

FORM TP 2012094



TEST CODE **01335020**

MAY/JUNE 2012

CARIBBEAN EXAMINATIONS COUNCIL

**SECONDARY EDUCATION CERTIFICATE
EXAMINATION**

MECHANICAL ENGINEERING TECHNOLOGY

Paper 02 – Technical Proficiency

2 hours 40 minutes

03 MAY 2012 (a.m.)

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of **THREE** sections. You **MUST** answer a total of **FIVE** questions.
SECTION A: You must answer the **COMPULSORY** question from this section.
SECTION B: You must answer **THREE** questions from this section.
SECTION C: You must answer **ONE** question from this section.
2. Use the first 10 minutes to read through the paper. Writing **MAY** begin during the 10-minute period.
3. Write your answers in the answer booklet provided.
4. Use sketches when necessary to support your answers.
5. Silent electronic calculators may be used.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

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01335020/F 2012



This paper is divided into THREE sections — A, B and C. You MUST answer the only question from Section A, THREE questions from Section B and ONE question from Section C.

This paper contains metric dimensions only. You should work your answers in the metric system.

SECTION A

You are allowed to use freehand sketches or rule-assisted sketches to answer this question which is based on Module B8 of the syllabus — Engineering Design. The question is worth 40 marks.

You are advised NOT to spend more than 50 minutes on this question.

1. Figure 1, on page 3, shows the incomplete design for a volleyball pole and net tensioning mechanism.

The pole is designed for use by both senior and junior volleyball players who use different heights on the pole.

Pulley A is to be attached to the pole without drilling holes in the pole and be able to move from the position X for senior players to the position Y for junior players.

Bracket C, which houses Pulley B and the handle, is attached to the pole at F.

Pulley B is fixed to the handle D and only rotates when the handle is turned.

The net support cord is attached to Pulley A and is turned clockwise by the handle to tension the net.

Complete the design, showing clearly the following:

- (a) Pulley A attached to the pole without using holes in the pole and being able to move between positions X and Y (9 marks)
- (b) A means of locking Pulley A in place (7 marks)
- (c) Bracket C attached to the pole (8 marks)
- (d) Pulley B attached to the handle (8 marks)
- (e) Pulley B secured in the housing and allowed to rotate and secured in any position to hold the tension on the net (8 marks)

Total 40 marks

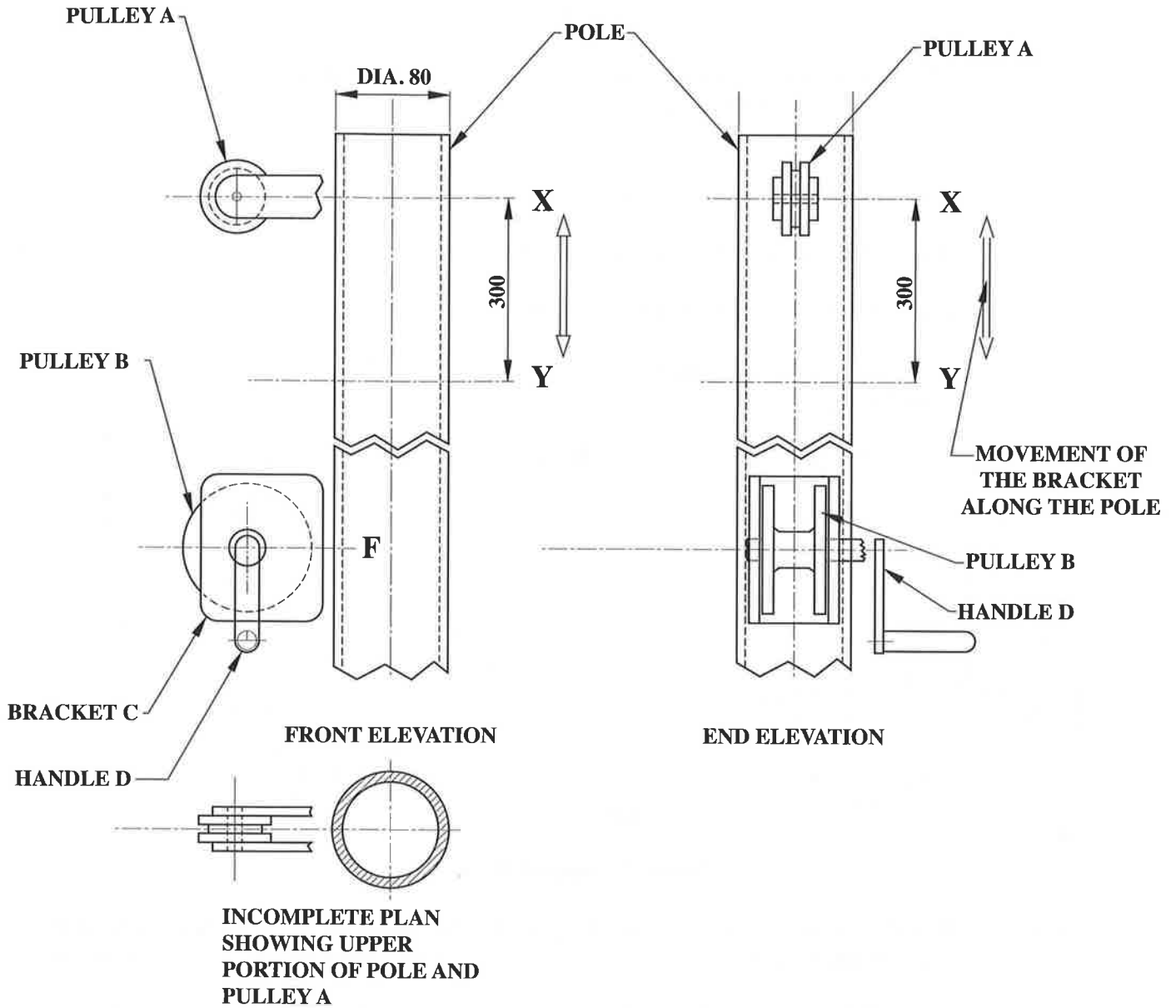


Figure 1. Incomplete design of a volleyball pole and net tensing mechanism

SECTION B

You are required to answer any **THREE** questions from this section.
EACH question is worth 20 marks.

2. Figure 2 shows two shims to be secured in the supporting block as follows:

- (i) Shim A is to be press fitted into the block.
- (ii) Shim B is to be threaded into the block.

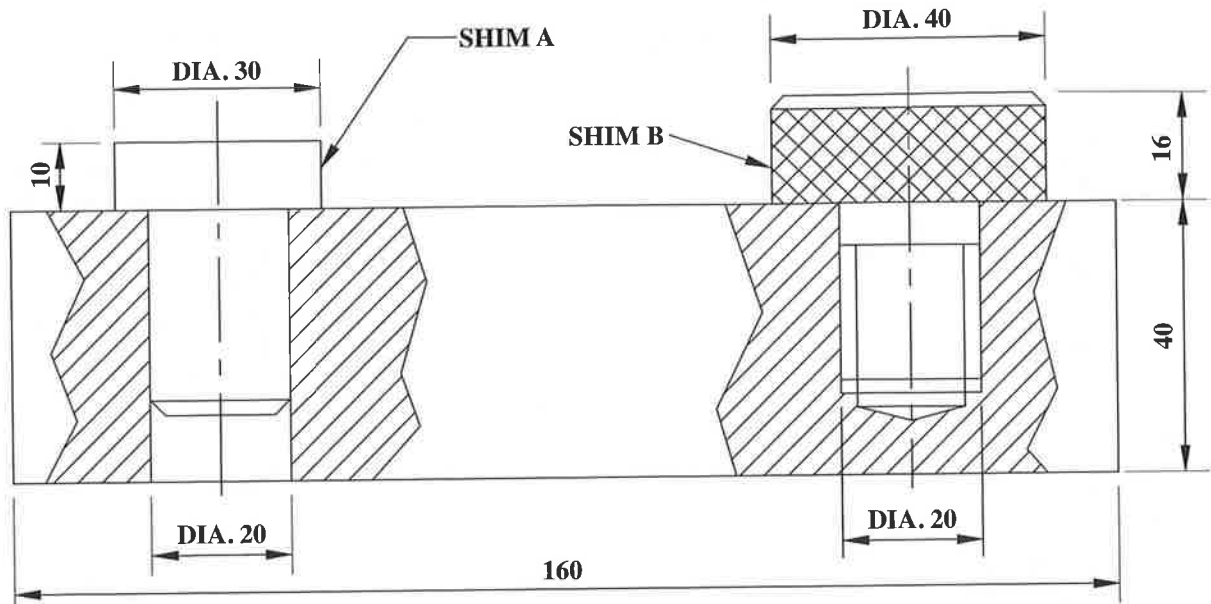


Figure 2. Support block

- (a) With the aid of a sketch, explain the procedure for threading the blind hole by hand to accommodate shim B. **(4 marks)**
- (b) State FOUR precautions that should be taken to reduce the risk of tap breakage while threading the hole in the component. **(4 marks)**
- (c) Explain the method of removing a broken tap from the component. **(4 marks)**
- (d) List, in sequence, the steps of procedure for fitting shim A into the block. **(4 marks)**
- (e) State the type of fit necessary to secure shim A into the block. **(1 mark)**
- (f) With the aid of sketches, indicate the difference in the main features of any TWO of the following engineering hammers:
 - (i) Cross pein
 - (ii) Ball pein
 - (iii) Straight pein**(3 marks)**

Total 20 marks

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3. Figure 3 shows a plumb bob that is to be produced on a lathe from a piece of mild steel stock 30 mm diameter by 140 mm long.

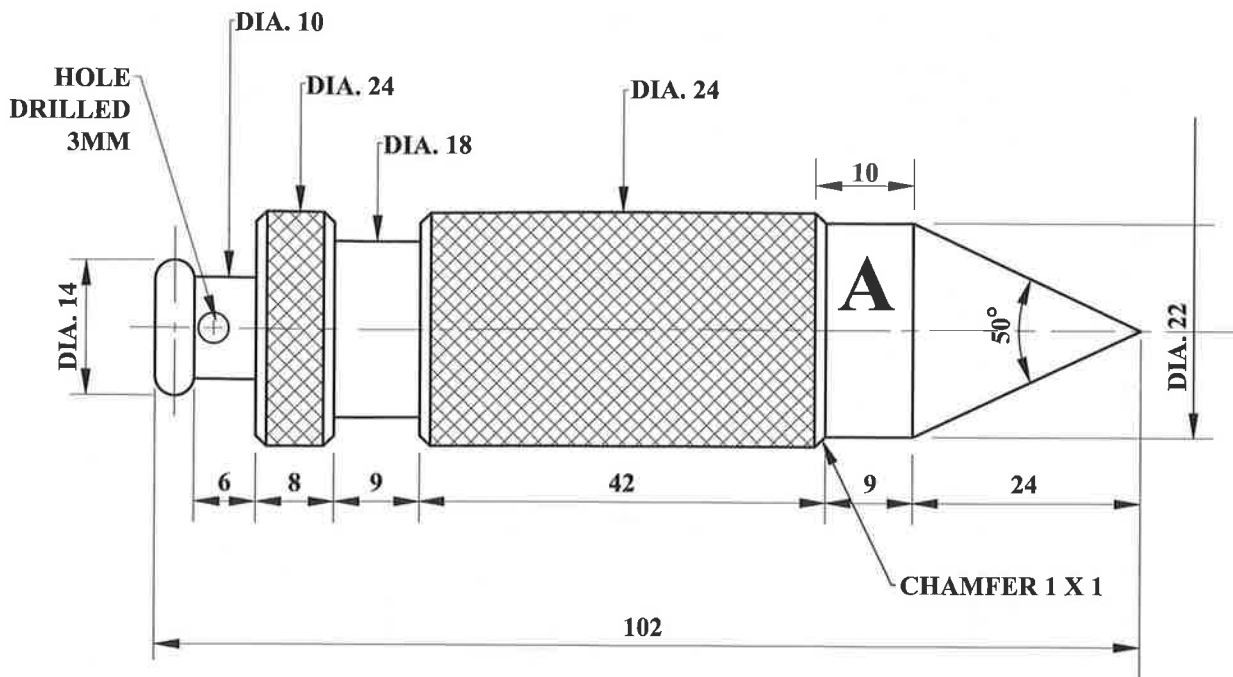


Figure 3. Plumb bob

- (a) With the aid of sketches, list in sequence the operations for making the component. (6 marks)
- (b) List the tools to be used in the sequence of operations at (a). (3 marks)
- (c) List the steps of procedure required to produce the knurled section of the plumb bob. (4 marks)
- (d) State TWO precautions to be observed while producing the knurled section of the plumb bob. (2 marks)
- (e) Calculate the spindle speed that is to be used to produce the 22 mm section labelled A if the cutting speed of the material is 30 m/min. (3 marks)
- (f) State TWO safety precautions that should be observed while working on the centre lathe. (2 marks)

Total 20 marks

4. Figure 4 shows a template that is to be produced from a sheet of mild steel 3 mm thick by 100 mm wide by 120 mm long. The material has been prepared to the required size and is ready to be marked out.

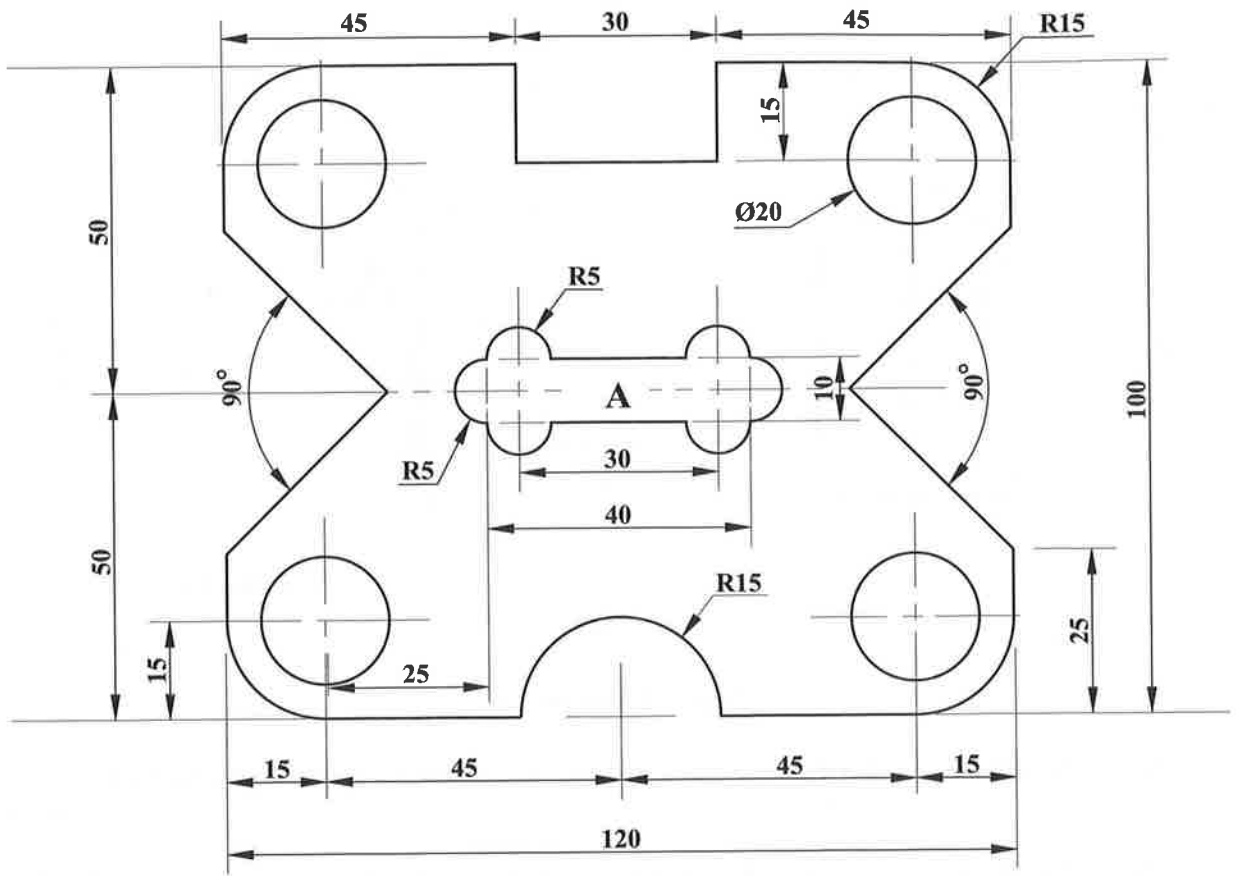


Figure 4. Template

- (a) (i) List the steps of procedure for marking out the template. **(6 marks)**
- (ii) Name the tools and equipment necessary for use in EACH step listed in (a) (i) above. **(3 marks)**
- (b) Outline, in sequence, the operations for cutting out slot A, using bench work tools. **(4 marks)**
- (c) Name appropriate tools for cutting out slot A. **(2 marks)**
- (d) State TWO methods of protecting the surface of the template from corrosion after it is made. **(2 marks)**
- (e) Describe ONE of the methods stated in (d) above. **(3 marks)**

Total 20 marks

5. A tinplate tray, 150 mm long by 50 mm wide by 20 mm high with 3 mm safe edges, is to be produced for storing small drills in the workshop.

- (a) (i) Draw a layout of the tray showing all bends and folds. **(4 marks)**
- (ii) With the aid of sketches, describe the steps of procedure that should be used to complete the tray. **(5 marks)**
- (iii) Name THREE processes that could be used for joining the ends to the sides of the tray. **(3 marks)**
- (iv) With the aid of sketches, describe ONE of the processes named in (a) (iii) above. **(5 marks)**
- (b) What is the composition of tinman's solder? **(1 mark)**
- (c) Name the TWO classes of fluxes used in sheet metalwork. **(2 marks)**

Total 20 marks

6. A component that is to be machined on the horizontal milling machine from a mild steel block $110 \times 30 \times 40$ mm is shown in Figure 5.

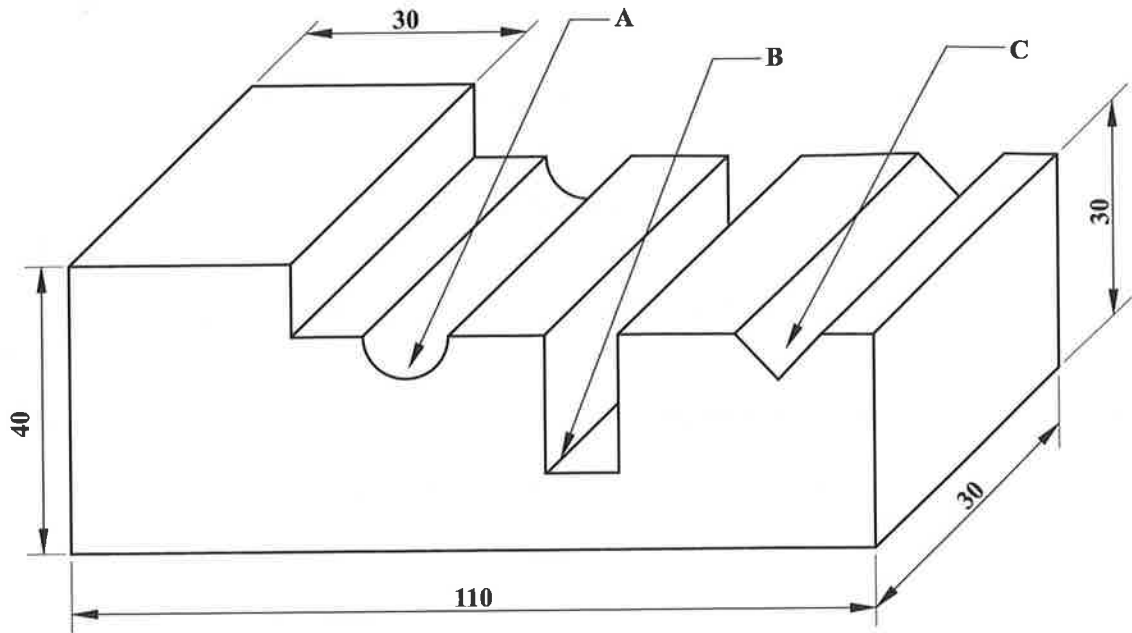


Figure 5. Milled block

- (a) (i) List the steps of procedure for setting up and machining the component. (7 marks)
- (ii) Sketch and name the cutter used to produce the slot at B. (3 marks)
- (b) The slot at B is to be machined using a 120 mm diameter milling cutter. The cutting speed of mild steel is 30 metres per minute.
- (i) State the formula for calculating the revolutions per minute of the cutter. (1 mark)
- (ii) Calculate the revolutions per minute required. (3 marks)
- (c) List TWO advantages and TWO disadvantages of the conventional (up-cut) method of milling. (4 marks)
- (d) State TWO safety precautions that should be observed when using the milling machine. (2 marks)

Total 20 marks

SECTION C

**You MUST answer any ONE question from this section.
EACH question is worth 20 marks.**

7. Two pieces of 3 mm thick mild steel plate, 50 mm wide × 150 mm long, are to be joined along the length to increase the width to 100 mm using the oxy-acetylene welding process.
- (a) (i) State the names of the TWO techniques commonly used in oxy-acetylene welding. **(2 marks)**
 - (ii) Which of the techniques stated in (a) (i) above is MORE suitable for carrying out the weld? **(1 mark)**
 - (b) Illustrate, with the aid of sketches,
 - (i) the preparation of the plates to accommodate the weld **(2 marks)**
 - (ii) a means of securing the plates during the welding process. **(2 marks)**
 - (c) List, in sequence, the steps of procedure to be taken in welding the pieces together. **(6 marks)**
 - (d) (i) State FOUR checks that should be made before opening the cylinder valves when carrying out oxy-acetylene welding. **(4 marks)**
 - (ii) List THREE checks that should be made after shutting down the equipment. **(3 marks)**

Total 20 marks

8. Figure 6 shows the elevation and plan of a chipping hammer to be forged from a piece of 20 mm diameter mild steel bar.

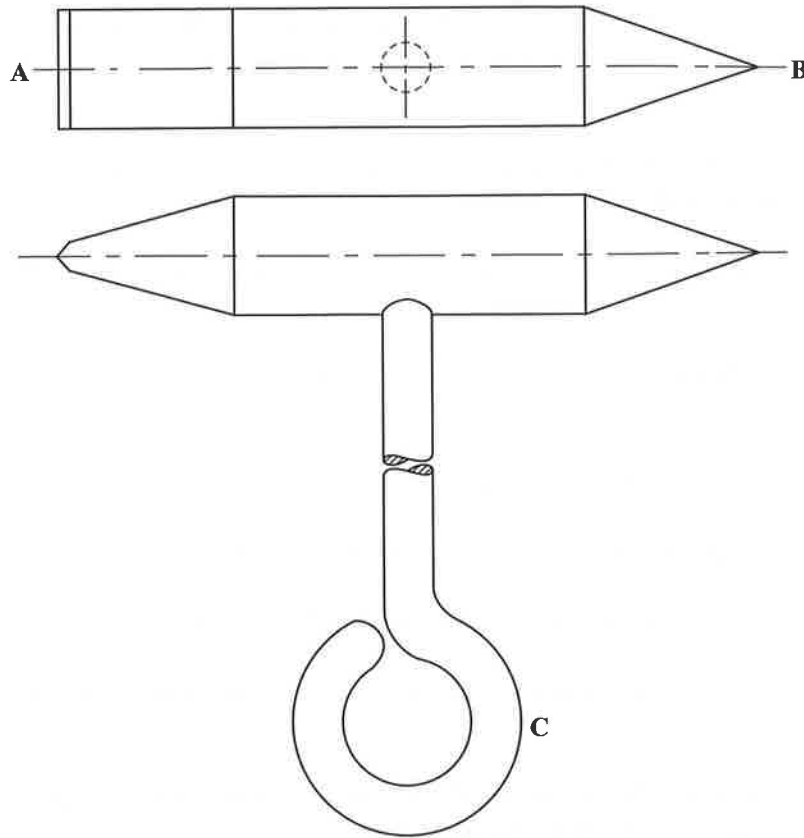


Figure 6. Chipping hammer

- (a) With the aid of sketches, describe the forging processes that should be carried out to produce the following:
- (i) The flat at A
 - (ii) The point at B
 - (iii) The eye at C
- (10 marks)**
- (b) State the differences between the following heat-treatment processes:
- (i) Hardening and case hardening
 - (ii) Hardening and tempering
 - (iii) Annealing and normalizing
- (6 marks)**
- (c) Which of the heat-treatment processes listed in (b) above would be used to heat-treat the chipping hammer? **(1 mark)**
- (d) Explain why this heat-treatment process would be necessary before the hammer could be used as a tool. **(1 mark)**
- (e) State TWO reasons for heat-treating steel in the workshop. **(2 marks)**

Total 20 marks

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9. (a) Explain the following procedures with respect to the care of machines in the school's workshop:
- (i) Lubrication
 - (ii) Preventative maintenance (2 marks)
- (b) State why EACH procedure listed in (a) is necessary. (2 marks)
- (c) List the steps of procedure for carrying out general maintenance to machines in the school's workshop. (6 marks)
- (d) State FOUR advantages of using plastics for the mass production of various articles. (4 marks)
- (e) State TWO disadvantages of using plastics for the mass production of various articles. (2 marks)
- (f) With the aid of a sketch, describe a process of insulating the handles of tools made from metal. (4 marks)

Total 20 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.