VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education
Year

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

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

VCE VET ENGINEERING STUDIES

Written examination

Day Date

Reading time: *. to *.** (15 minutes)**
Writing time: *. to *.** (1 hour 30 minutes)**

QUESTION AND ANSWER BOOK

Structure of book

Number of questions	*Number of questions to be answered*	*Number of marks*
14	14	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 31 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.

April 2019

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 (4 marks)

Name one suitable engineering material to manufacture each of the products listed in the table below.

Manufactured product	Engineering material
a toolbox to be powder-coated	
surgical equipment	
the exterior panels of an aircraft	
the legs for a welding bench in a workshop	

Question 2 (4 marks)

Identify the most suitable machine or equipment for each of the processes listed in the table below. Give one specific practice that operators should implement in order to maintain the machine or equipment and ensure it operates safely.

Process	Machine or equipment	Specific practice
cutting large pieces of sheet metal		
deburring the ends of sawn mild steel rods		

Question 3 (2 marks)

Plastic has replaced many products made of metal. One example is the use of plastic for bumper bars on cars.

What are **two** advantages of using plastic instead of metal?

_____

_____

Question 4 (4 marks)

a. Identify each fastener shown in the table below and the tool that is used to apply the fastener. 3 marks

	Fastener	Tool used to apply the fastener
		
		
		

Sources (from top): 2stockista/Shutterstock.com; Tawansak/Shutterstock.com; notsuperstar/Shutterstock.com

b. High-performance adhesives provide an alternative to traditional joining methods such as welding and the use of fasteners.

Provide **one** advantage of using adhesives rather than welding or the use of fasteners as joining methods. 1 mark

_____

_____

Question 5 (13 marks)

Technical drawings show how a product should be manufactured.

a. There are four main line styles used in technical drawings. Two are listed in the table below.

Sketch each line style and explain when each line style would be used. 4 marks

Line style	Sketch of line style	When line style would be used
continuous thick		
chain		

b. Figure 1 shows the top view of a block.

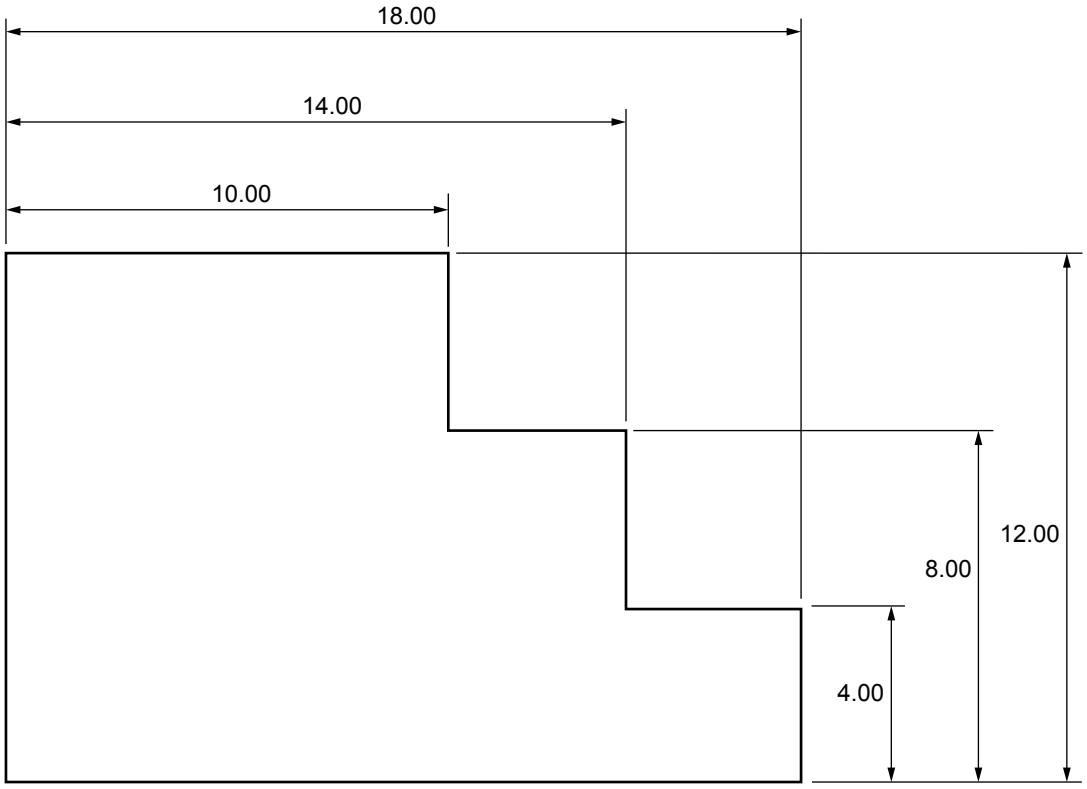


Figure 1

i. Clearly label the edges of the block in Figure 1 with the two datums according to AS 1100 of the Australian Standards for technical drawings. 2 marks

ii. Calculate the perimeter of the block in Figure 1. 2 marks

c. Identify one advantage and one disadvantage of each drawing method listed in the table below. All four answers must be different. 4 marks

Drawing method	Advantage	Disadvantage
freehand sketch		
using CAD software		

d. Explain the purpose of having completed technical drawings reviewed by a co-worker. 1 mark

_____

Question 6 (2 marks)

Figure 2 shows a metal ring that will be made from a 20 × 3 flat bar.

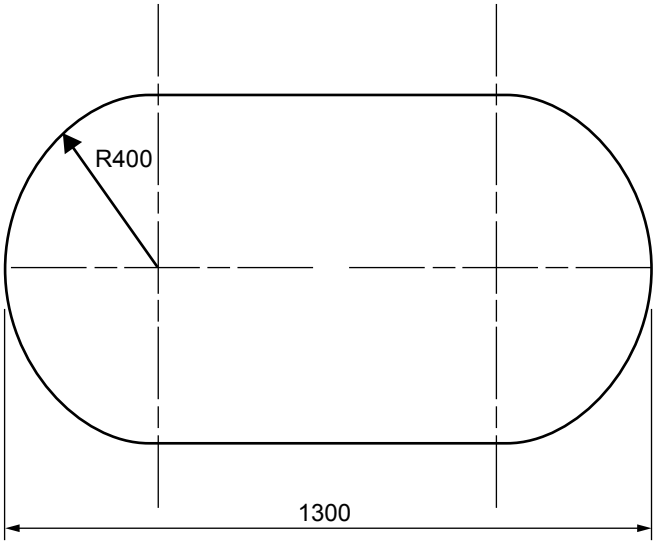


Figure 2

Calculate the length of steel required to make one metal ring. Round your answer to the closest millimetre.

Question 7 (2 marks)

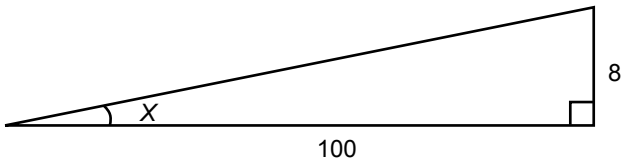


Figure 3

Calculate the value of angle *X* in Figure 3. Give your answer correct to two decimal places.

Question 8 (15 marks)

A student has produced a design brief for a school project. Part of the design brief is shown below.

Design brief

Standard box made from sheet metal (mild steel)

Description

A standard box is to be constructed from mild steel sheet metal as shown in Figure 4.

The standard box will be constructed using the outline pattern shown in Figure 5.

Materials	Equipment	Personal protective equipment (PPE)	Time taken to construct
20-gauge sheet metal (mild steel)	shearing machine	safety eyewear	1½ hours
	sheet metal brake	welding mask	
	welder	overalls	
	welding rods	safety boots	
		welding gloves	

Drawing

Standard box made from mild steel sheet metal

Four sides and a bottom, but no top

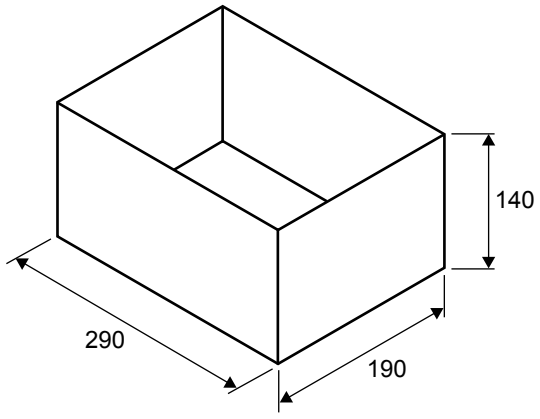


Figure 4

Outline pattern of the standard box

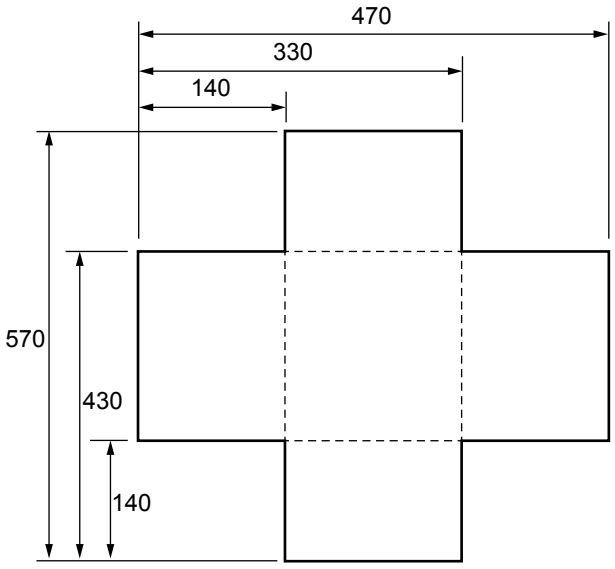


Figure 5

Procedure

1. Shear a rectangular piece of sheet metal measuring _____ mm × _____ mm.
2. Use snips to cut the desired outline pattern as shown in Figure 5.
3. Fold the pattern as shown by the _____ lines in Figure 5, using the _____ machine.
4. Weld the folded-up edges together (check with the teacher that the welder setting is correct).

a. There are missing components in the 'Procedure' section of the design brief on page 7.

Use the design brief to fill in the missing components in the box below. 4 marks

Procedure

1. Shear a rectangular piece of sheet metal measuring _____ mm × _____ mm.
2. Use snips to cut the desired outline pattern as shown in Figure 5.
3. Fold the pattern as shown by the _____ lines in Figure 5, using the _____ machine.
4. Weld the folded-up edges together (check with the teacher that the welder setting is correct).

Table 1

Gauge	Galvanised steel		Mild Steel	
	Thickness (mm)	**Weight per area (kg/m^2)**	**Thickness (mm)**	**Weight per area (kg/m^2)**
20	1.006	7.888	0.912	7.151
22	0.853	6.692	0.759	5.955
24	0.701	5.497	0.607	4.760
26	0.551	4.322	0.455	3.565
28	0.475	3.725	0.378	2.968
30	0.399	3.127	0.305	2.390

b. Based on Table 1, what is the weight per area (kg/m^2) for 20-gauge sheet metal (mild steel)? 1 mark

_____

c. Calculate the surface area of the outline pattern. 3 marks

_____

_____

_____

_____

_____

d. Calculate the total weight of the standard box. Give your answer correct to two decimal places. 1 mark

e. What is the maximum number of outline patterns that can be cut from 1200 × 3000 sheet metal? Show your working. 2 marks

f. The student submitted the design brief for final endorsement and it was returned to them for refinement as there were a number of potential problems that needed to be addressed.

One problem was that each cutting of the sheet metal would produce rough and sharp edges that could cause cuts.

i. What step should be added to the procedure to remove the rough and sharp edges? 1 mark

ii. What change should be made to the drawing to limit the occurrence of rough and sharp edges? Include a sketch in the space provided below to show the change. 2 marks

iii. The student decided to use thicker material. The teacher said it could be advantageous to drill relief holes at the point where the two bend lines meet in a piece of sheet metal, as shown in Figure 6.

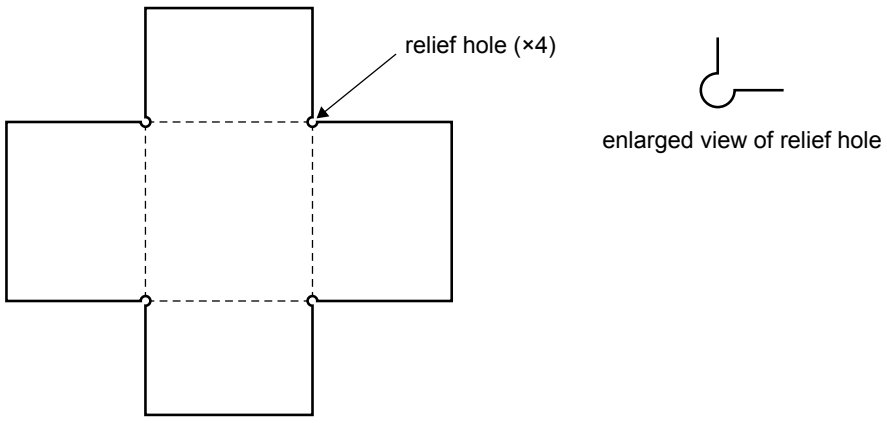


Figure 6

What is the purpose of the relief holes shown in Figure 6? 1 mark

Question 9 (5 marks)

A pedestal grinder is shown in Figure 7.

Figure 7

a. Why is the pedestal grinder shown in Figure 7 unsafe to use? 1 mark

_____

b. Explain **one** problem that could arise if the pedestal grinder shown in Figure 7 were to be used? 1 mark

_____

c. Gloves are a common item of PPE. However, sometimes gloves can be a safety hazard.

Provide a specific task for which gloves should **not** be used. Explain your answer. 1 mark

_____

d. Provide two practical reasons why a work area should be kept clean, with all tools organised. 2 marks

1. _____

2. _____

Question 10 (15 marks)

A customer requested a holder for a 9 kg gas bottle, as shown in the technical drawing in Figure 8.

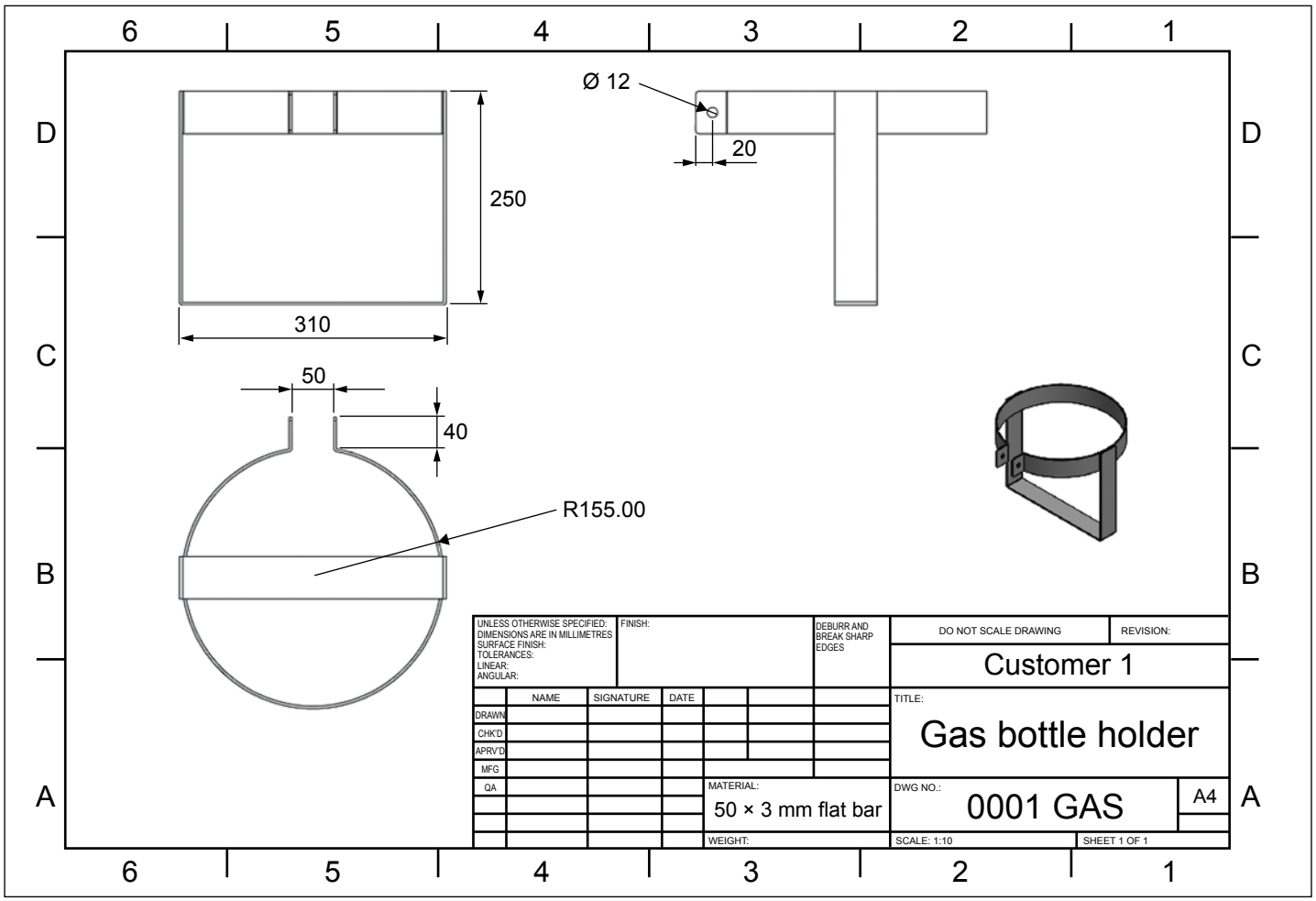


Figure 8

a. Technical drawings have a section where important details, such as the scaling and material required for a job, are recorded.

What is the name given to this section of a technical drawing? 1 mark

_____

Figure 9

b. Calculate the total length of material needed to make the U-shaped support bracket and the adjustable clamp ring as shown in Figure 9. Give your answer correct to the nearest millimetre. 4 marks

c. How many linear metres of flat steel bar would be required to make 10 gas bottle holders? 1 mark

d. A hardware store sells flat steel bars at a standard 6 m length as shown in Table 2.

Table 2

Flat steel bar		
Size	**$/Length**	**Length**
50 × 3	$23.00	6.0 m
50 × 5	$38.00	6.0 m
50 × 6	$45.00	6.0 m
Flat galvanised steel bar		
Size	**$/Length**	**Length**
25 × 3	$22.00	6.0 m
50 × 3	$34.00	6.0 m
40 × 5	$53.00	6.0 m
50 × 6	$78.50	6.0 m

i. From Table 2, select the most durable material for making the gas bottle holders. State the reason for your selection. 2 marks

ii. Using the material selected in **part d.i.**, calculate the minimum number of flat bar lengths required to make 10 gas bottle holders. 1 mark

iii. What would be the cost of purchasing the minimum number of flat bar lengths calculated in **part d.ii.**? Show your working. 1 mark

e. Waste is produced during the manufacture of gas bottle holders.

Identify one waste product produced in the manufacture of gas bottle holders and one action that can be taken to minimise the production of this waste product. 2 marks

Waste product _____

Action _____

_____

f. Gas bottles filled with gas are to be supplied with each gas bottle holder. The gas bottles are not manufactured. They are bought and stored until distribution with the gas bottle holders.

Provide **one** safety feature that should be considered when storing the gas bottles. 1 mark

_____

_____

g. Heavy machinery uses exceedingly large amounts of power from the electricity grid.

Suggest **two** ways an engineering business can implement sustainable work practices to reduce the amount of energy it uses. 2 marks

_____

_____

_____

_____

Question 11 (8 marks)

a. Bearings have two main classifications: friction bearings and anti-friction bearings.

List one advantage and one disadvantage of each classification of bearing in the table below. 4 marks

Classification of bearing	**Advantage**	**Disadvantage**
friction bearings		
anti-friction bearings		

b. Figure 10 shows a third-angle projection of a solid bearing casing.

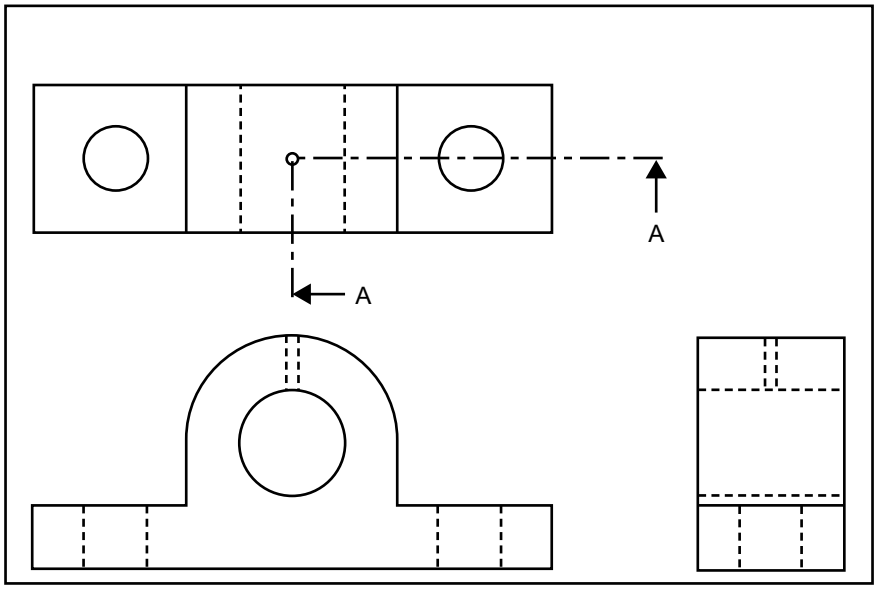
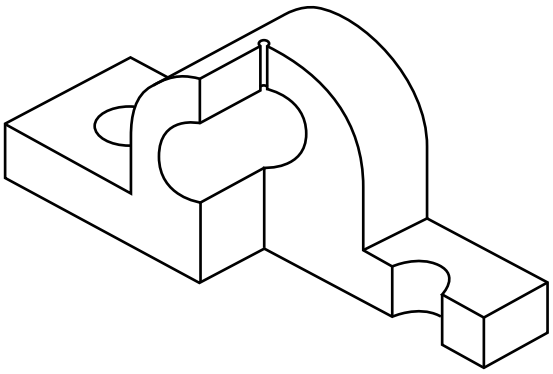


Figure 10

The diagram below shows the offset sectional isometric view of A-A.

Complete the diagram to show the cross-section A-A using technical drawing techniques. 2 marks



c. A bicycle contains bearings for various moving parts. The bearing used where an axle connects the two pedal cranks together commonly has an angular cup and cone bearing. An example of this type of bearing is shown in Figure 11.

Figure 11

Source: SergeyMarina/Shutterstock.com

Explain why an angular cup and cone bearing is most suitable for this application. 2 marks

_____

_____

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Question 12 (3 marks)

Figure 12 shows an isometric diagram of a metal component.

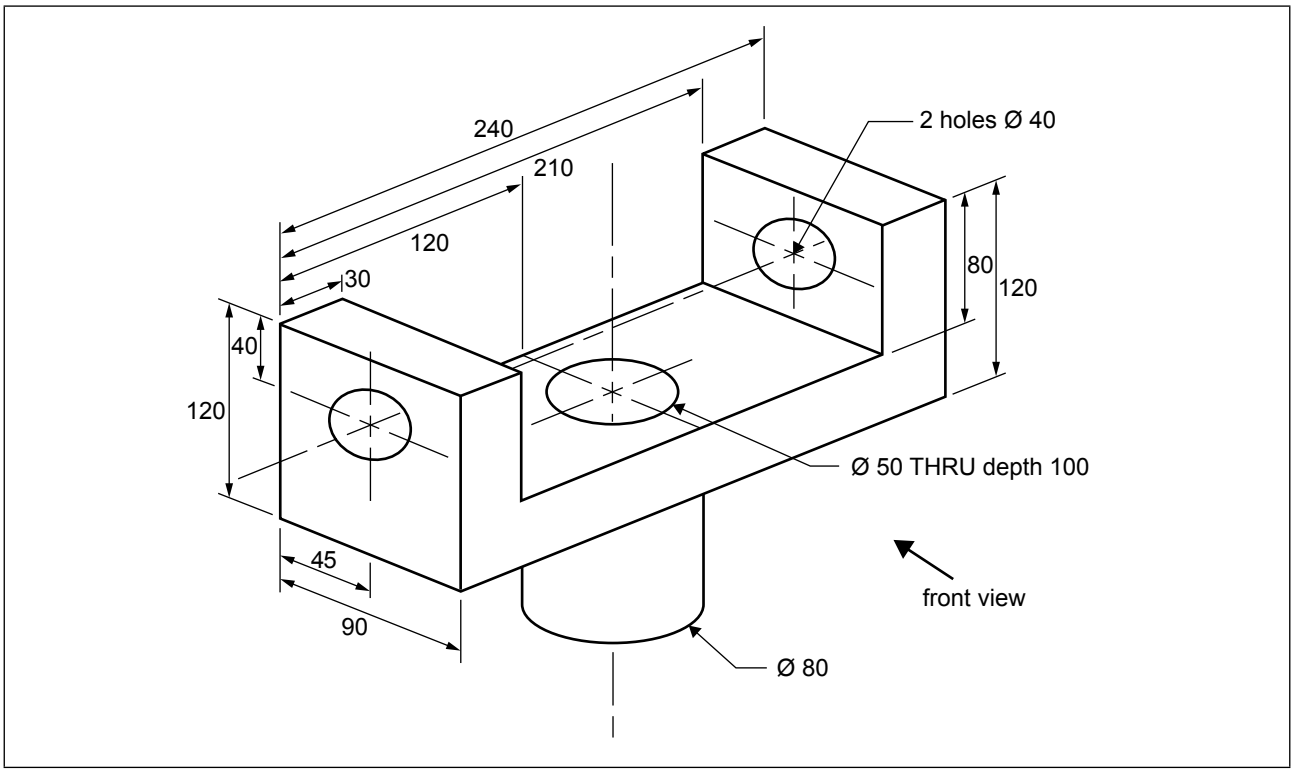
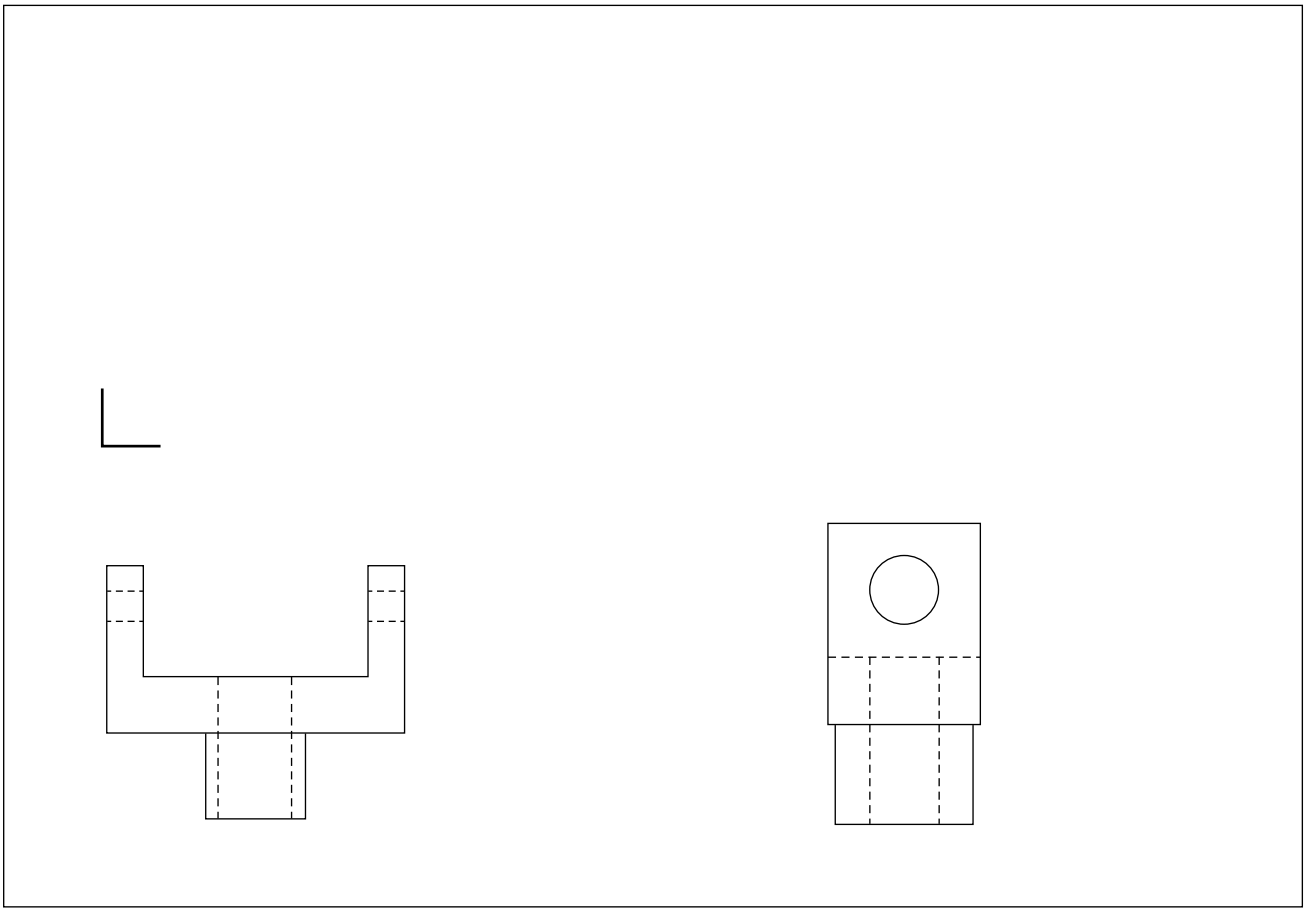


Figure 12

The front and side views of the metal component are shown on the diagram below.

a. Complete the sketches of the front and side views by adding the missing centre lines on the diagram below. 1 mark

b. Sketch the top view of the metal component in third-angle projection on the diagram below. Include all hidden and centre lines. 2 marks



Question 13 (9 marks)

Figure 13 is an exploded isometric drawing of a striker unit.

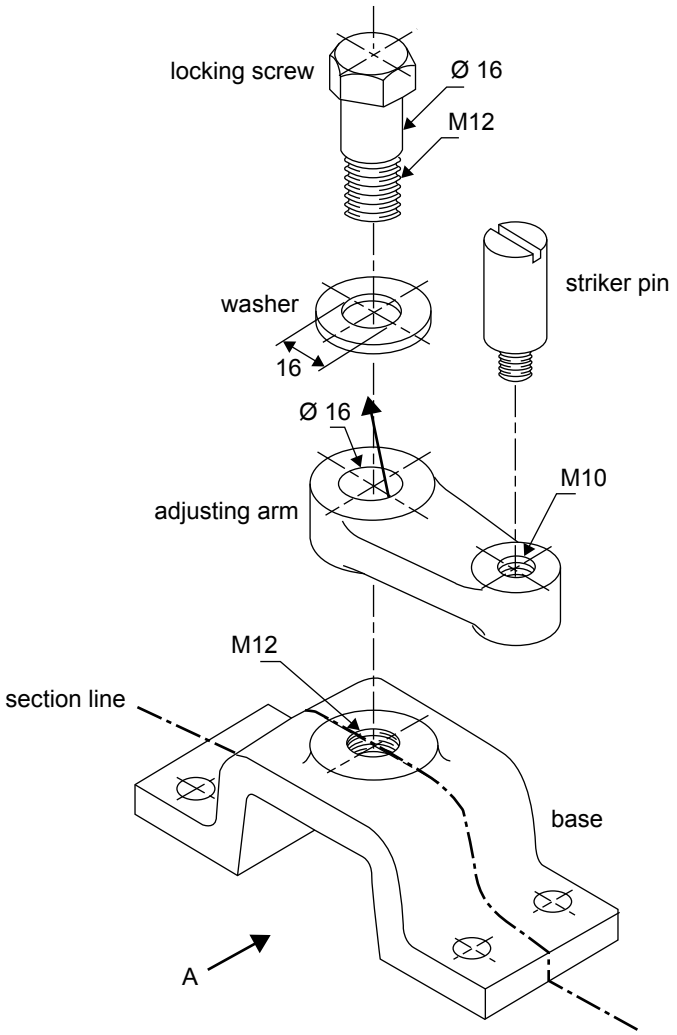
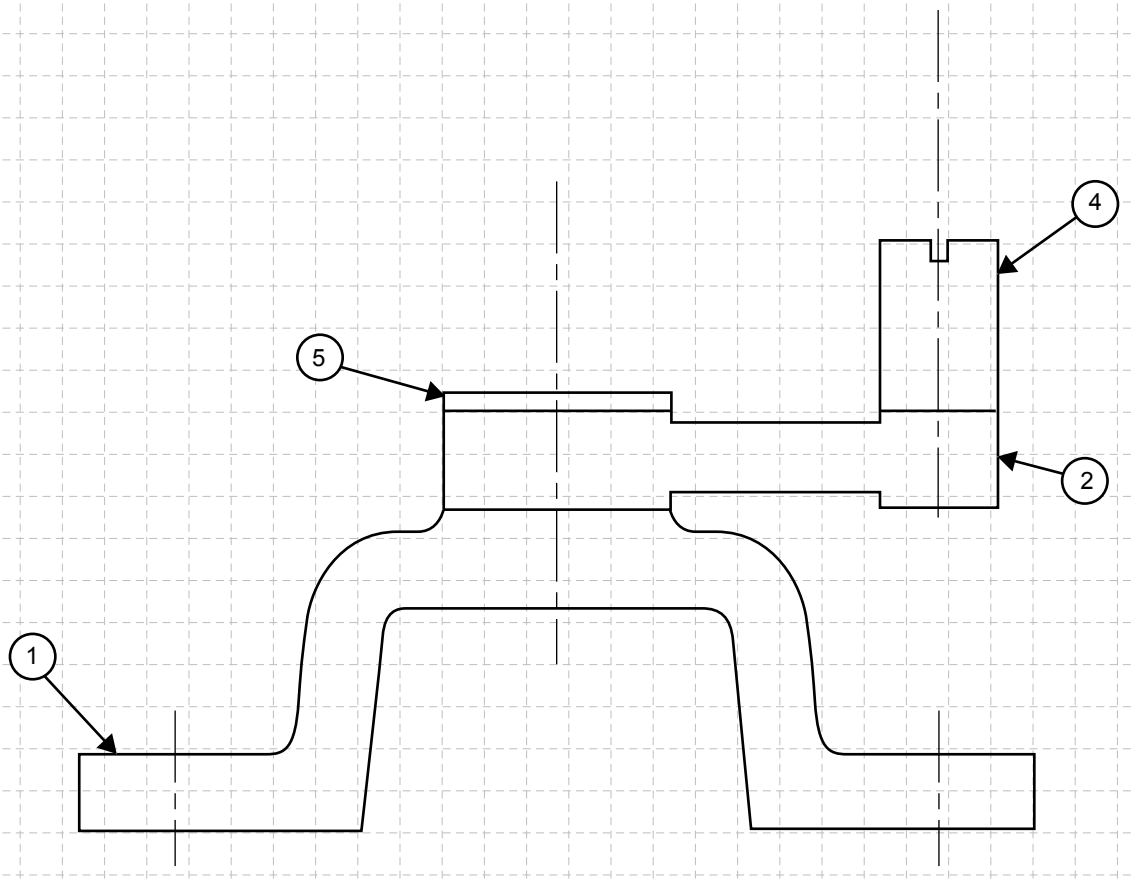


Figure 13

a. The diagram below is an incomplete front view assembly drawing of Figure 13 taken from the direction labelled A.

Complete the diagram with the missing details for the locking screw. The locking screw must be drawn using proportioned scaling and the appropriate centre line. 2 marks



ITEM

1	BASE	1	C.I.
2	ADJUSTING ARM	1	C.I.
3	LOCKING SCREW	1	M.S.
4	STRIKER PIN	1	M.S.
5	WASHER	1	M.S.
	DESCRIPTION	QTY	MAT'L
	STRIKER UNIT		

b. Assembly drawings normally do not contain dimensions.

Explain why dimensions are not normally included in assembly drawings. 1 mark

c. Material lists for different parts of a job can become long and complex, and should be saved on a computer.

Suggest a software program, other than CAD software, that will enable material requirements to be recorded. 1 mark

d. Changes are often made to assembly drawings. Sometimes only one component of an assembly drawing needs to be modified.

How is a modification of one component indicated on a pre-existing assembly drawing? 1 mark

e. A customer requires 50 of the striker units in a week. All of the parts will be designed in a workshop.

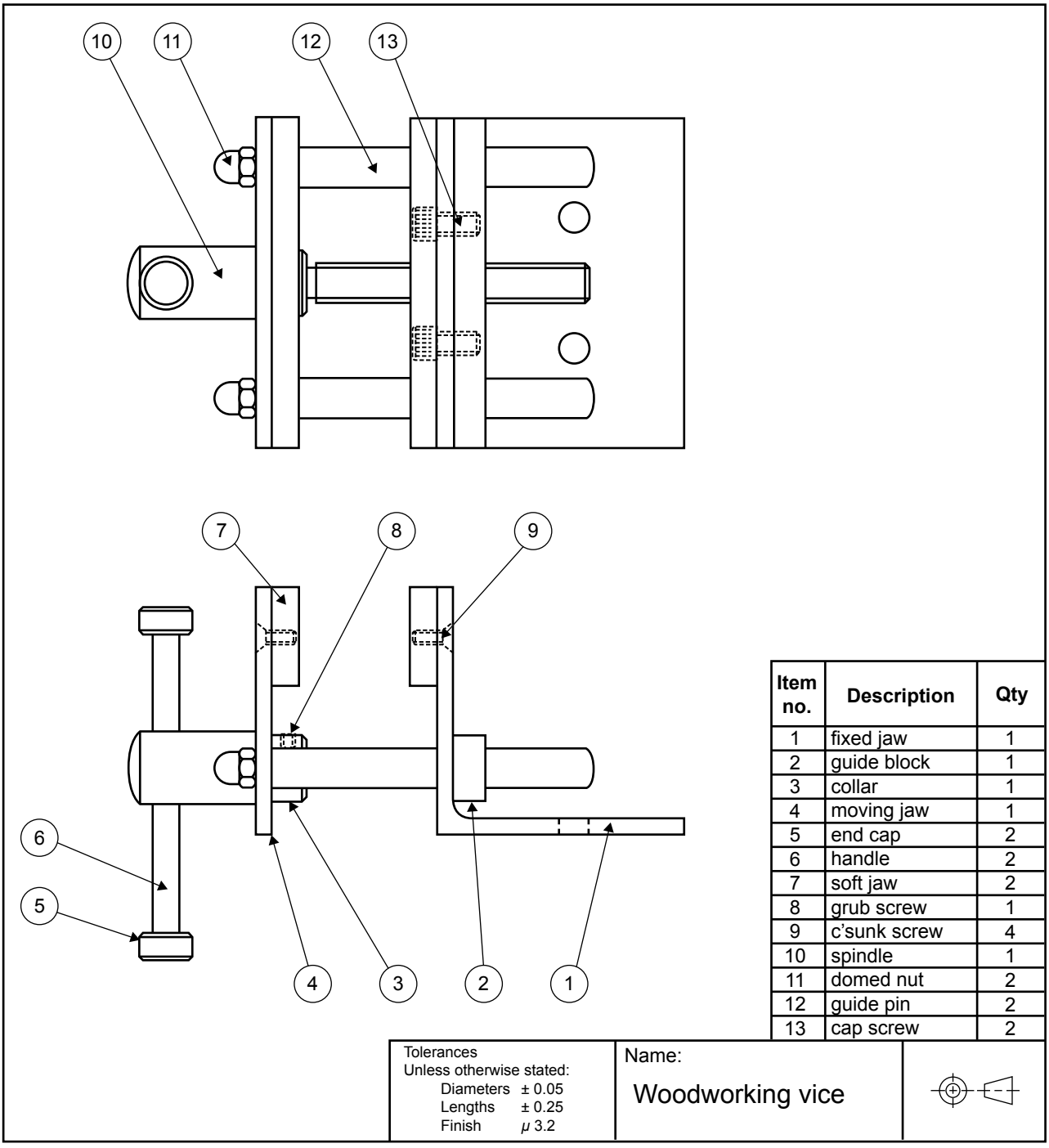
List **two** things that need to be considered to determine if the job can be completed in the required time. 2 marks

f. Conformance to requirements should be constantly monitored throughout the manufacturing process for the striker units.

Explain why it is important to constantly monitor conformance to requirements. 2 marks

Question 14 (14 marks)

Figure 14 shows a drawing of a vice used for woodworking.



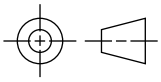
Item no.	Description	Qty
1	fixed jaw	1
2	guide block	1
3	collar	1
4	moving jaw	1
5	end cap	2
6	handle	2
7	soft jaw	2
8	grub screw	1
9	c'sunk screw	4
10	spindle	1
11	domed nut	2
12	guide pin	2
13	cap screw	2

Tolerances
Unless otherwise stated:
Diameters ± 0.05
Lengths ± 0.25
Finish μ 3.2

Name:
Woodworking vice

Figure 14

a. The symbol below is commonly found on technical drawings.



What does the symbol represent? 1 mark

_____

b. List **one** material that would be suitable to use for the soft jaws of the woodworking vice (Item no. 7 on Figure 14). Justify your answer. 2 marks

_____

_____

c. Figure 15a shows a detailed drawing of the collar (Item no. 3 on Figure 14) of the woodworking vice. Figure 15b shows the shape of the raw material that will be used to make the collar. The collar will be made from a piece of Ø 22 × 300 mm bright mild steel bar.

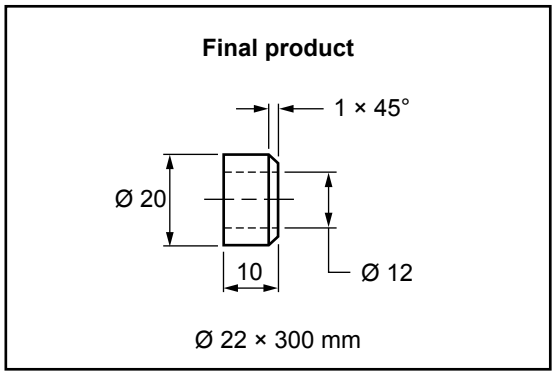


Figure 15a

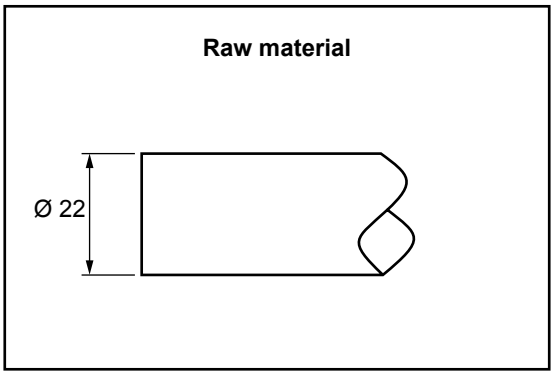


Figure 15b

i. Name the machine that will be used to make the collar shown in Figure 15a. 1 mark

_____

ii. Name two tools required to make the collar shown in Figure 15a. 2 marks

1. _____

2. _____

iii. The collar will be finished turned on the bar before being parted off.

Complete the table below to show the correct procedure for making the collar. 3 marks

Step	Procedure
1	Face off the end.

Figure 16 shows a detailed drawing of the guide block (Item no. 2 on Figure 14) on the woodworking vice.

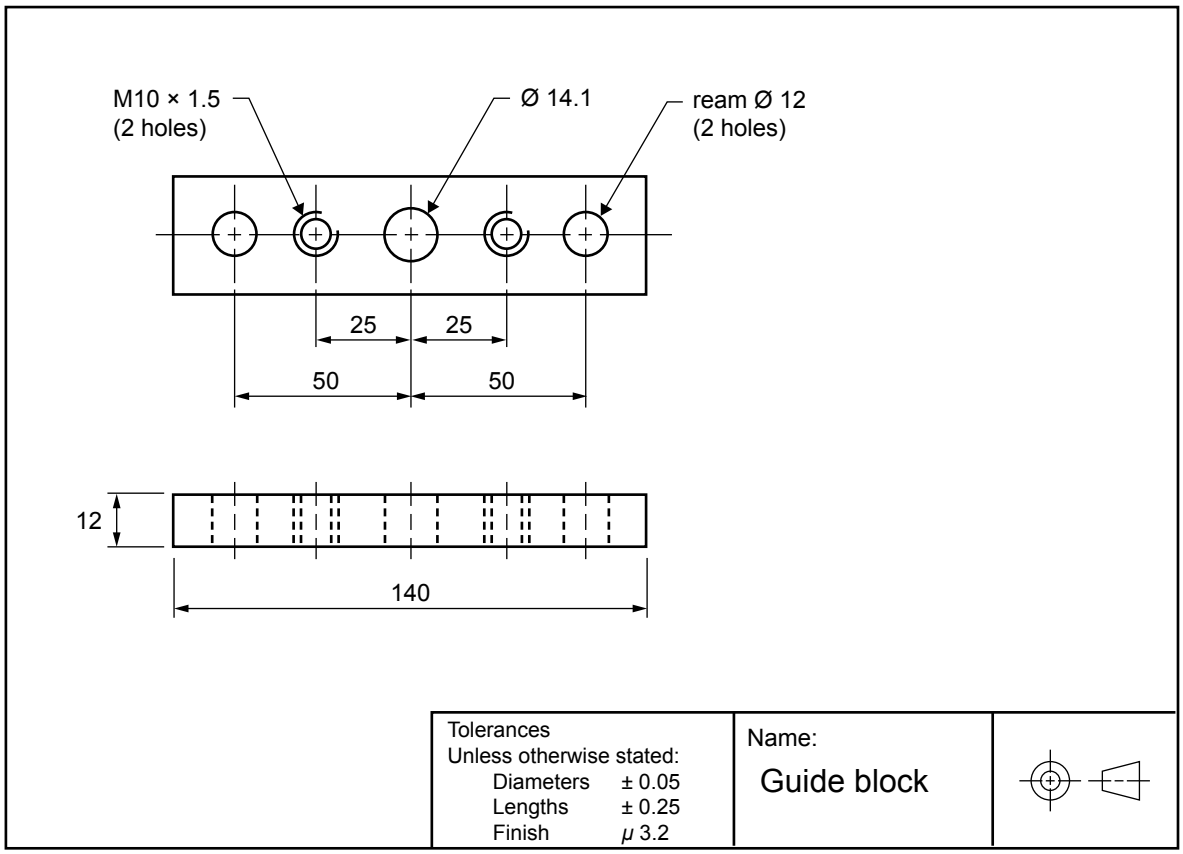


Figure 16

d. The guide block is made by drilling five holes into a piece of bright mild steel. Marking out the position of the holes with a ruler and scriber would not provide enough accuracy.

Describe how it would affect the operation of the woodworking vice if the holes are not accurately drilled into their correct positions. 1 mark

_____

_____

_____

e. What are the minimum and maximum lengths of the guide block? 2 marks

Minimum length _____

Maximum length _____

Table 3 shows a tapping chart.

Table 3

Metric – ISO Threads Coarse Pitch						
Nominal diameter (mm) M (mm)	**Pitch (mm)**	**Basic major diameter (mm)**	**Basic effective diameter (mm)**	**Basic minor diameter of internal thread (mm)**	**Basic minor diameter of external thread (mm)**	**Tapping drill size (mm)**	**Clearance drill size (mm)**
M1.0 × 0.25		1.00	0.838	0.693	0.729	0.75	1.05
M1.1 × 0.25		1.10	0.938	0.793	0.829	0.85	1.15
M1.2 × 0.25		1.20	1.038	0.893	0.929	0.95	1.25
M1.4 × 0.30		1.40	1.205	1.032	1.076	1.10	1.45
M1.6 × 0.35		1.60	1.373	1.170	1.221	1.25	1.65
M1.8 × 0.35		1.80	1.573	1.370	1.421	1.45	1.85
M2.0 × 0.40		2.00	1.740	1.509	1.567	1.60	2.05
M2.2 × 0.45		2.20	1.908	1.648	1.713	1.75	2.25
M2.5 × 0.45		2.50	2.208	1.948	2.013	2.05	2.60
M3.0 × 0.50		3.00	2.675	2.387	2.459	2.50	3.10
M3.5 × 0.60		3.50	3.110	2.764	2.850	2.90	3.60
M4.0 × 0.70		4.00	3.545	3.141	3.242	3.30	4.10
M4.5 × 0.75		4.50	4.013	3.580	3.688	3.70	4.60
M5.0 × 0.80		5.00	4.480	4.019	4.134	4.20	5.10
M6.0 × 1.00		6.00	5.350	4.773	4.917	5.00	6.10
M7.0 × 1.00		7.00	6.350	5.773	5.917	6.00	7.20
M8.0 × 1.25		8.00	7.188	6.466	6.647	6.80	8.20
M9.0 × 1.25		9.00	8.188	7.466	7.647	7.80	9.20
M10.0 × 1.50		10.00	9.020	8.160	8.376	8.50	10.20
M11.0 × 1.50		11.00	10.026	9.160	9.376	9.50	11.20
M12.0 × 1.75		12.00	10.863	9.853	10.106	10.20	12.20
M14.0 × 2.00		14.00	12.701	11.546	11.835	12.00	11.25
M16.0 × 2.00		16.00	14.701	13.546	13.835	14.00	16.25
M18.0 × 2.00		18.00	16.376	14.933	15.294	15.50	18.25

f. Use the tapping chart to select the tapping drill size required for M10 threads. 1 mark

_____

g. Holes are required to be drilled.

Calculate the revolutions per minute (RPM) for a Ø 10 mm drill using a cutting speed of 30 m/min. 1 mark

$$\text{RPM} = \frac{300v}{d}, \text{ where } v = \text{cutting speed and } d = \text{diameter}$$

END OF QUESTION AND ANSWER BOOK