



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2013

Marking Scheme

MATERIALS AND TECHNOLOGY
METALWORK

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.

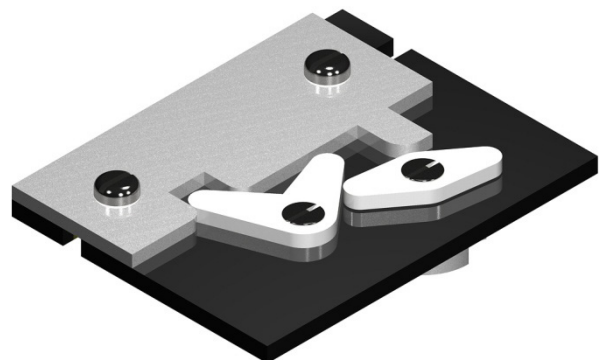
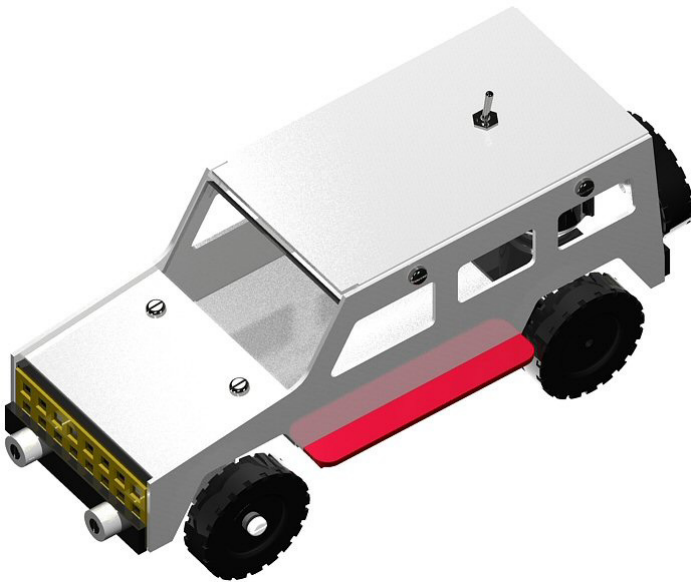
JUNIOR CERTIFICATE EXAMINATION, 2013

MATERIALS AND TECHNOLOGY

METALWORK – HIGHER LEVEL

MARKING SCHEME

**Written Examination, Practical Examination
and Project**



Written Examination - Answer Question 1, Section A and B, and three other questions.

Note: The solutions presented are examples only.

All other valid solutions are acceptable and are marked accordingly.

| | |
|--|---|
| <p>Question 1 – Section A (5 parts only)</p> <p>(a) (i) Name part A @ 2 marks (ii) Purpose @ 2 marks 4 MARKS</p> <p>(b) (i) Name part B @ 2 marks (ii) Description @ 2 marks 4 MARKS</p> <p>(c) (i) Material @ 2 marks (ii) Purpose @ 2 marks 4 MARKS</p> <p>(d) (i) Two ways @ 1 mark each (ii) One measure @ 2 marks 4 MARKS</p> <p>(e) Any one @ 4 marks 4 MARKS</p> <p>(f) (i) Explain @ 2 marks (ii) Name one @ 2 marks 4 MARKS</p> <p>(g) (i) Both components @ 1 + 1 mark (ii) Draw @ 2 marks 4 MARKS</p> | <p>Question 1 – Section B (5 parts only)</p> <p>(a) (i) Two safety precautions @ 1 + 1 mark (ii) Description @ 2 marks 4 MARKS</p> <p>(b) (i) Description @ 2 marks (ii) Two methods @ 1 + 1 mark 4 MARKS</p> <p>(c) (i) Description @ 2 marks (ii) Description @ 2 marks 4 MARKS</p> <p>(d) (i) Design @ 2 marks (ii) Method @ 2 marks 4 MARKS</p> <p>(e) Diagram @ 2 marks Window/Wheel @ 1 + 1 mark 4 MARKS</p> <p>(f) Uses @ 2 marks Two reasons @ 1 mark each 4 MARKS</p> |
| <p>Question 2</p> <p>(a) (i) Name @ 1 mark Description @ 3 marks (ii) Three factors @ 1 mark each 7 MARKS</p> <p>(b) (i) Method @ 2 marks, Diagram @ 2 marks (ii) Design @ 2 marks, Diagram @ 2 marks (iii) Description @ 1 mark, Diagram @ 2 marks (iv) Metal @ 1 mark, Finish @ 1 mark 13 MARKS</p> | <p>Question 3</p> <p>(a) (i) Spindle speed @ 2 marks (ii) Two reasons @ 2 + 2 marks (iii) Identification @ 2 marks (iv) Purpose @ 2 marks 10 MARKS</p> <p>(b) 4 marks 4 MARKS</p> <p>(c) (i) 2 + 1 marks (ii) 2 + 1 marks (iii) 2 + 1 marks (any 2 parts) 6 MARKS</p> |
| <p>Question 4</p> <p>(a) (i) Name @ 1 mark (ii) 3 elements @ 1 mark each (iii) Wall protection @ 3 marks (iv) Metal produced @ 1 mark Suitable applications @ 2 marks 10 MARKS</p> <p>(b) (i)-(iv) Two definitions @ 2 marks each 4 MARKS</p> <p>(c) (i) Two reasons @ 2 marks each (ii) One metal @ 2 marks 6 MARKS</p> | <p>Question 5</p> <p>(a) (i) 3 marks (ii) 2 marks (iii) 3 marks (iv) 2 marks 10 MARKS</p> <p>(b) (i) 2 marks (ii) Application @ 2 marks (iii) Two reasons @ 2 marks each (iv) Ratio @ 2 marks 10 MARKS</p> |
| <p>Question 6</p> <p>(a) (i) Description @ 3 marks (ii) Explanation @ 2 marks Diagram @ 2 marks (iii) Description @ 3 marks 10 MARKS</p> <p>(b) (i) Description @ 3 marks (ii) Outline @ 3 marks (iii) Two precautions @ 2 marks each 10 MARKS</p> | <p>Question 7</p> <p>(a) (i) Identify @ 2 marks (ii) Two advantages @ 1 mark each (iii) Two safety features @ 1 mark each (iv) Any two @ 2 marks each (v) 1 mark + 1 mark + 1 mark + 1 mark 14 MARKS</p> <p>(b) (i) Explanation @ 1 mark Difference @ 1 mark (ii) Three applications @ 1 mark each (iii) One method @ 1 mark 6 MARKS</p> |

Question 1, Section A – Compulsory

20 marks

Five parts *only* to be counted

- (a) (i) Part **A** is the Crankshaft. 2 marks
(ii) The Connecting Rod (Con Rod) connects the piston and the crankshaft. The reciprocating motion of the piston is converted to rotary motion of the crankshaft. *Explain the purpose @ 2 marks*

4 marks

- (b) (i) Part **B** is the Rocker. 2 marks
(ii) A push rod, which is activated by a cam on the camshaft, is connected to one end of the rocker. The rocker is mounted on the rocker shaft. When the push rod is forced up by the cam, the rocker pivots on the rocker shaft, causing the other end to push down on the valve and forcing it open. *Describe the function @ 2 marks*

4 marks

- (c) (i) Y-alloy aluminium is suitable for the piston. *Any suitable material @ 2 marks*
(ii) The piston rings provide a gas seal between the piston and the cylinder. The rings also prevent lubricating oil passing into the combustion chamber. *Explain the purpose @ 2 marks*

4 marks

- (d) (i) Engines produce waste oil and exhaust fumes, both of which can impact negatively on the environment. *Any two areas @ 1 mark each*
(ii) All modern cars are fitted with catalytic converters to reduce the impact of exhaust fumes. *Any measure @ 2 marks each*

4 marks

- (e) (i) John L. Baird - a Scotsman who in 1926 invented the Television.
(ii) Steve Jobs was a founder and CEO of apple computers. He also developed Pixar the computer animation film company.
(iii) Isaac Singer developed the singer sewing machine.



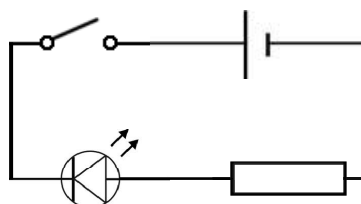
Any one @ 4 marks

4 marks

- (f) (i) Metals which do not contain Iron are known as non-ferrous metals. *Any suitable explanation @ 2 marks*
(ii) Copper is a suitable non-ferrous metal for the hot water cylinder. *Any suitable non-ferrous metal @ 2 marks*

4 marks

- (g) (i) C is a resistor. 1 mark
(ii) D is a light emitting diode. 1 mark



4 marks

Correct circuit diagram @ 2 marks

Question 1, Section B – Compulsory

20 marks

Five parts only to be counted

(a) (i) Safety precautions to be taken when drilling include –

- Tie back loose clothing
- Tie back long hair
- Wear eye protection
- Ensure that the work piece is secured properly.



Any two safety precautions @ 1 mark each

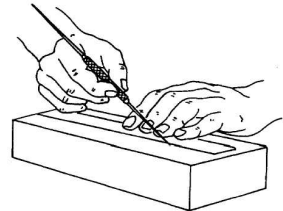
(ii) The 90° bends on the front axle support are completed by holding the work in a folding bar and striking the work with a mallet. The finished angles are checked with an engineers square.

Description @ 2 marks

4 marks

(b) (i) The arch is marked-out as follows –

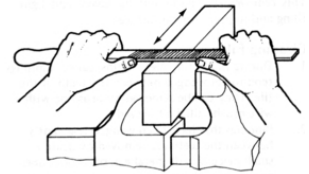
- Measure in 8mm from the left
- Using an engineers protractor mark an angle of 60° (to the right)
- Measure in another 52mm
- Using the engineers protractor, mark an angle of 60° (to the left)
- Measure up 20mm and draw a horizontal line to complete the arch.



Description @ 2 marks

(ii) A good quality finish is achieved by smooth filing (draw filing) and ensuring that all rough edges are removed using a smooth file. A polish may then be applied to achieve a high quality finish.

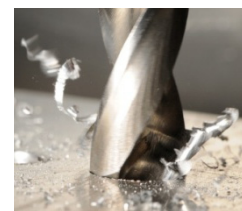
Any two methods @ 1 mark each



4 marks

(c) (i) The front window is marked-out as follows –

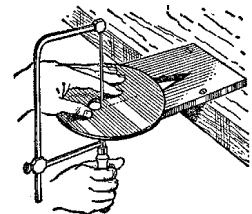
- The top holes are marked 14mm down, 11mm from the front and 12mm middle window
- The bottom holes are 14mm below at 60° for the front vertical for the last hole
- The shape is finished by drawing lines to each of the drilled holes.



Description @ 2 marks

(ii) The front window may be produced as follows –

- Drill the 4 holes 3.5mm
- Cut-out the sections between each hole
- File to the marked shape
- Smooth file finish.



4 marks

Any two steps @ 1 mark each

(d) (i)
(ii)



Suitable design @ 2 marks
Method of attachment @ 2 marks

4 marks

(e) (i)
(ii)

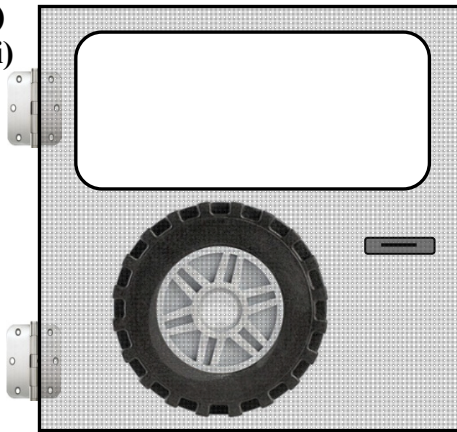


Diagram @ 2 marks
Window and Wheel @ 2 marks

4 marks

(f) (i) A Jeep may be used in the following situations –

- The military / Army
- On a farm.

Any two uses @ 1 mark each

(ii) The Jeep is used by the military as it is a strong robust vehicle capable of carrying large loads.

1 mark

The Jeep is a good vehicle on the farm as it capable of travelling off road with ease.

1 mark

4 marks

Question 2 **20 marks**

(a) (i) Stage five is the manufacture / making stage.
Name of stage @ 1 mark

This stage of the design process involves making the component(s) to the drawing specifications. Processes involved may include cutting, shaping, drilling and turning. The parts would then be assembled and finished.
Any description @ 3 marks

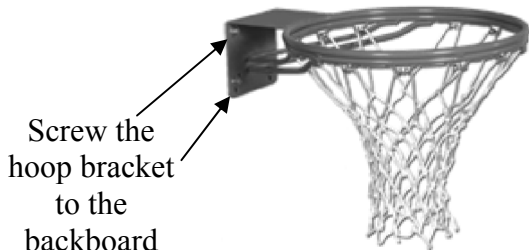
(ii) Factors used to evaluate the design of the toaster may include -

- function
- appearance
- safety
- manufacturing costs.

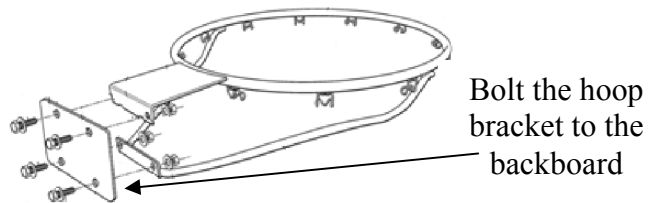
Any three factors @ 1 mark each

7 marks

(b) (i) The hoop may be bolted or screwed to the backboard as shown.



or



Suitable method @ 2 marks
Suitable diagram @ 2 marks

(ii) The backboard may be attached to a portable structure, fixed structure to the floor or a structure fixed to the wall.



or

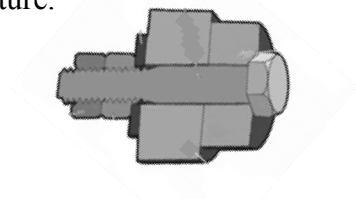


or



Design of structure @ 2 marks
Diagram of structure @ 2 marks

(iii) The backboard and hoop could be bolted to the metal structure.



Description @ 1 mark
Diagram @ 2 marks

(iv) The structure could be made from steel.
Any suitable metal @ 1 mark
 Paint would be a suitable finish for the steel structure.
Any suitable finish @ 1 mark

13 marks

Question 3 **20 marks**

(a) (i) Spindle speed is a measure of the number of rotations of the spindle. *2 marks*

(ii) The spindle speed may need to be varied for the following reasons -

- drilling different types of materials (hard or soft)
- using different size drill bits (small or large)
- different types of drill (HSS or HCS)
- the use or not of coolant.

Any two reasons @ 2 marks each

(iii) The hole shown is a countersunk hole. *Identification @ 2 marks*



10 marks

(iv) The morse taper sleeve is used when the taper shank of a tool is too small for the machine socket in which it is to be used. *Explanation of purpose @ 2 marks*

(b) The speed is 2800 RPM *Correct substitution @ 2 marks*
Correct calculation @ 2 marks

4 marks

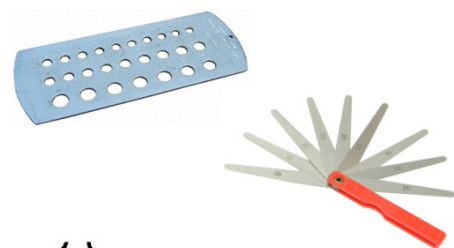
(c) (i) A **chuck key** is used to open and lock the chuck on a drill or a lathe.

An **allen key** is used for turning hexagonal socket head screws.

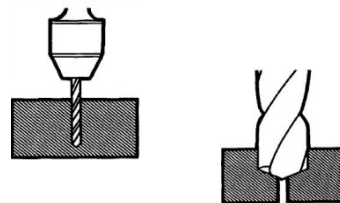


(ii) A **drill gauge** is used for checking drill sizes when it is not possible to read the markings on the drill.

A **feeler gauge** is made up of a set of thin steel blades of different thicknesses. It is used for measuring small gaps (e.g. spark plug gaps).



(iii) A **pilot hole** is a small hole drilled prior to drilling with a large drill ensuring effective cutting of the hole.



A **blind hole** is a hole which does not go all the way through a part. *Any two parts @ 2 marks+1 mark each*

6 marks

Question 4 **20 marks**

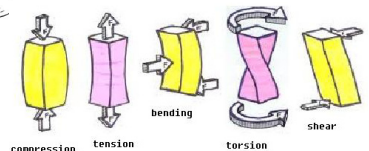
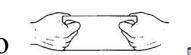
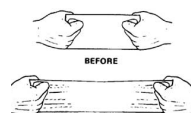
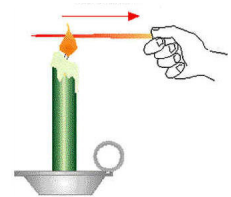
- (a) (i) The furnace shown is a blast furnace. *1 mark*
- (ii) The charge is made up of the following materials;
- Coke
 - Limestone
 - Iron ore.
- 3 elements @ 1 mark each*
- (iii) The metal furnace walls are protected by a refractory lining which insulates the furnace. *3 marks*
- (iv) Molten Iron is produced at spout A. *Metal produced @ 1 mark*

Molten Iron may be further refined to produce steel or cast iron.

Any suitable application @ 2 marks

10 marks

- (b) (i) **Brittleness** is the opposite of toughness. A brittle material can easily be fractured by an impact.
- (ii) **Conductivity** is the ability of a material to allow heat or electricity to flow through it.
- (iii) **Elasticity** is the ability of a material to return to its original shape when released from a force.
- (iv) **Strength** is the ability of a material to withstand forces of tension, compression, shear, bending and torsion.



Any two definitions @ 2 marks each

4 marks

- (c) (i) Alloys are used to produce products because alloying can improve properties or add new properties to a material. *Any two reasons @ 2 marks each*
- (ii) Brass would be a suitable metal for the musical instrument. *Any suitable metal @ 2 marks*

6 marks

Question 5

20 marks

- (a) (i) The design features featured in a modern motorcycle, but not in a vintage motorcycle, include –
- Better aerodynamics
 - More comfortable seating
 - Greater storage
 - Entertainment such as radio and music. *3 marks*
- (ii) The materials used to manufacture the vintage motorcycle were mostly metal and much less so than the modern motorcycle. The modern motorcycle uses more polymer materials. *2 marks*
- (iii) The safety features featured in a modern motorcycle, compared to a vintage motorcycle, include –
- Bigger tyres for better grip
 - Better breaking system
 - Larger windscreen
 - Larger and clearer indicating lights. *3 marks*
- (iv) The vintage motorcycle tended to have smaller engines thus producing smaller amounts of exhaust fumes in comparison to the modern engine. As much of the vintage motorcycle is made of metal it is suitable for recycling. The polymer used in the modern motorcycle has a greater negative environmental impact. *2 marks*

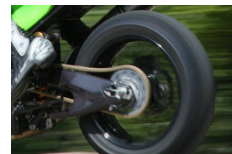
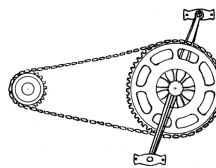
10 marks

- (b) (i) The drive mechanism shown is a chain and sprocket system. *2 marks*

- (ii) Suitable applications for the chain and sprocket include –

- A bicycle
- A motorcycle
- Farm machinery
- Camshaft drives for some engines.

Any suitable application @ 2 marks



- (iii) The chain and sprocket mechanism needs to be lubricated for the following reasons –

- to reduce friction which in turn improves mechanical efficiency
- to reduce wear
- to reduce noise.

Any two reasons @ 2 marks each



- (iv) The gear ratio is 4:1

2 mark

10 marks

Question 6

20 marks

- (a) (i) The copper brooch is firstly marked-out. The brooch is then cut to shape using a curved snips. A smooth file finish is then applied and edges are made safe.

3 marks

- (ii) Enamel is applied to the surface of the brooch in a powder form. It is then fired in a kiln to allow the powder to fuse. The brooch is then removed from the kiln to allow the enamel to cool and form a hard decorative finish on the surface of the pendant.



Explanation @ 2 marks

Diagram @ 2 marks

- (iii) **Engraving** - allows designs to be cut into a metal surface with sharp tools.



Etching - acid is used to bite away portions of a metal surface to produce a desired design.

Lacquering - involves the coating of a metal surface with a clear or tinted liquid to preserve its surface finish.

Any one description @ 3 marks

10 marks

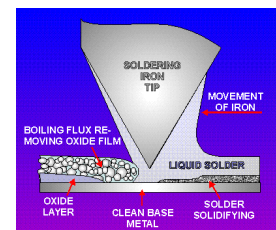
- (b) (i) The badge pin may be sweat soldered to the copper brooch. This requires a thin layer of solder to be applied separately to the badge pin and the copper. The parts are then brought together and heat is applied causing the soldered parts to fuse together.



Description of soldering @ 3 marks

- (ii) A flux is applied to both the copper brooch and the pin to prevent oxidation during the soldering process.

Outline of prevention of oxidation @ 3 marks



- (iii) The following safety precaution should be taken when soldering –

- Never touch the hot tip of the Iron.
- Replace the Iron in the holder when not in use.

Any two safety precautions @ 2 marks each

10 marks

Question 7 **20 marks**

- (a) (i) The lathe shown is a Computer Numeric Control (CNC) Lathe. *2 marks*
- (ii) Advantages of the CNC lathe include -
- It is in general more accurate than a conventional lathe.
 - It is faster in production and allows for mass production of a component to a consistent high tolerance finish. *Any two advantages @ 1 mark each*
- (iii) Safety features of the CNC lathe include -
- An emergency stop
 - The clear acrylic guard
 - Contact cut out switches when the guard is lifted. *Any two safety features @ 1 mark each*

- (iv) **Byte** – is a unit of digital information in computing and telecommunications that most commonly consists of eight bits.
- Wi-Fi** – is a popular technology that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network, including high-speed Internet connections.
- Operating system** – is a collection of software that manages computer hardware resources and provides common services for computer programs.
- App** – is a web application that is accessed by users over a network such as the Internet.
- Any two @ 2 marks each*



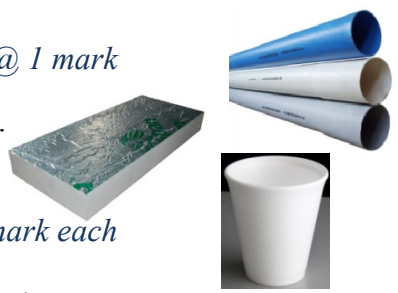
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|-----|---------------------|----------------|---------------|
| (v) | Mouse - | input | <i>1 mark</i> |
| | Digital camera - | output / input | <i>1 mark</i> |
| | Computer speakers - | output | <i>1 mark</i> |
| | Robotic arm - | output | <i>1 mark</i> |

14 marks

- (b) (i) Thermosetting plastics harden when they are heated. These plastics will not soften when they are reheated. *Explanation @ 1 mark*

One main difference is that thermoplastic are plastics that soften when heated and this allows these materials to be moulded into the required shape. *Any difference @ 1 mark*

- (ii) PVC - piping, clothing, signage, windows.
 Polyurethane - upholstery, insulation, clothing.
 Polystyrene - Food packaging, CD cases.
- Any one application for each @ 1 mark each*



- (iii) Environmental problems caused by incorrect disposal of plastics can be reduced by the reuse or recycling of the plastic. *1 mark*

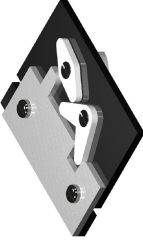



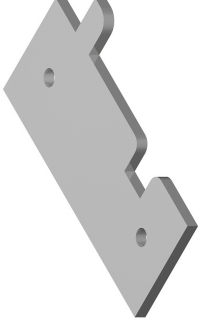
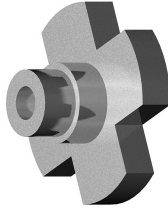
6 marks



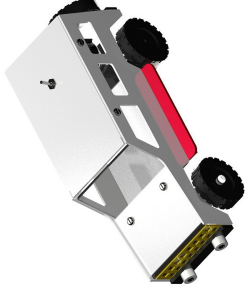
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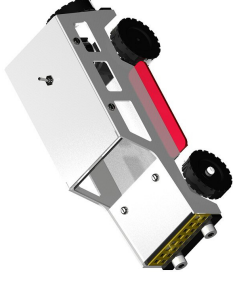
| Subjective Marking 1-10 | | 9-10 Excellent | 7-8 Very Good | 5-6 Good | 3-4 Poor | 1-2 Very Poor | | | |
|-------------------------|----------------------|---|---|------------------------------|--|--|---|------|-------|
| Subjective Marking 1-5 | | 5 Excellent | 4 Very Good | 3 Good | 2 Poor | 1 Very Poor | | | |
| Section | Part Number | Pictorial Sketch / Description | | | | | Concept | Mark | Marks |
| 1 | Parts 1, 2, 3, 4 & 5 |  |  | <p>Complete Piece</p> | <p>Assembly: Subjective Marking 1 - 5</p> | <p>Finish: Subjective Marking 1 - 5</p> | <p>Function: Subjective Marking 1 - 10</p> | 5 | 20 |
| | | | | | | | | 5 | |
| | | | | | | | | 10 | |
| 2 | Parts 1 & 4 |  | <p>Part 1 Backplate</p> | <p>Part 4 Cam</p> | <p>15</p> | <p>Mark Out</p> | <p>Slots</p> | 3 | 20 |
| | | | | | | | | 8 | |
| | | | | | | | | 4 | |
| 3 | Part 2 |  | <p>Part 2 Lever Arm</p> | <p>5</p> | <p>Mark Out</p> | <p>Hole & CSK</p> | <p>Profile</p> | 1 | 20 |
| | | | | | | | | 1 | |
| | | | | | | | | 3 | |
| | | | | | | | | 3 | |
| 4 | Part 3 |  | <p>Part 3 Slider</p> | <p>Mark Out</p> | <p>Profile</p> | <p>Radii</p> | <p>Mark Out</p> | 3 | 20 |
| | | | | | | | | 8 | |
| | | | | | | | | 6 | |
| 5 | Part 5 |  | <p>Part 5 Knob</p> | <p>Mark Out</p> | <p>End Profile</p> | <p>Diameters & Lengths</p> | <p>Mark Out</p> | 4 | 20 |
| | | | | | | | | 8 | |
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100 Marks (× 1.5 = 150 Total)

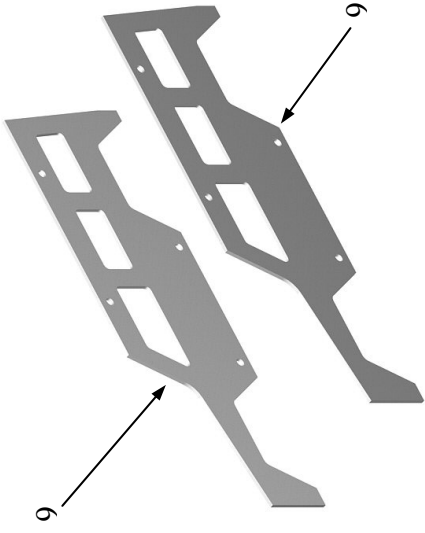
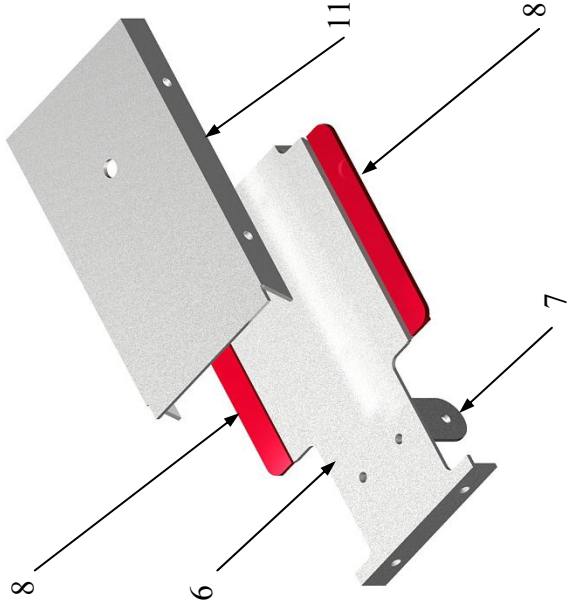


Junior Certificate Metalwork, Higher Level Project – Marking Scheme 2013

| Subjective Grading 1 – 5 | | 5 Excellent | 4 Very Good | 3 Good | 2 Poor | 1 Very Poor | Concept | Mark | Marks | |
|--------------------------|--|--|-------------|--------|--------|-------------|---------|---|----------------------------|----|
| Section | Part Number | Pictorial Sketch/Description | | | | | | | | |
| 1 | Complete Model (Design Element not included) | | | | | | | Assembly: Subjective Grade 1 – 5 Finish: Subjective Grade 1 – 5 Mechanical Function: 1 – 5 Electrical Function: 1 – 5 | 5 5 5 5 | 20 |
| | | Design Design and make: (i) a Rear Bumper for the model which is attached to the Chassis (Part 6) . (ii) a Rear Door which is hinged to the model. The door must include a window and have a spare wheel attached. It is not necessary to include glass or acrylic in the window (Note: 20% of the marks will be awarded for this section) | | | | | | Rear Bumper Design, Make & Attach: Subjective Grade 1 – 5 Rear Door Design: Subjective Grade 1 – 5 Make: Subjective Grade 1 – 5 Attach: Subjective Grade 1 – 5 | 5 15 | 20 |
| | | Parts 1, 2, 3, 4, 5 & 10 | | | | | | Part 1 Headlamp × 2 Part 2 Front Bumper Part 3 Front Grill Part 4 Front Grill Support Part 5 Bonnet Part 10 Windshield | 4 3 2 3 4 4 | 20 |
| | | | | | | | | Length, Diameter, Drill & CSK Length, Width & Drill Length & Width Length, Width & Drill Length, Width, Drill & Bend Length, Width, Drill & Bend | | |



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| | | | | | | | |
|---|--------------------|--|------------------------------------|----|----------------------------------|---|----|
| 4 | Parts 9 |  | Part 9 Left Hand Side Panel | 10 | Mark Out | 2 | 20 |
| | | | | | Internal Profiles | 4 | |
| | | | | | External Profile | 4 | |
| | | | Part 9 Right Hand Side Panel | 10 | Mark Out | 2 | |
| | | | | | Internal Profiles | 4 | |
| | | | | | External Profile | 4 | |
| 5 | Parts 6, 7, 8 & 11 |  | Part 6 Chassis | 8 | Mark Out | 2 | 20 |
| | | | | | Drill | 2 | |
| | | | | | Shape & Bend | 4 | |
| | | | Part 7 Front Axle Support | | Mark Out, Drill, Shape & Bend | 3 | |
| | | | | | Part 8 Running Board × 2 | 4 | |
| | | | Part 11 Roof | | Mark Out, Drill, Shape & Bend | | |