

STUDENT NUMBER  Letter

# VCE VET ENGINEERING STUDIES

## Written examination

Friday 12 November 2021

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

<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
21	21	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 28 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.**

**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), such as safety glasses and safety boots, list **two** specific safety precautions that should be taken when drilling holes into metal using a pedestal drill.

---

---

**Question 2** (2 marks)

Name one common hazard when operating a lathe and explain one control that could be used to minimise or eliminate that hazard.

Hazard \_\_\_\_\_

Control \_\_\_\_\_

---

**Question 3** (3 marks)

A maintenance worker has been asked to perform some repairs to steel shelving in a storage area of a factory.

This storage area has the safety sign shown in Figure 1 displayed on a wall.



**Figure 1**

- a. What does the safety sign shown in Figure 1 mean? 1 mark

\_\_\_\_\_

- b. List two work tasks that would be dangerous for the maintenance worker to perform in this storage area. 2 marks

1. \_\_\_\_\_

2. \_\_\_\_\_

**Question 4** (1 mark)

A complex part that will be mass-produced has been designed on a CAD system. It was decided that a prototype should be made on a 3D printer before going into mass production.

Give **one** specific advantage of making a prototype before going into mass production.

\_\_\_\_\_

\_\_\_\_\_

**Question 5** (4 marks)

Figure 2 shows a hacksaw frame that requires a hacksaw blade to be fitted for cutting 1.6 mm thick sheet metal.

Two blades are available for this task: one blade is labelled 32 TPI and the other blade is labelled 18 TPI.



**Figure 2**

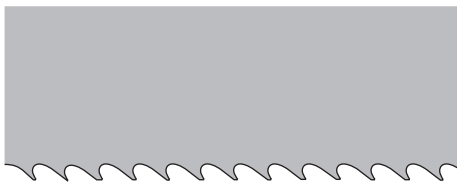
- a. Which of the two available blades is best suited to cutting the 1.6 mm thick sheet metal? Give a reason for your answer. 2 marks

Blade \_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_

Figure 3 shows the teeth of two hacksaw blades, labelled Blade A and Blade B.



Blade A



Blade B

**Figure 3**

- b. Which of the hacksaw blades shown in Figure 3 shows the correct direction of the teeth when the blade is inserted into the hacksaw frame shown in Figure 2? 1 mark

\_\_\_\_\_

- c. When fitting a hacksaw blade, it is important to tighten the blade.

Explain what can happen if the blade is not tightened. 1 mark

\_\_\_\_\_

\_\_\_\_\_

**Question 6** (1 mark)

A component is to be drawn at a scale of 1:50.




If the actual length of the component is 5.5 m, what will be the length of that component on the drawing?

---

---

**Question 7** (3 marks)

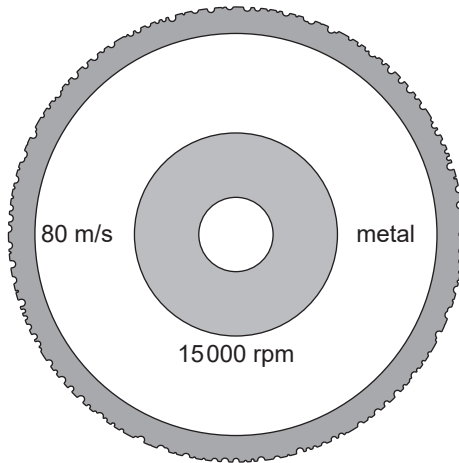
Name the three types of pliers shown below.

Type of pliers	Name
	
	
	

**TURN OVER**

**Question 8** (3 marks)

Figure 4 shows a new grinding disc that will be fitted to an angle grinder to replace an existing disc.



**Figure 4**

- a. Describe **two** checks that should be performed to ensure that the new grinding disc is safe to use before it is fitted to the angle grinder.

2 marks

---

---

---

---

- b. What safety precaution should be taken in relation to the angle grinder before removing the existing disc and fitting the new disc?

1 mark

---

**Question 9** (3 marks)

Figure 5 shows a tool commonly used in engineering workshops.



**Figure 5**

- a. What is the name of the tool shown in Figure 5? 1 mark
- 
- b. State **one** common use for this tool. 1 mark
- 
- c. What should be done periodically to maintain the accuracy of this tool? 1 mark
- 

**Question 10** (6 marks)

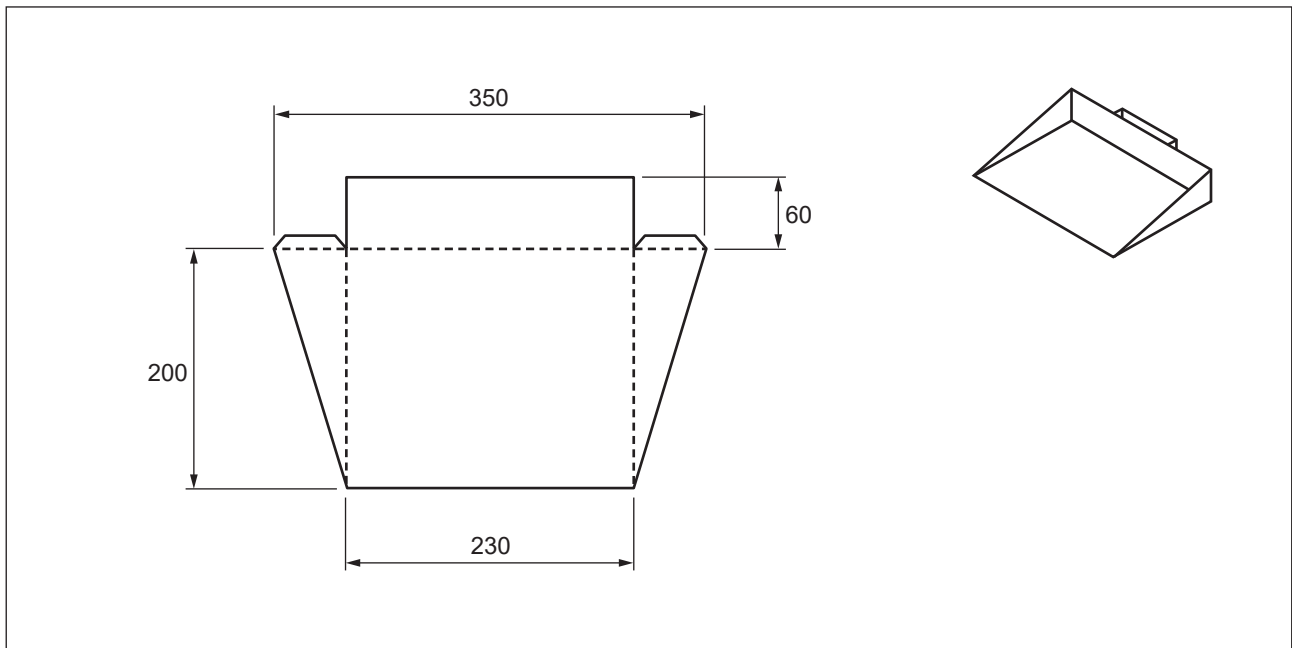
Complete the table below by identifying the most appropriate material for each of the applications listed.

Application	Material
surgical instrument	
soft drink can	
car engine block	
water supply pipe	
twist drill for use on metal	
frame for small shelving unit	

**TURN OVER**

**Question 11** (7 marks)

Figure 6 shows a dustpan that will be made from 1 mm thick sheet metal.



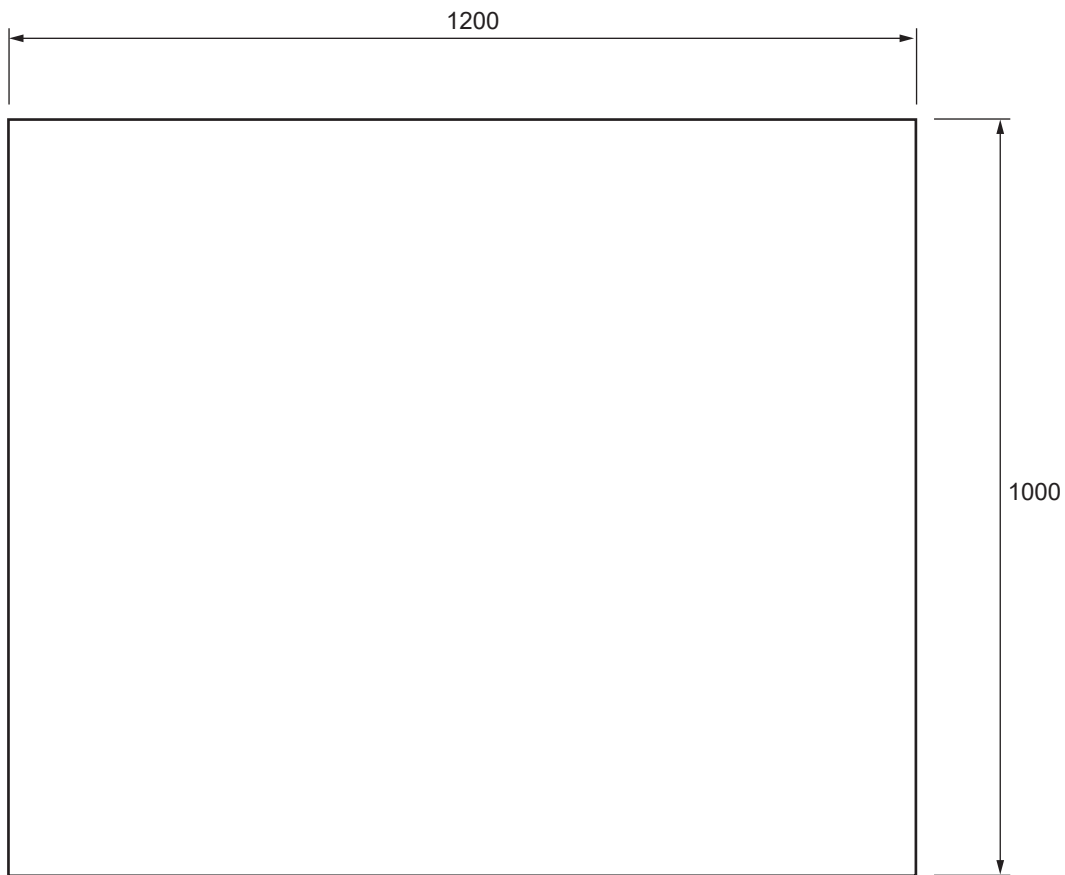
**Figure 6**



A piece of sheet metal measuring  $1200 \times 1000$  will be used to make a number of dustpans like the dustpan shown in Figure 6.

- a. i. Sketch how the dustpans should be laid out on the sheet metal to get the maximum number of dustpans and minimise waste.

1 mark



- ii. What is the maximum number of dustpans that can be made from this piece of sheet metal?

1 mark

---

One way to hold the dustpan together after folding is to use the fastener shown in Figure 7.

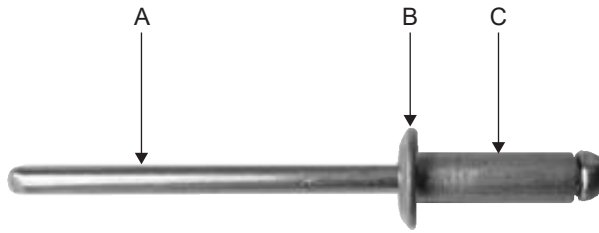


Figure 7

- b. What is the name of the fastener shown in Figure 7? 1 mark

---

- c. Which letter – A, B or C – in Figure 7 indicates the correct diameter to drill the hole in the sheet metal when using this fastener? 1 mark

---

- d. Instead of using the fastener shown in Figure 7, it was decided that welding would be more efficient when mass-producing the dustpans.  
Name the type of welding process that would be most suitable. 1 mark

---

- e. The three top edges of the dustpan shown in Figure 8 are a safety risk because they are sharp, even after deburring.

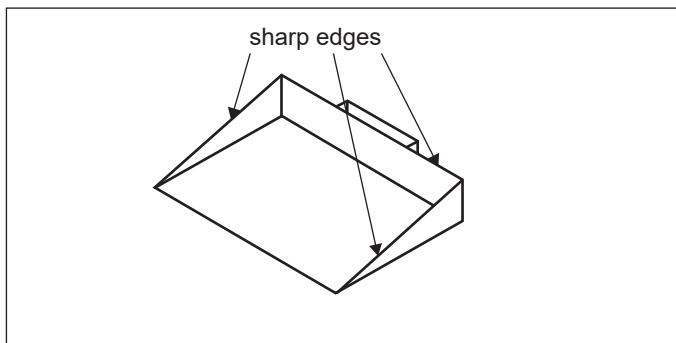


Figure 8

- Suggest **two** things that can be done to the dustpan to remove this risk of sharp edges. 2 marks

---



---

**Question 12** (3 marks)

- a. What is the main function of a bearing? 1 mark

---

- b. Bearings need to be lubricated.

What will happen if bearings are not lubricated? 1 mark

---

- c. A plain bearing and a roller bearing are being considered for a job.

State **one** main advantage that roller bearings have over plain bearings. 1 mark

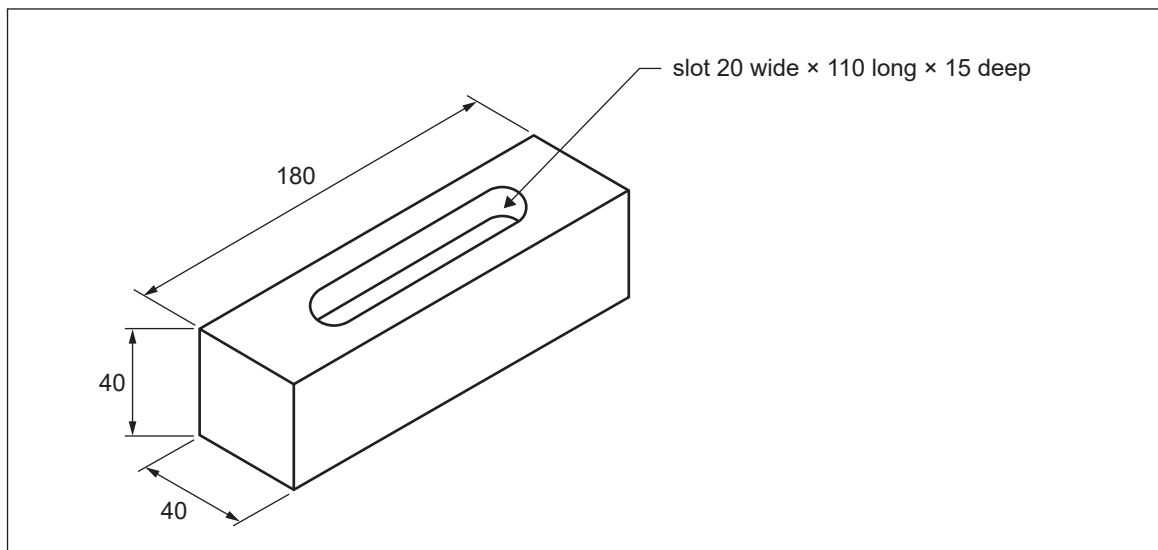
---

DO NOT WRITE IN THIS AREA

TURN OVER

**Question 13** (6 marks)

Figure 9 shows a steel block that requires a slot to be milled into the top using a  $\text{Ø } 20$  slot drill.



**Figure 9**

- a. Explain why a slot drill is better suited to this task than a standard end mill.

1 mark

---

---

Figure 10 shows a vice on the table of a vertical milling machine, which will be used to hold the steel block for machining the slot. A parallel strip has been clamped to the vice to help align the vice jaws with the milling machine table.



**Figure 10**

- b. Name one key piece of additional equipment that is required to align the vice jaws with the milling machine table. Explain the procedure for aligning the vice jaws with the milling machine table. 2 marks

Additional equipment \_\_\_\_\_

Procedure \_\_\_\_\_

- c. What will happen when machining the slot if the vice jaws are not aligned with the milling machine table? 1 mark

\_\_\_\_\_

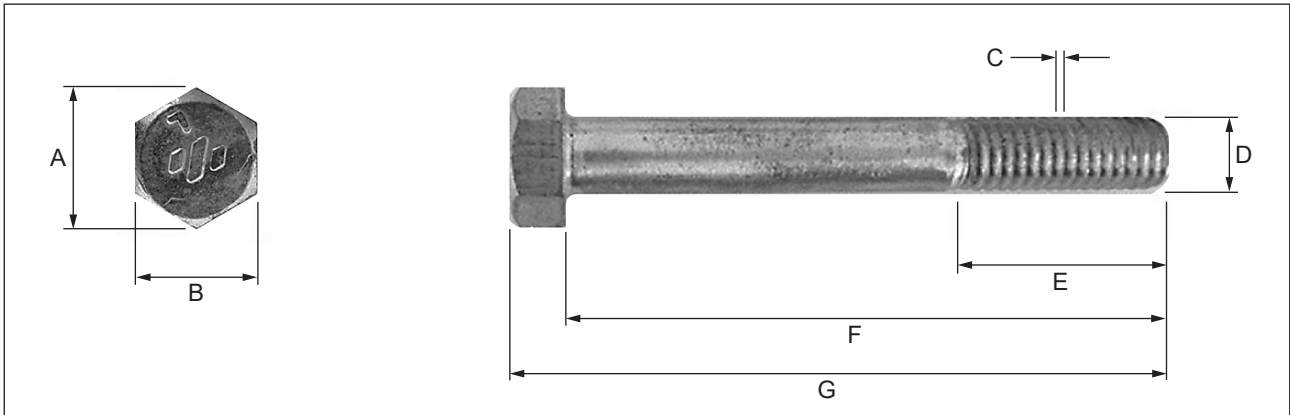
- d. Before starting the milling machine to machine the slot, list **two** things that should be checked for safety reasons. 2 marks

\_\_\_\_\_

\_\_\_\_\_

**Question 14** (4 marks)

A steel frame is being assembled using the type of bolt shown in Figure 11. More of the same type of bolt need to be ordered, so the bolt needs to be measured to determine the correct specifications.



**Figure 11**

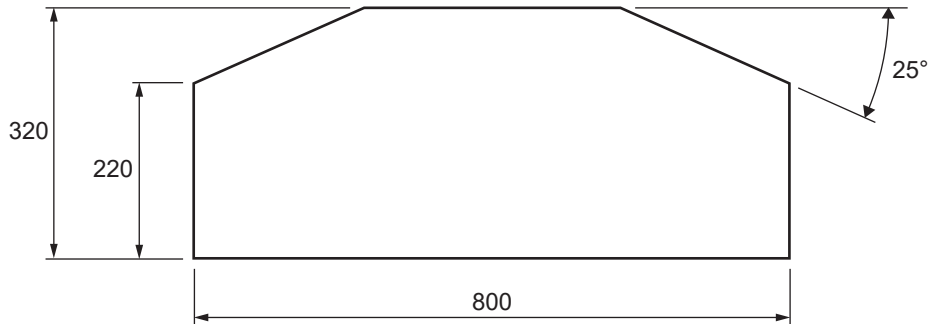
Complete the table below by matching each listed feature of the bolt to the corresponding letter in Figure 11 and by naming the most suitable measuring tool or gauge to measure that feature.

Feature	Letter representing feature	Measuring tool or gauge
major diameter		
pitch		
length		
spanner size		

DO NOT WRITE IN THIS AREA

**Question 15** (5 marks)

Figure 12 shows a 6 mm thick steel plate. A  $20 \times 3$  flat metal strip is to be cut and welded around the perimeter of the thick steel plate.

**Figure 12**

Calculate the length of the flat metal strip required to go around the perimeter of the steel plate shown in Figure 12.

---

---

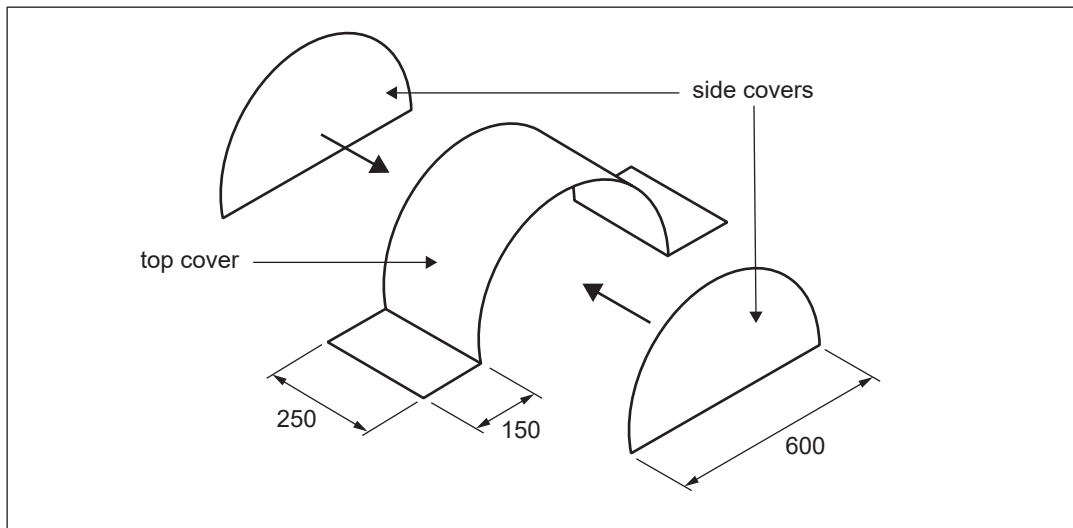
---

---

---

**Question 16** (6 marks)

Figure 13 shows a semicircular guard that will be manufactured from 1.5 mm thick sheet metal to cover a large pulley on a machine.



**Figure 13**

The top cover will be made from a single piece of sheet metal and bent to form the tabs.

- a. Calculate the length of sheet metal required to make one **top cover**. 2 marks

---



---



---

- b. Calculate the total weight of the completed guard (top cover plus two side covers). Use the following information. 2 marks

for 1.5 mm thick sheet metal – 1 m<sup>2</sup> = 11.2 kg

---



---



---

- c. The two side covers will be welded to the top cover to complete the guard.  
List two types of welding processes that would be suitable to weld the 1.5 mm thick sheet metal parts together. 2 marks

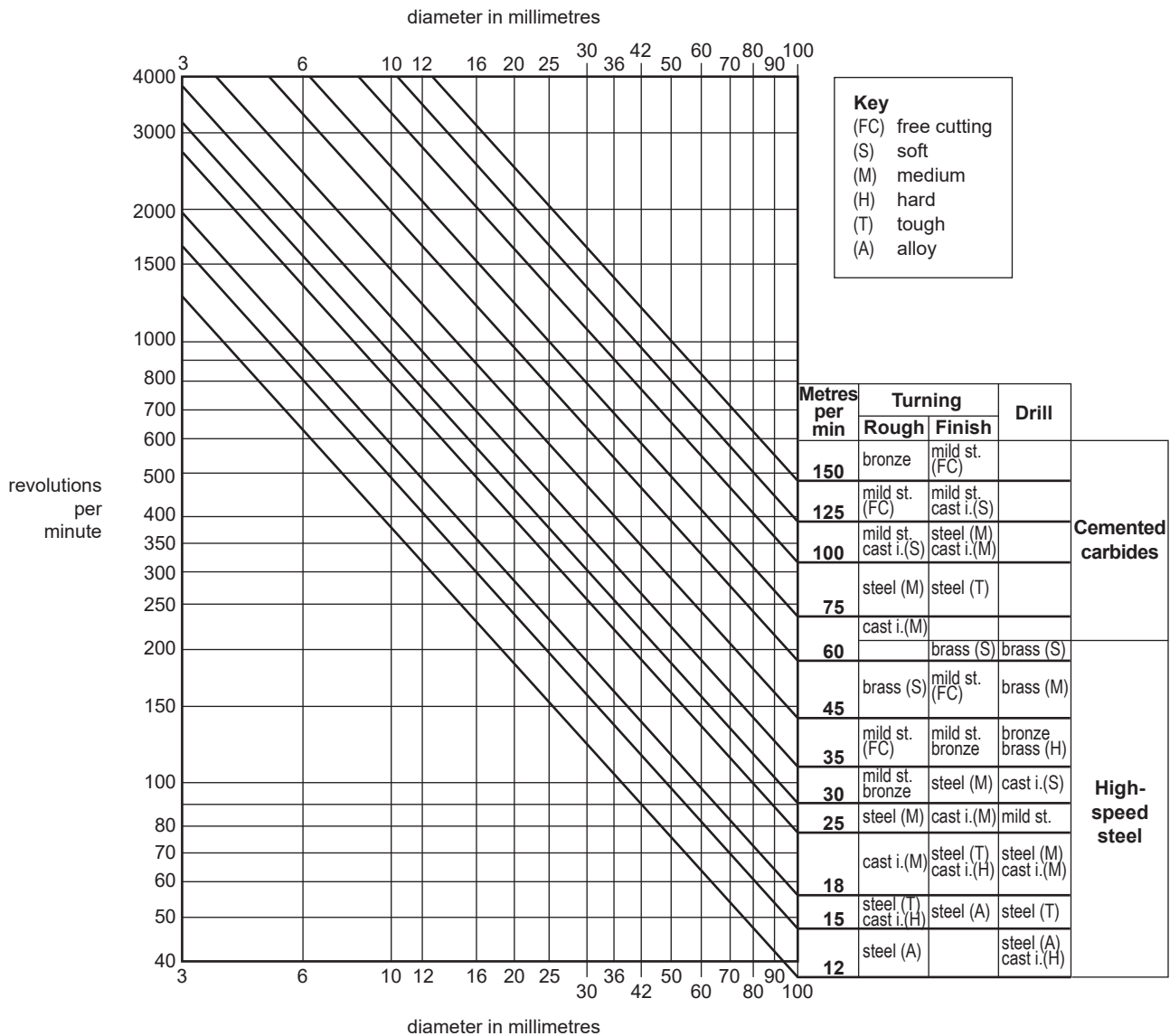
1. \_\_\_\_\_

2. \_\_\_\_\_



**Question 17** (2 marks)

Figure 14 shows a nomogram commonly used in engineering.

**Figure 14**

- a. Six holes need to be drilled into a piece of mild steel using a  $\text{Ø} 20$  high-speed steel drill bit.

Use the nomogram in Figure 14 to find the correct number of revolutions per minute (RPM) for drilling these holes.

1 mark

---

- b. Using the nomogram shown in Figure 14, find the cutting speed, in metres per minute, when rough turning cast iron (S) using a cemented carbide cutting tool.

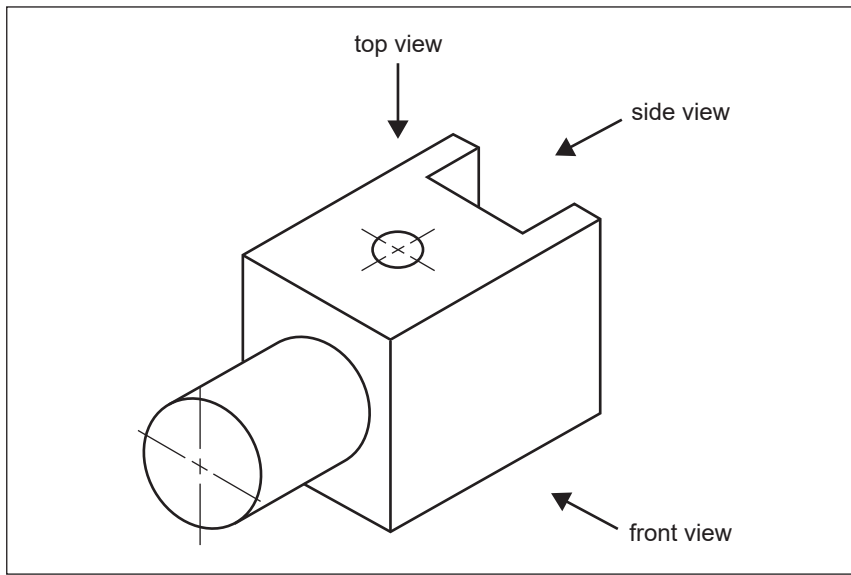
1 mark

---

**TURN OVER**

**Question 18** (4 marks)

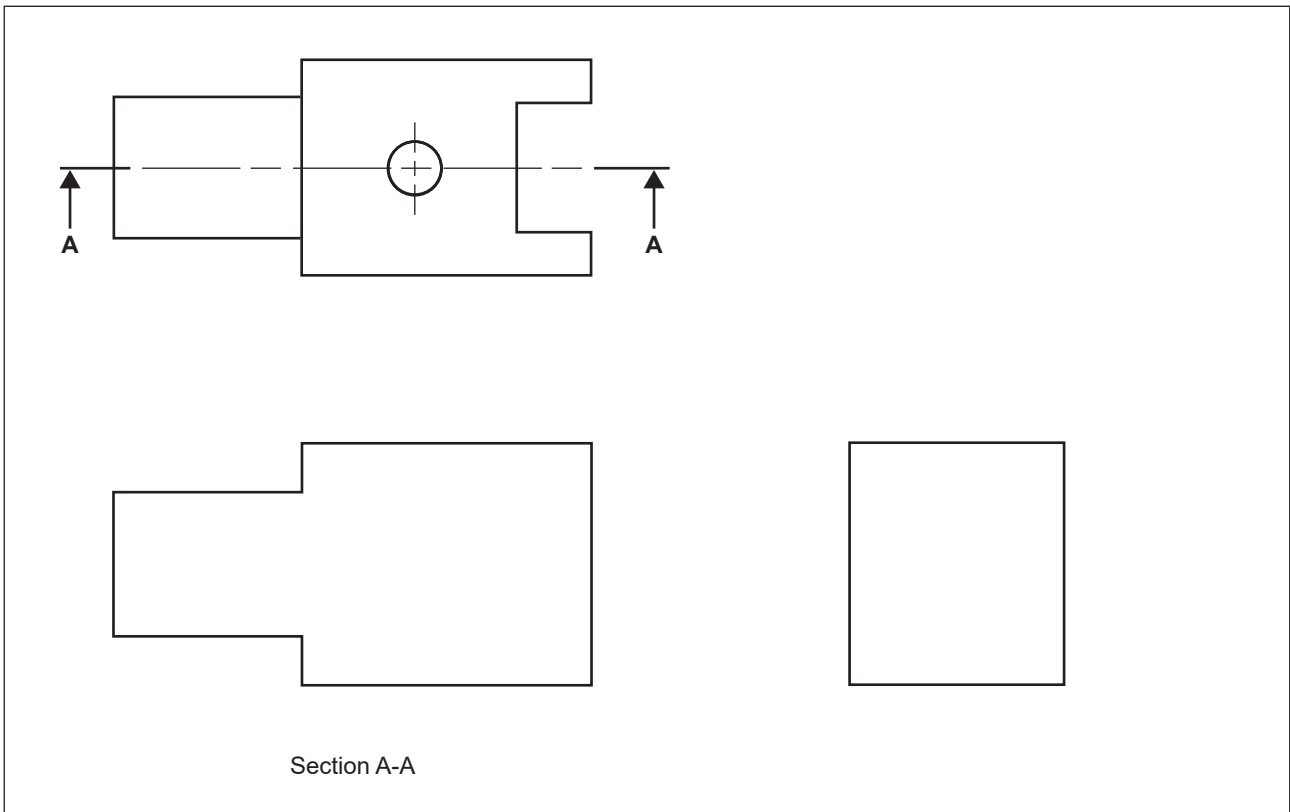
Figure 15 shows an isometric view of a steel block.



**Figure 15**

A third-angle projection view of the steel block is shown in Figure 16, with the front view sectioned. The front and side views of the drawing are not complete.

Complete the section A-A and the side view of the block in Figure 16. Show all outlines, section lines, hidden lines and centre lines.



**Figure 16**

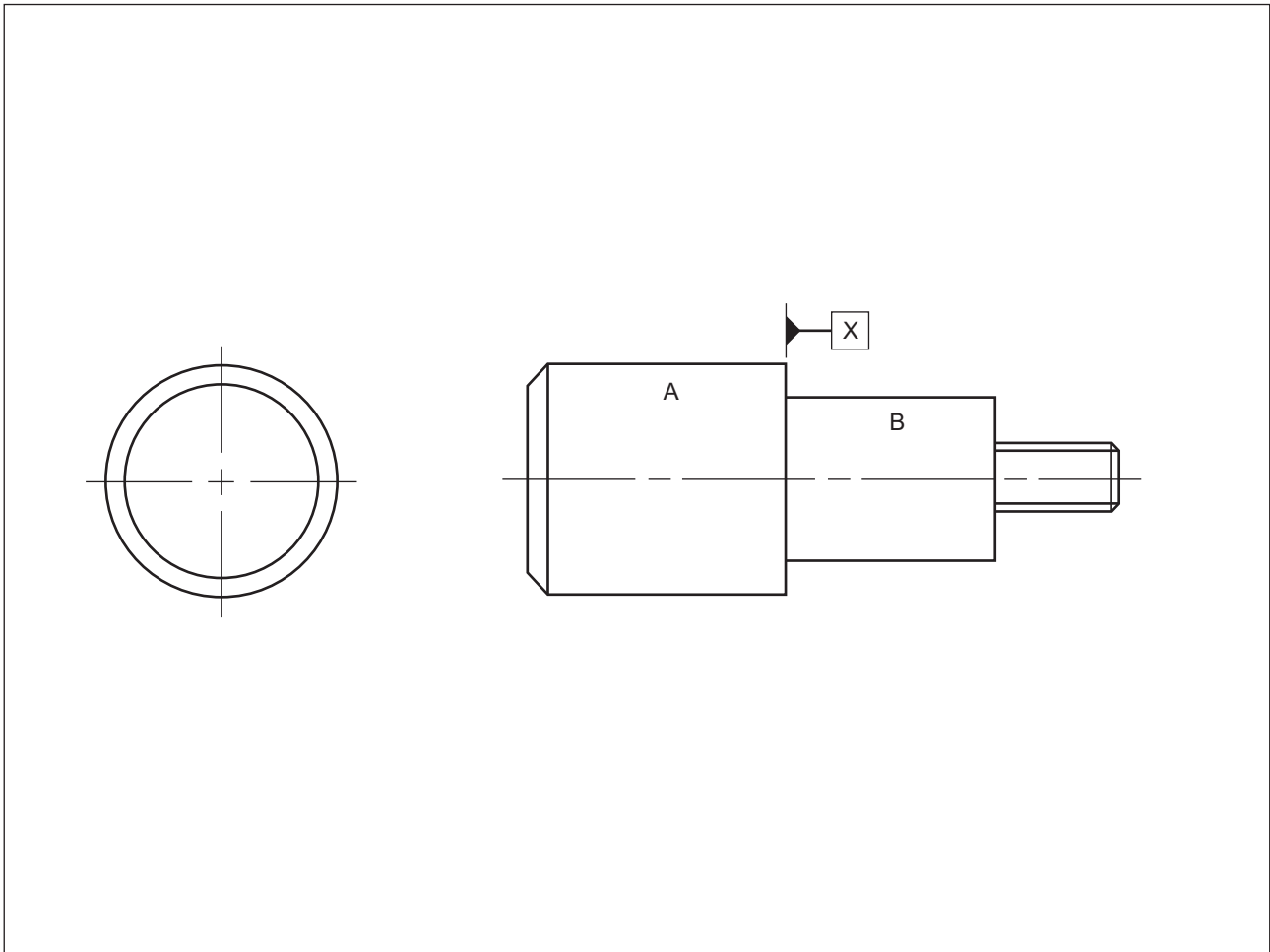
DO NOT WRITE IN THIS AREA

**Question 19** (4 marks)

Figure 17 shows a drawing of a stepped shaft that has not yet been dimensioned.

Using the following information, complete the drawing shown in Figure 17 to show all dimensions required to manufacture the stepped shaft:

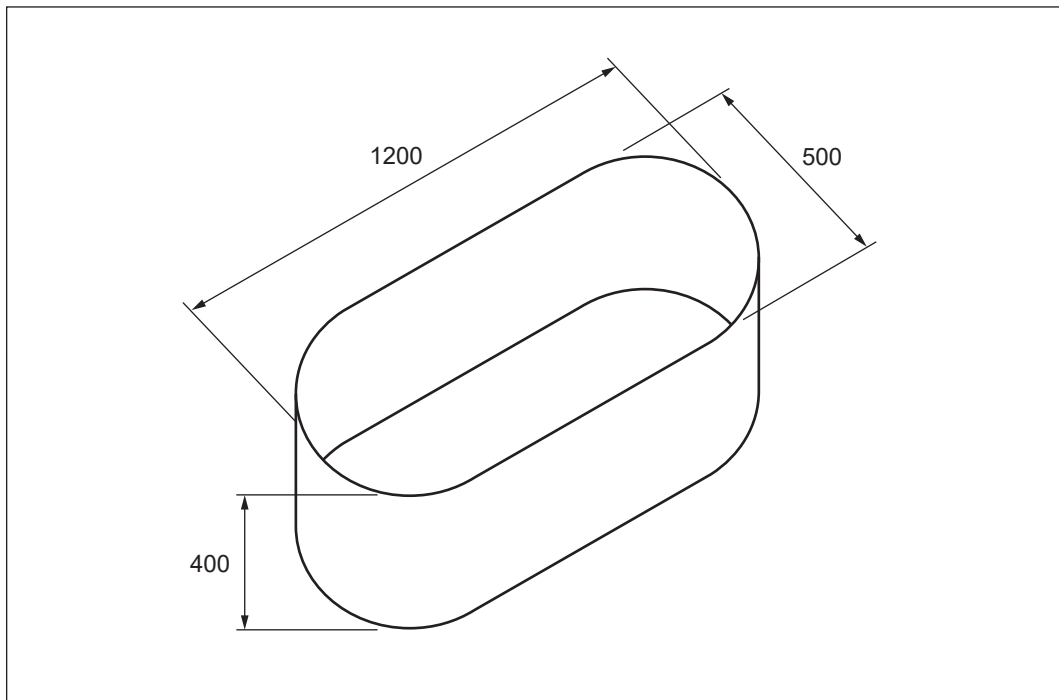
- all lengths to be dimensioned from datum X
- diameter A =  $\text{Ø } 50 \times 55$  long
- diameter B =  $\text{Ø } 42 \times 50$  long
- thread is  $\text{M}18 \times 2.5$  and 25 long
- chamfer is  $3 \times 45^\circ$



**Figure 17**

**Question 20** (5 marks)

Figure 18 shows a steel tank with semicircular ends and dimensions of  $1200 \times 500 \times 400$ .



**Figure 18**

- a. Calculate the volume of the tank shown in Figure 18 in cubic metres.

3 marks

---

---

---

---

- b. The outside surface of the tank, excluding the base, will be painted for protection.

Calculate the surface area to be painted in square metres.

2 marks

---

---

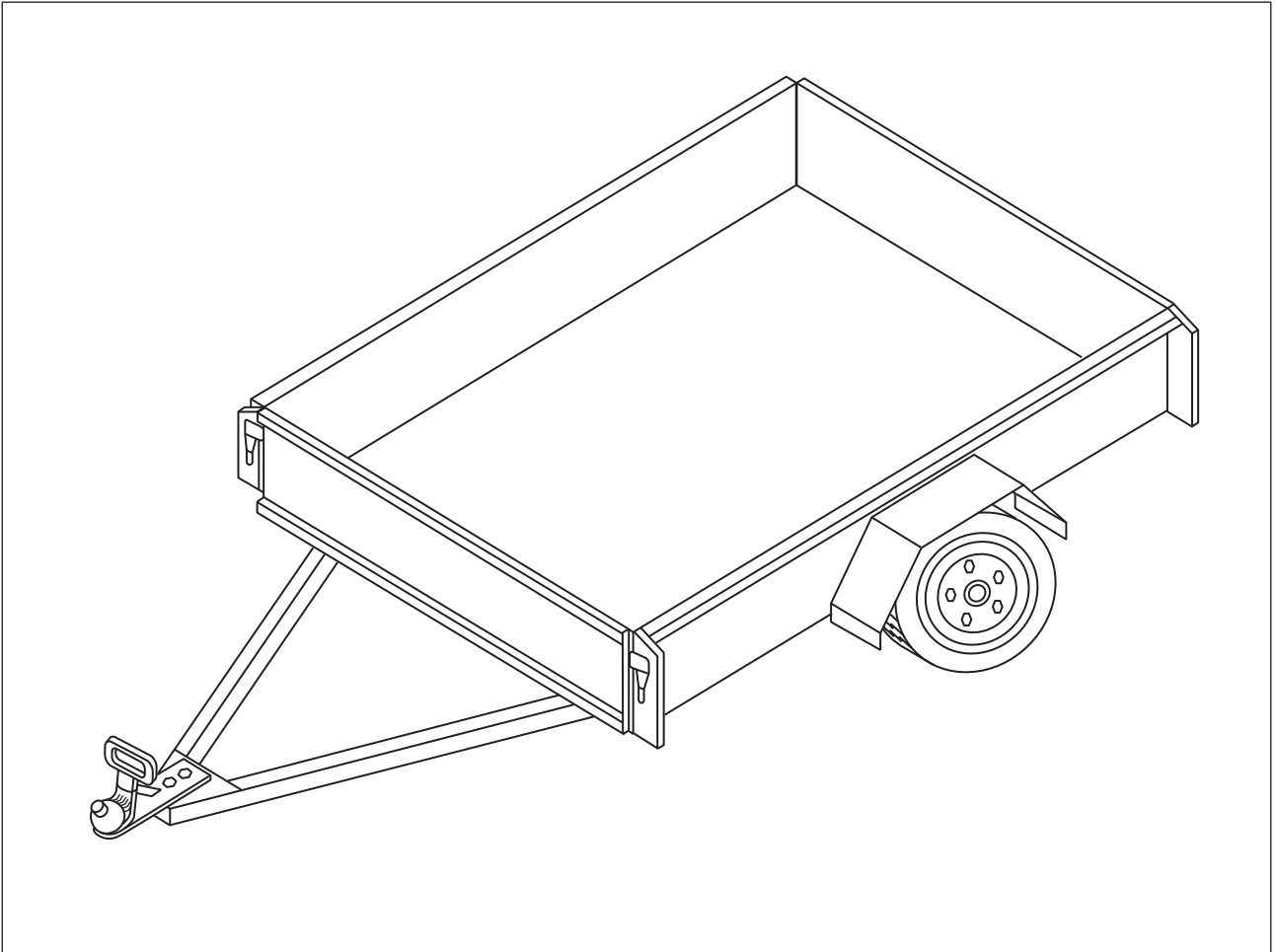
---

DO NOT WRITE IN THIS AREA

TURN OVER

**Question 21** (26 marks)

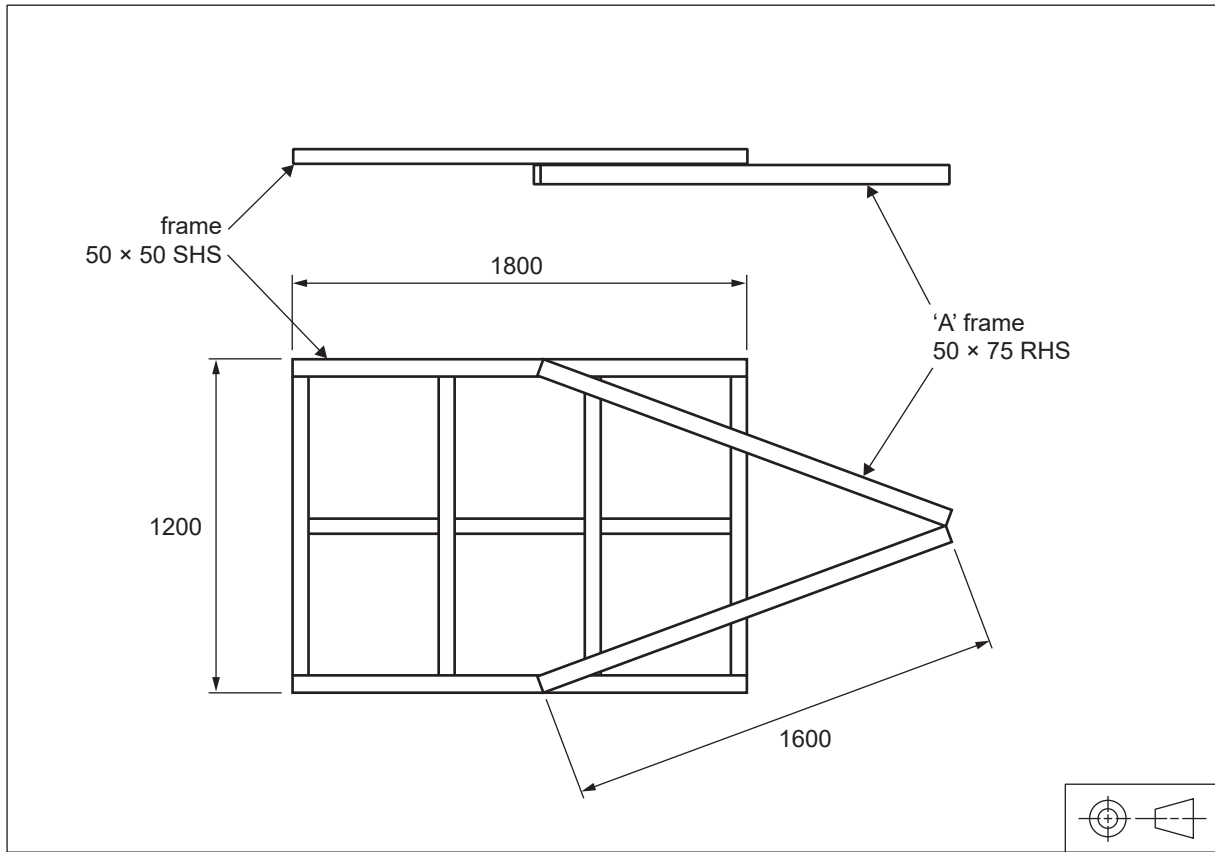
Figure 19 shows a trailer that will be manufactured in an engineering workshop. The following questions relate to the design and manufacture of the trailer.



**Figure 19**

DO NOT WRITE IN THIS AREA

Figure 20 shows the side and bottom views of the trailer frame.



**Figure 20**

- a. The individual pieces for the frame shown in Figure 20 need to be cut to length.

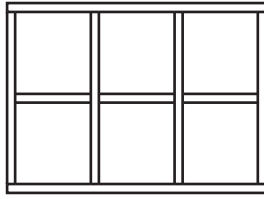
Complete the cutting list below for all the pieces required for one trailer frame.

4 marks

Material size	Number of pieces	Length

DO NOT WRITE IN THIS AREA

- b. The 50 × 50 SHS is being tack welded together, as shown in Figure 21. It is important that the frame is square before it is finish welded.



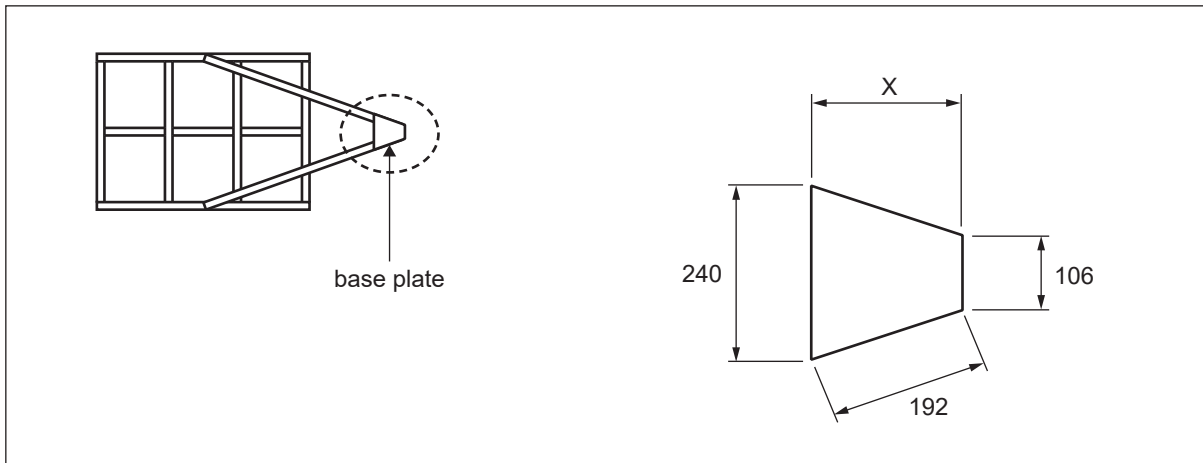
**Figure 21**

Describe two ways of checking the frame for squareness.

2 marks

1. \_\_\_\_\_
2. \_\_\_\_\_

Figure 22 shows the base plate that the coupling will be bolted onto.



**Figure 22**

- c. Calculate dimension X of the base plate shown in Figure 22. Show your working and give your answer correct to the nearest millimetre.

2 marks

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- d. What thickness of material would be most suitable to produce the base plate shown in Figure 22? Give a reason for your answer.

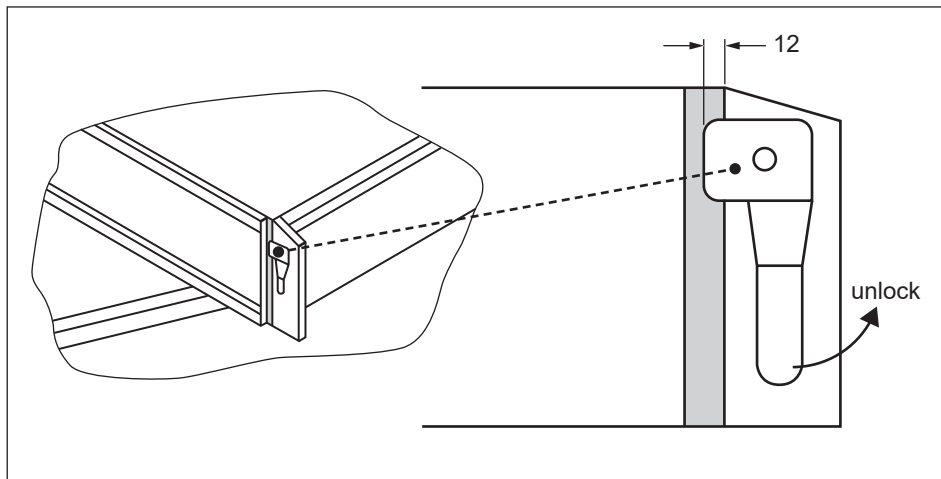
2 marks

Thickness \_\_\_\_\_

Reason \_\_\_\_\_



- e. Figure 23 shows one of the cam lock handles used to lock the front and rear tailgates of the trailer. The tailgate is locked when the cam lock is over the grey shaded area, overlapping it by 12 mm.



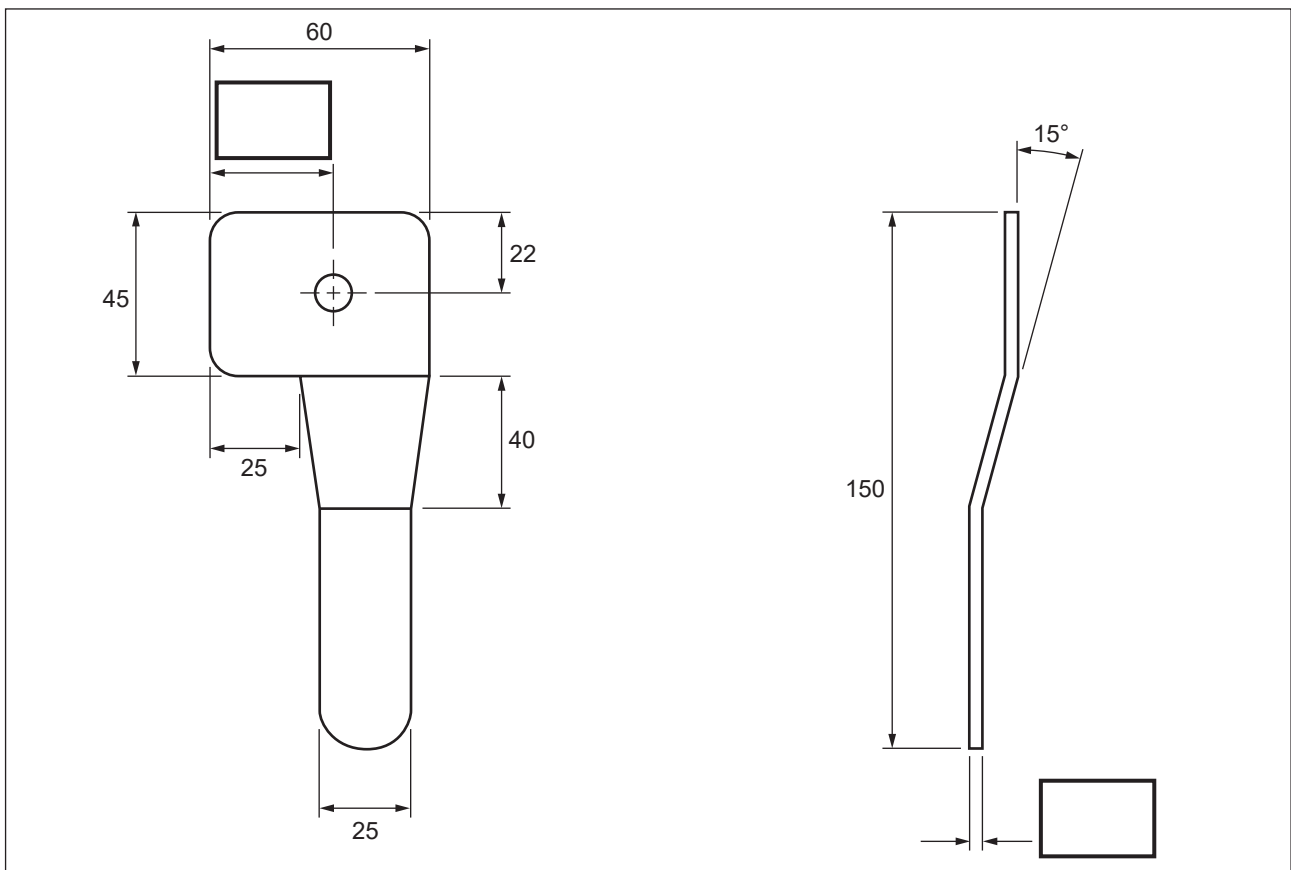
**Figure 23**

Figure 24 shows a detailed drawing of the cam lock handle. The drawing is missing two dimensions:

- the horizontal position of the pivot hole for the cam lock
- the thickness of the material

Complete the drawing shown in Figure 24 by filling in the two missing dimensions in the boxes provided.

3 marks



**Figure 24**

Figure 25 shows a detailed drawing of a stub axle that will be used for the trailer.

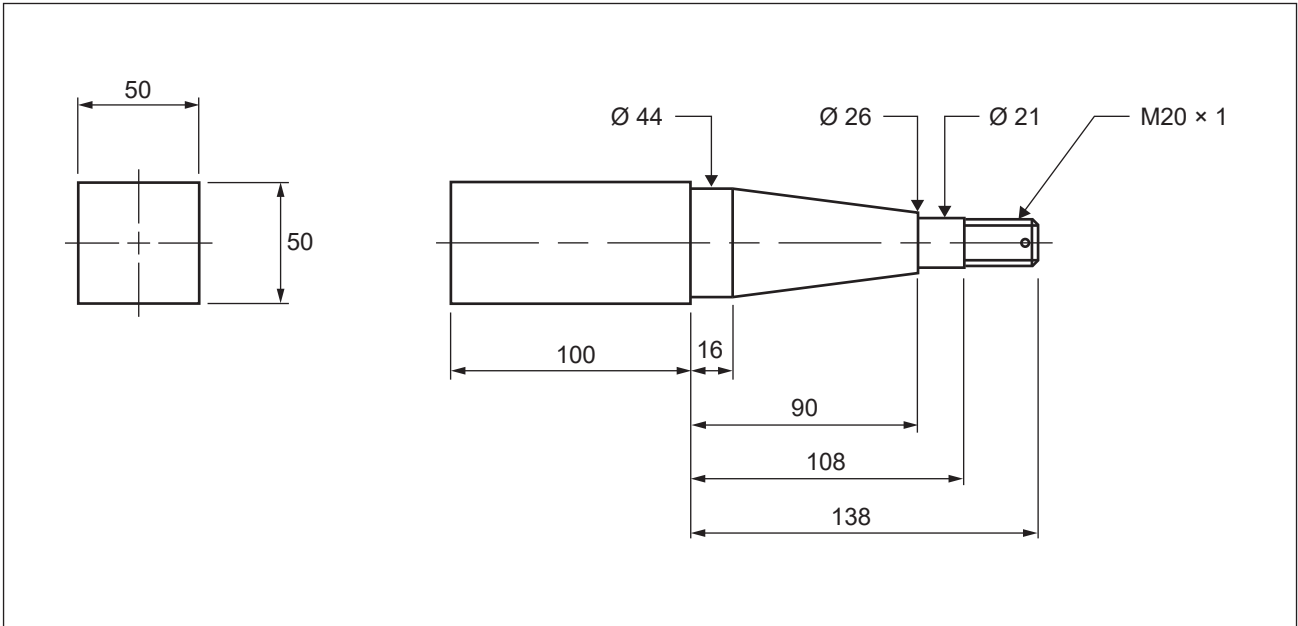


Figure 25

The stub axle shown in Figure 25 will be made from a 50 × 50 square steel bar.

A piece of the 50 × 50 square steel bar will be cut using a drop saw to make one stub axle on a lathe. The axle will be faced off in the lathe.

- f. What length of the square steel bar should be cut for the stub axle? 1 mark

---

The cut material for the stub axle will be held in the lathe for machining all the diameters and thread.

- g. State how the material should be held in the lathe so that **both** ends are held and supported. 2 marks

---



---

- h. Which part of the lathe will be swivelled and set to the angle for cutting the taper? 1 mark

---

- i. Calculate the angle to which this part of the lathe should be set to machine the taper. Show your working. 2 marks

---



---

DO NOT WRITE IN THIS AREA

- j. The assembled stub axles for the trailer will use tapered roller bearings.

Why are tapered roller bearings more suitable for this application than standard ball bearings? 1 mark

---



---

The castellated nut and Fastener X shown in Figure 26 will be used to hold the tapered roller bearing assembly in place.



castellated nut



Fastener X

Source: notsuperstar/Shutterstock.com

**Figure 26**

- k. What is the name of Fastener X shown in Figure 26? 1 mark

---

- l. What is the main advantage of using the fasteners shown in Figure 26 for the tapered roller bearing assembly compared to using a normal nut? 1 mark

---

The main stages of the project to design and build the trailer are shown in the table below. The main stages are **not** in the correct sequence.

Stage	Duration (days)
final inspection	1
prepare design drawings	4
assembly	3
order/delivery of material	6
research project requirements	2
fabrication	5
galvanising of frame	3

- m. Complete the chart below by showing the main stages and shading the timeline in the correct sequence. The first two stages are shown. 3 marks

Stage	Timeline (days)																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
<i>research project requirements</i>																											
<i>prepare design drawings</i>																											

- n. What would be the latest possible start date for the project if the trailer has to be completed by 30 November? Assume that staff work seven days a week. 1 mark

---