Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2015

Technology

Higher Level

Friday, 19 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) After many years of testing their computer-guided cars, Google has presented its *self-driving car* project.

(i) Outline **two** potential benefits of a self-driving car.

(ii) Suggest **two** reasons why it is it likely to take a number of years before self-driving cars become widely accepted.

2(b) The *Internet of Things* (IoT) is already a key concept in the automation of systems such as self-driving cars. These systems rely on electronic equipment and GPS to guide them safely without colliding with other road users or objects.

(i) The *Parksight 2.0*® system is used to locate vacant parking spaces in congested cities and to relay this information to drivers.
Suggest **two** technological systems that might contribute to this service.

(ii) Describe the function of the *bumper radar system* on a self-driving car.

(iii) Identify **two** other electronic sensors that could be used in self-driving cars.

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

2(c) Self-driving cars must be of the highest quality to ensure the safety of passengers and of other road users. *Conformance*, *durability* and *aesthetics* are three of the dimensions used to describe the quality of an item.

(i) Explain **any two** of these quality dimensions.

(ii) Name a problem-solving technique that could be used to improve the quality of a manufacturing process.

OR

2(d) The steering system in a self-driving car will require a means of moving the two front wheels at the same time and in the same direction.

(i) Describe, with annotated sketches, a mechanism used to steer the wheels of a motor vehicle.

(ii) The components of the steering mechanism are in constant movement while a car is driving.
Suggest **two** methods of minimising the wear on such steering components.

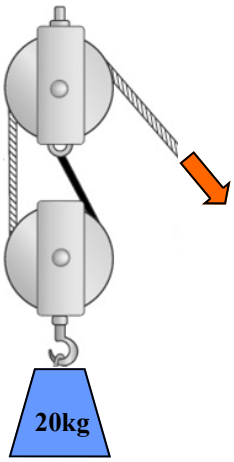
Question 3 - *Answer 3(a)* ***and*** *3(b)*

3(a) The *Rugby World Cup 2015* will be held in England. The third largest event in world sport will reach a thrilling conclusion at Twickenham when the best teams compete for the Webb Ellis trophy.

(i) Outline **two** technological advances which can contribute to the successful staging of large sporting events.

(ii) Outline **two** reasons why companies become major sponsors of sporting events like the Rugby World Cup.

3(b) Professional rugby players increase their body strength by a combination of field and gym work.



The pulley system shown is used to lift a 20 kg weight on an exercise machine.

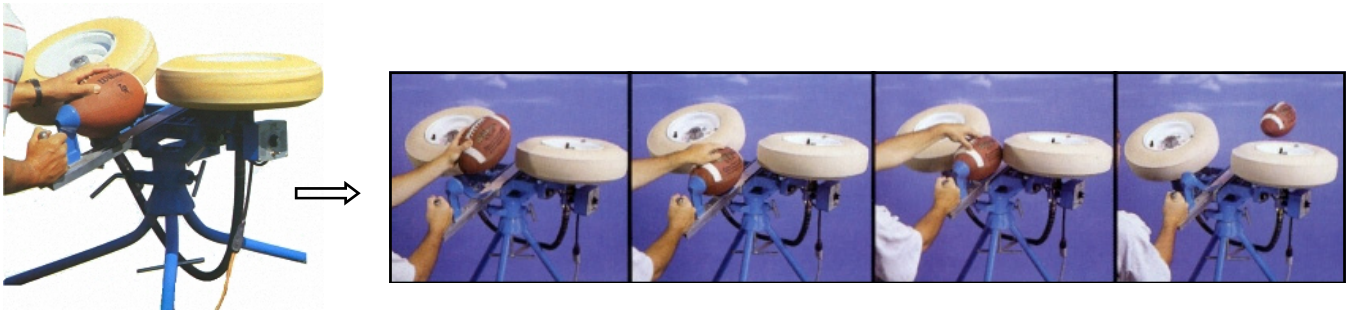
(i) State the mechanical advantage of the pulley system shown.

(ii) Calculate the force required to lift the 20 kg load.

(iii) If the weight is lifted 150 mm, calculate the distance the rope will have to be pulled.

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

3(c) A ball launcher can be used during rugby training sessions to improve ball handling. It consists of two wheels rotating in opposite directions. One of the wheels can be tilted to vary the launch angle of the ball.

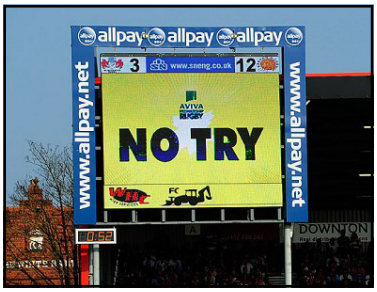


(i) Using annotated sketches, suggest a means of adjusting the tilt of the wheel **and** a means of locking it in the required position.

(ii) Describe how the two wheels could be made to rotate in opposite directions.

OR

3(d) Computers have brought about many advances in sport and sports science.



(i) Outline **two** ways in which computer technology could be used to improve player performance.

(ii) TMO (Television Match Official) technology is used to assist in deciding if a score should be allowed or if a foul has been committed. It uses multiple cameras to provide video evidence.
Describe **two** factors which influence the quality of recorded video images.

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

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

1(a) Automation of the domestic environment has increased dramatically over the past decade.

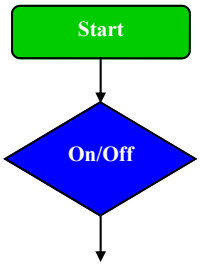
(i) Identify **two** advantages of this increased use of automation in our homes.

(ii) Suggest **two** sensor devices that provide information for domestic automation.

1(b) A test model of a washing machine is shown. The manufacturer has decided to simulate the washing sequence using a programmable PIC.

The following sequence is used:

- the user presses the On/Off button to start the wash cycle;
- the system checks that the door is shut;
- if shut, the door locks;
- the indicator LED goes ON;
- the motor turns the drum for 30 seconds;
- the indicator LED goes OFF;
- the door unlocks;
- the system waits for the next push of the On/Off button.



(i) Complete the flowchart of the simulation sequence.

(ii) Select a suitable type of motor for the rotating drum. Justify your choice.

(iii) Suggest a suitable electromechanical method of operating the door lock.

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

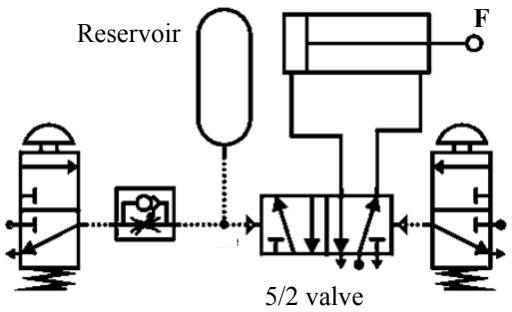
1(c) The *da Vinci SI* robot has four robotic arms and seven degrees of freedom. It gives surgeons the ability to perform the most complex and delicate procedures. Each arm is controlled using servo motors with encoders.

(i) Suggest **two** benefits of robotic surgery.

(ii) Explain the terms *degree of freedom* and *encoder*.

OR

1(d) The pneumatic circuit shown incorporates a time delay function.



(i) Name the circuit components that allow the time delay to operate.

(ii) Calculate the output force (F) if the cylinder has a radius of 20 mm and a pressure of 0.4 N/mm^2.

Note: *Force = pressure × area*

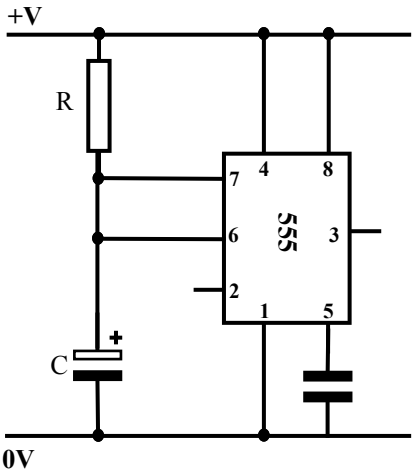
Option 2 - Electronics and Control - *Answer 2(a) and 2(b)*

2(a) 'Irish Water' has begun the controversial process of installing water meters countrywide. These meters use AMR technology *(Automatic Meter Reading)* and transmit information using Radio Frequency (RF) waves.

(i) State **two** advantages of using AMR technology in meter reading.

(ii) Identify **one** other common use of radio wave technologies.

2(b) An incomplete circuit diagram for a shower timer-unit is shown.
The unit is to give an audible warning when a preset time has elapsed.
This item is used to help consumers save water and energy.

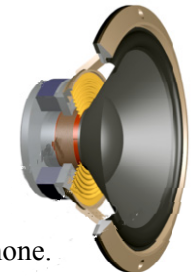


(i) Complete the circuit diagram in a monostable state.
Include a buzzer as an output device.

(ii) Describe the operation of this circuit.

(iii) Outline how the circuit/components could be modified to increase the preset time.

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



2(c) Loudspeakers are used in many multimedia devices.

(i) State the energy conversions that take place in a loudspeaker.

(ii) Describe, using notes and annotated sketches, the operation of a loudspeaker **or** a microphone.

OR

2(d) A bird feeding station includes a digital camera. The camera will be activated when a bird lands on the feeding station. The camera will activate during daylight hours only.

(i) Draw a Logic Gate circuit to activate the camera for the above conditions.

(ii) Using notes and sketches, suggest an electro-mechanical means of detecting when a bird has landed on the table.

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

3(a) The use of home broadband connections has made a significant impact on how people access entertainment sources including music, books and film.

(i) Describe briefly what is meant by a broadband connection.

(ii) Outline **two** advantages of using e-book readers rather than printed paper books.

3(b) (i) What is a computer motherboard?

(ii) Outline the function of the power supply in a computer.

(iii) Describe, with examples, **each** of the following elements of a computer motherboard:

- chipset
- expansion card slot
- BIOS.

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

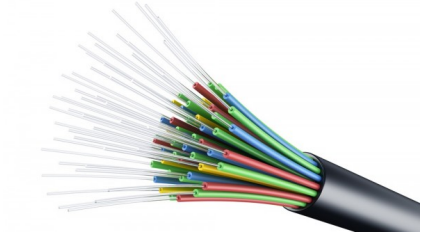
3(c) A computer network is a telecommunications network that allows computers to exchange data.

(i) Explain the following network-related terms:

- network node
- switch
- router.

(ii) Explain how data stored on a computer system or network can be *backed up* to prevent possible loss of valuable files.

OR



3(d) (i) Distinguish between a *computer firewall*, *pop-up blocker* and *phishing filter* as means of contributing to on-line security.

(ii) State **two** advantages of using fibre optic cables instead of traditional copper cables for data communications.

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

4(a) A company plans to manufacture a portable computer device suitable for use in school as part of an initiative to reduce schoolbag weight and to increase IT use in education.

The company has used techniques such as *perceptual mapping* and *reverse engineering* in their product planning and development.

(i) Explain the terms perceptual mapping and reverse engineering.

(ii) The device is used for an average of 5 hours every day.
During testing, the battery lasted for 5250 hours without failure.
Recommend a suitable guarantee period for the battery. Justify your recommendation.

4(b) The table below shows the temperature (in degrees Celsius) of a heat treatment furnace at different times of the day.

Day	Morning	Midday	Evening	Daily Mean
Monday	520	540	550	**537**
Tuesday	514	488	526	**509**
Wednesday	604	620	598	**607**
Thursday	588	528	580	**565**
Friday	590	598	600	**596**

(i) Calculate the values for the *process mean* and the *range* from the table above.

(ii) Determine the upper control limit (UCL) and the lower control limit (LCL) for the process above and plot them on a suitable control chart (assume the standard deviation is 25°C).

(iii) Evaluate the chart to determine if the process is in a state of statistical control. Justify your answer.

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

4(c) '*Full Steam Ahead*' is a new business which offers an ironing service. Bags of unironed clothing are collected and are returned on hangers to customers.
The cost to the business of manually ironing a bag of clothing is €20.

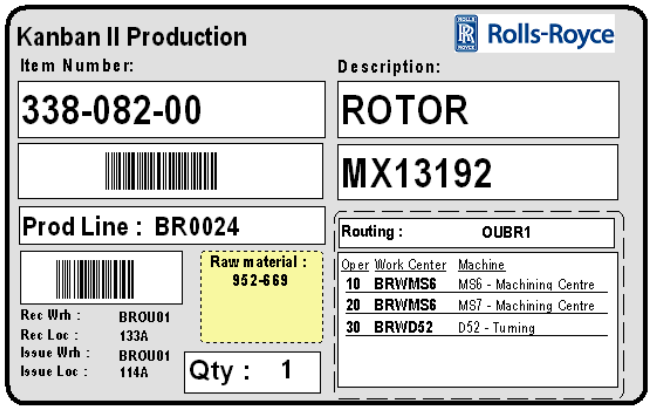
Full Steam Ahead are considering automating the ironing process at a cost of €600 for the initial set-up cost and €5 per bag of clothing thereafter.

(i) Draw a graph to show the costs of both the manual and automated systems for *Full Steam Ahead*.

(ii) Analyse the graph to determine the most profitable method for **both** 30 bags **and** for 60 bags of clothing to be serviced by *Full Steam Ahead*. Justify your answer.

OR

4(d) **Kanban** is a scheduling system for lean and Just-In-Time (JIT) production. Kanban was developed by Toyota as a system to improve and maintain a high level of production.



(i) Explain the principles of **both** Kanban and JIT systems.

(ii) Electronic Kanban systems are increasing in popularity. Outline **two** advantages of e-Kanbans.

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

5(a) Luas, the Dublin light railway system carries around 30 million passengers each year. A French company, Alstom, supply the tram carriages used by Luas. A range of materials including composites and glass are used in their production.

(i) Outline, with examples, **two** advantages of using composite materials.

(ii) Suggest **two** reasons for the extensive use of glass in the manufacture of Luas trams.

5(b) Luas tram-stop shelters are manufactured in a variety of modular designs such as the one shown below.

(i) Outline **two** reasons for cutting circular holes in the beams which support the roof sections.

(ii) Explain, using notes and annotated sketches, a method of assembling the metal sections of the tram shelter.

(iii) Describe, using notes and annotated sketches, a method of securely fixing the glass panels to the shelter frame.

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

5(c) Careful consideration of potential environmental degradation of the tram shelter is critical to ensure a successful and long-lasting product.

(i) Identify **two** causes of environmental degradation of the shelter.

(ii) Outline the role of product design in ensuring the long service life of a tram shelter.

OR

5(d) A number of existing bridges were used and some others were constructed during the development phase of the Luas tramlines. The Ann Devlin Bridge is shown.

(i) Compare any **two** common types of bridge in terms of:

- materials used
- span.

(ii) Explain the term *reinforced concrete*.

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