



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2017

Marking Scheme

Technology

Higher Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.



Leaving Certificate Examination, 2017

Technology

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Marking Scheme

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. The first large-scale ground based solar electricity generation park on the island of Ireland has opened in Co. Antrim. The 12 hectare solar farm at Crookedstone road, which cost €6.45 million to build, produces up to 5 MW of power from 20,000 photovoltaic panels.

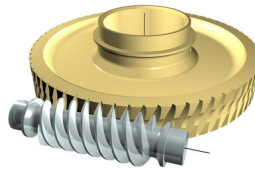
- (i) Outline **one** advantage of solar electricity generation.
Reduce fossil fuel dependency, renewable, less pollution, etc.
- (ii) Explain the meaning of abbreviation 'MW'.
Megawatt– the measure of power.



(2+4 marks)

2. The mechanism shown could be used in a car showroom turntable.

- (i) Name the mechanism shown.
Worm and wormwheel.



- (ii) Outline **one** advantage of using this mechanism.
Speed reduction, compact, strong drive, reliable, etc.



(3 + 3 marks)

3. Name and explain the functions of electronic components **A** and **B** in the partial circuit shown.

- (i) Component A

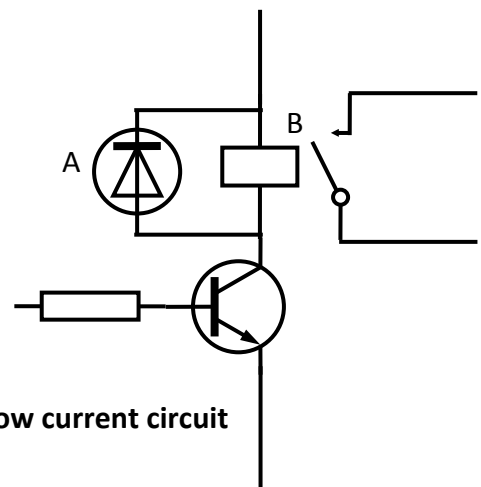
Name: **Diode**

Function: **Allows current flow in one direction, prevents feedback into relay, etc.**

- (ii) Component B

Name: **Relay**

Function: **Electromagnetic switch, can switch a high current circuit using a low current circuit**



(3+3 marks)

4. (i) Outline **two** essential functions of a laptop power supply unit.

Provides power to laptop, reduces voltage, converts AC to DC, charges battery, gives smooth supply, etc.



- (ii) A DC motor consumes 2 Watts of power and delivers 1.4 Watts of power at the output shaft. Calculate the efficiency of the motor.

Calculation:

$$\text{Efficiency} = \frac{\text{output power}}{\text{Input power}} = \frac{1.4}{2.0} \times 100 = 70\%$$



(3+3 marks)

5. A *torque wrench* is used to tighten the wheel bolts on a car.

- (i) Explain the term *torque*: **size of force exerted to cause rotation, etc.**
- (ii) If the length of the wrench is 500 mm and the required torque setting for the wheel bolt is 94 Nm, calculate the force required to achieve this torque.

Torque wrench



Calculation:

$$\begin{aligned} \text{Torque} &= \text{Force} \times \text{distance} \\ \text{Force} &= \text{Torque} / \text{Distance} \\ &= 94\text{Nm} / 0.5\text{M} = 188\text{N} \end{aligned}$$

(2+4 marks)

6. DOWN2EARTH materials are an Irish company specialising in sustainable food service packaging. Working alongside VEGWARE, they supply Ireland's largest range of certified compostable products and packaging to a wide variety of businesses in the food, catering and event sectors.

- (i) Give **one** example of a compostable consumer product.
Compostable sandwich boxes, coffee cups, trays, bags, etc.
- (ii) Outline **two** advantages of using compostable products.
Disposable products can be composted over a reasonably short space of time, food packaging does not need to be washed, less pollution, etc.



(2+4 marks)

7. The up and down movement of a lift is powered by an electric motor. The lift carriage has a mass of 900 Kg. Calculate the work done and the power required as the carriage moves 12 m from the ground floor to the top floor in 25 seconds.

Calculation:

Force	=	900kg x 9.81 (gravity)	=	8829N
		(Gravity = 10 also accepted)		
Work	=	force x distance	=	8829 x 12m
			=	105948 J or 105KJ
Power	=	$\frac{\text{work}}{\text{time}}$	=	105KJ/25 = 4.2Kw



(6 marks)

8. Outline the meaning of **any three** of the safety signs labelled A, B, C and D.



Fire equipment



Warning / Caution



First Aid



Mandatory/
action to be taken

(2+2+2 marks)

9. (i) Explain what is meant by a *Wifi hotspot*.
A location where internet access is available.



- (ii) Explain why browsing the internet at a public hotspot in a coffee shop might be slower than browsing on a home network.
Number of devices accessing public hotspot, quality of broadband connection, etc.

(3+3 marks)

10. Motor vehicle manufacturers are replacing steel components with plastic and composite materials in the construction of their cars.



Outline the impact on the environmental of **each** of the following materials used in car production, when disposed at the end of their useful life.

Steel:

Widely recycled, prone to degradation by rust, high energy used to dispose, etc.

Thermoplastics:

Recyclable material, degrades over time with pigment fade and brittleness, etc.

Fibre glass composite:

Long life, does not easily recycle, etc.

(2+2+2 marks)

11. The resistor colour code tables are shown.

- (i) State the value of the resistor R shown.



Value: **390000Ω / 390kΩ**

Colour band sequence is orange, white, yellow and silver.

- (ii) Calculate the lowest and highest possible values for the resistor R:

Lowest: **351,000Ω/ 351kΩ**

Highest: **429,000Ω/ 429kΩ**

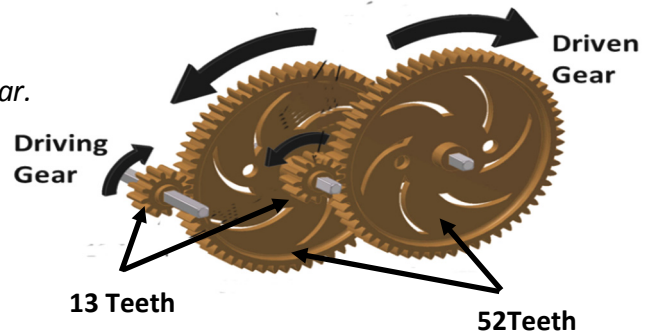
Colour code	
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Grey
9	white

Tolerance code	
1%	Brown
2%	Red
5%	Gold
10%	Silver

(2+4 marks)

12. (i) Using an arrow, indicate on the diagram the direction of rotation of the *driven gear*.

Clockwise



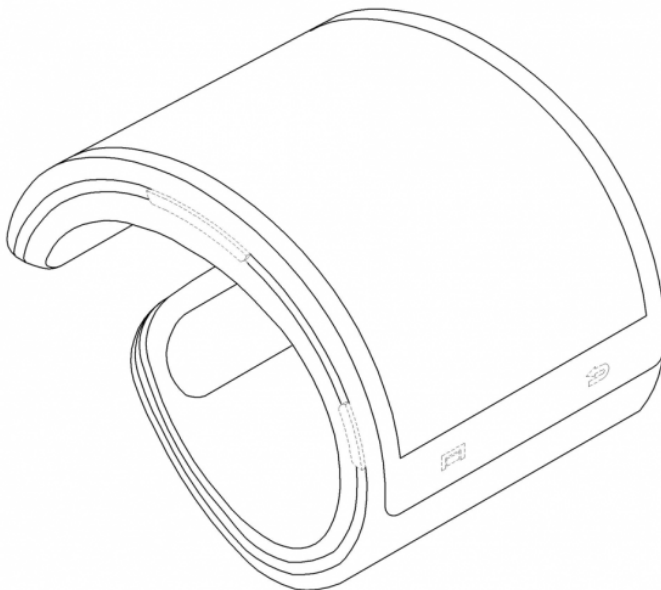
- (ii) If the *driving gear* is rotating at 500 rpm, calculate the output speed of *driven gear*.

Calculation:

Ratio	=	$\frac{13}{52}$	x	$\frac{13}{52}$	=	$\frac{1}{16}$
Output speed	=	500 rpm x 1/16			=	31.25 rpm

(2+4 marks)

13. Use **two** graphic techniques to enhance the representation of the smartwatch shown.



Two distinct graphic techniques required.

(3+3 marks)

14. CAM systems and robotic machines use CNC to provide commands for the machine to move in a particular direction at a given speed.

(i) Explain the terms:

CAM: **Computer Aided Manufacture.**

CNC: **Computer Numerical Control.**

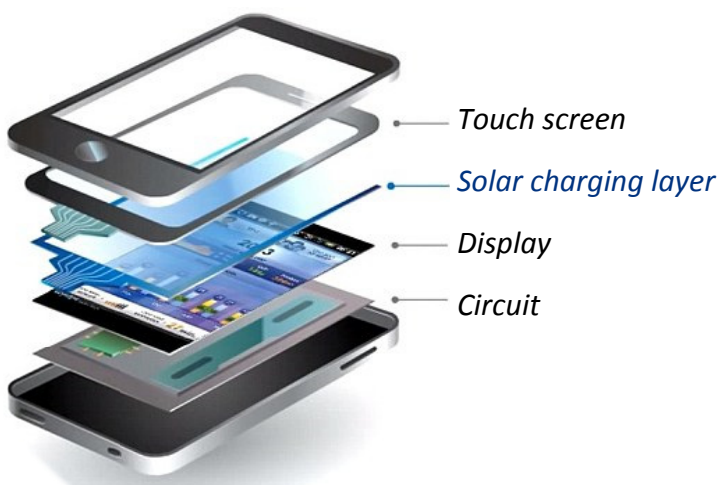
(ii) Give **two** reasons for the use of *pick and place* robotic machines are used in high-volume production.

Ease of programming, efficient control, effective and reliable method of carrying out repetitive tasks, work longer, etc.



(4+2 marks)

15. The graphic below highlights an innovative layer with solar charging properties in a prototype mobile phone. Sketch the **assembled** phone.



Good quality assembled phone sketch.

(6 marks)

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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) (i) State **two** advantages of electricity generated from wind power over electricity production using fossil fuels.

Renewable source, good location for wind, wind technology is improving and becoming more efficient, less pollution, etc.



- (ii) Explain what is meant by an installed capacity of 2527 MW.

The maximum potential of power produced in Ireland from wind farms is 2527 megawatts.

(8 marks, 4+4)

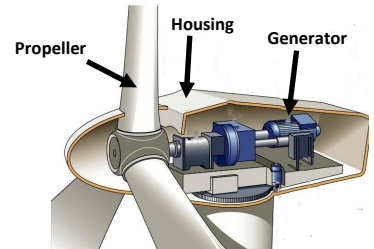
- 2(b) (i) State **two** energy conversions in a wind turbine system.

Wind - kinetic, mechanical - electrical, magnetic - electrical, etc.

- (ii) Describe, using annotated sketches, a mechanism to increase the speed of the output shaft by a ratio of 30:1 in order to produce electricity at the generator.

A gearbox is used to increase the turbine speed.

Planetary or compound gear systems could be used.



- (iii) Suggest, using annotated sketches, a method of reducing energy losses due to friction as the propeller rotates.

Sketch showing low friction bearing systems to reduce friction and lessen energy losses, etc.

(10 marks, 4+4+2)

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

- 2(c) (i) Explain the term composite material using concrete as an example.

Composite materials are made from two or more constituent materials with significantly different physical or chemical properties are combined to produce a material with different characteristics.

Concrete mixes cement and sand with additives and generally reinforced with steel bars.

Turbine tower is designed to stand in the concrete foundation.



- (ii) Suggest, using annotated sketches, an appropriate means of attaching the wind turbine to the reinforced concrete foundation/base.

The wind turbine could be attached using rawl bolts/bolts set in concrete, etc.

(6 marks, 3+3)

OR

- 2(d) Explain, with examples, what is meant by **each** of the three 'Pillars of sustainability' given below:

Environmental sustainability

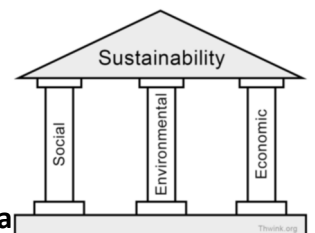
Use of renewable sources of energy, prevention of pollution of air, water, land and waste, natural resources will eventually run out, etc.

Social sustainability

An understanding of the needs of society including the development of a reasonable standard of living, education, community and equal opportunity, etc.

Economic sustainability

Provide for profit, cost saving, economic growth with research and development, etc.



(6 marks, 2+2+2)

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

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

- 3(a)** (i) Outline **one** application of wearable technology for leisure use.

Activity trackers, smart watches, etc.



(8 marks, 4+4)

- (ii) Describe **one** electronic sensor that could be used in wearable technology.

Voice activated control, accelerometer control, thermistor, etc.

- 3(b)** (i) Explain the term ergonomically designed.

Designing products, systems or processes to take account of the interaction between them and the people who use them.

- (ii) Describe the value of GPS (Global Positioning System) capability for the Viper Pod monitoring technology.

Global Positioning Systems (GPS) provides location and time information to a receiver anywhere on earth with a line of sight to four or more GPS satellites.

This provides monitoring data for the pod allowing analysis to happen.

- (iii) If the LED has a $V_f = 3.2V$ with $I_f = 25mA$, calculate the value of the protective resistor required when powered by a 9V battery.

$$R = \frac{V - V_f}{I_f} = \frac{9 - 3.2}{0.025} = \frac{5.8}{0.025} = 232\Omega$$

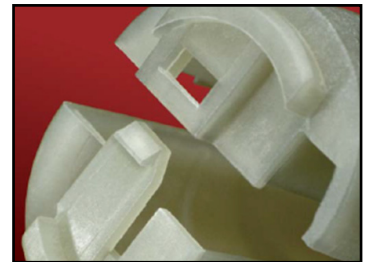
(10 marks, 2+4+4)

Answer 3(c) or 3(d)

- 3(c)** (i) Describe, using annotated sketches, how the two parts of the casing might be assembled.

The individual parts are injection moulded and designed to be close fitting.

The parts may clip together (as shown) or may use small screws to join the coloured parts together.



- (ii) The pod weighs less than 50g. Suggest **one** design detail of the casing to help ensure that the pod is light yet durable.

Choice of plastic material, thin sections for moulding, reinforced ribs, etc.

(6 marks, 4+2)

OR

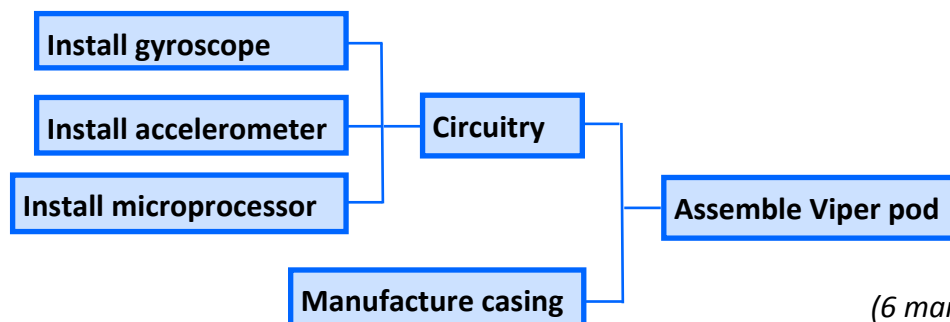
- 3(d)** (i) Name **one** quality characteristic and specify **one** related quality attribute for the Viper Pod.

Characteristic - light weight. Attribute - weighs 50g

Characteristic - data capture. Attribute - GPS monitoring technology

Characteristic - durable. Attribute - identify manufacturing processes used, etc.

- (ii) Outline a simple work breakdown structure for the production of the Viper Pod.



(6 marks, 2+4)

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) Select **two** systems in a domestic setting that can be automated. In each case justify your selection.
Heating, washing machines, lighting, security systems, etc.

Selection justified.

- (ii) *Phone Apps* are now commonly used in conjunction with home automation systems.

Explain why phone Apps are appropriate for this application.

Phone Apps allow remote access to home automation giving greater convenience security and control.

(10 marks, 6+4)

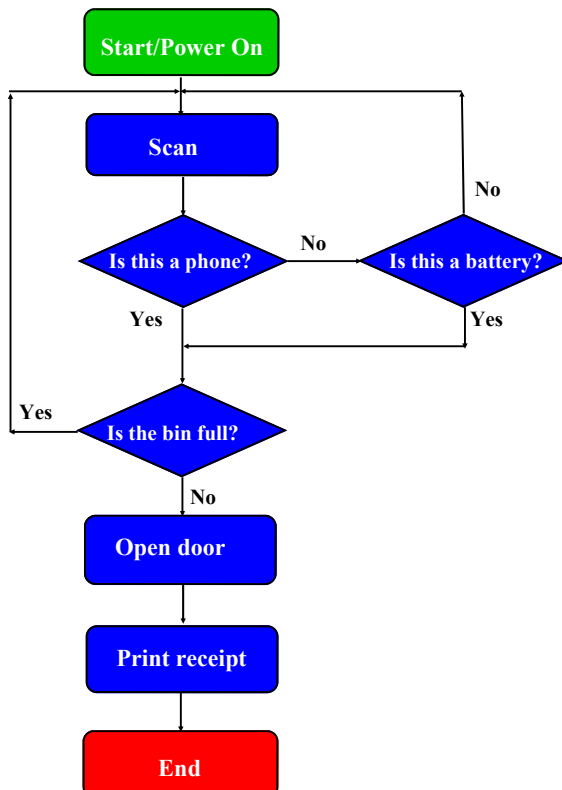
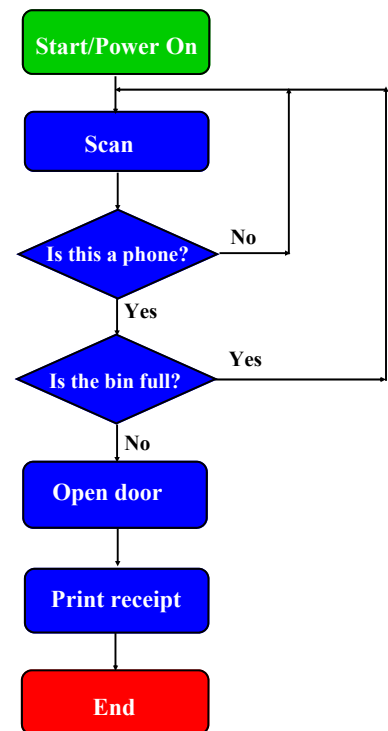
- 1(b) (i) Draw a flowchart for the operating sequence of the smart bin.

Complete flowchart.

- (ii) Name **two** sensors required for the smart bin to operate.

Light sensor, weight sensor, proximity switch, limit switch, etc.

- (iii) Suggest a modification to your flowchart to allow the smart bin to accept the phone and battery separately.



Any valid alternative solution accepted.

(16 marks, 10+2+4)

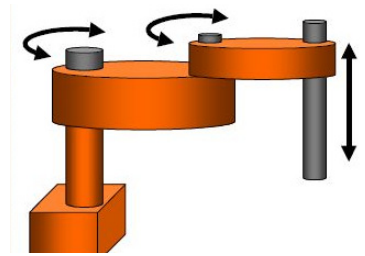
Answer 1(c) or 1(d)

1(c) (i) Name and describe the main features of a waste sorting robot such as that shown.

SCARA robots can move and place objects quickly and accurately. A range of end effectors are available, it stands vertically but can manipulate laterally, multiple degrees of freedom, etc.

(ii) Explain the function of *encoders* in robotic control.

Encoders give movement feedback to robots. This will determine speed, distance and position for robotic control.



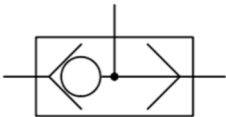
(14 marks, 8+6)

OR

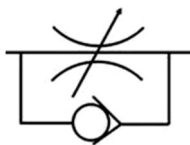
1(d) (i) Outline **two** reasons for the use of pneumatic control in compactor systems.

Provide a reliable strong crushing action, safe, can operate in hostile or corrosive environments, etc.

(ii) Distinguish between the functions of the pneumatic components whose symbols are shown at **A** and **B**.



A - shuttle valve/OR valve, allows air to flow from one source and blocks another, it is used in machine safety control.



B - uni-directional flow control valve, allows air to flow in one direction, it allows air flow to be restricted, it is used in cylinder speed control.

(14 marks, 6+8)

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 how a seven-segment LED display could improve the chess timer.
It could be programmed to count down each interval, timing is more precise, etc.

- (ii) State **one** function of a capacitor in a timer circuit.
To store electrical energy and release it when needed.

- 2(b) (i) Explain the terms IC and DIL.

IC - Integrated circuit.

DIL - Dual in line.

- (ii) Name a suitable output transducer (device) and describe the operation of the timer circuit.

A buzzer is a suitable output.

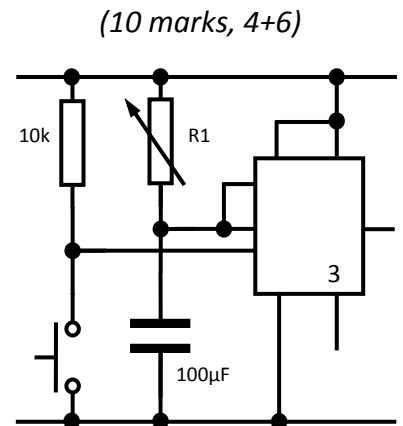
When the PTM switch is pressed the output at pin 3 is activated for a set time determined by the values of variable resistor R1 and the 100µF capacitor C1. The output pin 3 stays 'high' until the capacitor voltage reaches two-thirds of the supply voltage.

A signal is then sent to the threshold pin which turns off the output and the capacitor discharges. If the switch is pressed again the process is repeated, etc.

- (iii) Calculate the value setting for R1 to produce a 30 second pulse duration (t).

Formula $t = 1.1 \times R1 \times C1$

$$R1 = \frac{t}{1.1 \times C1} = \frac{30}{1.1 \times 0.0001} = 272k\Omega$$



(10 marks, 4+6)

(16 marks, 4+8+4)

Answer 2(c) or 2(d)

- 2(c) (i) Select the most suitable transistor from the table to provide a collector current of 60mA if the base current is 0.4mA. Give a reason for your answer.

Current Gain = $I_c/I_b = 60/0.4 = 150$.

BC107 as the current gain is 150.

- (ii) Name and explain the function of the transistor arrangement shown in Fig. 1.

Darlington Pair- the combination of transistors is used to make switching time faster, improve sensitivity, greater amplification, etc.

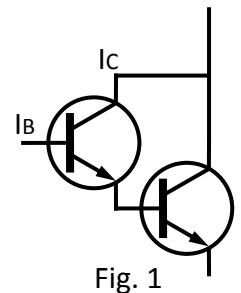


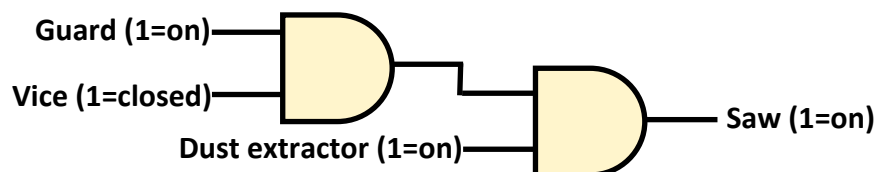
Fig. 1

(14 marks, 8+6)

OR

- 2(d) (i) Using logic gates, draw a circuit that could be used to control the saw.

Suggested solution:



- (ii) Suggest a suitable sensor for use with the safety guard of the saw.
Push to make switch, strain gauge, piezoelectric sensor, limit switch, etc.

(14 marks, 10+4)

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) Explain, with examples, how virtual reality technology has applications in **any two** of the following:

Entertainment -

description of VR in video games, music concerts, rollercoasters, etc.

Education and training -

description of VR in training simulation for medical or military uses, flight and vehicular applications, etc.

Marketing and advertising -

allows the user to experience a product or service, take tours, etc.



(10 marks, 5+5)

3(b) (i) Suggest **three** best practice guidelines for a user of online services.

Exercise caution in sharing of sensitive or personal data, keep security systems updated, do not engage with unsecured services, use passwords and encryption software, etc.

(ii) Describe with examples, the use of **any two** of the following advanced search operators.

* (asterisk) **search will fill in blanks if you not sure what is next e.g. song lyrics**

+ (plus symbol) **finds information on search topic + words included**

" " (quotation marks) **search for the exact term eg "BC109 transistor"**

(iii) Outline the role of a *firewall* in network security.

Firewalls are programmes or devices that acts as a barrier to keep destructive elements out of a network or specific computer. Firewalls are configured with specific criteria to block unauthorized access to a network.

(16 marks, 4+6+6)

Answer 3(c) or 3(d)

3(c) (i) List **three** tasks of a network administrator when setting up and maintaining a computer network.

Install network and computer systems, maintain and upgrade computer systems, diagnose and repair hardware and software issues, monitor network and systems to improve performance, administer access rights for network users, etc.

(ii) Outline the main features of a *client-server network* and a *peer-to-peer network*.

A client server network has a centralised powerful computer as a hub to which personal computers or workstations are connected.

A peer-to-peer (P2P) network is a distributed application architecture that partitions workloads between computers. This allows the sharing of data without the need for a central server.

(14 marks, 6+8)

OR

3(d) (i) Explain the term full HD 1080p.

High Definition with 1080 progressive scan.

(ii) Differentiate between video at 30 fps and video at 120 fps.

30 frames per second gives a good flow of video reproduction for most applications.

120 frames per second gives a smoother video with a positive impact on slow motion shots.



(14 marks, 8+6)

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

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

4(a) (i) Explain **each** of the following aspects of *Design for Environment* (DfE) production:

- Manufacture - **Reduce to minimum possible areas such as energy use, emissions and waste products. Materials and processes should be non-toxic, less packaging etc.**
- Consumption - **Packaging materials be minimal, reuse and bio-degradable. Use little amounts of energy etc.**
- Disposal - **Select materials that recycle, design products to be serviceable rather than disposable, reuse, etc.**



(ii) Briefly outline the impact of poor quality production on product life cycle and market share.

Product life cycle is likely to be reduced as product quality is poor, product likely to fail early, expected life cycle will diminish, etc.

Market share will be reduced as customers are lost, product may have to be relaunched, loss to reputation, etc.

(10 marks, 6+4)

4(b) (i) Explain, with examples, the Pareto principle of quality management.

This is the 80/20 rule where roughly 80% of the effects come from 20% of the causes e.g. 80% of computer crashes are contributed to 20% of software bugs.

(ii) Outline the role of *accelerated testing* in the production of roller bearings for a bicycle wheel. **Accelerated tests are used to determine when a product will most likely fail. These tests are carried out in a shorter period of time as the expected 'real world' life is too long, etc.**

(iii) A Quality Control scheme is in operation for a process producing ball-bearings.



Each hour 6 bearings are taken and their diameters measured. The process delivers a mean diameter of 20 mm with a standard deviation of 0.03mm. The lower and upper specification limits are 19.97 mm and 20.01 mm respectively.

Calculate the process capability index and give the 'control state' of the process.

$$\text{where } C_p = \frac{\text{Tolerance Range}}{6\sigma} = \frac{20.01 - 19.97}{6 \times 0.03} = 0.22$$

$C_p < 1$ and is not capable

(16 marks, 4+6+6)

Answer 4(c) or 4(d)

4(c) (i) Name production processes corresponding to A, B, C and D of the matrix shown.

A - Once-off projects: tend to produce single or low number of items, can be expensive etc.

B - Batch production: products produced over a particular period of time as demand for the items may fluctuate, low volume, used for sporting items that may change each year etc.

C - Mass production: standard products are produced in large volumes, demand is high and stable, used for household electrical items etc.

D - Continuous production: Generally factories are dedicated to single number of products with high volume, systems are highly standardised and automated, used to produce products such as sugar etc.

(ii) Distinguish between the *business strategy* and the *manufacturing strategy* of a medical devices firm.

A business strategy provides direction and focus for a the medical devices company through defining of the primary task, assess core competencies, determine order qualifiers and order winners and position the firm within the medical devices area.

A manufacturing strategy for medical devices decides how to offer a product and determines production processes. This is determined by the nature of the product e.g., a specialised piece of equipment may be manufactured as a once-off product while some commonly used instruments can be mass produced or made in batches.

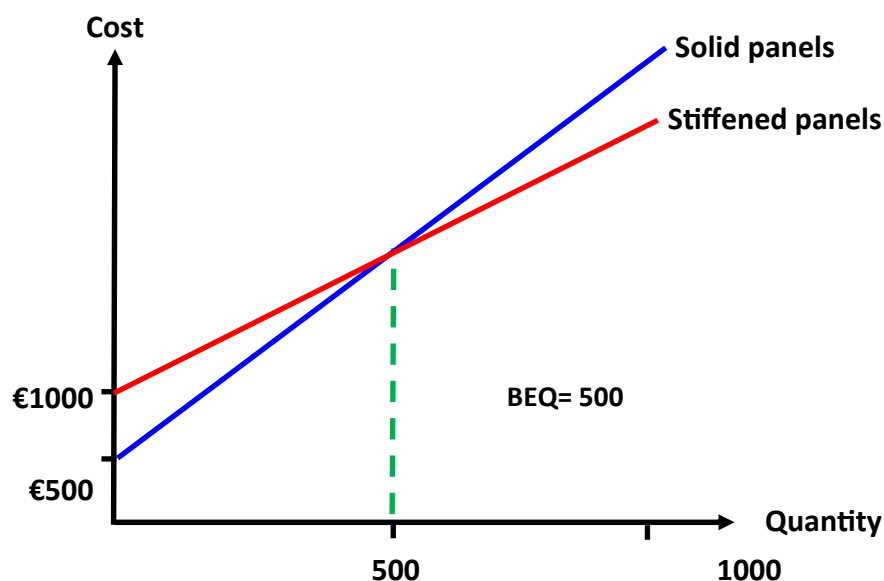
(14 marks, 8+6)

OR

4(d) (i) Explain, with specific examples, the distinction between fixed costs and variable costs.

Fixed costs remain constant regardless of activity and include rent, buildings, machinery, etc. **Variable costs** will increase and reduce as production changes, these include wages, utilities and materials used in production.

(ii) Represent the key features of this data to analyse production costs for up to 1000 panels.



(14 marks, 6+8)

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

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

- 5(a) (i) Differentiate between the forces of tension, compression and torsion.

Tension force tries to pull and stretch an object, compression exerts a force which compacts an object, torsion force causes a twisting action.

- (ii) Describe, with examples, how metal alloys **and** manufactured boards can increase the strength of a final material.

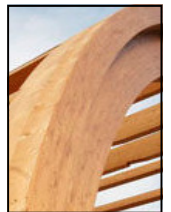
Metal alloys combine the properties of constituent metals to give a new metal with different properties e.g., brass is an alloy of zinc and copper giving an improvement in hardness and machinability.

Plywood consists of two or more layers of wood glued and pressed together with the direction of the grain alternating. This provides increased strength and stability to the material.

(10 marks, 4+6)

- 5(b) (i) Describe, using annotated sketches, how an arched structure such as that shown may be fabricated.
Separate layers of wood are shaped around a former then clamped and glued together (laminated) forming the arched structures.

- (ii) Describe, using annotated sketches, how metal nodes could be used to join a wooden structure.
Close-fitting metal joints connect the individual wooden members, (can use bolts with the node) these nodes provide a stronger joint than relying on wooden joints only.



- (iii) Outline the use of *triangulation* to make structures stronger.

Triangulation adds stability, strength and rigidity to structures as weight and force are pushed down from the top to the wider base of the triangle. A triangle is a geometrically rigid shape.

Answer 5(c) or 5(d)

(16 marks, 6+6+4)

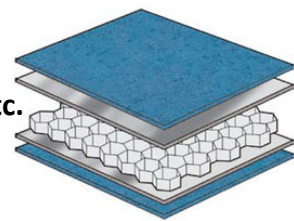
- 5(c) (i) Outline **two** advantages of using this material in marine applications.

The structure is strong due to lamination and honeycomb structure, aluminium is light, outer layers can be made in a range of finishes, colours, etc.

- (ii) Describe the role of the aluminium honeycomb structure in the design of this material.

The hexagonal honeycomb creates a strong structure with minimal use of expensive material, it creates a range of material thicknesses, the individual layers can be glued together successfully, etc.

(14 marks, 8+6)



OR

- 5(d) (i) State **two** reasons for using steel tubing in the construction of racing cars.

Tubing reduces weight, high strength-to-weight ratio, can be fabricated and welded successfully, reasonably cost effective, etc.

- (ii) Outline some benefits to consumers and to the environment of the increasing use of electric cars.

Consumers can expect reduced running costs, smoother and quieter driving experience, etc. The environmental benefits include less burning of fossil fuels, cleaner air, less noise pollution, etc.

(14 marks, 8+6)

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