



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2011

Marking Scheme

TECHNOLOGY

Higher Level



Leaving Certificate Examination 2011

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. In the promotion of alternative sources of energy for cars, a concept for a commercial solar charging station is illustrated. Outline **three** benefits of such a plan.

- (i) **Utilises the time period when cars are parked to recharge**
- (ii) **Reduction in use of fossil fuels/carbon footprint**
- (iii) **Less cost over time, Longer journeys can be undertaken, no need to return home to recharge etc.**



(2 + 2 + 2)

2. Describe **two** specific safety precautions that should be observed when:

Cutting a workpiece made in medium density fibreboard (MDF):

- (i) **Dust extraction/ Mask/ Air filtration unit to be used**
- (ii) **Wear eye protection etc.**



Soldering components onto a printed circuit board (PCB):

- (i) **Fumes need to be extracted**
- (ii) **Use soldering stand/ Do not overheat components etc.**

(2 + 1 + 2 + 1)

3. Technology has a significant influence on medical treatments, drugs and diagnostic techniques. The reshaping of the cornea in eye surgery is an example.

- (i) Identify the technology used.

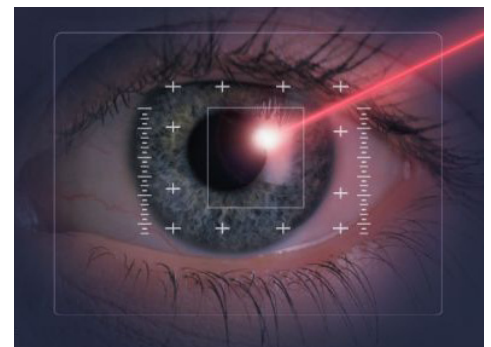
Laser

- (ii) Outline **two** advantages of using this technology rather than traditional surgery.

Accurate with precise control of process

Less invasive with short recovery time

Less risk of scarring etc.



(2 + 2 + 2)

4. The Salif Lemon squeezer by innovative designer, Philip Starck, is a source of debate.



(i) Name a suitable material for the lemon squeezer.

Silver, Stainless steel, polished Aluminium etc.

(ii) Explain why this material is suitable, make reference to function and manufacture.

Material will resist acids produced by lemons, non toxic, can be formed into shape easily, strong and durable etc.

(2 + 2 + 2)

5. Explain the computer terms:

(i) Wi-Fi

Wireless standard for connecting electronic devices etc.

(ii) Cache

A block of RAM used for the temporary storage of data that is likely to be used again, it will determine how fast data can be accessed.

(iii) Cookies

Cookies are pieces of data stored on a users computer by their web browser, they can be used for storing site preferences, authentication, tracking computer activity etc.

(2 + 2 + 2)

6. The room temperature indicator shown uses a 'smart material' as a sensor.

(i) What are 'smart materials'?

A material that responds to an external influence such as heat, light, pressure, current etc.

(ii) Describe the operation of the temperature indicator shown.

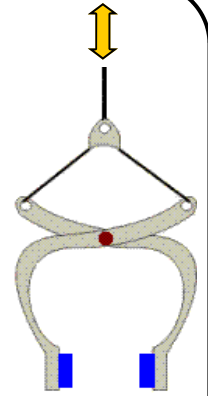
The thermochromic (thermocolor) material changes colour as the temperature changes. This principle is used for the temperature indicator.



(3 + 3)

7. Describe the operation of the bell crank mechanism used in the bicycle braking system shown.

The bell crank will change the direction of movement through 90°. The cable is pulled vertically and the brake pads will grip the wheel horizontally. An advantage is gained as both pads are moved at the same time in opposite directions.

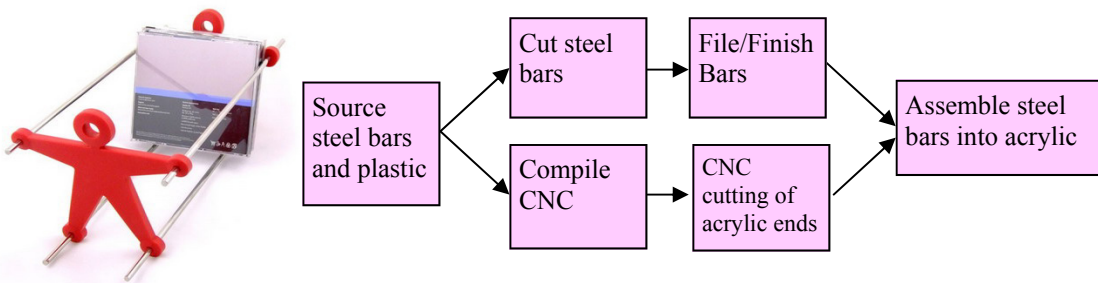


Outline the importance of friction in the operation of this braking system.

A soft rubber material (high friction) is used for the brake pads to grip onto the fast-moving wheels and hold the wheels as they come to a halt etc.

(3 + 3)

8. A 3D graphic of a CD holder is shown. Compile a Work Breakdown Structure (WBS) diagram for the manufacturing of the holder.



Suggest a suitable automated manufacturing method for the production of the acrylic ends for the holder.

CNC router/Laser cutter etc.

(4 + 2)

9. The graphics below show a resistor colour code table and three resistors **R1**, **R2** and **R3**.

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

(i) Calculate the values of resistors **R1**, **R2** and **R3**.

R1 - Red, Red, Red, Gold. **Value = 2200Ω**

R2 - Blue, Orange, Black, Gold. **Value = 63Ω**

R3 - Green, White, Black, Gold. **Value = 59Ω**

(ii) A light-emitting diode has a current rating of 0.15mA in a 9V circuit. Calculate the size of the protective resistor needed?

$$R = V / I = 9 / 0.15 = 60\Omega \quad (1 \text{ mark for formula, 1 mark for answer})$$

(iii) Select the most suitable resistor from **R1**, **R2** and **R3** to protect the above LED.

R2 = 63Ω

(3 + 2 + 1)

10. (i) Outline the meaning of the term *ergonomics*.

Ergonomics aim to match the design of equipment/devices with human body shapes and sizes etc.

- (ii) State **three** ergonomic factors which should be considered when designing a computer desk.

Height of the table top and the keyboard shelf.

Tilt and height of the monitor screen.

Distance to reach for the computer power button.

Position of bar not to interfere with comfortable sitting position etc.



(3 + 1 + 1 + 1)

11. Thermal and electrical properties of materials are very important in the electronics industry. Explain the properties *thermal conductivity* and *thermal insulation* with specific reference to the materials used to make the soldering iron shown.



Thermal conductivity

The ability of a material to allow heat to travel through it. The soldering iron tip can be made from copper as it allows the heat to move from the heater element to the tip etc.

Thermal insulation

The ability to resist the flow of heat. The handle of the soldering iron can be made from a thermosetting plastic such as phenol formaldehyde to withstand the high temperatures generated and protect the user from this heat etc.

(3 + 3)

12. There are three classes of lever.

(i) Identify which class of lever is used in each of the following items:

A



Class 2

B



Class 1

C



Class 3

(ii) For the can crusher shown, calculate the force applied to the can if the force applied at the end of the lever is 100N.
(The length of the lever is 500mm, distance to pivot is 200mm)

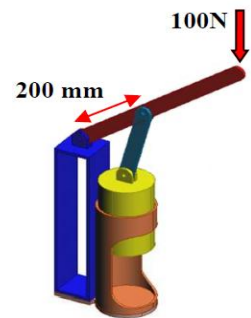
Calculation:

$$F_1 \times D_1 = F_2 \times D_2$$

(2 marks for formula, 1 mark for answer)

$$F_1 \times 0.2 = 100 \times 0.5$$

$$F_1 = 250\text{N}$$



(3 + 3)



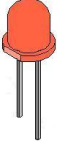

13. Make well-proportioned freehand sketches of three principal orthographic views of the portable radio shown.

A front elevation, a plan and an end view



(2 + 2 + 2)

14. Polarised electronic components must be connected correctly in a circuit. Complete the table by naming each component and describing a feature which identifies the correct way to connect it.

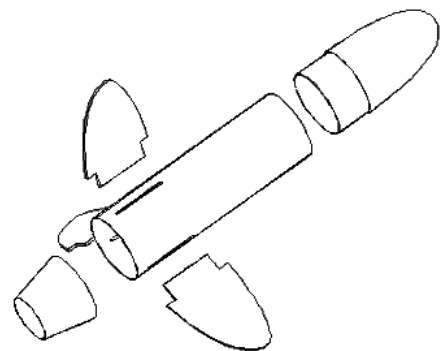
Component	Name	Identifying feature of component
	Diode	The band on the casing indicates the cathode
	Capacitor	Short leg/grey band marked on casing indicates the cathode etc.
	LED	Short leg and flat on rim of LED indicates the cathode etc.
	555 timer IC	Circle indentation at first leg (pin no.1) on timer casing etc.

(2 + 2 + 2)

15. An exploded view of a toy rocket is shown. Sketch a pictorial view of the **assembled** rocket and use rendering techniques to enhance the sketch.

Assembly/Rendering

Assembled sketch - 4
Rendering - 2



(4 + 2)



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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) In October 2010, a group of miners were trapped 700m underground for 69 days in San Jose, Chile. Shannon-based manufacturing company, Mincom International, provided the drill that facilitated initial contact with the 33 trapped miners, as shown in the graphics below.

(i) Describe **two** dangers associated with underground mineral mining.

**Deep tunnels are cut out of the underlying rock structure which are in danger of collapsing, miners can become trapped without an escape route;
Pockets of dangerous gases can be encountered in the mining process etc.**

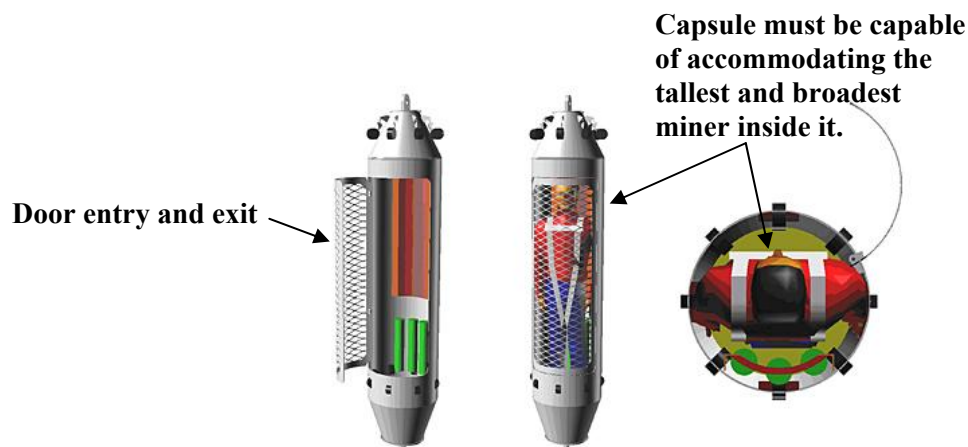
(ii) After seven attempts, a *pilot hole* was drilled to make contact with the group of miners. What is the purpose of drilling a pilot hole?

Pilot holes are generally drilled with a smaller bore to guide the larger hole in the right direction, this reduces the cutting forces needed to drill large holes.

A pilot hole was used to communicate with the group of miners to inform them of progress.

2(b) A rescue capsule was designed to bring each miner to the surface. Using neat, well-proportioned, annotated sketches propose a design for a suitable rescue capsule making reference to the following essential details:

- appropriate anthropometric data
- entry and escape from the capsule
- suitable materials
- manufacturing methods.



Good quality sketches labelled clearly

Suggested material is mild steel/alloy steel.

Manufacturing methods: Steel rolling, welding, spray painted etc.

Answer 2(c) or 2(d)

- 2(c) (i) Outline, with annotated sketches, a mechanism for raising and lowering the capsule in a safe and controlled manner to bring each miner to the surface.



**An automated winching/pulley system could effectively lift the capsule.
Locking method: Ratchet and pawl etc.**

- (ii) The structure of the rock raised a concern that the drilled hole might collapse.
Propose a design modification to the drilled hole to help prevent the collapse of its walls.

OR

- 2(d) (i) Images of the rescue of this group of miners were transmitted around the world in 'real-time' by satellite technology. Outline the impact of *satellite technology* and the *internet* on the reporting of this event.

**Satellite technology ensured that the event was transmitted across the world as it unfolded.
Viewers were able to follow the miners' ordeal by logging onto the internet at any time convenient to them etc.**

- (ii) Optical fibres transmit light rather than electrical signals and have the potential to revolutionise communication systems. Describe **two** advantages of the use of fibre-optic cables rather than traditional communication cables.

**Less prone to interference by external signals.
Large signals can be transmitted more effectively by fibre-optic cables over long distances.
Higher speeds of transmission etc.**

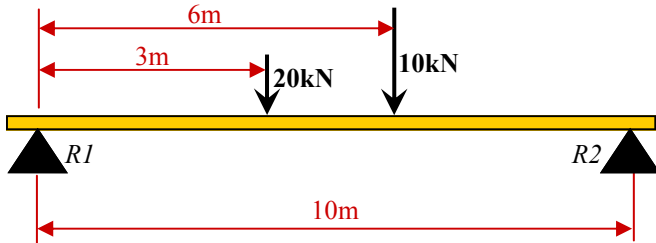
Question 3 - Answer 3(a) and 3(b)

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

3(a) (i) Distinguish clearly between a *static* load and a *dynamic* load. Use specific examples to support your answer.

**Static loads are stationary, e.g. house, table etc.
Dynamic loads are moving, e.g. moving car etc.**

(ii) From the information given, calculate the forces acting on **each** of the supports R1 and R2.



R2, moments taken about R1:

$$\begin{aligned} \text{Anti-clockwise moments} &= \text{Clockwise moments} \\ R2 \times 10\text{m} &= (20\text{kN} \times 3\text{m}) + (10\text{kN} \times 6\text{m}) \\ R2 \times 10\text{m} &= 60\text{kNm} + 60\text{kNm} \\ R2 &= \frac{120\text{kNm}}{10\text{m}} \\ R2 &= 12\text{kN} \end{aligned}$$

R1:

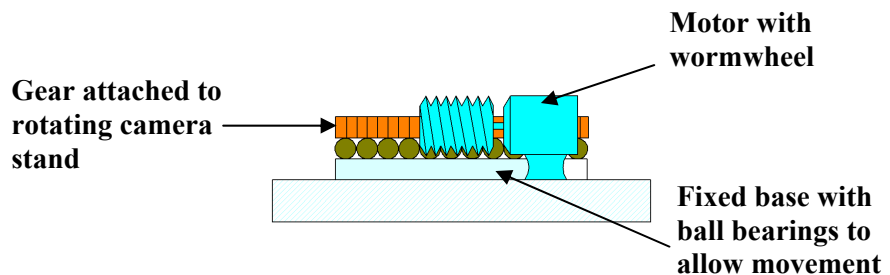
$$\begin{aligned} R1 &= \text{Total downward forces} - R2 \\ R1 &= 30\text{kN} - 12\text{kN} \\ R1 &= 18\text{kN} \end{aligned}$$

3(b) An airport car hire company monitors its' fleet of vehicles from the booking office. A number of surveillance cameras have been installed. One of the cameras can be manipulated by the office staff.



(i) Using annotated sketches, outline a control system at **A** to slowly rotate the camera in both directions.

Control system: worm and wheel with DPDT switch, servo motor etc.



(ii) Name a mechanism at **B** to tilt the camera through an angle of 45°.

Worm and wheel, gear drive, servo motor, stepper motor etc.

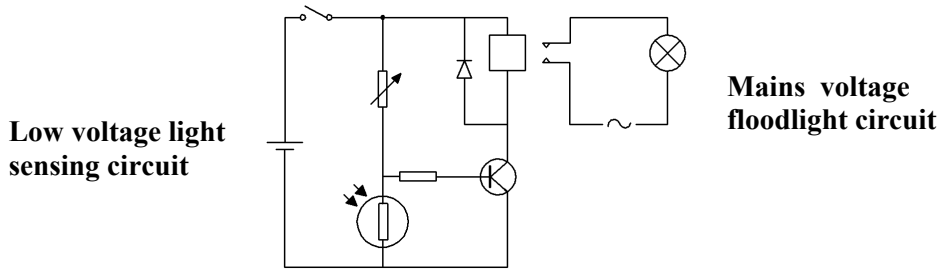
(iii) Outline some possible effects on the camera casing of prolonged exposure to ultra-violet rays from sunlight and acidic pollution from the atmosphere.

Degradation in colour, brittleness, warping, cracking of casing etc.

Answer 3(c) or 3(d)

3(c) The surveillance camera needs to sense light levels to operate effectively.

- (i) Draw a suitable circuit diagram which contains both a low voltage circuit that will sense changing light levels **and** a means of switching on a 240V floodlight at night-time.



- (ii) Specify the correct fuse rating in amps to protect a 600W floodlight operating on a mains supply at 240V.

Power = Voltage x Current

$\frac{\text{Power}}{\text{Voltage}} = \text{Current}$

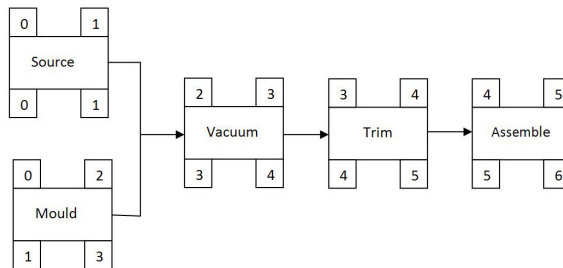
$\frac{600\text{W}}{240\text{V}} = \text{Current}$

Current = 2.5A

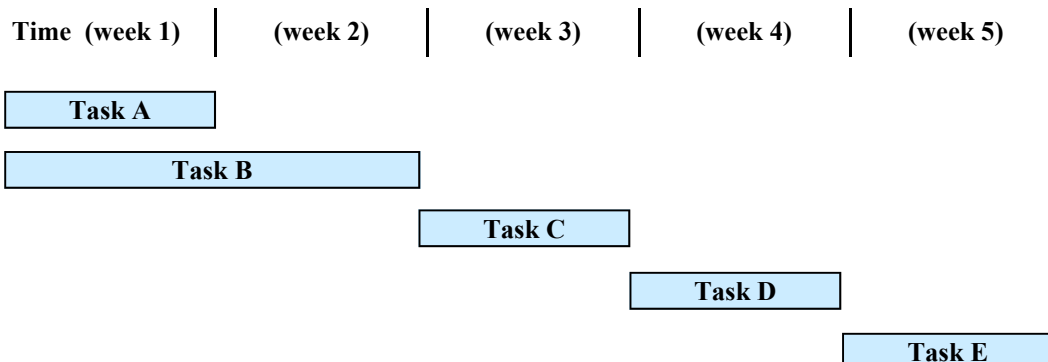
OR

3(d) The plastic dome protecting the camera is produced by vacuum forming.

- (i) The table shows the schedule of tasks for the production of the plastic dome and the assembly of the camera housing. Draw a critical path diagram for the project.



- (ii) Construct a Gantt chart for the scheduling of the tasks involved.



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

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

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

1(a) In the design of electronic circuits, their effectiveness can be tested by:

- Prototyping with real components

Prototyping: building circuits on test boards/breadboards to test their functionality etc.
Advantages: actual components are used, a working circuit is built, components can be changed easily etc.

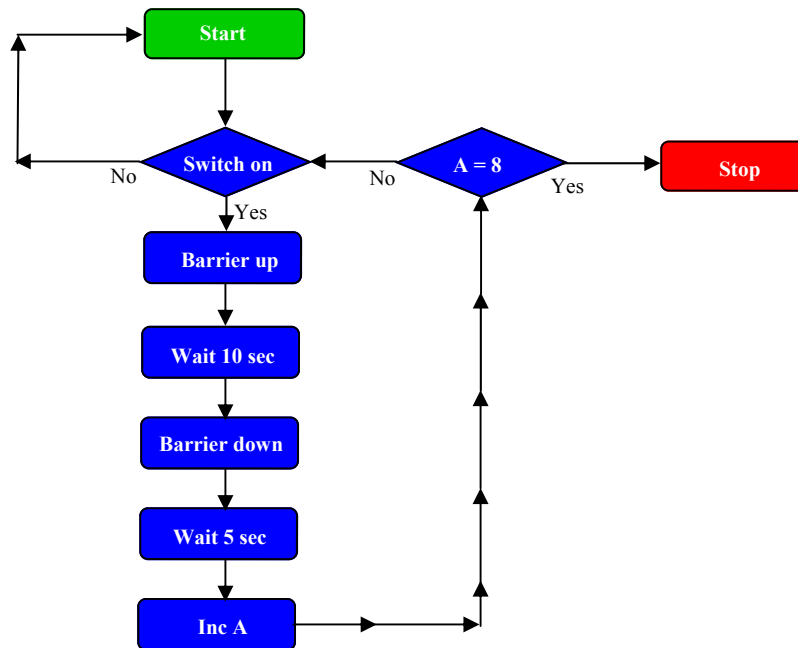
- Simulation using a computer software package.

Computer software, e.g. Circuit Wizard, can be used to test circuits without using real components.
Advantages: expensive components are not destroyed, easy testing and modification etc.

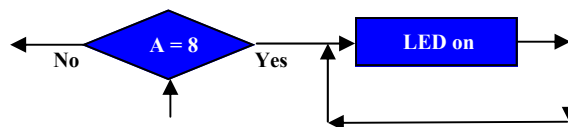
Explain how **each** of these methods can be used and outline **two** advantages of each method.

1(b) Shown is an incomplete program sequence which is intended to restrict the number of cars allowed into a car park to 8.

- (i) Complete the programme sequence so that a maximum of 8 cars are allowed to enter the car park.



- (ii) Modify the programme sequence so that a red LED will illuminate when the car park is full.



- (iii) Servo motors are used to control the car park entry barrier. Why are servo motors suitable for this application?

The servo motor gives a good degree of control and can rotate accurately up to a specific point. Most do not rotate through a full rotation, this is ideal for the car park barrier application.

Answer 1(c) or 1(d)

1(c) The 'hands' of a robot are often referred to as *end effectors*.

Mechanical grippers and vacuum grippers are examples of such end effectors.

- (i) Distinguish between the use of mechanical grippers and vacuum grippers as methods of robotic manipulation of objects.

Mechanical grippers close against the object to be manipulated with enough force to hold the object, the grippers can be powered by servo motor, pneumatic or hydraulic power. Size and delicacy of objects determine if mechanical grippers can be used etc.



Vacuum grippers have plastic or rubber suction cups which press against the object to be moved then air is drawn out creating a suction force. Surfaces need to be flat, smooth and clean etc.



- (ii) Describe the main features of a SCARA robot such as the one shown. (SCARA - Selective Compliant Assembly Robot Arm)

The SCARA robot has a combination of two horizontal rotational axes and a linear movement vertical axis.

It is used to quickly move components (in parallel planes) and can stack objects accurately etc.



OR

- 1(d) (i) The compressor in a pneumatic control system supplies compressed air in a conditioned form through the stages of *filtration*, *pressure regulation* and *lubrication*. Explain **each** of these stages.

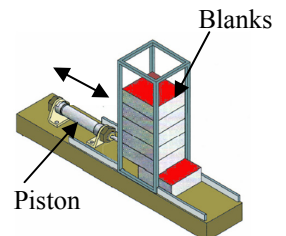
Filtration: the air is filtered to remove moisture and other particles which might damage pneumatic components.

Pressure regulation: the regulator supplies air at a constant pressure, this can be adjusted.

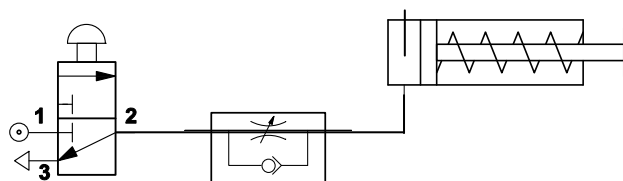
Lubrication: droplets of oil are added to the compressed air, this lubricates moving parts such as valves and cylinders etc.

- (ii) A pneumatic device supplies blanks to a machine for stamping. In this device:

- The piston advances a blank when a push-button is pressed.
- On releasing the push-button the piston retracts ready to advance the next blank.



By selecting from the given symbols, draw a suitable pneumatic control circuit for the stamping operation.



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) The 'WEEE man' sculpture was made from 3 tonnes of electrical waste and used to promote the WEEE directive. All electrical and electronic goods are subject to the PRF in Ireland to offset the cost of their recycling.



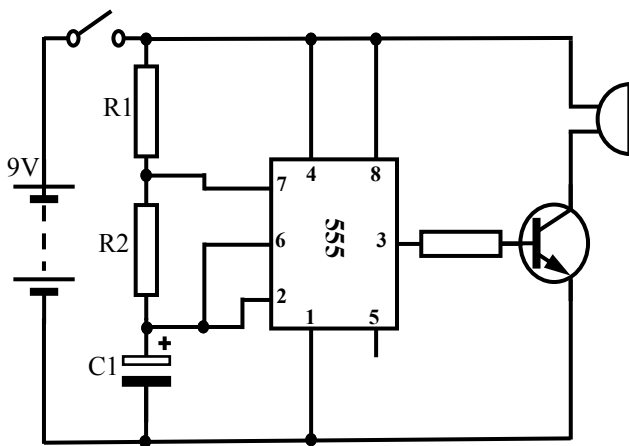
Explain the terms WEEE and PRF.

WEEE - Waste Electronic and Electrical Equipment directive is designed to reduce and control the disposal of such equipment.

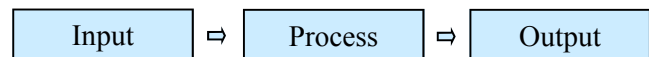
PRF - Product Recycling Fund is the charge applied to offset the cost of recycling electrical goods. It is applied to the purchase price and varies according to the type of electrical item.

- (ii) Outline the environmental impact of sending household batteries to landfill sites instead of to recycling centres.
Do not degrade easily, acid seeping into the local environment etc.

2(b) A student's design for an audible warning device is shown. The device is based on an Astable circuit.



- (i) Redraw the circuit and identify the three main elements shown.

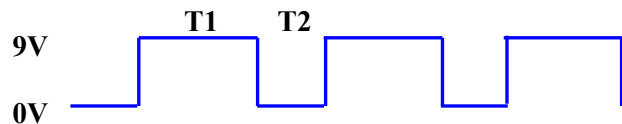


Input: Capacitor and resistors that govern IC

Process: 555 timer IC

Output: Buzzer

- (ii) Draw the output waveform for the 555 Astable circuit.



A square wave with T1 as time on and T2 as time off.

- (iii) Calculate the frequency for the circuit using the following resistor and capacitor values:
R1 = 100K; R2 = 47K and C1 = 100μF

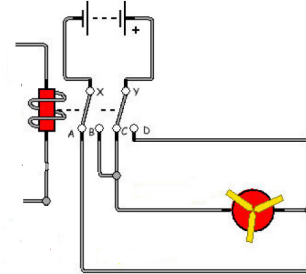
$$f = \frac{1.4}{(2R_2 + R_1) \times C_1} = \frac{1.4}{(2 \times 47k + 100k) \times 100\mu F}$$

$$f = 0.07\text{Hz}$$

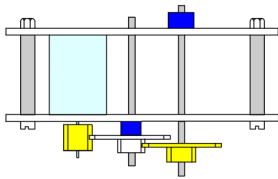
Answer 2(c) or 2(d)

2(c) DC motors are inexpensive and versatile but need to be controlled effectively. Describe, using appropriate diagrams, a method of achieving **each** of the following:

(i) Reversing the direction of a DC motor using a relay.



(ii) Reducing the speed of a DC motor.
Gearbox/worm and wheel/variable resistor etc.

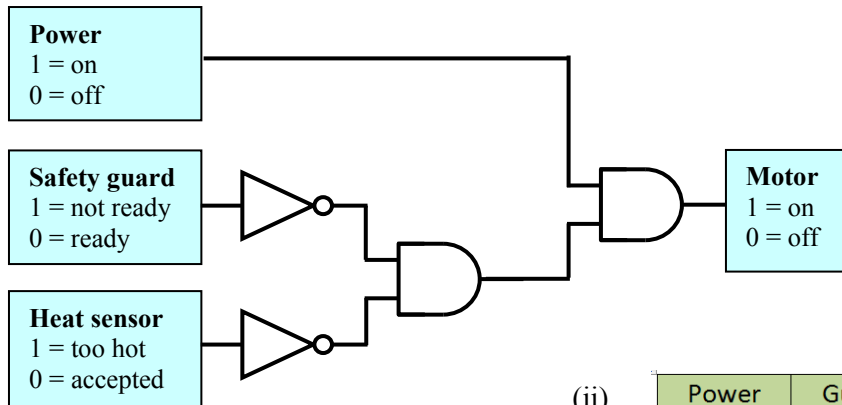


OR

2(d) The scroll saw shown will only operate if the power is switched on, the safety guard is in place and a heat sensor detects that the saw has not over heated.



(i) **Suggested solution using AND and NOT gates**



(i) Draw and label the logic gates required.

(ii) Draw the truth table for the system.

(ii)

Power	Guard	Heat	Motor
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

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) Email can be subject to *security issues*, *spam* and *viruses*. Explain any **two** of these terms.

Security issues such as phishing (looking for sensitive data, passwords, credit card details), fraud and criminal activity are often focused through email.

Spam is the unsolicited sending of bulk messages usually by email.

A virus is an unwanted programme that can copy itself and infect a computer etc.

- (ii) Outline, with examples, **two** functions of *encryption* in the use of information technology.

Encryption is used to make sensitive data more secure.

Encryption also compresses files and increases processing speeds etc.

- 3(b) (i) Among the different types of computer software are *system software*, *utility programmes* and *device drivers*. Describe, with specific examples, **each** of these software types.

System software, such as windows/Linux/Mac OS allow the computer to function.

Utility programmes perform maintenance tasks for the computer, they include defragmenters, format disk, anti-virus etc.

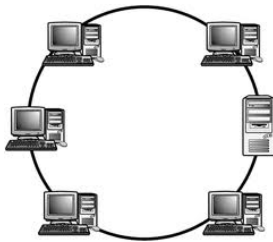
Device drivers control hardware and will run printers, scanners etc.

- (ii) A network interface card is needed for the networking of computers. State **two** functions of a network interface card.

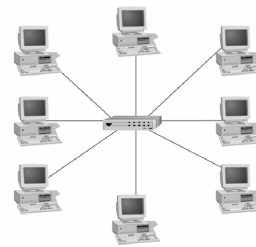
It provides a physical link to a computer network.

It allows a computer to communicate with a server, other computers, network printers etc.

- (iii) Using notes and/or sketches, distinguish between *ring* and *star* as network topologies.



Ring topology: all workstations are connected in a closed loop, data travels to next computer, gives equal access, if one computer fails the entire network is effected.



Star topology: each workstation is connected to a central switch, easy expansion, faults can be isolated to individual computers.

Answer 3(c) or 3(d)

- 3(c) (i) Explain **two** functions of the power supply unit of a computer.

Converts AC to DC, transforms 240V to lower voltages for disk drives and circuits, controls standby mode etc.



- (ii) Describe how pixels are used to form a bitmapped image.

The pixels form a grid, each pixel is assigned an address and colour value. The pixel grid forms the bitmap image etc.

OR

- 3(d) Audio sounds are converted into digital data through the process of digitisation. A series of three sound qualities, with their sample sizes and sampling rates are shown in the table below.

Sound Quality	Sampling rate (kHz)	Sample size (bits)
A	8	8
B	11.025	8
C	44.1	16

- (i) C represents the sound quality for commercial CD music tracks. Outline the effect that reducing the sampling rate and sample size would have on sound quality.

Reducing sampling rate and sample size would reduce the quality of sound produced etc.

- (ii) Describe **two** functions of a sound card such as the one shown.

Connects microphone, speakers and external players to the computer. Acts as an ADC as it changes sound to digital values. Acts as a DAC to prepare audio for speakers etc.



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

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

4(a) The office printer shown runs for an average of three hours each day. It has been subjected to a series of accelerated tests before release onto the market.



- (i) Describe **one** quantitative accelerated test that may be employed by the manufacturer of the printer.
The printer could be set to print continuously for a number of weeks, replicating normal daily usage in a short period of time, thus determining the life of the product.
- (ii) Outline two aspects of the design of this printer that may be evaluated by qualitative testing.
Suitability of hinge material to withstand impact opening its doors.
Design of control buttons.
Feeding mechanism for paper.
Quality of printing etc.
- (iii) The printer was tested for 3000 operating hours before a repair issue arose. Suggest, with reasons, a suitable guarantee period to be offered by the manufacturer.

$$\text{No. of days} = \frac{3000 \text{ hrs}}{3 \text{ hrs/day}} = 1000 \text{ days} = 2.74 \text{ years}$$

Guarantee period of 2 1/2 years to be offered as it can reasonably be expected that no warranty claim will arise within this timeframe.
The printer worked for 1000 days before any repair issue arose, the guarantee period would be less than this etc.

4(b) (i) Sampling is an important consideration in conducting market research. Describe the consequences of:

- not sampling enough of the target group

Results of sampling are less likely to be accurate, results cannot generate significant confidence

- excessive sampling of the target group.

Accuracy is not likely to be improved, time consuming, expensive etc.

(ii) A large batch of DC motors are manufactured using an automated process. A sample of the motors will be tested to assess the conformance of the length of the output shaft A.

The formula for calculating sample size is $S = (Z/E)^2$

where S = sample size;

E = the error which is acceptable as a proportion of standard deviation;

Z is a number relating to the confidence in the accuracy of the sample as shown in the given table.

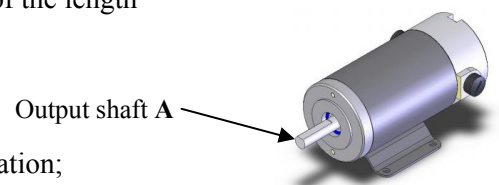
The standard deviation of the length of shaft A is already known and an error of 10% (0.1) of this is acceptable.

Calculate the sample size that will allow the conformance of shaft A to be determined with 95% confidence.

$$S = (Z/E)^2$$

$$S = (1.96/0.1)^2$$

$$S = 384.16 \text{ (385 motors to be tested)}$$



Confidence value for Z	
99%	2.58
95%	1.96
90%	1.64
80%	1.28

Answer 4(c) or 4(d)

4(c) (i) *Just in Time* Manufacturing (JIT) systems are used by many large companies such as car manufacturers.

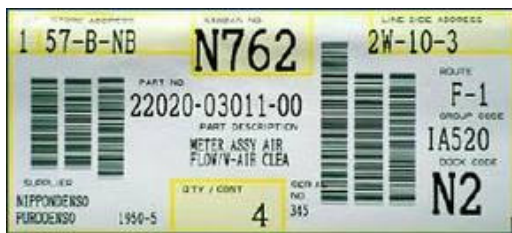


Outline the key impacts of a JIT strategy for a large manufacturer.

- Suppliers are co-ordinated with manufacturing company.**
- Minimal pressure on storage, materials, parts, tools, time etc.**
- There is a focus on the elimination of waste.**
- Increase in efficiency and reduces supply time to customers.**
- Creation of greater flexibility within work force etc.**



(ii) Shown are two examples of a *Kanban* card system.



manufactus		Product Line 1		KANBAN		Control cycle / Regelkreisnummer 0906928 - C1
Supply source / Quelle PWH-MSTK		Demand source / Senke VERZ				
Material 0906928		Materialdescription / Materialkurztext Bosch Polkern 1 263 104 811		Base unit / Mengeneinheit ST		
Size / Menge 1 x 14 x		Shipping unit / Transporteinheit 1 x 14 x		Printed / Gedruckt: 02.08.2008 Kanban ID: 0906928C110022		

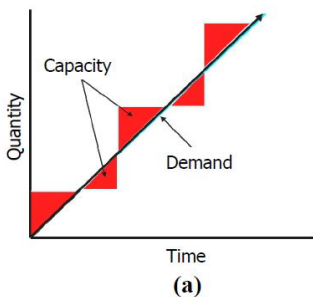
Outline the main features of a Kanban card system and give a specific application of its use.

Card system as a signal to replenish supply, it moves from one station to another, kanban cards contain information such as parts description, material, number, path from previous work station to next station.
Any relevant application, e.g. assembly of motor cars etc.

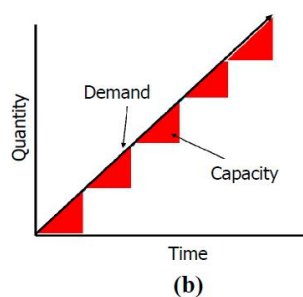
OR

4(d) Three basic capacity strategies utilised by companies are shown graphically below at (a), (b) and (c).

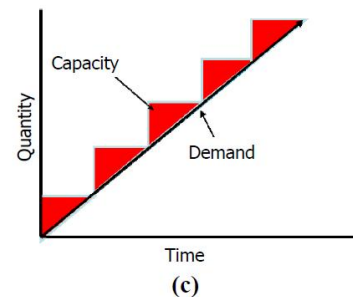
(i) Name and explain **each** strategy.



Average capacity:
Capacity increases to coincide with the average expected demand.



Lag capacity:
Capacity is expanded after a demand is identified.



Lead capacity:
Capacity is increased to cater for expected growth in demand.

(ii) Select a suitable strategy for a new business wishing to attract customers away from its competitors and justify your answer.

Lead capacity strategy indicates an ability to meet extra demand quickly. Stocking with excess products beyond what is required and having larger displays of products to attract customers.

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

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

5(a) (i) Outline the main environmental consequences of **each** of the following:

- promoting the use of softwoods rather than hardwoods for classroom furniture

Softwoods are less expensive and grow much faster than hardwoods. Tropical rainforests and temperate hardwood forests will not be depleted by using softwoods instead of hardwoods.

- using thermosetting plastics.

Using thermosetting plastics causes more pollution because thermosets cannot be recycled.

(ii) Describe a method of testing samples of ash, brass and polystyrene foam for thermal insulation properties.

Thermal insulation properties allow materials to retain heat and prevent it being dissipated.

The tank is filled with hot water. Wax on the end of each rod (material sample) melts once heat conducts along the rod. The rod that conducts the least amount of heat has the best insulation properties.



5(b) The casing for a computer mouse is shown.

The casing can be made from either aluminium or plastic.



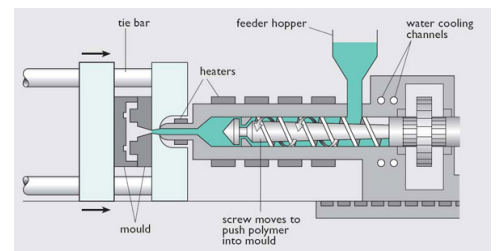
(i) Select a suitable plastic material for the casing and justify your selection.

ABS/Acrylic as it has good impact strength, hard, durable, shiny surface finish etc.

(ii) Describe, using annotated sketches, how the casing might be commercially manufactured.

Injection moulding:

A hollow split mould is machined to the shape of the casing. Plastic granules are held in the hopper and fed into the machine where it is heated and pushed into the mould cavity by a screw or ram mechanism. The molten plastic fills the mould under heat and pressure. It sets quickly, the mould is split and the casings can be removed and trimmed.



(iii) Explain, in detail, how the top and bottom parts of the mouse could be joined together while allowing for occasional disassembly to facilitate cleaning and maintenance.

A plastic computer mouse could have 'snap-on' connections.

Many are fitted together using mechanical screws.



Screws fixed from under the mouse

These can be hidden under the mouse 'feet'.



Screws are fixed through from the bottom of the mouse with circuit boards in place. These screws will thread into the mouse casing.

Answer 5(c) or 5(d)

- 5(c) (i) The plastic casing for the mouse could be manufactured using:
- Once-off production
Handcrafted using bench tools and milling cutters suitable for single, personalised item.
 - Batch production
Vacuum forming as moulds can be crafted in wood at a reasonable cost and are sufficient for the production a small quantity of casings.
 - Mass production.
Injection moulding as moulds are very durable but expensive to produce, manufacturing is automated and efficient etc.
- In the case of **two** of these production methods, name a specific manufacturing process which could be used. Outline **one** advantage of each process.

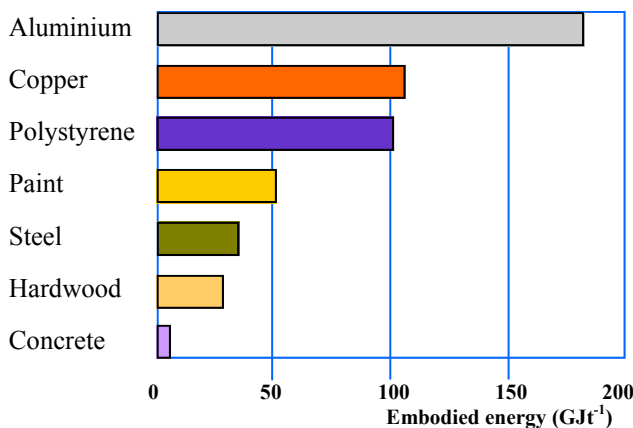
- (ii) Describe, using annotated sketches, **two** safety features that are integrated into the design of a CNC lathe or CNC router.

Safety screen protects work area.
Programme will warn the cutting tool from into the chuck or holding device.
Control panel on outside of machine with emergency stop
Interlock switch disengages power when door is open etc.



OR

- 5(d) Embodied energy is the total of the energy used in the extraction, manufacturing, marketing and disposal of a product throughout its lifecycle. The graphic shows the embodied energy values for some materials.



- (i) Outline the reasons for the high level of embodied energy in aluminium products.

Aluminium is usually found in low concentrations.
It demands a lot of energy to convert bauxite to aluminium.
It is often transported over long distances for refining and processing.
The recycling of aluminium requires additional energy etc.

- (ii) Metals are among the most widely recycled materials. Discuss the key reasons for this.

Metals are expensive to refine, process and purchase.
It is economically viable to recycle most metals.
Other materials such as plastics are difficult to recycle after use.
Supplies are diminishing yet demand is increasing (in both developed and developing economies).
Properties of metals lend themselves to recycling etc.

