Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2019

Technology

Higher Level

Monday, 24 June
Afternoon, 2:00 - 4:30

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. All questions in Section A carry 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. All questions carry 6 marks.*

1. Technological development has revolutionised the ways in which products are developed. Give **one** example for **each** heading below illustrating the impact of technology on the development of a mass-market drone.

(i) Research _____

(ii) Prototyping _____

(iii) Manufacture _____

2. The USB-C (or USB Type C) connector is increasingly seen on a range of devices, such as the laptop shown.
Outline **two** advantages of USB-C over other USB connectors.

(i) _____

_____

(ii) _____

_____

3. In the context of information security, *social engineering* refers to the manipulation of people to divulge personal and confidential information using techniques such as phishing or vishing.

(i) What is phishing?

_____

_____

(ii) Outline **one** method of guarding against social engineering.

_____

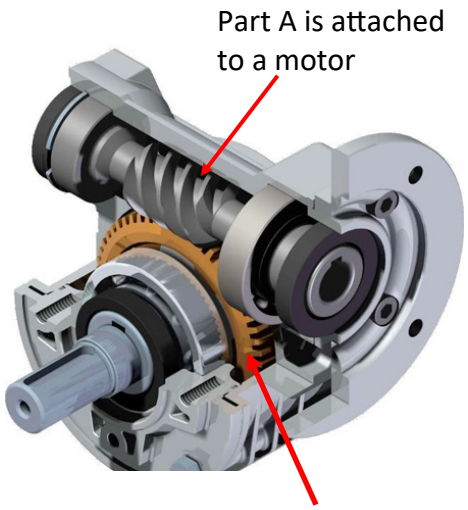
_____

4. (i) Name the mechanism shown in the graphic.

_____

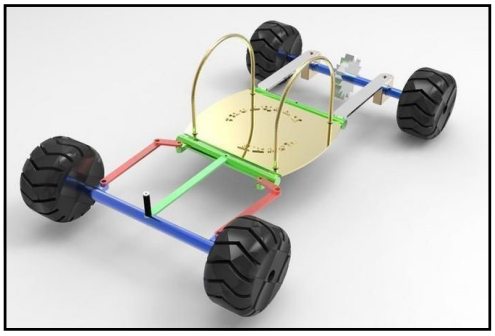
(ii) If the motor rotates at 300 RPM, determine the time taken for Gear **B** to complete one full revolution.

Calculation:



5. Compile a simple Work Breakdown Structure (WBS) for the manufacture, in a school workshop, of the buggy shown.

WBS:



6. (i) Describe the operation of the electronic component shown.

_____

_____

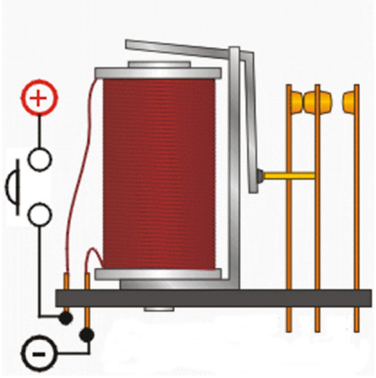
_____

(ii) Explain the abbreviations associated with this device.

NC _____

NO _____

COM _____

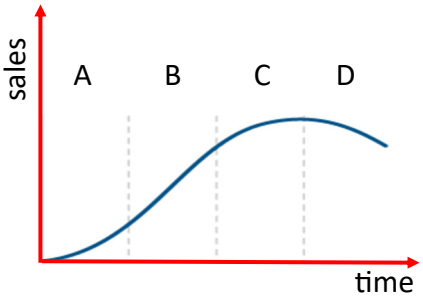


7. New products exhibit recognised phases following the launch and introduction phase (A). Name **each** of the phases B, C and D of the lifecycle graph shown.

B _____

C _____

D _____



8. The design and finish of the exercise machine shown is of high quality. The manufacturer also requires that the machine operates quietly.

Describe, using annotated sketches, how the pedals and their connecting shaft can be designed to operate with a minimum of noise.

9. Mamukko is a Kinsale based company that creates bags from selected reclaimed sails, liferafts, leather and other textiles. Each Mamukko bag is handcrafted in their workshop.

(i) Outline briefly the process of upcycling.

_____

_____

(ii) State the impact upcycling has on cost of materials **and** on processing a handcrafted bag.

_____

_____

_____

10. Sonarc, an Irish company, has created the world's first audio speaker which has no moving parts.

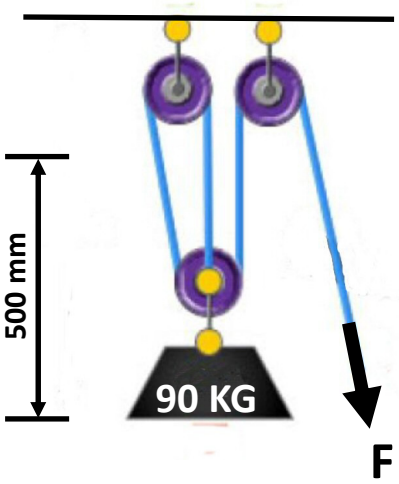
(i) State **one** energy conversion that takes place in an audio speaker.

(ii) Outline **two** advantages of designing an audio speaker with no moving parts.

11. The pulley system shown is used to assist in raising heavy loads.

(i) Calculate the work done to raise the 90 kg weight through 500 mm by applying a force at **F**.
Assume g = 9.81 m/s^2

Calculation:



(ii) Explain the term *mechanical advantage*.

12. Using an appropriate example, describe briefly how a product might be tested against a design specification.

Selected product: _____

Testing procedure: _____

_____

_____

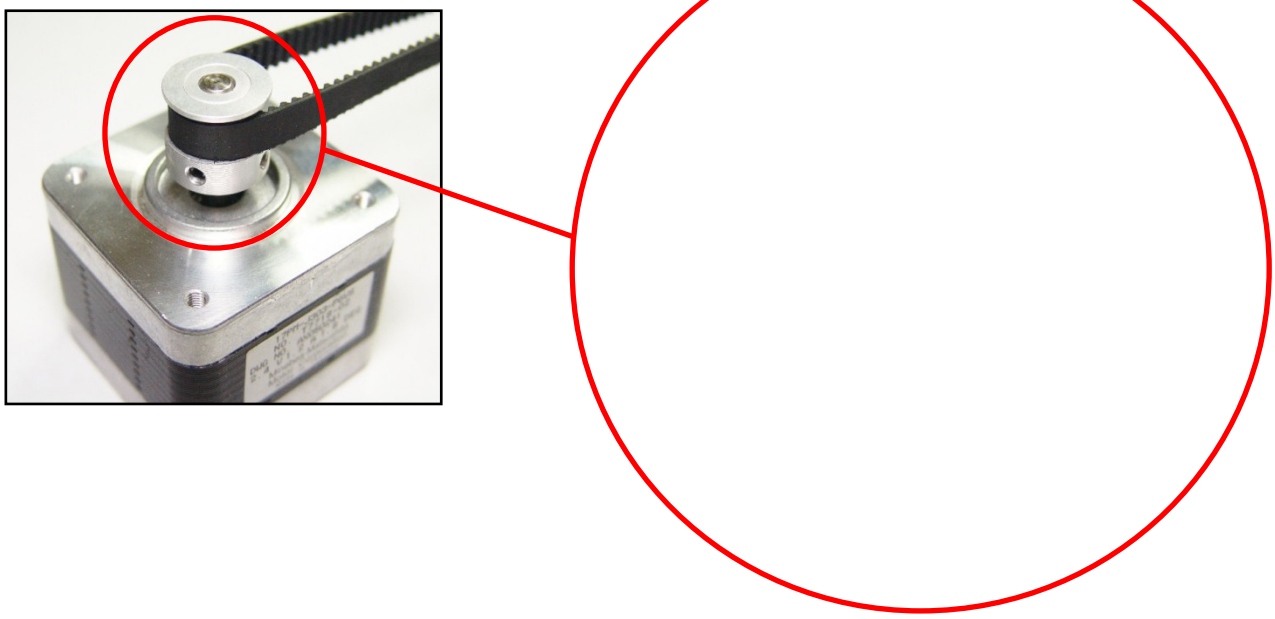
_____

_____

_____

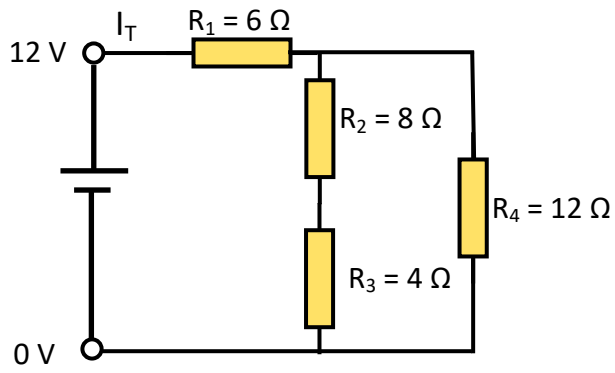
13. The pulley-wheel shown is driven by the motor.

Make a sketch showing how the pulley-wheel could be located on the motor shaft to prevent slippage.



Annotated sketch of detail to prevent slippage

14. (i) Calculate the total resistance of the circuit shown.

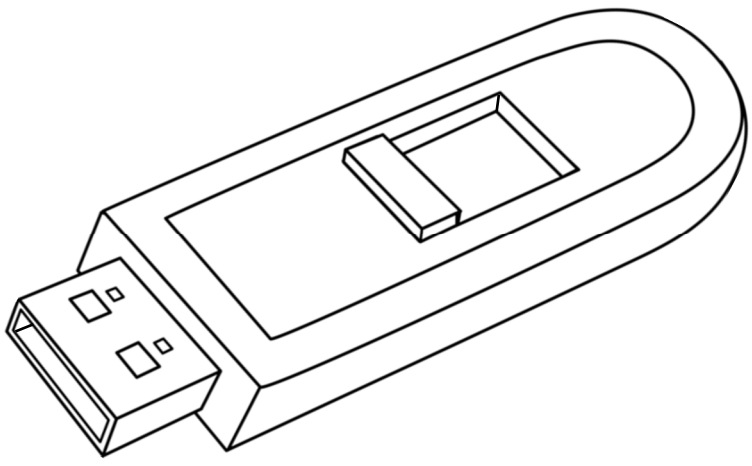


Calculation:

(ii) Calculate the current (I_T) drawn from the 12 V supply.

Calculation:

15. Use **two** graphic techniques to enhance the representation of the device 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.*

All questions in Section C carry 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.

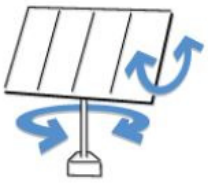
Section B - Core - *Answer Question 2* ***and*** *Question 3.*

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

2(a) Output from solar photovoltaic panels varies depending on latitude, panel angle and orientation. In Ireland, a typical 3 kW home photovoltaic installation would generate 2,600 kWh of electricity annually.

(i) Suggest a means of storing the energy generated during the daytime, for use at night or later.

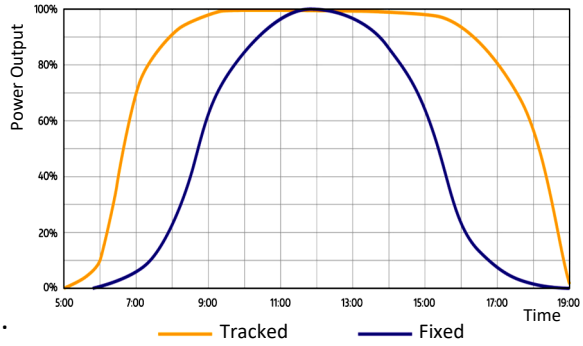
(ii) If a home uses 6500 kWh of electricity annually, calculate the percentage of this requirement that the typical 3 kW solar panel system described above may provide.



2(b) A dual-axis tracking system is used to position solar photovoltaic panels to maximise their output by tracking the path of the sun.

(i) Outline, using annotated sketches, a method of providing smooth and precise movement, in two axes, for a solar panel similar to that shown.

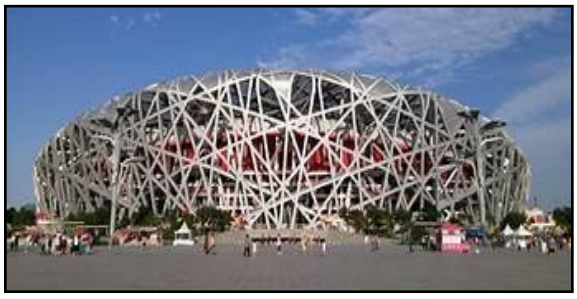
(ii) Draw a suitable circuit to detect reducing light levels and activate a mains-powered motor.



(iii) The graphs shown compare the output from a dual-axis tracked system with the output from a fixed-panel system.

Analyse the information provided and discuss the advantages and disadvantages of the **tracked** system.

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



2(c) The work of many progressive architects and engineers has been inspired by nature. An example is Beijing's national stadium which is often referred to as the 'Bird's Nest'.

(i) Outline **one** design feature of the Bird's Nest Stadium that maximises the use of natural light.

(ii) Structures must be able to withstand forces such as tension, torsion and shear.

Define **each** of these forces.

OR

2(d) Explain **each** of the following techniques, employed to enhance structural strength:

- Triangulated frames
- Alloying
- Corrugated structures.

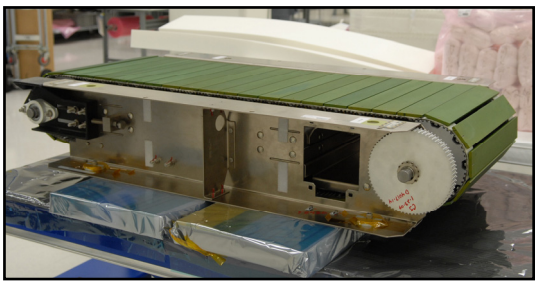
Question 3 *- Answer 3(a)* ***and*** *3(b)*

3(a) The anti-gravity treadmill has been inspired by NASA space technology. The treadmill was originally designed to allow astronauts become accustomed to partial weightlessness in space.

Outline **one** reason for using anti-gravity treadmill technology for:

- Rehabilitation from injury
- Professional athletics and sports.

3(b) NASA named its space station exercise treadmill after US comedian and host, Stephen Colbert. It is designed to work without an external power source and astronauts use shoulder straps to stay on the treadmill.



(i) List **three** desirable properties of the material chosen to make the belt of this treadmill.

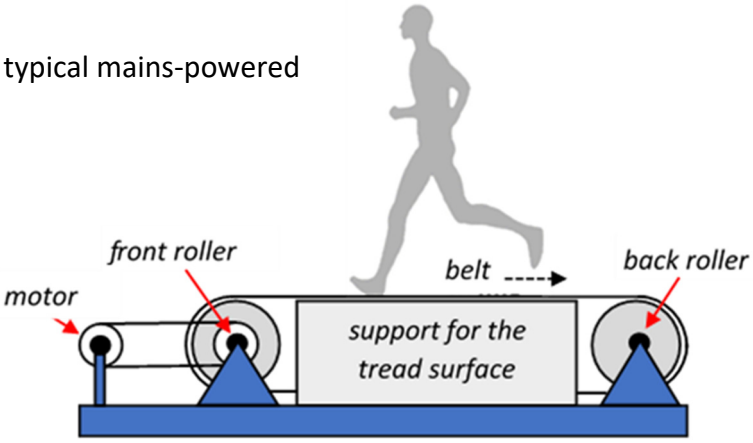
(ii) A concern was expressed that vibration from the treadmill might affect the instruments on the space station. Suggest, using annotated sketches, a method of minimising vibration while the treadmill is in use.

(iii) Describe, using annotated sketches, how the individual sections of the treadmill belt might be connected to form one continuous belt as shown.

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

3(c) (i) Give **two** electrical safety features of a typical mains-powered domestic treadmill.

(ii) Outline the purpose of any sensing system commonly used on a modern treadmill.



OR

3(d) (i) Outline **one** electrical method and **one** mechanical method of varying the output speed produced by an electric motor.

(ii) Describe **one** method of adjusting the incline of a treadmill.

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

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

1(a) Near-Field Communications (NFC) devices are used in contactless payment systems. These systems facilitate mobile electronic payment processing and electronic ticketing.

(i) State **three** specific applications of NFC technology.

(ii) Describe **two** possible limitations of NFC technology.

1(b) A 'kick to open' car boot system allows a driver to open and close the boot door by moving a foot beneath the rear bumper. This is a useful feature when approaching a car with both hands occupied with groceries or other goods.

The following sequence of operations is used:

If the car is locked and the owner has the key in their possession, the boot door will open when the owner moves their foot under the bumper. This activates a motor in the linear actuator which opens the boot door. It remains open for 5 minutes or until the owner covers a sensor on the boot door to signal it to close.

(i) Draw a flowchart for the operating sequence of the boot door system.

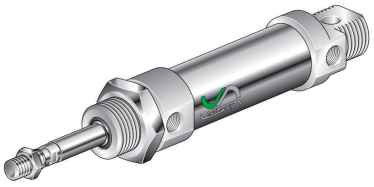
(ii) Add a flowchart modification that will detect an obstruction on closing the boot door and return it to the open position.

(iii) Describe **one** sensor that could be used to detect the movement of a foot under the bumper and **one** sensor to detect the presence of a key on the operator.

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

1(c) Draw a separate pneumatic circuit to control the double acting cylinder shown, in **each** of the following situations:

1. to operate at a controlled speed.
2. to operate in conjunction with a shuttle valve.



OR

1(d) (i) Describe, using annotated sketches, a method of programming a robot to spray-paint components on a production line.

(ii) Explain the importance of accurate and consistent positioning of components on an automated production line.

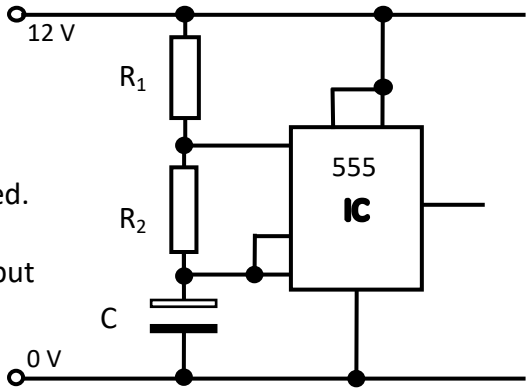
Option 2 - Electronics and Control - *Answer 2(a) **and** 2(b)*

2(a) House alarm systems make use of many elements of electronics and control.

(i) Draw a logic circuit and truth table for a device which can activate a security alarm if **either** sound or movement is detected after dark.

(ii) Suggest input **and** output electronic components for this circuit.

2(b) The glowing or flashing LED effect used by some speaker systems can be controlled by IC circuits.



(i) Draw the given circuit in your answerbook. Identify the pins on the IC and complete the circuit to include an LED output.

(ii) Describe how the flash rate of the LED could be adjusted.

(iii) Calculate the frequency (f) in Hertz, of the astable output if the value of C is 10 µF, R_1 is 2 kΩ and R_2 is 39 kΩ.

Note: $f = 1.44 / (R_1 + 2R_2) \times C$

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

2(c) The *transformer*, *rectifier* and *regulator* are key elements of an effective mains-operated power supply.

(i) Draw a circuit diagram of a regulated power supply.

(ii) Outline the function of **each** of the key elements of a mains-operated power supply which are listed above.

OR

2(d) (i) Explain what is meant by *back EMF.*

(ii) DC motors can typically have an efficiency of 70% to 85%.

Outline **two** reasons why a DC motor does not reach 100% efficiency.

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

3(a) Products such as the Manus VR glove have the potential to transform the way we work, learn, play games, shop and interact with others.

(i) Explain the terms *Virtual Reality* and *Augmented Reality.*

(ii) Outline your understanding of OSS (*open-source software).*

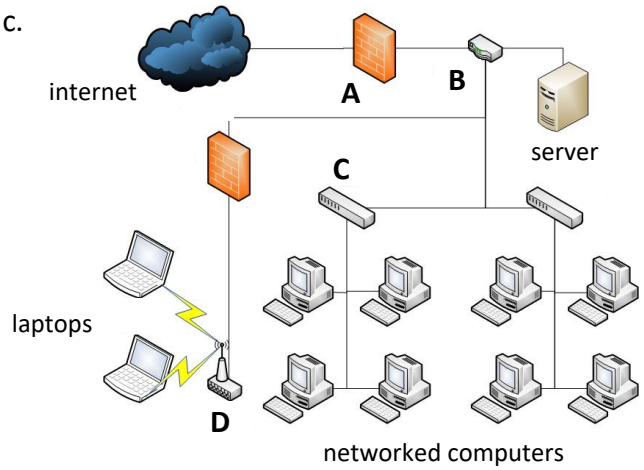
Manus VR glove

3(b) A typical LAN for a small business is shown in the graphic. It consists of wired computers and wireless laptops.

(i) Distinguish between a WLAN and WWAN.

(ii) Name and describe the function of components **A**, **B**, **C** and **D**.

(iii) Suggest **two** other features that could be added to increase the functionality of the LAN shown.



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

3(c) Wireless personal area networks (WPAN) are used for wireless connections over short distances. IR and Bluetooth are the most common WPAN technologies.

(i) State **one** advantage and **one** disadvantage of using a WPAN.

(ii) Explain the impact of **both** *absorption* and *reflection* on the performance of wireless technologies.

OR

3(d) The Rugby World Cup will take place in Japan during the autumn of 2019. It will be the first time this event is staged in Asia.

(i) Explain **three** elements of the URL shown below.

https://www.rugbyworldcup.com/supporters

(ii) *Blogs*, *wikis* and *podcasts* are often used for communicating opinion and information around major sporting events.

Explain what is meant by **each** of these three terms.

RUGBY WORLD CUP™ JAPAN日本2019

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

4(a) Manufacturing companies compete in the marketplace by virtue of one or more of the following competitive priorities:

- Cost
- Quality
- Flexibility
- Speed.

(i) Explain, using specific examples, **any two** of these priorities.

(ii) Distinguish between an *order qualifier* and an *order winner*.

4(b) An Irish business can import and re-package the electronic toy shown at €40 per unit. The costs of manufacturing the same product in Ireland are shown below.

The selling price of the toy is €50 per unit (both methods of production).

Cost of machinery	€25,000
Cost of tooling	€5,000
Variable Costs	€20 per unit
Sales Forecast	**20,000 units**

(i) Using a break-even graph, or otherwise, calculate the BEQ.

(ii) Determine whether it is more cost-effective for the electronic toy to be imported or manufactured in Ireland.

(iii) Calculate the profit earned on 20,000 units by importing and re-packaging the toy and the profit earned on 20,000 units by manufacturing the toy in Ireland.

Please turn over ⟹

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

4(c) (i) A commitment to continuous improvement is the basis of the Deming Cycle. The recognisable stages of this concept are Plan - Do - Study/Check - Act.

Describe **each** of the four stages of the Deming Cycle.

(ii) As production and manufacturing strategies developed, a focus on the concept of quality was central.

Describe **any two** of the following strategies:

- Just-in-Time Manufacturing (JIT)
- Lean production
- Total Quality Management (TQM).

OR

4(d) 'Capacity planning' is a way to analyse demand for a product and find an economical means of meeting that demand.

(i) Capacity can be managed using the following strategies:

- Capacity lead strategy
- Capacity lag strategy
- Average capacity strategy.

Distinguish clearly, with specific examples, between these capacity strategies.

(ii) Outline, using the manufacture of chocolate Easter eggs as an example:

- The consequences of creating excess capacity
  and
- The consequences of not being able to meet demand.

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

5(a) Worldwide, a staggering one million plastic bottles are sold every minute, many of which end up in the ocean.
The Cameroon non-profit organisation, Madiba & Nature, collect PET plastic bottles for reuse as plastic-bottle boats.

(i) Explain the abbreviaton PET.

(ii) Outline **three** disavantages of the extensive use of PET bottles.

5(b) Plastic bottles are mass-produced in a variety of shapes and designs.

(i) Describe, with annotated sketches, a method of producing plastic bottles.

(ii) The walls of plastic bottles are usually very thin, however they retain their shape and can be packed and transported safely. Outline **one** way in which plastic bottles are designed to maximise their strength.

(iii) Explain, with examples, **each** of the following plastic manufacturing techniques:

- Mass production
- Batch production.

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

5(c) (i) Identify specific safety precautions to be observed in **each** of the following uses of adhesives:

- Epoxy resins to join metals
- Cyanoacrylate (instant glue) to join plastics.

(ii) Outline **two** safety features that are integrated into the design of a bandsaw.

OR

'Petite Coiffeuse' by Eileen Gray

5(d) Irish furniture design has a rich tradition of excellence and craftsmanship, from Eileen Gray in the 1920's to present day designers such as Joseph Walsh in Cork.

(i) Suggest **two** reasons for the use of tubular metal in the Petite Coiffeuse dressing table designed by Eileen Gray.

(ii) Irish furniture-maker, Joseph Walsh, designed the Enignium table in ash.
Describe, with annotated sketches, a process to produce a smooth and durable surface finish on the ash table.

'Enignium' by Joseph Walsh

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