

# DESIGN AND TECHNOLOGY - GCSE SAMPLE PAPER 2

## Level 1/Level 2 GCSE (9–1)

Candidate Name	Centre Number					Candidate Number				

### COMPONENT 1

**TIME ALLOWED - 1 hour 45 minutes**

#### **EQUIPMENT REQUIRED**

Drawing and writing equipment, coloured pencils and a calculator

#### **INSTRUCTIONS**

You are to answer all questions.

This example examination paper can be duplicated and printed out if required but not edited in any way.

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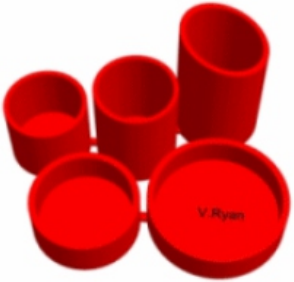

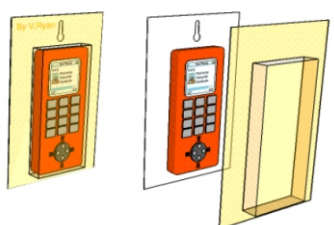
## Section A - CORE

Answer all the questions in this section

**1a.** The table below is divided into three columns. Column 'A', shows an image of a product. Column 'B' identifies the manufacturing process and Column 'C' names a material(s) suitable for the manufacturing process.

Complete the table below by adding the missing information.

The first answer has been completed for you.

<u>(A) PRODUCT</u>	<u>DESCRIPTION</u>	<u>PROPERTY</u>
	<p><b>DESKTIDY</b> <u>INJECTION MOULDING</u></p>	<p><i>Thermoplastics such as polystyrene, nylon, polypropylene and polythene are ideal plastics for this type of manufacturing process.</i></p>
<p>WORLD ASSOCIATION OF TECHNOLOGY TEACHERS <a href="https://www.facebook.com/groups/254963448192823/">https://www.facebook.com/groups/254963448192823/</a> <a href="http://www.technologystudent.com">www.technologystudent.com</a> © 2018 V.Ryan © 2018</p>		
<p><b>HELPFUL LINK</b> <a href="http://www.technologystudent.com/prddes1/rotate2.html">http://www.technologystudent.com/prddes1/rotate2.html</a></p>		
	<p><b>'PLASTIC' TROPHY</b> <u>ROTATIONAL MOULDING</u></p>	<p><b>1 mark</b></p>
<p><b>HELPFUL LINK</b> <a href="http://www.technologystudent.com/gprep07/vac2.html">http://www.technologystudent.com/gprep07/vac2.html</a></p>		
	<p><b>BLISTER PACKAGING</b> <u>VACUUM FORMING</u></p>	<p><b>1 mark</b></p>

**PRODUCT**

**DESCRIPTION**

**PROPERTY**

HELPFUL LINK

<http://www.technologystudent.com/equip1/hypres1.htm>



STEEL TRAY  
COMPRESSION  
MOULDING

**1 mark**

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HELPFUL LINK

[http://www.technologystudent.com/despro\\_fish/charity9.html](http://www.technologystudent.com/despro_fish/charity9.html)



PACKAGING  
DIE CUTTING

**1 mark**

HELPFUL LINK

<http://www.technologystudent.com/rmprep09/inject1.html>



WHEELIE BIN  
BLOW  
MOULDING

**1 mark**

**1b.** The manufacturer of the greetings card has included aroma pigments, in the form of a 'scratch and sniff' patch.



SCRATCHABLE  
AROMA PATCH

**(I)** How could aroma pigments, applied to the scratch and sniff patch, improve the appeal of the greetings card? **2 marks**

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**(II)** The greetings card is manufactured by a web-fed printer. What is web-fed printing? **2 marks**

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2. The photograph shows a roll of foam, which will be used to manufacture cushions.



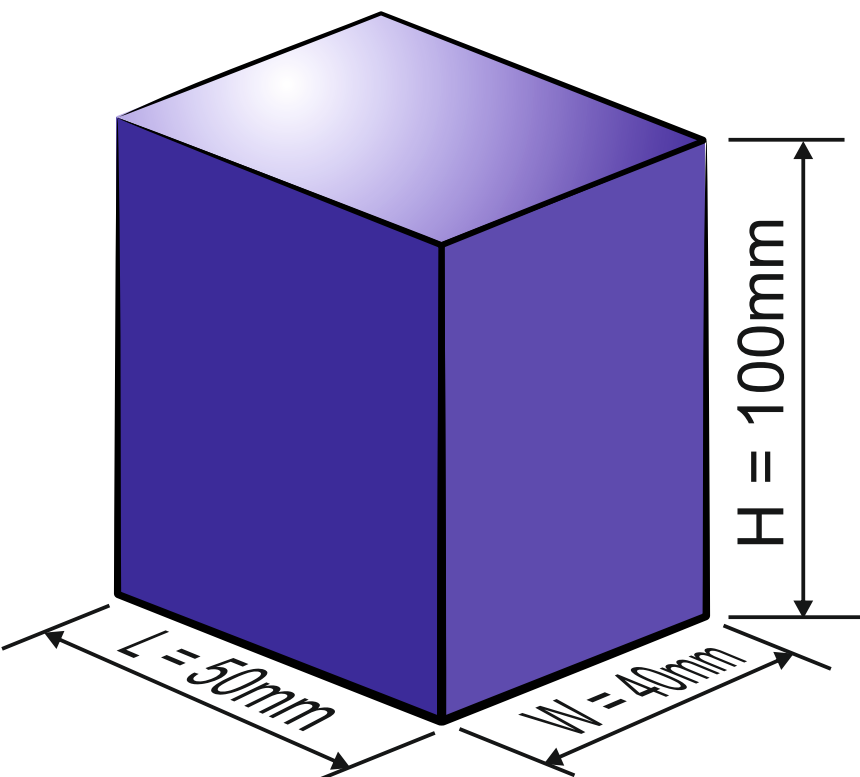
2a. Name a suitable polymer for the manufacture of this product? In your answer explain the physical properties that make it suitable. **2 marks**

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2b. The manufacturer has switched suppliers and the foam is now supplied in the shape of a rectangular prism, NOT a roll of foam. What is the volume of the rectangular prism, shown below. **3 marks**



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HELPFUL LINK

[http://www.technologystudent.com/joints\\_flash/nylon1.html](http://www.technologystudent.com/joints_flash/nylon1.html)

**2c.** The foam cushions will be covered with nylon, woven into a textiles materials  
List two physical properties of nylon. **2 marks**

(i)

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(ii)

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HELPFUL LINK

[http://www.technologystudent.com/joints\\_flash/nylon2.html](http://www.technologystudent.com/joints_flash/nylon2.html)

**2d.** Briefly describe how nylon is manufactured. **2 marks**

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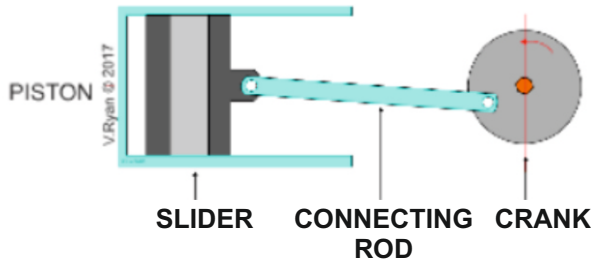
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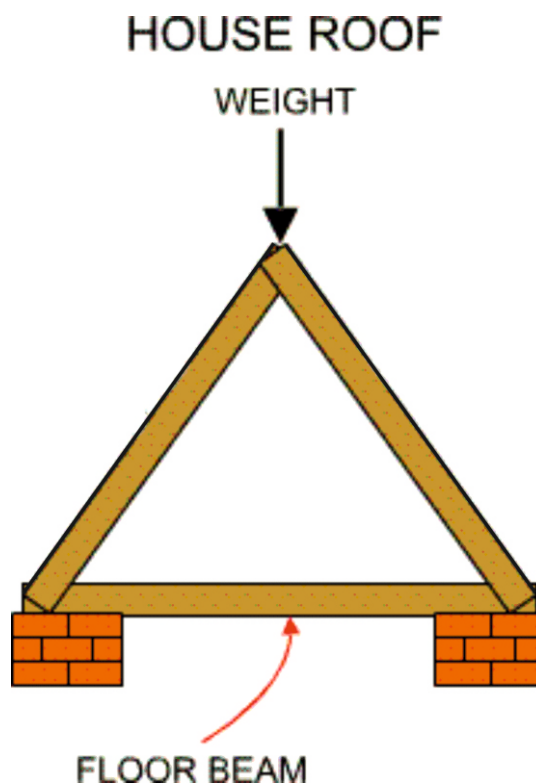
3a. The diagram below represents a type of movement.

(I) Name the movement. **1 mark**



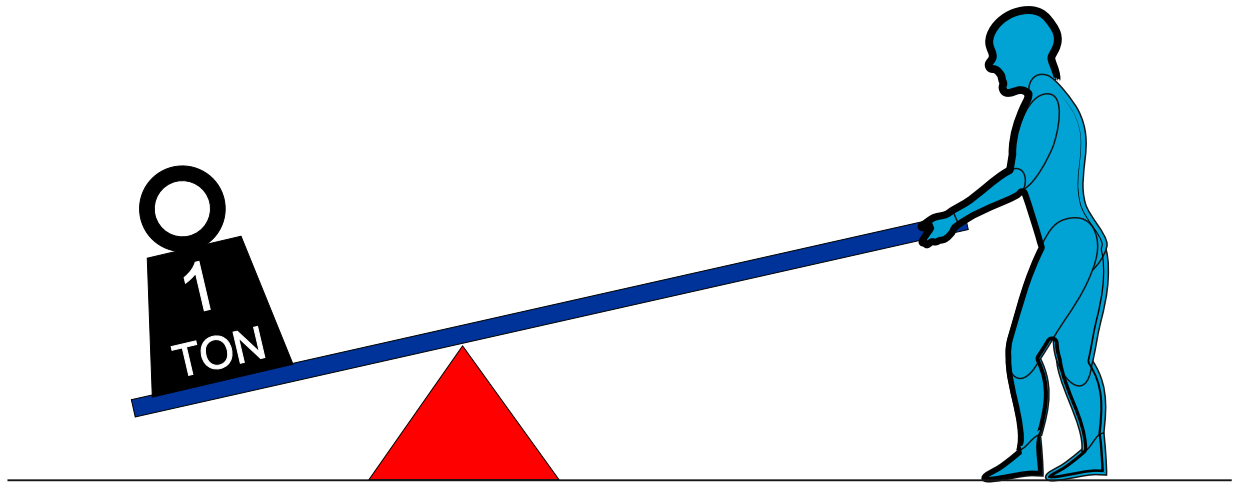
(I) Describe the movement. **1 mark**

3b. The diagram below, shows the structure holding up roof of a house. In terms of forces, label the struts and ties? **2 marks**

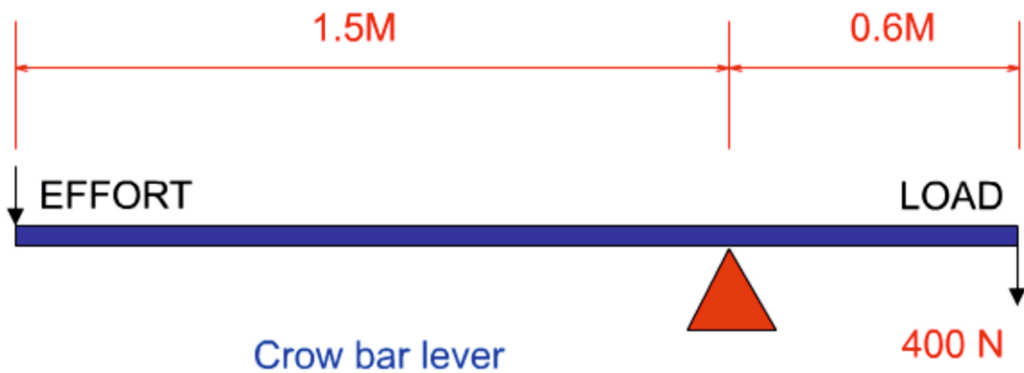


3c. The diagram shows the practical application of a lever. Clearly identify the EFFORT, LOAD and FULCRUM **3 marks**

EFFORT                  LOAD                  FULCRUM



3d. The simplified diagram below, represents a crow-bar being used to move a 400n load. What EFFORT is required to move the load? **4 marks**




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4a. Why does a pulley wheel have a grooved edge?

1 mark

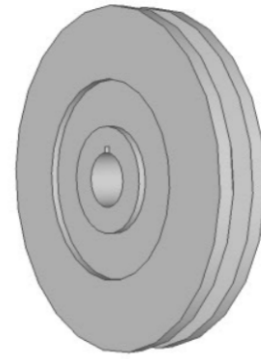
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A GROOVED PULLEY WHEEL

4b. A simple pulley system is seen opposite. Calculate the velocity ratio 2 marks

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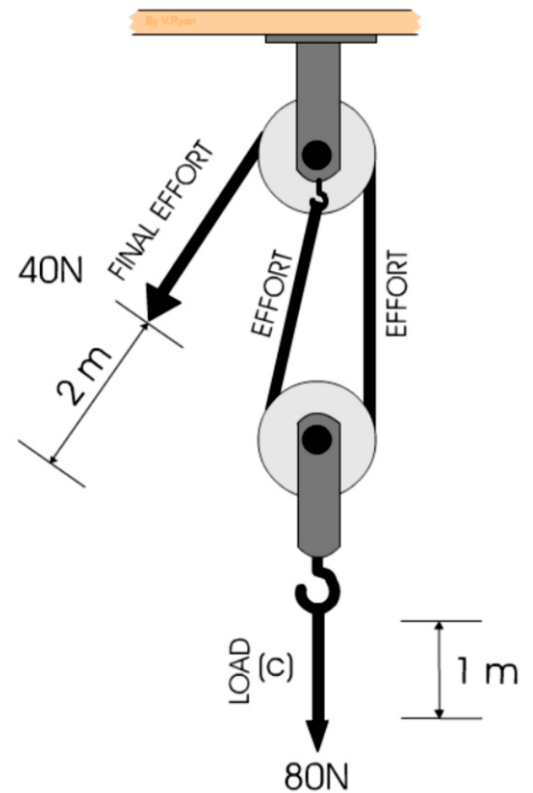
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4c. What is the efficiency of the pulley system? 2 marks

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**4d.** The total amount of renewable energy produced in 2016 was 90 Terawatt hours (Twh).

The ratio of hydroelectricity compared to other renewable energy forms was 1:12.

What amount of energy was produced through hydroelectricity ? **3 marks**

HYDROELECTRICITY : OTHER RENEWABLE FORMS  
**1 : 12**

EXPLANATION: \_\_\_\_\_

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**4e.** If total amount of renewable energy produced in 2016 was 100 Terawatt hours (Twh) AND the ratio of hydroelectricity compared to other renewable energy forms was 1:9.

What amount of energy was produced through hydroelectricity ? **3 marks**

HYDROELECTRICITY : OTHER RENEWABLE FORMS  
**1 : 9**

EXPLANATION: \_\_\_\_\_

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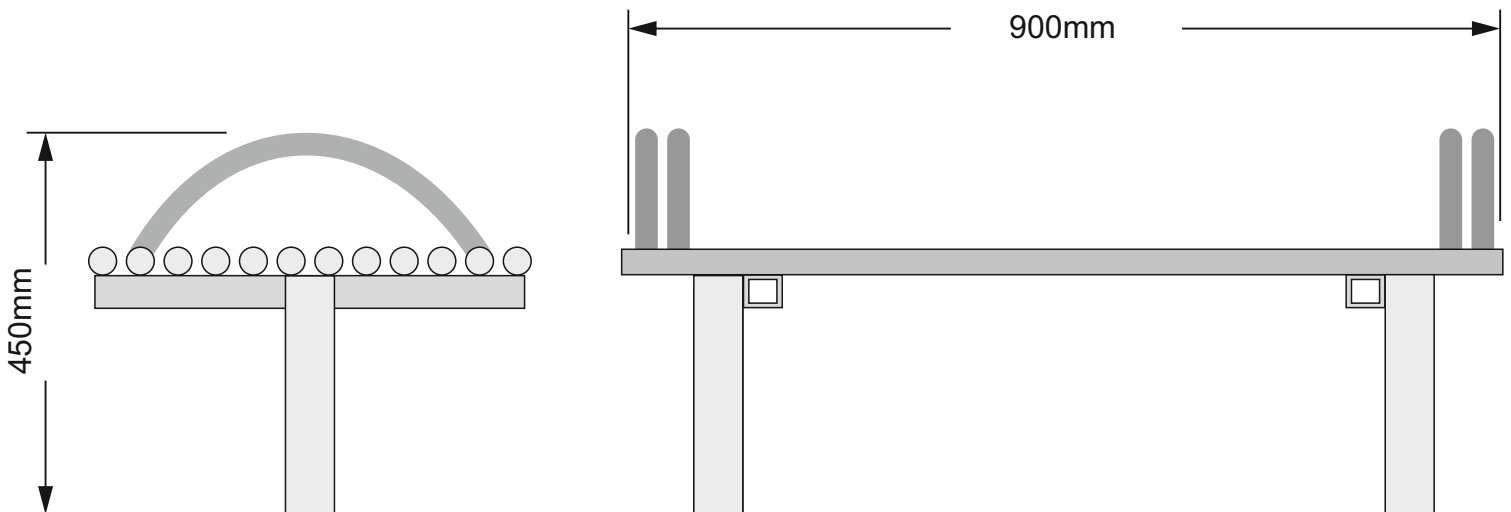
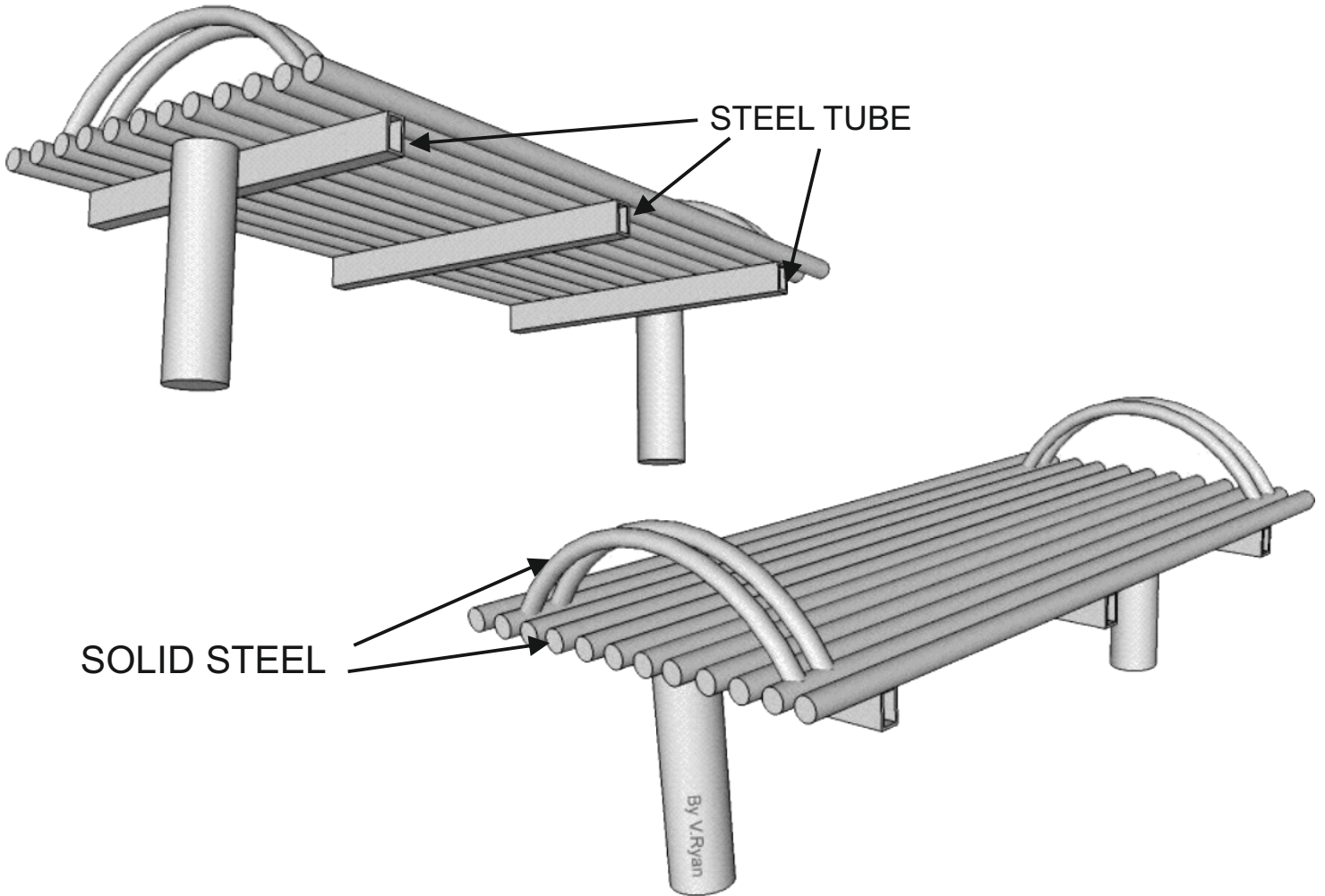
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# SECTION B – METALS

Answer ALL questions

HELPFUL LINK <http://www.technologystudent.com/joints/steelbnch1.html>

5. The Illustrations show a solution for a steel public bench.



**5a.** The steel bench needs to be improved to include the following specification points.

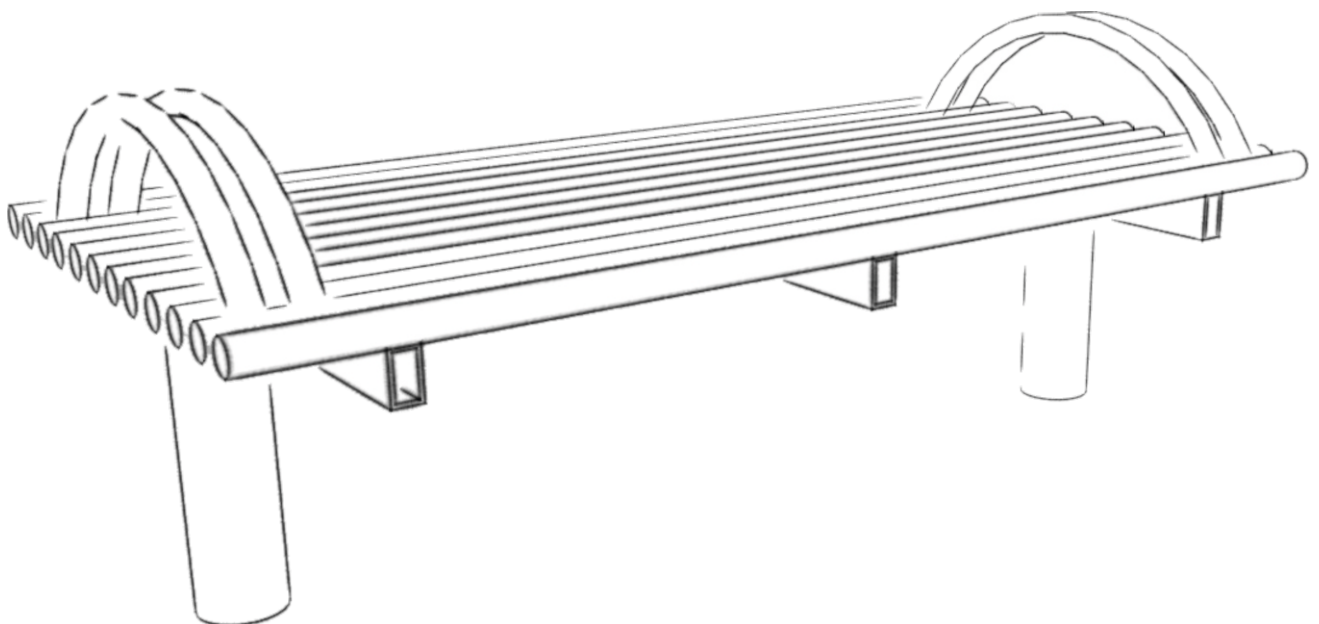
The steel bench must:

- (I) Have a support for the user's back.
- (I) Be interlockable / stackable with other units of the same design.
- (iii) The steel bench must weigh less, than suggested by the original design.

Use notes and/or sketches to show how the public seat could be modified to satisfy the addition specification points, listed above.

Produce clear drawings / sketches, using the outline of the original design to show how the additional specification points can be satisfied.

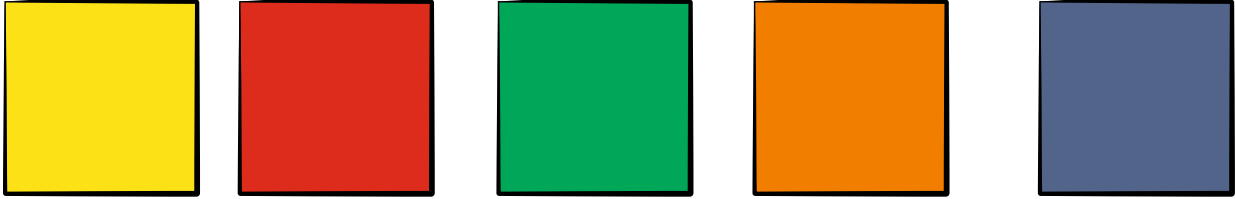
**6 marks**





**5b.** The steel bench must be available in a range of durable colours as shown below. This is achieved through a process called **Powder Coating**.

SAMPLE POWDER COATING COLOUR FINISHES



In the space below explain / describe the powder coating process. **4 marks**

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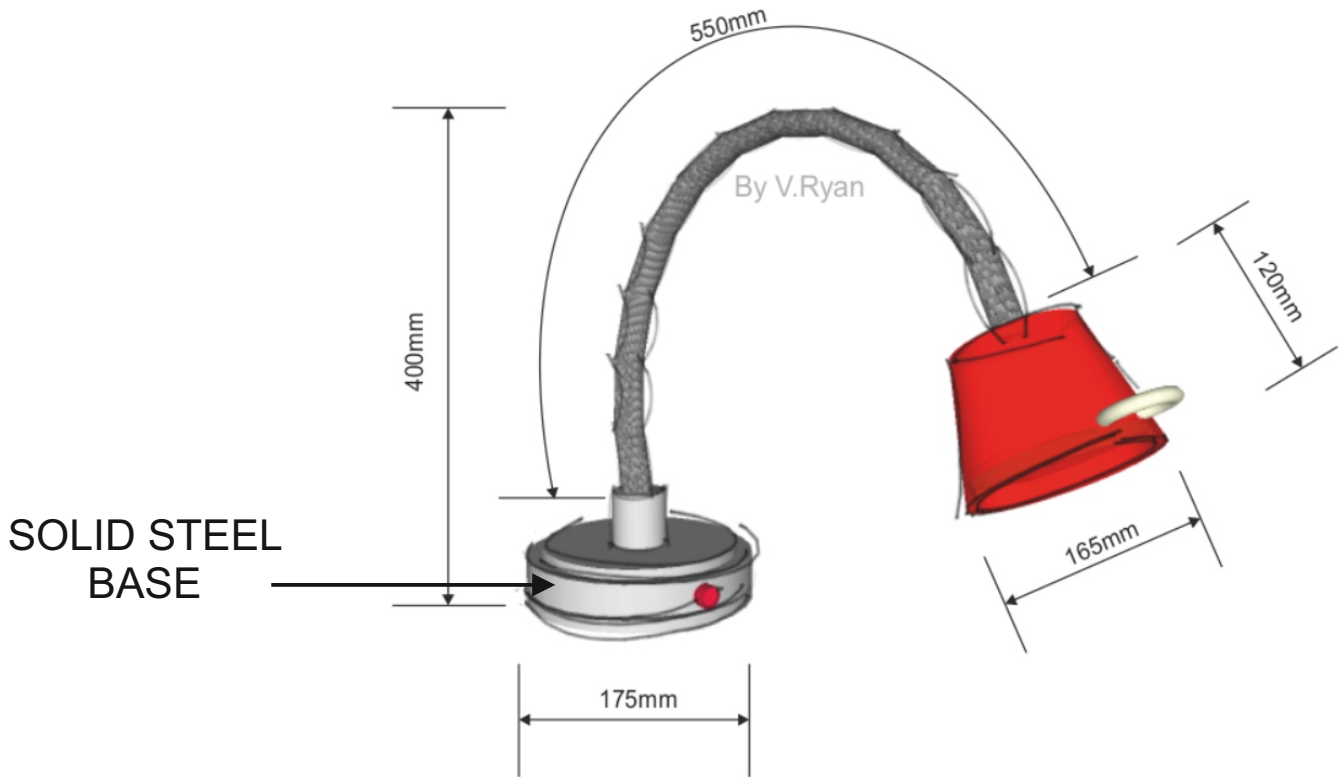
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6a. Carefully study the adjustable 'table top lamp'. The base is made from chromed, solid steel.



Write two reasons why chromed solid steel is suitable for the base of the lamp.  
**2 marks**

(I)

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(II)

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**6c.** The components have been machined, prior to being chemically blacked.

What is a machined finish?

**2 marks**



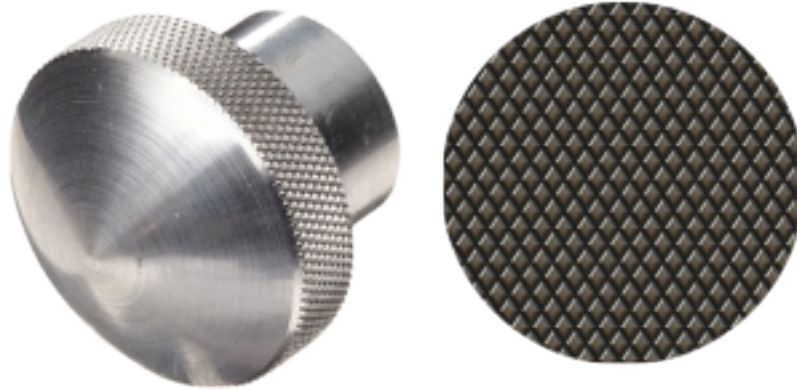
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**6d.** The component seen below has a knurled pattern finish. In the space below, explain the knurling process. Use both notes and sketches. **6 marks**



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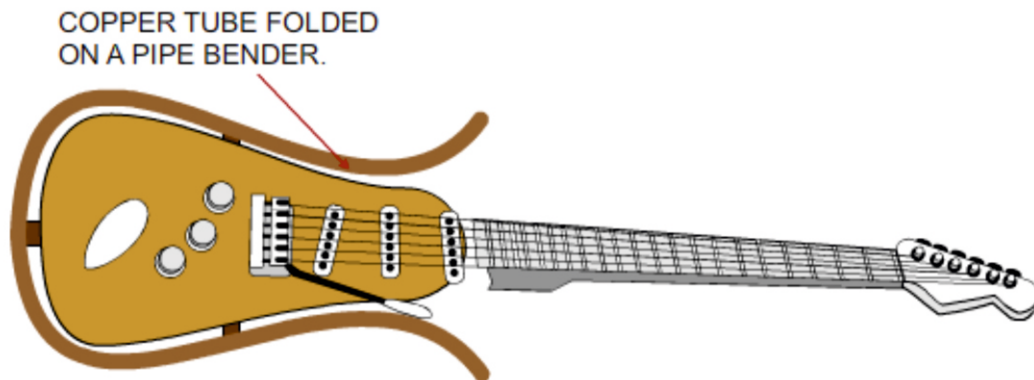
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7. The electric guitar shown below, has a decorative copper tube, shaped to follow the contours of the guitar body. A pipe bender has been used to shape the copper tube.



7a. In the space below, draw a pipe bender and explain how it could be used to manufacture the shaped copper tube. **4 marks**

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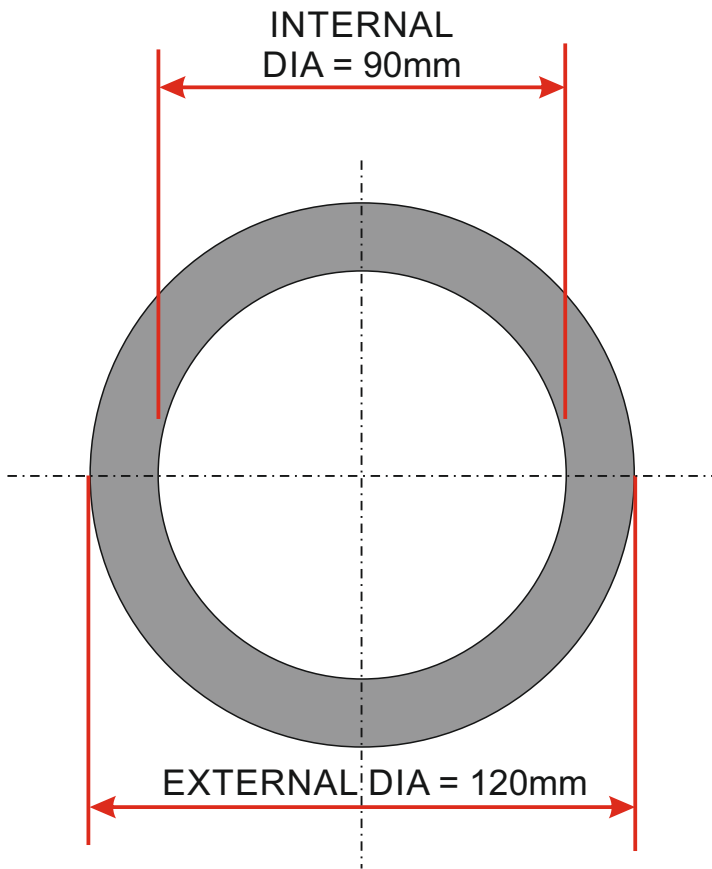
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7b. Name another piece of equipment that could be used to shape the copper tube. **1 mark**

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**7c.** A piece of steel tube can be seen opposite. The external and internal diameters can be read from the diagram.

What is the area of the surface at one end of the steel? **5 marks**

**FORMULA**

$$\text{AREA} = \pi r^2$$

$$\pi (\text{pi}) = 3.14$$

Treat the surface at the end of the tube as two circles and find the area of each one:

EXTERNAL DIAMETER

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INTERNAL DIAMETER

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Then, subtract the area of the internal circle from the area of the external circle, to find the total surface area of the tube.

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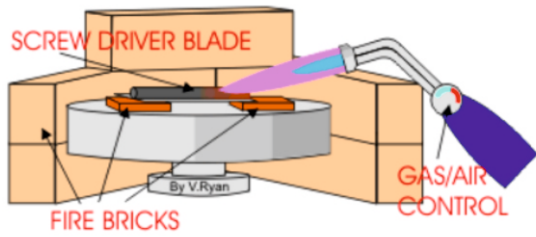
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The total surface area of one end of the tube is \_\_\_\_\_



7. The screwdriver shown opposite has been manufactured in a school workshop. The steel blade has been through the heat treatment process called hardening and tempering.

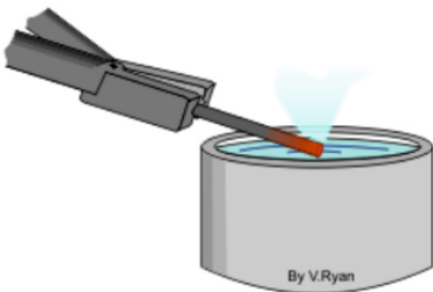
7d. Complete the stages explaining the hardening and tempering process (below). The first stage has been completed, as an example. **6 marks**



**STAGE ONE:**

The screw driver blade is heated, slowly at first, warming up the whole blade. Then the heat is concentrated on the area at the end of the blade. This gradually becomes 'red' hot.

**STAGE TWO:**




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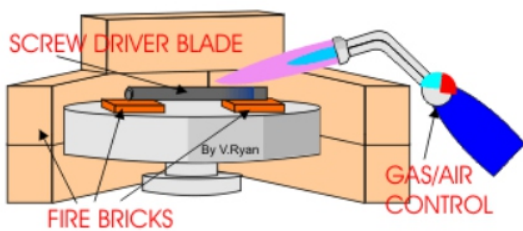


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**STAGE THREE:**




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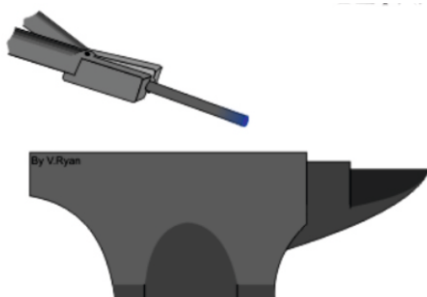


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**STAGE FOUR:**




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8. The products show below have been electroplated, to give them a 'quality' finish.

GOLD PLATED  
WATCH



COPPER PLATED  
MUG



SILVER PLATED  
TEAPOT



SILVER PLATED  
GOBLET



CHROME  
ELECTROPLATED  
TAP



8a. Using notes and a sketch(s), describe the electroplating process, used on the products above.

**9 marks (4 marks - notes and 5 marks - sketch(s))**

**NOTES:**

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**SKETCH(S)**

**8b. What is an alloy? 3 marks**

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**8c. Alloying agents (such as chromium, vanadium and nickel) enhance the properties of the parent metal. Complete the table, by adding Properties and Uses, for each alloying agent. 6 marks**

ALLOYING AGENT	PROPERTIES	USES
<b>CHROMIUM</b>		
<b>VANADIUM</b>		
<b>NICKEL</b>		

# SECTION B – PAPER AND BOARDS

Answer ALL questions

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5. A design solution for packaging of a toothbrush set, is shown below. The aim is to encourage younger people to clean their teeth thoroughly (improving oral hygiene and general health).

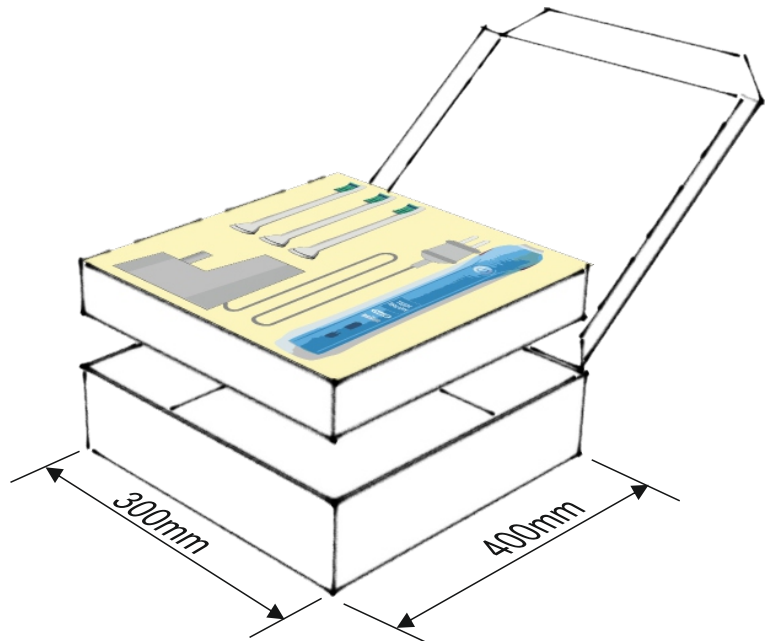
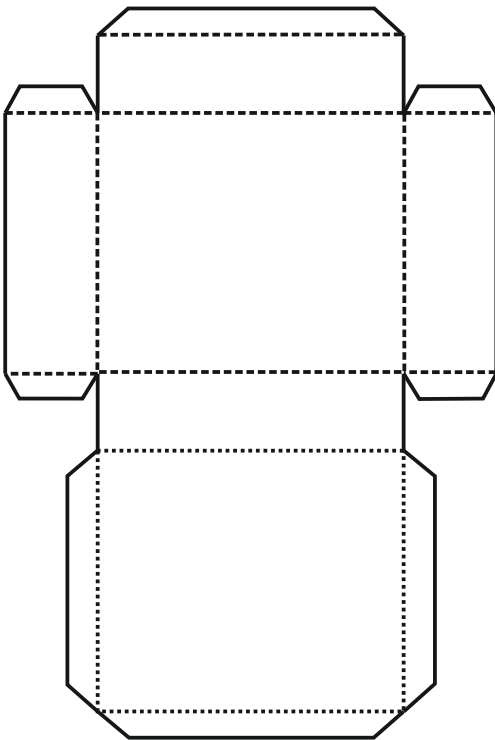
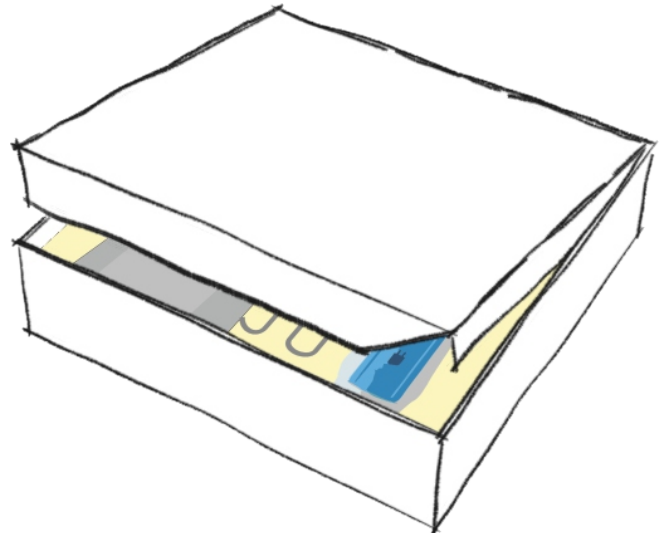
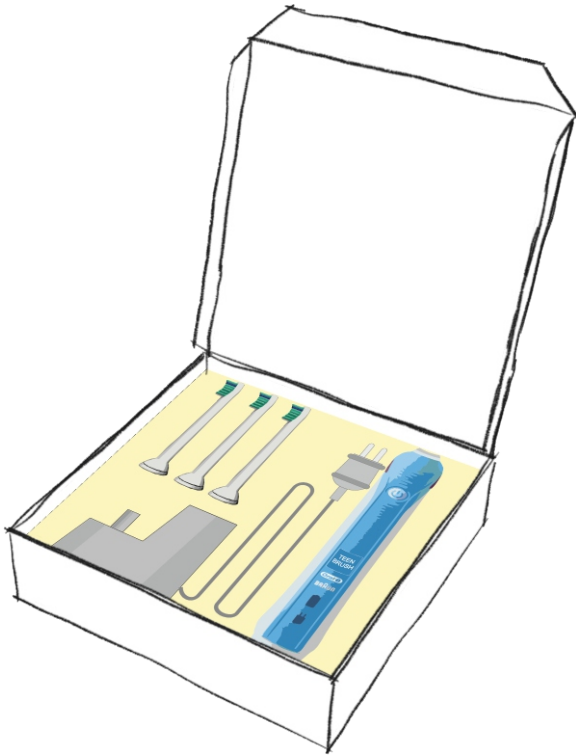
100 % recyclable

Lightweight

Environmentally friendly material.

Materials supplied from a certified sustainable source.

Supplied in flat sheet form and folded to form the 3D version.



**5a.** The packaging for a toothbrush set needs improving, so that it meets the additional specification points:

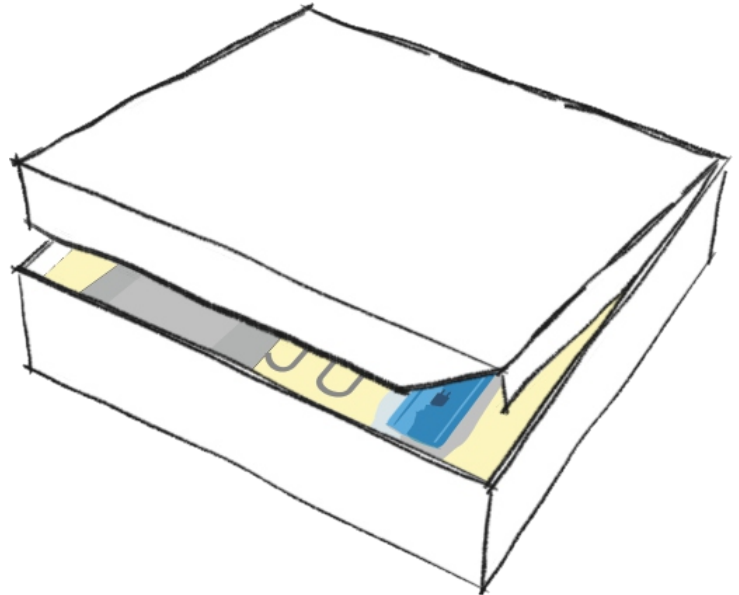
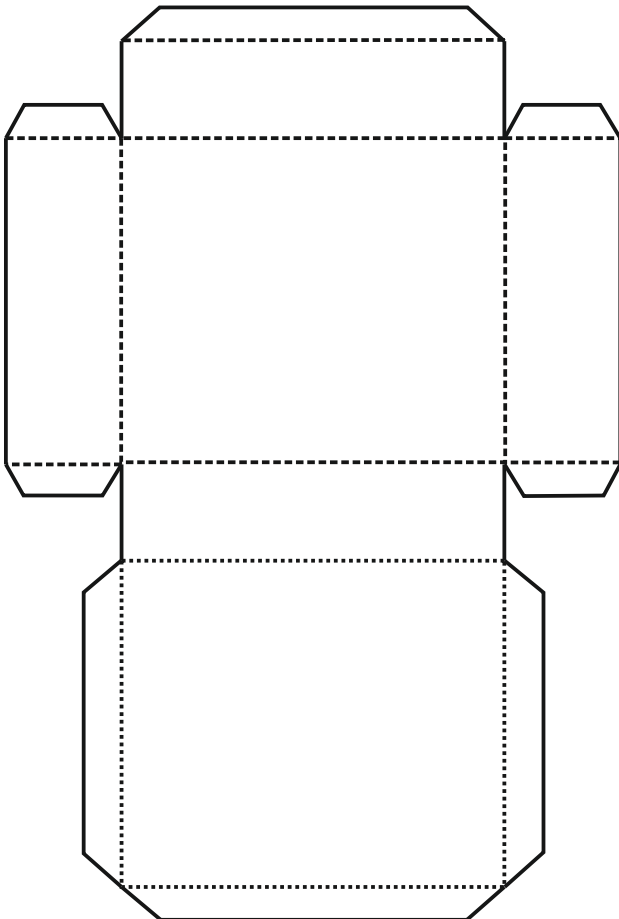
The packaging must:

- (I) Have a clear 'window', allowing potential customers to view the products inside the packaging.
- (II) The packaging must have a folding handle, allowing the customer to carry the product to the checkout.
- (III) The packaging must be environmentally friendly, displaying recycling logos, a logo associated to the use of sustainable materials AND a logo that shows that the contents satisfy British and European Standards.

Use notes and/or sketches to show how the packaging could be modified to satisfy the additional specification points, listed above

Produce clear drawings / sketches, using the outline of the original design, to show how the additional specification points can be met.

**6 marks**



**5b.** Quick Response Codes are usually seen on packaging (see example below). What is a QR Code? **4 marks**



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6a. The image on the T Shirt seen opposite, has been 'printed' through a process called 'screen printing'. This process is also often used on card / board products.



Explain the screen printing process. Include both notes and a sketch(s) in your answer **4 marks**

SKETCH(S)

NOTES:

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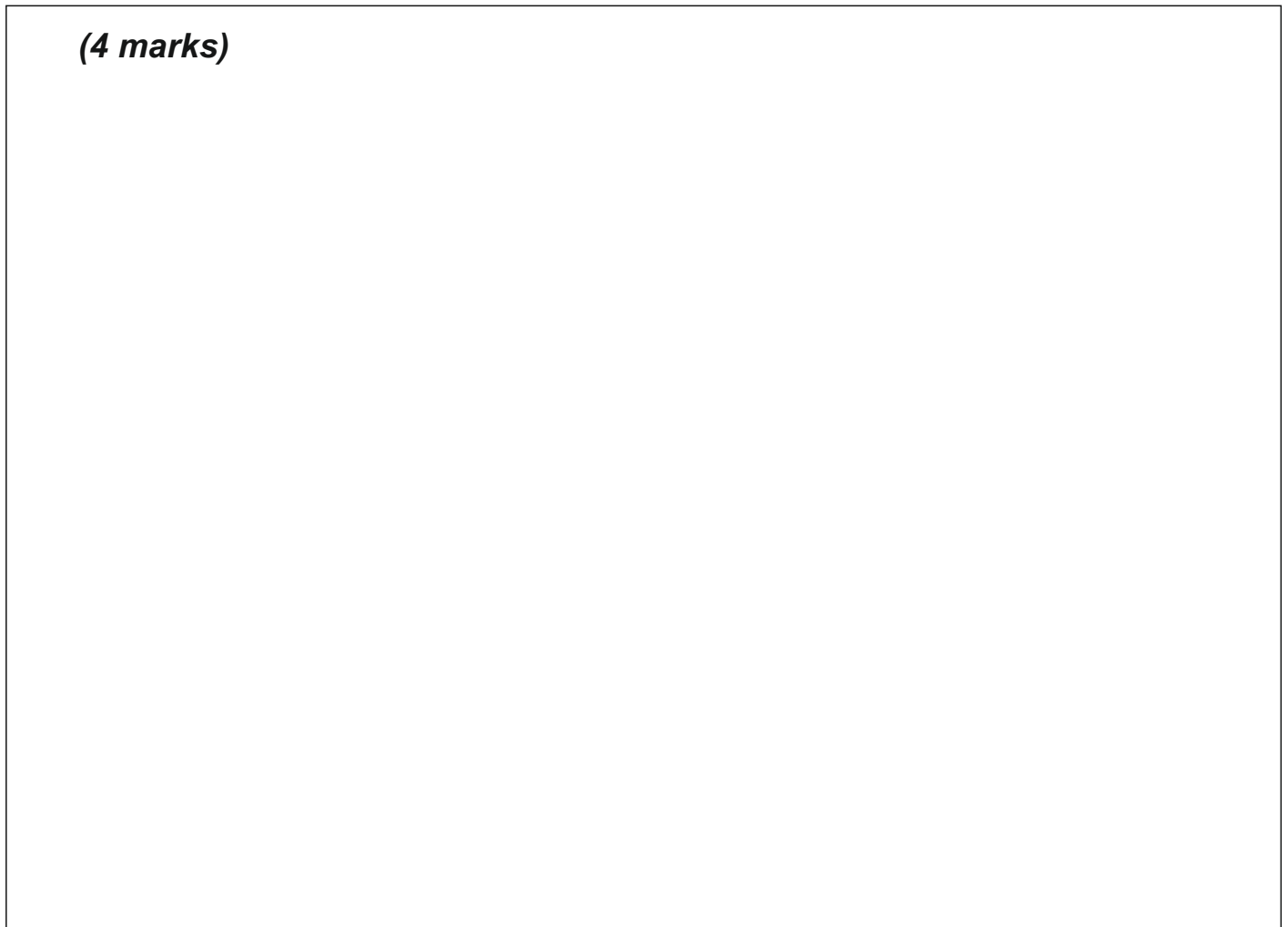


**6d.** When the packaging is manufactured, the various shapes are cut out, as a flat net / development. How is this achieved? In the space below, name a suitable process, draw a labelled diagram to represent the process and add notes that explain the process. **Total of 8 marks**

PROCESS NAME: \_\_\_\_\_  
**(1 mark)**

LABELLED DIAGRAM

**(4 marks)**



NOTES: **(3 marks)**

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**6e.** Greeting cards and quality writing paper, often have areas that have been embossed. This gives the card / paper a more luxurious feel, when it is handled. Embossing is also visually appealing (see the example).

In the space below, explain the embossing process. Use notes and sketches in your answer.

**Total of 5 marks**



EMBOSSSED AREA

LABELLED SKETCH ( **3 marks**)

NOTES ( **2 marks**):

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**8a.** Two symbols, often seen on card packaging are seen below. What do they represent?  
**2 marks ( 1 mark per answer)**

(I) \_\_\_\_\_

\_\_\_\_\_



(II) \_\_\_\_\_

\_\_\_\_\_



**8b.** The logo shown opposite is sometimes printed on packaging.

Explain the meaning of this logo. **4 marks**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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**9a.** Designers make models throughout the design and development of a product? Why is model making important? **2 marks**

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**9b.** Name two model making materials used by designers and describe the characteristics that make them suitable for model making. **3 marks**

Modelling Material:

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Characteristics:

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**9c.** Biodegradable inks are slowly increasing in popularity, for the printing of text and illustrations on packaging.

**(I)** What are biodegradable inks? **1 mark**

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**(II)** What are the advantages of biodegradable inks? **3 marks**

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**10a.** A range of paper and boards exist. Complete the table below by describing each material and giving a practical application. The first row has been completed for you.

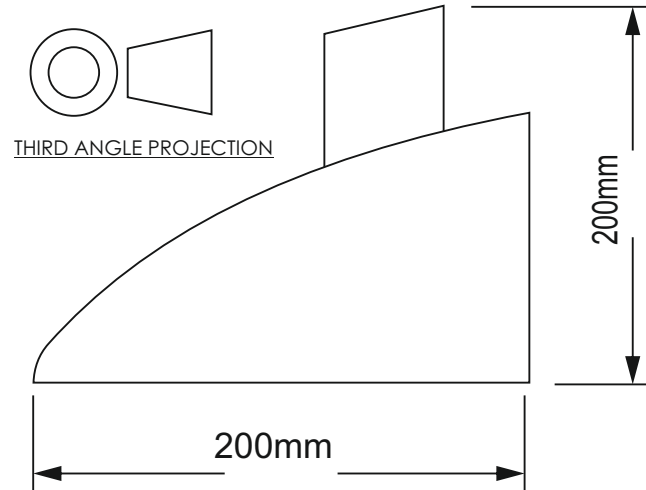
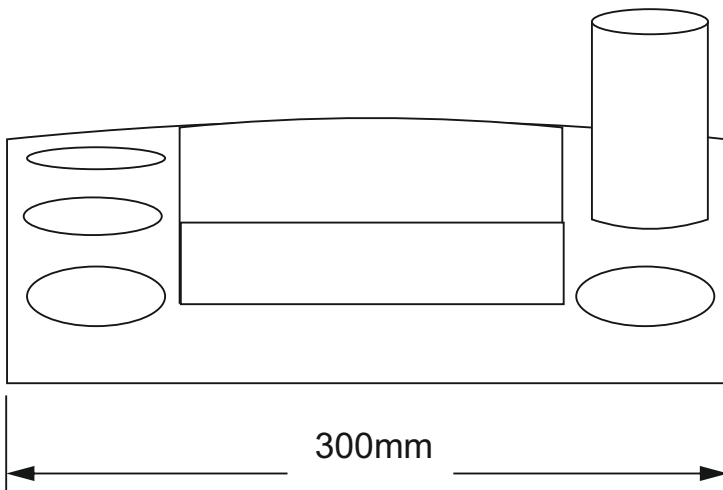
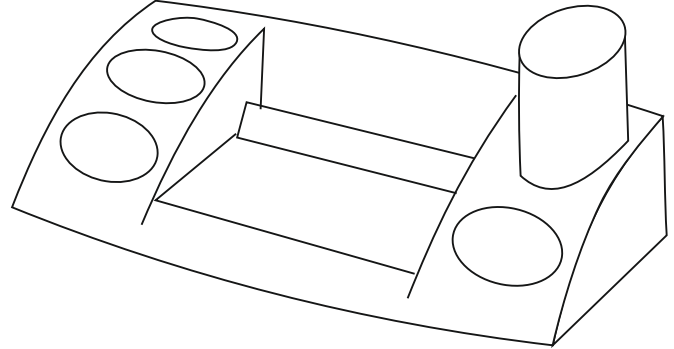
**Total of 9 marks**

<b>MATERIAL</b>	<b>DESCRIPTION</b>
<p><b>CORRUGATED BOARD</b></p>	<p><i>This type of board is often used for packaging large electrical items. These large boxes (often brown in colour) protect the contents from damage. Corrugated board is strong because it is composed of a top and bottom layer and in between there is a triangulated section. A triangular section is very strong compared to its weight.</i></p>
<p><b>DUPLEX BOARD</b></p> <p><b>3 marks</b></p>	<hr/> <hr/> <hr/> <hr/>
<p><b>TRACING PAPER</b></p> <p><b>3 marks</b></p>	<hr/> <hr/> <hr/> <hr/>
<p><b>FOIL LINED BOARD</b></p> <p><b>3 marks</b></p>	<hr/> <hr/> <hr/> <hr/>

# SECTION B – POLYMERS

Answer ALL questions

## OFFICE DESKTOP ORGANISER



The desktop organiser is manufactured from a suitable polymer

It is drop resistant, relatively unbreakable.

The organiser will help the client complete tasks such as writing, drawing and general office work.

Manufactured from recycled material.

Lightweight but very strong.

Manufactured in a range of colours.

The cost to the customer is £7.50.

**5a.** The office desktop organiser, needs to be improved to include the following specification points.

**The desktop organiser must:**

**(I)** Have an ergonomically designed handle, so that it can be transported from table to table, with ease.

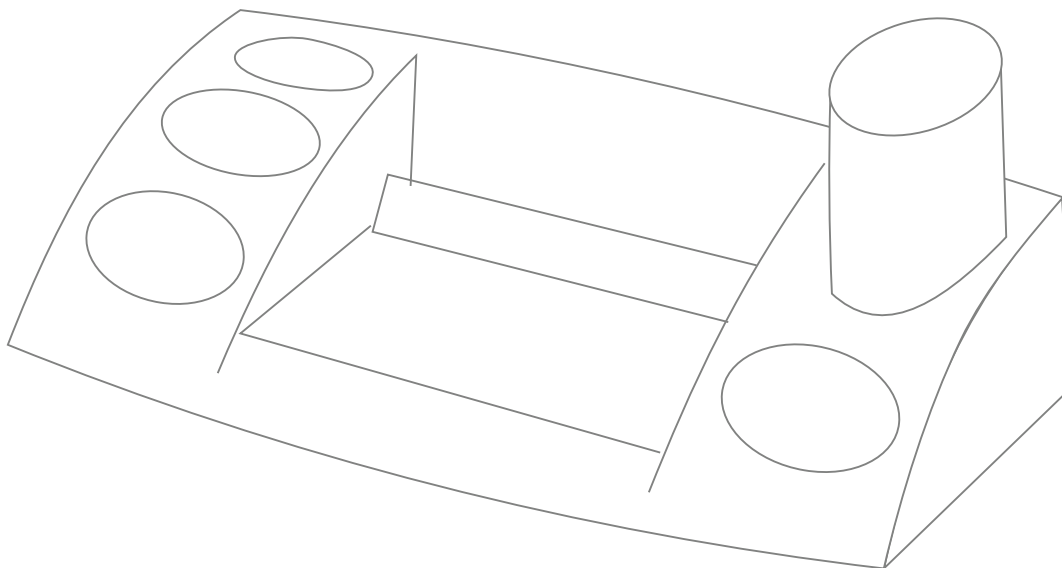
**(II)** The desktop organiser must store an increased range of stationary equipment; Pens, pencils, ruler, scissors, glue, paper clips, compass, protractor, calculator, stapler, mobile phone etc....

**(III)** The organiser must have an area that is a safe resting place for a hot drink.

Use notes and/or sketches to show how the Desktop Organiser could be modified to satisfy the additional specification points, listed above

Produce clear drawings / sketches, using the outline of the original design to show how the additional specification points can be met.

**6 marks**





**5b.** Name a suitable material for the manufacture of the desktop organiser.  
**1 mark**

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**5c.** The desktop organiser is manufactured through a process called injection Moulding. Describe injection moulding. **3 marks**

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**5d.** In the space below, draw a labelled diagram that represents the injection Moulding process. **4 marks**

**5e.** Why is the material you named in question 5b, suitable for the manufacture of this desktop organiser. **2 marks**

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**5f.** Name another material that would be suitable for the desktop organiser and explain why it is suitable. **2 marks**

NAME:

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WHY SUITABLE:

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**5g.** in the space opposite, sketch the recycling symbol for material you named in question 5b. **2 marks**



**6a.** The desktop organiser manufacturer is considering using TPEs. What are Thermoplastic Elastomers (TPEs)? **2 marks**

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**6b.** What are the general properties of TPEs? **2 marks**

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**6c.** Describe some uses of TPEs. **2 marks**

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**6d.** Why is a thermoplastic Elastomer (TPE) suitable for the manufacture of the TV remote control seen opposite?

Make reference to General Properties, Product function, aesthetics, and product manufacture in your written answer.

**5 marks**



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**8a.** The carrier bag seen opposite is manufactured from polylactide (PLA), an environmentally friendly polymer.



Write **four** reasons why this material is suitable for the carrier bag. Justify each 'reason'.

**Total of 8 marks ( 1 mark per reason, 1 mark per justification)**

**(i)**

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**(ii)**

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**(iii)**

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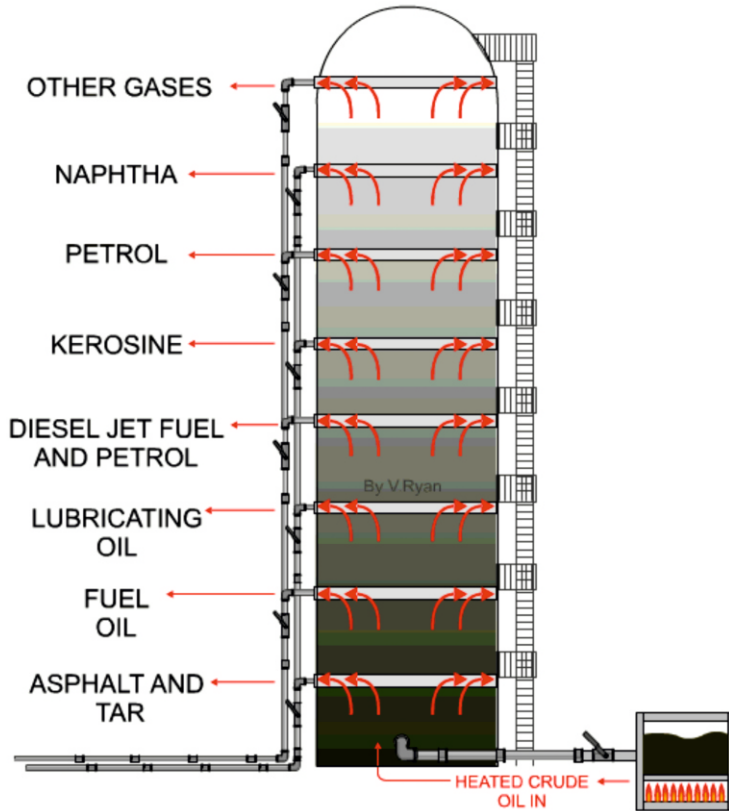
**(iv)**

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**9a.** Most polymers are manufactured from refined crude oil, using a process called **distillation**. Briefly describe this process. **4 marks**



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**9b.** What are thermosetting plastics? **3 marks**

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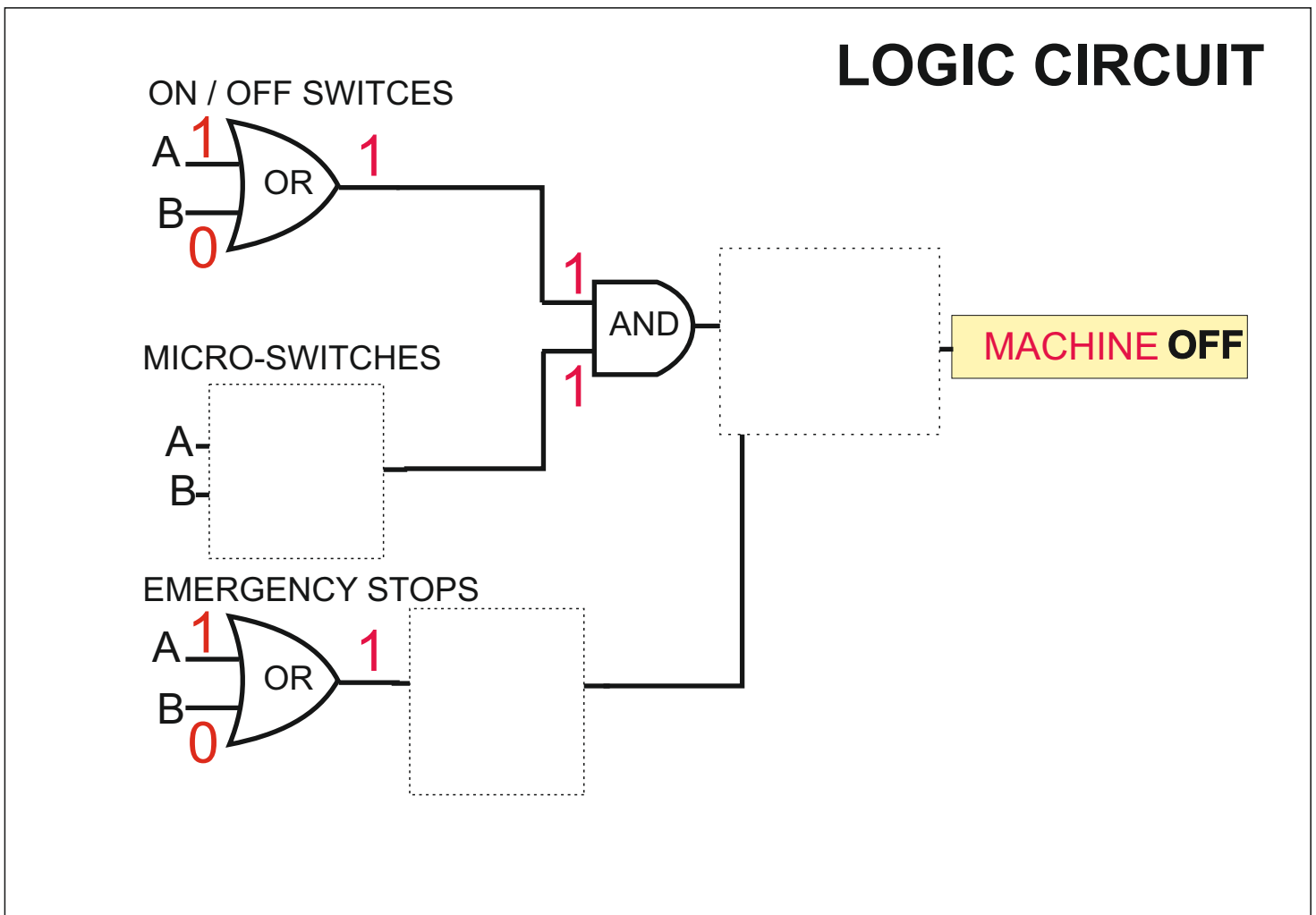
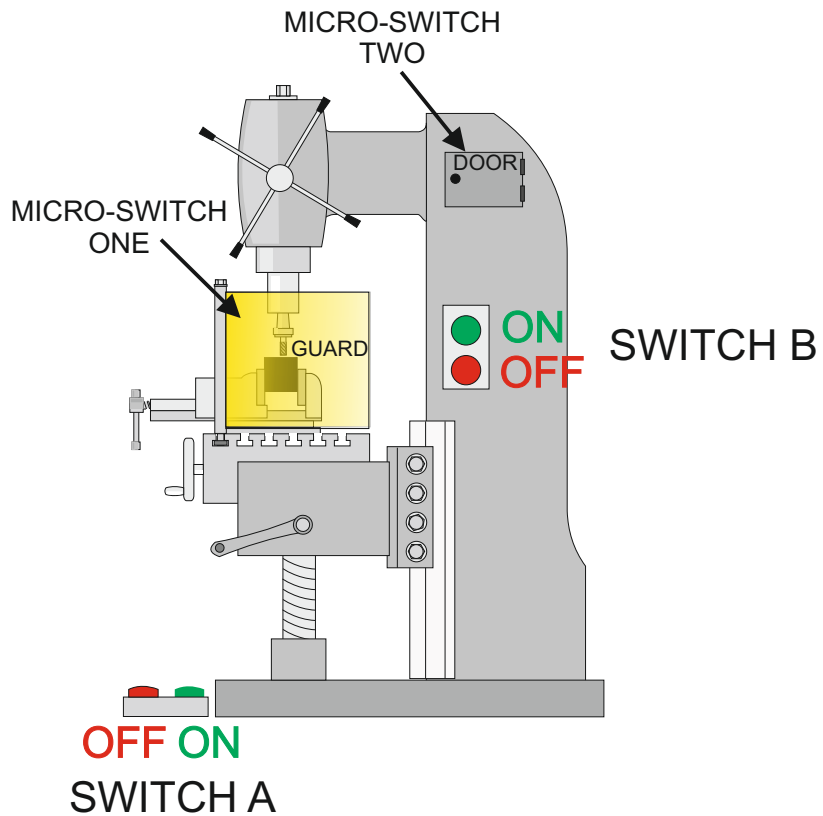


# SECTION B – SYSTEMS

Answer ALL questions

5. A metal cutting milling machine has two ON/OFF switches, either will allow the cutter to run. The first switch is on the side of the machine (B) and the second is a foot operated switch (A).

The machine has two micro-switches (one on the 'door' and one on the guard) if any of these are released the cutter will stop. The first micro-switch is on a guard, if this is opened the machine will stop. The second micro-switch is on a door which allows access to the moving mechanism of the milling machine. If this is opened the machine will stop.



**5a.** The logic circuit needs to include the following specification points.

The circuit must:

- (i) Include two emergency stop switches, found on the walls of the workshop, either capable of stopping all machines in the workshop.
- (ii) The machine must stop if a guard or machine door is opened.
- (iii) Either of the ON / OFF switches must activate / deactivate the machine.

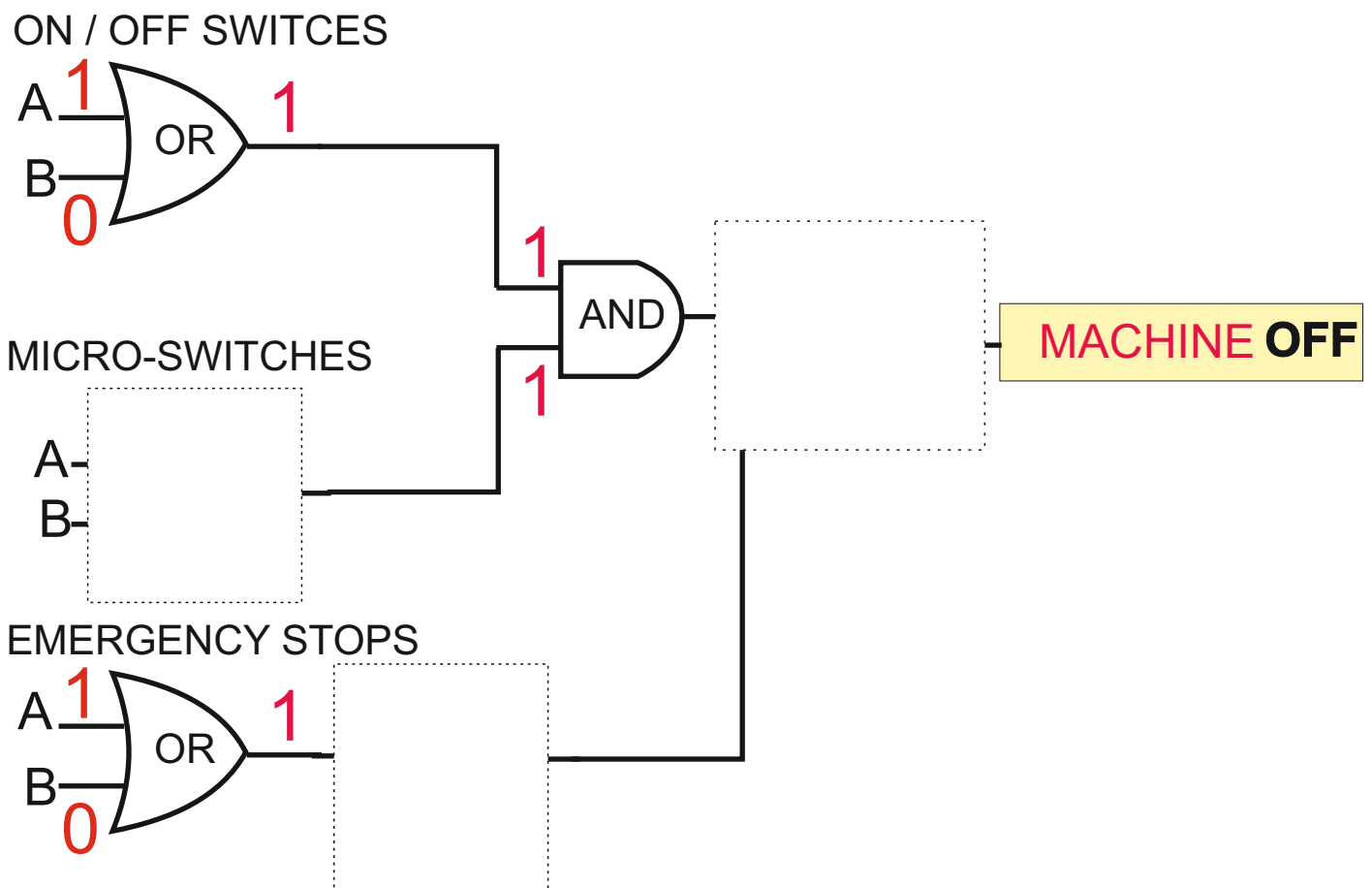
Use notes and/or sketches to show how the circuit could be modified to satisfy the specification points, listed above

Complete the logic circuit/diagram (adding suitable gates and their logic outputs), using the circuit diagram below, showing how the specification points can be met.

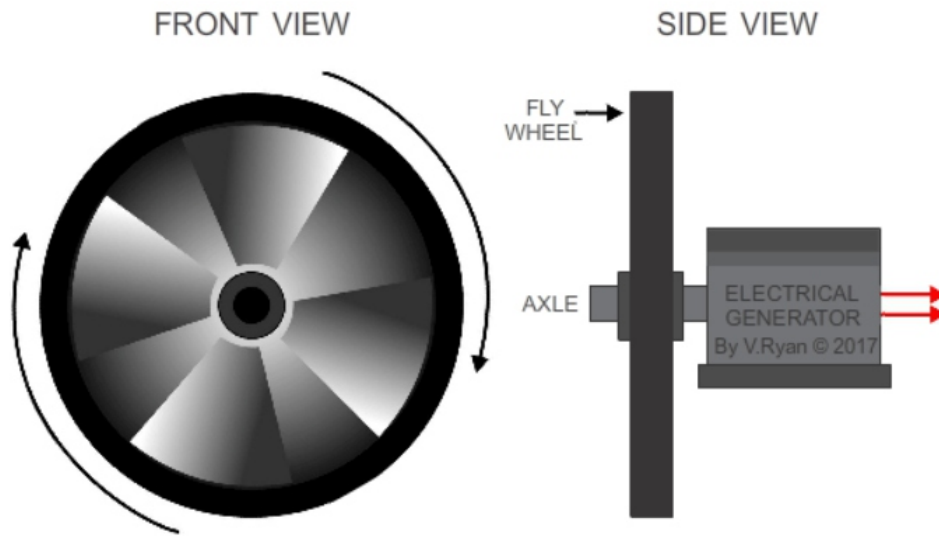
**6**

**marks**

*The micro-switches are normally logic '1' (true, high, on) when pressed. Draw the logic diagram for this machine.*



**5b.** Flywheels are one efficient way of storing energy. In simple terms, explain how a flywheel works. **2 marks**



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**5c.** Describe one modern practical application of a flywheel system. **2 marks**

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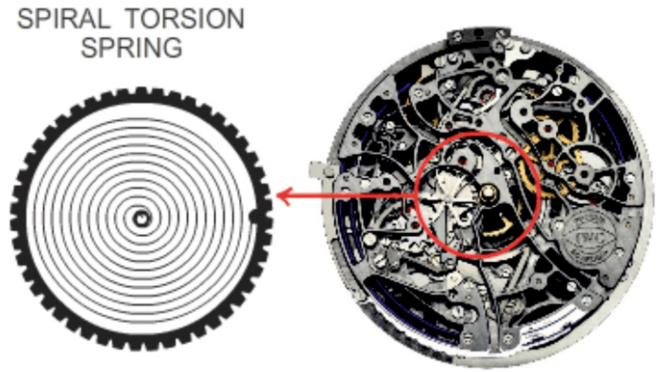
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**6a.** Springs have a variety of uses. They are often seen in expensive ‘mechanical’ / wind-up (analog) watches, such as seen opposite. How does the spiral torsion spring contribute to the movement of the hands?

**1 mark**



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**6b.** Describe one way in which springs have been applied to a system, that can store excess electrical energy and release it when required. Include notes and a simple diagram. **3 marks**

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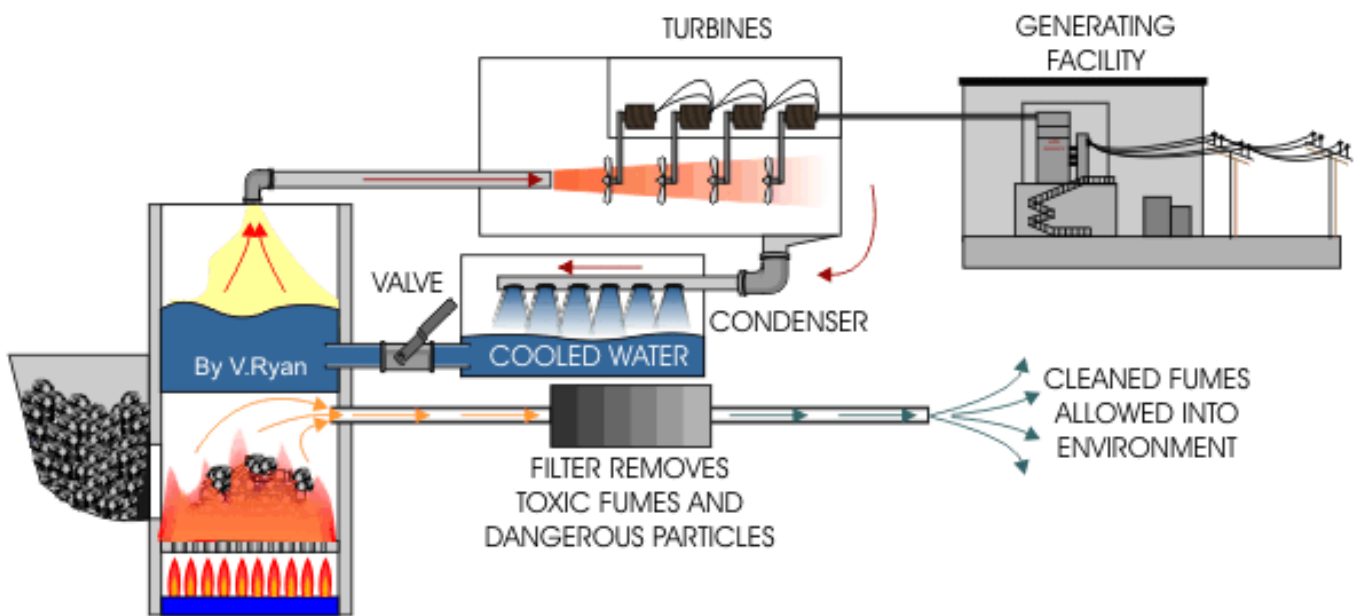
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7a. The diagram below outlines the production of electricity and its distribution. Explain each of the three aspects of the overall process. **4 marks**

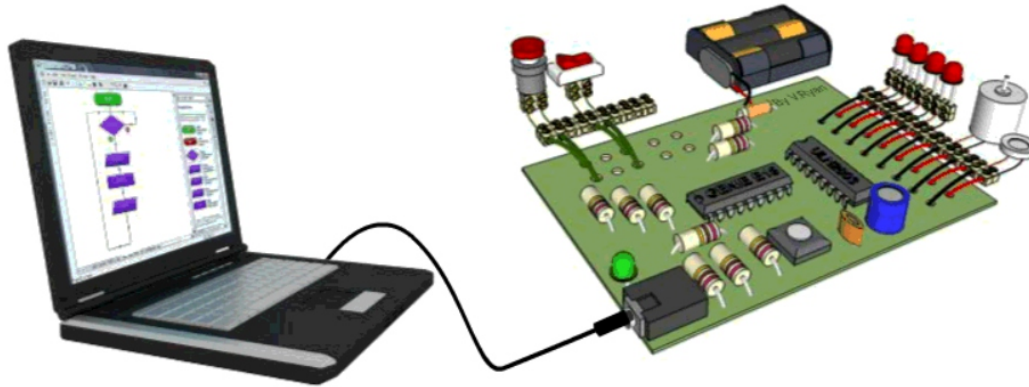
FUEL AND FURNACE	TURBINES AND GENERATING FACILITY	DISTRIBUTION TO NATIONAL GRID
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<hr/>	<hr/>	<hr/>



**8a.** A typical PIC microcontroller, connected to a computer, is shown below. What is the full terminology for PIC ? **1 mark**

PIC=

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CIRCUIT WIZARD SOFTWARE -  
USED TO PROGRAM THE  
GENIE PIC MICROCONTROLLER

A GENIE PIC MICROCONTROLLER  
PROGRAMMABLE CIRCUIT

**8b.** PIC microcontrollers are programmed via computer software. Other than programming, how is the software used? **4 marks**

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**8c.** LDRs are often used as inputs to PIC microcontrollers. How does the resistance of an LDR change, depending on the light level? **3 marks**

LIGHT DEPENDENT RESISTOR



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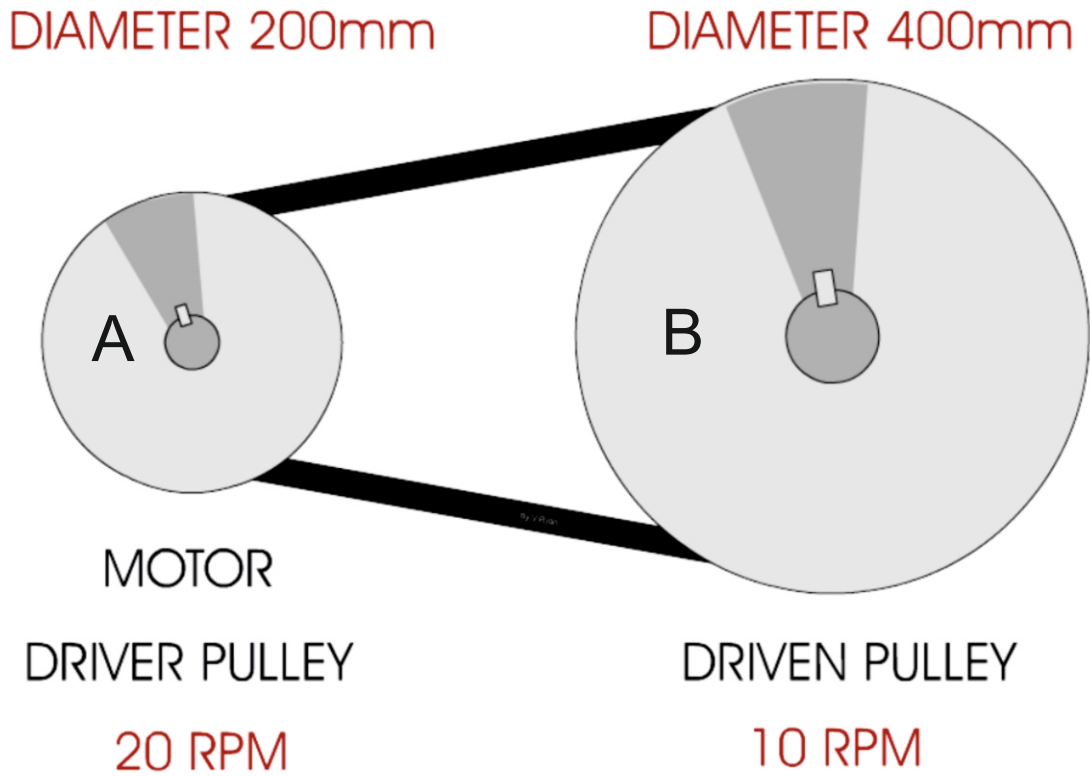
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10a. Pulleys, such as the combination shown below, are regularly used in machines and mechanical devices.



(I) Calculate the Velocity Ratio of the pulley system. Include all your working out **2 marks**

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(ii). Calculate the RPM of pulley 'B'. Include all your working out. **3 marks**

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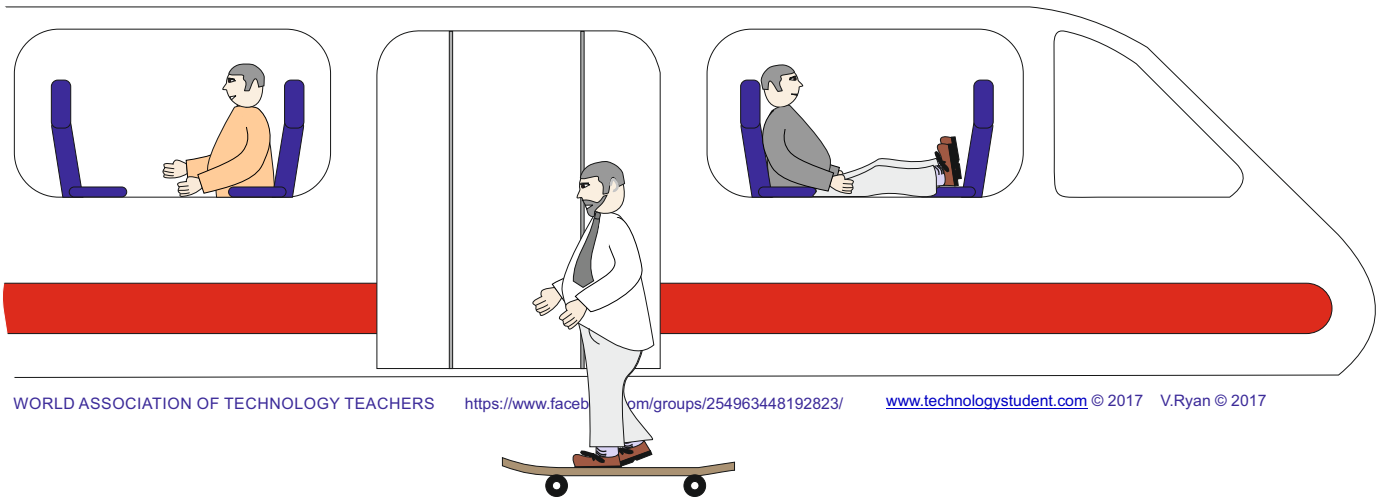
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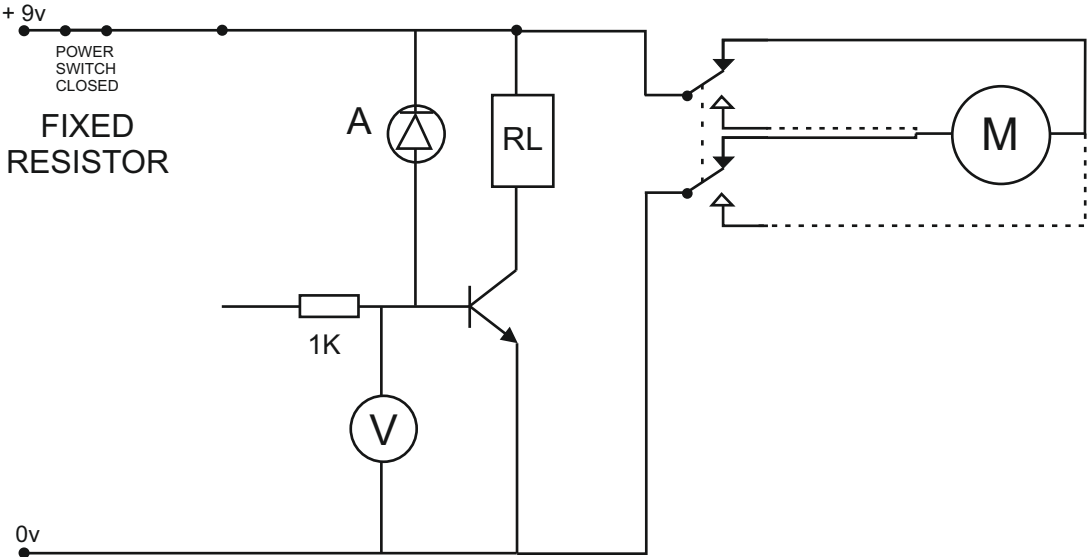


The drawing shows one of the passenger doors to a train. The passenger doors will only open when the train is stationary at the platform. A sensor circuit controls the opening and closing of doors which open automatically when a passenger approaches.

**12a.** Name a suitable sensor for this procedure. **1 mark**

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**12b.** The incomplete circuit for the operation of the doors is seen below. Complete the circuit by adding the components required to represent your sensor. **3 marks**



**12c.** Describe one safety feature the door control system should have. **1 mark**

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**13.** Most electronic products are financed, manufactured and distributed through a system called Globalisation.

**13a.** In general terms, what is globalisation? **4 marks**

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**13b.** Describe / explain some of the disadvantages of globalisation. **5 marks**

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# SECTION B – TIMBERS

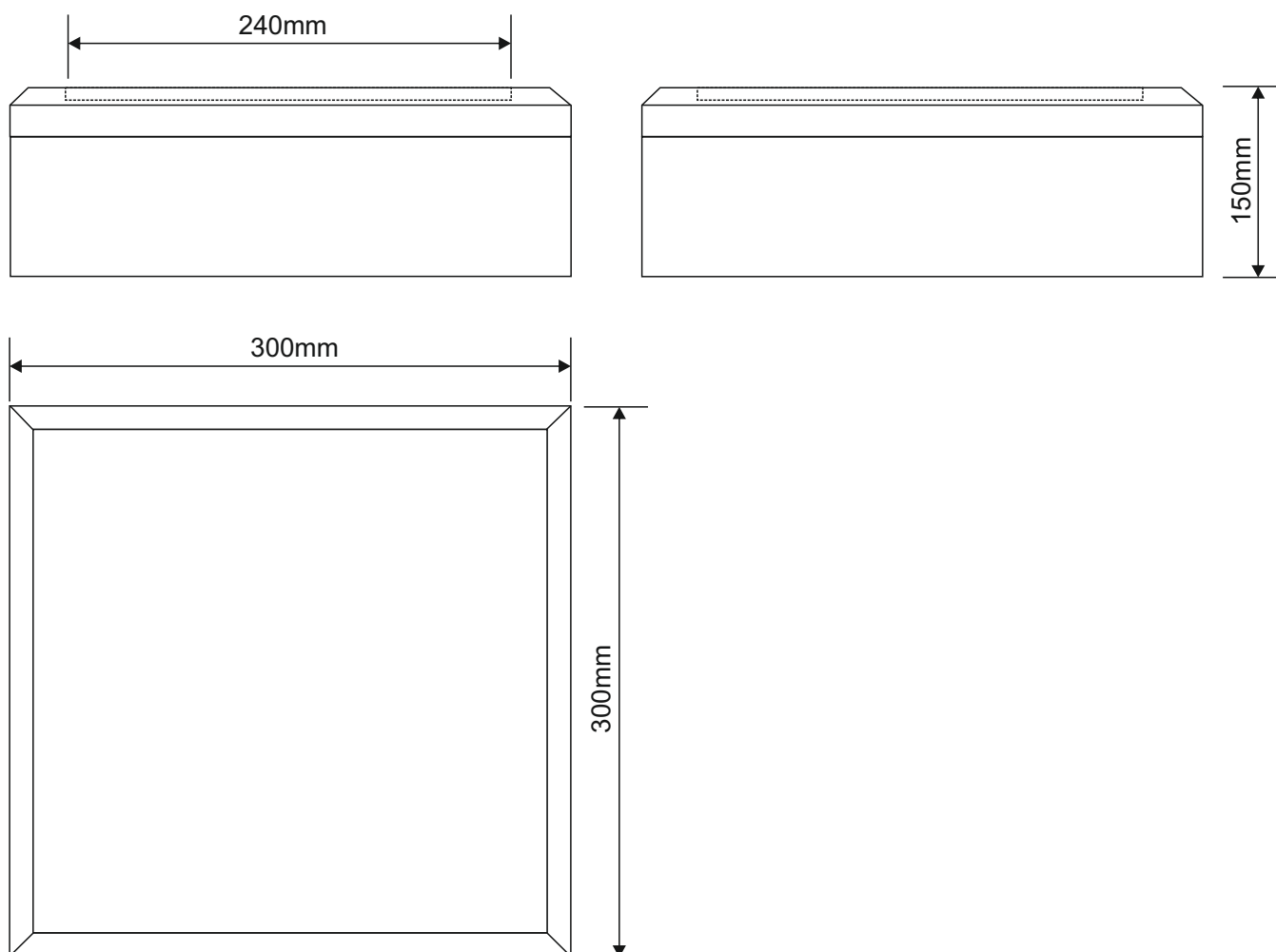
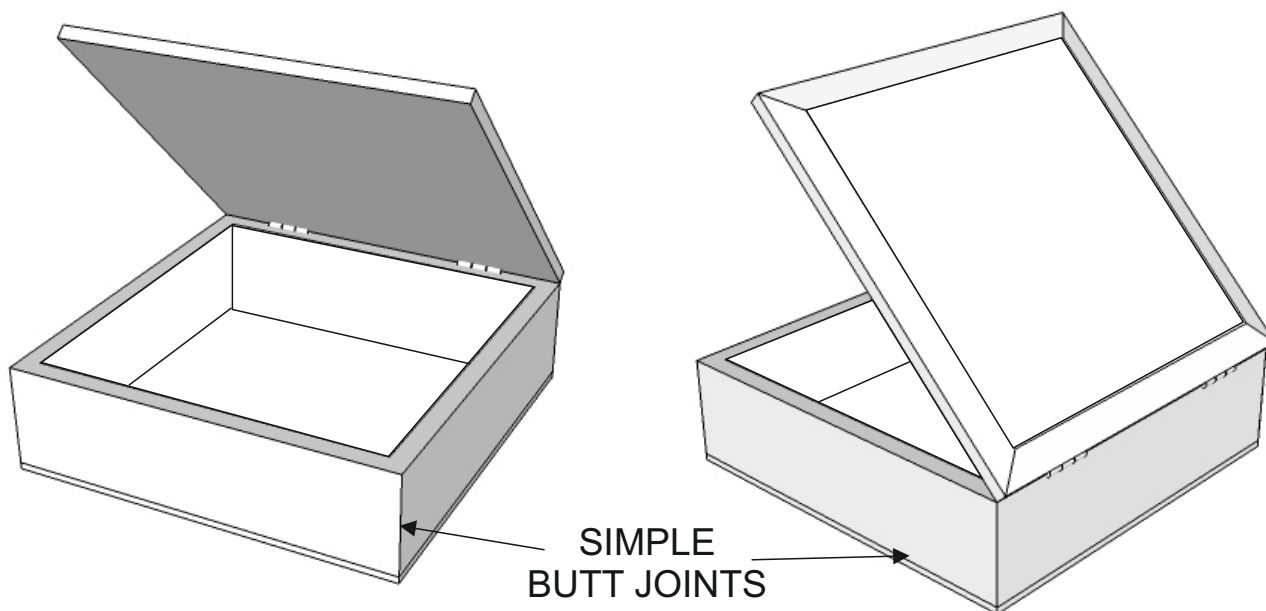
Answer ALL questions

WORLD ASSOCIATION OF TECHNOLOGY TEACHERS

<https://www.facebook.com/groups/254963448192823/>

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## Bits and Bobs Storage (timbers)



This storage box is available in a variety of natural woods. Traditional jointing methods have been used during its manufacture. It has a quality finish and can be locked for security.

**5a.** The storage box, needs to be improved to include the following specification points.

The storage box must:

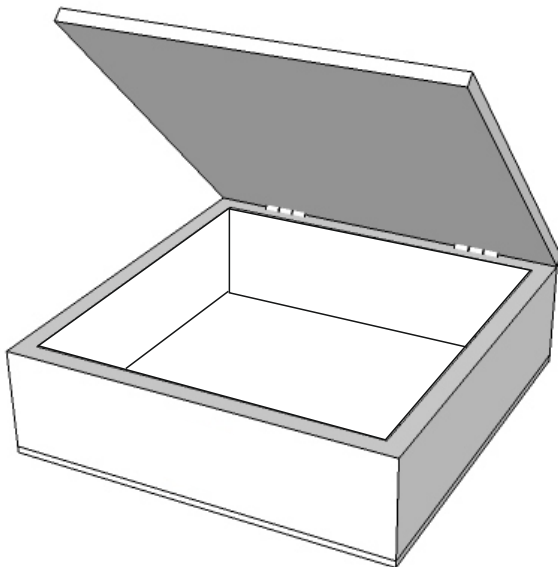
- (i) Have an ergonomically designed handle, to enable easy transport.
- (ii) They must be divided within the storage unit, to store different types of 'small' items.
- (iii) The corner joints of the storage unit, need to be upgraded so that they are strong and can withstand 'knocks'.

Use notes and/or sketches to show how the storage box could be modified to satisfy the additional specification points, listed above

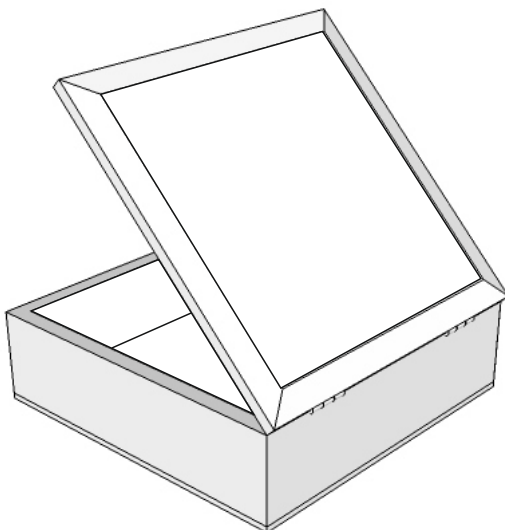
Produce clear drawings / sketches, using the outline of the original design and the space alongside, to show how the additional specification points can be met.

**6 marks**

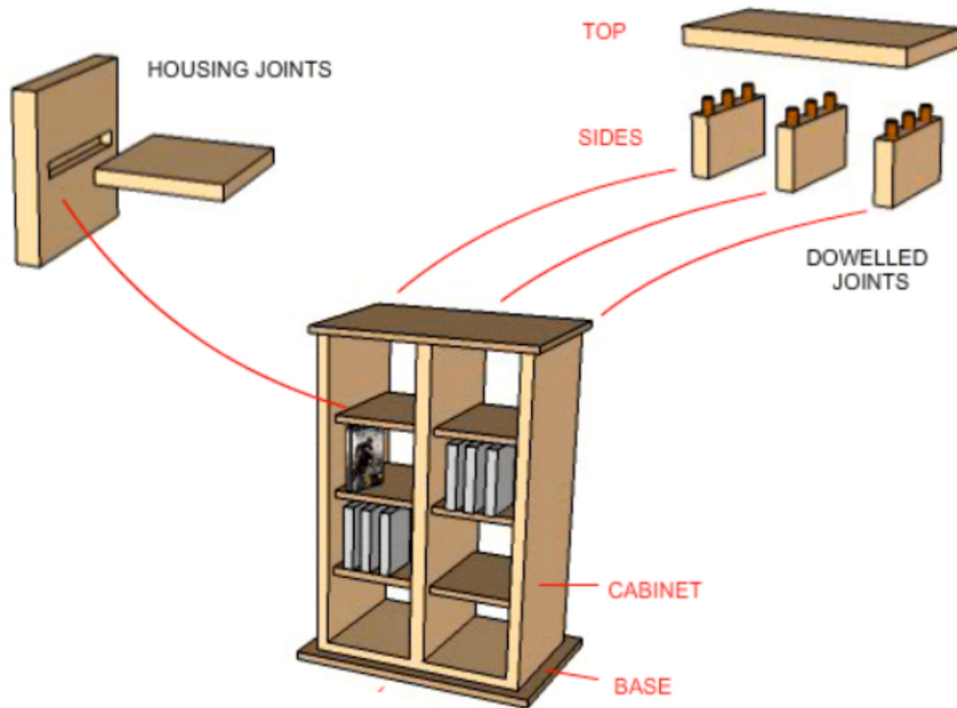
ORIGINAL DESIGN



SKETCHING AREA



**5b.** The DVD storage unit is manufactured from Pine or any other suitable natural wood, as requested by the customer.



**(I)** Explain why a plain housing joint is suitable for the DVD storage unit.  
**2 marks**

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**(II)** Explain why dowelled joints are suitable for the top and sides.  
**2 marks**

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**5c.** The panels / sides of the DVD storage unit are to be varnished, producing a high quality finish.

**(I)** Using notes and sketches, describe the stages involved in 'sanding' / 'glass papering', the surface of the 'wood' panels / sides, in preparation for varnish.

**4 marks**

**(II)** How can varnish be applied to natural wood, ensuring a good finish? **2 marks**

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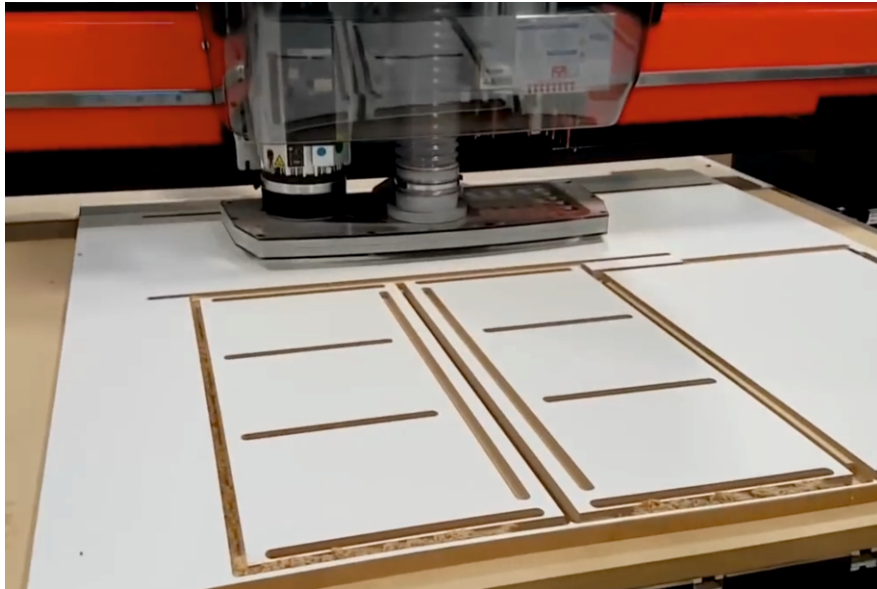
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**6a.** A retailer has ordered a large number of natural wood DVD storage units, manufactured by a CNC Router, as seen below.

**(I)** What is the meaning of CNC. **1 mark**



**(II)** Describe 2 **advantages** of using CAM in the manufacture of large numbers of this product. **2 marks**

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**(III)** Describe 3 **disadvantages** of using CAM in the manufacture of large numbers of this product. **3 marks**

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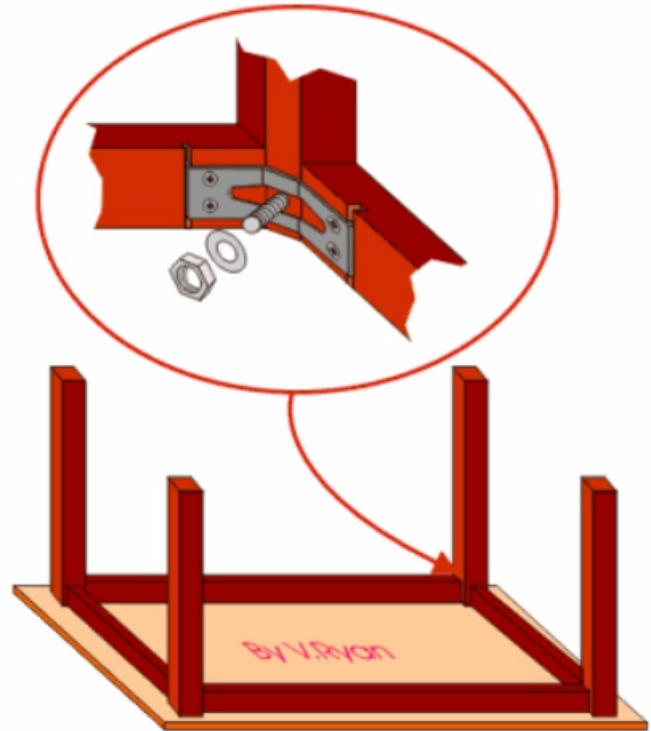
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7. The table seen opposite is a piece of 'knock-down' furniture, held together by a common 'knock-down' joint.

7a. What is the name of the knock-down joint? **1 mark**

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7b. The table is to be updated, with the joints being permanently glued together. In the space below, name and sketch a suitable joint that can replace the knock-down joint. **4 marks**



**9a.** Explain why plywood can be described as a composite material. Include both notes and a sketch(s) in your answer **4 marks**

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**9b.** What are the advantages of using plywood over other natural woods? **2 marks**



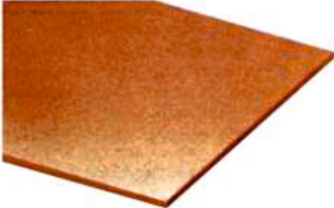
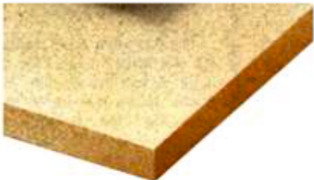
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10a. List one standard size of a wood based composite board: **1 mark**

10b. A number of wood based boards are listed below. Write a description of each board, alongside its name / picture. **8 marks in total**

<b>BOARD</b>	<b>DESCRIPTION</b>
<p><b>BLOCKBOARD</b></p>  <p><b>2 marks</b></p>	<hr/> <hr/> <hr/> <hr/>
<p><b>CHIPBOARD</b></p>  <p><b>2 marks</b></p>	<hr/> <hr/> <hr/> <hr/>
<p><b>HARDBOARD</b></p>  <p><b>2 marks</b></p>	<hr/> <hr/> <hr/> <hr/>
<p><b>MEDIUM DENSITY FIBREBOARD (MDF)</b></p>  <p><b>2 marks</b></p>	<hr/> <hr/> <hr/> <hr/>

**11a.** What is a sustainable forest and why are sustainable forests important? **3 marks**

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**11b.** The logo shown opposite is sometimes printed on timber and packaging.  
Explain the meaning of this logo. **3 marks**



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**11c.** The logo shown opposite is sometimes printed on timber and packaging.  
Explain the meaning of this logo. **3 marks**



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**ADD YOUR OWN TEXTILES  
SPECIFIC EXAMINATION  
QUESTIONS**