



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2014

Technology
Higher Level

Friday, 20 June
Afternoon, 2:00 - 4:30

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) The official emblem of the 2014 FIFA World Cup tournament is shown. It is central to the brand identity of the tournament.

- (i) State **two** reasons for creating an emblem for a large sporting event.
- (ii) Outline **two** ways in which ideas could be generated in order to develop a design for the emblem.



2(b) Security at large scale events such as the World Cup is a major concern. Each stadium has entry turnstiles which use barcode, proximity or biometric readers to confirm the identity of those seeking access.

- (i) State **two** advantages of using barcodes.
- (ii) Explain the term 'biometric'.
- (iii) Outline **two** Quality Attributes of an effective security system.



Answer 2(c) or 2(d)

2(c) Communication between referees and officials has become easier through the use of wireless communication systems which transmit sound at UHF in the range 450 – 470 Mhz.

- (i) Describe **two** pieces of hardware required for wireless communication.
- (ii) Outline **two** advantages of using a wireless communication system.



OR

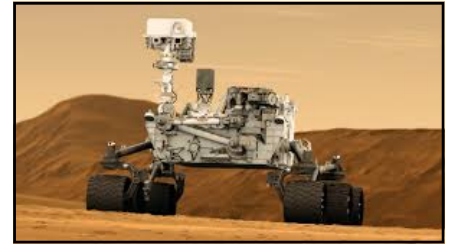
2(d) A shin guard or pad is an essential piece of equipment in sports such as football, camogie, hurling and soccer. These guards have a hard outer shell with a softer inner lining and are designed to protect the lower leg from impact.

- (i) List **one** property required of the material used to manufacture the outer shell and **one** property of the material used to manufacture the inner lining.
- (ii) Describe, using notes and annotated sketches, a method of fastening the shin guard in place during a match.



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

3(a) On August 6, 2012, the Mars rover 'Curiosity' landed safely having travelled over 560 million kilometres in less than a year. Radioisotope power systems are installed on the rover, using plutonium as fuel.

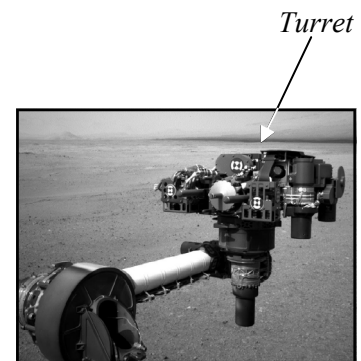
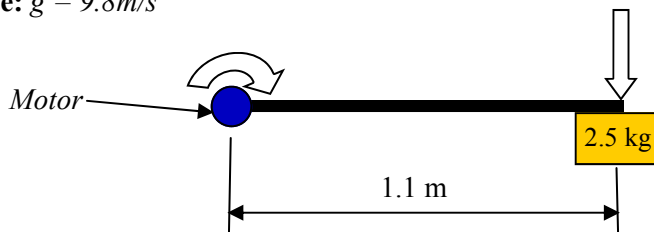


- (i) Suggest **two** reasons for using radioisotope power rather than solar power systems.
- (ii) Outline **two** technological benefits accruing to society from the science and engineering developed for space exploration.

3(b) The rover has a robotic arm with a cross-shaped *turret*, which holds five devices. The turret can rotate through a 350° angle.

- (i) Name any **two** electronic devices that might be attached to the turret.
- (ii) A servo motor is used to move the robotic arm. From the data given below calculate the torque of the motor required to move the arm.

Note: $g = 9.8\text{m/s}^2$

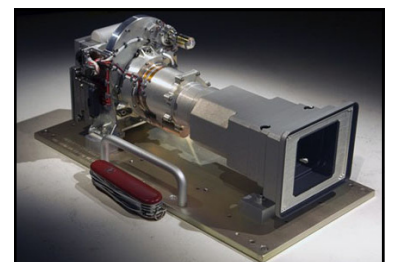


- (iii) Each wheel of the Mars rover is driven independently and designed to rotate with very little friction as this reduces power usage. Sketch and label a drive mechanism for the rover wheel and include a means of reducing friction as the wheel rotates.

Answer 3(c) or 3(d)

3(c) The Mars rover sends spectra and true colour images to Earth using its on-board camera system (*MastCam*).

- (i) Compare *bitmap* and *vector* based images, making reference to quality and sharpness.
- (ii) Outline a process of editing to reduce the brightness of a photograph sent back from the Mars rover.



OR

3(d) Correct material choice for the Mars rover was vital so that it could withstand the severe conditions encountered on Mars with temperatures ranging from 30°C in daytime to -50°C at night.

- (i) Distinguish clearly, with examples, between *ceramic* and *composite* materials.
- (ii) Describe a comparison test which could be used to inform the selection of materials capable of withstanding the extremes of temperature expected on Mars.

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

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

1(a) Many 3D printers are described as Cartesian (XYZ) printers. Printers produced by the award-winning Co. Louth company, Mcor Technologies®, use paper to build up three-dimensional printed models. The models produced are eco-friendly and suitable for rapid prototyping.

- (i) Outline the suitability of 3D printing for prototyping a mobile phone.
- (ii) Explain, using sketches, the terms *polar coordinate system* and *cylindrical coordinate system*.



1(b) Air conditioning units are used to control temperature, humidity, air quality and air movement. A typical air conditioning unit is shown.

- When the power is turned on, a red pilot light illuminates
 - The room temperature is then compared with the desired temperature
 - If the room temperature is too high or too low, the air conditioner fan runs until the desired temperature is achieved
 - A green light remains illuminated while the room is at the desired temperature.
- (i) Draw a flowchart for the operation of this air conditioning unit.
 - (ii) Modify the flowchart to include an alert for the user if the motor in the air conditioning unit overheats.



Answer 1(c) or 1(d)

1(c) Ekso is a wearable robot or exoskeleton that enables people with lower-extremity paralysis or weakness to stand and walk. It is powered by two high-capacity lithium batteries which drive the hip and knee motors in proper sequence.

- (i) Ekso uses a *closed-loop control system* to maintain proper positioning of the exoskeleton. Outline the principles of a closed-loop system of control.
- (ii) Compare *servo motors* and *stepper motors* as sources of motive power.



OR

1(d) (i) Describe the main features of a pneumatic control system and give **two** common applications.

- (ii) A barrier to control cars entering and leaving a car park is raised and lowered by pneumatic control.

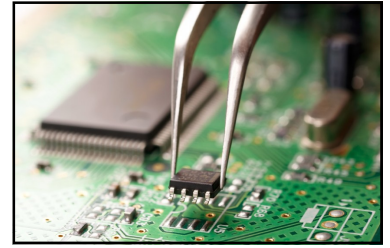
Draw a suitable pneumatic control circuit to operate the barrier.



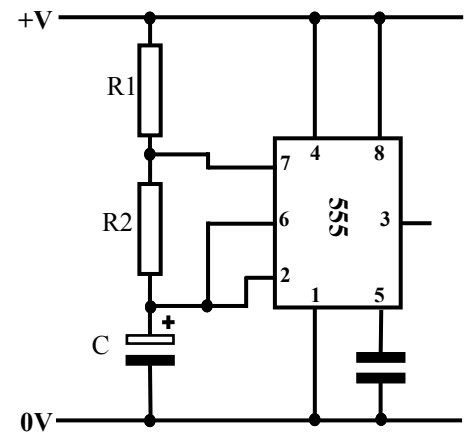
Option 2 - Electronics and Control - Answer 2(a) and 2(b)

2(a) Integrated circuits with semiconductor components are used to control electrical household devices.

- Distinguish clearly, with examples, between *conductor*, *insulator* and *semiconductor* materials.
- An electrical heater with a resistance of 24 ohms is connected to a 240V supply for 12 hours. Calculate the cost of operation if electrical energy costs 25 cents per kWh.



2(b) An ultrasonic pest deterrent device is shown. It uses a 555 timer to send out an ultrasonic sound at regular intervals to deter pests. It also incorporates a soft-glow nightlight.

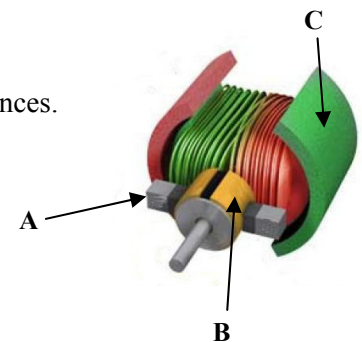


- The circuit shown is *astable*. Describe what is meant by an astable circuit.
- The soft-glow nightlight stays on continuously while the ultrasonic sound is emitted at intervals. Describe how the given circuit could be modified to achieve this.
- For the given circuit, if the value of C is $10\mu\text{F}$, R1 is $10\text{k}\Omega$ and R2 is $68\text{k}\Omega$ calculate the frequency.
Note: $f = 1.44 / (2R2 + R1) \times C$

Answer 2(c) or 2(d)

2(c) DC motors are inexpensive and versatile and are used in many electrical appliances.

- Name parts **A**, **B** and **C** of the DC motor shown.
- Describe **one** electrical and **one** mechanical method used to change the direction of rotation of a DC motor.



OR

2(d) The weather station shown will activate an alarm when cold temperatures are detected at night. It also has an override switch to turn the unit off.



Switch	Night	Temp	Alarm
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

- Draw a logic circuit to reflect the given truth table.
- Name any sensor which could be used in the weather station.

truth table

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

- 3(a)** (i) Describe **two** potential health problems related to the prolonged use of mobile computing devices.
- (ii) Outline **one** method of reducing the potential health impact of using a laptop computer.



- 3(b)** (i) A large company has a LAN. The IT manager of the company wants to replace it with a WLAN. Explain the differences between a LAN and a WLAN.
- (ii) Explain the term *ad-hoc* in relation to wireless networking.
- (iii) Differentiate between *infrared* and *radio frequency* in relation to wireless transmission.



Answer 3(c) or 3(d)

3(c) Software applications are key to effective use of ICT.

- (i) Describe the advantages and disadvantages for a company of using *proprietary* software rather than *open source* software.
- (ii) Word processing software allows *font editing* to enhance a document. For **each** of the following items of functionality, name a software package which includes that feature.

Feature	Software package
Slide transition	
Use of counters	
Mute, play and pause	
Crop	

OR

- 3(d)** (i) Distinguish between *voice recognition* and *chip and pin* as methods of verifying data.
- (ii) Outline what is meant by **each** of the terms: *computer hacking*, *spam*, *data encryption*.

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

4(a) A new concept phone called *Phonebloks* is under development in which the phone is made up of detachable blocks. The design aims are to reduce e-waste and to allow upgrading or replacement of the *modular* blocks.



- (i) Outline what is meant by a modular approach to design.
- (ii) Explain the terms *reverse engineering* and *feasibility study*.

- 4(b)
- (i) Explain the difference between a process that is *capable* and a process that is *not capable*.
 - (ii) For a product such as *Phonebloks* to be successful, all blocks need to be made to specifications that ensure they are interchangeable and will fit into any assembly of the same type.

The graphic shows a camera block-lens which is produced by two different manufacturers. Measurement of samples from the manufacturers of the camera lens are given below:

Manufacturer **A** - standard deviation = 0.04077

Manufacturer **B** - standard deviation = 0.01620



The lens must have an outside diameter between 7.85 mm and 7.95 mm.

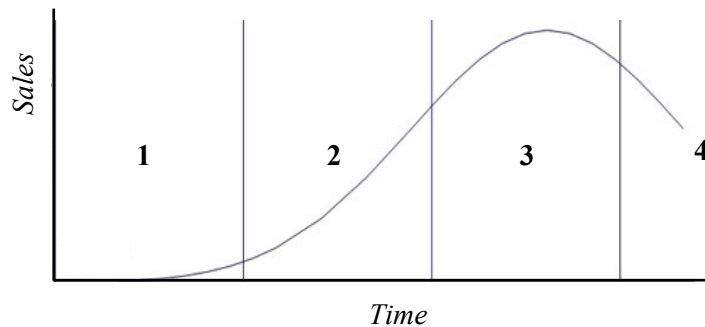
Calculate the process capability index for each manufacturer

where: $C_p = \frac{\text{Tolerance Range}}{6\sigma}$

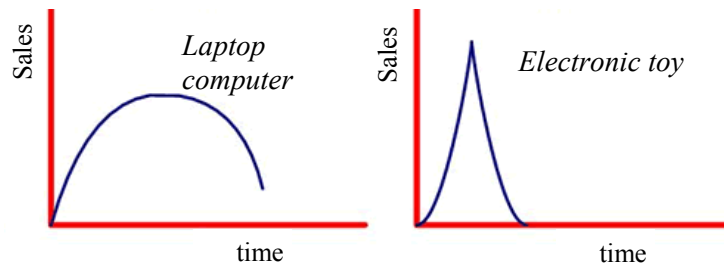
- (iii) Which manufacturer should be chosen to manufacture the lens? Justify your selection.

Answer 4(c) or 4(d)

4(c) (i) Name and briefly describe the four stages in the life cycle of a product.



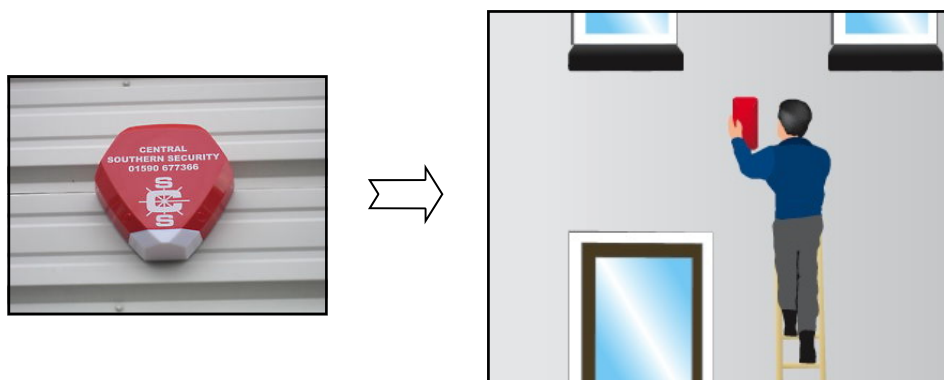
(ii) Discuss the differences between the life cycle graphs of the electronic devices shown below.



OR

4(d) (i) Reliability and durability are quality dimensions. Briefly outline what is meant by each of these terms.

(ii) The graphics show the casing for a domestic alarm.



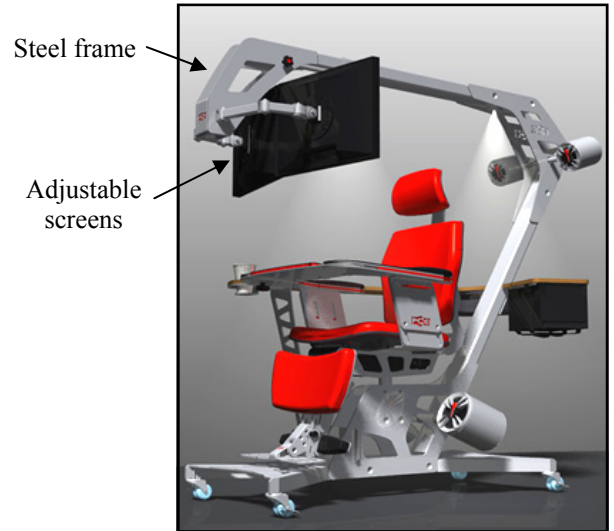
Suggest **three** important characteristics of the alarm casing.

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

- 5(a) (i) Describe the main properties of *thermosetting plastics*, *ferrous metals* and *softwoods*. Use specific examples in each case to support your answer.
- (ii) Outline **two** potential hazards when using adhesives to bond materials.

5(b) An innovative design for a computer workstation is shown.

- (i) Suggest **two** reasons why the workstation frame is made from steel.
- (ii) The seat is made from four polypropylene parts. Outline a manufacturing process suitable for the production of these parts.
- (iii) Explain, using notes and annotated sketches, a method of attaching the adjustable screens to the steel frame.



Answer 5(c) or 5(d)

- 5(c) (i) The computer workstation above was found to have a number of design limitations. In particular, the seating arrangement was uncomfortable for long term use. Outline, using notes and annotated sketches, a modification that would rectify this issue.
- (ii) The keyboard shelf is hinged to allow easy access to the workstation. Explain why *accelerated testing* was used to test the hinge and describe how such a test could be carried out.

OR

5(d) The H-racer model car shown operates on 100% clean fuel produced by a miniature solar-powered hydrogen refuelling station, which converts water to hydrogen using energy captured from the sun.

- (i) Give **two** reasons for the development of technologies such as the hydrogen fuel cell.
- (ii) Outline the environmental impact of producing this model car, from the production of the initial polymers to end-of-life disposal.



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