Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2016

Technology

Higher Level

Friday, 24 June
Morning, 9:30 - 12:00

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. *Product evolution* is seen in the development of mobile phone technology.

(i) Identify a recent development in the evolution of mobile phone technology.

_____

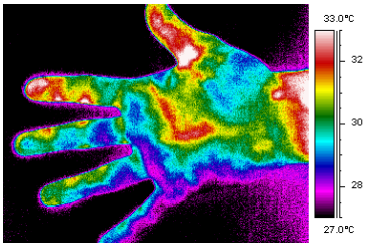
_____

(ii) Outline **one** impact of continuous evolution on product lifecycle.

_____

_____

2. Infrared technologies are used in industrial, scientific and medical applications.



(i) Describe **one** advantage of infrared technology.

_____

_____

(ii) Outline how infrared technology can be used in communication applications.

_____

_____

3. *Food miles* is the distance food travels from the farm to our plates. Energy is used to grow, process, transport and store food.
Analyse the impact of the food miles concept under the following headings:

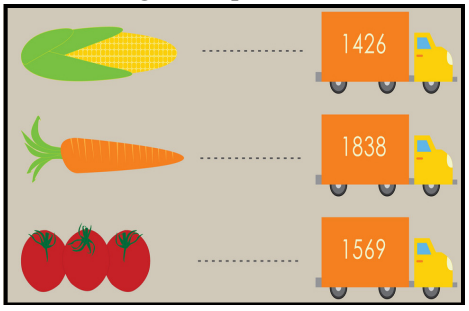
(i) Packaging and transport.

_____

_____

_____

Average transport distance



(ii) Seasonal production of food.

_____

_____

_____

4. *Skylock* is a keyless bike lock that uses multi-sensor technology to provide *remote monitoring* and crash alerts to keep you and your bike safe. The lock includes solar charging capability and can be activated using a mobile phone. It is made from *hardened* steel with an impact resistant rubber shell.

(i) Explain the term remote monitoring.

(ii) Explain what is meant by hardness as a material property.

5. Australian designer, Marc Newson, designed his 'Gluon Chair and Ottoman' in 1993.
The sides of the chair are made from lacquered *polyurethane*.

Suggest **two** reasons for the selection of polyurethane as a suitable material.

(i)

(ii)

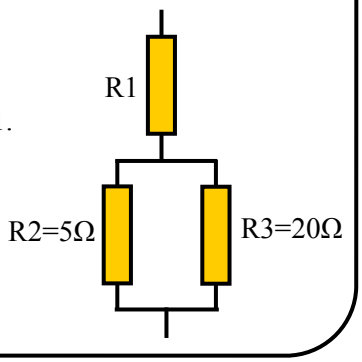
6. A resistor with a gold band denotes a 5% tolerance.

(i) State the minimum and maximum values of a 470Ω resistor with a gold band.

Minimum value:	Maximum value:

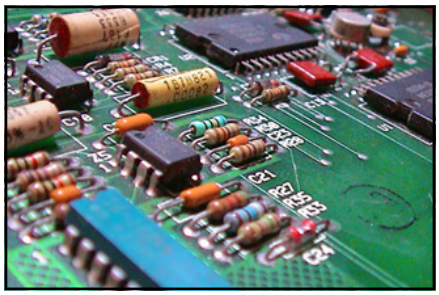
(ii) If the **total** resistance in the circuit is 24Ω, calculate of the value of resistor R1.

Calculation:



7. Analyse the environmental impact of manually soldering a circuit as part of a technology project in terms of:

(i) Energy use.



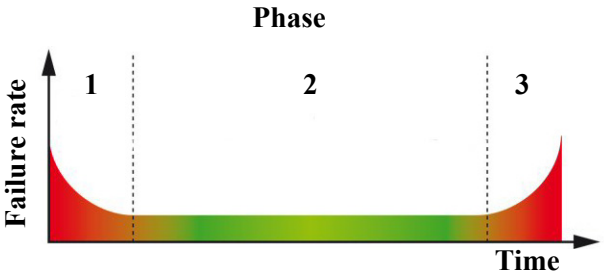
(ii) Soldering materials used.

8. *Product reliability* is often charted as a 'bathtub' graph with three distinct phases.
Describe **each** of these phases.

Phase 1

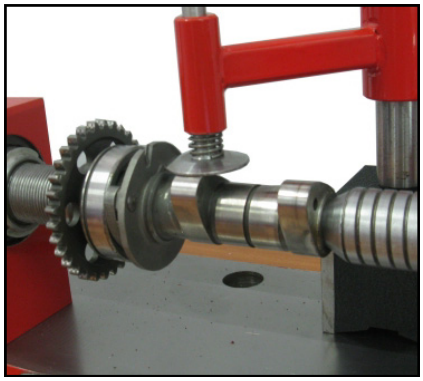
Phase 2

Phase 3



9. The testing machine shown uses a *cam* and *follower*.

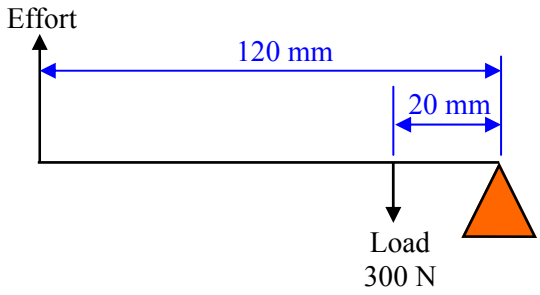
(i) Name the type of follower shown.



(ii) Sketch the typical profile of a snail cam (drop cam).

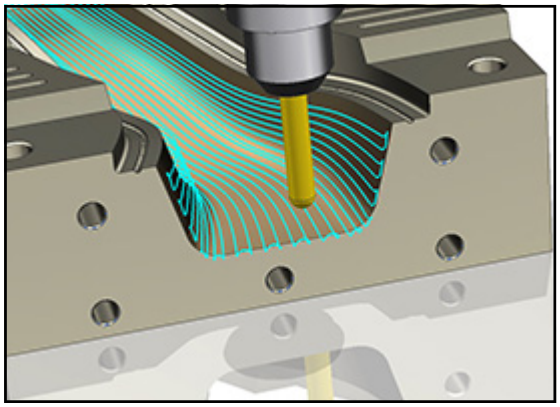
10. (i) Identify the *class of lever* used in the bicycle brake mechanism shown.

(ii) Calculate the effort required for the lever shown below.



Calculation:

11. (i) Explain the term *Computer Aided Manufacturing*.



(ii) Describe a specific use of **each** of the following computerised technologies:

CNC lathe.

3D printing.

12. (i) Arrange the following units in order of *increasing* size:

1 gigabyte 1 terabyte 100 kilobytes.

_____

_____

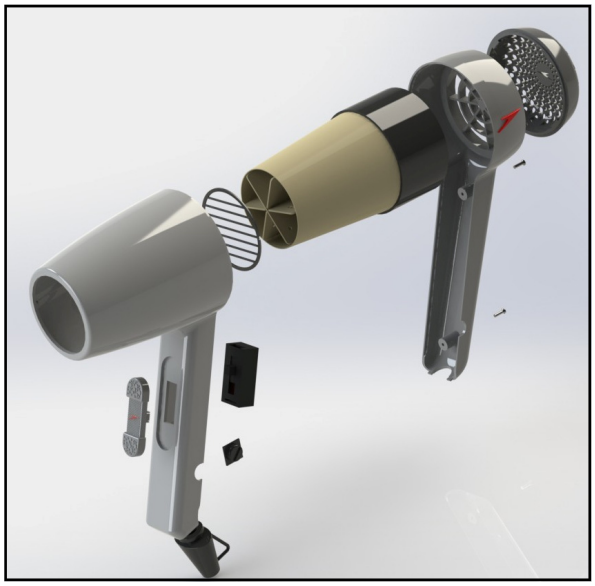
_____

(ii) 1000 bytes is commonly referred to as 1 kilobyte.
State the number of bytes in each of the following:

A document of 196 KB _____

A photograph of 4 MB _____

13. An exploded view of a hairdryer is shown.
Make a well-proportioned freehand sketch of **one** orthographic view of the **assembled** hairdryer.



14. The wind-up torch shown incorporates a number of ergonomic design considerations.

Identify **two** ergonomic features of the wind-up torch shown and explain the function of each feature identified.

(i) _____

_____

_____

_____

(ii) _____

_____

_____

_____

15. Use **two** graphic techniques to enhance the representation of the remote control 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 options presented.*
All questions in Section C carry 40 marks.

Instructions:

(a) Answer these questions in the answerbook provided.

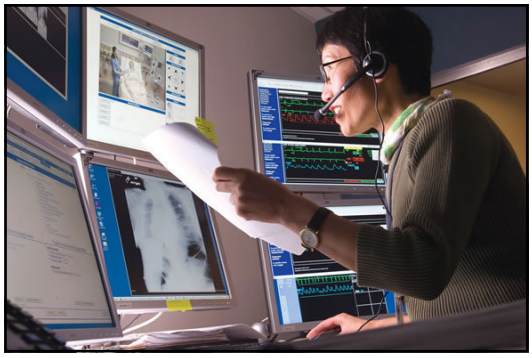
(b) Write your examination number on the answerbook.

(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) In 2015, 34% of healthcare organisations worldwide cited *telemedicine* as a priority for future investment. Telemedicine is the use of technologies to provide health treatment and patient care remotely.

(i) Outline **two** communication technologies that could be used in telemedicine.

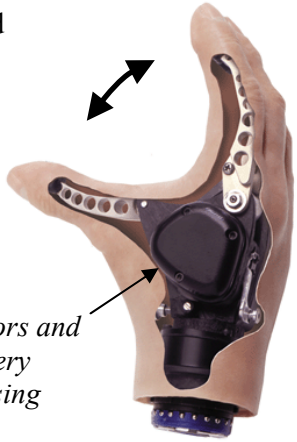
(ii) Suggest **two** benefits of the widespread use of telemedicine techniques.

2(b) Aerospace materials, advanced motor designs and special safety circuitry are integrated into the design of prosthetic devices. Motion-controlled wrists and hands have helped many people with missing limbs to experience an improved quality of life.

(i) Name **one** type of motion demonstrated in the prosthetic hand shown.

(ii) Describe, using annotated sketches, the electro-mechanical operation of the pinching movement of the thumb and finger of the hand shown opposite.

(iii) Suggest a suitable material for the linkages in the prosthetic hand. Justify your answer making reference to material properties.



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

2(c) Safety is of paramount importance in the design of prosthetic devices.

(i) These devices can have a Factor of Safety (FoS) of 5. Explain the term 'Factor of Safety of 5' and outline why it is critical in the design of prosthetic devices.

(ii) Early prototype prosthetic hands used electrical switching of motors to control movement. Describe, with the aid of annotated sketches, a typical circuit to operate a motor providing an 'open and close' pinching movement.

OR

2(d) Open Bionics™ created the *Dextrus* prosthetic hand which won the 2015 UK James Dyson design award. The design of the hand is open source and uses 3D scanning and 3D printing techniques.

(i) Distinguish between the processes of 3D scanning and 3D printing.

(ii) Outline the impact of open source, 3D scanning and 3D printing on the affordability of prosthetic hands.

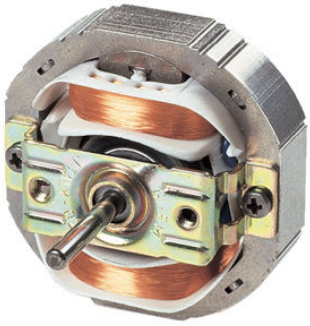
Question 3 - *Answer 3(a)* ***and*** *3(b)*

3(a) Plans have been announced by Swift Composite Prototypes to build Ireland's first electric sports car (the *Alex eroadster*) with the hope of building 1000 cars by 2017.

(i) Outline **two** advantages of the use of carbon fibre in the design of the Alex eroadster.

(ii) Describe **one** significant challenge which has limited consumer acceptance of electric car technology to date.

3(b) It is planned that the eroadster will be powered by 80 kW AC electric motors on the rear wheels. The designers estimate that the two-seater car will be able to reach 100 km/h in less than 10 seconds and drive for over 250 km on a single charge due to a revolutionary new battery design. A regenerative braking system and roof-mounted solar panels are also included.



(i) Calculate the cost of operating an 80 kW machine, at full load, for 2 hours if a unit of electricity costs 18.5 cent.

(ii) Electric motors can range from 80% to 95% efficiency. Suggest **two** sources of loss of energy in an electric motor.

(iii) Explain a possible role for the solar panels on this car.

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

3(c) A group of students, with the help of Rolls Royce, built and drove a prototype electric car to race against teams from other schools in the Greenpower Formula Goblin race.

(i) Using annotated sketches, suggest an aerodynamic body-profile for the car to improve its efficiency and speed.

(ii) Outline the **advantages** of both:
- a chain and sprocket drive *and*
- a toothed belt drive

as drive systems for the car.

OR

3(d) (i) Explain the purpose of compiling a Gantt chart as part of the planning process for the production of the prototype race car.

(ii) The team of students worked through the following stages over the course of a school year:
- Product research (10 hours)
- Develop sketches of design ideas (10 hours)
- Produce final drawings (8 hours)
- Source materials (6 hours)
- Group 1 to fabricate car frame (30 hours)
- Group 2 to manufacture car body (20 hours)
- Assemble and test car (8 hours)

Construct a Gantt chart for the project.

Section C - Options - *Answer **any two** of the Options.*

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

1(a) A microcontroller is an embedded integrated circuit containing a processor core, memory and programmable input/output peripherals.

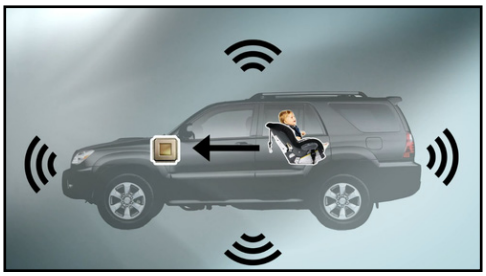
(i) Name **two** products that use microcontrollers.

(ii) Suggest **two** input devices and **two** output devices used with microcontrollers.

1(b) A safety alarm which alerts the driver when a child remains in their car seat has the potential to protect children especially during warm summers or in countries with very warm climates.

The safety alarm uses the following sequence:

- when the engine stops, wait 2 minutes, a sensor is used to detect if the driver is sitting in the car;
- if the driver is not present, a sensor checks if a child is sitting in their car seat;
- if a child is present, the alarm sounds for 1 minute;
- if the alarm is not reset, the driver is alerted by text;
- alarm remains on until reset by the driver.

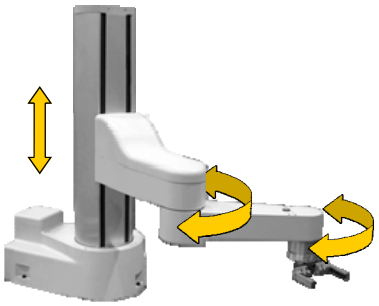


(i) Complete a flowchart for this sequence.

(ii) Suggest a suitable sensing system to check for the presence of the child in the car seat.

(iii) Suggest a modification to your flowchart sequence to check for an excessive build-up of heat in the car.

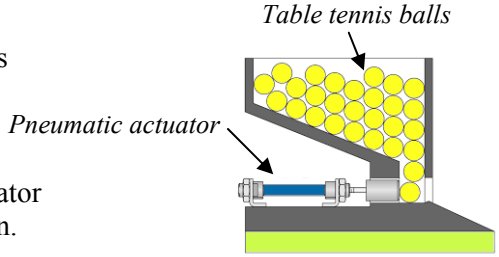
*Answer 1(c) **or** 1(d)*



1(c) (i) Name and describe the main features of the robotic arm shown.

(ii) Describe, using annotated sketches, the work envelope of the robotic arm shown.

OR



1(d) (i) Suggest **two** reasons why pneumatic control systems are sometimes used in preference to electrical systems.

(ii) The graphic shows an automated table tennis ball-dispenser. When a ball is required a pushbutton is pressed. A pneumatic actuator then moves forward quickly and returns slowly to its initial position.

Draw a diagram of a pneumatic circuit for dispensing the table tennis balls.

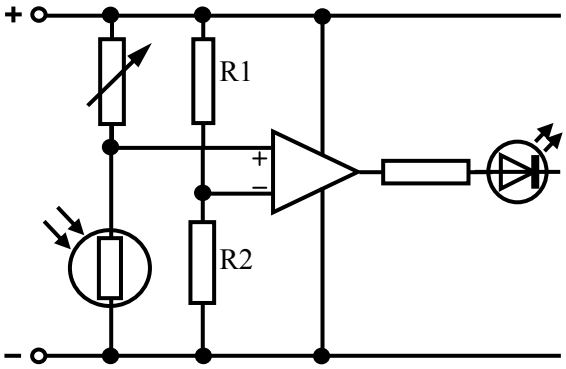
Option 2 - Electronics and Control - *Answer 2(a) and 2(b)*

2(a) The Internet of Things (IoT) brings sensing and control technology to all aspects of modern living.

(i) Outline **two** home automation systems that can be controlled to enhance convenience, energy efficiency or security.

(ii) Discuss some privacy concerns arising from automation and the automatic capture of large amounts of data (Big Data).

2(b) An incomplete circuit diagram for the control panel of an oil-fired heating system is shown.
Light levels from the burner flame are monitored and a warning LED illuminates if the flame extinguishes.



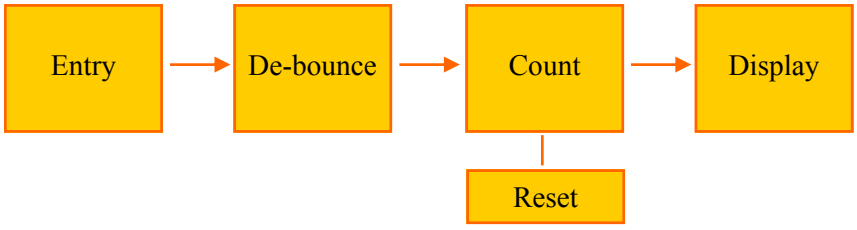
(i) Name the main components and give the function of each.

(ii) Describe the operation of this circuit.

(iii) Redraw the circuit diagram to include a relay which controls a 220 V oil pump.

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

2(c) A digital counter is used at an entrance turnstile to monitor the number of people entering a football stadium. The system uses the following block diagram.



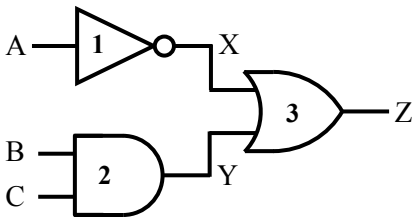
(i) State the purpose of the de-bounce stage.

(ii) Describe the operation of suitable components for the following:
- entry switching
- display device.

OR

2(d) (i) Name the logic gates labelled 1, 2 and 3 in the circuit shown.

(ii) Complete a truth table to represent the circuit.



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

3(a) *Cloud computing* has become increasingly popular in recent years.

(i) Describe briefly what is meant by cloud computing.

(ii) Outline, using appropriate examples, the benefits and limitations of using remote systems for storing electronic files.

3(b) (i) Distinguish between the functions of *registers*, *cache* and *main memory* as types of primary storage.

(ii) Describe **two** modes of long term data storage, making reference to capacity, volatility and accessibility.

(iii) Outline the main features of a *compressed* file.

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

3(c) Wireless connectivity is crucial in the development of sensing and automation systems.

(i) Distinguish, with examples, between LAN and WLAN.

(ii) Explain *interference*, *absorption* and *reflection* as influences on the performance of a wireless network.

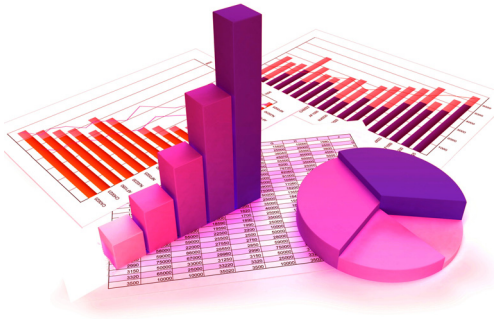
OR

3(d) (i) Distinguish between *bitmap* and *vector* graphics in terms of image encoding, file size and editing.

(ii) Text, sound, images and video are usually part of a multimedia presentation.
Give a typical file extension for **each** of these multimedia elements.

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

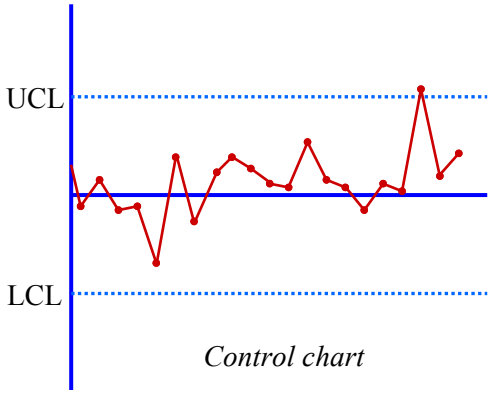
4(a) *Market research* is the process of collecting information to help determine whether or not a market exists for a proposed product or service. Market research is typically the initial stage in product development and life cycle analysis.



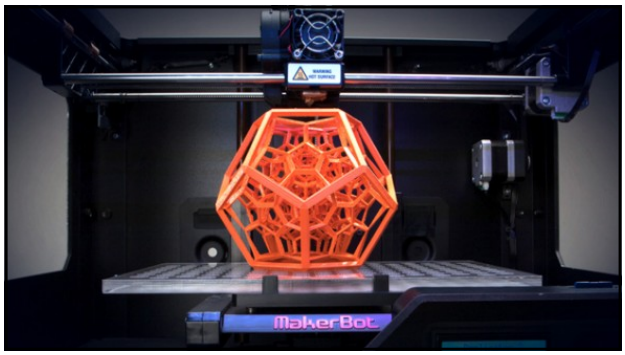
(i) Outline the main stages in the life cycle of a mass-produced electronic product.

(ii) *Re-branding* a product or service can impact on its life cycle.
Suggest **two** benefits for the business and **two** benefits for the consumer of redeveloping and re-launching a brand identity following a process of market research.

4(b) '*Ship-Shape'* is a 3D printing service that produces a range of engineering products for companies that require a method of producing prototypes and products at short notice.



Control chart



(i) Explain the terms UCL and LCL.

(ii) Using the control chart shown, describe where the process is *out of control*.
Suggest **one** indicator that predicts that the process may not remain in control.

(iii) Distinguish between *Quality Control* and *Quality Assurance* in a manufacturing context.

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

4(c) A company intends to produce 500 limited edition 16 GB USB memory sticks presented in attractive retail packaging.

Two alternative methods are available for packaging the USB memory sticks - using a skilled manual operative or using an automated process.

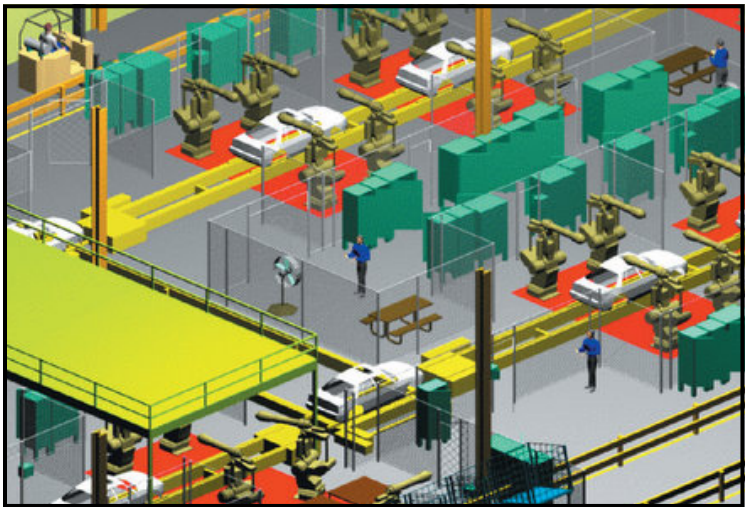
Skilled labour costs €2.50 per unit to package the USBs.
The automated process costs €0.10 per unit to package the USBs with an initial cost of €1000 to set up the machine.

(i) Draw a graph to show the cost of each packaging method.

(ii) Using the graph or other means calculate the break-even quantity and recommend a method of packaging the USB sticks.

OR

4(d) *Facility layout* refers to the arrangement of machines, departments, workstations, storage areas, aisles and common areas within a factory.



(i) Describe, using annotated sketches, **two** types of facility layout.

(ii) Outline an appropriate facility layout for the production of fuse box units for cars if the processes required to produce each fuse box include:

- populating circuit board (15 minutes)
- placing completed circuit in a plastic housing (2 minutes)
- labelling completed fuse box unit (3 minutes).

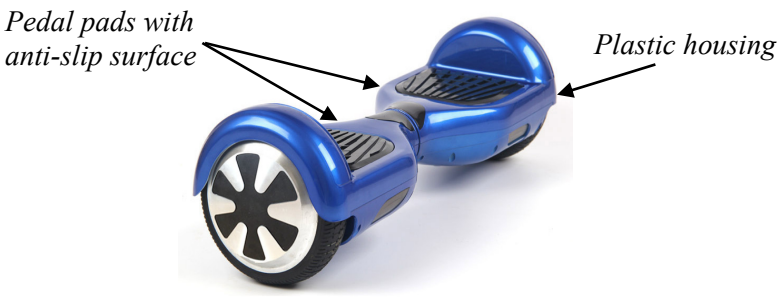
Option 5 - Materials Technology - *Answer 5(a) **and** 5(b)*

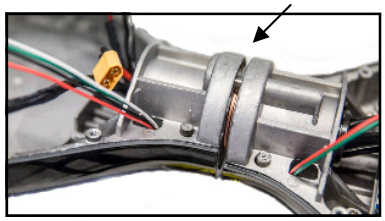
5(a) Lexus recently developed a working hoverboard called *Slide*. The Slide hoverboard can only levitate over a specially constructed magnetic track.

(i) Outline **three** properties of plywood that make it a suitable material for the manufacture of hoverboard or skateboard decks.

(ii) The wheels of a traditional skateboard are subject to considerable wear over time. Describe a simple material test which could be used to determine if a given material is suitable for use in skateboard wheels.

5(b) Self-balancing motorised scooters, also referred to as hoverboards, have been designed for control by the rider's feet. These boards can travel at up to 10 km/h and often include lights operated by remote control.





Detail of the two-part metal chassis

(i) Select a suitable material for the anti-slip surface on the pedal pads. Justify your answer.

(ii) Describe, using annotated sketches, a suitable production method for the plastic housing.

(iii) The chassis of the hoverboard is made of two separate metal parts which pivot independently of each other, as shown.

Outline, using annotated sketches, a method of joining these parts together while accommodating the pivot/swivel motion.

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

5(c) (i) A limited edition version of the hoverboard housing is to be produced in green to celebrate the Irish soccer team's participation in the UEFA Euro 2016 finals.

Why are *batch production* techniques appropriate for this limited edition?

(ii) A once-off model of a skateboard is commissioned with a unique oak deck.

Describe appropriate processes for the safe manufacture of this deck.

OR

5(d) Biodegradable materials decompose under natural conditions.

(i) In the past, expanded polystyrene was commonly used as a material for takeaway coffee cups.

Suggest **two** alternative materials for takeaway coffee cups which can be recycled or will biodegrade.

(ii) Discuss **two** advantages of incineration as a method of disposing of expanded polystyrene.

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