Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2024

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. Apple Vision Pro is an augmented reality and virtual reality headset which has recently been launched.
Distinguish between augmented reality (AR) and virtual reality (VR).

Augmented Reality (AR):
AR enhances the real-world environment by overlaying digital information, such as images, text or 3D models onto it. Users can still see and interact with the physical world while digital content is integrated into their view.

Virtual Reality (VR):
VR creates a completely immersive, computer-generated environment that isolates users from the physical world. Users are fully immersed in a simulated reality through a headset or other VR devices.

(6 marks, 3 + 3)

2. Garden decking panels are increasingly being manufactured from composite materials.

Outline **two** advantages of using composite materials when manufacturing garden decking.

Composite materials can last longer, stronger, are less prone to degradation, will not need surface finishing, can be more impact resistant, various finishes can be got, non-slip etc.

(6 marks, 3 + 3)

3. A 4K UHD interactive touch screen with integrated proximity sensor is shown.

(i) Explain the term **UHD**.

UHD: Ultra High Definition.

(ii) State the function of the proximity sensor integrated into this screen.

The integration of proximity sensors into UHD screens enhances user experience, convenience, and energy efficiency by allowing the display to respond intelligently to the presence or absence of users in its vicinity.

(6 marks, 3 + 3)

4. The guitar amplifier shown may typically contain a Darlington pair.

(i) Name the main electronic component used in a Darlington pair.

Transistor.

(ii) Outline how a Darlington pair works.

A Darlington pair is a configuration of two bipolar transistors (typically NPN type) connected in a way that amplifies the overall current gain of the pair. The Darlington pair is commonly used in electronic circuits where high current gain is achieved by combining the current gain of both transistors.

(6 marks, 2 + 4)

5. **(i)** Use the resistor colour-code table to calculate the value of the resistor shown.

Resistor bands:
Brown
Black
Red
Gold

Value: **1000 Ω**

Tolerance code		
	Brown	1%
	Red	2%
	Gold	5%
	Silver	10%

Colour code		
	Black	0
	Brown	1
	Red	2
	Orange	3
	Yellow	4
	Green	5
	Blue	6
	Violet	7
	Grey	8
	White	9

(ii) Accounting for tolerance, state the maximum and minimum possible values for this resistor.

Maximum value: **1050 Ω**
Minimum value: **950 Ω**

(6 marks, 4 + 2)

6. Network diagrams use nodes similar to that shown.

EST	EFT
Task:	
LST	LFT

(i) Explain the abbreviations.

EST: Earliest Start Time

LFT: Latest Finish Time

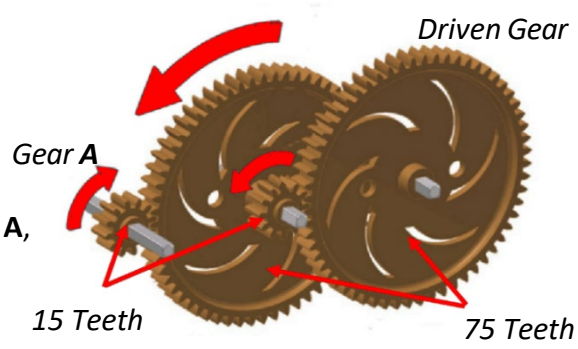
(ii) Explain how the critical path of a network diagram is established.

The critical path in a network diagram is the sequence of tasks or activities that determines the overall duration of a project.

(6 marks, 4 + 2)

7. **(i)** Name the type of gear train shown in the image.

Compound gear train.



(ii) Calculate the angular velocity of the driving gear **A**, if the output speed at the driven gear is 17 RPM.

Calculation:
Driven/Driver x Driven/Driver
75/15 x 75/15 = 5/1 x 5/1 = 25/1 = 25:1
Gear A rotates 25 times faster.
25 x 17 = 425 RPM.

Gear speed Gear A **= 425 RPM.**

(6 marks, 2 + 4)

8. An exploded view of a garden lantern is shown. Sketch a pictorial view of the assembled lantern.

(6 marks)

9. The voltage drop at 20 mA is a common specification for light emitting diodes (LEDs). The voltage drop for a batch of coloured LEDs is shown below.

Light emitting diode	Red LED	Orange LED	Yellow LED	Green LED
Voltage drop at 20 mA	1.8 V	2.0 V	2.3 V	3.0 V

(i) Using the given data, calculate the value of the protective resistor required for one green LED in a 12 V lighting project.

$R = (V_S - V_{LED})/I = (12-3) / 0.02 = 450\ \Omega$

(ii) Describe the effect of replacing the green LED with **two** red LEDs placed in series for the same lighting project.

Red LEDs have a lower forward voltage (1.8 V) which means that two red LEDs will have a forward voltage of 3.6 V. This compares to a 3.0 V for the single green LED. A smaller protective resistor (420 Ω) can be used for the two red LEDS in series.

(6 marks, 4 + 2)

10. The GPS luggage tag shown uses *satellite navigation systems* and *cellular data connectivity* to track luggage. The tag can also be scanned using a *QR code* on the back of the device.

Explain **each** of the terms.

Satellite Navigation Systems:
Satellite Navigation Systems, commonly known as satellite navigation or satnav, are systems that use signals from satellites to determine the position, velocity, and real time information of a receiver anywhere on Earth. GPS is the most common example.

Cellular data connectivity:
Cellular data connectivity refers to the ability of a mobile device to access the internet and other data services using cellular networks. It allows users to connect to the internet, browse websites, use online applications and transmit/receive data through mobile devices.

QR Code:
A QR code, or Quick Response code, is a two-dimensional barcode that consists of black squares arranged on a white square grid. QR codes are designed to store and quickly retrieve information, making them a versatile tool used in various applications.

(6 marks, 2 + 2 + 2)

11. **(i)** Calculate the mechanical advantage of a forklift if it lifts a weight of 1800 kg with an effort force of 200 N. Assume g = 9.81 m/s^2

Calculation:
Mechanical advantage = Load force / effort force
1800 x 9.81/200 =
17,658/200 = 88.29

(ii) Explain the advantage of a low *centre of gravity* on the operation of the forklift.

The center of gravity refers to the point where the entire weight of the forklift is considered to be concentrated. The low center of gravity increases stability, reduces the risk of tipping, improves handling, makes the forklift more maneuverable making the machine safer.

(6 marks, 4 + 2)

12. Using the headings in the table below, describe the carbon footprint associated with producing small batches of car parts, such as the bracket shown, using 3D printing rather than traditional manufacturing processes.

alternator bracket for a vintage car

Energy Consumption:
It can take a long time to print each product using electrical energy running for hours. Traditional metal cutting will shape the object quickly using high powered machines.

Waste generation:
3D printing generates minimal waste, subtractive manufacturing of drilling and cutting will generate waste materials. Other forms of traditional manufacturing such as injection moulding or casting will not create much waste.

Materials used:
3D printing is associated with plastic materials (e.g. PLA, ABS, etc.) but has now expanded to a wider range of plastics, composites and metals including aluminium and stainless steel. Traditional manufacturing can process the full range of materials.

(6 marks, 2 + 2 + 2)

13. eBörd is a smart table with wireless charging capabilities built into its glass surface. It generates energy through the capture of indoor and outdoor light.

(i) State **one** energy conversion that takes place in the eBörd table.

Solar/light to electrical energy.
Electrical to magnetic energy and magnetic to electrical/chemical energy

(ii) Outline **two** reasons for using tubular metals in the design of the table shown.

Makes the structure stiffer and less flexible, less metal used, hollow sections are used to house wiring and other components, increased strength, lightweight etc.

(6 marks, 2 + 4)

14. Epoxy adhesives and PVA glue are commonly used when assembling materials.

(i) Suggest an appropriate application for epoxy resin **and** for PVA glue

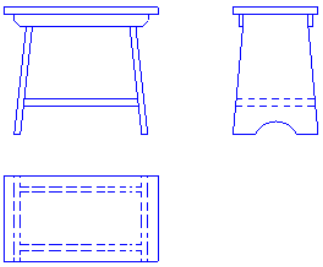
Epoxy resin:
can be used as a permanent finish or strong bonding applications such as construction, adhering metals and composites as well as plastic and woods, repair of a full range of items from jewellery to boats, etc.

PVA glue:
wood and paper adhesives, arts and craft use, bookbinding, etc.

(ii) State **two** safety hazards to be aware of when using adhesives
Use of solvents, generation of fumes, skin reaction to adhesives, danger of adhering the user to adhesive, etc.

(6 marks, 4 + 2)

15. Make well-proportioned freehand sketches of **two** principal orthographic views of the fireside stool designed by Irish furniture maker Tricia Harris.



Any **two** orthographic views

(6 marks 3 + 3)

Section B - Core *Answer Question 2 **AND** Question 3* **48 marks**

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

2(a) (i) Name **three** devices that may be controlled by a home automation system.

Smart thermostats for heating, lighting systems, locking systems, doorbells, camera systems, motion sensors units, blind and shade control, smoke and CO monitors, etc.

(ii) Explain how energy efficiency might be enhanced with the installation of a home automation system:

Settings may have automated switch off, voice control, systems can be integrated with temperature or lighting control, energy consumption and water heating can be monitored, power management, remote operation etc.

(8 marks, 4 + 4)

2(b) (i) Describe, with examples, **each** of the following parts of a home automation system:

Controller hub: **this device will manage and integrate home automation systems. It provides centralised control, supports device compatibility, ensure security and privacy, may have capability for remote access, etc.**

Smart lighting and thermostats: **heat and lighting systems can have remote or sensor control. Systems can create immersive experiences (mood or interactive lighting)**

Sensors and cameras: **can be used to record, monitor and control activity.**

(ii) User interface: **this is the point of interaction between a user and a computer system, it includes keyboards, touchscreens, voice recognition, etc.**

Bluetooth: **Bluetooth is a wireless communication standard that facilitates short-range data exchange between electronic devices.**

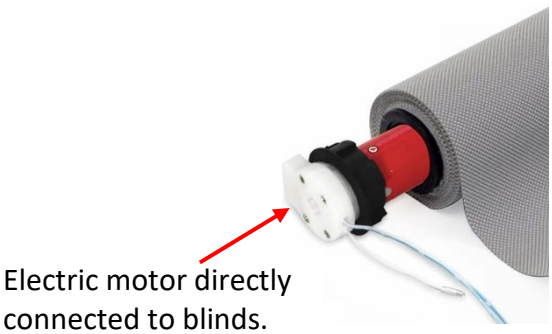
(iii) Outline **two** ways of protecting privacy and data security when using home automation systems.
Use of strong passwords, encryption, software updates, device authentication, review privacy settings, consider methods of storage of data, etc.

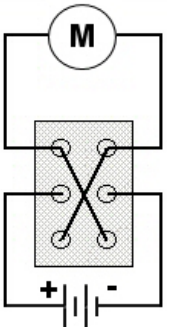
(10 marks, 4 + 4 + 2)

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

2(c) (i) Describe, with annotated sketches, a motorised system to open and close a roller blind.

Suggested solution:
Roller blind systems are generally driven directly by motor or gearbox motor to control speed. Manual systems are driven by toothed belt or plastic drive chain. All automated systems will need a motor to drive in both directions.





A relay can be used for higher voltages (including mains)

(ii) Outline **two** factors that affect the efficiency of a DC motor.
Environment/temperature, maintenance, age, magnetic losses etc.

(6 marks, 4 + 2)

OR

2(d) **(i)** Explain **any two** of the quality dimensions of performance, conformance, and reliability**.**

Performance:
The hub needs to perform its necessary functions every time in an efficient manner. Poor performance could result in poor perceived quality which will reduce its competitiveness in the market.

Conformance:
the degree to which a product's design and operating characteristics meet established standards.

Reliability:
This dimension reflects the probability of a product malfunctioning or failing within a specified time period.

(ii) Briefly describe **each** of the steps in the Deming Cycle.

Plan:	**Design or revise business process components to improve results**
Do:	**Implement the plan and measure its performance**
Check/Study:	**Assess the measurements and report the results to decision makers**
Act:	**Decide on changes needed to improve the process**

(6 marks, 2 + 4)

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

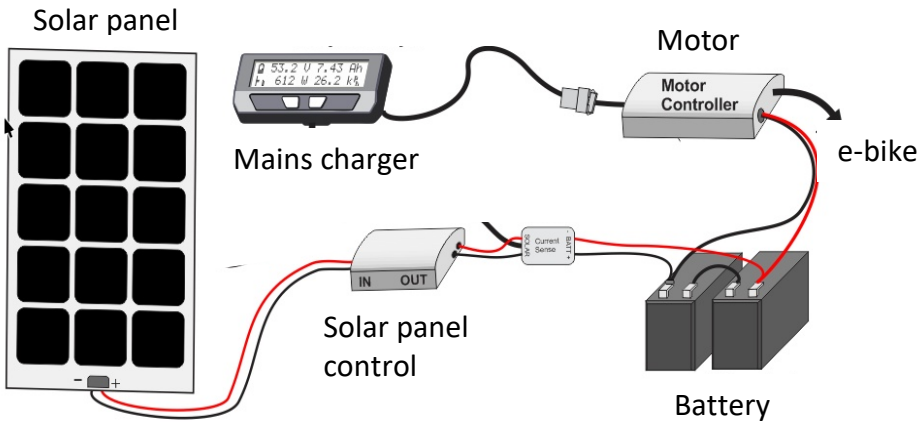
3(a) (i) Outline **two** safety benefits of using flexible bollards.

Are readily visible and reflective at night, will bend without breaking, minimal damage to vehicles that hit them, etc.

(ii) Suggest an appropriate plastic material used to produce these bollards.
Justify your selection.
Polypropylene/ABS/polycarbonate/polyurethane: impact resistant plastic material, can mould easily into shape, will recycle if they need to be replaced, uv resistance, etc.

(8 marks, 4 + 4)

3(b) (i) Describe the components and operation of a mains-powered charging system **and** of a solar charging system for the e-bike.

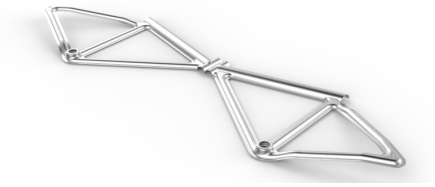


Solar charging will require solar panel to capture solar energy, controller and sensor systems to process the electrical charge. The battery will collect, store and distribute energy for the e-bike.

A mains charging system can be used to top-up or provide a full charge for the battery and e-bike.

(ii) Outline, using annotated sketches, **two** advantages of producing the bicycle frame by pressing it from sheet metal.

The folded frame does have fewer welded joints which can strengthen the structure.
The hollow frame can be used to house batteries and circuits.
Hollow structure is stiff yet lightweight, durable etc.



(iii) Calculate the total energy a solar panel generates in 4 hours with an output of 50 watts per hour and 15% efficiency.

15% efficiency = 0.15
Total energy = (50 watts/hour × 4 hours) × 0.15 = 30 watt/hour

(10 marks, 4 + 4 + 2)

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

3(c) **(i)** Outline **two** reasons for using carbon fibre for the handlebars.

Able to withstand impact – tough material, lightweight, can be coloured, complex shapes can be produced, strong, resistant to tear, aesthetic appeal, etc.

(ii) Compare the manufacture of tubular handlebars and carbon fibre handlebars making reference to fabrication, integration of features, and aesthetic appeal.

	Fabrication	**Integration of features**	**Aesthetic appeal**
Tubular metal	Cut and weld, time consuming for large production	Space for features can be added or cut out of tubes	Welding of tubes can be unsightly or a feature on some metals e.g. stainless steel
Carbon fibre	Can be shaped in a single piece.	Features can be integrated into design shape	Finish can be coloured, tactile material

(6 marks, 3 + 3)

OR

3(d) **(i)** Discuss the contribution to user safety of **any two** features of the prototype helmet.

LIDAR / communication system: **will alert of hazards.**
The Led lights: **give a strong illumination for the back of helmet.**
Face shield/Front visor **will protect eyes/face from dust/flies etc.**

(iii) Outline **two** advantages of 3D printing as a production method for the shock absorbing inner liner of the helmet.

Has the potential to customise for individual with 3D scanning, reduced waste with additive manufacturing, will dissipate heat with mesh design, lightweight, etc.

(6 marks, 4 + 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) What is a digital footprint?

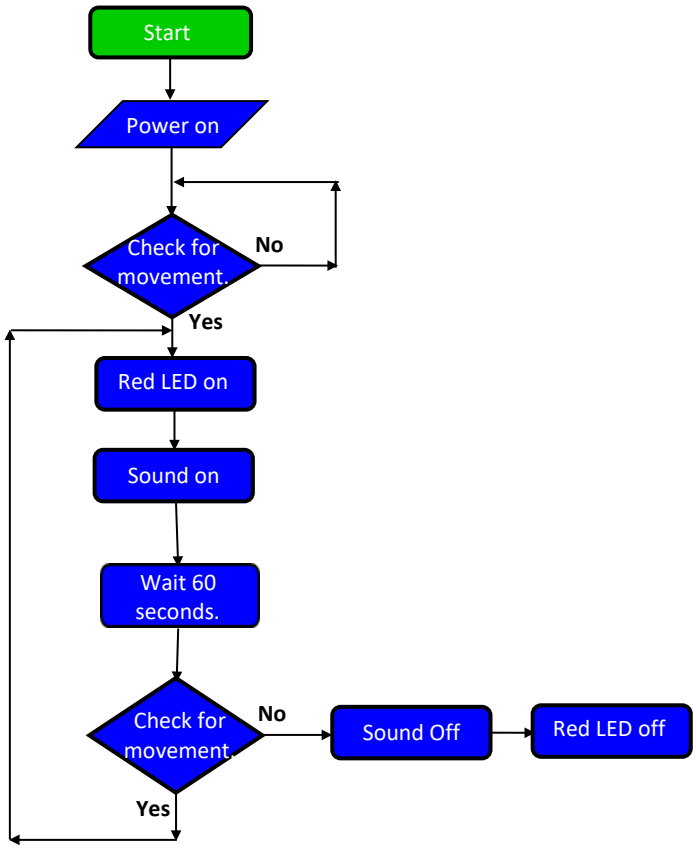
A digital footprint refers to the trail of data and information that individuals leave behind as they engage in online activities. Elements of a digital footprint can include personal details, preferences, online behaviours, and communication patterns.

(ii) Suggest **two** sources of data for the IoB.

Wearable devices (trackers, smartwatches, etc.), phone Apps, social media, biometric sensors, cameras and monitoring systems, etc.

(10 marks, 6 +4)

1(b) (i) Draw flowchart.



(ii) Modification:

Add a counter function, (inc/compare/expression) command or place output after second compare command, to activate the sprinkler.

(iii) Suggest an electronic means of producing the deterrent sound.

Piezoelectric speaker/buzzer connected to the motion sensor.

(16 marks, 10 + 4 + 2)

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

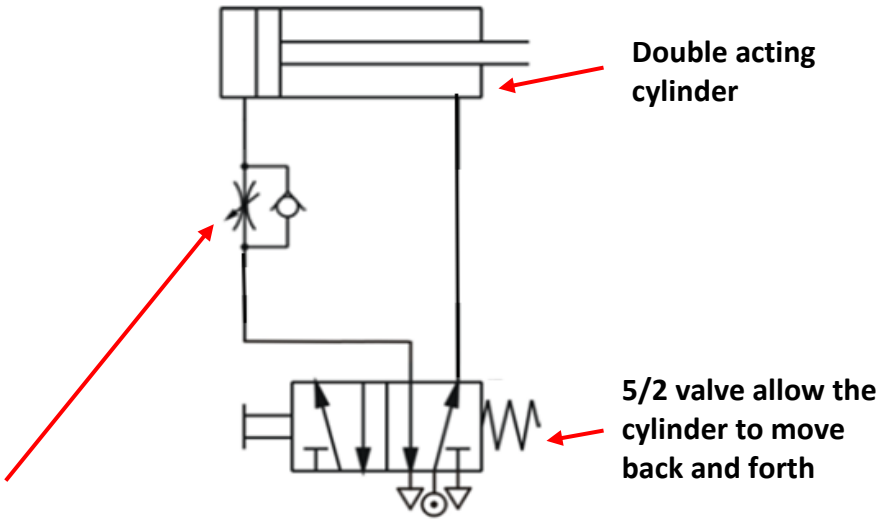
1(c) **(i)** CAD: **Computer aided drawing/drafting**
CAM: **Computer aided manufacture**
CNC: **Computer numerical control**

(ii) Outline the operation of a closed loop control system.
Closed loop control is also known as feedback control. The response or the actual result is continuously compared with the desired result. The control output is adjusted to reduce any deviation, this ensures the response will follow the desired outcome.

(14 marks, 6 + 8)

OR

1(d) **(i)** Draw a pneumatic circuit diagram to control the movement of the two-way cylinder.



(ii) **Flow control valve, slow speed of the ram moving forward, with unrestricted speed on return.**

(14 marks, 8 + 6)

Option 2 - Electronics and Control

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

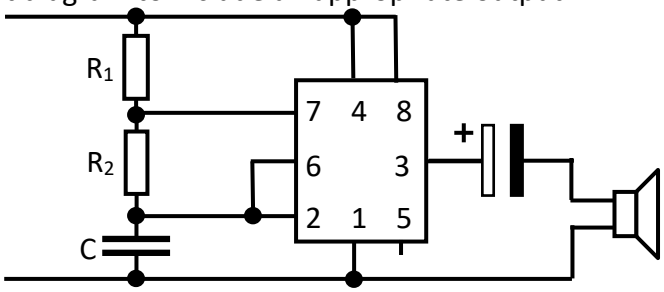
Answer 2(a) ***and*** *2(b)*

2(a) (i) Operation of wireless charger.
The charger is connected to a power supply, when turned on, it generates an alternating current (AC) in a coil within the charger which produces an electromagnetic field. When you place a device on the charger it receives the magnetic field from the charger and turns it into DC current to charge the battery.

(ii) Suggest **two** benefits of wireless charging of devices.
Convenient, safer and prevents tripping, charging of multiple devices together, chargers can be integrated into furniture/vehicles etc

(10 marks, 6 + 4)

2(b) (i) Redraw the circuit diagram to include an appropriate output.

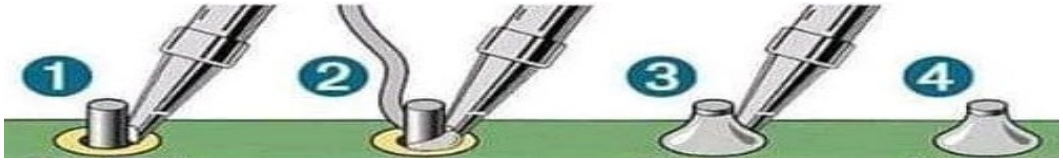


(ii) Calculate the frequency of the output if:
R1 = 10 kΩ, R2 = 60 kΩ and C = 10 µF.
Note: f = 1.44 / (R1 + 2R2) × C

f = 1.44 / (R1 + 2R2) × C = 1.44 / (10000 + (2 x 60000)) × 0.00001
1.44/(130,000 x .00001) = 1.44 / 1.3 f = 1.107 Hz

(iii) Describe, with annotated sketches, the process of soldering a printed circuit board (PCB) for the circuit shown. Make reference to a means of protecting the IC and best practice for safe soldering in a school workshop.

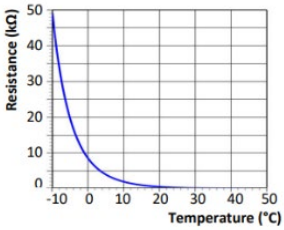
A soldering iron and flux-cored solder is used for soldering, soldering should take place in a well-ventilated area.
Heat sensitive components, such as transistors and ICs, can use sockets which will be soldered on to the PCB. This will absorb the heat of soldering and allow the IC to be inserted when cool – it also allows these components to be replaced easily.



Soldering iron heats the pad and component pin. | Solder is introduced. | Solder build-up. | Allow to cool.

(16 marks, 6 + 6 + 4)

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



2(c) (i) State the approximate resistance of this thermistor at 0°C

From the graph: **8 kΩ (+/-1)**

(ii) Explain why this thermistor has an effective range between -10°C and 20°C.

At -10°C, the graph rises steeply making accurate temperature differentiation a challenge. Above 20°C, the thermistor does not make a significant change in resistance.

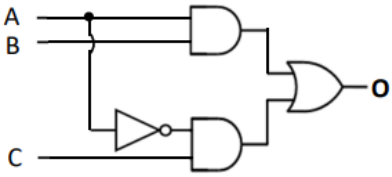
(14 marks, 6 + 8)

OR

2(d) (i) Draw a truth table to represent the operation of the logic gate system shown with **O** as the output.

Truth table:

A	B	C	O
0	0	0	**0**
0	0	1	**1**
0	1	0	**0**
0	1	1	**1**
1	0	0	**0**
1	0	1	**0**
1	1	0	**1**
1	1	1	**1**



(ii) Outline the function of transistors and relays when constructing logic circuits.

Transistor: **will create an electronic switching/current amplification for electronic circuits.**

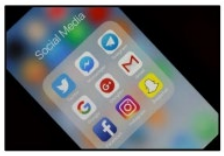
Relay: **provides a method of controlling higher voltage circuits (including mains supply) using a low voltage electronic circuit.**

(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) Outline **one** benefit and **one** drawback of social influencing.
Benefits of social influencing:
Product awareness, product discovery, discounts and offers, growth of brands.

Drawbacks of social influencing: **Inauthentic content, misleading content, can portray a certain way of life that young people can feel pressure to live up to etc.**

(ii) Explain the social media influencer terms; *reels, endorsements, and affiliate links.*

Reels:
allow influencers to create and share short videos. They are typically 15 to 60 seconds long and can include music, text, stickers, and special effects. Reels are popular for showcasing creative and engaging content, including tutorials, challenges, and behind-the-scenes glimpses etc.

Endorsements:
and collaborations occur when a social media influencer partners with a company to promote their services or products. The influencer uses their platform to create content that showcases or endorses the brand. This can be done through sponsored posts, videos, reels, stories etc.

Affiliate links:
are unique URL's provided to influencers by brands or affiliate programs. When the influencer shares the link with their audience they can click on it and make a discounted purchase. The influencer then earns a commission or a percentage of the sale for each audience purchase. (10 marks, 4 + 6)

3(b) (i) Explain the phone feature 4K videos at 30/60 fps.
4K videos have a horizontal resolution of approx. 4000 pixels with the standard of 3840 × 2160.

The "fps" in "30/60 fps" stands for "frames per second." It indicates the number of individual frames or images displayed in one second of video.

(ii) Describe, with examples, each of these phone protection systems:

Secure enclave for biometric data:
a dedicated and isolated area within the phone's hardware or software architecture that is designed to securely store, process and manage sensitive biometric information for authentication purposes. This is especially relevant in smartphones where biometric data, such as fingerprints or facial scans, is commonly used to unlock devices, authorize transactions and enhance overall security.

Secure communication protocols:
Phone secure communication protocols refer to the methods and standards employed to ensure the security, privacy and integrity of data transmitted between mobile devices and other systems. This includes the use of HTTPS (Hypertext Transfer Protocol Secure), VPN (Virtual Private Network), etc.

Remote tracking and wiping:
Remote tracking, locking and wiping capabilities through features like "Find My Phone" to locate a lost device and protect or remove sensitive data.

(iii) Outline **two** advantages of data transfer using USB Type-C.
Type-C connection is reversible (can be used in either direction), has superior transfer speed, allows connections to many devices etc.

(16 marks, 4 + 8 + 4)

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

3(c) (i) Explain **each** of the following in relation to secure connections:

Data encryption: **a system that converts plaintext or readable data into an unreadable format (ciphertext) using an algorithm and an encryption key. The purpose of data encryption is to secure sensitive information making it difficult for unauthorised individuals or entities to access, understand or manipulate data without the proper decryption key.**

VPN: **Virtual Private Network – to establish secure and encrypted connections over the internet to allow users to access private networks remotely.**

Multiple firewall: **a range of firewall layers to enhance security, these include perimeter firewall that will block malicious traffic before it reaches the internal network, internal firewall to prevent the spread of threats, application firewall protects specific services, etc.**

(ii) Explain the term *network eavesdropping* and the possible consequences for a business.

Network eavesdropping:
is the unauthorised monitoring, reading or interception of network communications usually with the intention of capturing sensitive data. It often takes the form of passive surveillance and is aided by unencrypted communication.

Consequences**: Loss of business, reputation damage, financial loss and loss of confidential information.**

(14 marks, 8 + 6)

OR

3(d) (i) Online advertising commonly incorporates images, video, and sound. Give a typical file extension for **each** of the elements listed above.

Images: **.jpg, .jpeg, .gif, .heic, .png**
Video: **.mp4, .mov, .wmv**
Sound: .**m4a, .wav, etc.**

(ii) Outline the function of **any two** of the following types of server:

Domain Controller:
provides centralised authentication and user access and accounts, it manages policies for network security and configuration.

File Server:
stores and organises files and folders, facilitates sharing of resources and manages control permissions.

Application Server: **provides a platform for hosting and executing applications, it manages multiple users.**

(14 marks, 6 + 8)

Option 4 - Manufacturing Systems

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

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

4(a) (i) Explain how companies use the following techniques in the development of new products for market:

Perceptual mapping: **a market research technique which allows companies to see how customers perceive their products in relation to others. Allows a company to find gaps in the market, look at brand positioning while developing products.**

Capacity planning: **Allows a company to ensure they have the necessary resources and capabilities to meet the demand for their products or services. They can forecast future demand for new products.**

(ii) Distinguish between an *order qualifier* and an *order winner* when a company is developing a product.

Order qualifier **meets the basic requirements or characteristics which consumers look for in a product.**
An order winner **is a product with unique attributes which set it apart from the others and make it more desirable to consumers.**

(10 marks, 4 + 6)

4(b) (i) Distinguish between once-off, batch, and mass production, and state which system of production is most appropriate for fulfilling this order.

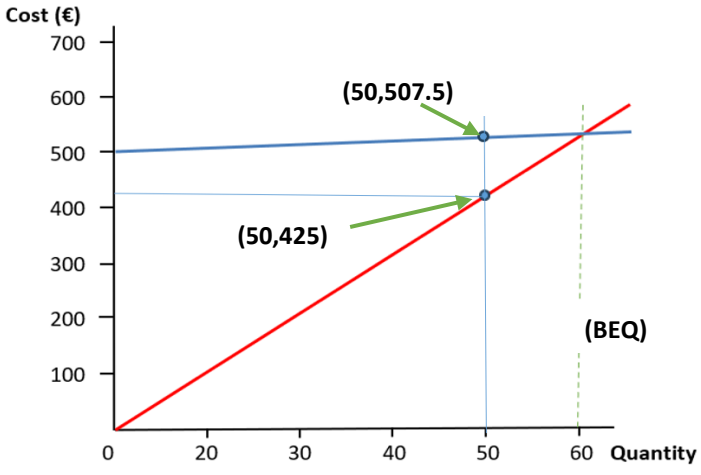
Once-off: **Once-off projects: tend to produce single or low number of items, can be expensive, etc.**

Batch production: **products produced over a particular period of time as demand for the items may fluctuate, low volume, used for sporting items that may change each year etc.**

Mass production: **standard products are produced in large volumes, demand is high and stable, used for household electrical items etc.**

Batch production is most appropriate for this order.

(ii) Using the information above, draw a graph to show the cost of assembling the trophies using option **A** and option **B**.



(iii) Determine the BEQ (break-even quantity) and recommend the most suitable assembly method for the product.

$$\text{BEQ (break-even quantity)} = \frac{\textbf{Fixed costs}}{\textbf{Manual cost per unit – automated cost per unit}}$$

$$= \frac{\textbf{500}}{\textbf{8.5 – 0.15}} = \textbf{60}$$

Option A is most suitable for a batch of 50 products.

(16 marks, 6 + 6 + 4)

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

4(c) (i) Outline, with examples, the difference between quantitative accelerated testing and qualitative accelerated testing.

Quantitative accelerated testing: **focuses on the analysis of measurable parameters such as material properties, performance and failure rates. These will predict product performance over an extended period.**

Qualitative accelerated testing: **seeks to understand overall behavioural characteristics and failure of a product under accelerated conditions. Products are also subject to stress testing but there is a greater emphasis on observing qualitative aspects such as visual inspections, assessments of wear and tear and subjective analysis.**

(ii) Explain **each** of the main stages of the 'bathtub' curve making reference to product reliability at each stage.

A **illustrates early failure rates which decreases quickly as faults are corrected. Some early products will have inadequate reliability.**

B **has a low failure rate; the product is reliable.**

C **is the wear-out phase where failures increase and reliability becomes a significant issue as the product becomes less reliable usually due to extended service.**

(14 marks, 8 + 6)

OR

4(d) (i) Name and describe **each** of the lifecycle stages **A, B, C**, and **D**.

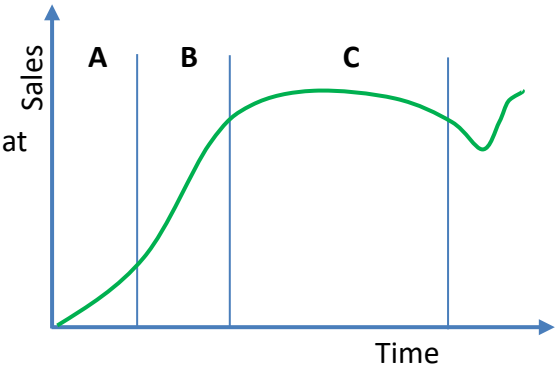
A - Introduction: After all research and development is complete, the product is launched. The product may have few competitors and sales may remain low and it may take time for the market to accept the new product.

B - 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.

C - Maturity: Sales will reach their peak. Other competitors enter the market with alternative solutions and increasing competition.

D - 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) An updated lifecycle for the hair styling product is shown above. This shows a significant change at stage **D** for the product.



Suggest **two** possible reasons for this change.

The product has gained additional sales:
Enhanced features may have been added.
Product may have been relaunched with a marketing campaign.
New markets may have been targeted.
Price adjustment.
Seasonal demand.
Effective customer satisfaction may encourage repeat buyers.

(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) State **two** reasons for using branded packaging.
It creates a source of company advertising, it can make a product more attractive, it may have greater value than generic packaging, etc.

(ii) Outline **two** reasons for the extensive use of corrugated cardboard in the packaging industry.
Strong and light material, will absorb impact, can store and stack products effectively, product may be reused, it will recycle, it is compostable, etc.

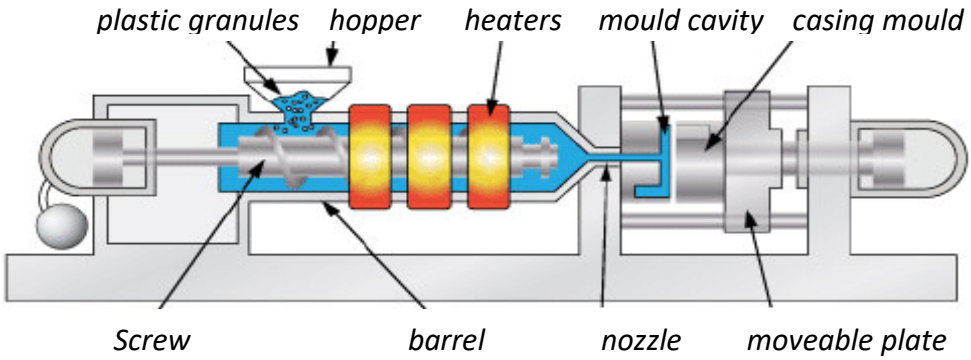
(10 marks, 4 + 6)

5(b) (i) Distinguish between thermoplastics and thermosetting plastics.

Thermoplastics: **these are moulded into shape and can then be recycled when their initial use is complete.**
Thermosetting plastics: **Plastic products are moulded into shape for permanent use, they will not recycle.**

(ii) Describe, with annotated sketches, a suitable mass production method to produce the outside casing of the barcode scanner.

Injection Moulding/Mass 3D Printing.



- **Granulated thermoplastic polymer is fed into the 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 inject the polymer into the mould and create the shape of the casing.**

(iii) Outline **two** plastic additives which might be used when producing the scanner.
Pigments add colour, lubricants make it mouldable, plasticisers increase flexibility, fillers add bulk to the plastic.

(16 marks, 4 + 8 + 4)

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

5(c) **(i)** Describe **three** stages in fabricating the presentation box, similar to that shown, using hand crafting techniques.

Cut the pieces to size.
Corners can be attached at right angles with joints, adhesives or dowels.
The base of the box can be permanently attached.
The box lid can be designed to hinge and close or sit on top of the box sides.
A finishing technique (varnish, stain, wax, etc.) can be applied.

(ii) Outline a technique to incorporate the company crest on the presentation box.

A company crest can be hand engraved, carved, use marquetry, laser cut, etc.

(14 marks, 6 + 8)

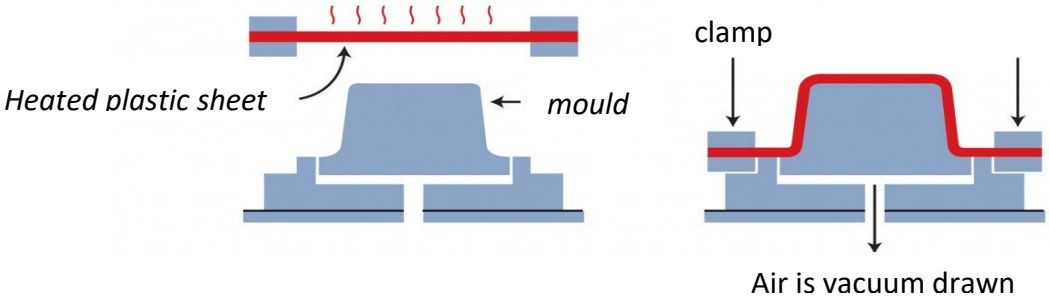
OR

5(d) **(i)** State **two** other reasons for using PET as a food packaging material.

It is transparent, lightweight, can be recycled effectively, it is non-reactive to moisture and gas, strong and durable, resistant to a range of chemicals, etc.
PET stands for Polyethylene Terephthalate.

(ii) Describe, with annotated sketches, a method of forming the strawberry package shown from a sheet of PET.

Vacuum forming:
This method is used to produce hollow shapes in plastic sheets. A shaped mould is produced and placed in the machine. The sheet of plastic is placed over the mould and clamped. An air-tight seal is required.
The sheet of plastic is heated until soft and then drawn down onto the mould. A vacuum is created when the air is removed from the area around the mould.
The plastic sheet will take the shape of the mould.



(14 marks, 6 + 8)

Coimisiún na Scrúduithe Stáit
State Examinations Commission

2024. M103P
2024. M104P

Leaving Certificate Examination, 2024

Technology

Coursework Briefs

Ordinary Level and Higher Level

200 marks

The Thematic Briefs for the Leaving Certificate Examination 2024 are given overleaf.

The Coursework must be available for assessment by Friday 22 March 2024.

Leaving Certificate Technology

Ordinary Level and Higher Level 2024

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. Digital drawings or other manufacturing details, if presented for assessment, must be included in **hardcopy** format in your design folio.
8. Where computer aided manufacture (CAM) is used, supporting CAD drawings must be included in your design folio to authenticate your own individual work.
9. The coursework should display knowledge and skills developed through your study of the core and chosen options.
10. All important operating features of the artefact must be clearly visible and be easily accessible without dismantling.
11. 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.
12. 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.
13. You must reference and acknowledge all research sources used such as: publications including books, professional journals and government reports; online sources and other types of media; any material generated using artificial intelligence (AI) software or applications; and material from specialist organisations and relevant individuals. To include such material without properly referencing the source will be considered plagiarism. In addition, the copying from, or reproduction of, material from such sources may also be considered plagiarism.
14. Material copied directly from the Internet or from other sources and presented as your own work will not receive any marks.
15. Any case of suspected copying, plagiarism (which includes the use of AI software), improper assistance, or procurement of work prepared by another party will be thoroughly investigated.

The coursework must be available for assessment by Friday 22 March 2024.

Leaving Certificate 2024 - Higher Level

Thematic Brief

User experience **refers to the overall experience a person has when interacting with a product or service, especially in terms of how easy or pleasing it is to use.**

It encompasses all aspects of the user's experience, including ease of use, accessibility, responsiveness, speed, and the satisfaction the user feels while using the product or service. User experience is an important design consideration as it has a significant impact on how users perceive, and interact with, a product or service.

Enhancing the experience of pedestrians and other people in public spaces is central to ensuring their safety and comfort. The provision of appropriate infrastructure, lighting, and accessibility is essential. Products and services such as smart pedestrian crossings, pedestrian bridges, shared spaces, smart waste bins, drinking fountains, bike racks, bus shelters, and pedestrian-friendly pavements can improve the user experience in public spaces and streets.

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 or product that enhances the experience of pedestrians or others in a public space of your choice.

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.***