2023.M104A

2023L065A1EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2023

Technology

Section A and Answerbook

Higher Level

Monday 26 June Afternoon 2:00 - 4:30

160 marks

Examination Number

Day and Month of Birth

For example, 3rd February is entered as 0302

Centre Stamp

Instructions

Write your Examination Number and your Day and Month of Birth in the boxes on the front cover.

Write your answers to all parts of the examination into this answerbook. This answerbook will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner.

Write your answers in blue or black pen. You may use pencil for sketches, graphs and diagrams only.

There are three sections to this examination. Attempt **all three** sections.
Questions for Sections B and C are supplied separately but your answers must be written in this answerbook.

Section A 72 marks
Core – Short-answer questions.
Answer **any twelve** questions in this section.
Each question carries 6 marks.

Section B 48 marks
Core – Long-answer questions.
Answer **both** of the core questions presented.
Each question in Section B carries 24 marks.

Section C 40 marks
Options – Long-answer questions.
Answer **one** of the five optional questions presented.
Each question in Section C carries 40 marks.

Section A.

Answer **any twelve** questions. All questions carry 6 marks.
Write your answers in the spaces provided.

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

(i) Explain the term IoT.

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

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

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

1.

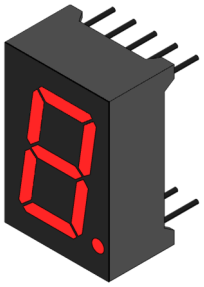
2.

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

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

Calculation:

4. An electronic output component is shown.



(i) Name the component shown.

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

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

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

Calculation:

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

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

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

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

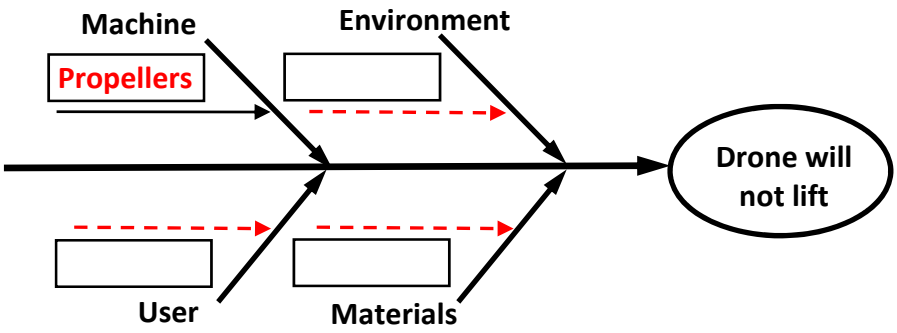
7. Ergonomic keyboards, similar to that shown, have become popular in recent times.

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

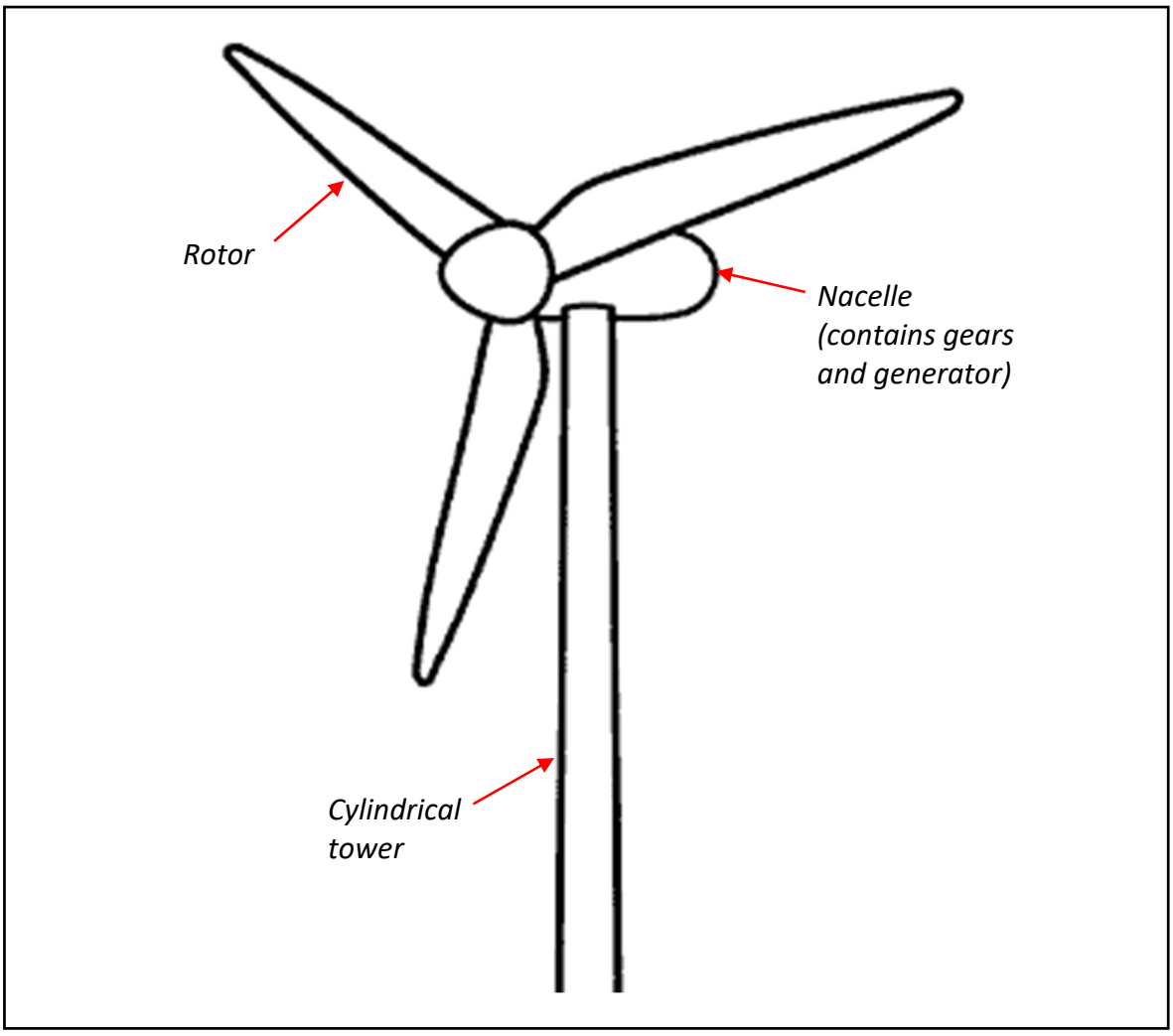
(ii) Outline **two** reasons for the use of ergonomically designed office products.

1.
2.

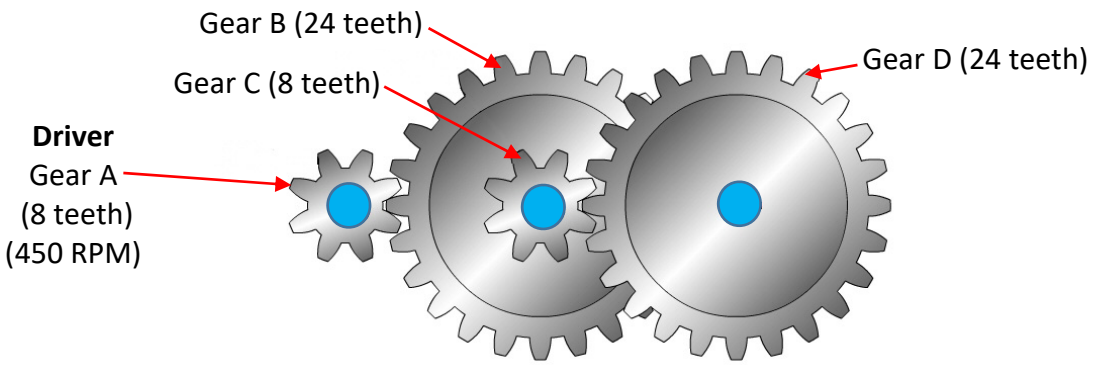
8. Complete the cause and effect diagram below by suggesting **three** factors to analyse the performance of a drone that fails to lift off the ground. One has been completed for you.



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



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



Calculation:

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

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

1.
2.

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

1.
2.

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

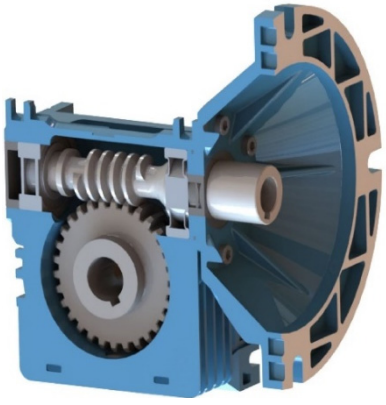
(i) State **two** material properties of gold that make it suitable for jewellery manufacture.

1.
2.

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

Recycling:
Upcycling:

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



(i) Name the mechanism and describe its operation.

Name:
Operation:

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

1.
2.

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

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

1.
2.

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

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

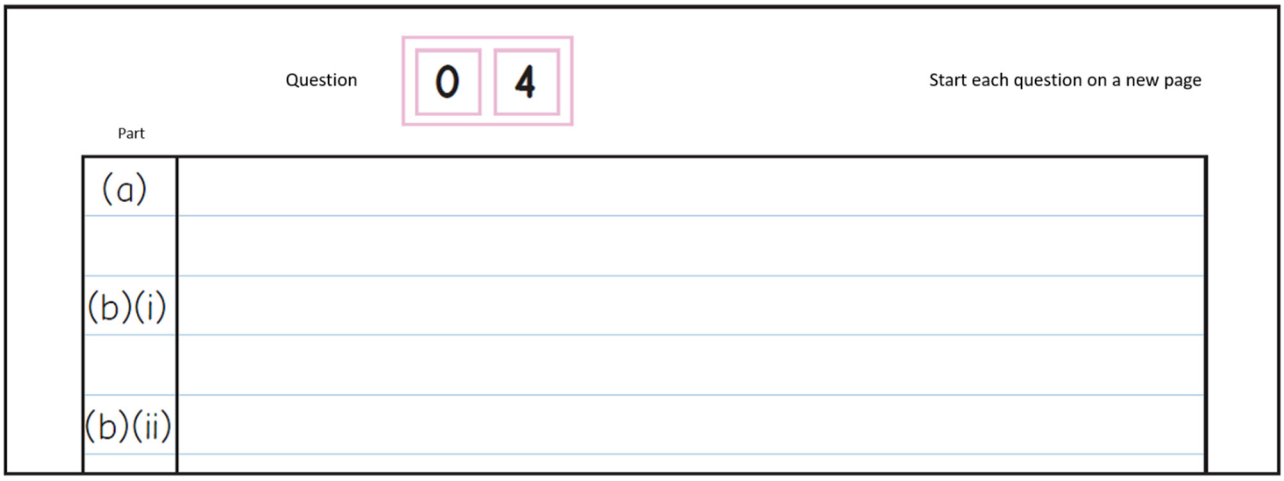
Answerbook for Sections B and C

Instructions

Questions for **Sections B** and **C** are supplied separately.

Start each question on a new page. Write the question number in the box at the top of each page.

Use the left-hand column to label each part, as shown below.



You do not need to use all of the pages in this answerbook. If you run out of space in this answerbook, you may ask the superintendent for more paper.

Write your answers in blue or black pen. You may use pencil for sketches, graphs, and diagrams only.

Question

Start each question on a new page

Part

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part	

Question

Start each question on a new page

Part

Acknowledgements

Image 1. Page 3. Q.1. https://www.irishtimes.com/tags/centre-for-research/
Image 2. Page 3. Q.2. https://www.madeofirish.com/collections/copper-fish-studio-1
Image 1. Page 4. Q.3. https://www.pumpworld.co.uk/Specify/Supergen-Selector
Image 2. Page 4. Q.4. https://grabcad.com/library/connector-rj11-rj12-rj45-1
Image 1. Page 5. Q.6. https://www.milwaukeetool.com/Products/Power-Tools/Drilling/Right-Angle-Drills/0721-20
Image 2. Page 5. Q.6. https://skycraftsurplus.com/products/hobby-motor-1-5-12-volt-dc-3-000-rpm.html
Image 3. Page 5. Q.7. https://www.logitech.com/en-us/about/designawards.html
Image 1. Page 6. Q.9. https://easydrawingguides.com/how-to-draw-a-wind-turbine/
Image 1. Page 7. Q.10. https://www.notesandsketches.co.uk/Gears.html
Image 2. Page 7. Q.11. https://driftinnovation.com/products/drift-vented-helmet-mount-1
Image 1. Page 8. Q.12. https://www.juvidesigns.com/
Image 2. Page 8. Q.13. https://www.iqsdirectory.com/articles/gearbox/gear-reducers.html
Image 1. Page 9. Q.14. https://www.hindleys.com/shop-online/vacuum-forming-sheet-hips.html
Image 2. Page 9. Q.15. https://www.museum.ie/en-IE/Museums/Decorative-Arts-History/Exhibitions/Eileen-Gray

Do not write on this page

Leaving Certificate – Higher Level

Technology Section A and Answerbook

Monday 26 June

Afternoon 2:00 - 4:30

2023.M104BC

2023L065A2EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2023

Technology

Section B and Section C

Higher Level

Monday 26 June Afternoon 2:00 - 4:30

160 marks

Instructions

Section B 48 marks
Core- Long-answer questions.
Answer the **two** core questions presented.
Each question in Section B carries 24 marks.

Section C 40 marks
Options- Long-answer questions.
Answer **one** of the five optional questions presented.
Each question in Section C carries 40 marks.

THESE QUESTIONS ARE TO BE ANSWERED IN THE ANSWERBOOK ATTACHED TO **SECTION A.**

Do not hand this up.

This document will not be returned to the State Examinations Commission.

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

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

2(a) Snap Inc. have developed *Pixy*, a mini drone with a camera.
The personal drone has six *pre-programmed* flight paths from which the user can choose. It will take off, and land, from the user's hand.

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

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

2(b) The yellow casing of the Pixy drone is 3D printed as two parts which house the circuitry and motors.

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

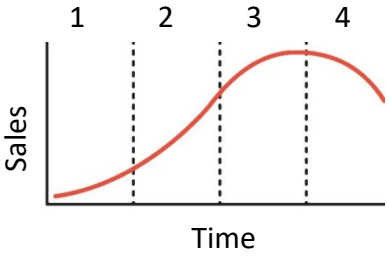
(ii) Outline, with annotated sketches, a means of allowing the battery pack to be changed easily.

Replaceable battery pack

(iii) The Pixy drone is paired with your phone using Bluetooth.
Describe what is meant by Bluetooth and give **two** examples of its use.

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

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



(ii) Concerns were raised over a flight time of five minutes and a reduction in company support for the device, despite initial high demand.
Outline the possible impact of these concerns on the product lifecycle of the Pixy drone.

OR

2(d) The properties of smart materials may be modified in a controllable and reversible way.
Describe, with examples, **each** of the following smart materials:

- Shape memory materials
- Piezoelectric materials.

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

3(a) Volkswagen have developed a prototype carpark robot for charging electric vehicles. Vehicles do not need to be parked at a charging station as this robot can move to a vehicle *autonomously*.

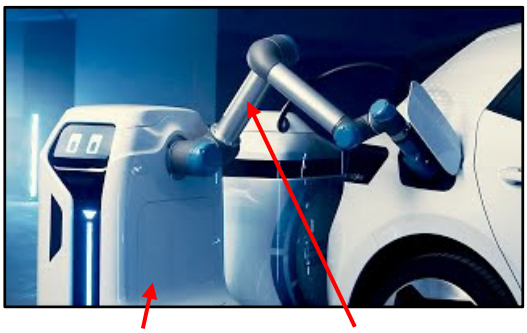
(i) Explain what is meant by the term autonomously.

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

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

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

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



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

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

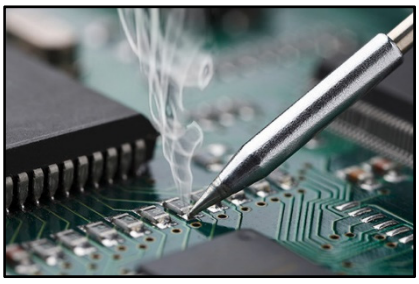
(ii) A common semiconductor material for light emitting diodes (LEDs) is gallium arsenide. Describe, with another example and application, the term *semiconductor* material.

OR

3(d) The Health and Safety Authority (HSA) identifies that risk assessment is central to managing safety, health, and welfare effectively.

Describe **each** of the following steps in carrying out a risk assessment for the manufacture of circuits:

- identify the hazards
- assess the risks
- put control measures in place.



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

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

1(a) Enterprise Ireland report that Irish companies are producing innovative solutions in immersive technologies (VR and AR) across a range of industries.

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

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

1(b) The iBowl 3-in-1 aquarium monitoring system is capable of monitoring and maintaining water quality in an aquarium or fish tank.

The iBowl performs the following steps when operating:

- a green LED illuminates when powered on
- temperature is constantly monitored, with a heater enabled if the temperature falls below a set level
- water quality is monitored by total dissolved solids (TDS) sensors. Poor quality water is drained and clean water is pumped in if needed
- water pH is constantly displayed.

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

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

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

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

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

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

OR

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

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

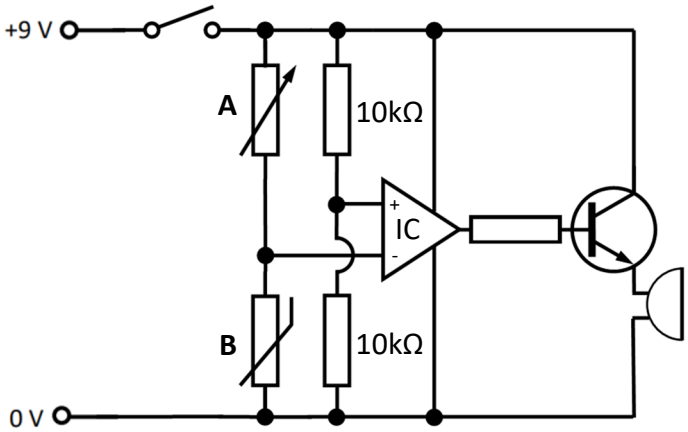
Option 2 - Electronics and Control - *Answer 2(a) **and** 2(b)*

2(a) The installation of solar panels and photovoltaic systems has been incentivised through the Sustainable Energy Authority of Ireland (SEAI).

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

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

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



(ii) Describe the operation of the circuit making reference to the IC and switching components.

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

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

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

(ii) Outline the role of induction in the operation of a wireless charging device.

OR

2(d) The coffee machine operates when a pod and a cup are in place and the water is at the correct temperature.
If all these conditions are not met, a red LED continuously flashes.

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

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

Option 3 - Information and Communications Technology

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

3(a) The use of ICT has an environmental impact in terms of raw materials used, obsolete technology, and energy demand of computer systems such as *web servers* and *data centres*.

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

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

3(b) Laptop computers capable of running 3D CAD programmes require careful specification.

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

- processor
- installed memory (RAM)
- graphics.

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

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

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

3(c) Social engineering attacks, such as phishing, can target individuals, events and organisations.

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

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

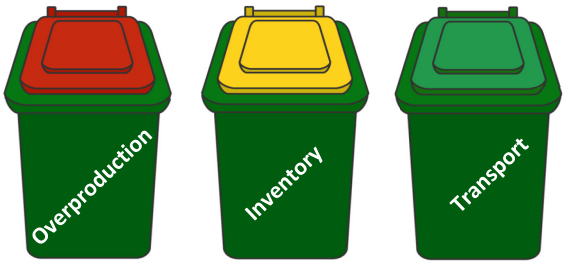
OR

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

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

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

4(a) Large multinational companies have well established Just-in-Time (JIT) relationships with independent manufacturing contractors all over the world.
Some sources of waste in lean manufacturing are identified as:
overproduction, inventory, and transportation.



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

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

- waste from overproduction
- inventory waste
- transportation waste.

4(b) The helmet shown includes a mounted action camera.
To correctly mount the camera a precision-cut hole must be drilled in the helmet.

The table below shows the number of daily product defects over the period of one week.

Day	Mon	Tue	Wed	Thurs	Fri	Sat	Sun
No. of defects	9	11	8	9	10	8	8

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

- the mean of the process
- the UCL
- the LCL.

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

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

Please turn over ⟹

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

4(c) Headsets must be of the highest quality to ensure that the user has a positive experience.

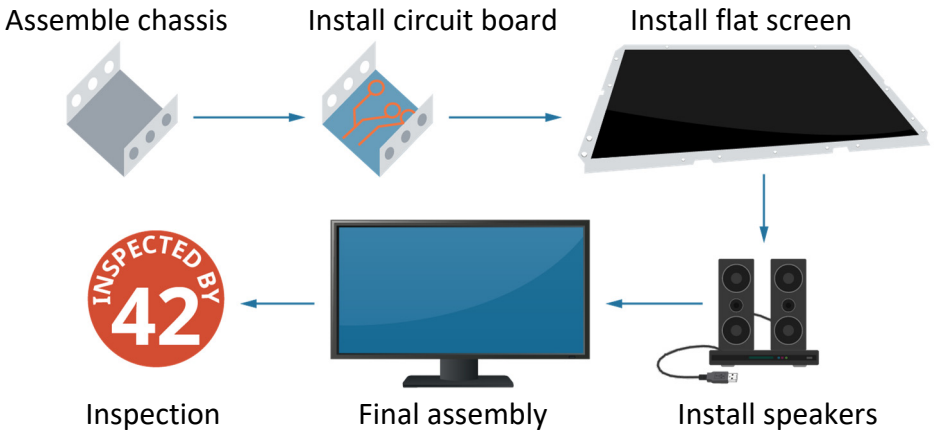
(i) Explain, with examples, any **two** of the following dimensions of quality:

- performance
- serviceability
- features.

(ii) Describe the Pareto principle.

OR

4(d) The assembly sequence of a flat screen television is shown below.



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

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

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

5(a) Initially used in the production of models and prototyping, 3D printing has evolved into a final product manufacturing process.

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

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

5(b) The gaming mouse casing shown consists of a top part and a bottom part which are a snap-fit assembly.

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

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

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

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

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

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

OR

5(d) Computer devices are frequently packaged in corrugated cardboard boxes.

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

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

Do not write on this page

Acknowledgements

Image 1. Page 2. Q.2a. https://www.gsmarena.com/snap_stops_development_of_its_snapchat-_pixy_selfie_drone-news-55469.php
Image 2. Page 2. Q.2b. Q.2b. https://folou.co/mundo/snapchat-dron-pixy-fotos/
Image 3. Page 2. Q.2c. https://www.researchgate.net/figure/Product-service-life-cycle_fig2_316137762
Image 1. Page 3. Q.3a. https://www.greencars.com/news/volkswagens-ev-charging-robots
Image 2. Page 3. Q.3b. https://www.carmagazine.co.uk/car-news/tech/volkswagen-charging-robot/
Image 3. Page 3. Q.3d. https://www.circuitspecialists.com/blog/basic-indoor-soldering-station-setup/
Image 1. Page 4. Q.1a. https://www.businessbecause.com/news/online-mba/7908/edtech-trends-2022
Image 2. Page 4. Q.1b. http://digilifeweb.com/Aquarium-Monitor-IBowl-3-in-1
Image 3. Page 4. Q.1d. https://www.mfgnewsweb.com/archives/metalfmg_fabricating_waterjet/apr18/pics/FANUC-R-1000iA_120F-7B-Welding-Robot-1.jpg
Image 1. Page 5. Q.2a. https://ecohorizon.ie/the-news-we-have-been-waiting-for-is-finally-here/
Image 2. Page 5. Q.2d. https://www.breville.com/us/en/products/nespresso.html
Image 1. Page 6. Q.3a. https://www.3blmedia.com/news/global-emissions-ict-sector-par-aviation-industry
Image 2. Page 6. Q.3b. https://www.binarytides.com/best-laptops-for-animation-and-graphics/
Image 1. Page 7. Q.4a. https://www.allaboutlean.com/muda/
Image 2. Page 7. Q.4b. https://www.amazon.co.uk/GoPro-Helmet-Front-Mount-Camera/dp/B01GCKO9Z8
Image 1. Page 8. Q.4c. https://www.flipkart.com/audio-video/toshiba~brand/pr?sid=0pm
Image 2. Page 8. Q.4d. https://courses.lumenlearning.com/wm-introductiontobusiness/chapter/facility-location-and-layout/
Image 1. Page 9. Q.5a. https://www.recompute.com.au/blog/environmental-impact-of-3d-printing/
Image 2. Page 9. Q.5b. https://www.catch.com.au/product/2-4ghz-honeycomb-lightweight-wireless-gaming-mouse-rgb-gamer-mice-for-game-white-11264695/
Image 3. Page 9. Q.5d. https://www.dreamstime.com/stock-photography-computer-mouse-cardboard-box-image22828612

Do not hand this up

Leaving Certificate – Higher Level

Technology Section B and Section C

Monday 26 June

Afternoon 2:00 - 4:30