



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2012

Marking Scheme

Technology

Higher Level



Leaving Certificate Examination, 2012

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Section A - Core (72 marks)

*Answer any twelve questions in the spaces provided.
All questions in Section A carry 6 marks.*

Section A. Answer any twelve questions. All questions carry 6 marks.

1. In the promotion of alternative sources of energy in Ireland, the harvesting of wind energy has been prioritised. Outline the main advantages of a wind-powered energy system.

**Suitable for Irish climate/exposed areas,
Reduce reliance on imported fossil fuels,
Less pollution,
Can be harvested on land/at sea etc.**



2. Corrugated cardboard is a commonly used material in the packaging industry.

Describe **one** advantage and **one** disadvantage of using cardboard rather than expanded polystyrene in the packaging of electrical items.

Advantage: **Made from renewable wood, more environmentally friendly than polystyrene etc.**

Disadvantage: **Will not mould as effectively as polystyrene, not waterproof etc.**

Give **one** reason for the corrugation of cardboard.

Considerably adds to strength and rigidity, better impact protection etc.



3. A variety of materials is used in the manufacture of modern boats.

Name a suitable material to be used for each boat-part listed and outline a property of each material.

Part	Material	Property
Sail	Nylon/Canvas etc.	Lightweight, colourful, strong, will not tear easily etc.
Mast	Aluminium	Strong and lightweight in tubes
Hull	Fibre glass	Impact resistant, moulds in one piece, waterproof etc.



4. Irish furniture designer and architect, Eileen Gray, produced this design for her Bibendum Chair in the 1920's, taking inspiration from the 'Michelin man' tyre character. The legs are made from chrome-plated tubular steel.

(i) Outline **two** anthropometric aspects associated with the design of this chair.

Height of seat, measurement of width of seated area etc.



(ii) Suggest **one** reason for a chrome plated finish.

Protection against rust, appearance, easy to clean etc.

5. The forces acting on a structure can be described in terms of *tension*, *compression*, *shear* and *torsion*. Briefly explain **any three** of these terms.

Descriptions of **any three** terms:

Tension - pulling or stretching force

Compression - squeezing force.

Shear - cutting force

Torsion - twisting force etc.



6. (i) Name the computer symbol shown.

Universal Serial Bus (USB) interface

(ii) Name **two** devices associated with the use of this symbol.

Printer, camera, mouse, memory stick etc.



7. Distinguish between *potential energy* and *kinetic energy*.

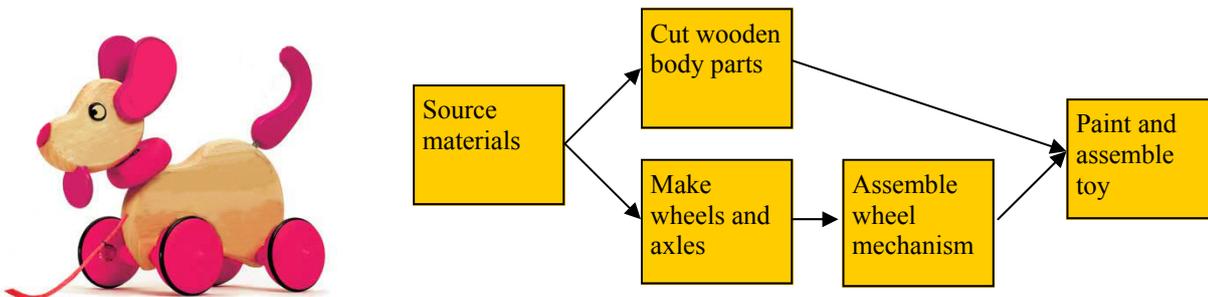
Potential energy due to the position of an object.
Kinetic is energy due to the motion of an object.

Identify an energy conversion that takes place in:

- (i) A 12V car battery **Chemical to electrical.**
- (ii) An electric motor **Electrical to kinetic/mechanical etc.**

8. A design for a wooden toy is shown.

Compile a Work Breakdown Structure (WBS) diagram for the manufacturing of this toy.



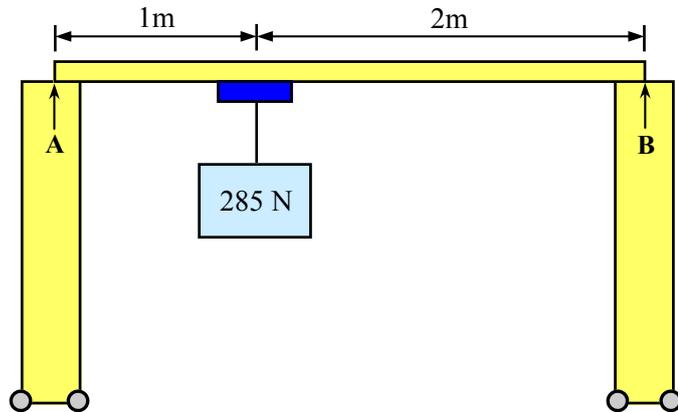
9. Supermarkets use automated point of sale (POS) equipment or ‘checkouts’ with barcode readers.

Outline **two** functions of a barcode system.

A quick and efficient way of processing and totalling information such as prices.
An effective method of instant stock monitoring and control etc.



10. The graphics show a gantry crane. Using the principle of moments calculate the reaction force at pillar **A**. (Show all calculations).

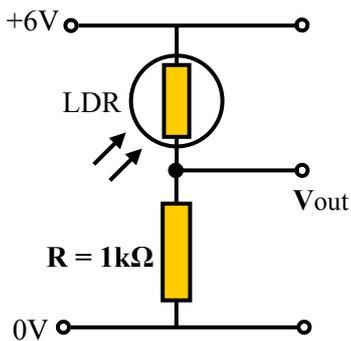


Calculation:

$$A \times 3\text{m} = 285\text{N} \times 2\text{m}$$

$$A = 190\text{N}$$

11. The circuit shown uses a voltage divider to sense light levels.



- (i) State the principal property of the LDR that is used to sense light levels.

Electrical Resistance

- (ii) Under changing light conditions, the value of the LDR varies from 2000Ω to 3000Ω .

For each resistance given, calculate the corresponding values for V_{out} .

V_{out} at 2000Ω

$$V_{OUT} = \frac{R}{R + R1} \times V$$

$$V_{out} = 2V$$

V_{out} at 3000Ω

$$V_{OUT} = \frac{R}{R + R1} \times V$$

$$V_{out} = 1.5V$$

12. Bearings, such as the system shown, are commonly used in machines and vehicles.



(i) Outline **two** reasons for using bearing systems.

**Reduction of friction,
Smooth motion,
Less wear,
Reduction in noise and heat etc.**

(ii) The generation of heat due to friction needs to be minimised in bearings. Name **two** lubrication materials used to minimise heat.

**Oil,
Grease,
Dry graphite etc.**

13. Make well-proportioned freehand sketches of **three** principal orthographic views of the laptop shown.

Front elevation, plan or either end view



14. In the standardisation of safety signs, colour and shape are important.
Four safety signs are shown.



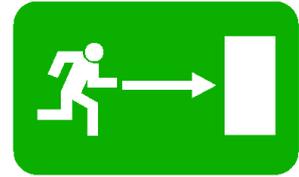
(i) Yellow - caution



(ii) Blue - mandatory



(iii) Red - fire



(iv) Green - positive action

State the meaning of the signs shown at (i) and (ii) above:

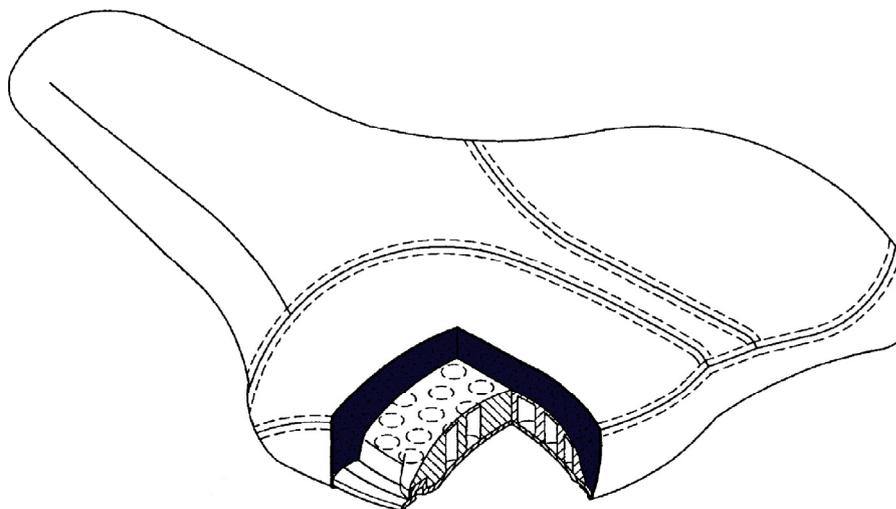
- (i) **Flammable hazard.**
- (ii) **Ear protection must be worn.**

Outline the importance of colour in safety sign design.

Categories of safety signs are colour coded to indicate the level or nature of the hazard etc.

15. Use **two** graphic techniques to enhance the graphic representation of the bicycle saddle shown.

Two suitable graphic techniques



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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.

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

Question 2 - Answer 2(a) and 2(b) (a) - 8 marks, (b) - 10 marks, (c) OR (d) - 6 marks

- 2(a)** The launch of the Olympic stadium in London featured a 3D model of the new structure. The model was produced directly from a CAD file using a 3D printer.
- (i) Outline **two** reasons for producing a model of the stadium.
Two outlined reasons - prior publicity before the stadium is built, visual interpretation of technical details/design concepts/scale, etc.
 - (ii) Outline **two** ways in which technology assists athletes in preparation for the Olympic games.
Two clear examples - video analysis of performance to maximise performance, textiles and shoes are designed to aid speed of athletes, etc.
- 2(b)** A PCB board for a novelty Olympic games themed toy is shown.
- (i) Name the components **A, B** and **C**.
A - Buzzer, B - Capacitor, C - PTM switch
 - (ii) Component **B** can be *polarised*. Explain the term polarised.
The component must be connected the right way round with + leg connected to + power supply.
 - (iii) State **two** advantages of using LEDs rather than light bulbs in this toy.
Any two - cost, lower power use, range of colours, longer lasting, smaller etc.

Answer 2(c) or 2(d)

- 2(c)** Newly introduced models of smartphones go through a sequence of stages known as a *product life cycle*.
- (i) Explain the term product life cycle.
A marketing theory that four identifiable developmental stages exist in the life span of a product. It is used to guide marketing strategy and decisions etc.
 - (ii) Using a smartphone as an example, describe the **four** stages of the product life cycle.
1. Introduction - Design/Research/Testing/Manufacture/Marketing/Distribution/Sales
2. Growth - Marketing/Acceptance/Sales growth
3. Maturity - Sales peak/plateau
4. Decline - Sales decline/superseded/Obsolescence

OR

- 2(d)** Traditionally, posters and billboards were used to advertise products and services at major sporting events and festivals. In recent years technology has changed many aspects of the advertising industry.
- (i) Explain what is meant by "*Product Placement*" and give an example of where it might be used.
A form of advertisement where branded goods are placed in a context usually devoid of advertising such as movies, sports events or television shows.
 - (ii) Outline **two** forms of promotion that use online advertising.
Two promotion forms such as search engine results pages, banner ads., blogs, social networking advertising, e-mail marketing including spam, etc.

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

(a) - 8 marks, (b) - 10 marks, (c) OR (d) - 6 marks

3(a) In recent years, the Irish government has encouraged the use of diesel and *hybrid* cars through tax incentives.

- (i) State the meaning of the term hybrid.
A hybrid is composed of a mixture of elements. In car technology, hybrids run on both fossil fuels (diesel, petrol) and electric energy (battery, solar).
- (ii) Outline **two** advantages of choosing to purchase a hybrid car rather than a petrol car.
Two significant advantages explained - Energy saving through reduced use of fossil fuels, Switching between energy sources to boost power or conserve fuel, Environmentally friendly etc.

3(b) A combination of *linkages* and *levers* is used to control the amount of petrol released into the car carburettor shown.

- (i) Distinguish between a linkage and a lever.
A lever is a rigid bar pivoted around a fixed point. A linkage is a bar(s) that may transmit or alter motion.
- (ii) What is the function of the spring?
The spring will return the pedal to its original place, it provides resistance to the push of the pedal.
- (iii) Determine the class of lever of the accelerator pedal and calculate the mechanical advantage if AB = 165mm and BC = 55mm.
Class 1 lever
Mechanical Advantage = $\frac{165}{55} = 3$

Answer 3(c) or 3(d)

3(c) At the design and prototyping stage of car manufacture, methods such as computer simulation and wind tunnel testing are employed.

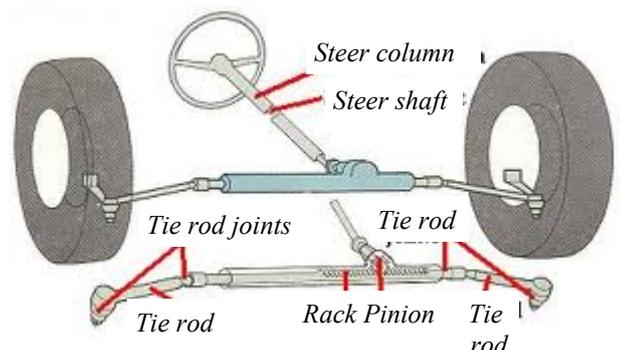
- (i) Outline **two** reasons for using computer simulation in car design.
Cost efficient - don't need to build models until later stages.
Design aspects and systems can be tested by computer programmes, etc.
- (ii) Outline **two** aspects of car design that can be tested using prototypes in a wind tunnel.
Two aspects such as aerodynamics, airflow, dynamic pressures can be measured, body shape safety, etc.

OR

3(d) The graphic shows an incomplete car steering system.

- (i) Name a mechanism used in a car steering system.
Rack and pinion
- (ii) Using notes and annotated sketches, describe the mechanism by which the wheels remain parallel as the car is steered.

Steering mechanism described with parts identified



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

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

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

1(a) (i) Outline **three** advantages of the use of computer-aided manufacturing techniques in industrial production. **Three significant advantages such as accuracy, automated tooling, speed of production for large volume work, etc.**

(ii) Describe the role of remote control technology in a life threatening environment such as a nuclear power station.

Key points: mechanised control of devices without manual operator, safety of operator, control from a distance through visual link, operator in control, etc.

1(b) (i) Programmable PIC systems can be expensive to design and build, yet are widely used. Outline **three** advantages of using programmable chips.

Three significant examples explained - PICs can be programmed and reprogrammed, circuitry more reliable, increased flexibility and adaptability, reliability of circuits, can solve simple and complex circuits, etc

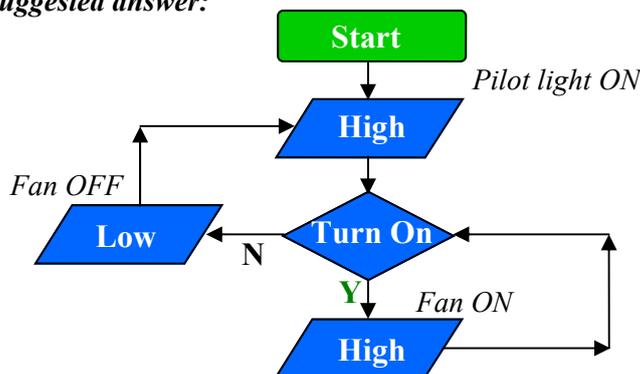
(ii) Shown is a hand dryer which is controlled using a PIC programme.



When the main power switch is turned on a green pilot light illuminates. The dryer motor starts automatically when hands are placed in it and remains on until the hands are removed. A touch-free sensor is used to detect the presence of hands in the dryer.

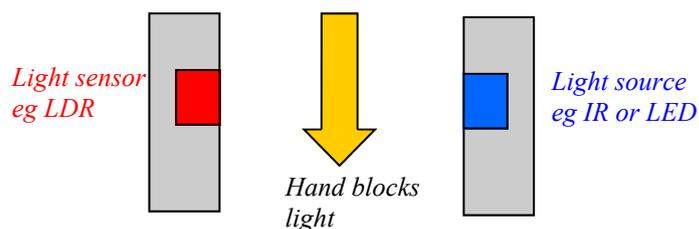
Compile a flowchart for the operation of the dryer.

Suggested answer:



(iii) Using notes and annotated sketches, describe a touch-free sensor system suitable for this hand dryer.

Suggested sketch with explanation needed:



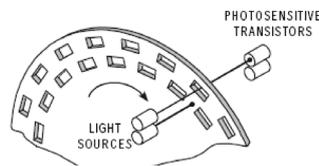
Answer 1(c) or 1(d)

- 1(c) (i) Describe the main features of a cartesian robot making reference to work envelope and applications. **Common industrial robotic configuration, description of work envelope, X-Y-Z co-ordinates, linear movements, large scale work, etc.**

Uses: 'pick and place' work, stacking sheet materials, application of adhesives, CNC machines etc.

- (ii) Describe the purpose and operation of an *encoder* in closed loop control. **A closed loop control system monitors its movements through the provision of feedback. When working with DC motors, shaft encoders are commonly used as accurate feedback can be provided.**

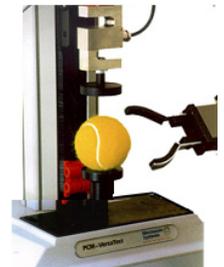
Description of operation of encoder such as disk encoder shown.



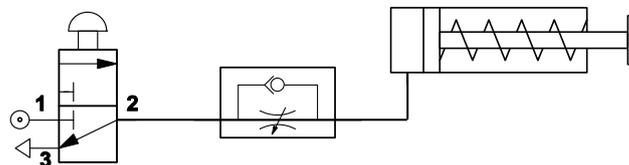
OR

- 1(d) (i) Give **two** common applications of pneumatic control. **Bus doors, dentist drills, fabrication tools (staplers, etc.), painting, car tyre changing equipment**

- (ii) The graphic shows a pneumatically controlled machine used to test tennis balls by applying a consistent load. The piston compresses the ball when a push-button is pressed. On releasing the push-button, the piston retracts ready to advance the next ball.



Draw a suitable pneumatic control circuit for the operation of this machine.



More complex test circuits e.g. reciprocating movement, are acceptable.

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

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

- 2(a) (i) Describe **two** modern technologies that have contributed to making our roads safer.
Any two such as traffic management systems, electronic road signs, speed cameras, etc.
- (ii) Identify **two** electronic safety features which are incorporated into modern cars and explain how they help improve driver safety.
Accelerometer activated air-bags reduce injury, anti-lock brake systems control car skids, etc.

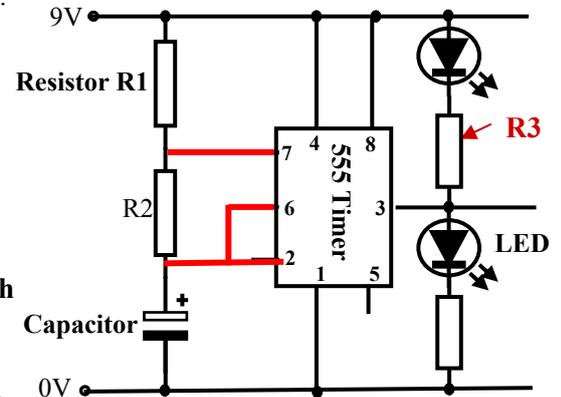
- 2(b) (i) Redraw the completed *astable* circuit, labelling all components.
Redraw/label circuit

- (ii) Distinguish between monostable and astable configurations.

Monostable: This is a system which has only one stable state. It can be made to change but it will always return to its original stable state, used in timing circuits etc.

Astable: This is a system which has no stable state. It changes from one state to the other all the time, used to flash lights etc.

- (iii) Calculate the value of R3 if the LED operates at 2V and 20mA.
 $R = V / I = 2 / 0.02 = 100\Omega$



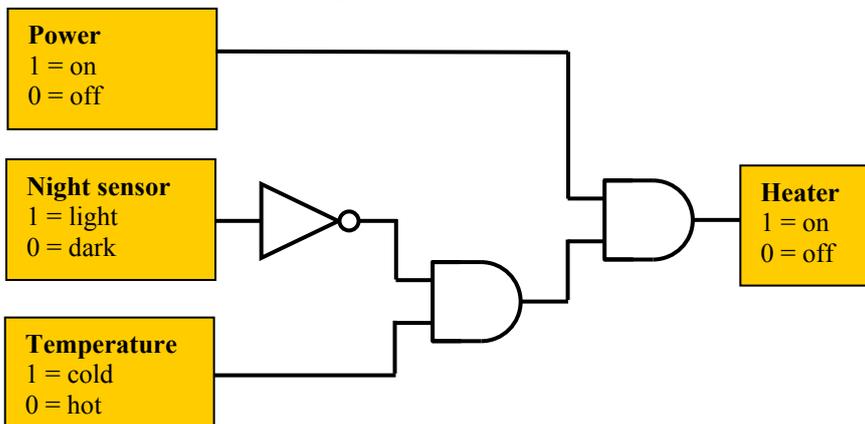
Answer 2(c) or 2(d)

- 2(c) (i) Name and state the function of **each** of the components A, B and C in this circuit.
A - Diode: protect the transistor from back EMF caused by the relay coil.
B - Relay: switch on the high voltage motor.
C - Transistor: to switch on the high current relay coil from the low voltage circuit.
- (ii) Calculate the gain of component C if the ammeter readings at $I_B = 0.6\text{mA}$ and $I_C = 90\text{mA}$.
 $\text{Gain} = \frac{I_C}{I_B} = \frac{90}{0.6} = 150$

OR

- 2(d) A gardener builds a device to switch on a heater when there is frost at night. There is an override switch to turn off the device during the warmer summer months.

- (i) Draw a logic gate and truth table for this system.
- (ii) Identify sensing components for use at X and at Y.



Power	Light	Heat	Heater
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

X- LDR, Y- Thermister

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

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

- 3(a) (i) Distinguish clearly between a *database* and a *spreadsheet*.
Database: A computerised filing system with the capacity to store and organise large volumes of information.
Spreadsheet: Software to sort information in tables, graphs, charts and mathematical forms etc.
- (ii) Outline **two** factors that have made *tablet computers* one of the fastest growing consumer products in recent years.
Two factors such as tablet technology is lightweight, transportable, increased availability of Wi-Fi, ease of use, development of user applications, etc.
- 3(b) (i) Explain the abbreviation **VoIP** making reference to a specific example of software and hardware required for such a system.
VoIP - Voice over Internet Protocol allows a user to make calls through a computer
Description of system and equipment such as Skype/Viber software, computer with broadband connection, microphone, camera, etc.
- (ii) State **two** advantages of using fibre optic cables instead of traditional copper cables for data transfer.
Two points such as secure data transmission, immune to crosstalk and RF noise, signals travel further etc.
- (iii) Outline the main features of *peer* networks **and** of *client* networks.
Peer networks: Resources are shared by members in workgroups without the need for additional software or additional storage.
Client networks: dedicated servers control 'log in' and access to resources with each user having a password accessed user account.

Answer 3(c) or 3(d)

- 3(c) (i) Name and state the function of **any three** parts of a computer motherboard.
Processor socket: to hold computer processor
Ports: for serial, parallel, audio/video, PS/2, Modem, USB
Graphics slot: for graphics card
Chipset: northbridge and southbridge
Memory sockets, heat sink etc.
- (ii) Outline a functional difference between ROM and RAM.
Read Only Memory is an IC programmed with data when it was manufactured, it is not modified by the user.
Random Access Memory is the main computer memory, programmes in use are held in RAM with contents lost if the computer is switched off.

OR

- 3(d) (i) Distinguish clearly between computer *worms*, *trojans* and *spyware*.
Worm: replicates itself with the intention of infecting other computers.
Trojans: a standalone malicious programme that can make copies of itself, steal information or harm host computers.
Spyware: malware that collects information about users without their knowledge including personal information and internet use habits etc.
- (ii) Internet security is a key issue when browsing the internet. Explain the use of *pop up blocker* and *phishing filter* tools to help protect the user from malicious content and fraud.
Pop up blocker: software that disables advertising windows from appearing when using a computer
Phishing filter: a tool to prevent the gathering of information such as passwords, usernames and banking details, often sought through false e-mailing etc.

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

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

- 4(a) (i) Describe the essential principles of JIT.

Suppliers are coordinated with the manufacturing company, products are delivered in line with market demand. This reduces the amount of stock stored with less materials, parts, tools and space used. Advantages include quick response to demand, less investment in storage, quick turnaround of products, increased workforce flexibility, reduces waste, etc.

- (ii) Outline **two** implications of a significant break in supply chain for a JIT manufacturing system after an event such as the Japanese earthquake.

Vital components may become unavailable in a short space of time, Alternative manufacturers may take time to source and produce items in short supply, Production may cease quickly in other plants without regular supply of parts, No built-up stock available for market etc.

- 4(b) Measurement of samples from two manufacturers of the bearings shown yielded the following results:

Manufacturer A: standard deviation 0.0103

Manufacturer B: standard deviation 0.0123

The inner diameter of the bearing must not be smaller than 24.95mm and not bigger than 25.02mm.

- (i) Calculate the *Process Capability Index* for each manufacturer

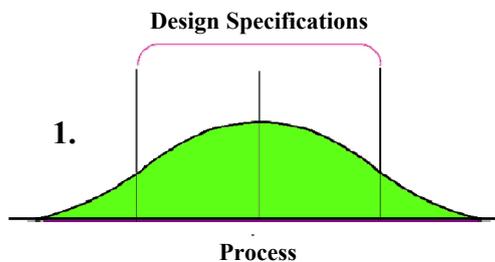
$$\text{A: } C_p = \frac{\text{Tolerance Range}}{6\sigma} = \frac{25.02 - 24.95}{6(0.0103)} = 1.13$$

$$\text{B: } \frac{25.02 - 24.95}{6(0.0123)} = 0.95$$

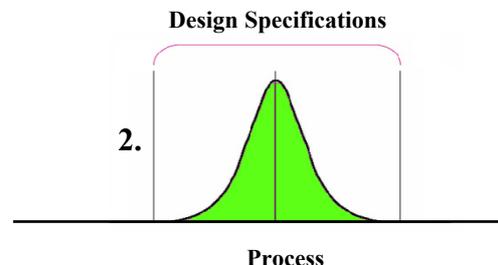
- (ii) Which manufacturer should be chosen so that the bearings will always meet design specifications? Give **one** reason for your answer.

Manufacturer A - tolerances will be met all the time, no products will have defects, process is capable.

- (iii) Identify the graph which would best describe the Process Capability of **each** manufacturer.



Manufacturer B



Manufacturer A

Answer 4(c) or 4(d)

4(c) (i) Distinguish between *Quality Control* and *Quality Assurance*.

Quality Control: inspects components after manufacture, defective components will be rejected but some non-conforming parts may not be identified.

Quality assurance: The process of maintaining high quality standards through the development of quality systems at all aspects of the production process etc.

- (ii) A strategy consists of four steps:
1. Define a primary task
 2. Assess core competencies
 3. Determine order qualifiers and order winners
 4. Position the firm.

Explain the **four** steps using examples in each case.

Define a primary task: Represents the purpose of the firm with the identification of the business area in broad terms.

Assess core competencies: Identify what the business does best in terms of knowledge or process.

Determine order qualifiers and order winners: Qualifiers is a characteristic of a product that makes a consumer consider buying it and order winners make the consumer want to buy it.

Position the firm: Choosing a number of important things to concentrate on and do very well, this will determine how well the firm competes in the marketplace etc.

OR

4(d) (i) Name and explain each of the **four** steps of the Deming Cycle.

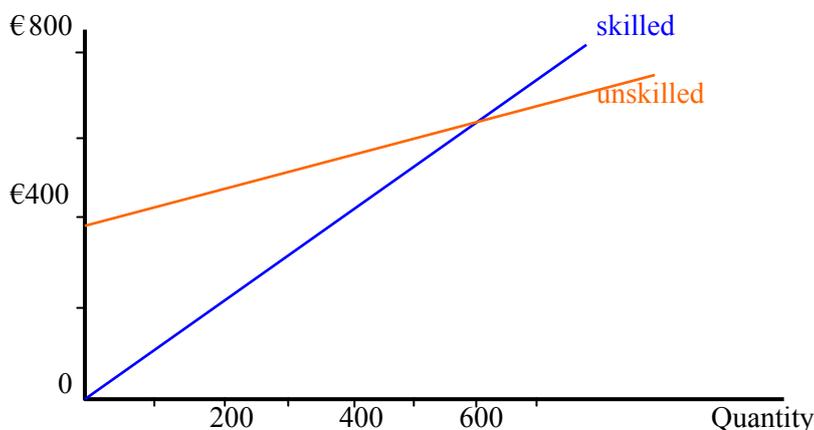
Plan – the current situation is analysed, data gathered and solutions are suggested.

Do – the suggested solution is tested or piloted.

Study – the trial solution is examined critically highlighting problems and opportunities.

Act – the solution is implemented and adopted as standard procedure.

(ii) (a) Draw a graph to show the costs of each method of engraving the medals.



(b) Determine the **BEQ** from the graph or otherwise.

$$\text{BEQ} = \frac{\text{Setup cost}}{\text{Manual cost/item} - \text{Automated cost/item}} = \frac{390}{1.1 - 0.45} = 600 \text{ units}$$

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

(a) - 10 marks, (b) - 16 marks, (c) OR (d) - 14 marks

5(a) (i) Briefly compare and contrast **each** of the following pairs of materials:

**Natural fabrics are created from animals (leather, wool) or plants (cotton, linen).
Synthetic fabrics are manufactured or 'man-made' and include nylon and acrylic.
Thermoplastics will mould more than once and are recyclable, polyethylene and polyvinyl chloride (PVC) are examples. Thermosetting plastics can only be shaped once and are usually harder and will withstand higher temperatures, polyester resin and phenol formaldehyde are common thermosets.
Ferrous metals contain iron, most are susceptible to rust with steels the most common.
Non-ferrous metals such as copper and aluminium do not contain iron etc.**

(ii) Outline the impact of acid rain on **each** of the following - mild steel, oak, acrylic.

Mild steel: hasten the rusting process

Oak: staining or discolouration

Acrylic: lose pigmentation etc.

5(b) (i) Select a suitable material for the frame of a user-powered wheelchair and justify your selection.

Suggestion: Stainless steel as it is strong, can be welded and will not rust etc.

Other valid answers acceptable.

(ii) Most frame parts are manufactured in tubular form, outline **two** advantages of using tubes rather than solid sections.

Stronger, lighter and less expensive etc.

(iii) Explain, using notes and annotated sketches, a method of assembling the frame for the user-powered wheelchair.

Clearly identify fabrication methods and describe with sketches. Tubes are cut and bent into shape and can be welded together (Stainless steel is TIG welded), Fasteners etc.

Answer 5(c) or 5(d)

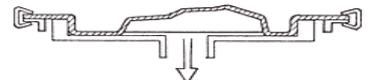
5(c) (i) Identify a suitable manufacturing process to make a batch of 100 such casings.

Suggested process - Vacuum forming

(ii) Describe, using notes and annotated sketches, the process you have selected to produce the casings.

This method is used to produce hollow shapes in plastic sheets. A shaped mould is produced, usually in wood, and placed in the machine. The sheet of plastic is placed over the mould and clamped.

An air-tight seal is required. The sheet of plastic is heated until soft and then drawn down onto the mould. A vacuum is created when the air is removed from the area around the mould. The plastic sheet will take the shape of the mould. The machine is turned off and the mould is removed from the plastic. The hollow shape is trimmed.



OR

5(d) (i) Explain the terms carbon footprint and sustainable design.

Carbon footprint is the total set of greenhouse gas emissions caused by an organisation, event, product or individual. It is usually expressed in terms of carbon dioxide emitted.

Sustainable design refers to the designing of objects, the built environment and services to comply with economic, social and ecological sustainability (meeting our needs without undermining the ability of future generations to meet their needs).

(ii) Distinguish, using examples, between **each** of the elements of the waste disposal hierarchy of 'Reduce, Reuse and Recycle'.

Reduce: Minimise waste by buying less and using less.

Reuse: discarded items are used again.

Recycle: separation of materials that may be incorporated into new products etc.

