



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2015

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.

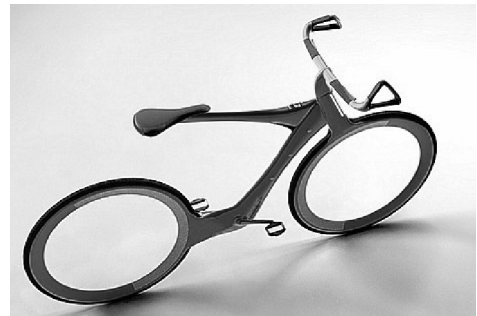
JUNIOR CERTIFICATE EXAMINATION, 2015

**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) Material @ 2 marks 4 MARKS</p> <p>(b) (i) Name part B @ 2 marks (ii) Purpose @ 2 marks 4 MARKS</p> <p>(c) (i) Description @ 2 marks (ii) Explain @ 2 marks 4 MARKS</p> <p>(d) (i) Any two @ 1 mark each (ii) Any one @ 2 marks 4 MARKS</p> <p>(e) Any one @ 4 marks 4 MARKS</p> <p>(f) (i) One process @ 2 marks (ii) Description @ 2 marks 4 MARKS</p> <p>(g) (i) Each component @ 1 + 1 mark (ii) Symbol @ 2 marks 4 MARKS</p>	<p>Question 1 – Section B (5 parts only)</p> <p>(a) (i) Description @ 2 marks (ii) Explain @ 2 marks 4 MARKS</p> <p>(b) (i) Outline @ 2 marks (ii) Description @ 2 marks 4 MARKS</p> <p>(c) (i) One advantage @ 2 marks (ii) One alternative @ 2 marks 4 MARKS</p> <p>(d) (i) Explain @ 2 marks (ii) Illustrate @ 2 marks 4 MARKS</p> <p>(e) (i) Describe / Diagram @ 2 marks (ii) Describe @ 2 marks 4 MARKS</p> <p>(f) Diagram @ 2 marks Design @ 2 marks 4 MARKS</p>
<p>Question 2</p> <p>(a) (i) Name @ 1 mark Two pieces @ 2 + 1 mark (ii) Three factors @ 1 mark each 7 MARKS</p> <p>(b) (i) Design @ 1 + 1 + 1 + 1 mark, Diagram @ 3 marks (ii) Metal @ 1 mark, Finish @ 1 mark (iii) Alternative design @ 2 mark Diagram @ 2 marks 13 MARKS</p>	<p>Question 3</p> <p>(a) (i) Name four parts @ 1 mark each (ii) Description @ 2 marks (iii) Outline one method @ 2 marks (iv) Explain @ 2 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) Name two @ 1 + 1 mark Two applications @ 1 + 1 mark (ii) Two reasons @ 1 + 1 mark 6 MARKS</p> <p>(c) (i) Name two @ 1 + 1 mark (ii) Description @ 2 marks 4 MARKS</p>	<p>Question 5</p> <p>(a) (i) Comparison @ 2 marks (ii) Two features @ 2 + 1 marks (iii) Two safety features @ 2 + 1 marks (iv) Two advantages @ 1 mark each 10 MARKS</p> <p>(b) (i) Identify @ 1 mark (ii) Two applications @ 2 marks each (iii) Risk @ 2 marks, feature @ 2 marks (iv) One method @ 1 mark 10 MARKS</p>
<p>Question 6</p> <p>(a) (i) Name each @ 1 + 1 + 1 mark (ii) State each @ 1 + 1 + 1 mark (iii) Purpose @ 1 mark (iv) Function @ 1 mark (v) Two safety precautions @ 1 mark each 10 MARKS</p> <p>(b) (i) Two properties @ 2 marks each (ii) Outline @ 2 marks (iii) Describe @ 1 mark, Diagram @ 1 mark (iv) Explain @ 2 marks 10 MARKS</p>	<p>Question 7</p> <p>(a) (i) Identify @ 1 mark (ii) Two advantages @ 1 mark each (iii) Select @ 1 mark, one reason @ 2 mark (iv) State @ 1 mark, one advantage @ 1 mark (v) One problem @ 2 marks 10 MARKS</p> <p>(b) (i) Label four @ 1 mark each (ii) Illustrate @ 2 marks (iii) Any two explanations @ 2 marks each 10 MARKS</p>

Question 1, Section A – Compulsory

20 marks

Five parts *only* to be counted

- (a) (i) Part **A** is a piston. *Name @ 2 marks*
(ii) Aluminium or Aluminium Alloy is typically used to make a piston. *Suitable material @ 2 marks*

4 marks

- (b) (i) Part **B** is a camshaft. *Name @ 2 marks*
(ii) The camshaft has cams machined onto it. The cams operate as the shaft rotates and force the valves to open as required. *Describe the purpose @ 2 marks*




4 marks

- (c) (i) The power stroke follows the compression stroke. The fuel / air mixture is ignited by a spark from the spark plug, creating a large force on the surface of the piston. This force causes the piston to move downward. The valves remain closed during the power stroke. *Description @ 2 marks*
(ii) The piston rings provide a gas seal between the piston and the cylinder. These piston rings also prevent lubricating oil from passing into the combustion chamber. *Explanation @ 2 marks*

4 marks

- (d) (i) Engines can produce a number of types of pollution including atmospheric, soil and river as well as noise pollution. *Any two @ 1 mark each*
(ii) Engines are now fitted with catalytic converters to reduce the toxic effects of exhaust gasses. *Any one development @ 2 marks*

4 marks

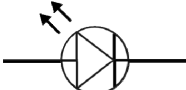
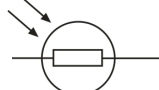
- (e) (i) Jack Dorsey is credited with the invention of twitter.  
(ii) Henry Ford invented the 'Model T' motor car and the first assembly line for mass production. 
(iii) John Dunlop invented the pneumatic tyre. *Any one @ 4 marks*

4 marks

- (f) (i) The trophy may be inscribed by the process of engraving. *Any suitable process @ 2 marks*
(ii) *Enamelling* - is carried out by fusing powdered glass to a metal surface, by firing, usually between 750 and 850 °C (1,380 and 1,560 °F). The powder then melts, flows, and hardens to a smooth, durable vitreous coating on metal. This process also be carried out on glass or ceramics. *Any suitable description @ 2 marks*

4 marks

- (g) (i) **C** is a Light Emitting Diode (LED). *1 mark*
D is a Light Dependent Resistor (LDR). *1 mark*

- (ii)  **OR**  *Any one symbol @ 2 marks*
LED Symbol **LDR Symbol**

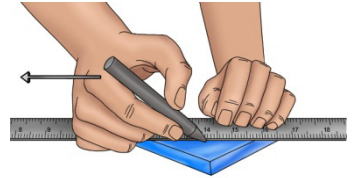
4 marks

Question 1, Section B – Compulsory

20 marks

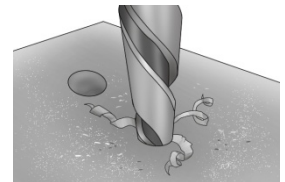
Five parts only to be counted

- (a) (i) The windscreen is marked out as follows:
- mark 55mm from the left hand side and also mark a horizontal centre line
 - measure 40mm above and below the centre line on the left side and 30mm above and below the centre line on the right hand side. Join these points
 - mark up 16mm above the left centre line and measure in 5mm for the slot hole
 - The window is shaped by marking the holes, measure 11mm and then 10mm in from the from right and then marking 11mm parallel to the top edge and bottom edge to locate the four holes. These positions are then dot punched.



Description @ 2 marks

- (ii) The window is shaped as follows:
- the holes are marked 11mm and then 10mm in from the from right and then marking 11mm parallel to the top edge and bottom edge to locate the four holes. These positions are then dot punched
 - The 4 holes are drilled with a diameter 6mm bit
 - The marking-out of the shape is finished by drawing lines to each of the drilled holes
 - The shape is then cut from hole to hole
 - The shape is finished by rough and smooth filing remembering to protect the hole from damage while filing.



4 marks

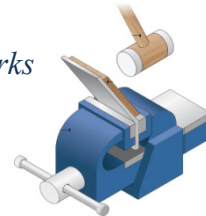
Description @ 2 marks

- (b) (i) A good quality finish is achieved on the edge profile of the right mudguard 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 45° bends on the right mudguard 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 engineer's protractor.



4 marks

Description @ 2 marks

- (c) (i) The advantage of the perpendicular motor and gearbox is that it is compact and it increases the torque generated by the motor.

Any one advantage @ 2 marks

(ii) Alternative drive mechanisms that could be used to drive the model may include:

- belt and pulley drive
- chain and sprocket drive
- meshing gears drive
- simple gearbox drive.

4 marks

Any one alternative drive @ 2 marks

(d) (i) The operation of the circuit is controlled by the on / off switch. When the switch is closed current flows from the battery to the motor forcing it to rotate. The motor operates the gearbox.

Operation @ 2 marks

(ii) LED lighting could be fitted to the front panel of the model as shown.

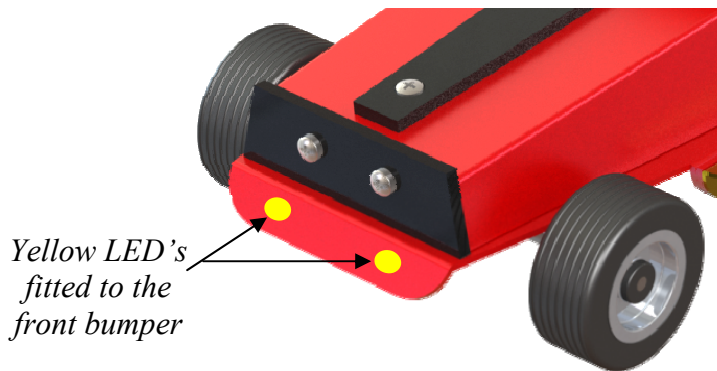
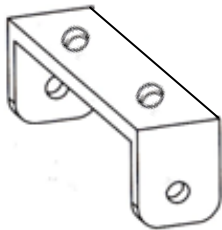


Illustration @ 2 marks

4 marks

(e) (i)



Design & Diagram @ 2 marks

(ii) The axle support is filed to give a curved finish at each end. A hole is drilled at both ends of the support to accommodate the size of the axle. The support shape is finished by bending both ends at 90°.

Description @ 2 marks

4 marks

(f) An additional design feature could include the inclusion of a spoiler, a racing number or extra lighting.



Any one suitable feature @ 2 marks
Suitable diagram @ 2 marks

4 marks

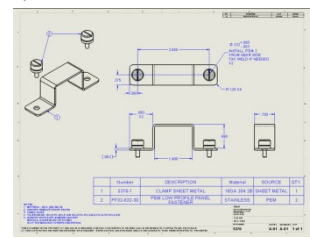
Question 2 **20 marks**

(a) (i) Stage five is the 'production drawing'.

Name of stage @ 1 mark

(ii) This production drawings include information such as:

- dimensions
- list of materials
- assembly details
- part names.



Any two pieces of information @ 2 + 1 mark

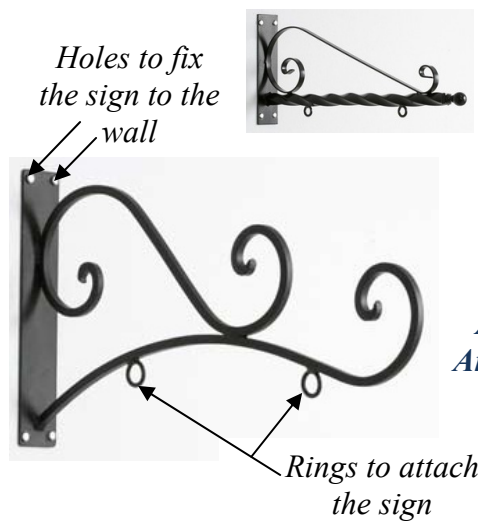
(iii) Factors to be considered in the design of the desk fan include:

- stability
- electrical circuit and operation
- suitability of materials
- safety features
- appearance.

7 marks

Any three factors @ 1 mark each

(b) (i) Examples of possible design solution are shown.



Design of bracket @ 1 mark
Any suitable means of attachment @ 1 mark
Any suitable method to fix to a wall @ 1 mark
Any suitable decorative feature @ 1 mark
Diagram of structure @ 3 marks



(ii) The bracket could be made from steel.

Any suitable metal @ 1 mark

Paint would be a suitable finish for a steel bracket

Any suitable finish @ 1 mark

(iii) Possible alternative designs for the sign are shown.



Suitable design @ 2 marks
Suitable diagram @ 2 marks

13 marks

Question 3 **20 marks**

- (a) (i) Part A is the **Base** *1 mark*
 Part B is the **Table** *1 mark*
 Part C is the **Chuck** *1 mark*
 Part D is the **Feed Lever** *1 mark*



- (ii) The table is raised with the aid of a rack and pinion mechanism. The pinion is connected to the handle and meshes with the rack fixed to the pillar. The table is raised or lowered by rotating the handle.
Descriptions of mechanism @ 2 marks



- (iii) The drill is fitted with an adjustable depth stop. This can be set to prevent the feed level moving beyond the set position therefore allowing a blind hole to be drilled.
Outline @ 2 marks

- (iv) The drill drift can be used to remove the chuck from the spindle. The drift is placed into the slot in the spindle. Gentle tapping of the drift forces the chuck to separate from the spindle.



Explanation @ 2 marks

10 marks

- (b) The speed is 3000 RPM
Correct substitution @ 2 marks
Correct calculation @ 2 marks

4 marks

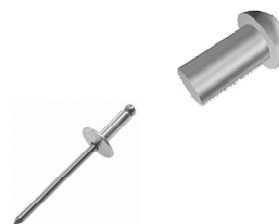
- (c) (i) A **countersunk screw** is a screw with a countersunk head. This screw can be fitted in a countersunk hole which ensures that the head finishes flush with the surface.
 A grub **screw** is used to prevent relative movement between parts. A grub screw can be screwed below the surface



- (ii) A **circular split die** is used to create a screw thread on a round bar. This type of die is most commonly used in school workshops. The split allows for a small amount of opening and closing of the die.
 A **die nut** is used for clearing the grooves of damaged or rusty threads.



- (iii) A **snap head rivet** is a rivet with a dome shaped head. The rivet can be used to join metal plates by shaping with a ball peen hammer and finishing with a rivet snap.
 A **pop rivet** is used to join light sheet metal with the aid of a pop rivet gun. The second head is formed when the gun draws the pin of the rivet through the rivet.



Any two parts @ 2 marks +1 mark

6 marks

Question 4

20 marks

(a) (i) The furnace shown is a basic oxygen furnace. *1 mark*

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

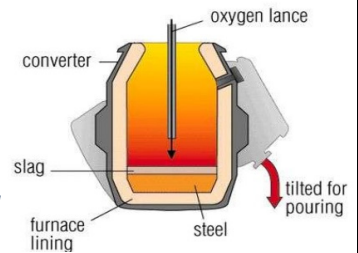
- Scrap metal
- Lime
- Molten iron.

3 elements @ 1 mark each



(iii) The charge is melted with the aid of part A – the oxygen cooled lance. Oxygen is blown down through the water cooled lance onto the charge. This causes a rise in temperature and the heat generated melts the charge.

Description of melting the charge @ 3 marks



(iv) Part B shows the tapping spout. When the furnace is tilted, the molten steel is poured out spout B.

Function of part B @ 3 marks

10 marks

(b) (i) Alloy steels include:

- stainless steel – cutlery and kitchen sinks
- high speed steel (HSS) - drill bits and taps.

Any two alloy steels @ 1 + 1 mark

Any two applications @ 1 + 1 mark



(ii) Materials are alloyed with steel to improve properties such as:

- wear resistance
- improved resistance to temperature
- improved corrosion resistance.

Any two reasons @ 1 mark each



6 marks

(c) (i) Heat treatment which can be applied to steel include:

- hardening
- tempering
- stress relieving.

Any two processes @ 1 mark each

(ii) Hardening – a piece of high carbon steel is heated to a cherry red. It is then quenched rapidly in water or oil to make the steel hard. The hard steel will also be brittle and may need to be tempered to make it suitable for use.

Description any one process @ 2 marks

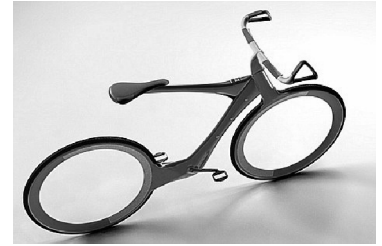


4 marks

Question 5

20 marks

- (a) (i) The design features featured of the wheel of the modern bicycle differ from a traditional bicycle in the following ways:
- no central axis / support
 - no spokes
 - no mounting of gears on the rear wheel
 - rigid circular wheel.



Comparison @ 2 marks

- (ii) Design features of the modern bicycle shown include:
- revised frame shape and saddle support
 - alternative to traditional chain drive mechanism
 - advanced handlebar design.

Any two features @ 2 + 1 marks

- (iii) Safety features that could be added to the modern bicycle might include:
- a bell
 - a light
 - reflector fitted to the rear of the saddle
 - reflectors fitted to the pedals.

Any two features @ 2 + 1 marks



- (iv) The advantages of using a bicycle as a mode of transport may include:
- shorter journey times in built up areas
 - generation of less air pollution
 - increased physical fitness for the user.

Any two advantages @ 1 mark each

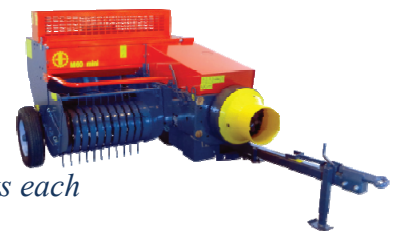
10 marks

- (b) (i) The drive mechanism is a chain and sprocket. *1 mark*

- (ii) Suitable applications of a chain and sprocket drive include:

- a bicycle
- farm machinery
- a motorbike.

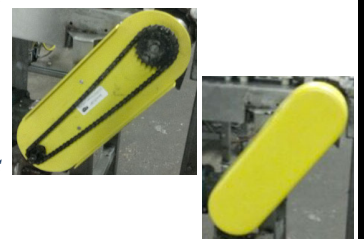
Any two applications @ 2 marks each



- (iii) A major risk associated with the chain and sprocket is that items (clothing, hands etc) can get caught in the mechanism. *Any one risk @ 2 marks*

To reduce the risk of items getting caught in the mechanism a guard is usually mounted around the chain and sprocket drive.

Any one feature @ 2 marks



- (iv) The application of grease to a chain and sprocket drive will reduce friction and as a result will reduce wear of the mechanism.

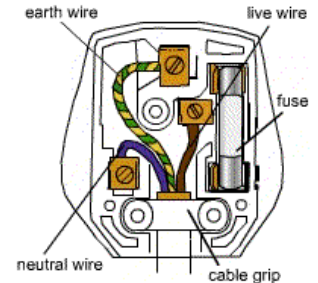
Any suitable method @ 1 mark

10 marks

Question 6

20 marks

- (a) (i) Terminal **A** is called live *1 mark*
 Terminal **B** is called earth *1 mark*
 Terminal **C** is called neutral *1 mark*
- (ii) Terminal **A** is called live is wired brown *1 mark*
 Terminal **B** is called earth is wired yellow / green *1 mark*
 Terminal **C** is called neutral is wired blue *1 mark*
- (iii) The purpose of part **D** is the cable grip. This is used to hold the lead / flex in place. *Purpose @ 1 mark*
- (iv) If a fault develops, the 3A fuse will blow and cut off the electrical supply. *Function @ 1 mark*
- (v) Safety precautions to be observed when using electrical appliances include:
- ensuring electrical cable is not damaged
 - ensuring appliances are correctly earthed
 - avoid appliances making contact with water.
- Any two safety precautions @ 1 mark each*

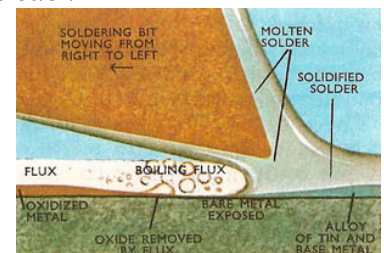


10 marks

- (b) (i) Properties of soft solder include:
- low melting point
 - good electrical conductivity
 - non-corrosive.
- Any two properties @ 2 marks each*



- (ii) The main differences between passive and active flux include –
- A passive flux is protective and prevents oxidation during soldering.
 - An active flux firstly removes oxides (cleans) and then prevents further oxidation during soldering.

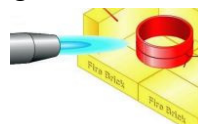


2 marks

- (iii) *Sweating* – is a soldering process used to join large areas. The surfaces to be joined are tinned with solder. The parts are brought together and heated until the solder on both remelts and unites. *Description @ 1 mark*
Diagram @ 1 mark



- (iv) Silver solder is also known as hard solder. Silver solder is an alloy of silver, copper and zinc. Silver solder has a melting point of between 680° and 800°, depending on the composition.



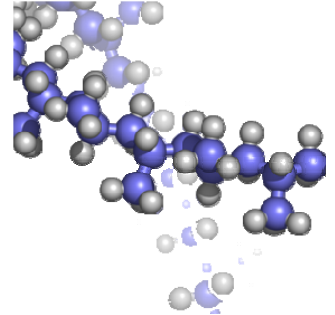
2 marks

10 marks

Question 7

20 marks

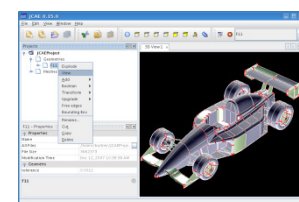
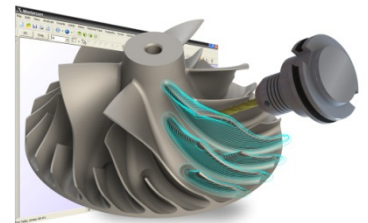
- (a) (i) The lathe shown is a CNC lathe. *1 mark*
- (ii) The advantages of a CNC lathe over a conventional lathe include –
- increased production of components
 - increased accuracy of components produced
 - safer working environment.
- Any two advantages @ 1 mark each*
- (iii) Acrylic is the most suitable polymer for the manufacture of the safety guard. *1 mark*
- Acrylic may be a clear thermoplastic polymer making it very easy to shape and therefore suitable as a safety guard. As a clear polymer the operator can easily see the manufacturing process in progress. *Any one reason @ 2 marks*
- (iv) Acrylic is a thermoplastic polymer. *1 mark*
- Thermoplastic polymers can be softened by heating making it possible to shape them for many applications. *Any one advantage @ 1 mark*
- (v) Environmental problems caused by careless disposal of plastic materials may include:
- air pollution
 - ground and water pollution
 - harm to birds and animals. *Any one problem @ 2 marks*



10 marks

- (b) (i) *Correct label @ 1 mark each*
- (ii) *Illustrate @ 2 marks*

- (iii) **RAM** – stands for random access memory. This is a form of temporary memory storage on a computer. Data stored in RAM is lost when the computer is switched off.
- CAM** – stands for computer-aided-manufacture and is the use of computer software to control machine tools and related machinery in the manufacturing of components.
- Canned cycles** – enables a number of repetitive operations to be carried out by a single block of a program.
- CAD** - is the use of computer systems to assist in the creation, modification, analysis, or optimisation of a design. *Any two explanations @ 2 marks each*



10 marks



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Junior Certificate Metalwork - Higher Level Practical Examination - Marking Scheme 2015


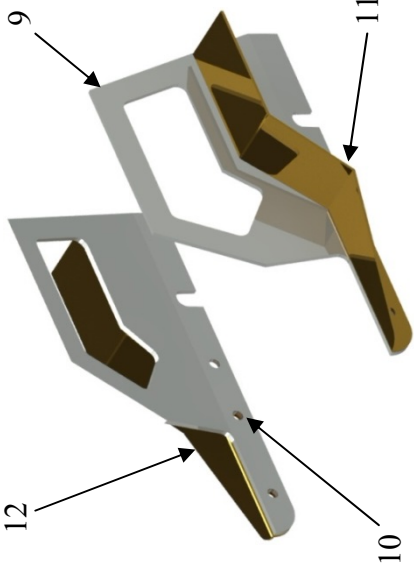
Subjective Marking 1/10		9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor						
Subjective Marking 1/5		5 Excellent	4 Very Good	3 Good	2 Poor	1 Very Poor						
Section	Part Number	Pictorial Sketch / Description					Concept		Mark	Marks		
1	Parts 1, 2, 3, 4, 5 & 6						Complete Piece	Assembly: Subjective Marking 1 - 5		5	20	
								Finish: Subjective Marking 1 - 5				5
								Function: Subjective Marking 1 - 10				
2	Part 1						Part 1 Backplate	Mark Out		4	20	
								Profile				10
								Holes				
3	Part 2						Part 2 Slotted Wheel	Mark Out		5	20	
								Slot \times 4				8
								Profile				
4	Parts 3 & 4						Part 3 Drive Wheel	Mark Out		2	20	
								Wheel Diameter				2
								Holes and Profile				
5	Parts 5 & 6						Part 4 Knob	Mark Out		1	20	
								Lengths & Diameters				4
								24 mm Square				
								M4 Hole				1
								Mark Out				
								Profile				9
Holes		3										
Diameter 5.5 mm			3									
Head Length 4 mm		2										

100 Marks (\times 1.5 = 150 Total)



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State Examinations Commission
Junior Certificate Metalwork - Higher Level Project - Marking Scheme 2015



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	Marks
1	Complete Model (Design Element not included)	 <p>Assembly Finish Function</p>	<p>Assembly: Subjective Grade 1-5</p> <p>Finish: Subjective Grade 1-5</p> <p>Mechanical Function: Subjective Grade 1-5</p> <p>Electrical Function: Subjective Grade 1-5</p>			5	20	
			<p>Front Axle and Front Axle Support(s): Subjective Grade 1 – 5</p> <p>Design: 5</p> <p>Make and Attach: 5</p>			10		
			<p>Light System: Subjective Grade 1 – 5</p> <p>Design: 5</p> <p>Make and Attach: 5</p>			10		
2	Design	<p>Design and make the following and attach them to the model:</p> <p>(i) a Front Axle and Front Axle Support(s);</p> <p>(ii) a Light System, incorporating at least two LEDs.</p> <p>(Note: 20% of the marks will be awarded for this section)</p>					20	
3	Parts 9, 10, 11 & 12		<p>Part 9 Left Side Panel</p> <p>Part 11 Left Mudguard</p> <p>Part 10 Right Side Panel</p> <p>Part 12 Right Mudguard</p>			5	20	
			<p>Mark Out, Drill, Shape & Bend</p>			5		
			<p>Mark Out, Drill, Shape & Bend</p>			5		
			<p>Mark Out, Drill, Shape & Bend</p>			5		



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4	Parts 1, 3, 4 & 8			Part 3 Roof / Rear Panel	Mark Out, Drill, Shape & Bend	8	20
		Part 8 Windscreen	Mark Out, Drill, Shape & Bend	5			
		Part 1 Bonnet	Mark Out, Drill, Shape & Bend	4			
		Part 4 Bonnet Trim	Mark Out, Drill, CSK & Shape	3			
5	Parts 2, 5, 6, 7 & 21			Part 2 Chassis	Mark Out, Drill, Shape & Bend	12	20
		Part 5 Grill	Mark Out, Drill & Shape	3			
		Part 6 Grill Support	Mark Out, Drill & Shape	2			
		Part 7 Windscreen Support	Mark Out, Drill & Shape	2			
		Part 21 Rear Axle	Length	1			

100 Marks (× 1.5 = 150 Total)