



**Coimisiún na Scrúduithe Stáit**  
*State Examinations Commission*

# **JUNIOR CERTIFICATE 2009**

## **MARKING SCHEME**

**Written Examination, Project and Practical Examination**

### **Materials and Technology** **METALWORK**

#### **HIGHER LEVEL**

# Written Examination: Materials and Technology – METALWORK

## Marking Scheme and Sample Solutions

Answer Sections A and B of Question 1 and three other questions – Total:100 Marks

### Question One – Section A

20 Marks

*Five parts only to be counted*

- (a) The Spark plug provides the spark for igniting the compressed fuel mixture. 4 marks **4 Marks**
- (b) (i) Part 'C' are the Cooling fins. 2 marks  
(ii) These fins create a greater surface area on the outside of the engine, which is exposed to the air. This helps to keep the engine cool. 2 marks **4 Marks**
- (c) As the piston moves upwards a partial vacuum is created below the piston which allows the fuel /air mixture into the crankcase. At the same time the charge from the previous stroke is being compressed above the piston. At the end of the upward stroke the compressed mixture is ignited by the Spark plug. 4 marks **4 Marks**
- (d) This type of engine is commonly used to power Motorcycles and small engines for boats. Any two @ 2 marks each **4 Marks**
- (e) (i) Thomas Edison – invented the Phonograph, improved Dynamos, 110-120V electric motor, magnetic ore separator, Electrical vote recorder, developed typewriter, developed telegraphic systems, steel alkaline storage battery, pre-cast buildings, development of motion pictures and Incandescent electric lamp;  
(ii) Henry Maudslay – invented the Screwcutting lathe;  
(iii) Frank Whittle – invented the Jet engine. Any one @ 4 marks **4 Marks**
- (f) (i) Perspex is a suitable plastic material for the photo frame. 2 marks  
(ii) The photo frame is bent to shape using a hot wire strip heater. 2 marks **4 Marks**
- (g) (i) Component 1 is a resistor. 1 mark  
Component 2 is a buzzer. 1 mark  
(ii) The LDR is a light dependent resistor. The resistance of the LDR drops as light falling on it increases. It acts as a light sensor in the circuit shown and controls when the buzzer sounds. 2 marks **4 Marks**  
Any one symbol @ 2 marks

**Question One – Section B**

**20 Marks**

*Five parts only to be counted*

(a) Steps which could be taken to prevent damage to the acrylic when drilling include-

- Secure the material correctly
- Support the material when drilling
- Select a suitable drill speed
- Select a suitable feed rate
- Drill a pilot hole.

*Any two @ 2 marks each*

**4 Marks**

(b) (i) The Left Undercarriage is 30mm X 63mm

*2 marks*

(ii) The Left Undercarriage is bent in a bending machine or in a vice using a folding bar and mallet. The angle accuracy is checked using a bevel protractor.

*2 marks*

**4 Marks**

(c) (i) The surface finish on the Control Panel is firstly achieved by keeping the protective coating on the acrylic while working on it. The edges are smooth file finished and sharp edges are removed before a polish finish is applied.

*2 marks*

(ii) The surface finish on the Aluminium is firstly achieved by using protective clamps in the vice while working on it. The edges are smooth file finished and sharp edges are removed. Steel wool may then be used before a polish finish is applied to all surfaces.

*2 marks*

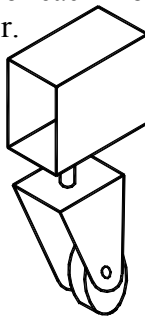
**4 Marks**

(d) The model is controlled by switches and two variable resistors. These control the speed of rotation of each motor and in turn the speed of each propeller.

*4 marks*

**4 Marks**

(e)



*Suitable design 2 marks  
Suitable diagram 2 marks*

**4 Marks**

(f) Advantages of a remote control panel include-

- Being able to operate at a safe distance
- Ability to repair the electric circuit without having to open up the model itself.

*Any two suitable advantages @ 2 marks each*

**4 Marks**

## Question Two

20 Marks

- (a) (i) Pieces of information contained in the production drawings may include -
- dimensions
  - materials used
  - assembly detail
  - client details
  - parts list.

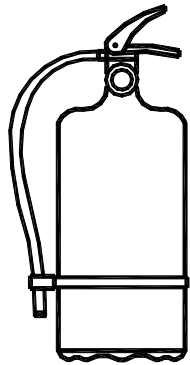
*Any **three** pieces of information @ 1 mark each*

- (ii) Safety precautions to be observed include-
- use of protective clothing
  - tie back long hair.

*Any **two** safety precautions @ 2 marks each*

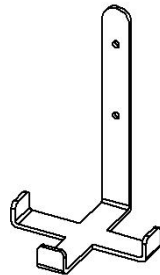
**7 Marks**

- (b) (i)



*Drawing the elevation @ 4 marks*

- (ii)



*Any suitable design @ 3 marks*

- (iii)



Wall plugs and screws may be used to secure the bracket to the wall.

*Any suitable method to secure @ 2 marks*

*Suitable diagram @ 2 marks*

- (iv) Sand may also be used to extinguish a fire in the Metalwork room.

*Any suitable method used to extinguish @ 2 marks*

**13 Marks**

### Question Three

20 Marks

- (a) (i) Tap 1 is a Taper tap. 2 marks  
 Tap 2 is a Plug tap. 2 marks
- (ii) The Taper tap is used to start a screw thread in a hole. 2 marks  
 The Plug tap is used to finish a screw thread. It may also be used to thread a blind hole. 2 marks
- (iii) Part A is the Crest of the screw thread. 1 mark  
 Part B is the Root of the screw thread. 1 mark  
 Part C is the Pitch of the screw thread. 1 mark

11 Marks

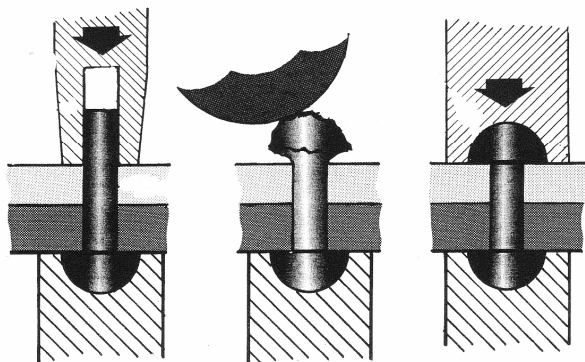
- (b) The speed is 2000RPM.

Correct substitution 2 marks, calculation 2 marks OR  
 Correct answer 4 marks

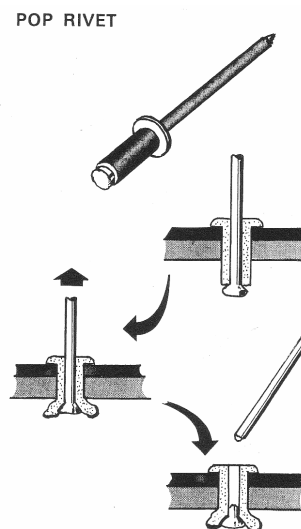
4 Marks

- (c) (i) Rivet A is a Snap head rivet. 1 mark  
 Rivet B is a Pop rivet. 1 mark

(ii)  
 FORMING A  
 SNAP HEAD



OR



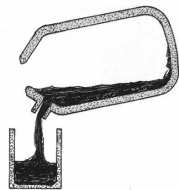
5 Marks

Any suitable description @ 3 marks

## Question Four

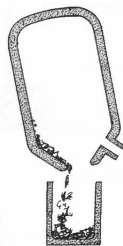
20 Marks

- (a) The Basic Oxygen furnace is shown. 1 mark **1 Mark**
- (b) The charge is made up of molten iron, mill scale, scrap metal and lime. 3 marks **3 Marks**
- (c) The charge is placed in the furnace. The lance is lowered and oxygen is blown onto the surface of the charge. When the temperature and composition are correct, the lance is withdrawn, the furnace is tilted and the molten steel is poured into a ladle. The furnace is then tilted in the opposite direction to empty the slag 2 marks **2 Marks**
- (d) Water runs down the outside of the lance to prevent it from melting. 1 mark **1 Mark**
- (e) The Refractory Lining is a heat resistant material, which insulates the furnace from heat loss. 2 marks **2 Marks**
- (f) (i) The furnace is tilted to remove the steel.



Description 1 mark, Diagram 1 mark

- (ii) The furnace is turned upside down to remove the slag.



Description 1 mark, Diagram 1 mark

(g)

Composition	Alloy	Property
Copper + Zinc	Brass	Good resistance to corrosion
Iron + Carbon	Steel	Good malleability when heated
Lead + Tin	Solder	Good conductor

*Redraw @ 1 mark*  
*Correct **three** alloys @ 1 mark each*  
*Any **three** suitable properties @ 1 mark each*

**7 Marks**

## Question Five

20 Marks

- (a) (i) The Windscreen is made from glass; *1 mark*  
The Metal body is made from aluminium; *1 mark*  
The Tracks are made from medium carbon steel. *1 mark*

- (ii) Glass is suitable for the Windscreen as it is transparent; *1 mark*  
Aluminium is suitable for the body as it will not rust; *1 mark*  
Medium Carbon Steel is suitable for the tracks as it has greater strength than mild steel and is more wear-resistant. *1 mark*

- (iii) Safety features include-
- Warning sirens;
  - Emergency brake for passengers
  - Warning lights
  - Level crossing.
- Any two safety precaution @ 1 mark each*

- (iv) Linear, circular and reciprocating motion may take place at wheel mechanism.  
*Any two types of motion @ 1 mark each*

- (v) Environmental factors may include -
- Trains emit less CO<sub>2</sub> than other forms of transport;
  - Reduces the numbers of people in cars therefore reduce the amount of CO<sub>2</sub> produced.
- Any two environmental effects @ 1 mark each*

12 Marks

- (b) (i) A Chain and Sprocket drive mechanism is shown. *2 marks*

- (ii) This type of drive mechanism may be used on a bicycle, motorcycles, farm machinery or timing chains.  
*Any suitable application @ 2 marks*

- (iii) The gear ratio is 4:1. *2 marks*

- (iv) The driven sprocket turns @ 100 RPM. *2 marks*

8 Marks

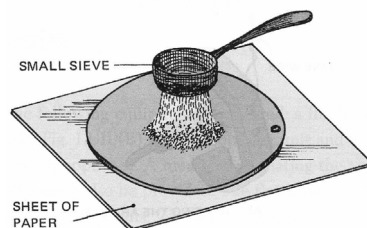
## Question Six

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.

3 marks

- (ii) 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.



Description @ 2 marks

Diagram @ 2 marks

- (iii) Engraving - allows designs to be cut into metal surfaces with sharp tools.  
Lacquering - involves the coating of a metal surface with a clear or tinted liquid to preserve its surface finish.  
Mottling - uses a wooden dowel and carborundum paste to produce a polished circular finish on the metal surface.

10 Marks

Any **One** @ 3 marks

- (b) (i) Examples of heat treatment processes include Hardening, Tempering, Annealing and Normalising.

Name any **two** heat treatments @ 1 mark each

- (ii) Example – Annealing.

Annealing is carried-out to make a material as soft as possible by heating it to a cherry red and allowing it to cool slowly.

Description of **One** named process @ 4 marks

- (iii) Heat treatments may be carried-out for the following reasons -

- To alter the properties of a material
- To allow a material be used for a particular application.

Any **two** suitable reasons @ 1 mark each

- (iv) Protective clothing should be worn.  
When lighting a gas torch point it away from you.

Any **two** suitable safety precautions @ 1 mark each

10 Marks



## Question Seven

20 Marks

- (a) (i) The Lathe shown is a CNC lathe

1 mark

- (ii) **Test run** – this is a simulation on the monitor before the program can be run on the CNC lathe.

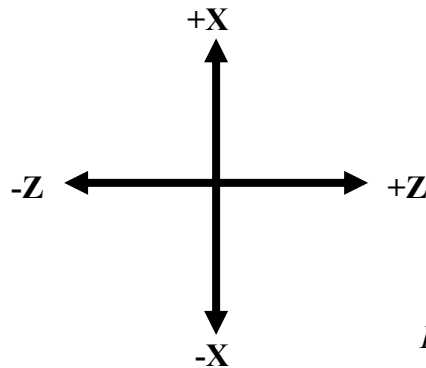
**G-Codes** – these codes control the tool movement.

**Tool offsets** – when machining with a variety of tools the position of the tips may vary. A tool offset takes this into account when machining

**Tool park position** – this is the co-ordinates given to the tool at the start and end of machining.

Any **two** @ 2 mark each

- (iii)



Label **each** axes @ 1 mark each

- (iv) The CNC lathe is more accurate.  
The CNC lathe is faster

Any **two** advantages @ 1 mark each

- (v) Safety features of the CNC lathe include-

- An emergency stop
- The clear acrylic guard
- Contact cut out switches when the guard is lifted.

14 Marks

Any **three** suitable safety features @ 1 mark each

- (b) (i) A Compact disk.  
A Memory stick.

1 mark

1 mark

- (ii) CAD/CAM stands for Computer-Aided-Design and Computer-Aided-Manufacture. It enables a part to be designed on screen using a mouse and then the computer writes a manufacturing program.

2 marks

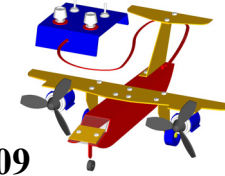
- (iii) CAD/CAM tends to be faster and more accurate.

Any **two** suitable advantages @ 1 mark each

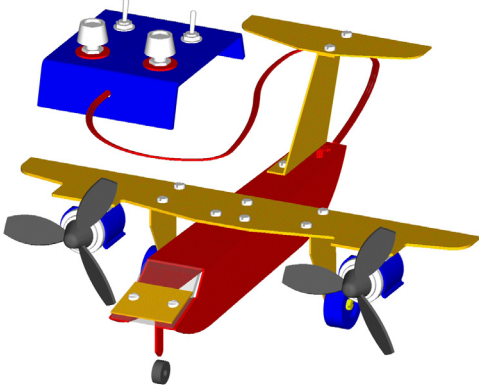
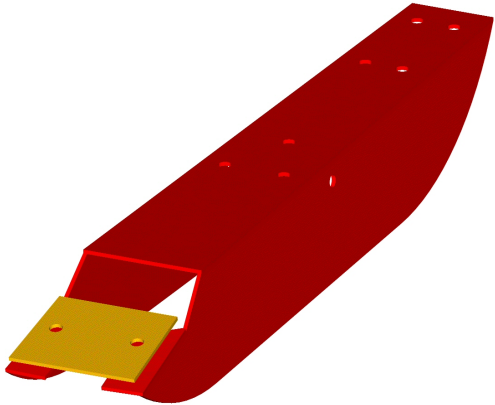
6 Marks



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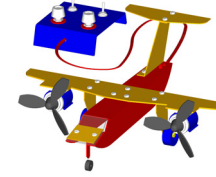


**Junior Certificate Higher Level Metalwork Project, Marking Scheme 2009**

Subjective Grading: 1-10		9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor			
Subjective Grading: 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)		Assembly			Subjective Grade 1-5	5	20	
			Finish			Subjective Grade 1-5	5		
			Mechanical Function			Subjective Grade 1-5	5		
			Electrical Function			Subjective Grade 1-5	5		
2	Design	Design Make & Attach a Castored Nose-wheel and a Battery Holder for the model. These should be integrated as a unit. The integrated unit when secured within the fuselage should ensure that the model is in a horizontal position.	Design			Subjective Grade 1-10	10	20	
			Make			Subjective Grade 1-5	5		
			Attach			Subjective Grade 1-5	5		
3	Parts 4 & 9		Fuselage		18	Marking Out	5	20	
						Drill	3		
						Bend	4		
						Shape	6		
			Noseplate		2	Marking Out			2
		Drill & Shape							



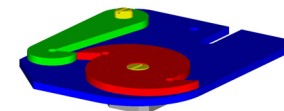
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Junior Certificate Higher Level Metalwork Project, Marking Scheme 2009

4	Parts 2, 3, 8 & 10		Fin	6	Marking Out	1	20
					Drill & Bend	3	
					Shape	2	
			Wing	8	Marking Out	3	
					Drill & Shape	5	
			Windscreen	3	Marking Out	1	
					Drill, Bend & Shape	2	
			Tailplane	3	Marking Out	1	
					Drill & Shape	2	
			5	Parts 1, 5, 6 & 7		Control Panel	
Drill & Bend	4						
Shape	1						
Right Undercarriage	5	Marking Out				1	
		Drill & Bend				2	
		Shape				2	
Left Undercarriage	5	Marking Out				1	
		Drill & Bend				2	
		Shape				2	
Wheel ×2	4	Turn, Drill & Recess				4	

100 Marks (× 1.5 = 150 Total)



Junior Certificate Higher Level Metalwork Practical, Marking Scheme 2009

Subjective Grading 1-10		9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor	
Subjective Grading 1-5		5 Excellent	4 Very Good	3 Good	2 Poor	1 Very Poor	
Section	Part Number	Pictorial Sketch / Description	Concept			Mark	Mark
1	Parts 1, 2, 3 & 4		Complete Piece	Assembly Grade 1 - 5	5	20	
				Finish Grade 1 - 5	5		
				Function Grade 1 - 10	10		
2	Part 1		Backplate	Marking Out	4	20	
				Length	1		
				Width	1		
				45° Angle	1		
				Radii 10mm & 30mm	5		
				Tapped Hole	2		
				6mm Slot	4		
Ø4mm & Ø10.5mm holes	2						
3	Part 2		Pawl	Marking Out	4	20	
				Length 50mm	3		
				Radii 10mm	4		
				Tangents	4		
				Holes	2		
				60° Angle	3		
4	Part 3		Ratchet	Marking Out	4	20	
				Radii 25mm	6		
				Ø5.5mm CSK	2		
				60° Angles	6		
				Clearance Holes	2		
5	Part 4		Knob	Marking Out	5	20	
				Lengths 3.5, 10 & 4mm	3		
				20mm Square	4		
				Chamfer ×4	4		
				Ø15mm & Ø10mm	2		
				M5 Tapped Hole	2		

100 Marks (× 1.5 = 150 Total)