheating due to limited air circulation space, blocking of vents and prolonged use.

(16 marks, 6 + 6 + 4)

Answer 3(c) ***or*** *3(d)*

3(c) **(i)** Outline the meaning of the following terms: *spear phishing*, and *whaling*, used to describe cyberattacks.

Spear phishing: targets specific individuals with personalised attacks, it attempts to trick recipients into disclosing confidential information or performing actions that compromise security.

Whaling focuses on high-ranking executives to exploit their authority and gain access to sensitive information or commit financial fraud.

(ii) Explain how simulated phishing attacks might be helpful in improving user awareness of cyber security.

Realistic scenarios can be created where participants can experience phishing attempts in a controlled environment.
Behaviours can be changed through the recognition of suspicious activities and increased awareness of appropriate actions.
Simulations can be tailored to the work of the company.

(14 marks, 8 + 6)

OR

3(d) **(i)** Distinguish between *address bus*, *data bus* and *control bus* in the transfer of data.

Address bus is responsible for transmitting the memory address or device address from the processor to other components, such as memory modules or input/output devices. The address bus is unidirectional, meaning data flows only in one direction from the processor to the other components.

Data bus used to send or receive data (bidirectional) during read or write operations. It carries instructions, operands, or any other information being processed.

Control bus transmits various signals, including read/write signals, interrupt signals, clock signals, and synchronization signals. It controls the timing and sequencing of operations, enabling components to coordinate their activities.

(ii) Outline **two** methods of increasing security during file transfer.

Encrypting the data being transferred ensures that even if intercepted, it remains unreadable to unauthorised individuals.
Use of secure usernames and passwords, two-factor authentication, or digital certificates to verify the identity of the parties involved in the file transfer.
Keep the file transfer software and associated systems up to date with the latest security patches and updates.
Use secure file transfer practices, including the importance of using strong passwords, recognising phishing attempts and following security protocols.

(14 marks, 8 + 6)

Option 4 - Manufacturing Systems

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

Answer 4(a) ***and*** *4(b)*

4(a) (i) Outline the principle of a Just-in-Time inventory system.

Suppliers are coordinated with the manufacturing company; products are delivered in line with market demand. This reduces the amount of stock stored with less materials, parts, tools, and space used. Advantages include quick response to demand, less investment in storage, quick turnaround of products, increased workforce flexibility, reduces waste, etc.

(ii) Explain the impact of JIT on **each** of the following types of waste:

Waste from overproduction occurs when more products are produced than demanded leading to storage costs, obsolescence of products, etc, JIT demands that planning minimises production wastes.

Inventory waste can reduce cash flow due to excess inventory; it has storage implications.

Transportation waste impacts with cost of fuel, vehicles, damage in transit, environmental impact, delays in delivery which puts extra pressure on tight JIT schedules.

(10 marks, 4 + 6)

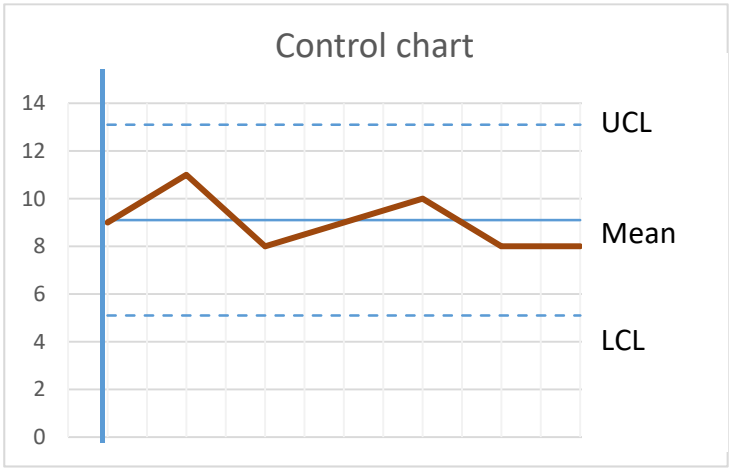
4(b) (i) Using the data above and assuming σ = 1.34, calculate the following:

Mean = $\frac{9 + 11 + 8 + 9 + 10 + 8 + 8}{7} = \frac{63}{7}$ **= 9**

UCL = 9 + 3 σ = 9 + (3 × 1.34) **= 13.02**

LCL. = 9 - 3 σ = 9 - (3 × 1.34**)** **= 4.98**

(ii) Draw a suitable control chart for the above data.



(iii) Determine the control state of this process based on the control chart.

The process is in control with defects appearing either side of the mean line and no obvious trend evident of creep towards the UCL or LCL.

(16 marks, 6 + 8 + 2)

*Answer 4(c) **or** 4(d)*

4(c) **(i)** Explain, with examples, any **two** of the following dimensions of quality:

Performance dimension describes a product's essential function. For the headset, the quality of sound and microphone are essential aspects of performance. **Serviceability** is the ease at which a user can repair a faulty product or get it fixed. **Features** are a secondary aspect of performance. They add extra functionality to the essential operations of a product. Features for the headset might include, Bluetooth connectivity, touch controls etc

(ii) Describe the Pareto principle.
The Pareto principle, also known as the 80/20 rule or the law of the vital few, is a principle named after the Italian economist Vilfredo Pareto. It states that for many events or phenomena, roughly 80% of the effects come from 20% of the causes. For example, around 80% of a company's profits may come from 20% of its customers, or 80% of the company's problems may stem from 20% of its products or processes.

(14 marks, 8 + 6)

OR

4(d) **(i)** Compare *product layout* and *process layout* as appropriate facility layout types for the assembly of the flat screen television shown.

Product Layout
Activities arranged in sequence of operation, assembly line for each product, specialised machines, efficient, effective for mass production, flexibility not required.

Process Layout
Similar activities grouped together in the work area, flexible, suitable for low volume or batch production.

(ii) Outline **two** ways in which Design for the Environment (DfE) can be integrated into the process of selecting components and the assembly of such televisions.

Recyclable materials can be selected, assembly routines can allow similar materials to be segregated easily, component parts may be designed for repair and easy replacement, the use of easily available standard parts reduces obsolescence, etc.

(14 marks, 8 + 6)

Option 5 – Materials Technology

Answer 5(a) ***and*** *5(b)* *(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks*

5(a) (i) Describe 3D printing as an *additive manufacturing* process.

3D printing is a process that allows for the creation of three-dimensional objects layer by layer. It involves the transformation of a digital design or model into a physical object by adding material layer upon layer, rather than subtracting or moulding it.

(ii) Discuss the environmental impact of 3D printing making reference to energy consumption, materials used, and product design.

Energy consumption: The printer is electrically operated. It does take a long time to run through a printed object as objects are created layer by layer, each layer must be cured enough to accept the next layer.
Materials used: A range of metals, ceramics and composite materials can be 3D printed. A common material is polylactic acid (PLA) which is a biodegradable material.
Product design: A significant advantage of 3D printing is that complex models can be printed, these might otherwise take significant time to fabricate. Material use can be minimised.

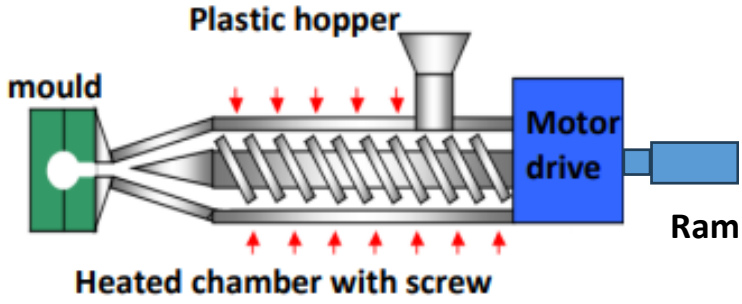
(10 marks, 4 + 6)

5(b) (i) Outline **one** positive and **one** negative aspect of the honeycomb vents in the outer casing of the mouse.

Positive aspects: it allows any heat generated to dissipate, it creates an interesting visual design feature, etc.
Negative aspects: it is likely to collect dirt, hygienically it is difficult to clean, etc.

(ii) Describe, using annotated sketches, a process suitable for the mass production of the outer casing of the mouse.

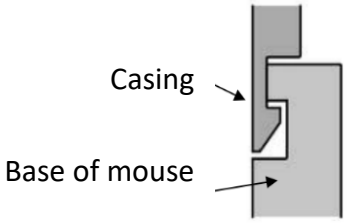
Injection Moulding:



- **Granulated thermoplastic polymer is fed into the heated chamber/barrel from the hopper.**
- **The screw moves the polymer forward.**
- **Heaters melt the polymer to liquid.**
- **When there is enough liquid polymer, the ram will pull back the screw and force it forward again to inject the polymer into the mould and create the shape of the casing of the mouse.**

(iii) Outline, with annotated sketches, method of assembling the two parts of the mouse.

The casing and the mouse base could be assembled with a snap click system that uses the flexibility of plastic material.



(16 marks, 4 + 8 + 4)

Answer 5(c) ***or*** *5(d)*

5(c) **(i)** Describe, using annotated sketches, how accelerated testing may be carried out on the buttons of the gaming mouse.

Accelerated can be carried out on the buttons of a computer mouse by automatically simulating repetitive actions of pressing the buttons on a fatigue testing machine.
The testing machine can detect failure of the device.

(ii) Outline **two** advantages of material non-destructive testing (NDT) methods in product development.

Products are not damaged while testing which reduces costs.
Products can be tested while in use allowing preventative maintenance.
Internal faults can be detected by x-ray and other NDT methods, etc.

(14 marks, 8 + 6)

OR

5(d) **(i)** Explain the purpose of corrugation when producing cardboard.

Corrugation adds greatly to the stiffness of cardboard materials, it adds to the thickness of the material without using too much solid cardboard, it adds strength to the packaging allowing it to absorb loads and shocks, etc.

(ii) Compare the environmental impact of using expanded polystyrene **or** corrugated cardboard as packaging materials.

Expanded polystyrene packaging is foamed and will not recycle, it is moulded to shape making it less suitable for reusing, it is a long-life plastic material, etc.
Corrugated cardboard as packaging material can be reused, it is usually produced from a sustainable source, it costs less to produce than expanded polystyrene, etc.

(14 marks, 8 + 6)

Coimisiún na Scrúduithe Stáit
State Examinations Commission

2023. M103P
2023. M104P

Leaving Certificate Examination, 2023

Technology

Coursework Briefs

Ordinary Level and Higher Level

200 marks

The Thematic Briefs for the Leaving Certificate Examination 2023 are given overleaf.

The Coursework must be available for assessment by Friday 31 March 2023.

Leaving Certificate Technology

Ordinary Level and Higher Level 2023

Instructions to candidates:

1. The coursework submitted for assessment must consist of two components:
   - a design folio *and*
   - an artefact.

2. If **either** assessment component (written examination or coursework) is submitted at Ordinary Level, the subject is graded at Ordinary Level.

3. All coursework submitted for assessment must be clearly identified with your examination number.

4. The coursework submitted for assessment must be **your own individual work** and must be completed in school under the supervision of the class teacher.

5. Your coursework must not be removed from the school setting under **any** circumstances as doing so may result in such coursework being considered invalid.

6. The design folio should record all stages of your work and should document how the artefact meets the stated thematic brief.

7. When using research sources, including the Internet, the sources **must be acknowledged**. Research material copied directly from the Internet or from other sources and presented as your own work will not receive any marks.

8. The coursework should display knowledge and skills developed through your study of the core and chosen options.

9. All important operating features of the artefact must be clearly visible and be easily accessible without dismantling.

10. Where an electrical supply is used to operate the artefact, it should be of low voltage output. Where specialised equipment is required, it must be set up by you, have clear operating instructions and be ready to use.

11. The coursework presented for assessment must be displayed in an attractive manner. Multimedia presentations, where submitted, must be of **maximum** 3 minutes duration, must be set up by the candidate and must be ready for viewing.

The coursework must be available for assessment by Friday 31 March 2023.

Leaving Certificate 2023 - Higher Level

Thematic Brief

Many countries, cities and localities hold celebrations or festivals to mark special events or aspects of history or culture. Some such festivals are known globally while others have a significance on a more local level. Vibrant in nature, such festivals and celebrations often nurture creativity and curiosity and appeal to many of our senses. They can typically include street theatre, parades, dance, light shows, contemporary circus, animated sculptures, and music. These events also provide an opportunity to celebrate cultural diversity in the range of spectacles on show.

In a context of your choice and with a focus on modern materials and processes, design and manufacture a working model of a device, system, artefact or animated diorama suitable for inclusion in a festival or parade celebrating aspects of culture or identity.

Your solution should include an electro-mechanical element and should also be well presented.

Note: The maximum dimension of the artefact you present for assessment should not exceed 500 mm.
If multimedia presentations are used to enhance your display, a hardcopy printout and a digital file (USB flash drive) must be included in your portfolio.

Coursework at Higher Level is weighted as follows:

- Design Folio - 50% of marks
- Artefact - 50% of marks

Total - 200 marks

Design Folio - Higher Level - 100 marks			
No.	***Heading***	***Description***	***Marks***
1	Analysis of thematic brief	Evidence of research of the broader context of the theme. Specification of chosen parameters.	10
2	Overall management of the project	Analysis of available resources, time and budget constraints; proposed timeframe/Gantt chart, etc.	5
3	Environmental impact of the project	Demonstration of environmental awareness during **design and realisation**. Analysis of materials chosen for manufacture. Consideration of energy requirements, reuse/recycling etc.	10
4	Research, investigation and specifications of brief	Further research into chosen area. Analysis of existing solutions including sub-systems. A statement outlining the candidate's final brief and related specifications.	10
5	Design ideas and selection of optimum solution	Annotated **freehand** sketches **related to your design specification**, outlining three possible solutions. Optimum solution identified and justified.	15
6	Sketches and drawings for manufacture	Detailed annotated sketches and drawings including all elements/aspects of solution; circuit diagrams/flowcharts/models/prototypes/dimensions/ scale/assembly details.	15
7	Production planning	Materials and component list **and** costings; scheduling, work breakdown structure; Gantt charts, critical path diagrams.	10
8	Product realisation	Sequence of manufacture including photographic record.	10
9	Testing, evaluation and critical reflection	Testing against chosen brief. Evaluation of final artefact. Comparison of planned schedules and actual schedules. Suggested modifications with justification. Critical reflection on the entire process	10
10	Presentation and ICT	Correct sequence of presentation. Quality of material presented. ICT skills in production and presentation of folio.	5

Artefact - Higher Level - 100 marks			
No.	***Heading***	***Description***	***Marks***
1	Artefact meets theme and specifications	Solution presented fulfils the thematic brief and the specifications as identified by the candidate.	10
2	Originality and creativity	Originality and creativity in design, aesthetics and ergonomics. Creative and appropriate use of materials.	15
3	Production skills	Processing of materials. Assembly of materials. Range and depth of skills.	30
4	Functionality	Artefact works well. Appropriate/limited use of commercial components/solutions.	20
5	Quality and finish	High quality manufacture. Artefact well finished. Due regard for health and safety.	15
6	Presentation	Coursework well presented. Parts well integrated and labelled where appropriate.	10

Note: ***While the general headings and marks above will largely remain the same, breakdowns may vary depending on the actual brief for any given year.***