Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2020

Technology

Higher Level

2 Hours 30 Minutes

There are **three** Sections in this paper. Attempt **all three** Sections.

Section A: Core - Short-answer questions.

Section B: Core - Long-answer questions.

Section C: Options - Long-answer questions.

Section A - Core *(72 marks)*

Instructions:

(a) *Answer **any twelve** questions in the spaces provided. Each question in Section A carries 6 marks.*

(b) *Draw all sketches in pencil.*

(c) *Hand up this booklet at the end of the examination.*

(d) *Write your examination number in the box provided and on all other pages used.*

Centre Number

Section	Mark
Section A	
Section B	
Section C	
Total	
Grade	

***Examination Number*:**

Section A. *Answer **any twelve** questions. Each question carries 6 marks.*

1. The 'National Policy Framework on Alternative Fuels Infrastructure for Transport in Ireland 2017 to 2030' has been published. This policy framework sets the ambitious target that, by 2030, all new cars and vans sold in Ireland will be zero-carbon emitters.

Name **two** zero-carbon emission fuels used for vehicles.

(i) _____

(ii) _____

2. The medals for the Tokyo 2020 Olympics are being manufactured from 78,985 tonnes of recycled electronics, including 6.21 million recycled mobile phones, according to the Tokyo 2020 Olympics medal project.

Outline **two** reasons for the use of gold in electronic components.

1. _____

_____

2. _____

_____

3. Reverse vending machines are common across the world. Ireland's first reverse vending machine has been installed in Carrickmacross, Co. Monaghan.
The machine identifies plastic PET bottles by barcode and dispenses vouchers in return.

(i) Explain the abbreviation PET.

_____

_____

(ii) Outline **one** challenge in recycling plastic bottles.

_____

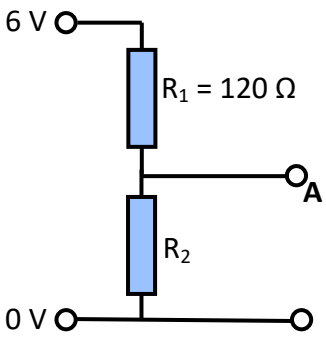
_____

_____

4. (i) Name the mechanism shown.

(ii) Explain the *self-locking* feature of this mechanism.

5. (i) A circuit requires a 5 V supply. Find the value of $\mathbf{R_2}$ in order to deliver a 5 V supply at **A**.



(ii) The resistor R_1 has a red tolerance band (± 2%).
Calculate the maximum and minimum values of the resistor.

Calculation:

6. Briefly assess the suitability of a *spreadsheet application* for each of the following tasks.

(i) Store information:

(ii) Process numerical data:

(iii) Edit images:

7. Compile a *Work Breakdown Structure* (WBS) for the acrylic menu holder shown.

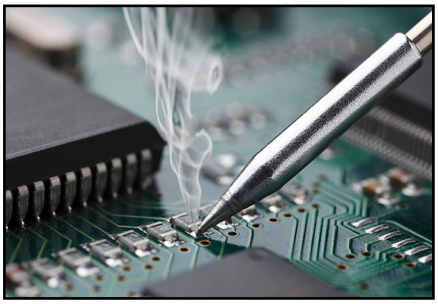
8. The Minister for Communications has proposed an Online Safety Act targeting cyberbullying and material that promotes self-harm or encourages nutritional deprivation. It is proposed that an Online Safety Commissioner be appointed to enforce such regulations.

(i) Explain the term *cyberbullying.*

(ii) Outline the importance of *privacy settings* in the prevention of cyberbullying.

9. Soldering of electronic components on circuit boards can be hazardous.

(i) Outline a source of fumes from soldering which could be a health hazard.



(ii) Describe a method of minimising this hazard.

10. Snowboards are designed and manufactured from a range of materials which are laminated to produce the finished board. The structure includes a wooden core, metal edge, fibreglass sheet and printed plastic coversheet.

Complete the chart below by naming materials that may be used in the manufacture of a snowboard.
The first entry has been completed for you.

Part	Material	Reason for choice of material
Composite layer	Fibreglass	Strong/flexible material
Wooden core		
Metal edge		
Plastic coversheet		

11. An LED display is limited to a current of 15 mA with a voltage drop of 1.95 V.
The supply voltage is +6 V.

Calculate the value of the current limiting resistor that should be used for the display.

Calculation:

12. Websites can be analysed using information similar to that shown below to establish data on visits to the landing page and length of time spent on the site.

Sessions	Users	Page Views	Pages per Session
624,935	299,488	5,826,244	9.32

Explain the terms:

(i) cookie _____

(ii) landing page _____

(iii) 9.32 pages per session _____

_____

13. The LED bulb below is shown in an exploded view.

Sketch a pictorial view of the **assembled** LED bulb.

14. An e-scooter uses a 24 V electric motor attached to a drive mechanism to propel it. The motor is rated at 2750 RPM and 252 W.

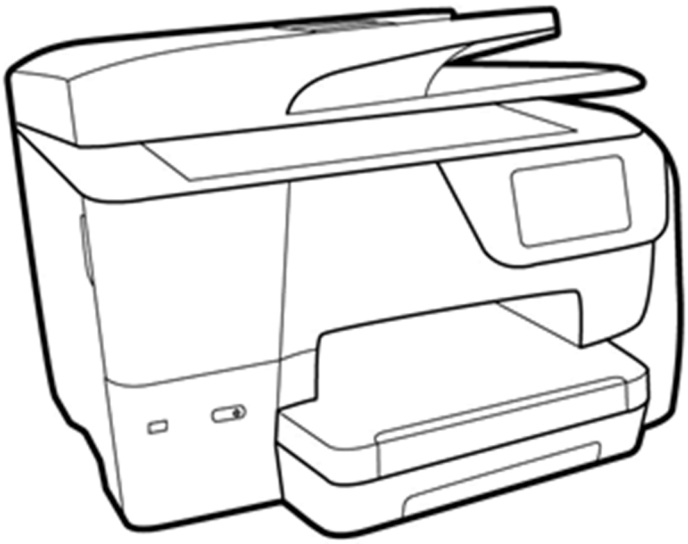
(i) Calculate the maximum current drawn by the motor.

Calculation:

(ii) If the driven gear **A** has 96 teeth and the driver gear on the motor has 12 teeth, calculate the rotational speed of the driven gear at maximum motor RPM.

Calculation:

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



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Section B - Core *(48 marks)*

*Answer **both** questions.*

Each question in Section B carries 24 marks.

Section C - Options *(80 marks)*

*Answer **two** of the five optional questions presented.*

Each question in Section C carries 40 marks.

Instructions:

(a) Answer these questions in the answerbook provided.

(b) Write your examination number on the answerbook.

(c) Draw all sketches in pencil.

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

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

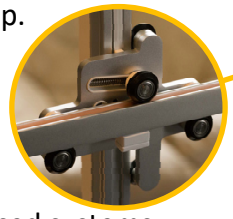
Question 2 *- Answer 2(a)* ***and*** *2(b)*

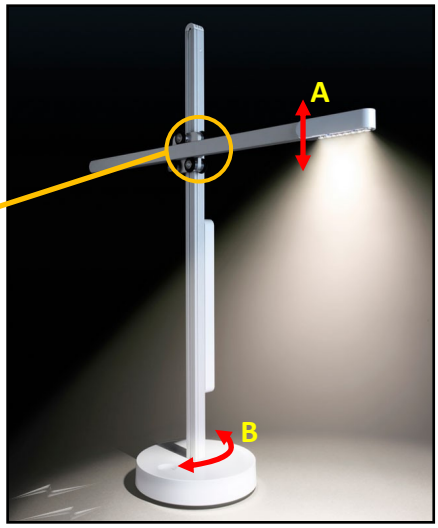
2(a) Explorer Mark Pollock has collaborated with Dublin City University and Ekso Bionics© in a robotic rehabilitation programme.
The programme helps people with paralysis to walk with the aid of a battery-powered *exoskeleton suit* which provides balance and proper body positioning.

(i) Suggest **two** safety elements that should be integrated into the exoskeleton suit.

(ii) Describe, with the aid of annotated sketches, a method of strapping the exoskeleton to the user's leg.

2(b) The Lightcycle™ lamp by Jake Dyson is influenced by the construction industry and is adjusted manually by pushing the arms.





(i) Suggest a possible inspiration from the construction industry for the design of the Lightcycle™ lamp.

(ii) Outline, using annotated sketches, how the roller-and-groove system shown could be manufactured.

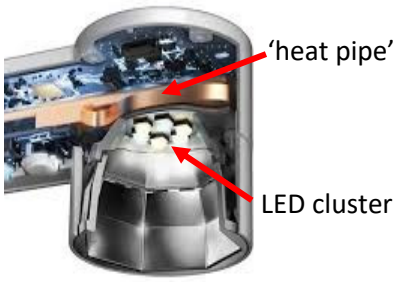
(iii) Describe, using annotated sketches, mechanised systems to adjust height **A** and rotary movement **B**.

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

2(c) The Dyson Lightcycle™ lamp monitors light colour and brightness throughout the day and then adjusts the output of the LED cluster, which is predicted to last for 60 years due to *heat pipe* technology.

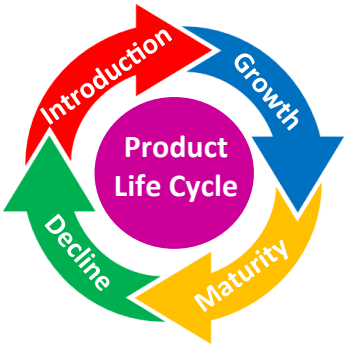
(i) Briefly outline how adjusting light colour, intensity and brightness of the lamp might have a positive impact on user wellbeing.

(ii) Suggest the purpose of the *heat pipe* and outline its possible impact on LED life span.



OR

2(d) The four recognised stages of a product life cycle are shown in the graphic.



(i) Draw a typical product life cycle graph to represent product sales over time.

(ii) Using the Dyson Lightcycle™ lamp as an example, describe **each** of the stages in a product life cycle.

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

3(a) Kitchen appliances such as blenders, mixers and whisks improve efficiency in preparing fresh foods.

(i) Suggest **two** technological advances that could make such appliances more energy efficient.

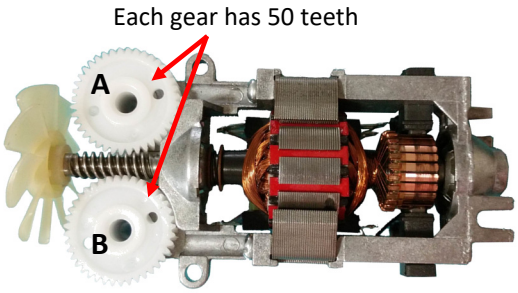
(ii) State **two** technologies used in the preservation of food.

3(b) A food processor is driven by an electric motor with a range of speed options. A gear system is used to rotate the beater shafts.

(i) Describe a means of producing a range of speeds and reversal of rotation.

(ii) The gears **A** and **B** shown are made from nylon. Give **two** reasons for choosing nylon to produce the gears.

(iii) The gears **A** and **B** drive the beaters. Calculate the rotational speed of the beaters when the motor runs at 2000 RPM.



Food processor drive unit

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

3(c) During the product design process, engineers strive to produce designs that address the capabilities, limitations and needs of the user.

(i) Distinguish between *ergonomics* and *anthropometric data* in product design.

(ii) Describe, with annotated sketches, **one** ergonomic feature and **one** anthropometric feature of the hand blender shown.

OR

3(d) Two commonly used food packaging boxes for the fast-food industry are shown.

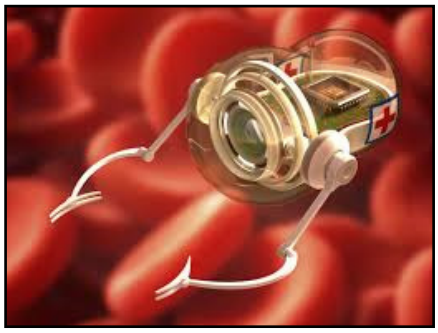
Compare the environmental footprint of the boxes, making reference to manufacturing processes, material properties and recyclability.

Box A.
Made from expanded polystyrene.

Box B.
Made from cardboard.

Section C - Options - *Answer **any two** of the five optional questions.*

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



1(a) Nanorobotics is an emerging technology creating machines or robots whose components are at or near the scale of a nanometre (1×10^{-9} metres). Nanorobotics is expected to have a significant influence in healthcare, construction and manufacturing in the future.

(i) Explain the notation 1×10^{-9} metres.

(ii) Suggest **two** potential uses for nanorobotics in medicine.

1(b) *Flow* is a personal air pollution sensor designed by Plume Labs to help you understand what you are breathing and to warn of air pollution. Strapped to a bag, bike or belt this device provides measurements of nitrogen dioxide, volatile organic compounds and particulate matter in the air.

The following sequence of operation is used:

The power is turned on.
After 3 seconds, a green LED flashes to indicate the device is operational.
The level of each pollutant is checked.
When the level of any pollutant increases, three amber LEDs flash.
If the level of any pollutant goes above a pre-set threshold, three red LEDs flash and a buzzer sounds until the reading drops back to a safe level.

These data are sent to a smart phone for processing by an app.

(i) Draw a flowchart for the operating sequence of the device.

(ii) Modify your flowchart to include an alert if any pollutant level remains high for more than 10 minutes.

(iii) Suggest a method of transferring the data from the device to a smart phone.

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

1(c) The robot *Rubion* picks and packages strawberries using a delicate clasping mechanism. It has the ability to pick between 180 and 360 kilograms of strawberries per day.

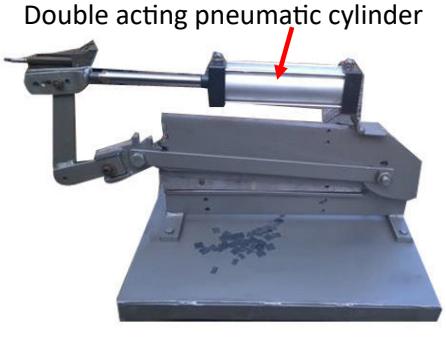
(i) Rubion uses a *closed-loop* control system to ensure proper positioning. Outline the principles of a closed-loop control system.

(ii) Describe, using annotated sketches, an end-effector that could be used to pick strawberries without bruising.

OR

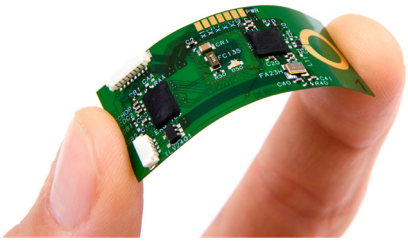
1(d) (i) Draw a pneumatic circuit diagram to operate the double-acting cylinder on the sheet metal cutter shown.

(ii) Describe another suitable application for a double-acting pneumatic cylinder.



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

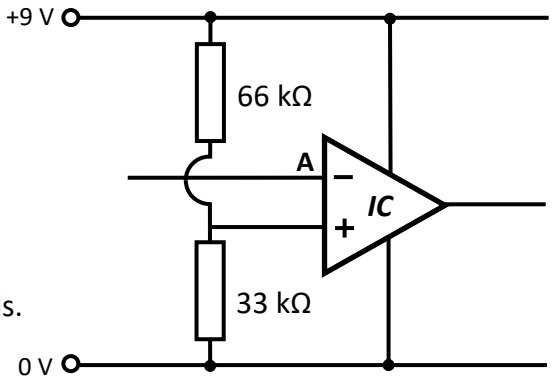
2(a) Flexible electronics, or flex circuits, is a technology for mounting flexible printed circuits (FPCs) and devices on bendable polyimide sheets.



(i) Outline **two** advantages of using flexible printed circuits (FPC).

(ii) Describe **one** application of such flex circuits.

2(b) The incomplete circuit shown is designed to provide an alert when light levels drop.



(i) Complete the circuit to include a suitable input and output.

(ii) Describe how the circuit operates making reference to the **IC** and voltage at **A**.

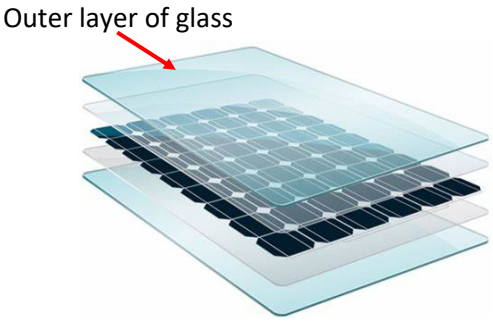
(iii) Printed circuit boards (PCBs) increasingly use surface-mounted components rather than drilled boards.

Describe **two** reasons for the use of surface mount ICs.

Surface mount IC

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

2(c) The photovoltaic (PV) panel shown has a number of layers.

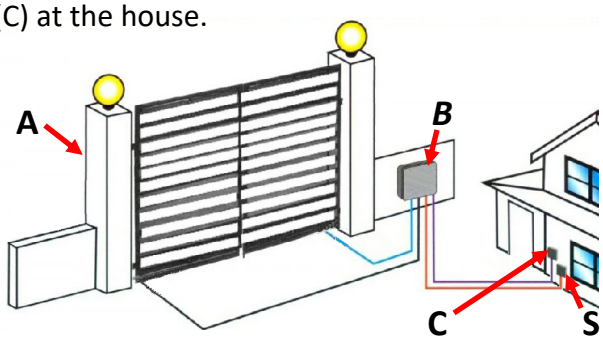


(i) Outline **two** reasons for the use of glass in the outer layer of the PV panel.

(ii) Explain the operation of a PV system, making reference to equipment, energy conversion and supply of AC current.

OR

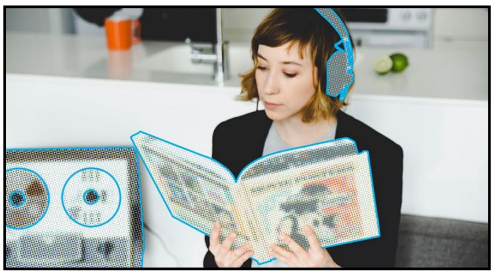
2(d) The automated gate system shown has two keypads (A and B) to open the gates, one inside and one outside the entrance. The system also has a master on/off switch (S) and a gate opening switch (C) at the house.



(i) Draw a logic circuit diagram to represent the operation of the gates.

(ii) Compile a truth table for this logic circuit.

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



3(a) A new commercial era described as 'The End of Ownership' is emerging for a range of products and services. This refers to a move toward paying a subscription for access to, or use of, a service rather than outright purchase.

(i) Outline **two** advantages of the use of subscription services for access to music or movies.

(ii) Distinguish between *annual licence, perpetual licence* and *consumption licence* as models of subscription services.

3(b) (i) Compare the main features of *ASCII* and *Unicode* as forms of code for information interchange.

(ii) Describe, with annotated sketches, the setting up of a LAN for three wired computers and a shared printer. Make reference to equipment used, security and set-up procedures.

(iii) Internet users can be at risk from malicious actions such as:

- Pharming
- Phishing
- Baiting.

Explain **each** of these terms.

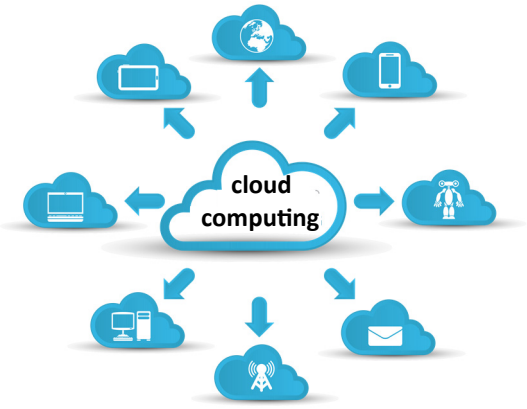
*Answer 3(c) **or** 3(d)*

3(c) Tablet computers use solid-state storage media rather than magnetic storage media.

(i) Suggest **two** reasons for the increasing use of solid-state storage for tablet technology, despite the extra cost.

(ii) Explain the possible effect of sudden movement or physical shock on magnetic media.

OR



3(d) The consistent growth of cloud computing has been a feature of the ICT sector in recent years.

(i) What is cloud computing?

(ii) Outline **two** advantages and **two** disadvantages of cloud computing.

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

4(a) *Fairphone is made of recycled and fairly sourced materials and is manufactured in a way which respects human and environmental rights. Fairphone supports programs to reduce e-waste and the phone is entirely modular. As a result, your Fairphone can live longer. (Fairphone.com)*

The Fairphone 3 is supplied only with phone, bumper, screwdriver and box.
The phone integrates Fairtrade™ gold into the manufacturing process and is rated with a perfect score for repairability (iFixit).

(i) Explain the term *Design for Environment* (DfE).

(ii) Explain **each** of the following Fairphone features in terms of DfE:

- The modular design
- Fair employment conditions for workers
- Phone supplied without charger, case, earphones or USB-C cable.

4(b) *Custom Coasters* is a woodcraft shop that allows customers to personalise their own coasters, with options for shape, logo and material.

An order for 2500 coasters is received from a hotel chain, that requires a logo to be placed on each one. Due to the large order, the shop owner is considering buying an engraving machine instead of manually carving the logo on each coaster.

The following data describe the options available:

Engraving machine purchase cost - €3,600.
Unskilled labour to operate machine - €0.52 per coaster.
Or
Skilled labour to manually carve required logo - €2.55 per coaster.

(i) Draw a graph to show the cost of manufacturing the coasters using each method. Hence or otherwise find the BEQ.

(ii) Suggest **two** additional costs which might be incurred by changing to a fully automated process.

(iii) Outline **one** feature which could be highlighted when marketing a manually produced item and **one** feature which could be highlighted when marketing a machine-produced item.

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

4(c) (i) A core principle of lean manufacturing methodology is the removal of waste within an operation.

Describe, with reference to a specific example, **each** of the following potential sources of waste in a manufacturing context:

- Defects
- Time
- Production
- Stock.

(ii) Continuous-flow manufacturing is an approach to manufacturing that is associated with a just-in-time and kanban production system as well as with demands for ongoing improvement.

Explain the principles of *continuous-flow* manufacturing and *just-in-time* production.

OR

4(d) Planned obsolescence has been a feature of some everyday products since the 1950s, with examples as diverse as light bulbs, cars, phones, computers and print cartridges.

(i) Outline **two** problems of planned obsolescence for the consumer and **two** benefits of planned obsolescence for the manufacturer.

(ii) Describe, with reference to a specific example, each of the following dimensions of quality:

- Durability
- Perceived quality.

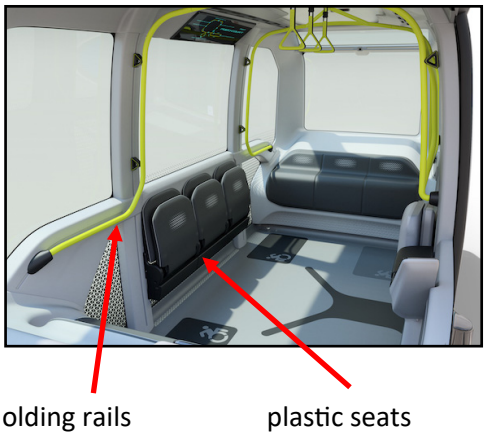
Option 5 - Materials Technology - *Answer 5(a)* ***and*** *5(b)*

5(a) The Toyota e-Palette electric shuttle will transport athletes at the 2020 Olympic and Paralympics Games. It is planned as an automated electric vehicle.

(i) Explain the roles of once-off production and batch production in vehicle development.

(ii) Suggest **three** materials suitable for use in the manufacture of the e-Palette vehicle and give a key property of each.

5(b) The interior of the e-Palette vehicle is shown.



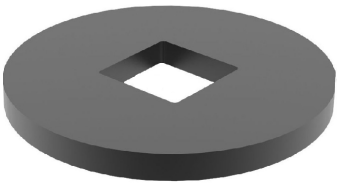
(i) Suggest a material, manufacturing process and surface finishing technique for the manufacture of the holding rails.

(ii) Describe, with the aid of annotated sketches, a method for manufacturing the plastic seats.

(iii) Outline **three** features of the e-Palette vehicle interior which have been designed with user safety in mind.

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

5(c) (i) Distinguish between a scroll saw and a bandsaw, making reference to type of cutting blade, motion of cutting blade and operator safety.



(ii) Outline, with the aid of annotated sketches, the steps required to produce a square cut-out in the centre of the circular acrylic workpiece shown.

OR

5(d) "The problem of plastic pollution in the ocean is even worse than anyone feared. There's actually more micro-plastic 1,000 feet down than there is in the Great Pacific Garbage Patch" *Greta Thunberg.*

(i) Explain, using an example, the term *single-use plastic*.

(ii) Outline **one** way in which **each** of the following could reduce their use of single-use plastics:

- Food industry
- Schools
- Home.

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