VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2020

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER | | | | | | | | | | Letter |

VCE VET ENGINEERING STUDIES

Written examination

Thursday 26 November 2020

Reading time: 9.00 am to 9.15 am (15 minutes)
Writing time: 9.15 am to 10.45 am (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Number of questions	*Number of questions to be answered*	*Number of marks*
18	18	100

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, one scientific calculator, a protractor, a set square and aids for curve sketching.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied
- Question and answer book of 25 pages

Instructions
- Write your **student number** in the space provided above on this page.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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Instructions

Answer **all** questions in the spaces provided.

All dimensions are in millimetres (mm) except where specified.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1 (2 marks)

Apart from wearing the correct personal protective equipment (PPE), describe two safety precautions that should be taken when using an angle grinder.

1. _____

2. _____

Question 2 (2 marks)

Metals are divided into two main categories: ferrous and non-ferrous.

Give an example of a ferrous metal and a non-ferrous metal.

Ferrous metal _____

Non-ferrous metal _____

Question 3 (4 marks)

Figure 1 shows four hand tools typically used in engineering.

A **B** **C** **D**

Figure 1

Complete the table below by correctly naming each hand tool and listing a typical use for each tool.

Hand tool	Name	Typical use
A		
B		
C		
D		

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Question 4 (1 mark)

Give **one** advantage that 3D printing has when compared to traditional manufacturing processes.

_____

Question 5 (2 marks)

When selecting the correct number of revolutions per minute (RPM) for a drill, the diameter of the drill and the material being drilled are two main factors that should be considered.

For each of the cases below, determine which of the drill bits requires the higher RPM and give your reasoning.

- Case 1
  Drill bit A – Ø 16 drill into mild steel
  Drill bit B – Ø 8 drill into mild steel

  Drill bit that requires the higher RPM _____

  Reasoning _____

- Case 2
  Drill bit C – Ø 10 drill into aluminium
  Drill bit D – Ø 10 drill into steel

  Drill bit that requires the higher RPM _____

  Reasoning _____

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Question 6 (2 marks)

Figure 2 shows an item commonly found in engineering workshops.

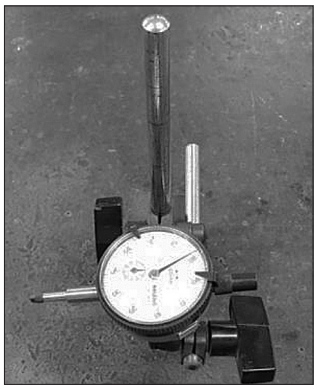

Figure 2

a. What is the name of the item shown in Figure 2? 1 mark

_____

b. Give a typical use for this item in an engineering workshop. 1 mark

_____

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Question 7 (8 marks)

The table below shows four types of spanners.

Complete the table by providing the name of each type of spanner and giving one main advantage of using that spanner instead of other types of spanners.

Type of spanner	Name	Main advantage
		
		
		
		

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Question 8 (3 marks)

Figure 3 shows a steel plate with tapered sides.

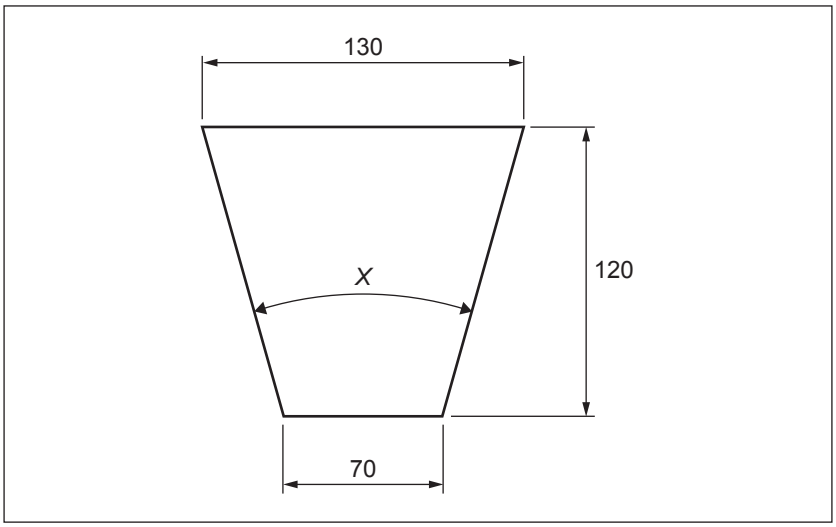

Figure 3

Calculate the angle *X* of the steel plate shown in Figure 3. Show your working.

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Question 9 (5 marks)

Figure 4 shows an angle block.

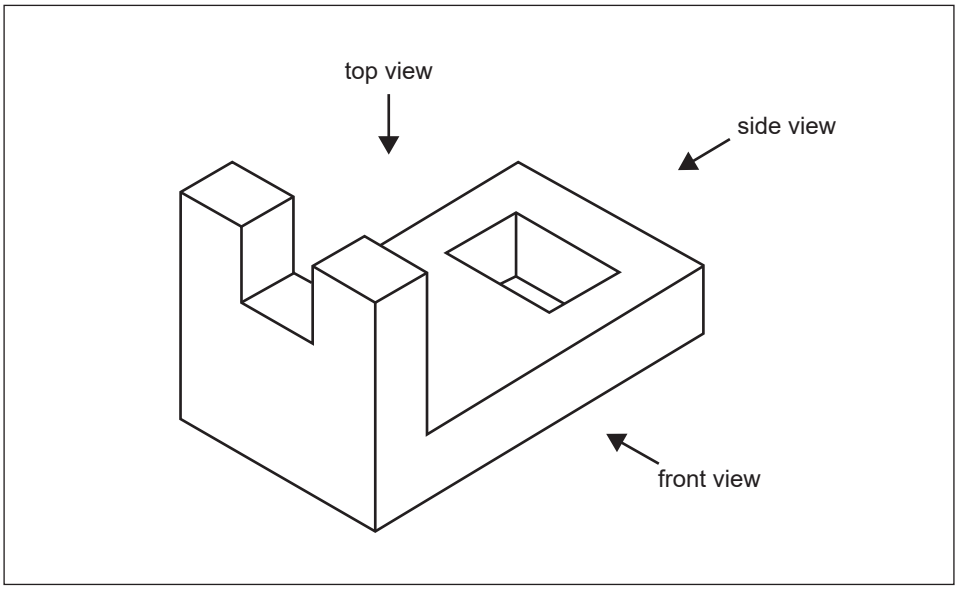

Figure 4

In the space provided below, draw the angle block shown in Figure 4 using third-angle projection. Your drawing should show:

- three views (top, side and front)
- all hidden detail.

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Question 10 (11 marks)

Figure 5 shows the design for a stepped shaft. The following questions relate to the stepped shaft shown in Figure 5.

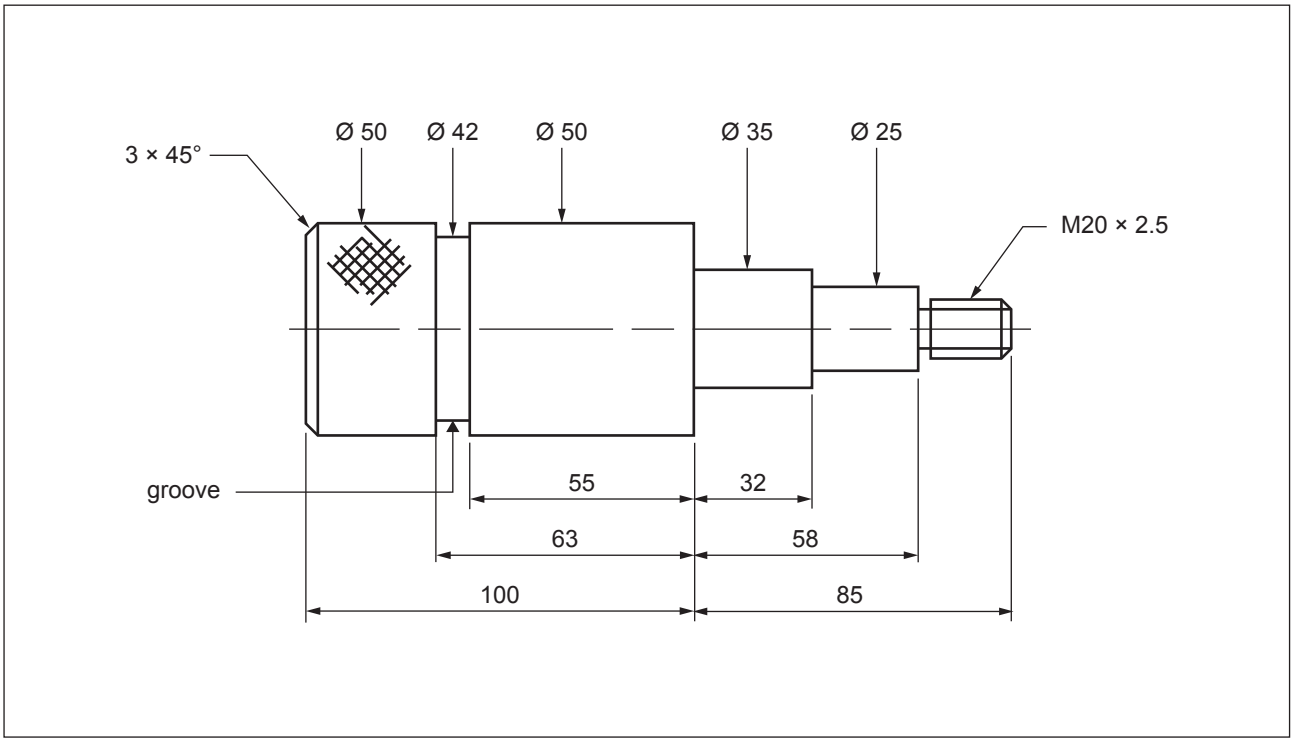

Figure 5

It is important that the lathe cutting tool used to make the stepped shaft is set on centre height.

a. Describe how the lathe cutting tool can be set to centre height. 1 mark

b. Describe what will happen if the lathe cutting tool is set above centre height when turning the stepped shaft. 1 mark

c. What is the total length of the stepped shaft? 1 mark

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d. The thread size is shown as M20 × 2.5

i. What does the 20 represent? 1 mark

ii. What does the 2.5 represent? 1 mark

iii. Calculate the depth of thread for the M20 × 2.5 thread using the formula 1 mark

$$depth\ of\ thread = 0.61 \times P$$

e. One of the diameters shown in Figure 5 has a crosshatching feature on it, represented by  .

i. Name this feature. 1 mark

ii. State the most common reason why this feature would be used on this part of the stepped shaft. 1 mark

f. The groove shown in Figure 5 will be machined on the lathe.

i. Find the width of this groove. 1 mark

ii. What is the depth of this groove? 1 mark

g. The chamfer shown in Figure 5 is 3 × 45°.

Describe how this chamfer could be made on the lathe. 1 mark

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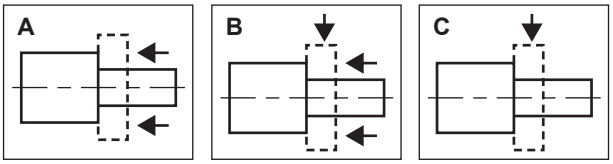
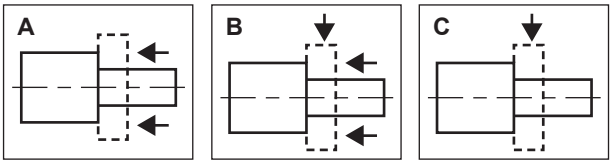
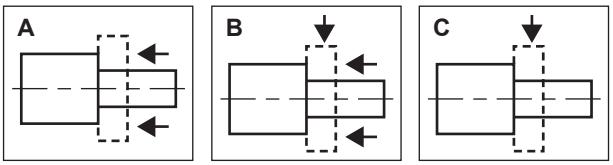
Question 11 (6 marks)

The table below shows three types of anti-friction bearings and three types of loads.

Complete the table below by naming each type of anti-friction bearing and identifying the type of load each bearing is designed to take by writing A, B or C in the spaces provided.

Anti-friction bearing	Name of bearing	Types of loads	Type of load bearing is designed to take (A, B or C)
			
			
			

Sources (bearings, from top): Iakov Filimonov/Shutterstock.com; Oleksandr_Delyk/Shutterstock.com; RATTHAPONG ANTHAYO/Shutterstock.com

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Question 12 (2 marks)

Figure 6 shows a design for part of a machine guard that requires a piece of aluminium sheet 0.8 mm thick to be joined to an aluminium rectangular hollow section (RHS) that is 25 × 50 × 1.5 thick, using screws.

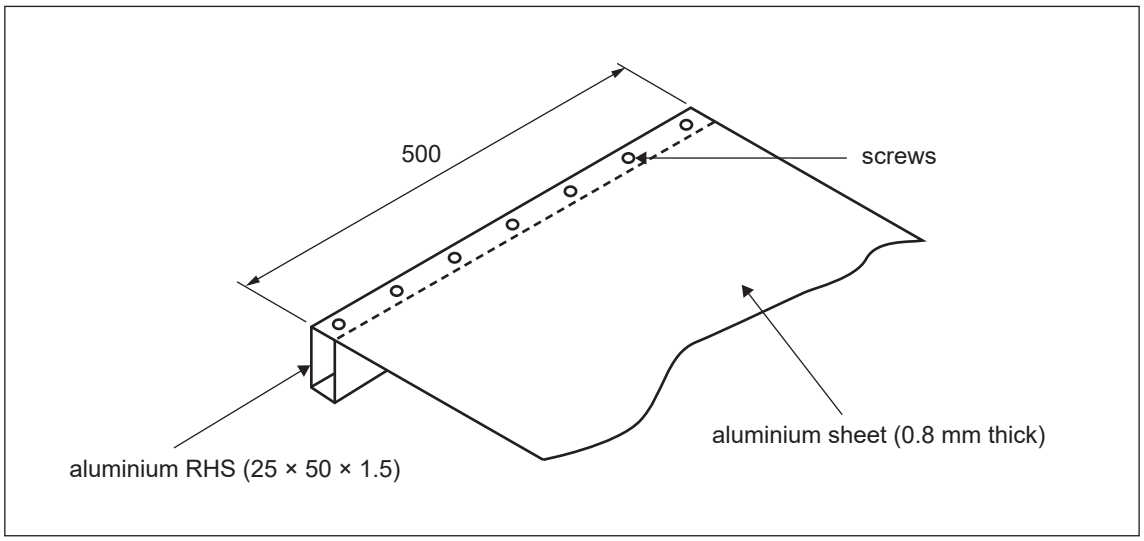


Figure 6

Figure 7 shows two types of screws that are available to join the aluminium sheet to the aluminium RHS shown in Figure 6.

Figure 7

a. It was decided that Screw B would be used for this application.

Name Screw B. 1 mark

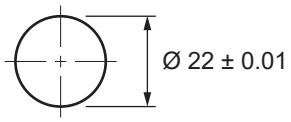
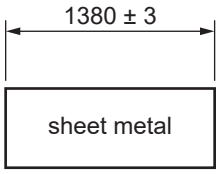
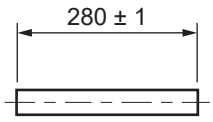
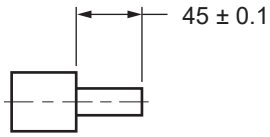
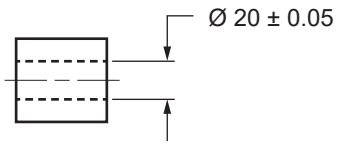
_____

b. State the main advantage of using Screw B instead of Screw A for this application. 1 mark

_____

Question 13 (5 marks)

In the table below, name the most appropriate measuring tool to measure each part shown.

Part	Measuring tool
	
	
	
	
	

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Question 14 (4 marks)

Figure 8 shows a design for a drill sharpening gauge that is made from mild steel. It will be made from flat bar with dimensions 50 mm × 123 mm × 3 mm. The ends of the flat bar are not square.

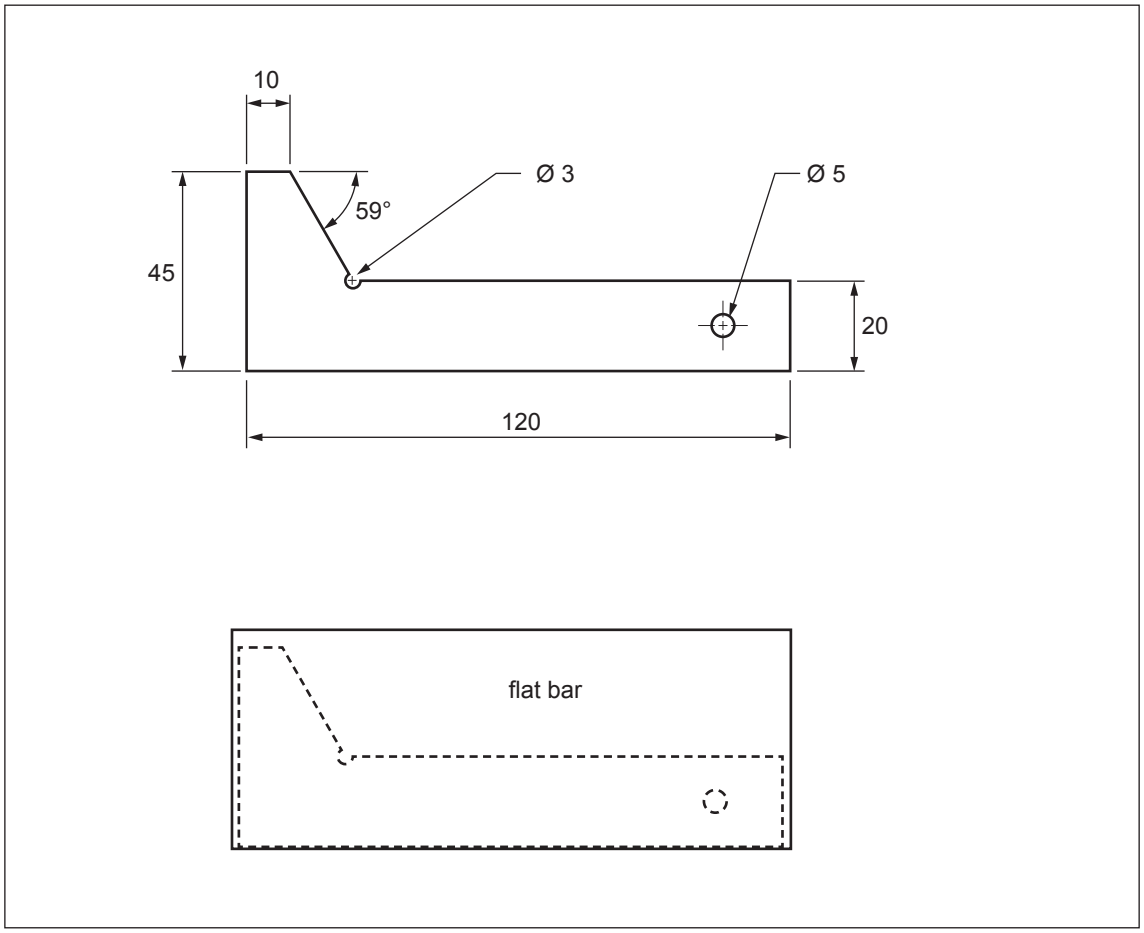

Figure 8

Complete the work plan below to manufacture the drill sharpening gauge shown in Figure 8. The first step has been completed.

Step	Task
1	*Mill one end square.*

Question 15 (12 marks)

Figure 9 shows the design for a steel component that will be produced on a vertical milling machine.

The component will be made from a 170 × 90 × 40 bar. These outside dimensions do not require machining.

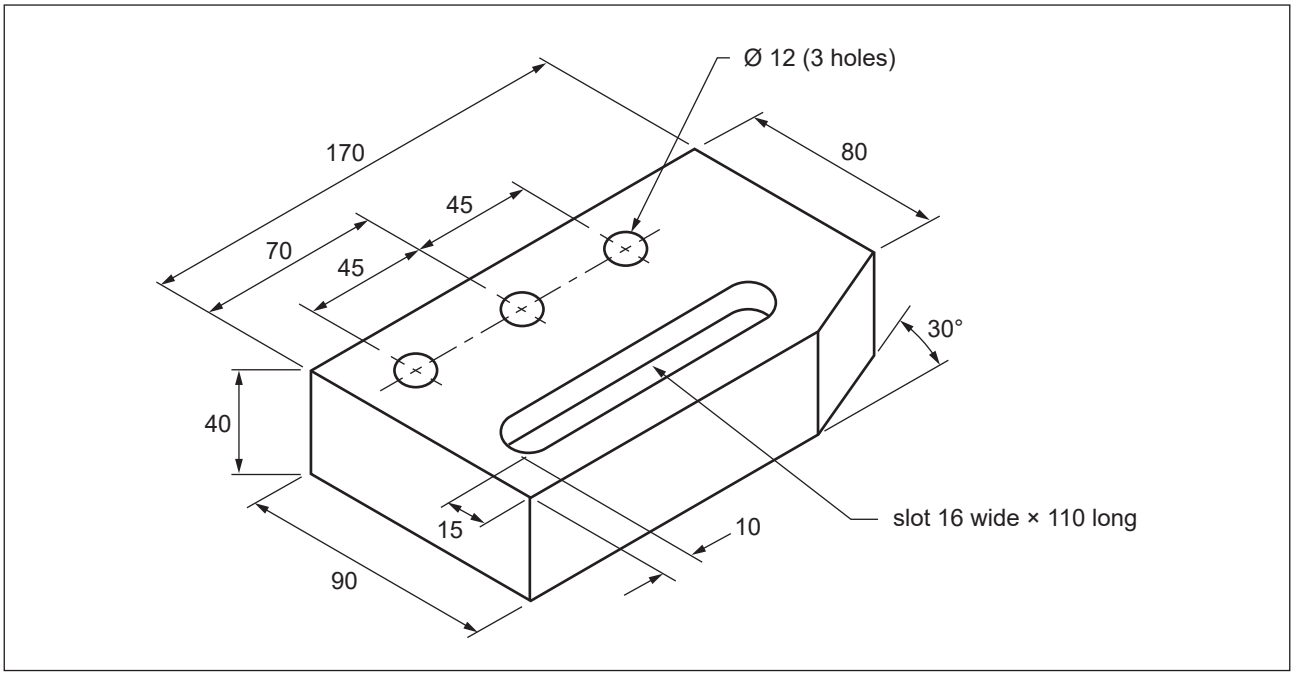

Figure 9

The vertical milling machine that will be used to make the component is shown in Figure 10. It has a digital readout for the three axes *x*, *y* and *z*.

a. In the boxes provided in Figure 10, label the three axes *x*, *y* and *z* for the vertical milling machine. 3 marks

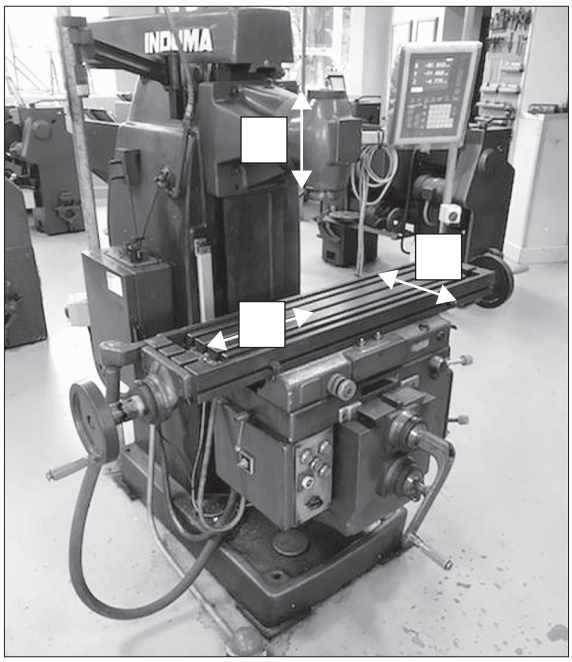

Figure 10

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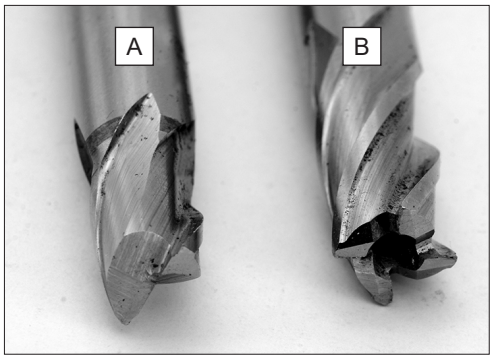
The 16 mm wide slot of the steel component shown in Figure 9 needs to be machined to 12 mm deep. Figure 11 shows two Ø 16 milling cutters, A and B, that are available to mill the slot.



Source: Kim Christensen/Shutterstock.com

Figure 11

b. Name the two milling cutters labelled A and B in Figure 11. 2 marks

A _____

B _____

c. Which milling cutter – A or B – is the most suitable for milling the slot? Provide a reason for your answer. 2 marks

Milling cutter _____

Reason _____

d. Calculate the RPM for the Ø 16 milling cutter using a cutting speed of 38 m/min. Show your working. Use the following formula. 1 mark

$$\text{RPM} = \frac{320v}{d}, \text{ where } v = \text{cutting speed and } d = \text{diameter}$$

_____

_____

_____

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e. The three Ø 12 holes need to be machined to a tolerance of $^{+0.02}_{-0.00}$

i. Provide the maximum and minimum diameters of this hole. 1 mark

Max. Ø _____

Min. Ø _____

ii. Name the tool that could be used to achieve this level of tolerance. 1 mark

_____

f. Describe how the steel component shown in Figure 9 will be held and set up on the vertical milling machine shown in Figure 10 to mill the 30° angle. 2 marks

_____

_____

_____

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Question 16 (19 marks)

Figure 12 shows the design for a letterbox that will be manufactured from four individual pieces of 1 mm thick flat sheet. The flat sheet will require some surface treatment to stop it from rusting.

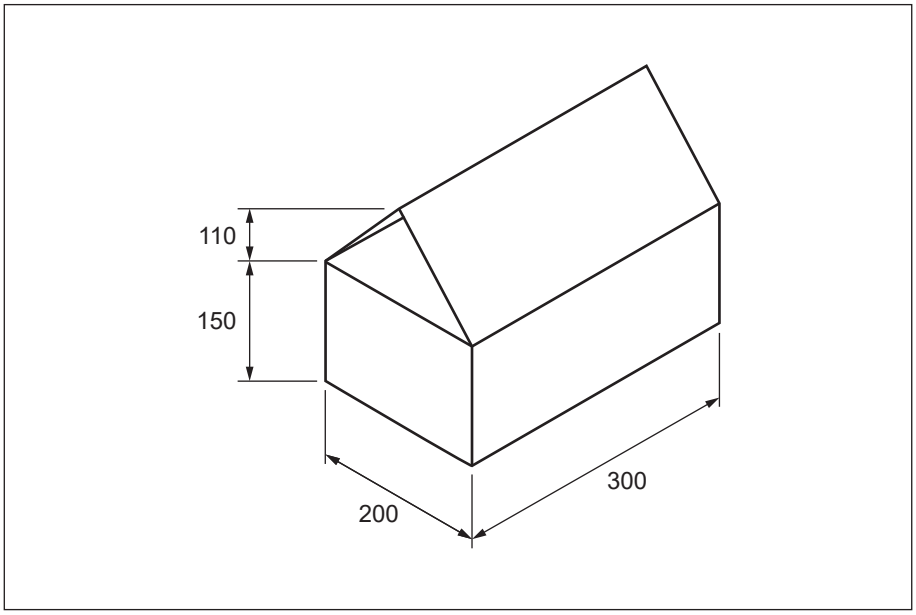

Figure 12

a. Apart from painting, name **two** types of commercially available surface treatments that could be used to stop the letterbox from rusting. 2 marks

_____

_____

b. Name **one** alternative material that the letterbox could be made from that would not require any surface treatment. 1 mark

_____

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c. Figure 13 shows how the four individual pieces of flat sheet that make up the letterbox will be assembled.

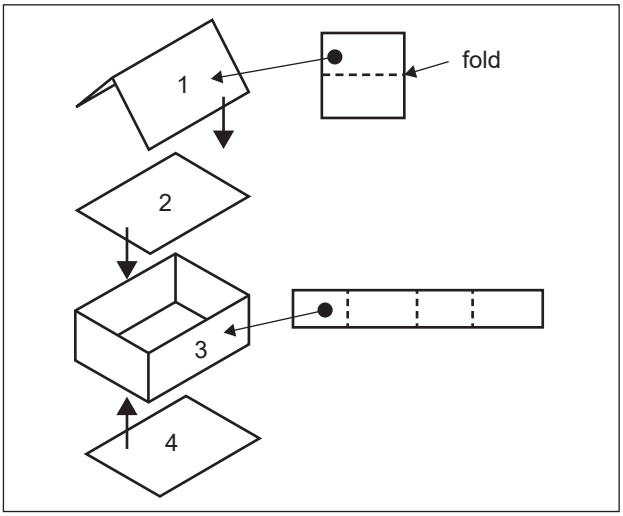

Figure 13

Provide the dimensions for each of the four pieces of flat sheet by labelling Figure 14 below in the spaces provided. 4 marks

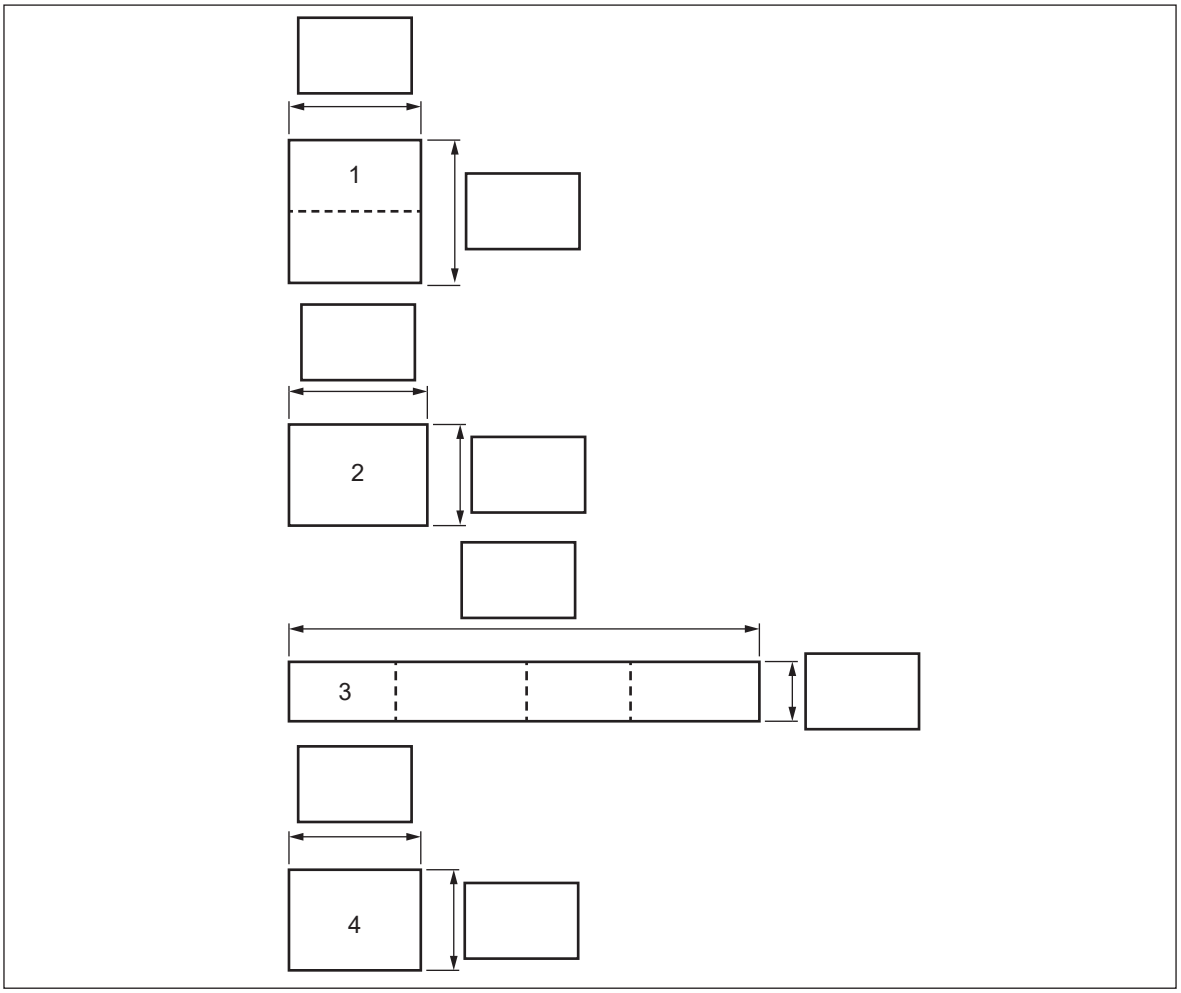

Figure 14

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d. Calculate the total surface area, in square metres, of the four pieces of flat sheet required to make one letterbox. 2 marks

e. The four pieces that make up the letterbox will be cut on a plasma cutter from a flat sheet measuring 1200 × 3600. The total weight of one 1200 × 3600 sheet is 24.9 kg.

Calculate the total weight of the four pieces that make up one letterbox. 2 marks

f. Figure 15 shows the 1200 × 3600 flat sheet from which the four pieces will be cut.

On Figure 15, sketch and label each of the four pieces to show how they should be laid out on the sheet for cutting in order to minimise waste. 2 marks

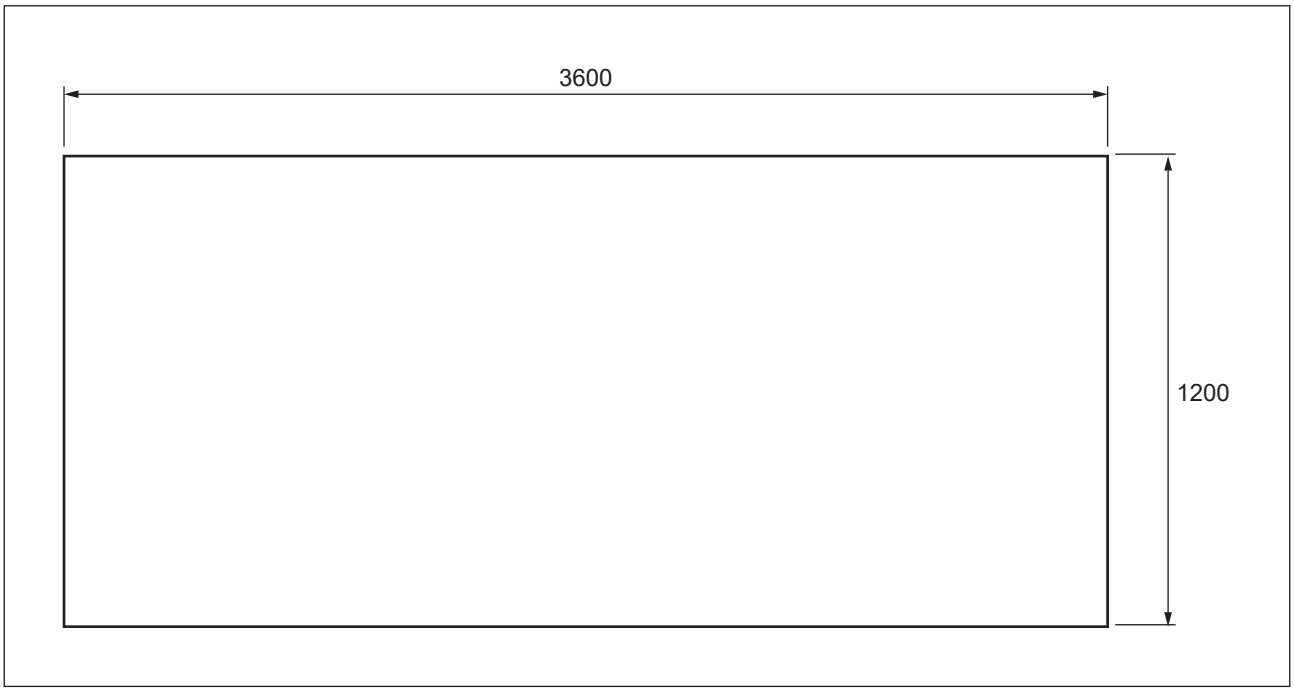

Figure 15

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g. The letterbox is designed to open on a hinge, as shown in Figure 16. After being made, the prototype was found to leak water into the letterbox from the top three edges when it rained. The leaking edges are indicated by arrows in Figure 16.

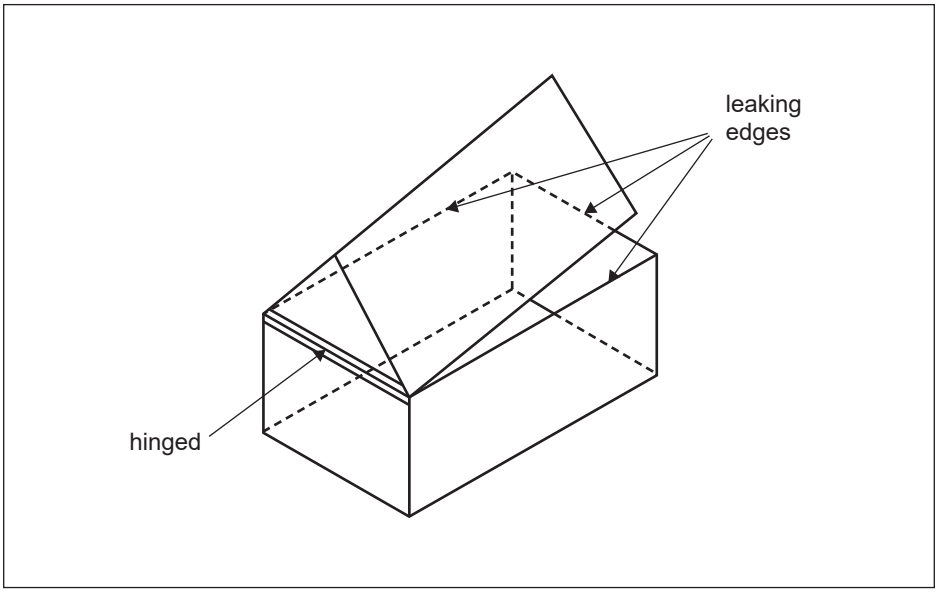

Figure 16

In the space provided below, sketch and describe **one** modification to the letterbox that could potentially stop water from leaking into the letterbox. 2 marks

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h. The letterbox will be mounted on a stand made from a Ø 40 steel pole, with a Ø 100 × 3 mm steel disc welded onto the pole, as shown in Figure 17.

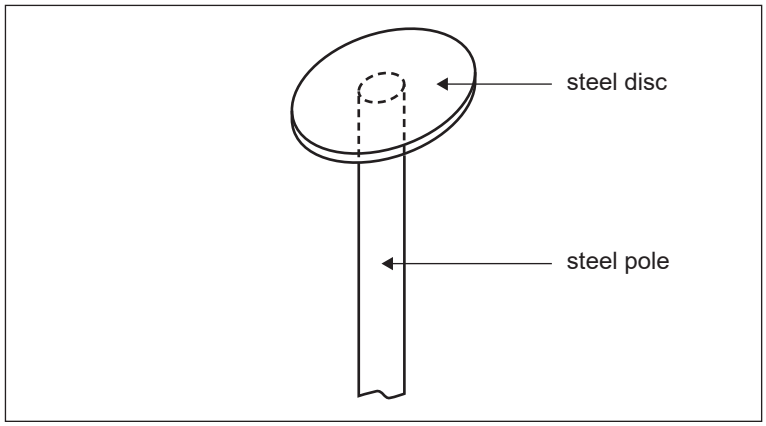

Figure 17

When welding the disc onto the steel pole using an arc welder, the welder was not arcing.

What are two checks that should be conducted to determine why the welder was not arcing as expected? 2 marks

1. _____

2. _____

i. Describe two methods of attaching the **letterbox** to the steel disc shown in Figure 17. 2 marks

1. _____

_____

2. _____

_____

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Question 17 (4 marks)

A 6 m length of metal rod will be cut up into pieces 180 mm in length using a cold saw.
The blade of the cold saw is 3 mm thick.

a. Calculate how many pieces of 180 mm length can be cut from the 6 m length of metal rod. 1 mark

b. What is the length of the off-cut that will be left after cutting all the pieces? 1 mark

c. Calculate the percentage that this off-cut represents of the total metal rod. 2 marks

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Question 18 (8 marks)

Figure 18 shows a round water tank made of plastic.

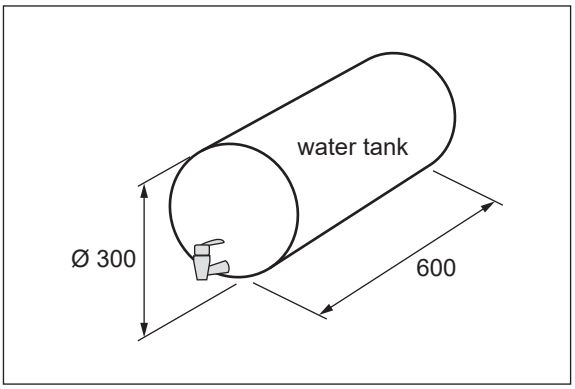

Figure 18

The water tank shown in Figure 18 will be attached to the outside of a large industrial bin, as shown in Figure 19, so that operators can rinse their tools. The industrial bin is made from 5 mm thick steel plate and will hold liquid detergent.

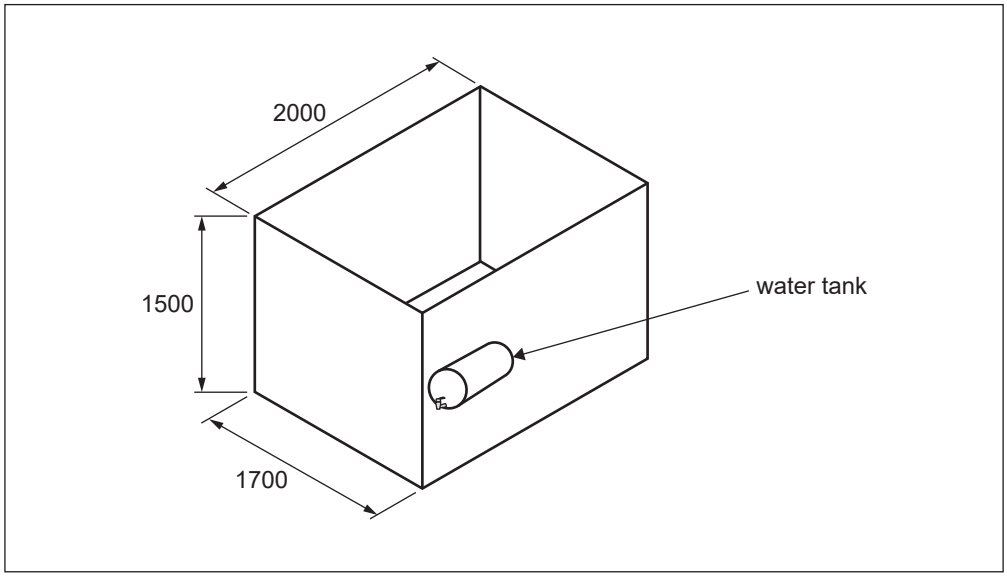

Figure 19

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a. In the space provided below, sketch a method for attaching the water tank securely to the side of the industrial bin. Your attachment method must allow for the water tank to be removed and replaced periodically. Your design must indicate:

- the types and sizes of materials used
- how the water tank will be attached.

5 marks

b. Calculate the volume of the water tank shown in Figure 18 in cubic metres. 2 marks

c. Calculate the total weight of the water tank shown in Figure 18, when it is full of water, using the following information:

- the empty water tank weighs 2.4 kg
- 1 m^3 = 1000 L
- 1 L = 1 kg

1 mark

END OF QUESTION AND ANSWER BOOK