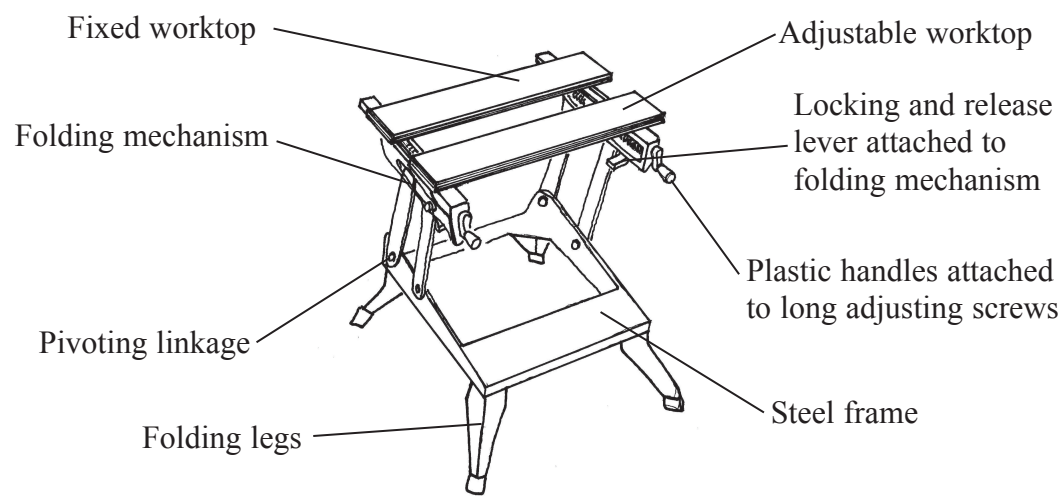




Answer ALL the questions. Write your answers in the spaces provided.

1. The drawing below shows details of a DIY workbench.



(a) Two specification points for the DIY workbench are that it must:

- fold for storage
- be able to clamp different sizes of material

Under each of the following headings, give **one** more point that should be included in the specification for the DIY workbench.

For each point, give **one** reason why it should be included.

(i) **Market**

Point .....

Reason .....

(2)

(ii) **Quality**

Point .....

Reason .....

(2)

(iii) **Environment**

Point .....

Reason .....

(2)



(b) The frame of the workbench is made from steel.  
One reason for using steel is that it can be finished using a plastic coating.

(i) Give **two** other reasons why steel is a suitable material from which to make the frame.

1 .....

2 .....

(2)

(ii) Give **two** reasons why plastic coating is a suitable finish for the frame.

1 .....

2 .....

(2)

(c) The worktops are made from 20 mm thick plywood. Plywood is made from several layers of wood glued together.

Give **two** properties of plywood that make it more suitable for the worktops than a single piece of solid wood.

For each property, give **one** reason why it makes plywood suitable.

Property .....

Reason .....

Property .....

Reason .....

(4)

(d) Quality control checks are carried out at important stages during the manufacture of the DIY workbench.

Name **two** important quality control checks that should be carried out during the manufacture of the DIY workbench.

1 .....

2 .....

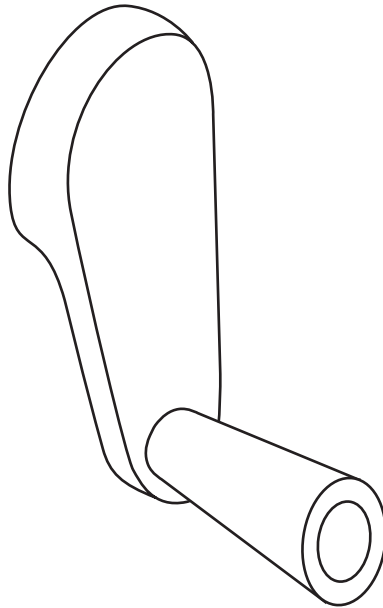
(2)



Leave  
blank

- (e) The plastic handles are made in high volume from a thermoplastic using the injection moulding process.  
The shape of the handles makes them suitable to be made from a thermoplastic.

The drawing below shows a thermoplastic handle.



Describe **one** way in which the shape of the handle makes it suitable to be made from a thermoplastic.

.....

.....

(2)



Leave  
blank

(f) Two purposes of the DIY workbench are that it must:

- fold for storage
- be able to clamp different sizes of material

Explain, under the following headings, how the DIY workbench achieves these purposes.

(i) Fold for storage.

.....  
.....  
.....

(2)

(ii) Be able to clamp different sizes of material.

.....  
.....  
.....

(2)

(Total 22 marks)

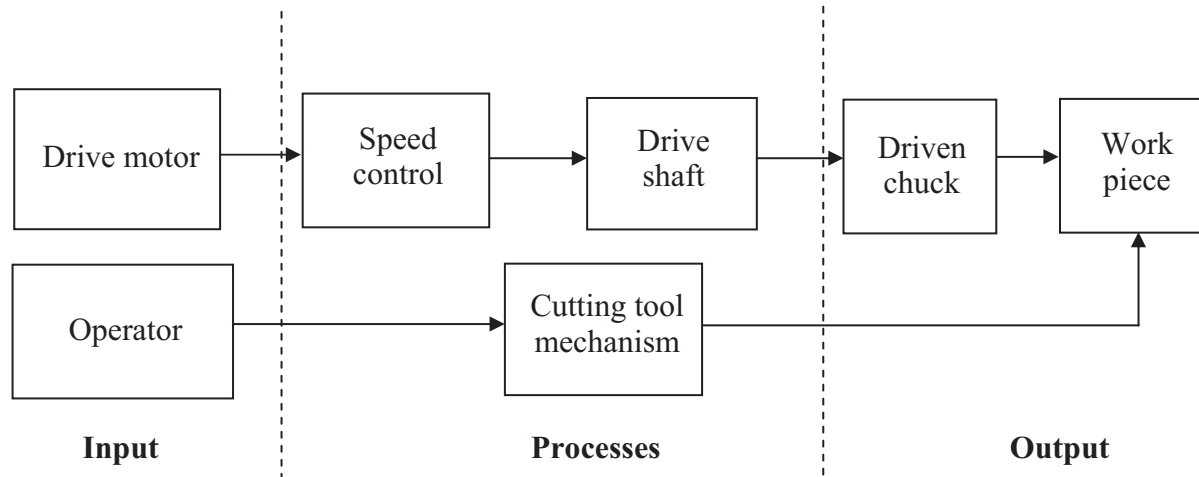
Q1

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2. (a) A centre lathe contains a combination of electrical and mechanical systems to make it work.

A simplified block diagram of the mechanical system is shown below.



(i) Name **one** appropriate mechanical system for providing the speed control in the block diagram.

..... (1)

(ii) Name the appropriate mechanical system that will disengage and engage the drive shaft to allow the speed to be changed.

..... (1)

(iii) Give the technical term for the output motion of the chuck.

..... (1)

(b) A computer can be used to control a lathe for single item production.

Give **one** reason for using a computer to control a lathe for single item production.

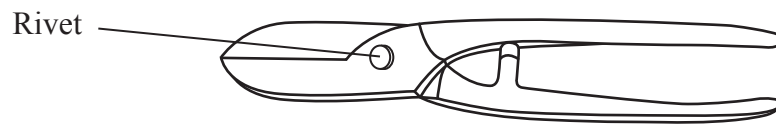
..... (1)

(c) Mechanical systems may be modelled using resistant materials. Describe **one** other way of modelling mechanical systems.

.....  
 ..... (2)



(d) The drawing below shows a pair of tin snips. The tin snips are joined by a rivet.



Describe how a riveted joint is made.

.....  
.....  
**(2)**

(e) Many metal parts are finished with a coating of Teflon.

Give **three** functional reasons why many metal parts are finished with a coating of Teflon.

1 .....  
2 .....  
3 .....  
**(3)**

(f) Machine parts may be made and assembled using CNC automated production methods.

One advantage of using CNC automated production methods is that it eliminates human error.

Explain **two** other advantages, to the manufacturer, of using CNC automated production methods.

1 .....  
.....  
2 .....  
.....  
**(4)**



Leave  
blank

(g) Manufacturers often buy-in plastic components for their products. These plastic components are made in high volume using the injection moulding process.

Give **three** reasons why the injection moulding process is used to make plastic components in high volume.

1 .....

2 .....

3 .....

(3)

(h) A machine part is designed using Computer Aided Design (CAD).

One task that CAD can perform is the creation of a 3D virtual product.

(i) Give **two** different tasks which CAD can perform when used to design machine parts.

1 .....

2 .....

(2)

(ii) Describe **one** way in which a 3D virtual product can be used in a CAD program to help when designing machine parts.

.....

.....

(2)

Q2

(Total 22 marks)





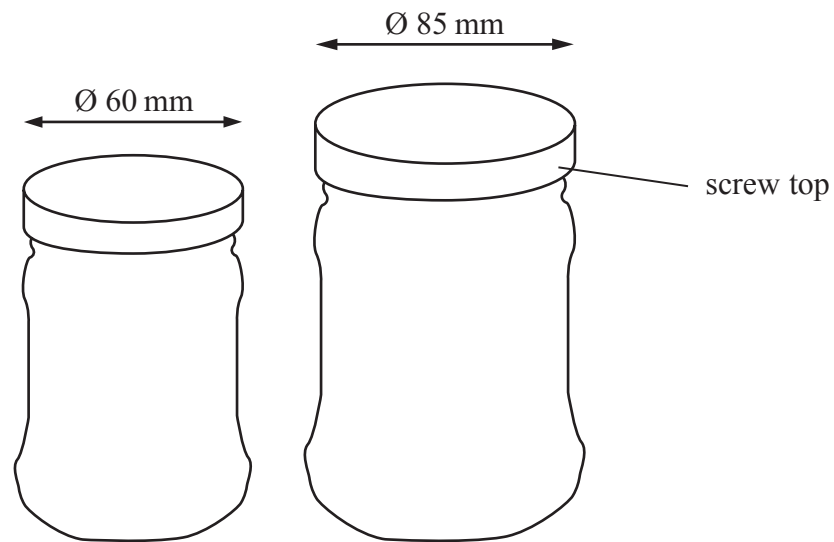
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3. A company designs devices to help disabled people.

People with arthritis in the hand find it difficult to open the screw tops of food jars.

A device to help them is needed.



**Food jars**

The specification for the food jar opening device is that it must:

- have a means of fitting comfortably into a person's hand
  - open the screw tops of the jars easily
  - be adjustable to open jars sized from 60 mm to 85 mm in diameter
  - be made from materials and finishes suitable for batch production
- (a) In the spaces opposite, use sketches and, where necessary, brief notes to show **two different** design ideas for the food jar opening device that meet this specification.

Do **not** evaluate your designs in part (a).

Candidates are reminded that if pencil is used for diagrams/sketches, it must be dark (HB or B). Coloured pens, pencils and highlighter pens must **not** be used.

**PLEASE DO NOT WRITE OR DRAW IN THIS SPACE.**

**PLEASE USE THE SPACES OPPOSITE FOR YOUR DESIGNS.**



**Design Idea 1**

Leave  
blank

**(8)**

**Design Idea 2**

**(8)**



Leave blank

(b) Three of the original specification points are repeated below.

Evaluate how **one** of your design ideas succeeds or fails to meet each of these specification points.

Write down the number of your chosen design idea (1 or 2) here: .....

(i) The food jar opening device must have a means of fitting comfortably into a person's hand.

.....  
.....  
.....

(2)

(ii) The food jar opening device must open the screw tops of the jars easily.

.....  
.....  
.....

(2)

(iii) The food jar opening device must be adjustable to open jars sized from 60 mm to 85 mm in diameter.

.....  
.....  
.....

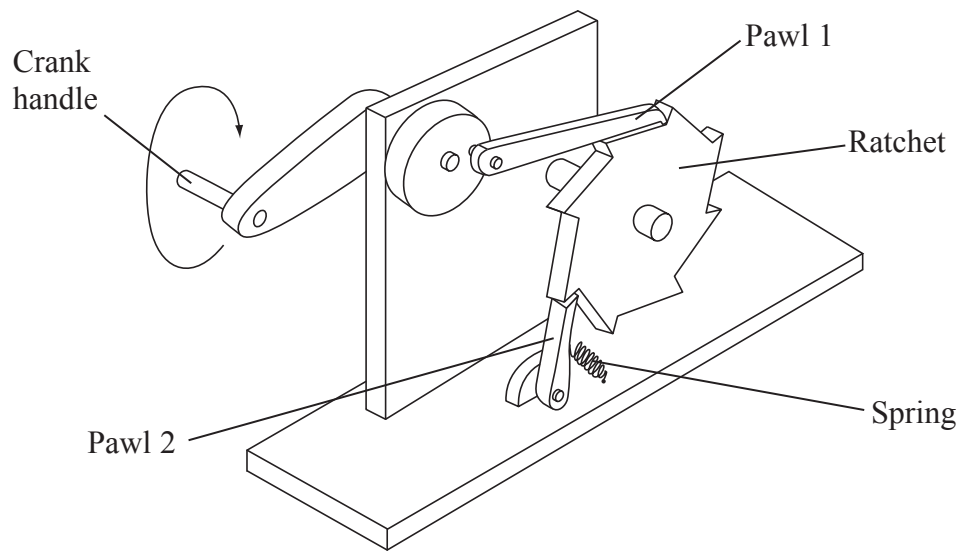
(2)

(Total 22 marks)

Q3



4. (a) The drawing below shows a model ratchet and pawl mechanism.



(i) Calculate the number of turns of the crank handle to make the ratchet turn once.

.....  
(1)

(ii) Describe **one** action of pawl 1 and the ratchet when the crank handle is turned in the direction shown.

.....  
.....  
.....  
(2)

(iii) Describe **one** action of pawl 2 and the ratchet when the crank handle is turned in the direction shown.

.....  
.....  
.....  
(2)

(iv) Name **two** types of motion made by pawl 1.

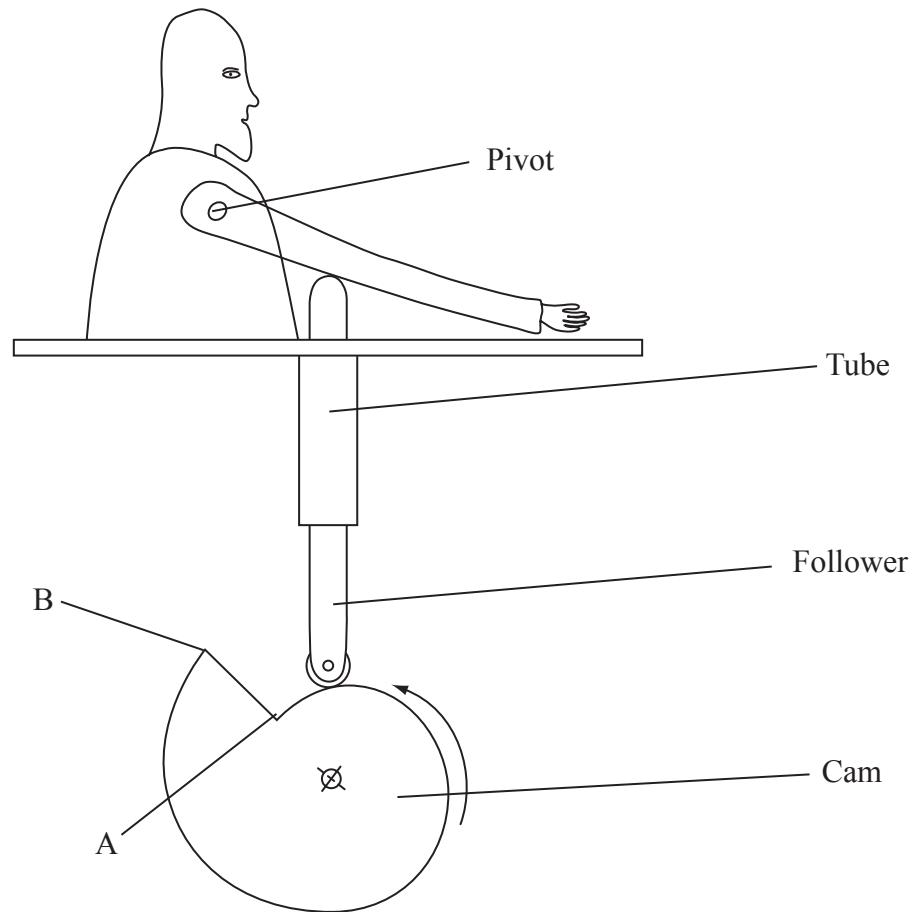
1 .....

2 .....

(2)



(b) The drawing below shows part of a model of a mechanical man.



The cam has a follower that passes through a tube. The follower is used to move the man's arm as the cam rotates.

(i) Describe the action of the man's arm as the follower travels from point A to point B on the cam.

.....  
.....

(2)

(ii) Describe the action of the man's arm as the follower travels from point B to point A on the cam.

.....  
.....

(2)



(c) Nitinol is a new metal alloy. It is a 'shape memory metal'. This means that it can be made to remember that it should be straight at a specific temperature. This feature is used in the temperature control system of bathroom taps and showers.

Describe **one** way in which this feature of Nitinol can be an advantage to consumers when used in bathroom taps and showers.

.....  
.....

(2)

(d) Mechanical products, such as DIY electrical tools, are produced using Computer Aided Design (CAD) and Computer Aided Manufacture (CAM). The use of CAD/CAM reduces the cost to the manufacturer of producing mechanical products in quantity.

Explain **two** ways in which the use of CAD/CAM has made the production of mechanical products cheaper.

1 .....

.....  
.....

2 .....

.....  
.....

(4)

**TURN OVER FOR QUESTION 4(e)**



Leave blank

(e) It is often cheaper to buy a new electric drill than to replace a faulty motor. This is part of planned product obsolescence.

(i) Give **one** moral issue the consumer faces when buying a new electric drill rather than replacing the motor.

.....  
(1)

(ii) Give **two** environmental issues the consumer faces when buying a new electric drill rather than replacing the motor.

1 .....

2 .....

(2)

(iii) Describe **one** way that parts from a broken electric drill can be recycled or reused.

.....

.....

.....

(2)

Q4

(Total 22 marks)

**TOTAL FOR PAPER: 88 MARKS**

**END**

