Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2021

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.

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2021

Technology

Higher Level

Marking Scheme

Section A - Core *(72 marks)*

Section A. *Answer **any twelve** questions. All questions carry 6 marks.*

1. Lighting company, SELC, was launched in 1982 in Belmullet, Co. Mayo.
The company specialises in networked smart street lighting using Wi-Fi and radio signals.
Explain the benefits of each of the following features:

(i) Dimmable LED lights replacing traditional lighting:

LED lights are energy efficient, long life, etc.

(ii) Automated control of lighting rather than manual switching:

Offers complete control, can overwrite environmental conditions, etc. *(3 + 3 marks)*

2. The SELC light controller uses a housing made from polycarbonate.

Outline **two** reasons for the use of polycarbonate to house the controller.

Any two reasons:

Polycarbonate can be transparent,
ultra-violet resistance,
impact resistant,
moulds well,
Insulator, etc.

(3 + 3 marks)

3. In December 2019, the U.S. Department of Justice charged the leader of an organised cyber-criminal group for his part in a global Dridex malware attack. The public are advised to ensure that electronic devices are patched, antivirus is turned on and updated, and files are backed up.

Explain the terms:

(i) 'patched'
Patches are software and operating system (OS) updates that address security vulnerabilities within a program or product. Software vendors may choose to release updates to fix performance bugs, as well as to provide enhanced security features, etc.

(ii) Anti-virus
Antivirus software is a program or set of programs that are designed to prevent, search for, detect and remove software viruses and other malicious software like worms, trojans, adware, etc.

(3 + 3 marks)

4. The torque wrench shown is set to deliver a torque of 206 Nm.
Calculate the force exerted by the operator to achieve this torque if X = 700mm.

Calculation:

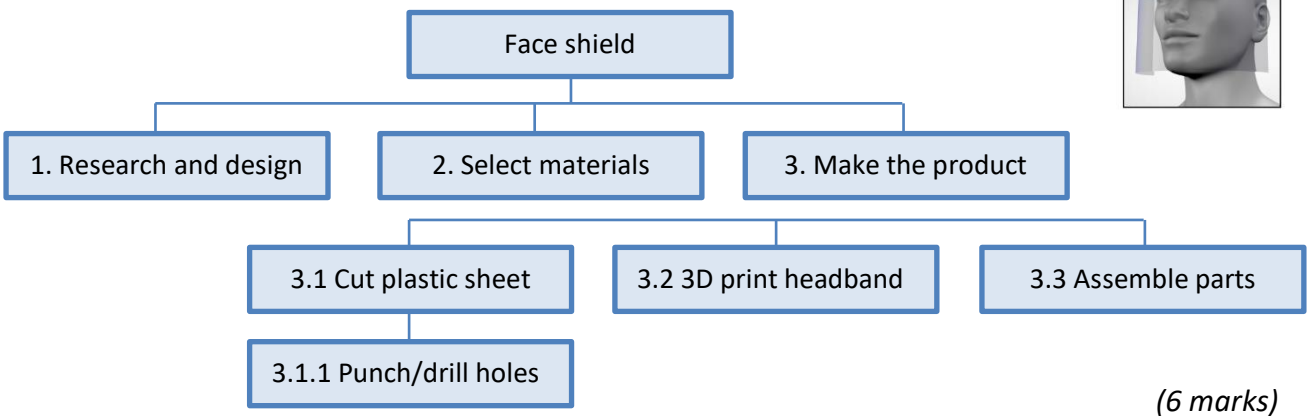
Torque = Force x Distance

Force = $\frac{\text{Torque}}{\text{Distance}} = \frac{206}{0.7} = 294\text{N}$

(6 marks)

5. Compile a Work Breakdown Structure (WBS) for the manufacture of the faceshield shown

Suggestion -other solutions and formats accepted



(6 marks)

6. The skin-frame type structure has gained popularity in 3D printing for items such as the Voronoi mushroom lamp shown. This approach uses a combination of frame and shell structures.

Outline **two** reasons for the use of such a combined structure.

Any two reasons:

Skin can be made very thin and still have rigidity,
allows light to pass through,
a variety of interesting shapes can be produced,
can be manufactured in a single piece,
strong, less material, etc.

(3 + 3 marks)

7. Amazon have used artificial intelligence (AI) to develop their virtual assistant, Alexa. The device is capable of undertaking a range of tasks including voice interaction, music playback, etc. Alexa can be paired with devices such as lights and speakers.

Outline the process of pairing electronic devices.

Bluetooth activated on both devices to be paired. One device picks up the signal from the other device, request to pair, new device. Select pair and the devices will connect if in range.

(6 marks)

8. Outline **two** features that might be integrated into the bench-mounted belt sander shown, to reduce vibration and minimise dust.

(i) Reduce vibration
Can be bolted to the bench,
can have shock absorbing rubber mountings,
rubber buffers, etc.

(ii) Minimise dust
Can be attached to dust collection or extraction system,
belt covers and dust bags, etc.

(3 + 3 marks)

9. Electronic components can be distinguished by material, electrical properties, and use.

Complete the table below.

Category	Material	Electrical Property	Use
Conductor	Copper	Allows current to pass through.	Electrical wire
Insulator	**PVC** **Silicon**	**Prevents current flow**	**Coating on wire**
Semi-conductor	**Silicon**	**Allows some current to flow under certain conditions**	**IC / Transistors**

(6 × 1 mark)

10. The helical-cut gears shown are mounted in a cast iron gearbox.

(i) State **two** reasons for using helical gears rather than straight spur gears.

Provide a stronger drive,
Capable of transmitting higher loads,
quieter in operation, last longer, smoother, etc.

(ii) Describe how such a gear system could be lubricated.

The oil lubricant is stored in the base of the housing, the oil level must reach the gears. As the gears rotate, the oil is captured by the gear teeth and transported around the gear system. This will ensure that all gears and bearings are coated without the need to have the housing filled with oil.

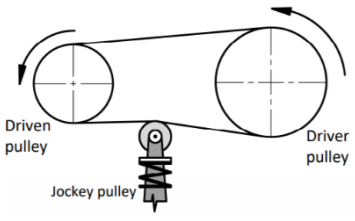
(4 + 2 marks)

11. The system shown has a driver pulley, diameter 40 mm, and a driven pulley, diameter 25 mm.

(i) Calculate the angular velocity (rotational speed) ratio of the system shown.

Calculation:

Ratio = Driven / Driver = 25 : 40 = 5 : 8

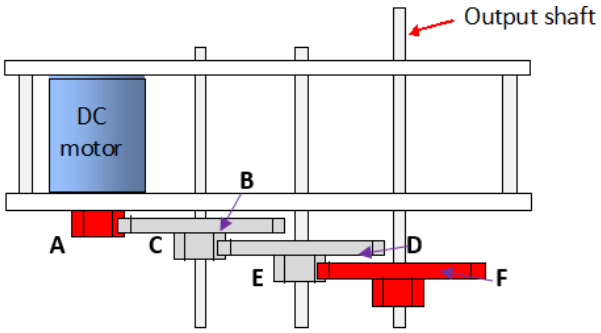


(ii) Explain the purpose of the spring-loaded jockey pulley.

The 'jockey pulley' is used to keep tension on the pulley belt. Even if the belt stretches the spring will automatically maintain the required tension without further adjustment.

(4 + 2 marks)

12. The gearbox shown uses three identical compound gears. The initial driver gear (20 teeth) is secured to the motor. For each of the three subsequent compound gears, the driver gear has 20 teeth and the driven gear has 50 teeth.



If the motor runs at 2000 rpm, calculate the angular velocity (rotational speed) at the output shaft.

Gear ratio $= \frac{B}{A} \times \frac{D}{C} \times \frac{F}{E} = \frac{50}{20} \times \frac{50}{20} \times \frac{50}{20} = \frac{125000}{8000} = 15.625 : 1$

Velocity of output shaft $= \frac{2000}{15.625} = 128$ **rpm**

(6 marks)

13. An exploded view of a retro games console is shown.

Sketch a pictorial view of the *assembled* console.

Any valid view of the assembled console is accepted.

(6 marks)

14. The Irish-designed Gúna occasional table is shaped to emulate the elegant sweep of a dress. The table is produced by laminating lengths of oak and African wenge timber.

(i) Explain the lamination process.

Lamination is the combination of two or more thin layers of material, normally held together with adhesives.

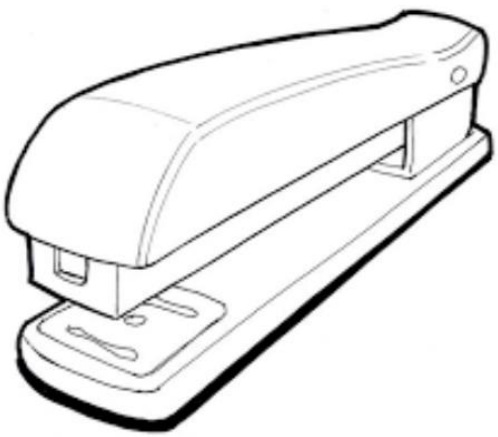
(ii) Outline **two** reasons for reducing the use of tropical hardwoods such as wenge.

Wenge is an endangered wood type due to over harvesting,
it has medicinal poperties,
protects plant and animal species,
better for environment, trees provide oxygen and reduces carbon dioxide,
the dust from cutting wenge is dangerous,
there is a lack of new trees, etc.

(2 + 4 marks)

15. Use **two** graphic techniques to enhance the representation of the materials used in the stapler shown.

Two distinct graphic techniques required:



(3 + 3 marks)

Coimisiún na Scrúduithe Stáit
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Leaving Certificate Examination, 2021

Technology

Higher Level

Marking scheme

Section B - Core *(24 marks)*

*Answer **one** question from the two questions presented.*

Each question in Section B carries 24 marks.

Section C - Options *(40 marks)*

*Answer **one** of the five options presented.*

All questions in Section C carry 40 marks.

Section B - Core *Answer Question 2 **OR** Question 3.*

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

2(a) On 30th May 2020, the Elon Musk-inspired 'Crew Demo-2' spacecraft by SpaceX was launched to the International Space Station. Crew Demo-2 is the first commercial orbital spaceflight launched from the United States.

(i) Describe **one** benefit of commercial input into space exploration.
Provides source of independent funding, has created a demand for reusable space craft, satisfies a public demand for space travel, etc.

(ii) Outline **two** materials or processes developed for space exploration that are now commonly used in daily life.
Lightweight materials – aluminium alloys and carbon fibre, solar panel technology, digital photography, Velcro, memory foam, fuel cell, etc.

(8 marks, 4 + 4)

2(b) The astronaut seats of the spacecraft are anthropometrically designed using carbon fibre and the synthetic textile, Alcantara.

(i) Explain what is meant by anthropometrically designed.

Design is based on the measurement, size and shape of the human individual.

(ii) Using annotated sketches, identify **three** anthropometric features of the customised seats of the Demo-2.

Head rests are made to fit the operator.

Space in front of the occupant allows movement.

Seats are measured to fit the operator; they can tilt back into a flat configuration.

The footrests can adjust to the length of the operator legs.

(iii) Explain **one** reason for the use of carbon fibre and **one** reason for the use of synthetic textile in the seats.
Carbon fibre – very strong material, lightweight, easy to fabricate, etc.
Synthetic textile – can be designed with specific properties, heat resistant, etc.

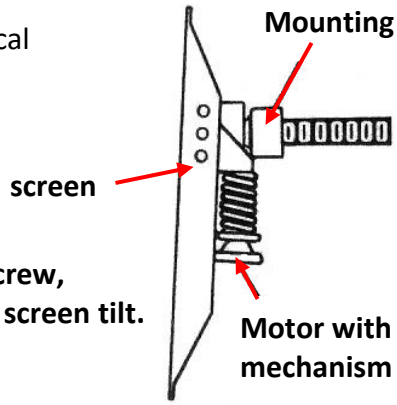
(10 marks, 2 + 6 + 2)

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

2(c) Most spacecraft use control levers and manual inputs but Demo-2 features a touchscreen interface.

(i) Outline **two** advantages of touchscreens over control levers and manual inputs.
Ease of operation, ease of navigation between tasks, access to large volumes of data, space saving in a tight capsule, more hygienic, easier to clean, less likely to be accidently hit/pressed etc.

(ii) Describe, using annotated sketches, an electro-mechanical means of tilting the touchscreens for better viewing by the astronaut team.



(6 marks, 2 + 4)

OR

2(d) Spacecraft must be of the highest quality to ensure the safety of astronauts and all other staff associated with space exploration.

Explain, with **one** example in each case, **each** of the following dimensions of quality:

Performance:
Performance refers to a product's primary operating characteristics. This dimension of quality involves measurable attributes. Example**: heat shield on spacecraft, rockets, etc.**

Reliability:
Reliability is the likelihood that a product will not fail within a specific time period. This is a key element for users who need the product to work without fail. Example**: safe return of spacecraft, software, electronic systems, etc.**

Conformance:
Conformance is the precision with which the product or service meets the specified standards.
Example: **materials used, locking device on hatches, computers, spacesuits, etc.**

(6 marks, 2 + 2 + 2)

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

3(a) HexGen is an award-winning design for a ski helmet. The helmet absorbs shock using a combination of a soft padding, 3D printed lining and a hard outer shell.

(i) Name a suitable plastic material for the outer shell and the padding layer respectively.

Outer shell – polycarbonate

Padding layer – expanded polystyrene/polyurethane foam.

(ii) Outline **two** advantages of 3D printing for the lining.

Produces a strong structure that can be made lightweight, the lining can be produced off-site, replacement parts can be transported by electronic file, no waste material, additive process, etc.

(8 marks, 4 + 4)

3(b) The prototype circuit operates an automated fan.

(i) Outline the function of the resistors R1 and R2.

R1 – thermistor, a resistor where the size of the resistance is dependent on temperature, resistance will vary according to heat levels.

R2 – Variable resistor, sets the sensitivity level of the thermistor.

(ii) Describe the operation of the circuit, making reference to **two** methods of protecting the transistor.

When temperature increases, the resistance of the thermistor decreases, in turn the resistance across the variable resistor increases and so does the voltage across the variable resistor. When the threshold voltage is reached, the transistor turns on and activates the relay, turning on the fan.

The resistor R3 will protect the transistor from input overload and the diode at the relay will prevent damaging feedback into the transistor from the relay.

(iii) The circuit needs to be tested before the design is finalised. Outline **one** advantage and **one** disadvantage of **each** of the following approaches to designing and testing circuits.

Circuit simulation software

Advantage: no components required, quick, easy adjustment and automatic measurement.

Disadvantage: may not be very accurate for specific components, software needed.

Physical prototyping boards

Advantage: uses circuit building techniques, easy to swap components, if it works on board it will work in the completed circuit.

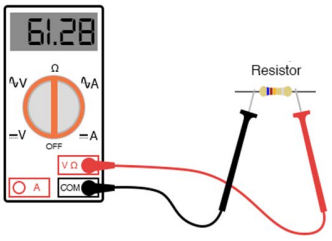
Disadvantages: requires electronic technical skills, connections may be incorrect.

(10 marks, 2 + 4 + 4)

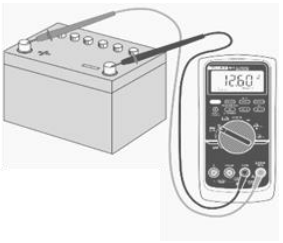
*Answer 3(c) **or** 3(d)*

3(c) Outline, with annotated sketches, how to safely use a multimeter to determine

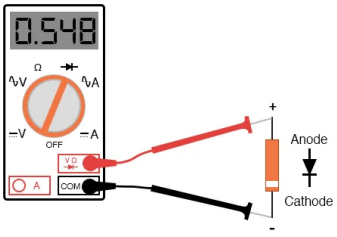
The precise value of a resistor:
The resistor value can be determined by placing the probes across the resistor, the size range can be altered until a value is displayed.



The voltage of a motorcycle battery:
12V motorcycle batteries can be set to measure in a range of 20V. A direct voltage reading will be given.



The direction of current in a diode:
Resistance, current or continuity can be used to determine the direction of current (polarity) of the diode.



(6 marks, 2 + 2 +2)

OR

3(d) In adventure sports, helmet cameras with GPS capability can be used to analyse performance.

(i) Outline **two** aspects of sports performance that could be analysed using data captured by a helmet camera.
Distance covered, speed, altitude, etc.

(ii) The camera has an internal battery. Suggest **one** method of enhancing the environmental sustainability of the camera's power source.
Use renewable batteries, the batteries could be charged by solar power as sports helmets are generally used outdoors, etc.

(6 marks, 4 + 2)

Section C - Options

*Answer **any one** of the five optional questions.*

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

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

1(a) The use of control systems in the food industry seeks to improve quality and affordability. Describe, with **one** example in each case, a technological innovation which has improved each of the following:

Farming production – **specialised automated machinery, drone technology for assessing crop condition, genetically modified foods (GMO) to improve food quality, etc.**

Food preservation – **freezing and refrigeration for transport and storage, sterilisation techniques, hydration of foods, etc.**

Packaging – **vacuum packing for freshness, anti-microbial packaging to suppress bacteria, etc.**

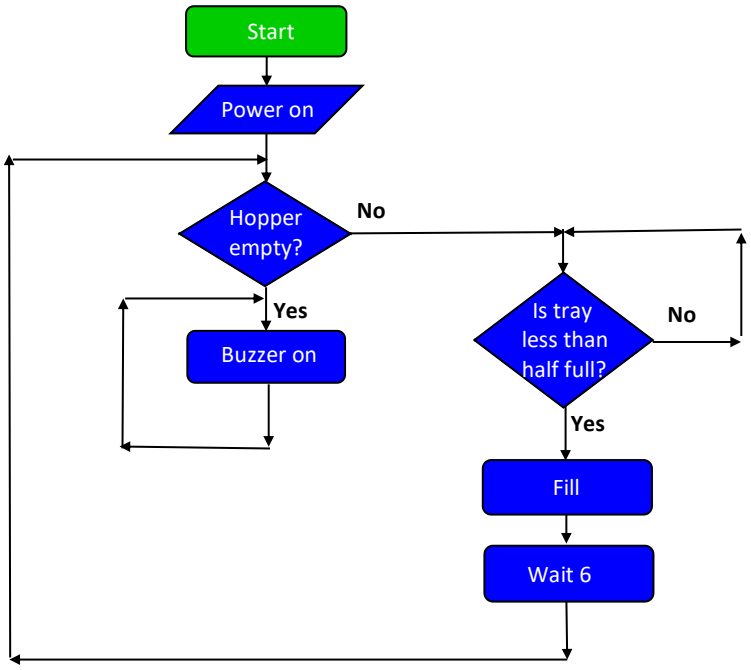
(10 marks, 4 + 3 + 3)

1(b)

(i) Outline **three** reasons why the programmable interface controller (PIC) is a suitable component to control the feeder.

Can be programmed, programme can be altered without rebuilding circuit, circuits can be mass produced, reliable operation, fast performance characteristics.

(ii) Redraw and complete the flowchart to control the feeder.



Any valid alternative solution accepted.

(iii) After a period of usage, a design problem was identified – the warning buzzer discharged the battery. Suggest a modification to the flowchart to rectify this problem.

The circuit should be altered to sound for a period of time and then turn off or use an alternative output component (such as a LED) as the buzzer will drain a battery quickly.

(16 marks, 4 + 8 + 4)

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

1(c) (i) Describe the main features of the humanoid robot.

In general, humanoid robots have a torso, a head, two arms and two legs. However, some forms of humanoid robots may model only part of the body for example, from the waist up. Some humanoid robots also have heads designed to replicate human facial features such as eyes and mouths. Androids are humanoid robots built to aesthetically resemble humans.

(ii) Proper placement of food constituents is vital in the cooking and presentation of a meal.

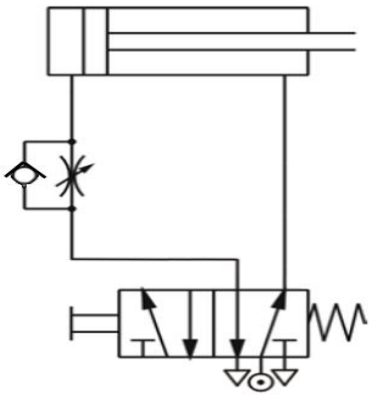
Describe how closed loop control is used to achieve accurate placement.

Closed loop control is also known as feedback control. The response or the actual result, using sensors is continuously compared with the desired result. The control output is adjusted to reduce any deviation, this ensures the robot follows the same routine for each operation.

(14 marks, 6 + 8)

OR

1(d) (i) Draw a pneumatic circuit diagram to operate the pneumatic bottle-capping machine.



Attach cylinder ram to bottle cap supply.

5/2 valve allow the cylinder to move back and forth once.

(ii) Outline a method of controlling the speed of the piston as it places the cap on the bottle.

Flow control valves to control the speed of the ram.

(14 marks, 8 + 6)

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

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

2(a) (i) Name one digital electronic component and one analogue electronic component.

Digital: **LED, Logic Gates, PTM switch, SPST, Microswitch, etc.**

Analogue: **Thermistor, LDR, Distance, Moisture, Pressure sensor, etc.**

(ii) Draw the typical waveform of:

A Digital signal

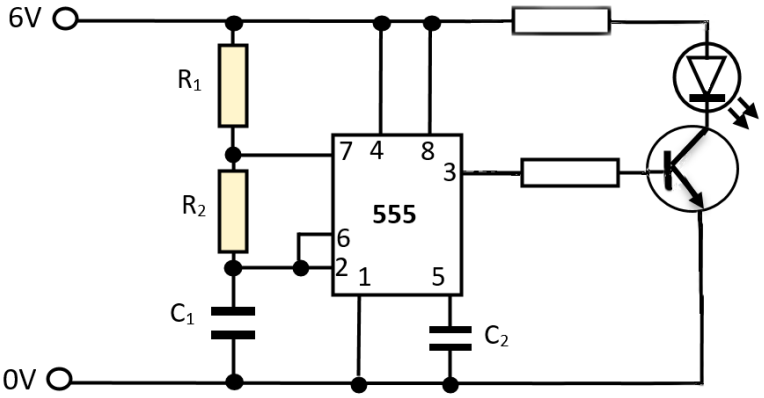
An Analogue signal.

(10 marks, 4 + 6)

2(b) (i) Explain the term astable.

Astable means that the circuit is not stable in any state. The output is continually changing between 'Low' and 'High' which produces output at intervals, etc.

(ii) Outline the operation of the circuit making reference to R1, R2, C1 and the threshold pin.



This is a 555 astable circuit, which behaves as an oscillator where the output pin 3 will periodically go high and low. In this circuit, R1, R2 and C1 components determine the timing of the oscillator. Pin 6 is the threshold pin. It detects when the voltage on the timing capacitor rises above 0.66 Vcc (i.e., 2/3 of the supply voltage) and resets the output when this happens.

(iii) Redraw and complete the circuit in your answer book to include a transistor and led output.
See diagram above.

(16 marks, 4 + 6 + 6)

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

2(c) (i) A transistor has a collector current of 0.1 A and a base current of 1 mA. Select the most suitable transistor from the table given and justify your answer.

C = BC107

$$\textbf{Transistor Gain} = \frac{\textbf{Collector current}}{\textbf{Base current}} = \frac{\textbf{0.1}}{\textbf{0.001}} = \textbf{100}$$

(ii) Calculate the collector current for transistor D (TIP31) if the base current is 0.3mA.

$$\textbf{Transistor Gain} = \frac{\textbf{Collector current}}{\textbf{Base current}}$$

Collector current = Transistor Gain x Base Current

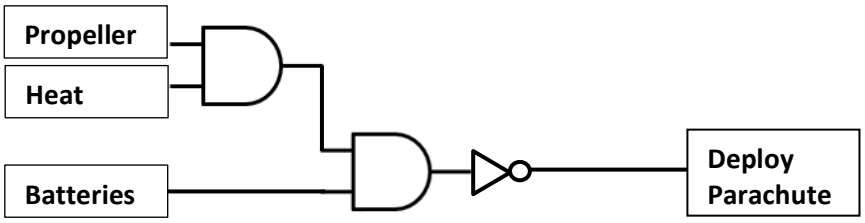
Collector current = 20 x 0.0003 = 0.006A or **6mA**

(14 marks, 6 + 8)

OR

2(d) The flight controller of a drone needs to ensure that all propellers are operational, heat does not build up excessively and batteries have sufficient charge to continue flying. If these conditions are not met a parachute can be deployed and power shut off.

(i) Draw a logic circuit for the flight controller to ensure the drone remains undamaged.



(ii) Describe an electronically controlled method of deploying the parachute.

Drone parachute deployed using solenoid/servo activated by output from Logic circuit.

(14 marks, 8 + 6)

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

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

3(a) (i) Explain the term Bluetooth.
Bluetooth is a short range wireless technology standard that is used for exchanging Data between fixed and mobile devices over short distances.

(ii) Outline the importance of personal data security in the use of the App.
This App recognises medical data, the data is sensitive to each individual, there can be no breaches of confidentiality with the use of this technology, etc.

(10 marks, 6 + 4)

3(b) A 8GB of RAM, 256GB SSD and 5GHz dual core central processing unit (CPU) are regarded as a basic specification for a laptop computer.

(i) Explain **each** of the elements of the specifications given above.

8GB of RAM – **the motherboard is capable of handling 8GigaBytes of Random Access Memory**

256GB SSD – **256 GigaBytes solid state drive gives good start-up speed and adequate storage for general applications.**

5GHz dual core CPU – **5GigaHertz dual core central processing unit has two processors with cache and controller, this provides an improved processing speed.**

(ii) Suggest **three** other features to be considered when purchasing a laptop.
Size and form (size of screen range from 11 to 17 inch and weigh from 1kg upwards), price, screen quality (touchscreen, colour resolution 1920x1080 is common), keyboard quality, battery life, USB capabilities, biometric security or other security features, build quality, etc.

(iii) Explain any **two** of the following-encryption, screen sharing, breakout rooms.

Encryption:
end to end encryption keys prevent unwanted access, increasing use of video conferencing platforms for sensitive information demands secure and protected transmission.

Screen sharing:
the practice of sharing the content of your screen with another or multiple devices, allows others to alter or display data.

Breakout rooms:
meeting or class participants can be divided into smaller groups to have private conversations or focus on a single topic, rooms can be timed and closed to return to main presentation.

(16 marks, 6 + 6 + 4)

Answer 3(c) or 3(d)

3(c) (i) Outline **two** functions of the mains-powered laptop power supply shown.
Convert AC mains voltage to DC, low voltage supply, etc.

(ii) Most wireless charger devices rely on AC inductive coupling to transmit power.

Outline **three** advantages of wireless charging devices.
Convenience that device does not need to have a wired connection to the charger, will deal with power surges effectively, charging ports will not get damaged, needs not be concerned with type or size of charging port, chargers can power a range of devices, etc.

(14 marks, 8 + 6)

OR

3(d) (i) Outline **two** advantages of 2-in-1 devices.
Readily portable - tend to be light and small, flexible use with well-developed touchscreen technology, can perform as a tablet or laptop with addition of keyboard, etc.

(ii) Explain why temperature sensors and gyroscopes are used in 2-in-1 devices.

Temperature sensors: **can be used to monitor heat build up in the device due to extended use or inappropriate location, can also power down devices for protection, etc.**

Gyroscopes: **gyroscope sensor is a device that measures tilt and orientation of a device, they are used to protect devices if dropped, motion sensing, alter screen orientation, part of interactive element of game applications, etc.**

(14 marks, 6 + 8)

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

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

4(a) (i) Distinguish, using specific examples, in each case the use of both the CE and Fairtrade®standards

CE mark indicates that a manufacturer has checked that the products offered meet EU safety, health and environmental requirements.

Fairtrade® products ensure that producers in growing countries are paid a fair and stable price. It is usually associated with producers in developing countries.

(ii) Businesses that achieve quality standards generally have a competitive advantage over other businesses.

Explain the competitive sales advantages for either Fairtrade ® or CE marked products.

Fairtrade seeks to create a stable market with producers expected to maintain standards and be sure of getting a fair price for their produce. Fairtrade contributes to sustainable development by offering better trading conditions to marginalised producers and workers.

CE products must meet European standards to ensure that products are safe and meet environmental standards. Some insurers will demand CE mark for this level of quality control.

(10 marks, 4 + 6)

4(b) A submersible solar-powered pump shown requires accurate fittings. Measurement of samples of the fittings produced by two manufacturers are summarised below:

Manufacturer A - standard deviation = 0.04077

Manufacturer B - standard deviation = 0.01620.

The fitting diameter must have an outside diameter between 39.85 mm and 39.95 mm.

(i) Calculate the process capability index for **each** manufacturer:

Manufacturer A $\mathbf{Cp = \frac{Tolerance\ Range}{6\delta} = \frac{39.95 - 39.85}{6 \times 0.04077} = \frac{0.1}{0.24462} = 0.409}$

Manufacturer B $\mathbf{Cp = \frac{Tolerance\ Range}{6\delta} = \frac{39.95 - 39.85}{6 \times 0.01620} = \frac{0.1}{0.0972} = 1.029}$

(ii) Select Manufacturer A **or** Manufacturer B to produce the fittings. Justify your selection.
Manufacturer B is capable with Cp at 1.029, it is more consistently accurate.

(iii) Outline the key features, with examples, of the Pareto principle of quality management.
This is the 80/20 rule where roughly 80% of the effects come from 20% of the causes e.g. 80% of problems in manufacturing operations could be resolved by dealing with 20% of underlying causes.

(16 marks, 8 + 4 + 4)

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

4(c) (i) Explain the terms LCL and UCL.

LCL – Lower Control Limit, the lowest acceptable value for the system to remain in control.
UCL – Upper Control Limit, the maximum acceptable level for the system to remain in control.

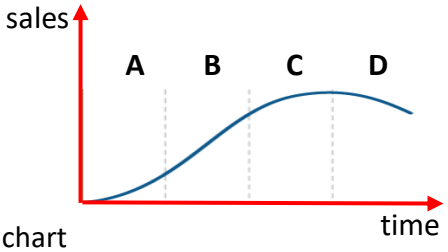
(ii) Using the chart, assess the degree of control exhibited by the manufacturer.

There is a high degree of control demonstrated by the manufacturing process as the control chart never exceeds the upper or lower control limits. Each time a reading close to the UCL or LCL is evident, the system is brought under control. There is a reasonable balance on both sides of the optimum mean value.

(14 marks, 6 + 8)

OR

4(d) (i) Outline, using annotated sketches, a typical product life cycle chart for a style of shoe.



Explain **each** stage of the chart

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) Outline **two** strategies that a business might adopt in order to extend the product life cycle of a range of shoes.

A range of strategies can be considered:

- **Increase marketing.**
- **Adding new features (design update, extend shoe colour, etc.) can enhance the shoe attractiveness.**
- **Identify new markets.**
- **Reduce price.**

(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) Explain the term synthetic fibre.

Fibre polymer materials that are man-made and manufactured by chemical synthesis from petrochemicals.

(ii) Identify **two** composite materials and their main consituents.

Concrete made from sand, gravel and cement which can be reinforced with steel rebar.

Reinforced fibre glass – sheets of glass fibre set in epoxy polymer.

MDF – wood fibres and glue, etc.

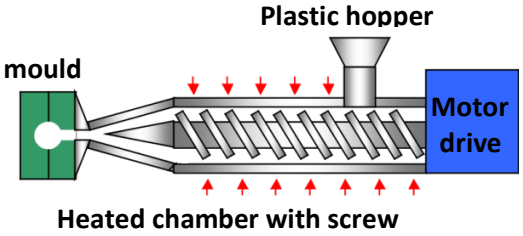
(10 marks, 4 + 6)

5(b) (i) Select a material that could be used to manufacture the door opener and justify your selection.

Nylon/Polypropylene/ABS – easy to mould into shape, tough material that will withstand impact and bending flexibility, etc.

(ii) Describe, using annotated sketches, a production method to produce a large quantity of hands free door openers.

Injection moulding: plastic pellets are loaded from the hopper through the heated chamber. It is pushed into the seat shaped mould by the rotating screw.



(iii) Outline the role of polymer additives in the production of items such as the door opener.

Fillers to enhance strength, Ultraviolet stabilisers reduce chemical breakdown and brittleness due to exposure to light, lubricants make moulding easier, pigments give colour, etc.

(16 marks, 4 + 8 + 4)

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

5(c) (i) Describe a method of cutting an intricate design in thin plywood making reference to equipment used, cutting action and safety.

Scroll saw **has a thin straight blade produces intricate work.**

Cutting action: **blade moves with reciprocating motion.**

Safety: **relatively safe if the user exercises due care as the blade can cause minor cuts, the workpiece needs to be gripped confidently, holdfast in place directly over plywood, etc.**

(ii) Outline how **both** thin sheets of plywood **and** thin aluminium tubing have a high strength to weight ratio.

Plywood:
Made from thin layers (veneers) of wood that are glued together under pressure. As wood is stronger in one direction, plywood increases its strength with layers placed at right angles to each other. It is less likely to split or be compromised by defects.

Thin aluminium tubing:
Aluminium is a lightweight material. The hollow shape reduces the mass of the material, without significant loss of material strength. Aluminium can also be alloyed with other elements/metals to further improve its strength without increasing weight significantly.

(14 marks, 6 + 8)

OR

5(d) (i) Outline **two** properties of nylon that make it suitable for the applications above.
Nylon is hard wearing, resistant to abrasion, easy to fabricate, etc.

(ii) Explain **two** advantages of using bio-nylon instead of conventional nylon.
Bio-nylon is plant based and better for the environment, renewable, it is a more environmentally sustainable material, biodegradable, etc.

(14 marks, 6 + 8)

Leaving Certificate Examination, 2021

Technology

Coursework Briefs

Ordinary Level and Higher Level

200 marks

The Thematic Briefs for the Leaving Certificate Examination 2021 are given overleaf.

The Coursework must be available for assessment by Friday 26 March 2021.

Leaving Certificate Technology

Ordinary Level and Higher Level 2021

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 26 March 2021.

Leaving Certificate 2021 - Higher Level

Thematic Brief

Throughout history, humankind has shown an innate trait - the desire to explore. Exploration has led to the development of new knowledge and understanding, and to discoveries and inventions.

Our achievements as a result of exploration are wide-ranging and significant. These achievements include landing on the moon and reaching the summit of Mount Everest, exploring our planet's natural resources, making advancements in medicine and industry, and developing systems that impact the quality of our lives.

In this context and with a focus on modern materials and processes, design and manufacture a working model of a device, system or technological aid that could be of benefit in an area or aspect of exploration 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.***

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