FORM TP 2011094

TEST CODE 01335020

MAY/JUNE 2011

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

MECHANICAL ENGINEERING TECHNOLOGY

Paper 02 - Technical Proficiency

2½ hours

04 MAY 2011 (a.m.)

GENERAL DIRECTIONS:

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. In addition to the 2½ hours, you are allowed 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.

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

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 general arrangement of a table-top grinder. The grinder is driven by a small motor running at a speed of 600 r.p.m. The drive to the system is transmitted from the motor to the headstock spindle by a V-belt pulley system. Tension on the drive belt is achieved by adjusting the headstock housing vertically (up and down) on the headstock support bracket.

The finished assembly has the motor, which has a metal case, firmly bolted to the machine base using four hexagonal head machine screws and washers. The headstock support bracket is fastened to the machine base by using two stud bolts with nuts and washers.

The larger pulley is assembled to the motor by using a woodruff key and set screw, while the smaller pulley is assembled to the headstock spindle by using a set screw. The headstock spindle is supported in the headstock housing by a bronze bushing as shown and is prevented from horizontal movement while in operation by two stops secured to the shaft.

Produce a design for the table-top grinder assembly, to meet the specifications above, by using sketches to show the following:

(a) Presentation: (i) neatness, (ii) clarity of details, (iii) proportionality **(6 marks)**

(b) The motor bolted to the machine base using hexagonal head screws and washers **(5 marks)**

(c) The large pulley assembled to the motor shaft with a woodruff key and set screw **(5 marks)**

(d) The small pulley assembled to the headstock spindle, aligned to the large pulley and secured with a set screw **(5 marks)**

(e) The headstock spindle assembled in the headstock housing with stops to prevent horizontal (side to side) movement **(5 marks)**

(f) The headstock housing assembled to the headstock support bracket with provision for tensioning the drive belt **(5 marks)**

(g) The headstock support bracket assembled to the machine base with stud bolts, nuts and washers **(5 marks)**

(h) The abrasive wheel secured to the spindle with a hexagonal nut and washer **(4 marks)**

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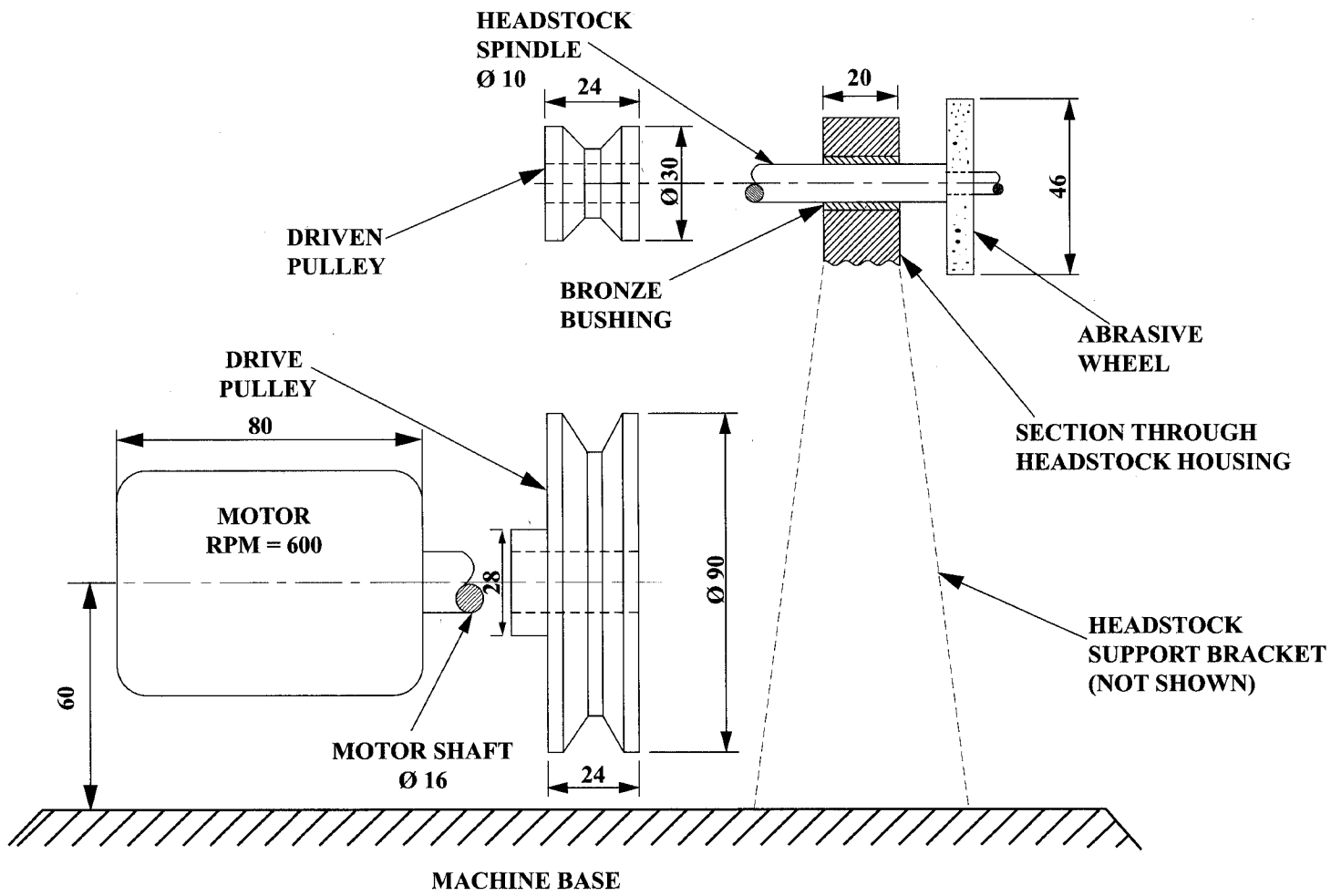

Figure 1. Table-top grinder

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SECTION B

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

2. The solid punch shown in Figure 2 is to be machined on the centre lathe. The punch is to be machined from a piece of bright mild steel 22 mm diameter by 200 mm long.

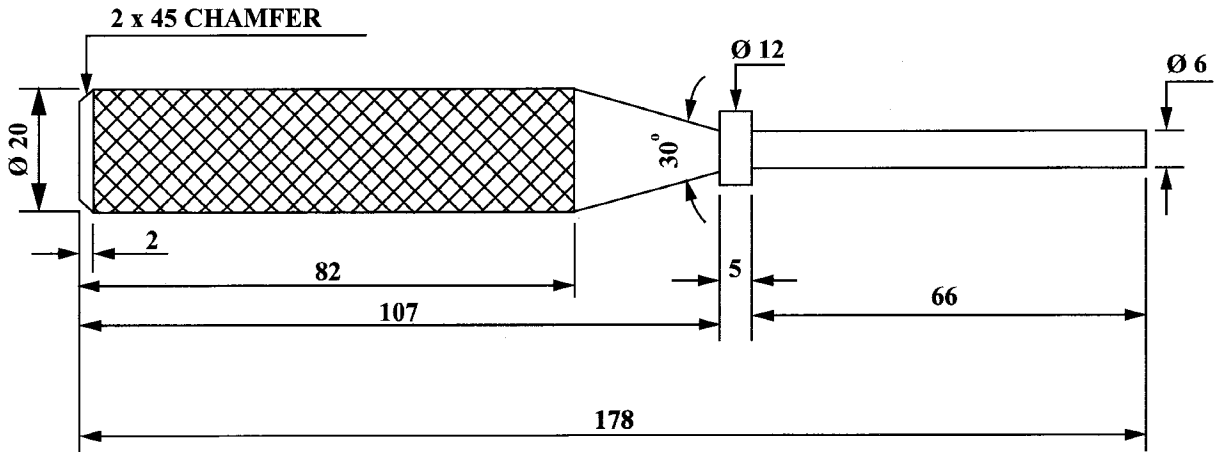

Figure 2. Solid punch

(a) List, in sequence, the steps of procedure required to produce the solid punch. **(6 marks)**

(b) List the tools to be used to produce the solid punch. **(2 marks)**

(c) Explain the procedure for knurling the component. **(4 marks)**

(d) During the turning operation it was observed that the

- tool was rubbing and not cutting the work
- work was climbing over the tool
- tool was chattering
- tool was becoming dull frequently.

(i) State ONE cause for EACH of the problems listed in (d) above. **(4 marks)**

(ii) Describe a remedy for EACH of the problems listed in (d) above. **(4 marks)**

Total 20 marks

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3. Figure 3 shows the elevation and plan of a plate cover to be completed in the workshop.

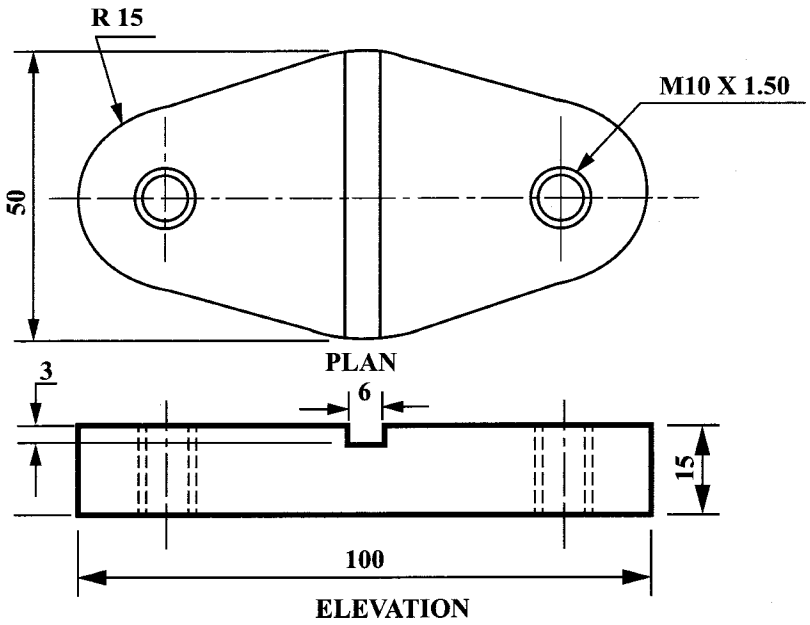

Figure 3. Plate cover

(a) With the aid of sketches explain the process for cutting the

(i) M10 × 1.50 thread **(5 marks)**

(ii) slot on the milling machine. **(5 marks)**

(b) What does M10 × 1.50 mean? **(2 marks)**

(c) Name TWO types of cutters used on the milling machine. **(2 marks)**

(d) State TWO advantages and TWO disadvantages of using conventional milling (up milling) on the milling machine. **(4 marks)**

(e) State TWO safety precautions that should be observed when using the milling machine. **(2 marks)**

Total 20 marks

4. Figure 4 shows a template that is to be produced from a piece of mild steel sheet, **90 mm** by 160 mm by 3 mm thick.

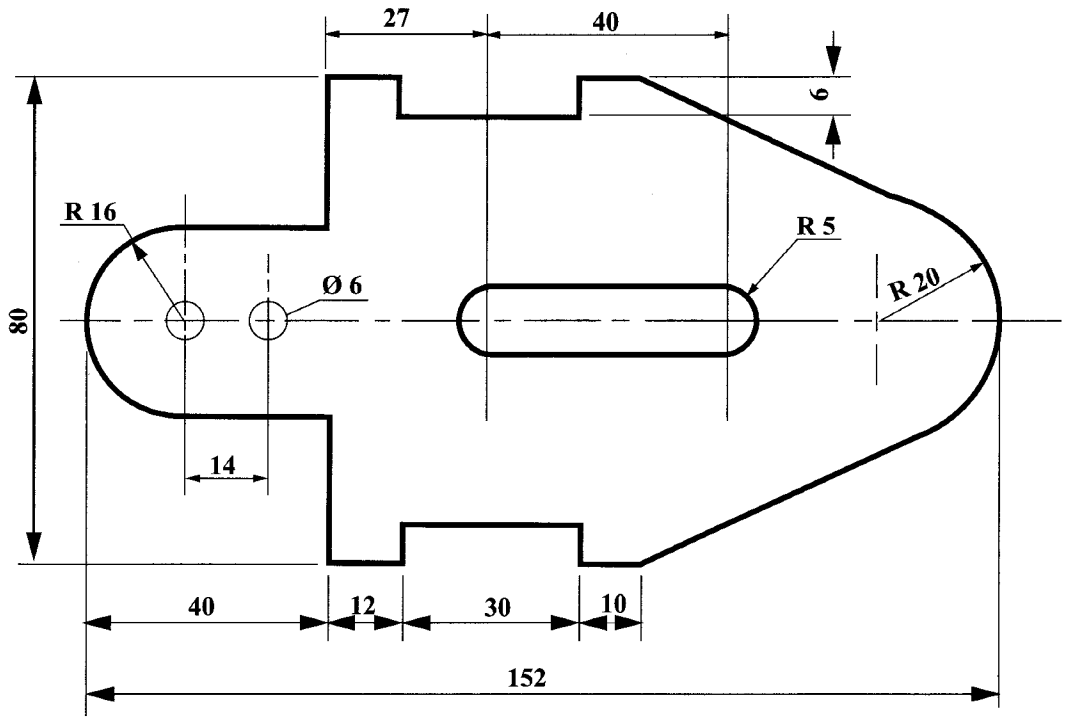

Figure 4. Template

(a) (i) List the steps of procedure to lay out the component. **(6 marks)**

(ii) Identify at least SIX layout tools that could be used in the process. **(3 marks)**

(b) Outline the steps for cutting out the 10 mm slot by chain drilling. **(4 marks)**

(c) Name THREE tools to be used in carrying out the steps outlined at (b) above. **(3 marks)**

(d) State TWO precautions to be observed to ensure precision while scribing the arcs on the component. **(2 marks)**

(e) List TWO safety precautions that should be observed while working with sheet metal. **(2 marks)**

Total 20 marks

5. Figure 5 shows a pictorial view of a section of a sheet metal air-conditioning duct to be constructed using folded corners to join the sides to a folded cover.

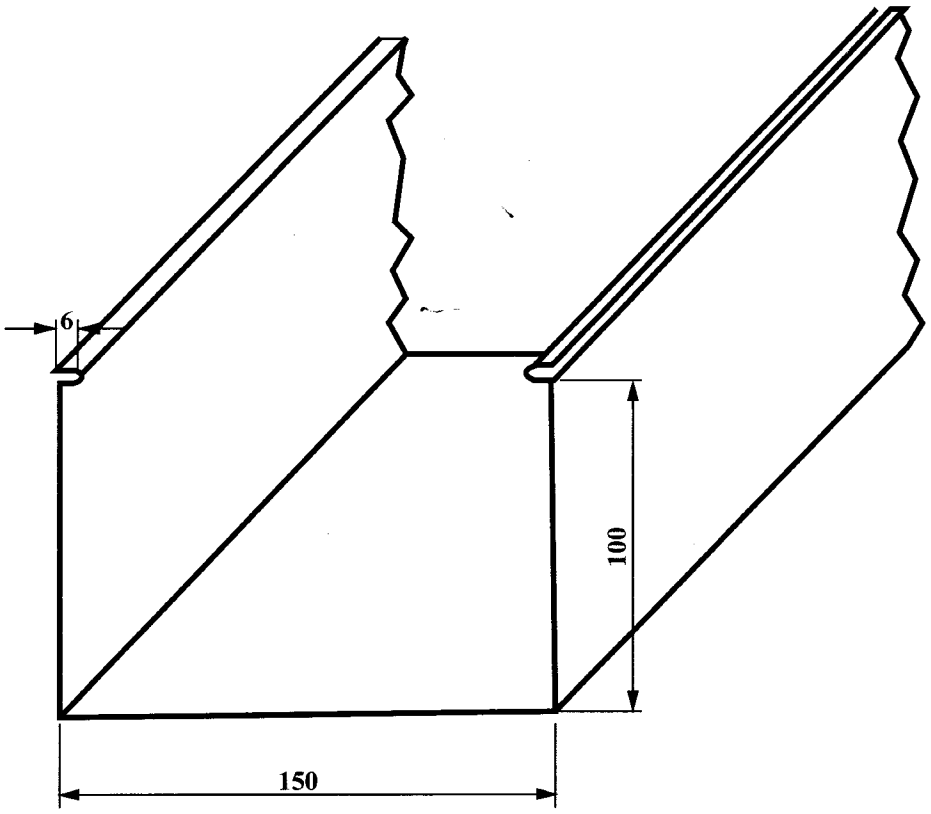

Figure 5. Air-conditioning duct

(a) Use a sketch to show a layout of the material before folding, indicating bend lines and dimensions. **(4 marks)**

(b) List the steps of procedure required for making the folds. **(6 marks)**

(c) Name TWO materials that could be used for making the duct. **(2 marks)**

(d) State ONE property that the materials named in (c) above should have. **(1 mark)**

(e) With the aid of a sketch, explain how several lengths of the duct could be joined together to minimize heat loss. **(4 marks)**

(f) List THREE safety precautions that should be observed when using the process stated in (e) above. **(3 marks)**

Total 20 marks

6. Figure 6 shows the material for making the stock and blade of a try square. The try square is to be assembled by fastening the sides to the spacer to form the stock. The stock is then fitted to the blade.

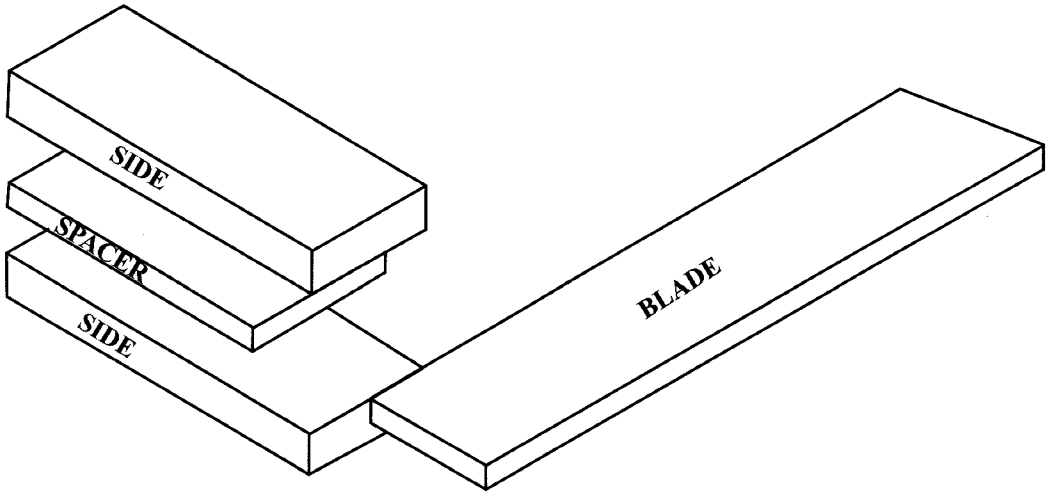

Figure 6. Material for making a try square

(a) State THREE methods, other than riveting, that could be used to fasten the stock **(handle)** to the blade. **(3 marks)**

(b) With the aid of sketches, list the sequence of operations for using countersunk **head rivets** to assemble the component. **(6 marks)**

(c) If the overall thickness of the stock is 10 mm, and 3 mm diameter rivets **are used to assemble** the component, how long should each rivet be cut to form another countersunk **head on** the rivet? **Show all working**. **(2 marks)**

(d) The surface of the stock is to be filed flat after riveting. With the aid of a sketch, **explain the** procedure for drawfiling the surface smooth and flat. **(4 marks)**

(e) List THREE cuts of files commonly used in the workshop. **(3 marks)**

(f) State TWO safety precautions that should be observed while using files. **(2 marks)**

Total 20 marks

SECTION C

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

7. Figure 7 shows two pieces of steel pipe which are to be welded end to end using the acetylene **or** arc welding process.

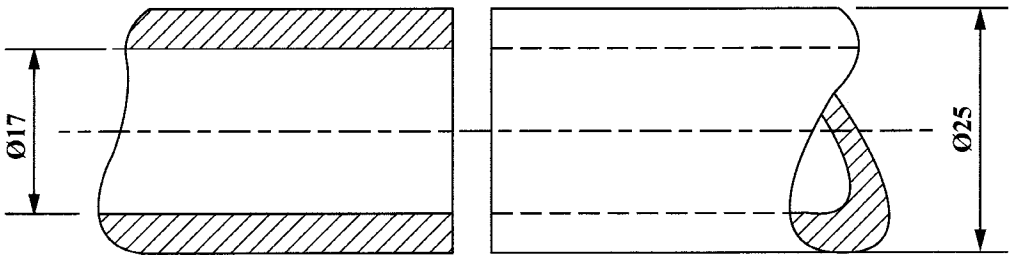

Figure 7. Steel pipe

(a) With the aid of sketches, list the steps of procedure to be followed to ensure strength and dimensional accuracy of the finished product. **(6 marks)**

(b) State THREE reasons why coated electrodes are used in electric arc welding. **(3 marks)**

(c) Explain briefly how sticking of the electrode can be avoided when striking an arc in electric arc welding. **(2 marks)**

(d) Explain the process of lighting and adjusting the oxy-acetylene torch to produce an oxidizing flame. **(4 marks)**

(e) List TWO factors that contribute to proper penetration in the arc welding process. **(2 marks)**

(f) State THREE safety precautions to be observed when doing electric arc welding. **(3 marks)**

Total 20 marks

8. Figure 8 shows a hollow punch which was made from 0.9% carbon steel.

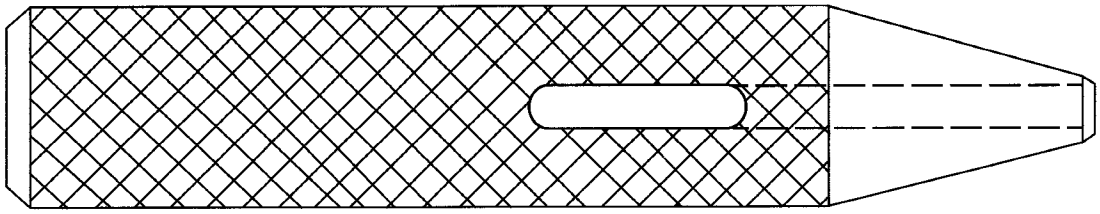

Figure 8. Hollow punch

The punch has been exposed to the following heat-treatment processes:

(i) Heated to cherry red and cooled slowly in ashes

(ii) Heated to cherry red and quenched in water

(iii) Heated to a temperature of 240 degrees Celsius and quenched quickly

(a) Name the physical property that is imparted to the steel after EACH of the processes listed in (i), (ii) and (iii) above. **(3 marks)**

(b) Which TWO of the properties listed in (a) above are necessary for the punch to function properly? **(2 marks)**

(c) If the punch in Figure 8 was made from 0.3% mild steel in the workshop, the heat-treatment process would have to be different to have it functioning as a tool.

(i) Name a heat-treatment process that could be used to remedy the situation. **(1 mark)**

(ii) With the aid of sketches, explain how this procedure could be carried out in the workshop. **(6 marks)**

(d) Copy the table below in your answer booklet and complete it by

(i) stating ONE important working property of EACH material listed

(ii) giving ONE engineering application of EACH material listed. **(8 marks)**

Material	Working Property	Engineering Application
1. Brass 2. Bronze 3. Cast Iron 4. High carbon steel		

Total 20 marks

9. Figure 9 shows a component that is to be produced from a 13 mm diameter mild steel rod, 300 mm long. One end is to be flattened by forging and a 10 mm diameter hole drilled through it as shown. The other end is to be inserted into a tube having a 13 mm bore.

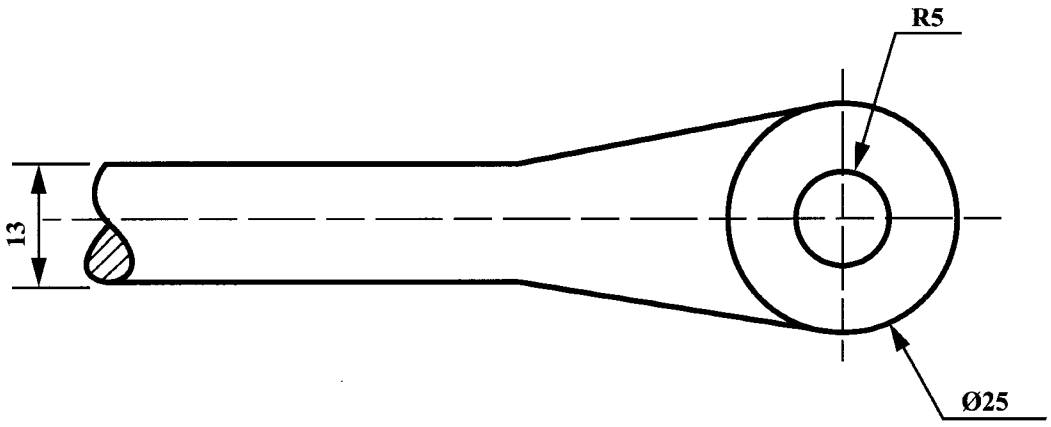

Figure 9. Forged component

(a) (i) List the steps of procedure for flattening the rod to accommodate the required hole. **(4 marks)**

(ii) List FOUR tools which must be used in the process described in (a)(i) above. **(2 marks)**

(b) (i) The surface of the metal was work-hardened during the forging process. What process could be used to prepare the flattened end for drilling? **(1 mark)**

(ii) State THREE methods that can be used for securing the bar in the tube. **(3 marks)**

(c) State TWO safety precautions that should be observed when flattening the rod. **(2 marks)**

(d) Copy the table below in your answer booklet and complete it by

(i) making a neat sketch to show EACH type of bearing

(ii) stating ONE application of EACH type of bearing. **(6 marks)**

Type of Bearing	Sketch	Application
Plain		
Ball		
Roller		

(e) List TWO procedures for extending the life of bearings. **(2 marks)**

Total 20 marks

END OF TEST