



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2017

Marking Scheme

METALWORK
MATERIALS AND TECHNOLOGY

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.

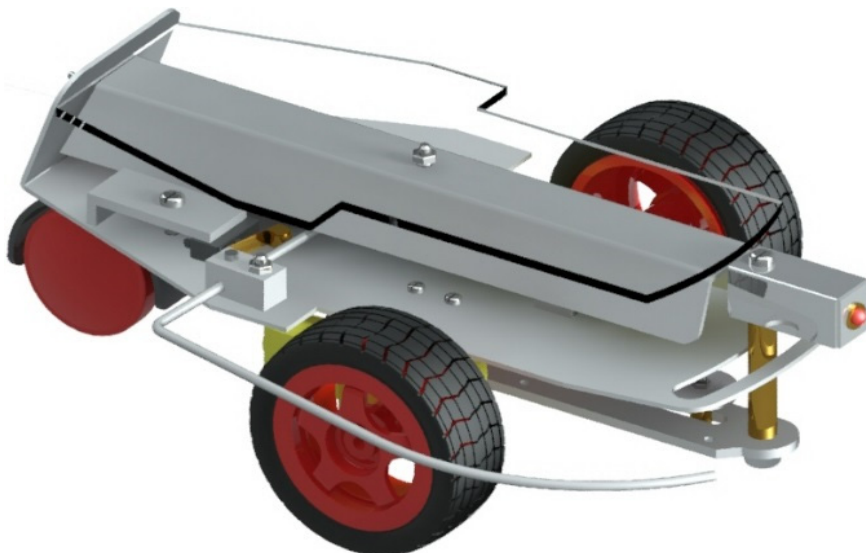
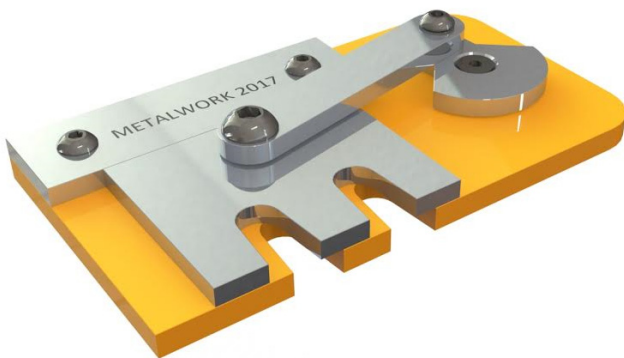
JUNIOR CERTIFICATE EXAMINATION, 2017

**METALWORK
MATERIALS AND TECHNOLOGY**

HIGHER LEVEL

MARKING SCHEME

Written Examination, Practical Examination and Project



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

Note: The solutions presented are examples only.

All other valid solutions are acceptable and are marked accordingly.

<p>Question 1 – Section A (5 parts only)</p> <p>(a) (i) Name part A @ 2 marks (ii) Purpose part A @ 2 marks 4 MARKS</p> <p>(b) (i) Name B @ 1 mark, Name C @ 1 mark (ii) Any one purpose @ 2 marks 4 MARKS</p> <p>(c) (i) Description @ 2 marks (ii) Explain @ 2 marks 4 MARKS</p> <p>(d) (i) Two applications @ 1 mark each (ii) Two effects @ 1 mark each 4 MARKS</p> <p>(e) Any one @ 4 marks 4 MARKS</p> <p>(f) (i) Identify @ 2 marks (ii) Two applications @ 1 mark each 4 MARKS</p> <p>(g) (i) Both components @ 1 + 1 mark (ii) One function @ 2 marks 4 MARKS</p>	<p>Question 1 – Section B (5 parts only)</p> <p>(a) (i) Description @ 2 marks (ii) One method @ 2 marks 4 MARKS</p> <p>(b) (i) Any two @ 1 mark each (ii) Description @ 2 marks 4 MARKS</p> <p>(c) (i) Explain @ 2 marks (ii) Explain @ 2 marks 4 MARKS</p> <p>(d) (i) Explain @ 2 marks (ii) Describe @ 2 marks 4 MARKS</p> <p>(e) Design @ 4 marks 4 MARKS</p> <p>(f) (i) Two reasons @ 1 mark each (ii) One example @ 2 marks 4 MARKS</p>
<p>Question 2</p> <p>(a) (i) Name @ 2 marks (ii) Any two @ 1 mark each (iii) Any three factors @ 1 mark each 7 MARKS</p> <p>(b) (i) Design @ 3 marks Securing method @ 2 marks Water Storage area @ 2 marks Diagram @ 3 marks (ii) Suitable metal @ 1 mark Reason @ 1 mark (iii) Suitable finish @ 1 mark 13 MARKS</p>	<p>Question 3</p> <p>(a) (i) Name @ 1 mark, Explain @ 2 marks (ii) Name @ 1 mark, Explain @ 2 marks (iii) Name @ 1 mark, Purpose @ 1 mark (iv) Two factors @ 1 mark each 10 MARKS</p> <p>(b) Substitution @ 2 marks, Calculation @ 2 marks 4 MARKS</p> <p>(c) (i) 2 + 1 marks (ii) 2 + 1 marks (iii) 2 + 1 marks (<i>any 2 parts</i>) 6 MARKS</p>
<p>Question 4</p> <p>(a) (i) Identify @ 2 marks (ii) Material @ 2 marks (iii) Name @ 1 mark, Description @ 3 marks (iv) Purpose @ 2 marks 10 MARKS</p> <p>(b) (i) Suitable material @ 1 mark (ii) Two reasons @ 2 + 1 marks 4 MARKS</p> <p>(c) (i) Name any three @ 1 mark each (ii) Description any one treatment @ 3 marks 6 MARKS</p>	<p>Question 5</p> <p>(a) (i) Any two design features @ 2 + 1 mark (ii) Any two properties @ 2 + 1 mark (iii) Any two environmental impacts @ 2 marks each 10 MARKS</p> <p>(b) (i) Direction @ 2 marks (ii) Gear ratio @ 2 marks (iii) Calculation @ 2 marks (iv) Name @ 2 marks, function @ 2 marks 10 MARKS</p>
<p>Question 6</p> <p>(a) (i) Suitable metal and reason @ 1 + 2 marks (ii) Explain @ 3 marks (iii) Identify @ 1 mark (iv) One reason @ 3 marks 10 MARKS</p> <p>(b) (i) Name two metals @ 1 mark each (ii) Any two properties @ 1 mark each (iii) Purpose @ 3 marks (iv) Any three safety precautions @ 1 mark each 10 MARKS</p>	<p>Question 7</p> <p>(a) (i) Identify @ 1 mark (ii) Explain @ 2 mark (iii) Any two safety features @ 1 mark each (iv) Redraw @ 4 marks (v) Explain any two @ 2 marks each 13 MARKS</p> <p>(b) (i) Instrument A and B @ 1 mark each (ii) One application @ 2 marks (iii) Any two functions @ 1 mark each (iv) Name @ 1 mark 7 MARKS</p>

Question 1, Section A - Compulsory

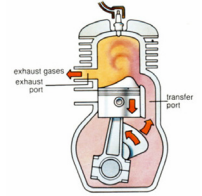
20 Marks

Five parts only to be counted

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

4 marks

- (b) (i) Part B is the inlet port *1 mark*
 Part C is the outlet (exhaust) port *1 mark*
 (ii) Port B, the inlet port, is where the fuel / air mixture is brought into the combustion cylinder.
 Port C, the exhaust port, is where the combusted fumes are released from the combustion cylinder.
Any one purpose @ 2 marks



4 marks

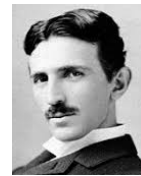
- (c) (i) As the piston moves up and down in reciprocating motion, part D, the crankshaft moves in a rotary motion. *2 marks*
 (ii) The two-stroke does not have an oil sump. Lubrication is done by mixing the oil with the fuel. The oil is burned upon combustion of the air/fuel mixture. *2 marks*

4 marks

- (d) (i) Two-stroke engines are commonly found in chainsaws, lawnmowers, outboard boat engines, etc. *Any two @ 1 mark each*
 (ii) Engines produce exhaust fumes which can lead to the creation of acid rain and pollution. Engines also create noise pollution, etc.
Any two @ 1 mark each

4 marks

- (e) (i) **Enzo Ferrari**; Italian entrepreneur; the founder of the Scuderia Ferrari motor racing team and Ferrari car brand.
 (ii) **Nikola Tesla**; Serbian American inventor, electrical engineer and physicist, best known for his contributions to the design of the modern alternating current electricity supply system.
 (iii) **John Logie Baird**; Scottish engineer and one of the inventors of the mechanical television. *Any one @ 4 marks*



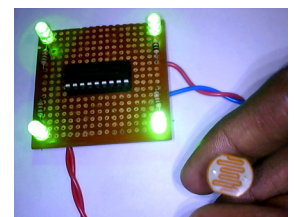
4 marks

- (f) (i) The garden light shown has a solar cell on top indicating that it can be power by solar energy. *2 marks*
 (ii) Solar cells are used to power items as diverse as calculators, water heating systems and vehicles.
Any two applications @ 1 mark each



4 marks

- (g) (i) E is a Light Dependent Resistor (LDR) *1 mark*
 F is a Capacitor *1 mark*
 (ii) A light-dependent resistor (LDR) is a light-controlled variable resistor. The resistance of the LDR decreases with increasing light intensity.
 A capacitor is a passive two-terminal electrical component that stores electrical energy in an electric field.
One function @ 2 marks



4 marks

Question 1, Section B - Compulsory

20 Marks

Five parts only to be counted

- (a) (i) The 70° bends on the central cover 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.

Describe @ 2 marks



- (ii) The finished angles may be checked using an engineers protractor.

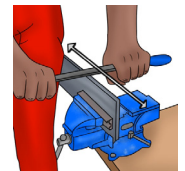
One suitable method @ 2 marks

4 marks

- (b) (i) Safety precautions to be taken when drilling the Ø13mm hole in the 1.5mm aluminium chassis include: -

- Ensure to drill a pilot hole
- Use a suitable drill speed
- Wear protective gloves
- Ensure that the work piece is secured properly.

Any two safety precautions @ 1 mark each



- (ii) A good quality finish is achieved on the edge profile of the aluminium chassis 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.

Describe @ 2 marks

4 marks

- (c) (i) The slot labelled A may be produced as follows: -

- Drill the Ø10mm holes at either end of the slot
- Draw two arcs at both sides of the holes to complete the outline of the slot
- Cut-out the sections between each hole
- File to the marked shape
- Smooth file to finish the slot.

Explain @ 2 marks



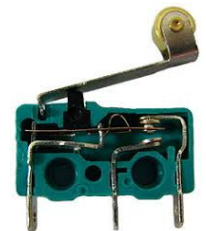
- (ii) The Nylock nut has a nylon insert to prevent loosening of the assembly when the vehicle is operating.

Explain @ 2 marks

4 marks

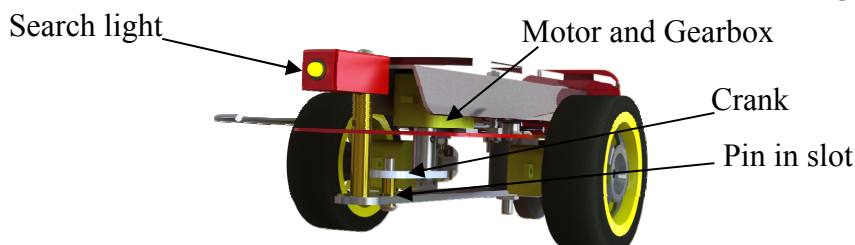
- (d) (i) A micro-switch with roller lever is an electric switch that is actuated by very little physical force on the roller lever.

Explain @ 2 marks

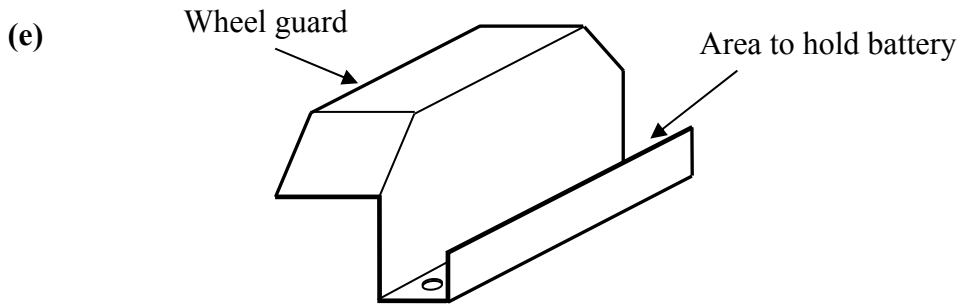


- (ii) The search light is driven by a motor connected to a gearbox. The gearbox turns a crank which has a pin inserted in a slot of the arm connected to the search light. As the crank turns the pin moves in the slot causing the light to move left and right.

Describe @ 2 marks



4 marks



Design @ 4 marks

4 marks

- (f) (i) Autonomous vehicles are designed for use in:
- situations that are a danger to humans
 - areas that are too remote for humans to access.
- Any two reasons @ 1 mark each*

- (ii) Autonomous vehicles may be used in:-
- Search and rescue situations
 - Searching for explosive material
 - Entering areas with fire or other hazardous materials.

One example @ 2 marks

4 marks



(a) (i) Stage seven is the “Testing Stage”

Name of stage @ 2 mark

(ii) Factors to consider during the testing stage include:

- Testing will highlight any problems with the design, allowing you to make changes.
- Is the product/materials safe for use?
- Does the design satisfy the brief?
- Are the dimensions suitable?



Any two @ 1 mark each

(iii) Factors to be considered when selecting material for the trampoline include:

- The suitability of the material for the proposed application, e.g. elastic material for the bed, soft material for the safety pad, strong non-corrosive frame materials.
- The cost of the material.
- The availability of the material.
- Weight of the material.

Any three suitable factors @ 1 mark each

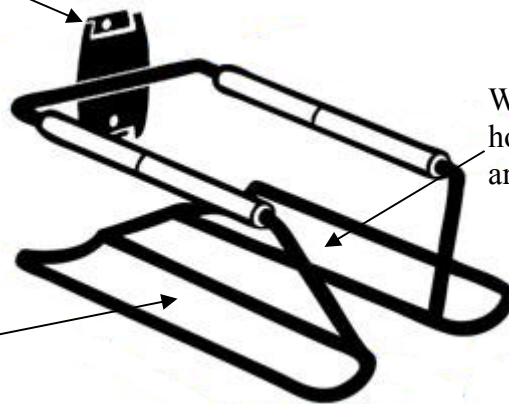
7 marks

(b) (i)

Attached to wall using two screws



Storage for six tennis balls



Water bottle can rest horizontally in this area



Any suitable design for storing rackets and balls @ 3 marks
Water bottle storage area @ 2 marks
Means to attach to a wall @ 2 marks
Diagram @ 3 marks

(ii) The storage rack could be made from steel, as it is a strong material and can be shaped easily.

Any suitable metal @ 1 mark
Any suitable reason @ 1 mark

(iii) Paint would be a suitable finish for a steel bracket.

Any suitable finish @ 1 mark

13 marks

Question 3

20 Marks

- (a) (i) A is Taper Turning

1 mark

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.

Explanation of taper turning @ 2 marks

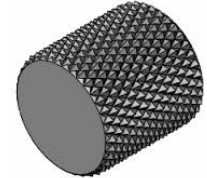


- (ii) B is Knurling

1 mark

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.

Explanation of knurling 2 marks



- (iii) Tool C is a centre drill.

Name @ 1 mark

A centre drill is used for starting the holes when drilling on the lathe.

Purpose @ 1 mark



- (iv) Factors which may impact on finish include:

- cutting speed
- type of material
- condition of the tool bit
- use of coolant

Any two factors @ 1 mark each

10 marks

- (b) The speed is 3000 rpm

Correct substitution @ 2 marks

Correct calculation @ 2 marks

4 marks

- (c) (i) A **grub screw** is used to prevent relative movement between parts. A grub screw can be screwed below the surface.

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.



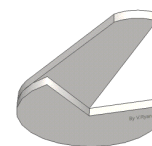
- (ii) A **cap nut** is a nut that has a domed top to cover the threads. This type of nut provides a safe decorative finish when used.

A **wing nut** is a type of nut with a pair of projections on either side for the fingers to turn it on a screw. They are often used on drum kits.



- (iii) A **centre square** is a hand tool used to accurately locate the centre of a round or cylindrical piece.

An **engineer's protractor** is a measuring device typically made from steel. It is divided into 180 equal parts and is used to measure and locate angles.



6 marks

Any two parts @ 2 marks +1 mark

Question 4

20 Marks

- (a) (i) The furnace shown is an Electric arc furnace. *2 marks*
- (ii) Steel is produced by the electric arc furnace. *2 marks*
- (iii) Part A is the Carbon Electrodes.

Name part A @ 1 mark

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 is the furnace door; it is opened to remove the slag from the furnace.

Function of part B @ 2 marks



10 marks

- (b) (i) A suitable material for the medical equipment would be stainless steel.

Name @ 1 mark

- (ii) Stainless steel is suitable as it has excellent resistance to corrosion. It is hygienic and easy to clean.

Any two reasons @ 2 + 1 marks



4 marks

- (c) (i) Three heat treatment processes include:

- Annealing
- Hardening
- Tempering.

Any three @ 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.

Describe any one heat treatment @ 3 marks



6 marks

Question 5

20 Marks

(a) (i) The design features of the concept racing car include:

- Aerodynamic front and rear spoilers.
- Aerodynamic body shape.
- Enclosed cockpit.
- Enclosed wheel structure.



Any two design features @ 2 + 1 marks

(ii) The main properties required of the material for the body of the racing car include:

- Tough material to withstand impact.
- Light material.
- Easily shaped to achieve aerodynamic shape.



Any two properties @ 2 + 1 marks

(iii) Environmental impacts of motor racing technology may be positive or negative and include:

- May cause noise pollution.
- May release increased exhaust fumes.
- Safety features which help reduce accidents.
- Energy harnessing systems reduce fuel consumption.



Any two environment impacts @ 2 marks each

10 marks

(b) (i) Wheel C will turn in a clockwise direction.

2 marks

(ii) The gear ratio is 2:1.

2 marks

(iii) Wheel C will rotate at 480 RPM.

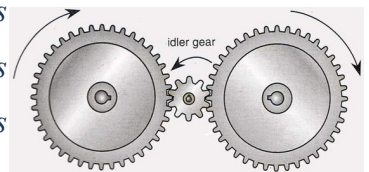
2 marks

(iv) Gear B is an idler gear.

Name @ 2 marks

The idler gear ensures that the direction of rotation of the input gear and output gear are the same.

Function @ 2 marks



10 marks

Question 6

20 Marks

- (a) (i) The soldering iron tip may be made from copper.

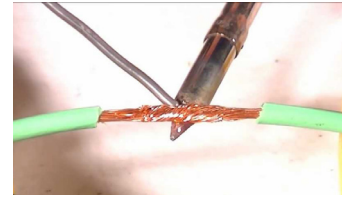
Suitable metal @ 1 mark

Copper is a suitable material as it is a good conductor of heat and electricity.

Suitable reason @ 2 marks

- (ii) An insulator is a material that restricts the transfer of either heat or electricity. Common insulators are glass, plastic, rubber and wood.

Suitable description @ 3 marks



- (iii) A thermosetting plastic would be most suitable for the handle of the soldering iron.

Identify @ 1 mark

- (iv) Thermosetting materials do not soften when heated making it suitable as a material for the soldering handle.

Suitable reason @ 3 marks

10 marks

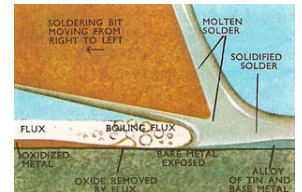
- (b) (i) Lead and tin are the two metals most commonly used to make solder.

Any two suitable metals @ 1 mark each

- (ii) Properties of solder which make it suitable for joining electronic components include:

- Low melting point
- Good conductivity
- Good to join with copper and brass.

Any two properties @ 1 mark each



- (iii) Fluxes are used to remove oxides from the surfaces of the parts being soldered and to prevent further oxidation when parts are heated.

Purpose @ 3 marks

- (iv) Safety precautions to be observed include:

- Never touch the hot tip of the Iron.
- Replace the Iron in the holder when not in use.
- Do not inhale the fumes from the soldering process.

Any three suitable safety precautions @ 1 mark each



10 marks

Question 7

20 Marks

(a) (i) The lathe shown is a CNC lathe. 1 mark

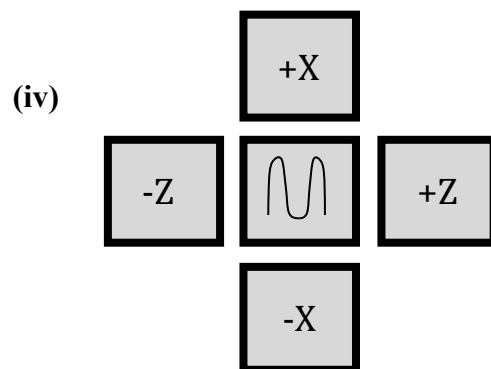
(ii) Stepper motors control the movement of the cutting tool in the CNC lathe. These motors are extremely accurate and move at a very fast speed.

Explain the function @ 2 marks



(iii) The CNC lathe has a safety guard, which protects the operator while the machine is cutting. If it is lifted while cutting the motor will cut out. The CNC lathe has an emergency stop button.

Any two safety features @ 1 mark each



Redraw @ 4 marks

(v) **Cloud Storage** – Computer files and data are stored on remote servers or “cloud” and can be accessed at any time from any place so long as you have Internet access. This saves the need to store files on your computer or carry the files around on a storage device.



URL – Uniform Resource Locator, colloquially termed a *web address*, is a reference to a web resource that specifies its location on a computer network and a mechanism for retrieving it. Most web browsers display the URL of a web page above the page in an address bar. A typical URL could have the form <http://www.example.com/index.html>, which indicates a protocol ([http](http://)), a hostname (www.example.com), and a file name ([index.html](http://www.example.com/index.html)).



App – A mobile app is a software application developed specifically for use on small, wireless computing devices, such as smart phones and tablets, rather than desktop or laptop computers.



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

13 marks

- (b) (i) Instrument **A** is a drill gauge.
Instrument **B** is a vernier calipers

1 mark

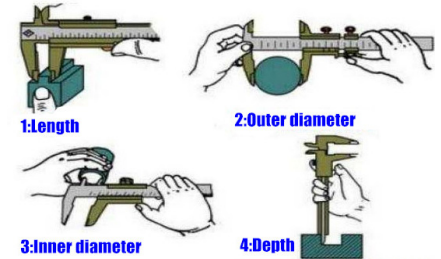
1 mark

- (ii) A drill gauge is a device used to identify the size of a drill bit. It contains a series of holes that represent various drill bit sizes. Each hole is marked with a measurement based on its size.



Application of A @ 2 marks

- (iii) The vernier callipers can be used to:
- Measure length
 - Measure an outside diameter
 - Measure an internal diameter
 - Measure depth.



Any two measuring functions @ 1 mark each

- (iv) Other measuring instruments used in engineering include:

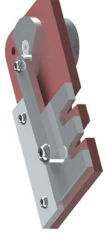
- Ruler
- Micrometer
- Screw pitch gauge
- Radius gauge.

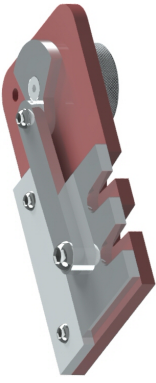
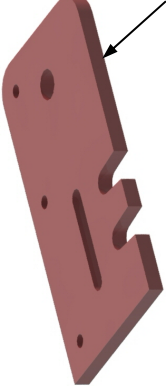

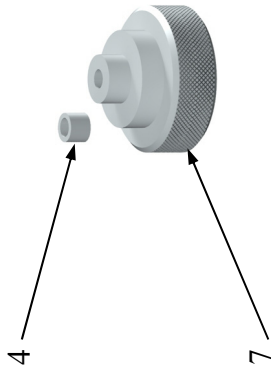

Name one @ 1 mark

7 marks



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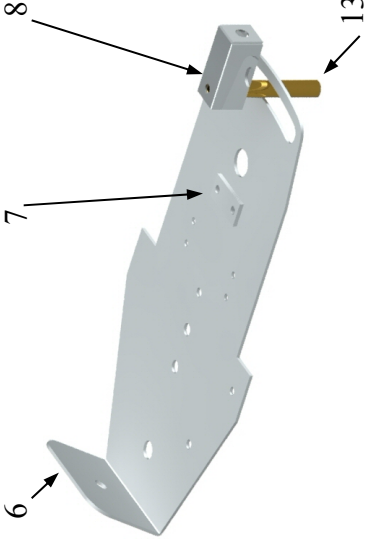


Junior Certificate Metalwork - Higher Level Practical Examination - Marking Scheme 2017								
Subjective Marking 1-10		9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor			
Subjective Marking 1-5		5 Excellent	4 Very Good	3 Good	2 Poor			
Section	Part Number	Pictorial Sketch / Description			Concept	Mark	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 5 10	20
2	Part 2				Part 2 Backplate	20	3 2 5 6 4	20
3	Parts 6 & 3				Part 6 Blade	15	3 5 6 1	20
4	Parts 7 & 4				Part 7 Knob	15	1 4 6 2 2	20
5	Parts 5 & 1				Part 5 Crank	15	2 10 3 3 2	20



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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)					Assembly: Subjective Grade 1-5		5	20
						Finish: Subjective Grade 1-5			
						Mechanical Function: Subjective Grade 1-5			
						Electrical Function: Subjective Grade 1-5			
2	Design	<p>Design, make and attach a separate unit for each side of the model, which will securely hold the Battery Holder (Part 30) and act as a mudguard for the Wheel (Part 28).</p> <p>(Note: 20% of the marks will be awarded for this section)</p>				Battery Holder and Mudguard Unit (× 2) Design: Subjective Grade 1 – 10 Make: Subjective Grade 1 – 5 Attach: Subjective Grade 1 – 5		10 5 5	20
3	Parts 6, 7, 8 & 13					Part 6 Chassis		12	20
						Part 7 Top Motor Spacer		1	
						Part 8 Search Light Holder		4	
						Part 13 Search Light Support		3	



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Junior Certificate Higher Level Metalwork Project Marking Scheme 2017



4	Parts 1, 2, 9, 10 & 14		<p>Part 1 Top Cover</p> <p>Part 2 Central Cover</p> <p>Part 9 Micro-switch Clamp</p> <p>Parts 10 & 14 Pivot & Sensor Arm</p>	<p>Mark Out, Drill & Shape</p> <p>Mark Out, Drill, Shape & Bend</p> <p>Mark Out, Drill & Shape</p> <p>Mark Out, Drill, Tap, Shape & Bend</p>	<p>6</p> <p>6</p> <p>2</p> <p>6</p>	20
5	Parts 3, 4, 5, 11, 12 & 15		<p>Part 3 Gearbox Coupling</p> <p>Part 4 Slotted Link Support</p> <p>Part 5 Slotted Link</p> <p>Part 11 Crank Arm</p> <p>Part 12 Sliding Pin</p> <p>Part 15 Support Column Screw</p>	<p>Mark Out, Turn, Drill & Tap</p> <p>Mark Out, Turn & Drill</p> <p>Mark Out, Drill, Slot & Shape</p> <p>Mark Out, Drill, Tap & Shape</p> <p>Mark Out, Turn & Drill</p> <p>Drill</p>	<p>4</p> <p>2</p> <p>8</p> <p>3</p> <p>2</p> <p>1</p>	20

100 Marks (× 1.5 = 150 Total)