



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2014

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.

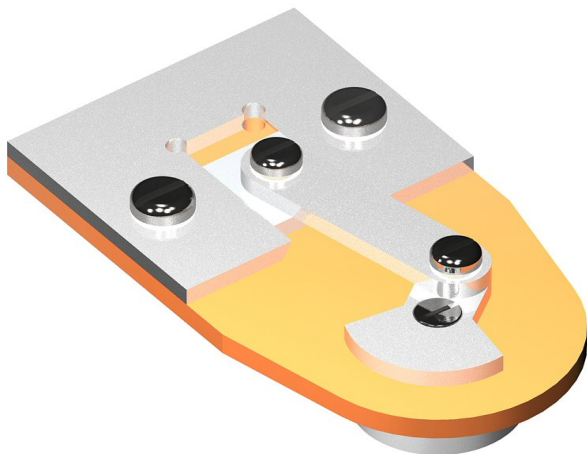
JUNIOR CERTIFICATE EXAMINATION, 2014

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 engine A @ 2 marks (ii) Purpose @ 2 marks 4 MARKS</p> <p>(b) (i) Name engine B @ 2 marks (ii) Purpose @ 2 marks 4 MARKS</p> <p>(c) (i) Compare @ 2 marks (ii) Explain @ 2 marks 4 MARKS</p> <p>(d) (i) Two applications @ 1 mark each (ii) One effect @ 2 marks 4 MARKS</p> <p>(e) Any one @ 4 marks 4 MARKS</p> <p>(f) (i) Name @ 2 marks (ii) One property @ 2 marks 4 MARKS</p> <p>(g) (i) Both components @ 1 + 1 mark (ii) Function @ 2 marks 4 MARKS</p>	<p>Question 1 – Section B (5 parts only)</p> <p>(a) (i) Outline @ 2 marks (ii) Description @ 2 marks 4 MARKS</p> <p>(b) (i) Description @ 2 marks (ii) Description @ 2 marks 4 MARKS</p> <p>(c) (i) Explain @ 2 marks (ii) Advantage @ 2 marks 4 MARKS</p> <p>(d) (i) Soldering procedure @ 2 marks (ii) Two safety precautions @ 1 + 1 mark 4 MARKS</p> <p>(e) Diagram @ 2 marks Console design @ 2 marks 4 MARKS</p> <p>(f) Two advantages @ 1 + 1 mark Two applications @ 1 + 1 mark 4 MARKS</p>
<p>Question 2</p> <p>(a) (i) Name @ 1 mark Description @ 3 marks (ii) Three tests @ 1 mark each 7 MARKS</p> <p>(b) (i) Modification @ 3 marks, Diagram @ 2 marks (ii) Slot @ 1 mark, Attach @ 1 mark, Decorative @ 1 mark, Diagram @ 3 marks (iii) Metal @ 1 mark, Finish @ 1 mark 13 MARKS</p>	<p>Question 3</p> <p>(a) (i) Name 3 operations @ 1 mark each (ii) Describe two @ 1 + 1 mark (iii) Two safety precautions @ 1 + 1 mark (iv) Two factors @ 2 + 1 marks 10 MARKS</p> <p>(b) Calculation @ 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) Three elements @ 1 mark each (iii) Description @ 3 mark (iv) Function @ 3 mark 10 MARKS</p> <p>(b) (i) Two properties @ 2 + 2 marks (ii) Identify alloy steels @ 1 + 1 mark 6 MARKS</p> <p>(c) (i) Two properties @ 1 + 1 mark (ii) One product @ 2 marks 4 MARKS</p>	<p>Question 5</p> <p>(a) (i) Design features @ 3 marks (ii) Propulsion @ 2 marks (iii) Safety features @ 3 marks (iv) Environmental impact @ 2 marks 10 MARKS</p> <p>(b) (i) Motion A & B @ 1 + 1 mark (ii) Example A & B @ 2 + 2 marks (iii) Identify @ 2 marks (iv) Two uses @ 1 + 1 mark 10 MARKS</p>
<p>Question 6</p> <p>(a) (i) Two reasons @ 2 + 2 marks (ii) Explanation @ 2 marks Diagram @ 2 marks (iii) Description @ 2 marks 10 MARKS</p> <p>(b) (i) Two reasons @ 2 + 2 marks (ii) Two heat treatments @ 1 + 1 mark (iii) Two reasons @ 1 + 1 mark (iv) Two safety precautions @ 1 + 1 mark 10 MARKS</p>	<p>Question 7</p> <p>(a) (i) Four purposes @ 1 mark each (ii) Four classifications @ 1 mark each (iii) Reason @ 1 mark, Method @ 1 mark (iv) Any two @ 1 + 1 mark (v) Explain @ 2 marks 14 MARKS</p> <p>(b) (i) Instrument A @ 1 mark Instrument B @ 1 mark (ii) One applications @ 2 marks (iii) Reading @ 2 marks 6 MARKS</p>

Question 1, Section A – Compulsory

20 marks

Five parts *only* to be counted

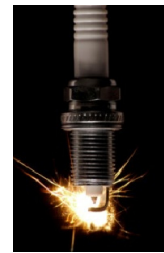
- (a) (i) Engine A is a four-stroke engine. 2 marks
(ii) The Connecting Rod (Con Rod) connects the piston and the crankshaft. The reciprocating motion of the piston is converted to rotary motion of the crankshaft. *Explain the purpose @ 2 marks*

4 marks

- (b) (i) Engine B is a two-stroke engine. 2 marks
(ii) The fins increase the external surface area of the engine which is in contact with air. This helps to cool the engine. *Describe the purpose @ 2 marks*

4 marks

- (c) (i) In the four-stroke engine the fuel/air mixture enters the cylinder when the inlet valve opens as the piston moves on the downward stroke. In the two-stroke engine the fuel/air mixture enters via the inlet port as the piston moves on the upward stroke. *Any suitable comparison @ 2 marks*
(ii) The fuel/air mixture is ignited by a spark from the spark plug when compressed in both the two-stroke and four-stroke engines. *Any suitable explanation @ 2 marks*

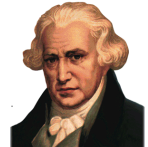


4 marks

- (d) (i) Engine A (four-stroke) is typically used in the modern motor car. 1 mark
Engine B (two-stroke) is typically used in motorbikes. 1 mark
(ii) Engines produce exhaust fumes which can lead to the creation of acid rain and pollution. *Any one environmental effect @ 2 marks*

4 marks

- (e) (i) Sir Timothy Berners-Lee is credited with the invention of the world wide web in 1989
(ii) Guglielmo Marconi invented the wireless in 1895
(iii) James Watt developed a steam engine (with separate condenser) in 1769 *Any one @ 4 marks*

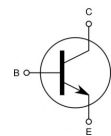


4 marks

- (f) (i) The disposable cup may be made from expanded polystyrene. *Any suitable plastic material @ 2 marks*
(ii) Polystyrene is suitable as it is a good insulator. This is important as the cup may hold hot drinks. *Any suitable property @ 2 marks*

4 marks

- (g) (i) C is a transistor. 1 mark
D is a variable resistor. 1 mark
(ii) The *transistor* is used as high speed switch and as current, voltage and power amplifiers. The resistance between the centre and end terminals of a *variable resistor* can be changed by turning the spindle. In a simple circuit the variable resistor may be used to dim the light output from a bulb. *Any one function @ 2 marks*



4 marks

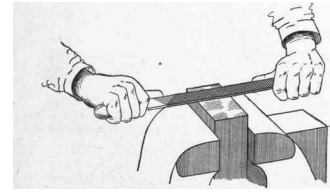
Question 1, Section B – Compulsory

20 marks

Five parts only to be counted

- (a) (i) 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.

Description @ 2 marks



- (ii) The 90° and 70° bends on the front motor support are completed by holding the work in a folding bar and striking the work with a mallet. Alternatively the support can be bent to shape using a folding machine. The finished angles are checked with an engineers protractor.

Description @ 2 marks



4 marks

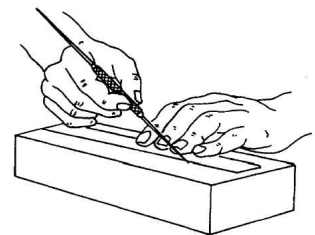
- (b) (i) The Ø8 mm holes are drilled as follows –
- The holes are firstly marked-out and punched according to the dimensions
 - The work is secured in the drill vice
 - A pilot hole (5mm) is drilled at each punch mark
 - The holes are finished by drilling with an 8mm drill.

Description @ 2 marks



- (ii) The front window is marked-out as follows –
- The top holes are marked 10mm down, 7mm in from the front left for the first hole and a further 6mm for the second hole
 - The bottom holes are 12mm below the top holes and are in 7mm for the first and a further 12mm for the second hole
 - The marking-out of the shape is finished by drawing lines to each of the drilled holes.

Description @ 2 marks



4 marks

- (c) (i) The electric circuit is wired to operate the two motors. The circuit has a battery connected and when the switch is engaged the motors will spin. An LED is connected to indicate when the motors are powered. The circuit has a variable resistor connected which enables the speed of the motors to be varied.

Explanation @ 2 marks

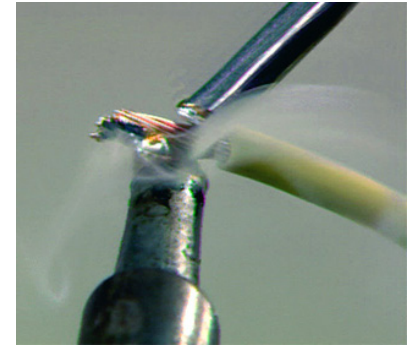


- (ii) The use of ribbon cable to connect the model and the control console ensures that the multiple wires required are connected neatly and tidily.

Any suitable advantage @ 2 marks

4 marks

- (d) (i) The components of the electrical circuit may be soldered as follows –
- Flux is applied to the ends of the components and the ends of the wires used to connect the components
 - A thin coating of solder is applied to each part to be joined
 - The components are brought together and heat from the soldering iron is applied causing the thin coatings of solder to fuse thus joining the components.



Suitable procedure @ 2 marks

- (ii) Safety precautions to be observed when soldering the circuit include –

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

Any two safety precautions @ 1 mark each

4 marks

(e)



Diagram @ 2 marks

Design of hand-held console @ 2 marks

4 marks

- (f) (i) Advantages of a Chinook Helicopter include –

- Increased lift ensuring a greater capacity to carry a load
- Improved control and manoeuvrability.

Any two advantages @ 1 mark each



- (ii) A Chinook Helicopter may be used for the following applications –

- Search and rescue
- Movement of cargo, supplies and aid
- Movement of troops and personnel.

Any two suitable applications @ 1 mark each



4 marks

Question 2 **20 marks**

(a) (i) Stage one is the analysis of the brief.

Name of stage @ 1 mark

This stage of the design process involves reading the brief and clearly understanding the requirements of the task as outlined in the brief.

Any description @ 3 marks

(ii) Tests which could be applied to the vacuum cleaner include -

- testing suction
- testing electrical circuits
- testing mobility
- testing retraction of the electrical cord.

Any three tests @ 1 mark each

7 marks

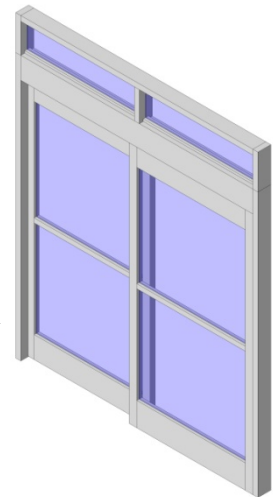
(b) (i) The door could be modified by replacing the double panels with a single panel as shown. Alternatively the door could be replaced by an automatic mechanism, as shown, which would allow the door to open when a person approaches.



Single Panel External Door

Or

Automatic External Door



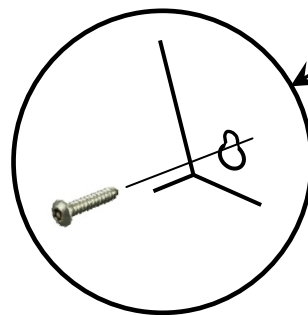
Suitable modification @ 3 marks
Suitable diagram @ 2 marks

(ii) A possible design solution is shown.



Slot for post

Decorative feature



The post box may be attached to the wall with screws. The back wall of the post box may have pre shaped holes as shown

Design of slot @ 1 mark
Any suitable means of attachment @ 1 mark
Any suitable decorative feature @ 1 mark
Diagram of structure @ 3 marks

(iii) The post box could be made from steel.

Any suitable metal @ 1 mark

Paint would be a suitable finish for a steel post box.

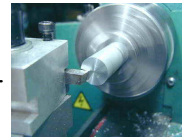
Any suitable finish @ 1 mark

13 marks

Question 3 **20 marks**

- (a) (i) Operation A is facing (surfacing) *1 mark*
 Operation B is knurling *1 mark*
 Operation C is taper turning *1 mark*

- (ii) **Facing** – the tool moves at right angles to the axis of the work producing a flat surface.
Knurling - the work is rotated slowly. A pair of serrated wheels are pressed against the work to create a grip on the surface of the work.



- Taper turning**- for short tapers the top slide is set to half the included angle of the taper. The tool is then fed by hand using the top slide feed handle to generate the taper. *Any two descriptions @ 1 mark each*



- (iii) Safety precautions to be observed include -
- tie back loose clothing
 - tie back long hair
 - wear eye protection
 - ensure that the work piece is secured properly
- Any two precautions @ 1 mark each*



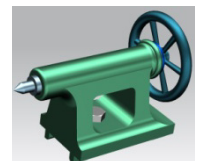
- (iv) Factors which may impact on finish include -
- cutting speed
 - type of material
 - condition of the tool bit
 - use of coolant
- Any two factors @ 2 marks + 1 mark*

10 marks

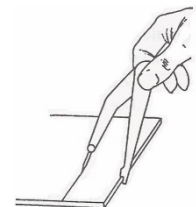
- (b) The speed is 2500 RPM
- Correct substitution @ 2 marks*
Correct calculation @ 2 marks

4 marks

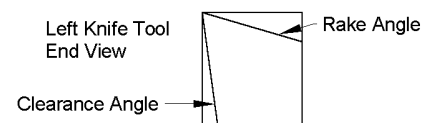
- (c) (i) The **headstock** houses the spindle and contains the gears to provide a range of spindle speeds. The **tailstock** can be moved along the bed of the lathe. It may be used to support long work or for drilling.



- (ii) An **outside callipers** is used for measuring diameters of work and comparing dimensions. An **odd-leg callipers** is used for scribing parallel lines or for scribing lines on a round bar on the lathe.



- (iii) A **rake angle** facilitates the removal of the chip during the cutting operation. A **clearance angle** ensures that only the cutting edge of the tool comes into contact with the work. *Any two parts @ 2 marks +1 mark*



6 marks

Question 4

20 marks

(a) (i) The furnace shown 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 charge is melted 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.

Description of melting the charge @ 3 marks



(iv) Part B shows the rollers. The rollers allow the furnace to tilt to pour or tap-off the molten steel.

Function of part B @ 3 marks

10 marks

(b) (i) Properties which could be improved by alloying include-

- hardness
- toughness
- corrosion resistance

Any two properties @ 2 marks each

(ii) Object C - a set of cutlery - is made from stainless steel. *1 mark*

Object D – a set of taps – is made from high speed steel. *1 mark*

1 mark

1 mark

6 marks

(c) (i) Properties of cast iron include –

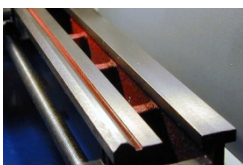
- good wear resistance
- brittleness
- fluidity – easy to cast

Any two properties @ 1 mark each

(ii) Cast iron is used to make the lathe bed, vice bodies, manhole covers and fire grates.

Any one suitable product @ 2 marks

4 marks



Question 5

20 marks

- (a) (i) The design features featured in a modern train, but not in a vintage train, include –
- better aerodynamics
 - more comfortable seating
 - automatic doors
 - access to Wifi

3 marks



- (ii) The vintage train used steam power to generate the energy for propulsion. Modern trains tend to be powered by diesel engines or may be electrically powered.

2 marks

- (iii) The safety features featured in a modern train, compared to a vintage train, include –
- no coal fire
 - better breaking system
 - equipment to break the windscreen
 - better warning signals.

3 marks



- (iv) The vintage train tended to burn large amounts of coal resulting in vast amounts of exhaust fumes. Many modern trains use electrical power which may be produced by means of renewal energy sources.

2 marks

10 marks

- (b) (i) Motion **A** is rotary motion

1 mark

Motion **B** is oscillating motion

1 mark



- (ii) Rotary motion occurs at the lathe chuck, drill chuck and car wheels
Any one example @ 2 marks

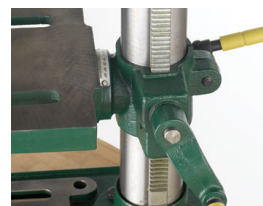
Oscillating motion occurs on a child's swing
Any one example @ 2 marks

- (iii) A rack and pinion mechanism is shown

2 marks

- (iv) A rack and pinion mechanism is found on a centre lathe and a drilling machine.
Any two uses @ 1 mark each

10 marks



Question 6

20 marks

- (a) (i) Reasons for applying decorative finishes to metals include –

- Improving the appearance of the metal
- Protecting the surface of the metal
- Adding value to the metal article

Any two reasons @ 2 marks each

- (ii) The handle of the pliers may be plastic coated with the aid of a fluidising unit. The pliers is attached to a piece of wire. The handles are heated to about 180°C. The heated handles are then dipped into the plastic powder which is acting as a fluid due to the air passing into the unit. The plastic particles stick to the handles giving them an even surface. The pliers is allowed hang while it cools.

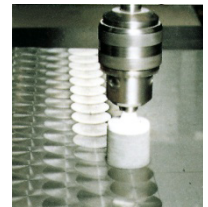
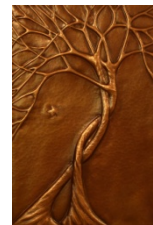
Explanation @ 2 marks

Diagram @ 2 marks



- (iii) **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.

Mottling – is the creation of overlapping polished circles on the surface of a metal. A dowel with one end coated in carbrundum paste is used to create the 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 the attractive appearance.



Engraving - allows designs to be cut into a metal surface with sharp tools. *Any one description @ 2 marks*

10 marks

- (b) (i) Heat treatment is carried-out on metal in some cases to increase its hardness. Brittleness in metal can also be reduced by heat treatment.

Any two reasons @ 2 marks each

- (ii) The scribe may be hardened or tempered *1 mark*
The copper bowl should be annealed *1 mark*

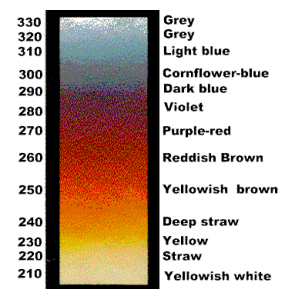
- (iii) Tempering the scribe removes brittleness making it tough and able to hold a sharp point. *1 mark*
Annealing the copper bowl removes internal stresses making it soft and easier to shape. *1 mark*

- (iv) Safety precautions to be observed when heat treating metals include –

- Being aware of steam rising from metals cooled in water
- Never pick up a piece of metal without being sure it is cold



10 marks



Question 7 **20 marks**

- (a) (i) Printer – used to make a hard copy of data 1 mark
- Scanner – used to input documents into a computer 1 mark
- CNC lathe – a lathe controlled by a computer program and used to accurately manufacture components 1 mark
- Mouse – used to move a pointer or cursor on the computer screen and select items or initiate actions 1 mark

- (ii) Printer - output 1 mark
 Scanner - input 1 mark
 CNC lathe - output 1 mark
 Mouse - input 1 mark



- (iii) Computer files should be backed up in case of loss of data due to a computer crash, loss of power, damage to the computer or the damage due to a computer virus. 1 mark

A computer file may be backed up as follows –

- to the network server
- to a memory stick
- to a portable hard drive
- to the cloud



Any one method @ 1 mark

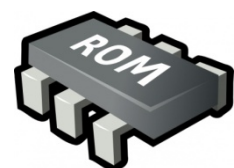
- (iv) **Modem** – A modem (modulator-demodulator) is a device that modulates an analog carrier signal to encode digital information and demodulates the signal to decode the transmitted information. A modem is used by computers to access the internet.



Webcam – is a video camera that feeds or streams its image in real time to or through a computer to computer network.



ROM – stands for Read-Only Memory and is a class of storage medium used in computers and other electronic devices. ROM is memory that can be read but not changed because it is fixed in the hardware.

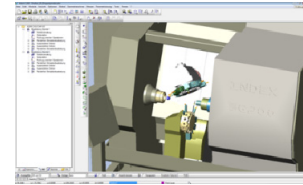


Virus – often perform some type of harmful activity on computers, such as stealing hard disk space or CPU time, accessing private information, corrupting data, displaying political or humorous messages on the user's screen, spamming their contacts, or logging their keystrokes.



Any two @ 1 mark each

- (v) CAD/CAM stands for Computer-Aided-Design and Computer-Aided-Manufacture. The use of CAD/CAM software allows for a component to be designed by computer and then manufactured based on the computer design.



2 marks

14 marks

- (b) (i) Instrument **A** is a Vernier Callipers *1 mark*
Instrument **B** is a Screw Pitch Gauge *1 mark*
(ii) A vernier callipers may be used to measure the diameter of material.

A screw pitch gauge is used to check the pitch and form of screw threads on nuts and bolts.

Any one application for A or B @ 2 marks


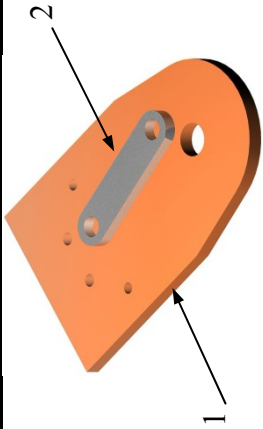
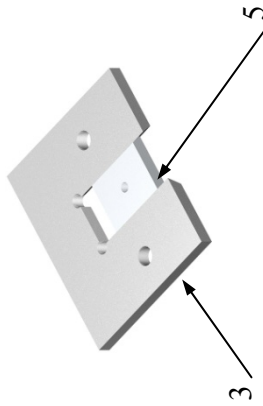
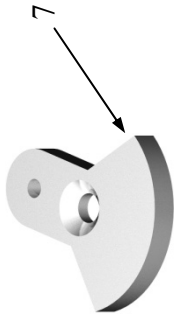
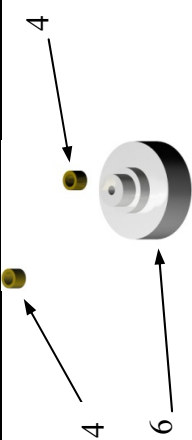
- (iii) 12.66 *2 marks*

6 marks



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Metalwork - Higher Level Practical Examination - Marking Scheme 2014

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	Assembly: Subjective Marking 1 - 5	Finish: Subjective Marking 1 - 5	Function: Subjective Marking 1 - 10	Mark	Marks			
1	Parts 1, 2, 3, 4, 5, 6 & 7					Complete Piece	Assembly: Subjective Marking 1 - 5	Finish: Subjective Marking 1 - 5	Function: Subjective Marking 1 - 10	5	20			
2	Parts 1 & 2					Part 1 Backplate Part 2 Conrod	15	5	2	8	5	1	4	20
3	Parts 3 & 5					Part 3 Cylinder Part 5 Piston	15	5	2	8	5	1	2	20
4	Part 7					Part 7 Crank	20		3	13	4	20		
5	Parts 4 & 6					Part 4 Bearing Part 6 Knob	6	14	6	2	10	2	20	

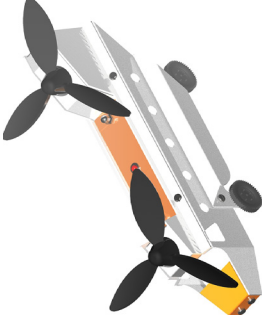
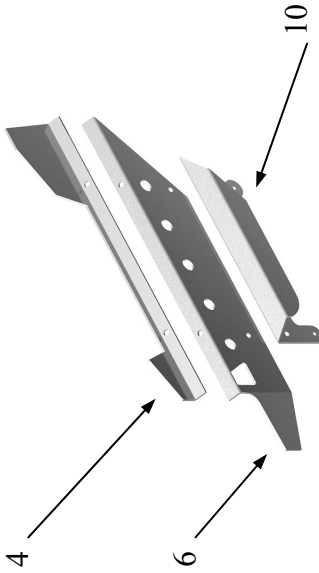
100 Marks (× 1.5 = 150 Total)

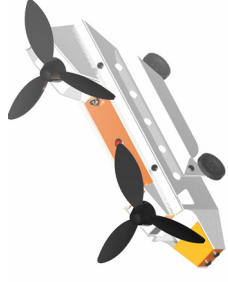


Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Metalwork - Higher Level Project - Marking Scheme 2014



		9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor			
		5 Excellent	4 Very Good	3 Good	2 Poor	1 Very Poor			
Section	Part Number	Pictorial Sketch/Description					Concept	Mark	Marks
1	Complete Model (Design Element not included)	 <p>Assembly Finish Function</p>					Assembly: Subjective Grade 1-5	5	20
							Finish: Subjective Grade 1-5	5	
							Electrical Function: Subjective Grade 1-5	5	
							Mechanical Function: Subjective Grade 1-5	5	
2	Design	<p>Design and make:</p> <p>(i) a Hand-held Control Console to operate the model. This Control Console must be attached to the model using Ribbon Cable and must include a 9 Volt battery with holder, an On / Off Switch and a Potentiometer.</p> <p>(ii) two Replica Engines for the model and attach to the rear of the Upper Panels (Parts 4 and 5).</p> <p>(Note: 20% of the marks will be awarded for this section).</p>					Control Console: Subjective Grade	10	20
							Design: 1 – 5 Make: 3 Attach: 2		
3	Parts 4, 6 & 10						Part 4 Upper Left Panel	4	20
							Part 6 Lower Left Panel	8	
							Part 10 Left Undercarriage Support	8	



4	Parts 5, 7 & 11		<p>Part 5 Upper Right Panel</p> <p>Part 7 Lower Right Panel</p> <p>Part 11 Right Undercarriage Support</p>	<p>Mark Out, Drill, Shape & Bend</p> <p>Mark Out, Drill, Shape & Bend</p> <p>Mark Out, Drill, Shape & Bend</p>	<p>4</p> <p>8</p> <p>8</p> <p>20</p>
5	Parts 1, 2, 3, 8 & 9		<p>Part 2 Front Motor Support</p> <p>Part 3 Rear Motor Support</p> <p>Part 1 Centre Support Plate</p> <p>Part 8 Nose Plate</p> <p>Part 9 Chassis</p>	<p>Mark Out, Drill, Shape & Bend</p> <p>Mark Out, Drill, Shape & Bend</p> <p>Mark Out, Drill & Shape</p> <p>Mark Out, Drill, Shape & Bend</p> <p>Mark Out, Drill, Shape & Bend</p>	<p>4</p> <p>5</p> <p>2</p> <p>3</p> <p>6</p> <p>20</p>