



**Coimisiún na Scrúduithe Stáit  
State Examinations Commission**

**JUNIOR CERTIFICATE 2011**

**MARKING SCHEME**

***MATERIALS AND TECHNOLOGY***  
**METALWORK**

**HIGHER LEVEL**

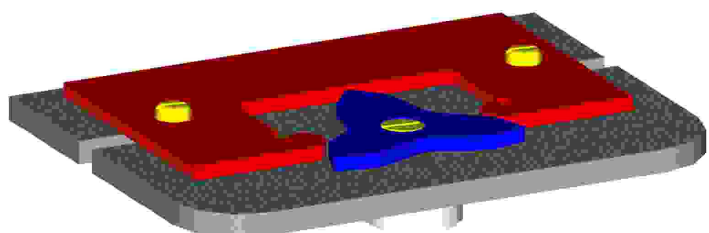
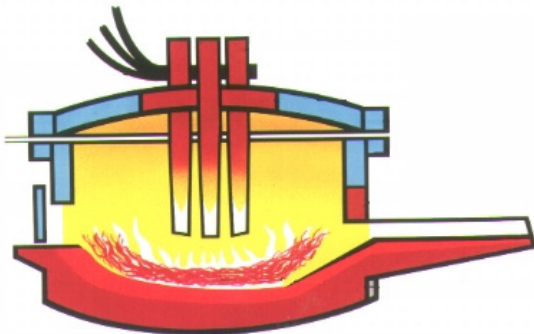
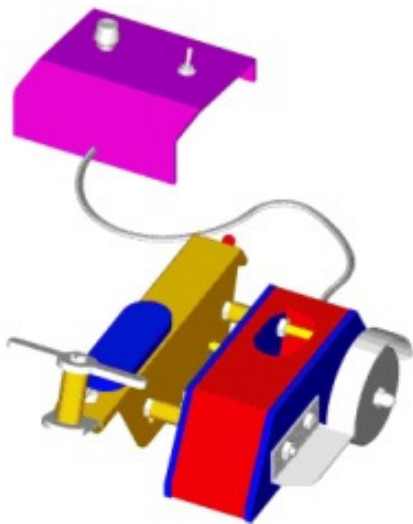
**JUNIOR CERTIFICATE EXAMINATION, 2011**

# **MATERIALS AND TECHNOLOGY**

**METALWORK – HIGHER LEVEL**

## **MARKING SCHEME**

**Written Examination, Practical Examination  
and Project**



# 2011 Written Examination – 100 Marks

## Summary of Marks

<p style="text-align: center;"><b>Question 1 – Section A</b></p> <p>(a) (i) Port A @1 mark + Port B @1 mark (ii) One purpose @ 2 marks <b>4 MARKS</b></p> <p>(b) (i) Part C @ 2 marks (ii) Explain @ 2 marks <b>4 MARKS</b></p> <p>(c) Description @ 4 marks <b>4 MARKS</b></p> <p>(d) Outline @ 4 marks <b>4 MARKS</b></p> <p>(e) Any One @ 4 marks <b>4 MARKS</b></p> <p>(f) (i) Any two @ 1 + 1 mark (ii) One application @ 2 marks <b>4 MARKS</b></p> <p>(g) (i) Both components @ 1 + 1 mark (ii) Diagram @ 2 marks <b>4 MARKS</b></p>	<p style="text-align: center;"><b>Question 1 – Section B</b></p> <p>(a) (i) Length @ 1 mark, Width @ 1 mark (ii) One instrument @ 2 marks <b>4 MARKS</b></p> <p>(b) (i) Two steps @ 1mark + 1 mark (ii) Description @ 2 marks <b>4 MARKS</b></p> <p>(c) (i) Description @ 2 marks (ii) Description @ 2 marks <b>4 MARKS</b></p> <p>(d) (i) Explanation @ 2 marks (ii) Two factors @ 1 mark + 1 mark <b>4MARKS</b></p> <p>(e) Design @ 2 marks Diagram @ 2 marks <b>4 MARKS</b></p> <p>(f) Design @ 2 marks Diagram @ 2 marks <b>4 MARKS</b></p>
<p style="text-align: center;"><b>Question 2</b></p> <p>(a) (i) Three @ 1 + 1 + 1 mark (ii) Two @ 2 + 1 mark <b>6 MARKS</b></p> <p>(b) (i) Elevation @ 3 marks (ii) Design @ 2 marks, Diagram @ 2 marks (iii) One decorative feature @ 3 marks (iv) Metal @ 2 marks, Finish @ 2 marks <b>14 MARKS</b></p>	<p style="text-align: center;"><b>Question 3</b></p> <p>(a) (i) Outline @ 2marks (ii) Two safety @ 1 + 1 mark (iii) Two reasons @ 2 + 2 marks <b>8 MARKS</b></p> <p>(b) 4 marks <b>4 MARKS</b></p> <p>(c) (i), (ii) &amp; (iii) Two parts @ 2 + 2 marks <b>8 MARKS</b></p>
<p style="text-align: center;"><b>Question 4</b></p> <p>(a) (i) 1 mark (ii) 3 elements @ 1 mark each (iii) Description @ 2 marks (iv) Explanation @ 2 marks (v) Outline @ 2 marks <b>10 MARKS</b></p> <p>(b) (i) (ii) (iii) &amp; (iv) Two @ 2 + 2 marks <b>4 MARKS</b></p> <p>(c) (i) 2 marks + 2 marks (ii) 2 marks <b>6 MARKS</b></p>	<p style="text-align: center;"><b>Question 5</b></p> <p>(a) (i) 1 mark + 1 mark + 1mark (ii) 1 mark + 1 mark + 1 mark (iii) 1 mark + 1 mark (iv) Two safety @ 1 mark each <b>10 MARKS</b></p> <p>(b) (i) 2 marks (ii) 2 marks (iii) 3 marks (iv) 3 marks <b>10 MARKS</b></p>
<p style="text-align: center;"><b>Question 6</b></p> <p>(a) (i) Description @ 3 marks (ii) Explanation 2 marks, Diagram 2 marks (iii) Description of One @ 3 marks <b>10 MARKS</b></p> <p>(b) (i) Description @ 2 marks (ii) Two processes @ 1 mark each (iii) Two reasons @ 2 marks each (iv) Two safety @ 1 mark each <b>10 MARKS</b></p>	<p style="text-align: center;"><b>Question 7</b></p> <p>(a) (i) 1 mark (ii) 1 mark + 1 mark (iii) 1 mark + 1 mark (iv) Selection @ 1 mark, reason @ 1 mark (v) 2 marks <b>10 MARKS</b></p> <p>(b) (i) Redraw @ 1 mark, Label 4 @ 1 mark each (ii) Two explanations @ 1 mark each (iii) Redraw @ 1 mark, illustrate @ 2 marks <b>10 MARKS</b></p>

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.

Question 1, Section A – Compulsory

20 marks

Five parts *only* to be counted

- (a) (i) Port **A** is the exhaust port. 1 mark  
Port **B** is the inlet port. 1 mark

- (ii) Port **A**, the exhaust port, is where the combusted fumes are released from the combustion cylinder.  
Port **B**, the inlet port, is where the fuel / air mixture brought into the combustion cylinder.

*Any one purpose @ 2 marks*

4 marks

- (b) (i) Part **C** is a cooling fin. 2 marks

- (ii) The cooling fins provide a greater surface area on the exterior of the engine, which is in contact with air. This provides a means of cooling the engine.

*2 marks*

4 marks

- (c) The spark plug is located in the combustion chamber. Its function is to provide a spark, at the right time, which ignites the fuel / air mixture. *Description @ 4 marks*

4 marks

- (d) The ignition of the fuel / air mixture forces the piston downwards. As the piston moves down the exhaust port becomes open, allowing the exhaust fumes out of the chamber. As the piston continues downward the fuel /air mixture is pulled into the cylinder. *Operation @ 4 marks*

4 marks

- (e) (i) Bill Gates is the founder of Microsoft.  
(ii) Alexander Graham Bell invented the telephone.  
(iii) John P. Holland invented the submarine. *Any one @ 4 marks*

4 marks

- (f) (i) High Speed Steel and Stainless Steel are two examples of alloy steels. *Any two alloy steels @ 1 mark each*

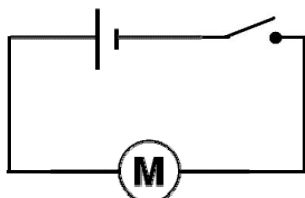
- (ii) High Speed Steel is used to make cutting tools such as drill bits and screw cutting taps.  
Stainless Steel is used to make items which are corrosion resistant such as kitchen sinks.

*One suitable application @ 2 marks*

4 marks

- (g) (i) **D** is a toggle switch. 1 mark  
**E** is a motor. 1 mark

- (ii)



*Circuit diagram @ 2 marks*

4 marks

**Question 1, Section B – Compulsory**

**20 marks**

*Five parts only to be counted*

- (a) (i) The length of the frame is 140 mm. *1 mark*  
 The width of the frame is 100 mm. *1 mark*

- (ii) A bevel protractor is used to measure the 60° angles on the frame.

*Any one instrument @ 2 marks*

**4 marks**

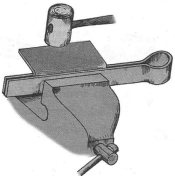
- (b) (i) The outline of the profile is produced by drilling, cutting, rough and smooth filing.

*Any two steps @ 1 mark each*

- (ii) Two 60° centre lines are drawn. The location of the Ø6 mm holes are marked-out and centre punched. The Ø6 mm holes are then drilled. The sides of the slots are then marked-out. The slots are then cut out. The slots are then given a file finish, while protecting the holes.

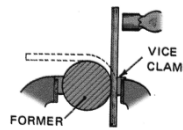
*Description @ 2 marks*

**4 marks**

- (c) (i)  The 90° bend is completed by holding the work in a folding bar and striking the work with a mallet. The finished angle is checked with an engineers square.

*Description @ 2 marks*

- (ii) The R 25 arc is produced by striking the work with a mallet and shaping it around a diameter 50mm circular former.



*Description @ 2 marks*

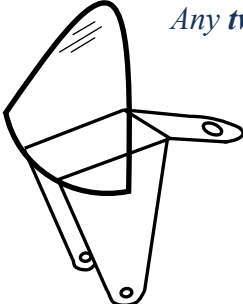
**4 marks**

- (d) (i) The resistor is a limiting resistor. It protects the LED from blowing in the circuit. *2 marks*

- (ii) Heating the Soldering Iron to the correct temperature and using a flux are necessary to produce a good quality soldered joint.

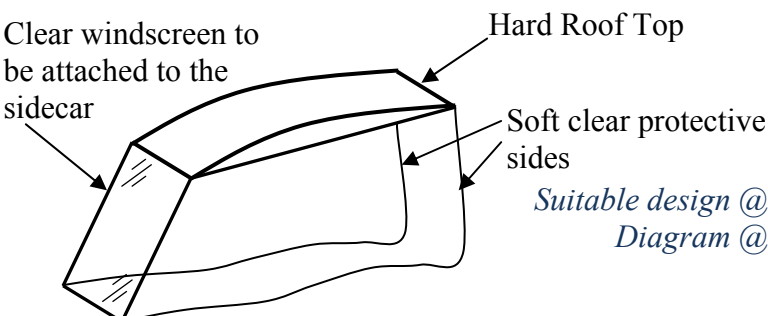
*Any two suitable factors @ 1 mark each*

**4 marks**

- (e) 

*Suitable design @ 2 marks*  
*Diagram @ 2 marks*

**4 marks**

- (f) 

*Suitable design @ 2 marks*  
*Diagram @ 2 marks*

**4 marks**

**Question 2** **20 marks**

- (a) (i) Points to consider when selecting materials include:
- The suitability of the material for the proposed application.
  - The materials properties.
  - The cost of the material.
  - The availability of the material.

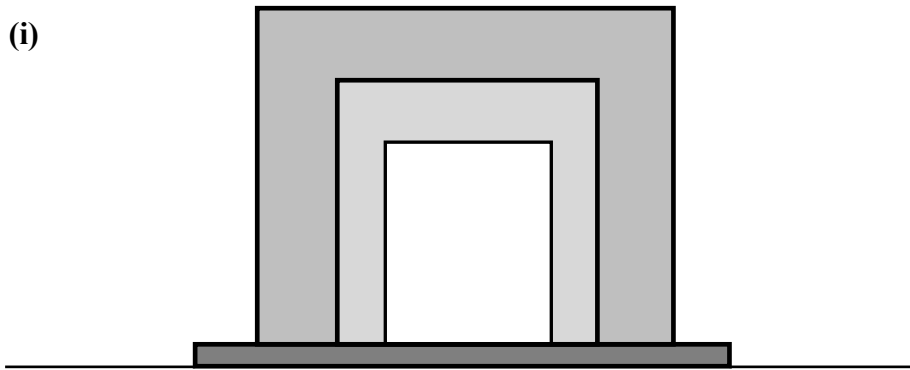
*Any **three** important points @ 1 mark each*

- (ii) Safety precautions to be taken include:  
 Wearing of eye protection.  
 Wearing of protective clothing.  
 Tying back of long hair.

**6 marks**

*Any **two** suitable safety precautions @ 2 + 1 marks*

- (b) (i)



*Draw elevation of the fireplace @ 3 marks*

- (ii)



The fire guard is hinged to allow it to be folded and stored

*Design of safety guard @ 2 marks  
 Diagram of Safety guard @ 2 marks*

- (iii) Scroll work is an example of a decorative feature.

*Design **one** decorative feature @ 3 marks*

- (iv) The safety guard could be made from mild steel.  
 Black paint would provide a suitable finish for the safety guard.

*Any suitable metal @ 2 marks  
 Any suitable finish @ 2 marks*

**14 marks**

**Question 3** **20 marks**

- (a) (i) The centres for the holes are located as follows –
- Measure 20mm from the top
  - Use the square to draw a horizontal line
  - Mark in 20mm from the left and right
  - Punch the centres

*Outline how to position the holes @ 2 marks*

- (ii) Safety precautions to be taken 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*

- (iii) Drills run at different speeds for the following reasons –  
 To allow different materials (hard or soft) to be drilled  
 To allow different size of drills to be used

*Any two reasons @ 2 marks each*

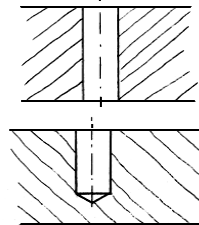
**8 marks**

- (b) The speed is 2000 RPM

*Correct substitution @ 2 marks*  
*Correct calculation @ 2 marks*

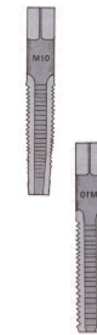
**4 marks**

- (c) (i) A **clearance hole** is a hole that is slightly larger than the size of the bolt or screw that passes through it.



A **blind hole** is a hole that does not go all the way through a part.

- (ii) A **taper tap** is tapered over the first 8 to 10 threads, helping it gradually start the threading of a hole.



A **plug tap** has only a short taper of only one or two threads. It is used when finishing a thread or tapping a blind hole.

- (iii) A **snap head rivet** has a semi-dome shaped head. It is used to make a permanent joint by hammering and forming a head on the opposite side.



A **pop rivet** is used for light work. The second head is formed by drawing a pin with a head through the rivet, using a pop rivet gun.



*Any two parts @ 2+2 marks each*

**8 marks**

## Question 4

20 marks

(a) (i) The furnace is an electric arc furnace. *1 mark*

(ii) The charge is made up of the following materials;

- Scrap metal
- Lime
- Mill scale or iron ore.

*3 elements @ 1 mark each*

(iii) The electrodes are lifted out of the furnace. The roof and electrodes are swivelled to one side. This allows the elements of the charge to be placed into the furnace.



*Description @ 2 marks*

(iv) The charge is heated by electric arcs. These arcs are generated by bringing the electrodes – part A – close to the charge in the furnace. Once the gap is small enough the arcs will jump from the end of the electrodes onto the charge and the heat generated will melt the charge.

*Explain @ 2 marks*

(v) Part B is the tapping spout. This is where the molten steel is poured from the furnace when it is tilted.

*Outline @ 2 marks*

**10 marks**

(b) (i) **Toughness** is the ability of a material to absorb energy from blows or impact.

(ii) **Strength** is the ability of a material to withstand forces of tension, compression, shear, bending and torsion.

(iii) **Malleability** is the ability of a material to extend in all directions without rupture.

(iv) **Brittleness** is the opposite of toughness. A brittle material can easily be fractured by an impact.

*Define any two properties @ 2 marks each*

**4 marks**

(c) (i) Brass – Copper and Zinc. *2 marks*  
Bronze – Copper and Tin. *2 marks*

(ii) The piston is made from Y-alloy aluminium. This aluminium alloy contains copper, nickel and magnesium.

*2 marks*

**6 marks**



## Question 5

20 marks

- (a) (i) The Seat is made from leather; *1 mark*  
The Exhaust pipe is made from chrome plated steel; *1 mark*  
The Body is made from high carbon fibre or aluminium. *1 mark*
- (ii) Leather is suitable for the Seat as it is soft and easy to shape; *1 mark*  
Chrome plated steel is suitable for the exhaust pipe as it is attractive in appearance; *1 mark*  
Carbon fibre is suitable for the body as it is light and easy to shape. *1 mark*
- (iii) **Advantage** - a motorbike is easy to guide through heavy traffic build up. *1 mark*  
**Disadvantage**- the motorbike rider is exposed to the elements of wind and rain. *1 mark*
- (iv) Safety features include-
- Warning lights
  - Indicating lights
  - Rear view mirror
  - Any other relevant safety feature.
- Any two safety features @ 1 mark each*
- (b) (i) The drive mechanism shown is a chain and sprocket. *2 marks*
- (ii) The gear ratio is 3:1. *2 marks*
- (iii) The speed of the driven is 150 RPM. *3 marks*
- (iv) Noise and wear can be reduced by the use of lubricant. Grease is most commonly use on chain and sprocket mechanisms. *3 marks*

10 marks

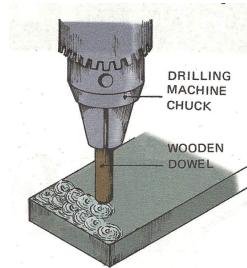
10 marks

## Question 6

20 marks

- (a) (i) The piece is firstly marked-out. The pendant is then cut to shape using a straight snips and a curved snips. A smooth file finish is then applied and edges are made safe. *Description @ 3 marks*

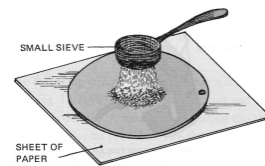
- (ii) An 8mm dowel with one coated in carbrundum paste is used to create a mottled effect on metal. One end of the dowel is held in the chuck of a drilling machine. The end with the paste is pressed onto the surface of the metal as it rotates creating a polished circle on the metal surface. An attractive finish is achieved by overlapping the circles.



*Explanation @ 2marks*

*Diagram @ 2 marks*

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



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



**Repoussé** - is a process where a raised design is formed on the work, almost entirely from the back, while the work is set in prepared pitch.



10 marks

*Description of any one @ 3 marks*

- (b) (i) **Hardening** – If a piece of high carbon steel is heated to a cherry red (temperature will depend on carbon content) and then cooled rapidly (in oil or brine) it becomes very hard and brittle.

*Description of hardening @ 2 marks*

- (ii) Other heat treatment processes include:

- Tempering
- Annealing
- Stress Relieving.

*Name any two heat treatment processes @ 1 mark each*

- (iii) Reasons for heat treating metals include:

- Changing properties such as hardness, strength and ductility.
- Improving the mechanical performance of the metal.
- Changing the appearance of the metal.

*Any two reasons @ 2 marks each*

- (iv) Safety precautions to be taken include:

- Wearing of protective clothing
- Wearing of eye protection
- Displaying of warning signs where hot material is left

*Any two safety precautions @ 1 mark each*

10 marks

## Question 7

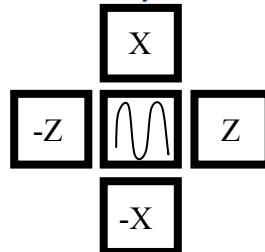
20 marks

- (a) (i) The lathe shown is a Computer Numeric Control (CNC) Lathe. *1 mark*
- (ii) **Part A** is the Chuck. This is used to hold the work and the work also rotates as the chuck rotates. *1 mark*  
**Part B** is the safety guard. It protects the operator while the machine is cutting. If it is lifted while cutting the motor will cut out. *1 mark*
- (iii) Acrylic is the most suitable of the materials listed from which to make the guard. It is most suited as it is easily shaped and is clear.  
*Correct selection @ 1 mark*  
*Reason for selection @ 1 mark*
- (iv) Thermosetting materials are polymers that harden when they are heated. These materials will not soften when they are reheated.  
 Thermoplastic materials are polymers that soften when heated and this allows these materials to be moulded into the required shape. *Explanation @ 2 marks*  
 The safety guard is a thermoplastic material. *1 mark*
- (v) Environmental problems caused by the incorrectly disposing of plastics include:
- Blockage to pipes and drains causing flooding
  - Poor image of locations where disposed
  - Animals that ingest the plastic may die.

10 marks

*Any one environmental effect @ 2 marks*

- (b) (i)

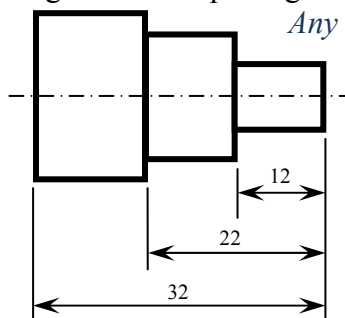


*Redraw @ 1 mark*  
*Label @ 1 mark each*

- (ii) **CPU** stands for the central processing unit. This is like the brain of the computer.  
**G – Codes** are used for controlling the tool movements  
**Canned cycles** – these enable a number of repetitive operations to be carried out by a single block of a program.  
**CAD** stands for Computer-Aided-Design. This allows for components to be designed on screen using a software package.

*Any two explanations @ 1 mark each*

- (iii)



*Redraw @ 1 mark*  
*Illustrate Absolute dimensions @ 2 marks*

10 marks



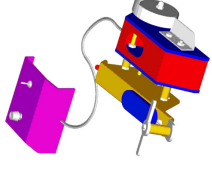
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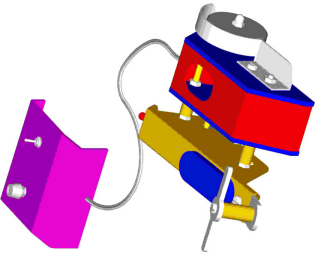
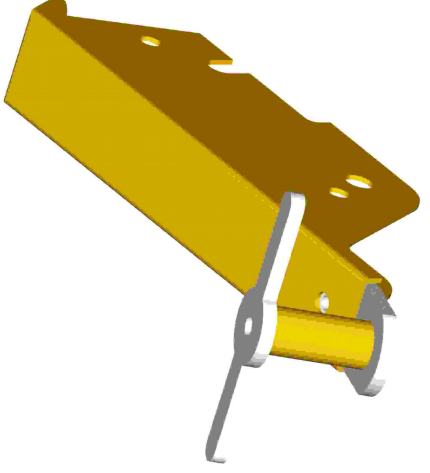
Subjective Marking 1-10		7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor			
Subjective Marking 1-5		5 Excellent	4 Very Good	3 Good	2 Poor			
Section	Part Number	Pictorial Sketch / Description			Concept	Mark	Mark	
1	Parts 1, 2, 3 & 4				Complete Piece	Assembly: Subjective Marking 1 - 5	5	20
						Finish: Subjective Marking 1 - 5	5	
						Function: Subjective Marking 1 - 10	10	
2	Part 1				Backplate	Mark Out	4	20
						Lengths 120 mm & 90 mm	4	
						Backplate Profile & Ø10.5 mm Hole	6	
						6 mm Slot × 2	6	
3	Part 2				Cam	Mark Out	5	20
						120° Divisions	3	
						Cam Profiles	10	
						Ø 5.5 mm CSK Hole	2	
4	Part 3				Knob	Mark Out	4	20
						Lengths 15.5 mm, 10 mm & 5 mm	3	
						Turn, Drill & Tap	3	
						Knob Profile	10	
5	Part 4				Slider	Mark Out	4	20
						Lengths 60 mm & 100 mm	4	
						Profile & Ø3.5 mm Holes	10	
						M6 Hole × 2	2	

Total: 100 Marks  
(× 1.5 = 150 Total)



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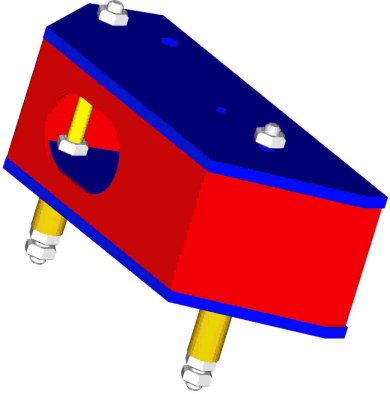
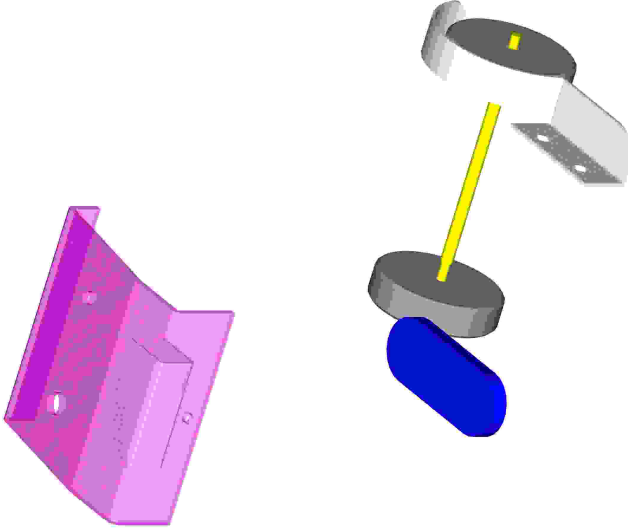


Subjective Marking 1-10		9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor		
Subjective Marking 1-5		5 Excellent	4 Very Good	3 Good	2 Poor	1 Very Poor		
Section	Part Number	Pictorial Sketch/Description			Concept		Mark	Mark
1	Complete Model (Not including Design Element)	 <p>Assembly, Finish &amp; Function</p>			Assembly: Subjective Marking 1-5		5	20
					Finish: Subjective Marking 1-5		5	
					Mechanical Function		5	
					Electrical Function		5	
2	Design	<p>Design and make a <b>Front Fork</b>, <b>Windscreen</b> and <b>Front Wheel</b> for the model. These should be integrated as a unit. The integrated unit when attached to the <b>Front Fork Support (Part 3)</b> should ensure that the model is in a horizontal position.</p>			Design: Subjective Marking 1-10		10	20
					Make: Subjective Marking 1-5		5	
					Attach: Subjective Marking 1-5		5	
3	Parts 1, 2, 3 & 4				Part 1 Handle Bar		3	20
					Part 2 Steering Column		2	
					Part 3 Front Fork Support		3	
					Mark Out Drill & Shape		3	
					Mark Out, Turn Drill & Length		2	
					Mark Out Drill, Tap, Shape & Bend		3	
					Part 4 Frame		12	
Mark Out		2						
Drill		3						
Shape		4						
Bend		3						



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4	Parts 7, 8, 10, 14 & 19		Part 7 Spacer × 2	2	Drill & Length	2	20
			Part 8 Sidecar Panel (inner)	5	Mark Out, Drill & Shape	5	
5	Parts 5, 6, 9, 11, 12, 13 & 15		Part 10 Sidecar Cover	6	Mark Out, Drill & Slot	3	20
					Shape & Bend	3	
			Part 14 Sidecar Panel (outer)	5	Mark Out, Drill, Tap & Shape	5	
			Part 19 Support Shaft × 2	2	Length	2	
			Part 5 Control Panel	5	Mark Out, Drill & Bend	5	
			Part 6 Seat	2	Mark Out & Shape	2	
			Part 9 Battery Holder	2	Mark Out, Shape & Bend	2	
			Part 11 Rear Axle	2	Length & Threaded Ends	2	
			Parts 12 & 13 Wheels	5	Turn, Drill, Tap, Width & Chamfer	5	
			Part 15 Sidecar Mudguard	4	Mark Out, Drill, Shape & Bend	4	

Total: 100 Marks  
(× 1.5 = 150 Total)