



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Cycle 2023

Marking Scheme

Engineering

Common 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.



Coimisiún na Scrúduithe Stáit
State Examinations Commission

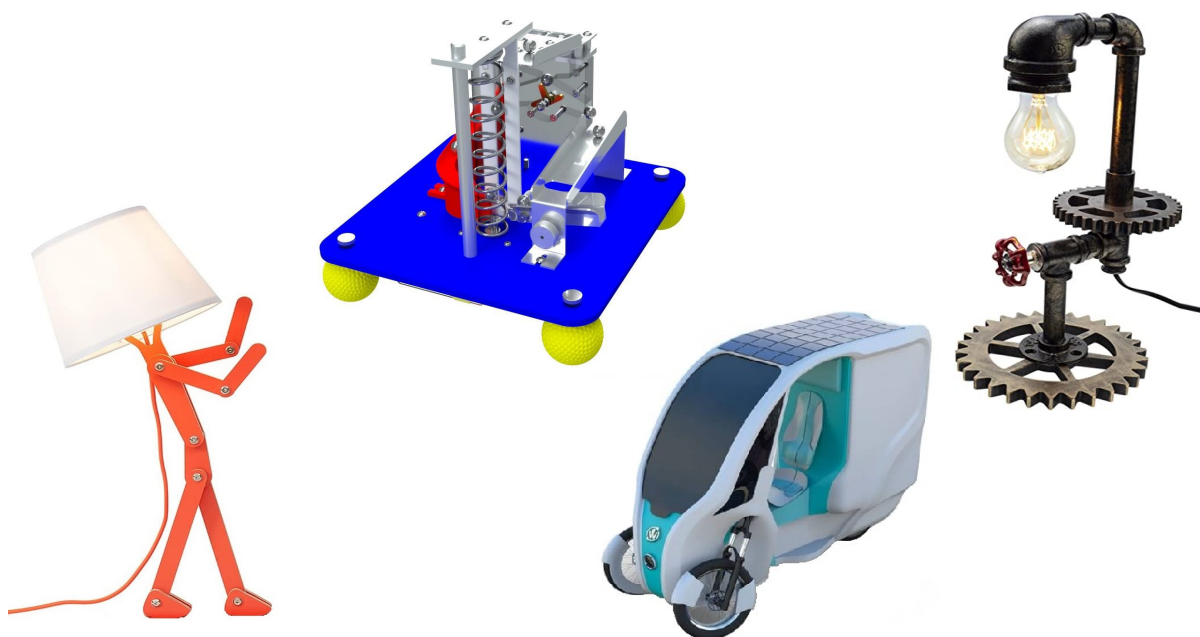
Junior Cycle Final Examination, 2023

Engineering

Common Level

Marking Scheme

Written Examination and Project



Written Examination — Marking Scheme

120 Marks — Answer all questions

Note: The solutions presented are examples only. All other valid solutions are acceptable and are marked accordingly.

Question 1 (30 marks) (a) (i) One advantage @ 3 marks (ii) One disadvantage @ 3 marks (b) (i) Select / Negative impact @ 1 + 2 marks (ii) Two properties @ 3 marks (c) (i) Explanation @ 3 marks (ii) One application @ 1 mark (iii) Description @ 4 marks (d) (i) Two applications @ 2 marks each (ii) Explanation @ 2 marks (e) (i) Correct tick @ 1 mark (ii) Explanation @ 1 marks (iii) Two processes @ 1 mark each	Question 3 (25 marks) (a) Complete table @ 4 marks (b) Two advantages @ 1 mark each (c) (i) Explanation @ 2 marks (ii) Two labels @ 1 mark each (iii) Two advantages @ 1 mark each (iv) Two reasons @ 1 mark each (v) One advantage @ 2 marks (vi) Explanation @ 2 marks (d) Explanation @ 1 mark (e) Match three sources @ 6 marks
Question 2 (35 marks) (a) (i) One reason @ 2 marks (ii) Name @ 1 mark Explanation @ 2 marks (b) (i) Overall length @ 1 mark Overall width @ 1 mark (ii) Description @ 3 marks (c) (i) Two precautions @ 2 mark each (ii) Explanation @ 1 mark (iii) Correct circle @ 1 mark (iv) Match @ 1 mark each (d) (i) Design & sketch @ 4 marks (ii) Material @ 2 marks Reason @ 1 mark (e) (i) Explanation @ 1 mark (ii) Correct circle @ 2 marks (iii) Use @ 1 mark (iv) Correct colour @ 1 mark each (f) Two advantages @ 1 mark each	Question 4 (30 marks) (a) (i) Two advantages @ 1 mark each (ii) Finish @ 2 marks (iii) Correct circle @ 2 marks (iv) One application @ 1 mark (v) Explanation @ 1 mark (b) (i) Correct identification @ 1 mark (ii) Name @ 1 mark (iii) Symbol @ 1 mark Complete table @ 3 marks (c) (i) Design & sketch @ 3 marks (ii) Two applications @ 1 mark each (d) (i) Two values @ 1 mark each (ii) Advantage @ 1 mark Disadvantage @ 1 mark (iii) Correct circle @ 1 mark (iv) One advantage @ 2 marks (e) (i) Explanation @ 1 mark (ii) Name @ 1 mark (iii) Correct ratio @ 1 mark (iv) Calculation @ 1 mark

Question 1 (30 marks)

(a) A dash cam for use in a car is shown opposite.

(i) Outline one advantage of using a dash cam.

Advantage: A dash cam can provide a digital record of any incident which may occur while driving. This may be helpful in the processing of any insurance claim.

Advantage @ 3 marks

(ii) Outline one disadvantage of using a dash cam.

Disadvantage: A dash cam could be a source of distraction while driving, which could be a trigger for an accident.
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Disadvantage @ 3 marks



(b) (i) Select one of the drinking straws shown and explain how its use may impact negatively on the environment.

Selection: Paper drinking straw

Negative impact: Incorrect disposal of the paper straw may cause an increase in litter. The production of paper straws requires the cutting of trees, which is harmful to the environment.
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Selection @ 1 mark, Negative impact @ 2 marks

(ii) State two properties of stainless steel.

Property 1: Stainless steel has good resistance to Corrosion.

Property 2: Stainless is a very strong, durable material With good resistance to wear.
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Two properties @ 3 marks



(c) A compression spring is used in the 2023 Junior Cycle Engineering Project, as shown.

- (i) Explain the meaning of the term compression.

Explanation: Compression is the act of applying
opposite pressing forces to force an object
into a smaller space.

Explanation @ 3 marks

- (ii) Identify one other application of a compression spring.

Application: A compression spring is used in
a click ball point pen (biro).

Application @ 1 mark

- (iii) Describe the function of the separator mechanism shown in the operation of the 2023 Junior Cycle Engineering Project.

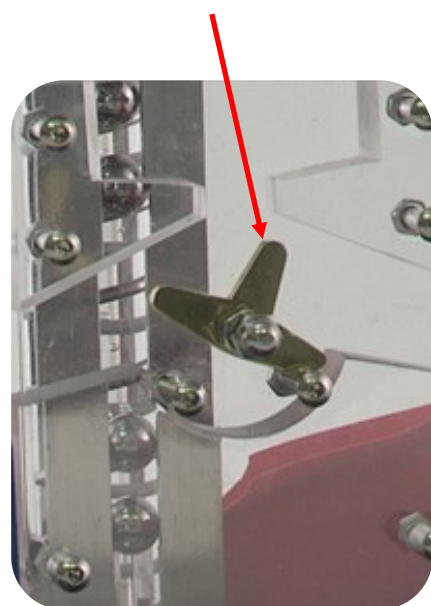
Description: The function of the separator
Mechanism is to control the path of each
marble around the machine. As a marble
falls onto the separator mechanism it turns
the marble into one path while closing the
the other path. The next marble to drop is
then turned into the alternative path.
This sequence continues for every second
marble.

Description @ 4 marks

Compression spring



Separator mechanism



- (d) (i) Drones have an increasingly important role in smart farming.
State two applications for a drone in farming.

Application 1: Drone technology can be used to provide additional security monitoring of a farm.

Application 2: Drone technology can be used to deploy materials to remote / inaccessible parts of a farm.

Two applications @ 2 marks each



Drone

- (ii) Explain why 3D printing is suitable for the manufacture of drone parts.

Explanation: 3D printing is an additional manufacturing process that results in little manufacturing waste.
3D printing is suitable for the manufacture of light complex plastic parts such as those found in a drone.



3D printed drone parts

Explanation @ 2 marks

- (e) (i) Tick the term which best describes the function of the pulley wheel in the gym machine shown.

Load	☐
Fulcrum	☒
Effort	☐

Correct tick @ 1 mark



- (ii) Explain why a pulley wheel is used in the gym machine shown.

Explanation: The pulley ensures that the machine cable moves freely, due to reduced friction, when the operator pulls the cable to lift the weights.

Explanation @ 1 mark

- (iii) Name two lathe processes used in the manufacture of the dumbbell bar shown.

Process 1: Facing

Process 2: Knurling

Two processes @ 1 mark each



Dumbbell bar

Question 2 (35 marks)

Engineering and product design are central to the production of custom made (bespoke) furniture and products, such as the novelty table lamp shown.

- (a) (i) The novelty table lamp shown has adjustable body parts. Outline one reason for this design feature.

Reason: This allows the lamp to be adjusted into fun
positions. The adjustable feature also allows the lamp
light be directed in particular directions.

Reason @ 2 marks

- (ii) Name the type of nut shown and explain why it is suitable for use on the novelty table lamp.

Name: Wing nut.
Explanation: A wing nut may be opened or closed by
hand (thumb) which is suitable for easy adjustment of
the novelty lamp.

Name @ 1 mark, Explanation @ 2 marks

- (b) The body parts of the novelty table lamp shown are made from acrylic.

- (i) Calculate, in millimetres, the overall length and overall width of the acrylic body part shown.

Overall Length: 105mm
Overall Width: 30mm

Overall length @ 1 mark, Overall width @ 1 mark

- (ii) Describe how the profile of the acrylic body part may be accurately marked out.

Description: A centre line is drawn down the middle of the
material. Two points, 80mm apart are marked on this
centre line. A R15mm arc is drawn at the upper point.
A R10mm arc is drawn at the lower point. A tangential
line is then drawn at the left and at the right of these
arcs to complete the outline profile of the body part.

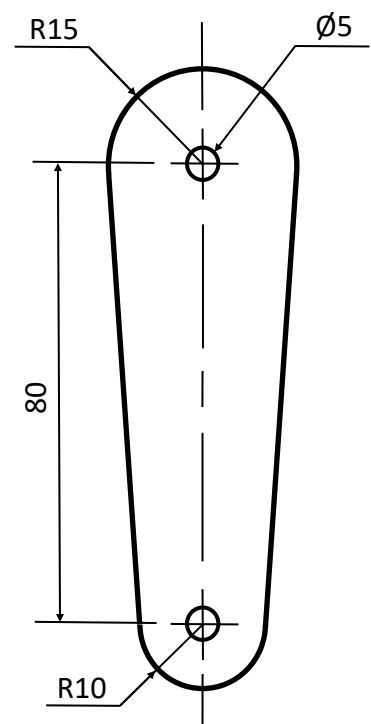
Description @ 3 marks



Novelty table lamp



Nut



*Dimensioned (mm)
acrylic body part*

- (c) (i) Identify two safety precautions to be taken when drilling the acrylic body parts.

Safety precaution 1: <i>Ensure to securely hold the material in a vice or a clamp prior to drilling.</i>

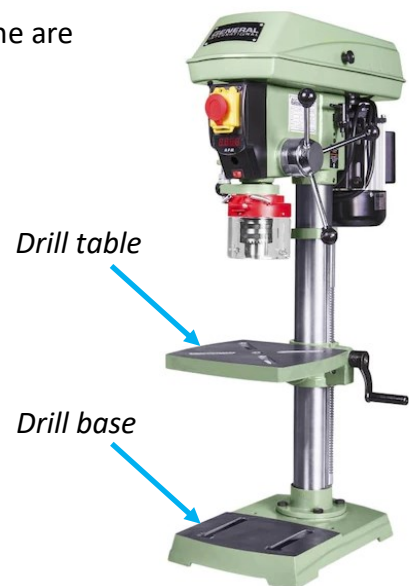
Safety precaution 2: <i>Ensure to select a suitable drill speed when drilling acrylic appropriate to the size of drill hole required.</i>

Two safety precautions @ 2 marks each

- (ii) Explain why the table and the base of a drilling machine are made from Cast Iron.

Explanation: <i>Cast Iron is a heavy, strong, hard</i>
<i>Material with excellent resistance to wear.</i>
<i>This makes cast iron a suitable material to</i>
<i>clamp work on when drilling material.</i>

Explanation @ 1 mark

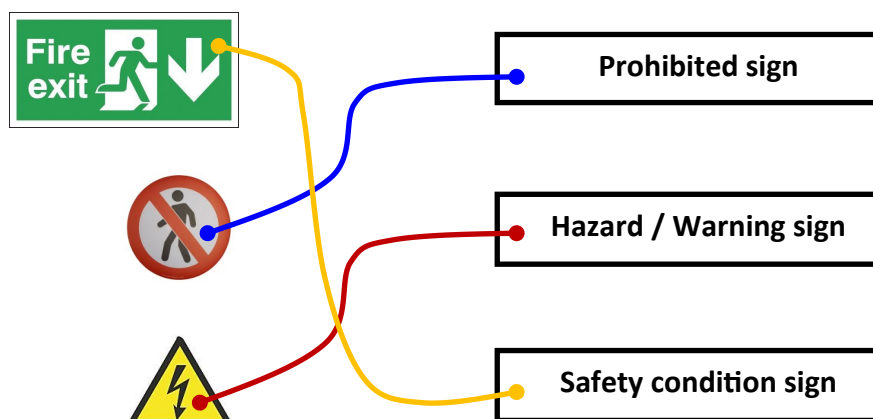


- (iii) Circle the correct alloy combination for Cast Iron.

<u>Iron and carbon</u>	Copper and zinc	Iron and chromium
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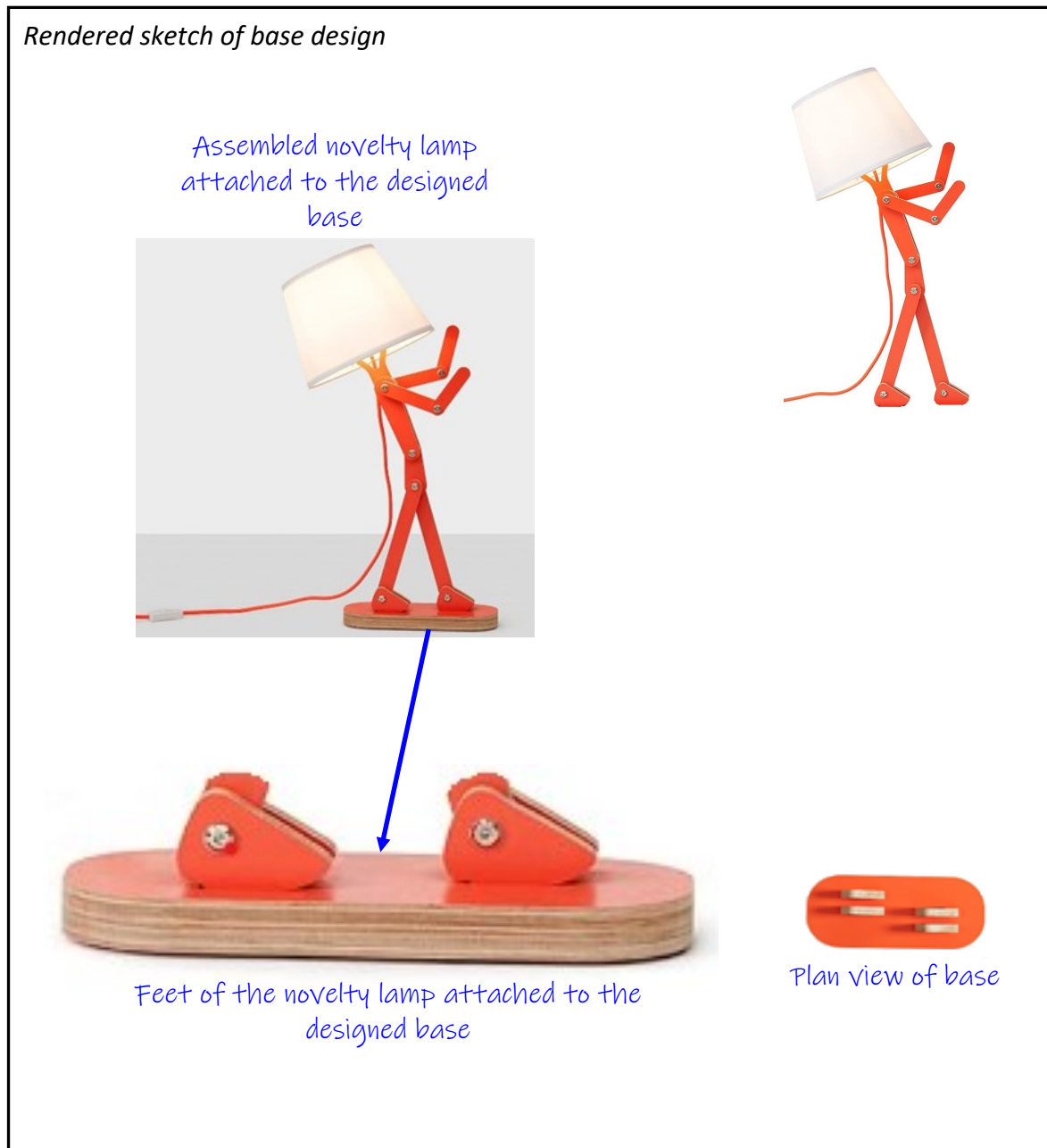
Correct alloy combination @ 1 mark

- (iv) Match each safety sign shown to the correct category, by drawing a line.



Correctly match @ 1 mark each

- (d) (i) The novelty table lamp often falls over when in use. Using a rendered sketch, design a base on which the lamp can be securely placed.



Design & sketch @ 4 marks

- (ii) Identify a suitable material for the base you designed and outline one reason for the selection of this material.

Material: *Plywood*

Reason: *Plywood is easy to shape. An attractive finish can be applied to plywood.*

It is easy to attach the legs of the novelty lamp to a plywood base.

Material @ 2 marks, Reason @ 1 mark

- (e) (i) Explain why copper is used in the manufacture of the electrical wires shown.

Explanation: Copper is an excellent conductor of heat and electricity which makes it suitable for use as electrical wire.

Explanation @ 1 mark

- (ii) Circle the correct classification for copper.

Ferrous metal	Non-ferrous metal
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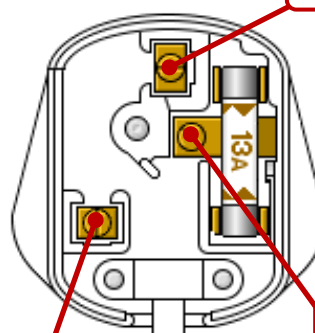
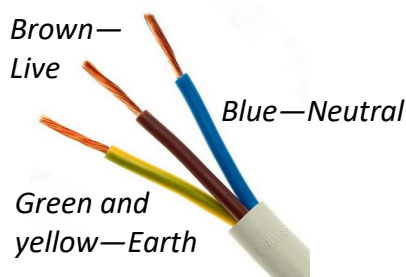
Correct classification @ 2 marks

- (iii) Suggest one other suitable use for copper.

Use: Copper water pipes and copper water cylinder are used in plumbing systems.

Use @ 1 mark

- (iv) Insert the correct wire colour for each plug terminal shown.



Colour: Green / Yellow

Colour: Brown

Colour: Blue

Correct colours @ 1 mark each

- (f) State two advantages associated with upcycling to produce bespoke / unique products like the table lamp shown.

Advantage 1: Upcycling materials reduces the amount of material that ends up in landfill which is an environmental benefit of upcycling.

Advantage 2: Using reclaimed materials and parts can drastically reduce manufacturing costs, making upcycling an economic benefit.

Two advantages @ 1 mark each



Bespoke table lamp

Question 3 (25 marks)

The Wello Family E-Trike is a hybrid electric vehicle designed for transporting passengers and cargo in urban areas.

This E-Trike has a built-in rechargeable battery and solar panels on the roof to provide power to the motor that assists the user while pedalling.



Wello Family E-Trike

- (a) The following four terms are associated with the design and engineering of E-Trikes.

Solar power	Cargo	Hybrid vehicle	Carbon footprint
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Complete the table below by inserting the most suitable term next to the description of the term.

Term	Description of Terms
Hybrid vehicle	A vehicle that uses two or more distinct types of power.
Cargo	Freight or goods carried by a ship, aircraft, or other vehicle.
Carbon footprint	A measure of the amount of carbon dioxide released into the atmosphere by your activities over a particular period.
Solar power	Heat radiation from the sun converted into electrical power.

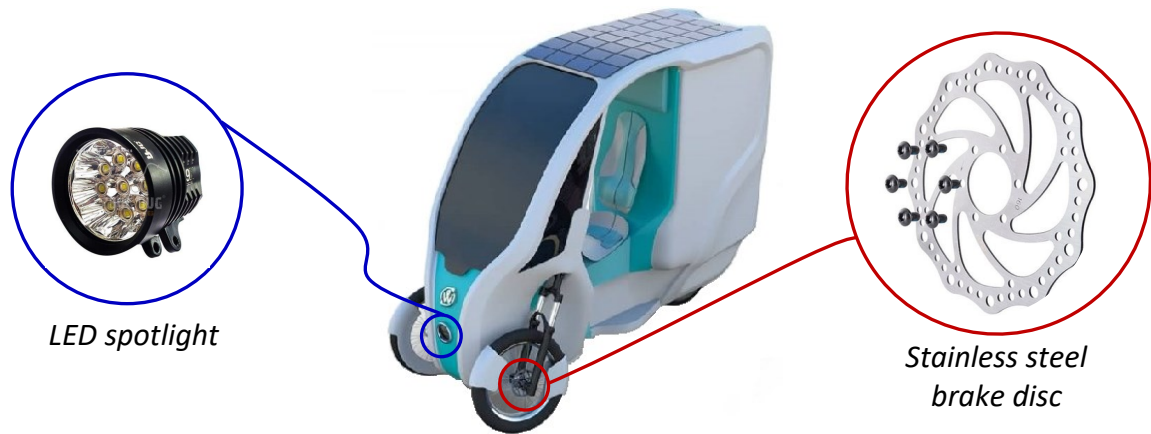
Complete table @ 1 mark each

- (b) State two advantages of using the E-Trike for travel in urban areas.

Advantage 1: E-trikes use renewable energy making them environmentally friendly
Advantage 2: The compact design of the E-trike makes it suitable for use in urban settings.

Two advantages @ 1 mark each

(c)

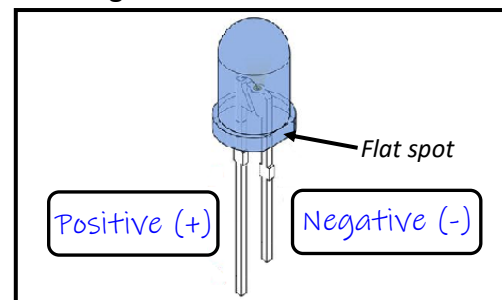


(i) Explain the meaning of the term LED.

Explanation: LED stands for Light
emitting diode. This is a semiconductor
device that emits light when current
flows through it.

Explanation @ 2 marks

(ii) Label the positive leg and negative leg of the LED shown.



Two labels @ 1 mark each

(iii) Outline two advantages of using LED lights over traditional light bulbs.

Advantage 1: LED lights tend to have a longer life span than traditional light
bulbs as they do not have a filament making them less prone to blowing.
Advantage 2: LED light bulbs use less energy than traditional light bulbs which
making them more environmentally friendly.

Two advantages @ 1 mark each

(iv) Outline two reasons for the holes in the design of the brake disc shown above.

Reason 1: The central holes are used to assemble the brake disc in the breaking
system as shown in the diagram above right.
Reason 2: The outer holes help to reduce the weight of the disc without
compromising the function of the disc. These holes also provide an attractive
design feature for the disc.

Two reasons @ 1 mark each

- (v) Outline one advantage of using Allen screws in the assembly of the stainless steel brake disc.

Advantage: Allen screws are used as they can only be loosened or tightened by Allen key, thus preventing unintentional stripping of the screw fastener.



One advantage @ 2 marks

- (vi) Explain why adhesives may be applied to an Allen screw when assembling a brake disc.

Explanation: The use of adhesive in the Allen screw assembly helps to ensure that the assembly will not come loose due to vibration.



Explanation @ 2 marks

- (d) The E-Trike is fitted with a pneumatic shock absorber. Explain the term *pneumatic*.

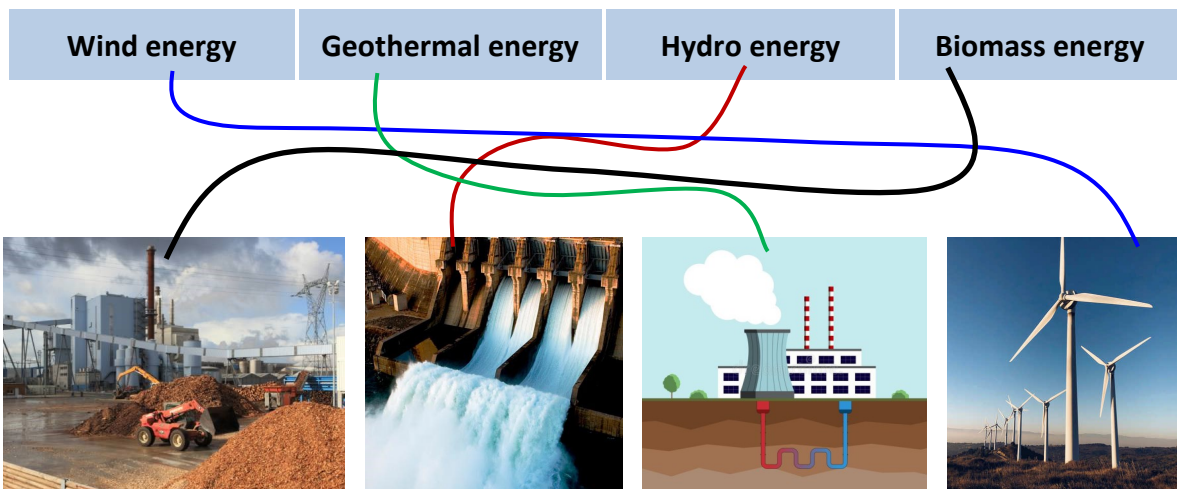
Explanation: Pneumatic refers to the use of air pressure to do work or move parts. Pneumatic shock absorbers are usually filled with air to ensure a smooth journey over bumpy surfaces.



Pneumatic shock absorber

Explanation @ 1 marks

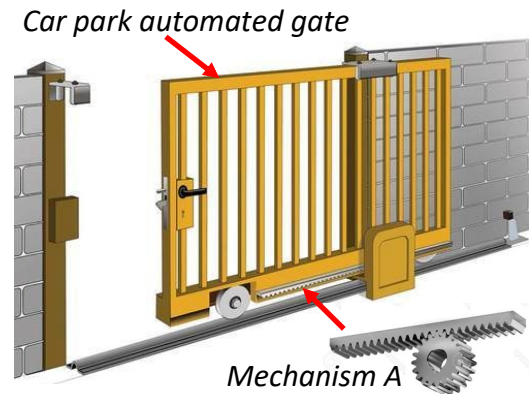
- (e) Match the renewable energy source to the correct diagram for that source. The first match is completed for you.



Match three sources @ 6 marks

Question 4 (30 marks)

Engineering electronic control systems are frequently used at car parking facilities in towns and cities.



- (a) (i) Identify two advantages of using an automated electric gate system.

Advantage 1: Automated electric gates are very convenient as you do not have to physically open or close the gate, particularly in bad weather.

Advantage 2: Automated electric gates ensure enhanced security as entry and exit from a facility can easily be controlled.

Two advantages @ 1 mark each

- (ii) The gate, shown above, is made from steel. Suggest a suitable finish which may be applied to the gate to help prevent corrosion.

Finish: Steel gates are commonly painted to prevent corrosion. Steel gates can also be galvanised for protection from corrosion.

Finish @ 2 marks

- (iii) Circle the correct name for *mechanism A* shown above.

Pulley and belt	Crank and slider	Ratchet and pawl	Rack and pinion
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Circle correct mechanism @ 2 marks

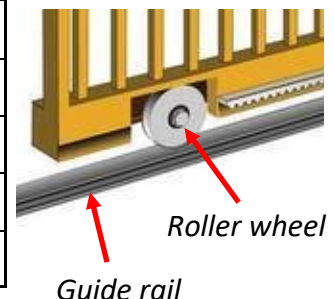
- (iv) Suggest one other suitable application for *mechanism A*.

Application: A rack and pinion mechanism is used in car steering mechanisms, on a centre lathe and pillar drilling machines.

One application @ 1 mark

- (v) Explain why the surfaces of the roller wheel and the guide rail are heat treated.

Explanation: As the gate requires regular movement to open and close, the guide rail and wheel are prone to wear. Heat treatment of both the wheel and guide rail helps to reduce wear of these parts and increases their life of use.

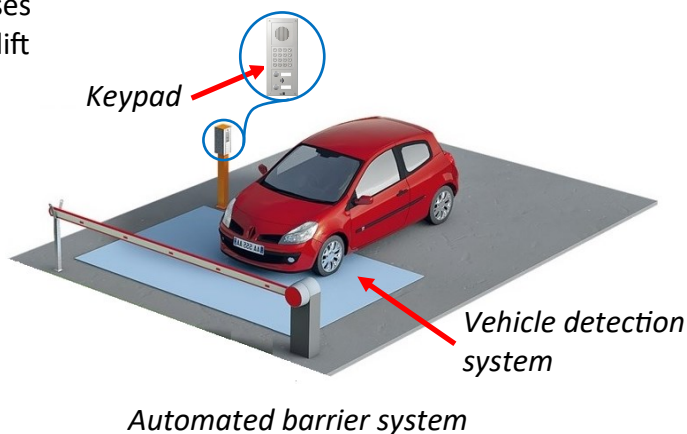


Explanation @ 1 mark

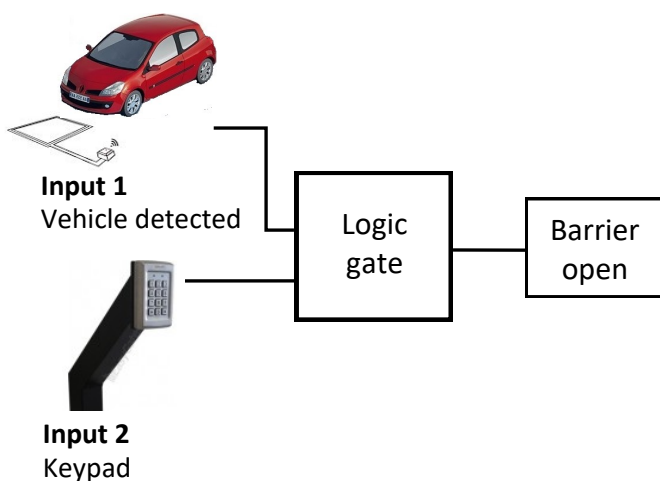
- (b) The automated barrier system shown uses a digital logic gate. The barrier will only lift when the vehicle is detected and the keypad is used.

(i) The keypad is a(n):

Type of device	Tick correct answer
Input device	☒
Output device	☐
Process device	☐



Correct identification @ 1 mark



The following information is relevant to activate the automated barrier system.

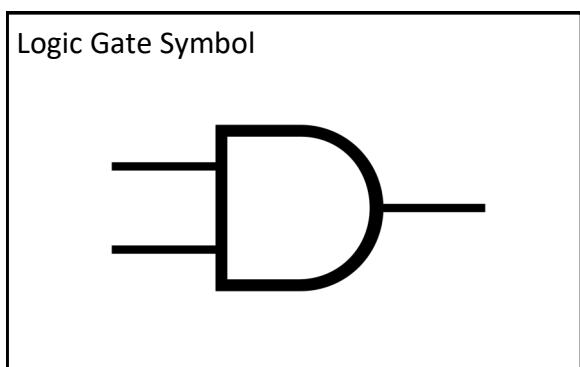
No vehicle detected = Logic Level 0
 Vehicle detected = Logic Level 1
 Keypad code incorrect = Logic Level 0
 Keypad code correct = Logic Level 1

(ii) Name the logic gate which is most suitable to activate the automated barrier system.

Name: *And gate.*

Name @ 1 mark

(iii) Draw the symbol for this logic gate and complete the Truth Table.



Symbol @ 1 mark

Input 1	Input 2	Output
1	0	0
0	0	0
0	1	0
1	1	1

Complete table @ 1 mark each correct row

- (c) (i) Using a rendered sketch, design a suitable bracket for the keypad shown.

The bracket you design should include:

- A method to securely hold the keypad
- A method to permanently attach the bracket to the floor.



Design & sketch @ 3 marks

- (ii) Identify two other applications where a keypad may be used.

Application 1: *Apartment block entry.*

Application 2: *House alarm.*

Two applications @ 1 mark each

(d) The automated barrier system contains circuits with various resistors.

(i) State the value of the resistors shown.



Red, Red, Red

Resistance value	2200 Ω
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1 mark



Brown, Black, Orange

Resistance value	10000 Ω
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1 mark

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

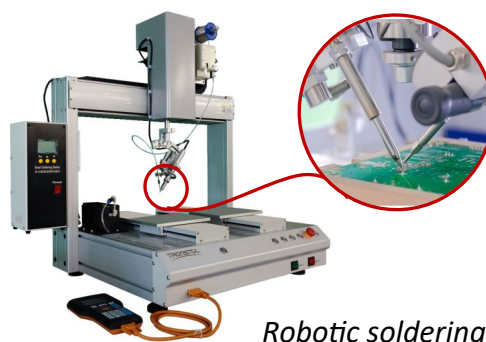
(ii) State one advantage and one disadvantage of using robotic technology in industrial soldering.

Advantage: Robotic soldering technology helps to improve the rate of completion and quality of soldered joints produced.

One advantage @ 1 mark

Disadvantage: Robotic technology reduces the need for human input, potentially leading to increased unemployment.

One disadvantages @ 1 mark



Robotic soldering

(iii) Circle the correct alloy combination for soft solder.

Copper and tin	Lead and tin	Copper and zinc	Iron and carbon
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Correct alloy combination @ 1 mark

(iv) Outline one advantage of using ribbon cable when wiring electronic devices.

Advantage: Ribbon cable has a number of individual wires grouped together, ensuring a tidy electronic assembly where used.



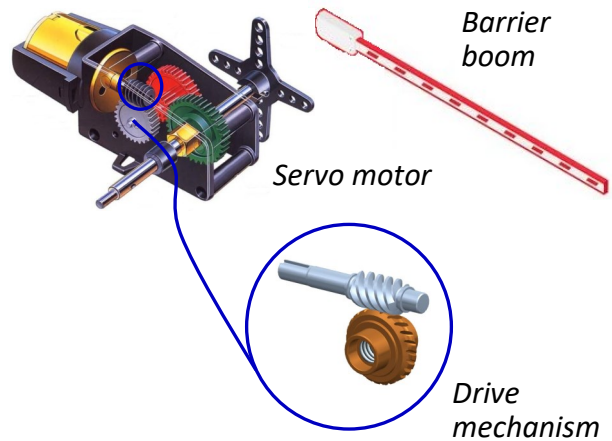
Ribbon cable

One advantage @ 2 marks

- (e) (i) Explain why a servo motor is suitable to control a barrier boom, as shown.

Explanation: Servo motors are highly efficient and provide high power output for their size. They are also very quiet when operating. Servo motors also provide fine controls when in operation making it suitable for the Barrier boom

Explanation @ 1 mark



- (ii) Name the drive mechanism, shown above, used in the servo motor gearbox.

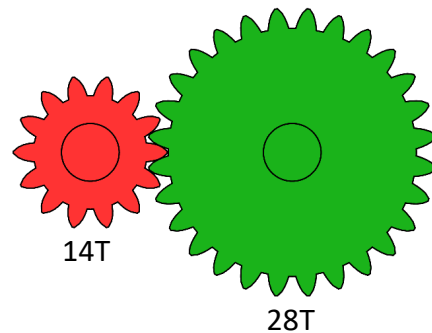
Name: Worm and wormwheel.

Name @ 1 mark

- (iii) If the driver gear, shown opposite, has 14 teeth and the driven gear has 28 teeth, tick the correct gear ratio for this gear train.

Gear ratio	Tick correct answer
1:2	☒
2:1	☐
1:4	☐

Correct gear ratio @ 1 mark



- (iv) Calculate how fast the driven gear turns, in RPM, if the driver gear rotates at 40 RPM.

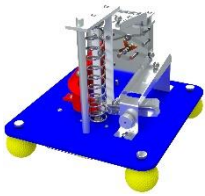
Calculation

Drive speed $\times$ Gear ratio = Driven speed

40 rpm $\times$ 0.5 = 20 rpm

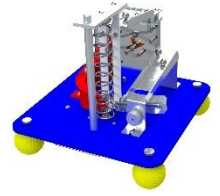
Answer is 20 RPM

Calculation @ 1 mark



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State Examinations Commission

**Junior Cycle Engineering Project
Model Helix Elevator - Marking Scheme 2023**



Section 1: Complete Model ('Design Element' not included)

Headings	Description	Marks
Assembly	Subjective Grade 1 – 20	20
Finish	Subjective Grade 1 – 20	20
Mechanical Function	Subjective Grade 1 – 15	15
Electrical Function	Subjective Grade 1 – 15	15
Section 1 - Total		70

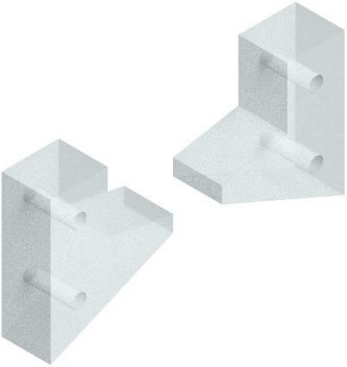
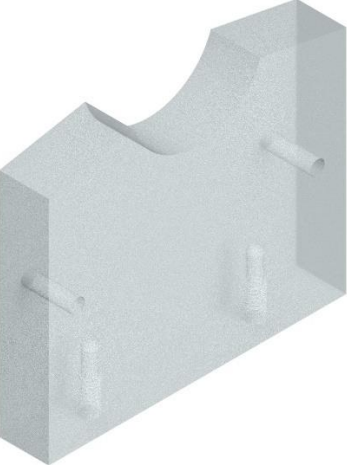
Section 2: 'Design Element' (Not required for 2023)

Section 2 - Total	--
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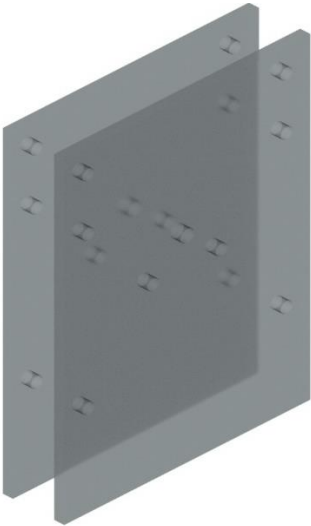
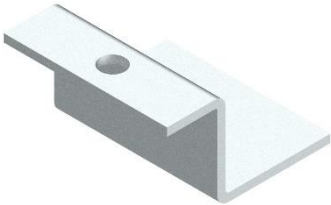
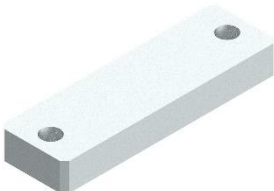
Section 3:

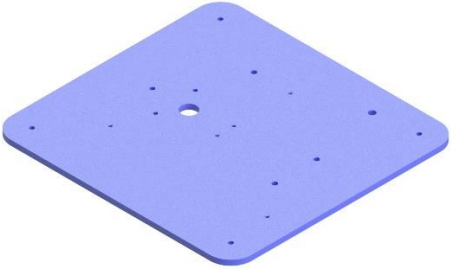
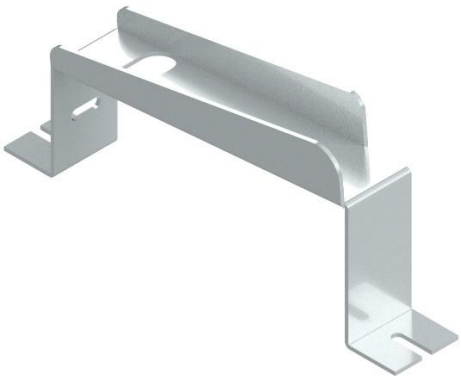
Headings	Description	Marks
Part 1 – Top Support 	Mark out, drill & tap	2
Part 2 – Elevator Stanchion 	Machine to length, taper turn, drill & tap	3
Part 3 – Spring Insert 	Machine to length, drill & tap	7
		5

Part 12 – Motor Adaptor 	Drill blind hole	1	10
Part 13 – Drive Pin 	Cut to length	1	
Part 14 – Adaptor Locator Pin 	Cut to length	1	
Part 5 – Elevator Track 	Mark out, drill, shape, slot & bend	8	10
Part 15 – Elevator Track Clamp 	Mark out & drill	2	
Part 6 – Mixer 	Mark out, drill, shape, slot & bend	10	10

Part 7 – Tower Slide (x2) 	Mark out, drill & shape	5 + 5	10
Part 8 – Tower Base 	Mark out, drill, shape & tap	10	10
Part 9 – Mixer Funnel (x2) 	Machine, drill & taper turn	5	5
Part 10 – Separator 	Mark out, drill & shape	9	10
Part 11 – Separator Axle 	Cut to length	1	
Section 3 - Total			70

Section 4:

Headings	Description		Marks
Part 16 – Funnel Spacer (x4) 	Machining to length	4	10
Parts 17 – Funnel Support 	Mark out, drill & tap	6	
Part 18 – Tower Cover (x2) 	Mark out & drill	5 + 5	10
Part 19 – Battery holder Support 	Mark out, drill, & bend	3	5
Parts 23 – Motor Spacer 	Mark out, chamfer & drill	2	

Part 20 – Base 	Mark out, drill, shape & tap	6	10
Parts 29 – Base Supports (x4) 	Drill	4	
Part 21 – Guide Rail (x2) 	Mark out, drill, shape & bend	3 + 3	10
Parts 22 – Marble Guide 	Mark out, drill & shape	4	
Part 24 – Marble Return Slide 	Mark out, drill, slot, shape & bend	15	15

Part 25 – Adjuster Nut 	Machine to size, drill, tap, knurl & chamfer	8	10
Part 26 – Adjuster Spacer 	Machining & drill	2	
Section 4 – Total			70
Overall Total			210