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MAY/JUNE 2014

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

MECHANICAL ENGINEERING TECHNOLOGY

Paper 02 – Technical Proficiency

2 hours 40 minutes

06 MAY 2014 (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. You are advised to take some time to read through the paper and plan your answers.

3. Write your answers in the answer booklet provided.

4. Use sketches when necessary to support your answers.

5. You may use a silent, non-programmable calculator to answer questions.

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 ruler-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, **provided as an insert**, shows a conceptual design for a low-cost treadmill. This design would use the angle of elevation of the platform to increase the load experienced by the user.

Part 1: The base, fabricated from steel, upon which the entire treadmill rests, is 3 m long and 2 m wide.

Part 2: The platform consists of TWO drums, C and D, and a leather belt which rotates as the user walks/jogs on the treadmill at variable speeds. The platform is 2 m long and 1 m wide.

Part 3: The handle is made from a 5 cm diameter pipe which is padded with sponge.

As part of the low-cost feature it is required that all adjustments are made manually, that is, by hand.

(a) Marks will be awarded for presentation under the following categories:

(i) Neatness **(2 marks)**

(ii) Clarity of details **(2 marks)**

(iii) Proportionality **(2 marks)**

(b) Complete the design, using sketches, to clearly show the following:

(i) A method of attaching the base to support the platform at Point A and Point B **(6 marks)**

(ii) A method which will allow the drum, C, to rotate about A so that the platform can be inclined up to a maximum of 30° along the axis X–X **(8 marks)**

(iii) The handle attached to the support at Point B **(4 marks)**

(iv) A method which will allow the platform to be inclined in 10° increments **(6 marks)**

(v) A method which will allow the handle to be adjusted about Point B and always remain vertical at any angle of inclination of the platform **(10 marks)**

Total 40 marks

SECTION B

You are required to answer any THREE questions from this section.

EACH question is worth 20 marks.

2. The test plug in Figure 2 is to be knurled and tapered on the centre lathe from a piece of material 40 mm in diameter.

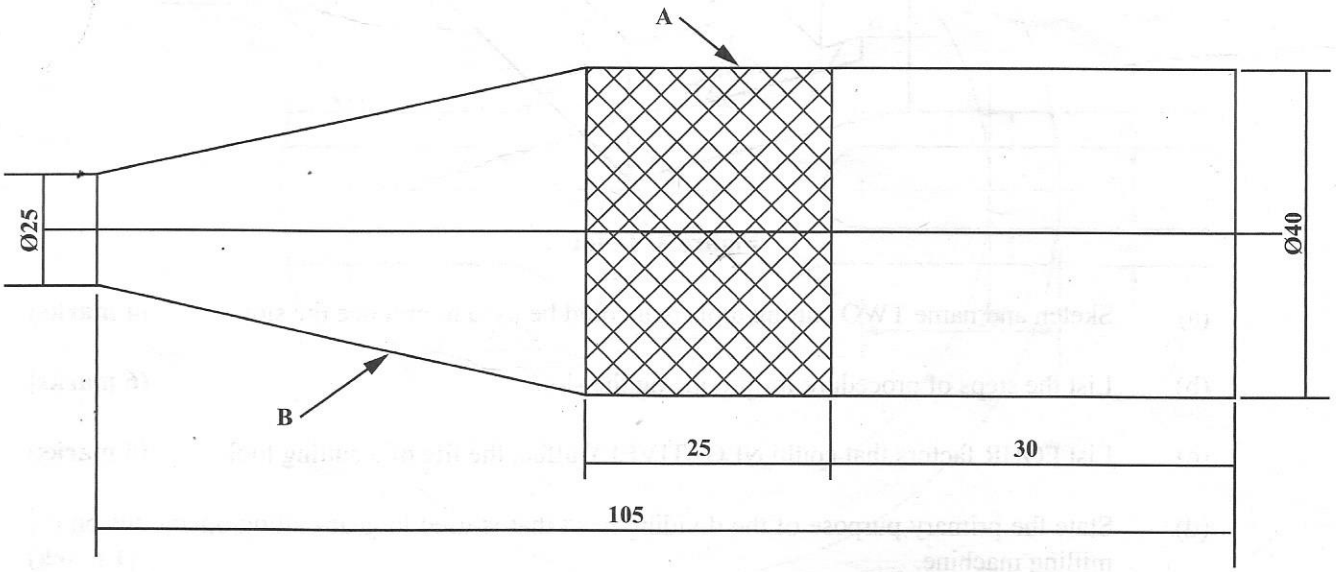

Figure 2. Test plug

(a) Name TWO types of lathe cutting tools that may be used to produce the test plug. **(2 marks)**

(b) List the steps of procedure for producing the knurled surface, A. **(6 marks)**

(c) State THREE precautions which should be taken to ensure that the BEST knurl is produced. **(3 marks)**

(d) Draw a sketch to show the work and cutting tool set-up to produce the taper. **(4 marks)**

(e) State TWO methods of obtaining the taper at B. **(2 marks)**

(f) State THREE safety precautions to be observed when using the lathe. **(3 marks)**

Total 20 marks

3. Figure 3 shows a component with a T-slot which is to be produced on the milling machine.

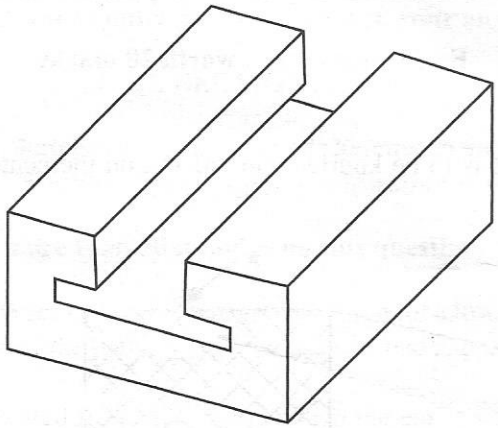

Figure 3. T-slot

(a) Sketch and name TWO cutting tools that could be used to produce the slot. **(4 marks)**

(b) List the steps of procedure for producing the slot. **(6 marks)**

(c) List FOUR factors that could NEGATIVELY affect the life of a cutting tool. **(4 marks)**

(d) State the primary purpose of the dividing head that is used in gear-cutting operations on the milling machine. **(1 mark)**

(e) Calculate simple indexing for 31 and 64 divisions, using the Browne and Sharpe plates having the following hole circles:

Plate 1	15, 16, 17, 18, 19, 20
Plate 2	21, 22, 23, 24, 25, 26
Plate 3	27, 28, 29, 30, 31, 32

(4 marks)

(f) State ONE safety precaution to be observed while using the milling machine. **(1 mark)**

Total 20 marks

4. Figure 4 shows the hub of a wheel puller to be produced from a 20 mm thick disc which is cut off from a 100 mm cylindrical bar.

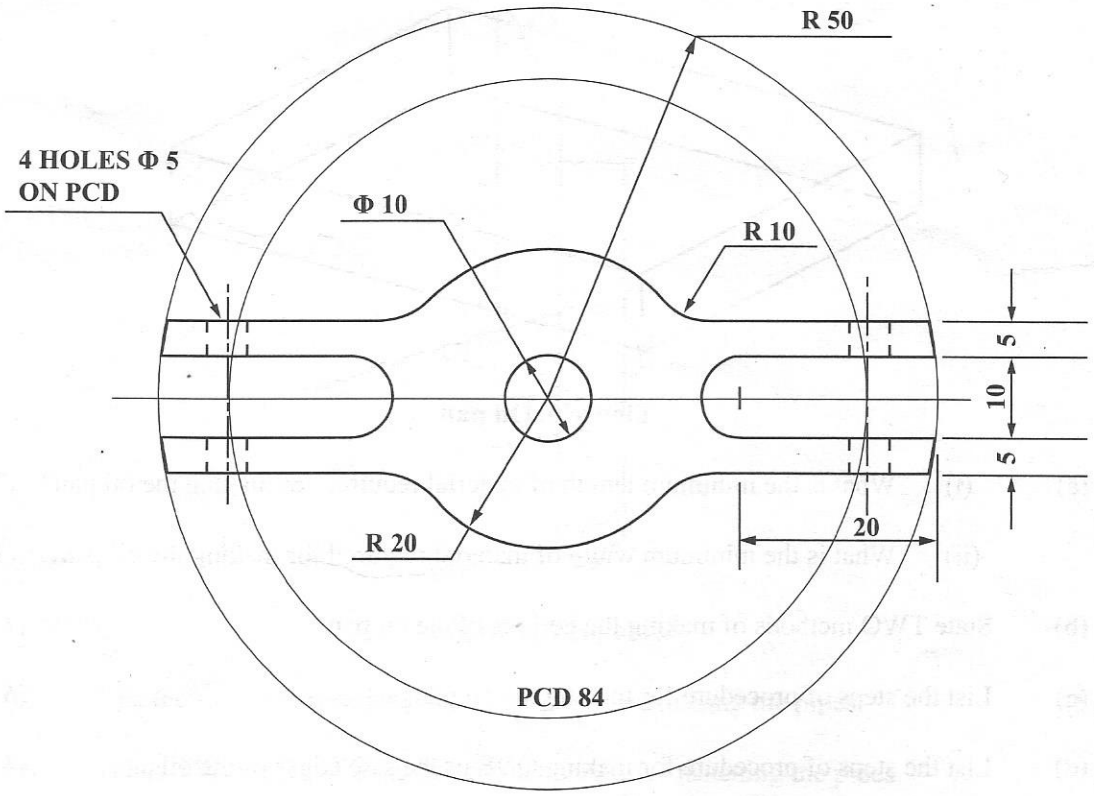

Figure 4. Wheel puller

(a) List the steps of procedure for marking out the hub as shown. **(6 marks)**

(b) List FOUR of the tools and equipment that are required for marking out the hub. **(4 marks)**

(c) State TWO precautions to be observed to ensure accuracy while marking out the wheel puller. **(2 marks)**

(d) Outline, **in sequence**, the steps of procedure for cutting out the 10 mm slots by chain drilling. **(4 marks)**

(e) Name TWO tools to be used to cut the slots. **(2 marks)**

(f) State TWO safety precautions that should be observed when cutting out the slots. **(2 marks)**

Total 20 marks

5. Figure 5 shows a pictorial view of an oil pan, 50 mm deep × 200 mm wide × 300 mm long. The oil pan is to be made from 24-gauge galvanized sheet in the workshop. An additional 10 mm must be included for making the edges safe.

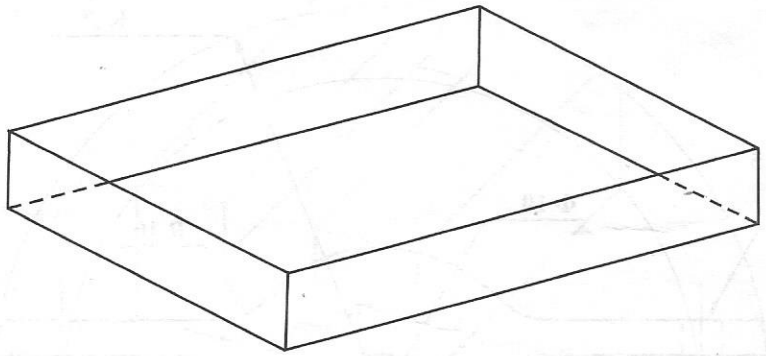

Figure 5. Oil pan

(a) (i) What is the minimum length of material required for making the oil pan? **(1 mark)**

(ii) What is the minimum width of material required for making the oil pan? **(1 mark)**

(b) State TWO methods of making the corners of the oil pan. **(2 marks)**

(c) List the steps of procedure for making the oil pan. **(6 marks)**

(d) List the steps of procedure for making ONE of the safe edges of the oil pan. **(4 marks)**

(e) State TWO methods of making the safe edge for the oil pan. **(2 marks)**

(f) Name TWO tools that will be necessary for completing the oil pan. **(2 marks)**

(g) State TWO safety precautions that should be observed when working with sheet metal. **(2 marks)**

Total 20 marks

6. Figure 6 shows two 50 mm diameter lengths of pipe that are to be joined together using bolts, nuts and washers, to extend the length of the pipes to form a flag pole.

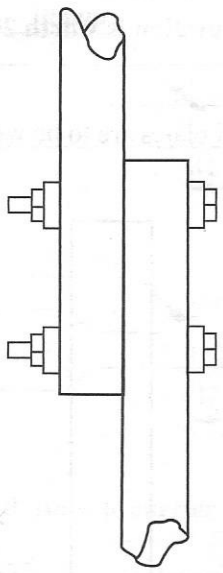

Figure 6. Flag pole

(a) List the steps of procedure for marking out and drilling the pipes. **(5 marks)**

(b) Name TWO types of bolts that could be used for fastening the pipes. **(2 marks)**

(c) Show, with the aid of a sketch, how the pipe can be held in position for drilling. **(3 marks)**

(d) With the aid of sketches, show the differences in shape of the cutting edges of any THREE types of cold chisels. **(3 marks)**

(e) List the steps of procedure for grinding the point of a flat cold chisel. **(5 marks)**

(f) State TWO safety precautions that should be observed when drilling the pipes. **(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 10 mm thick mild steel plates are to be welded together to form a 'T' in the component as shown in Figure 7.

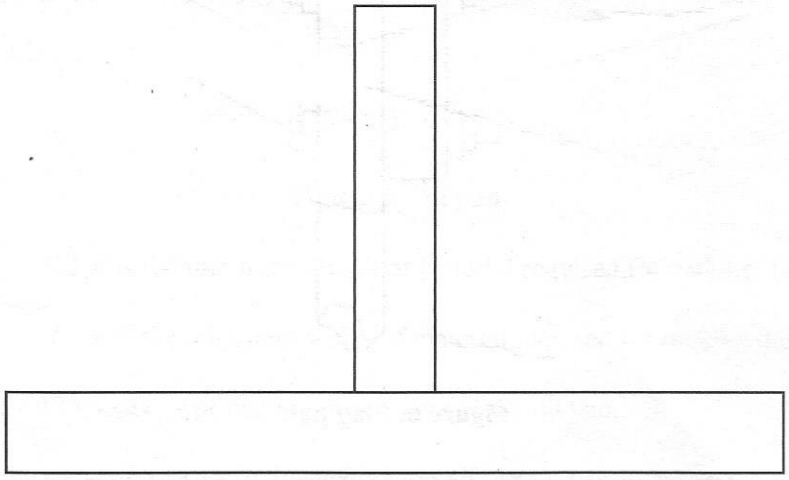

Figure 7. T-section component

Using EITHER the oxyacetylene OR arc welding process:

(a) List FOUR pieces of equipment necessary to carry out the process chosen. **(4 marks)**

(b) List the steps of procedure for welding the mild steel plates to form the 'T' component. **(6 marks)**

(c) State TWO pieces of personal protective equipment that must be worn when carrying out the operation. **(2 marks)**

(d) Three passes of the weld bead are needed to ensure a strong weld. With the aid of a sketch, show the sequence of the weld bead on both sides of the 'T'. **(4 marks)**

(e) State TWO safety precautions that should be taken while carrying out the welding process. **(2 marks)**

(f) State TWO defects that may occur as a result of improper welding. **(2 marks)**

Total 20 marks

8. Figure 8 shows a bicycle carrier support. A length of 12 mm diameter mild steel bar is to be flattened and drilled at one end, in order to attach it to a 10 mm diameter bolt at one end.

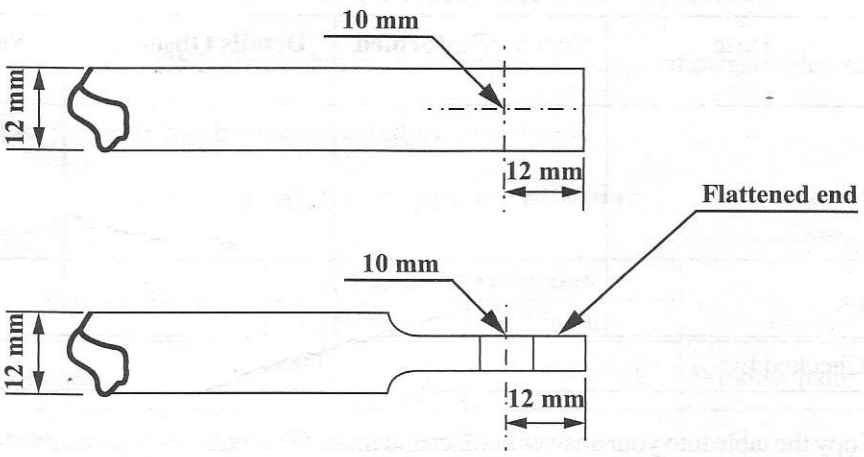

Figure 8. Bicycle carrier support

(a) State the process that should be used for flattening the rod. **(1 mark)**

(b) With the aid of sketches, list the steps of procedure for flattening the rod so that the required size of hole can be drilled. **(6 marks)**

(c) Name THREE tools that should be used in the process at (b) above. **(3 marks)**

(d) State TWO safety precautions that should be observed during the process. **(2 marks)**

(e) Table 1 shows four situations observed during foundry work.

TABLE 1: SITUATIONS OBSERVED DURING FOUNDRY WORK

Situation	Result	Remedy
The pattern used is the same size as the casting to be produced.		
The moulding sand in the mould is too dry.		
There is loose sand in the mould cavity.		
The pattern is produced without a draft angle.		

Copy the table in your answer booklet and for EACH situation, indicate the possible **result**, and a **remedy** for the situation. **(8 marks)**

Total 20 marks

9. (a) Table 2 shows the design of a maintenance chart for machines in the workshop.

TABLE 2: MAINTENANCE CHART FOR MACHINE LATHE #5 SERIAL #XY-56307

Date	Service Performed	Details Observed	Name of Service Personnel
Checked by:		Date:	

Copy the table into your answer booklet and make ONE entry to demonstrate that you understand how the table is used. **(4 marks)**

(b) Show, with the aid of sketches, THREE different mechanisms for transferring motion. **(6 marks)**

(c) State TWO types of lubrication which are necessary for any of the mechanisms shown at (b) above. **(2 marks)**

(d) State TWO safety precautions that should be observed when servicing a machine in the workshop. **(2 marks)**

(e) Table 3 shows five types of plastic. Copy the table into your answer booklet and for any THREE types of plastic:

(i) State the form in which EACH type of plastic is produced.

(ii) Give ONE article that is made from EACH type of plastic selected.

The first row has been completed as an example.

TABLE 3: TYPES OF PLASTIC

Type of Plastic	Form of Production		Article
	Rigid	Flexible	
Perspex	√		Window pane
PVC			
Polyethylene			
Polystyrene			
Nylon			

(6 marks)

Total 20 marks

END OF TEST

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