# CARIBBEAN EXAMINATIONS COUNCIL

## CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

**03 MAY 2022 (a.m.)**

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**FILL IN ALL THE INFORMATION REQUESTED CLEARLY IN CAPITAL LETTERS.**

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SUBJECT INDUSTRIAL TECHNOLOGY
OPTION B – MECHANICAL ENGINEERING TECHNOLOGY – Paper 02

PROFICIENCY TECHNICAL

REGISTRATION NUMBER | | | | | | | | | | |

| SCHOOL/CENTRE NUMBER | | | | | |
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| NAME OF SCHOOL/CENTRE |
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| CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST) |
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DATE OF BIRTH | D | D | M | M | Y | Y | Y | Y |

SIGNATURE _____

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MAY/JUNE 2022

CARIBBEAN EXAMINATIONS COUNCIL

# CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

## INDUSTRIAL TECHNOLOGY

## OPTION B – MECHANICAL ENGINEERING TECHNOLOGY

### Paper 02 – Technical Proficiency

*2 hours 10 minutes*

**READ THE FOLLOWING INSTRUCTIONS CAREFULLY.**

1. This paper consists of FIVE compulsory questions.
2. Use sketches where necessary to support your answers.
3. Write your answers in the spaces provided in this booklet.
4. Do NOT write in the margins.
5. You may use a silent, non-programmable calculator to answer questions.
6. This paper contains metric dimensions only. You should work your answers in the metric system.
7. You are advised to take some time to read through the paper and plan your answers.
8. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
9. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

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

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1. (a) Figure 1 is a diagram which shows labelled parts of an electric arc furnace.

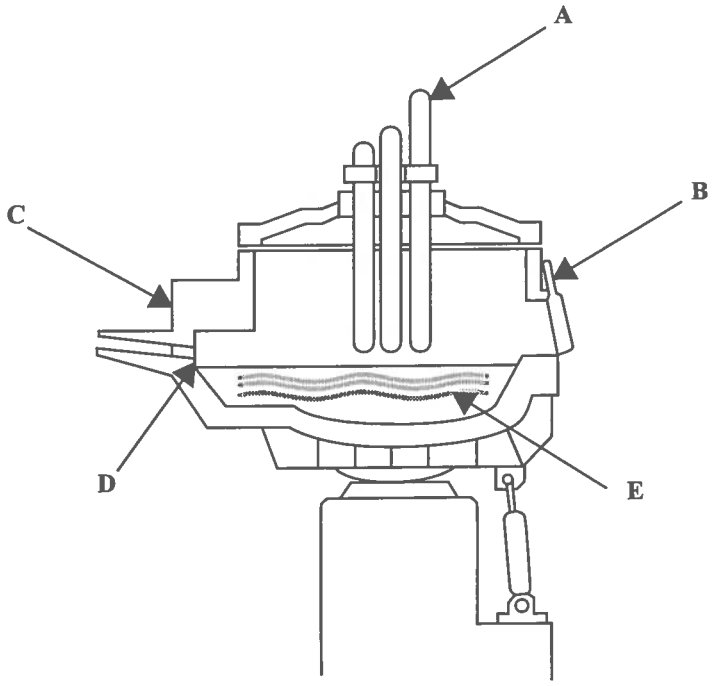



**Figure 1. Electric arc furnace**

Identify and state the function of any THREE of the labelled parts in Figure 1.

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Part .....

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Part .....

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**(6 marks)**

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(b) In a certain neighbourhood, many of the homes use hanging wire baskets for growing exotic flowers in open spaces. It was observed that many of these wire baskets are rusting.

Describe the steps required to develop a hanging wire basket business which capitalizes on this observation.

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**(6 marks)**

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(c) One of the pawns from a prized chess set was lost. An image of the pawn is shown in Figure 2. Analysis of the chess piece indicates that it was made from aluminium, and then painted.



**Figure 2. Pawn chess piece**

Outline the SIX sequential steps for producing the chess piece using greensand casting. Assume that you have a pattern made of wood.

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**(6 marks)**

**Total 18 marks**

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2. When designing artifacts, it is common to consider the mechanical properties of the materials which will be used.

(a) Define EACH of the following properties.

(i) Engineering stress

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**(2 marks)**

(ii) Engineering strain

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**(2 marks)**

(b) While working in an automobile workshop, you are asked to find a solution to having **one** engine hoist when there are **two** vehicles in the workshop. You have decided that you can suspend one engine from a hook in the roof, while the other will be supported by the hoist.

The materials which are available to you are as follows.

| Material | Young's Modulus Bars × 10 |
|---|---|
| 10 mm diameter steel rod | 2 Bars |
| 13 mm diameter aluminium rod | 0.7 Bars |

With tests carried out at a workshop, you discover that the engineering strain for both materials is 1% (0.01). It is estimated that the load to be suspended will weigh 545 kg. Assume that the gravitational constant (g) is 9.8 metres/sec (g).

Using the information for the steel rod, determine EACH of the following.

(i) Engineering stress

**(2 marks)**

(ii) Young's modulus or modulus of elasticity

**(4 marks)**

(iii) State whether it is possible to use the aluminium rod to construct the support. Justify your answer.

**(2 marks)**

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(c) With the aid of a labelled sketch, show how the vehicle's engine could be suspended using the steel rod.

**(6 marks)**

**Total 18 marks**

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3. Table 1 lists the three methods of heat transfer.

**TABLE 1: HEAT TRANSFER METHODS**

| Transfer Method | Medium | | | Vacuum |
|---|---|---|---|---|
| | Solid | Liquid | Gas | |
| Conduction | | | | |
| Convection | | | | |
| Radiation | | | | |

(a) Identify the medium or vacuum in which EACH heat transfer method is possible by placing an X in the appropriate column in Table 1. **(4 marks)**

(b) Describe a typical application or observation in the workshop for EACH of the heat transfer methods in Table 1.

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**(6 marks)**

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(c) Figure 3 shows a customized bolt which was made by die cutting a 10 mm diameter steel rod.



**Figure 3. Customized bolt**

Describe SIX sequential steps for making the bolt in the workshop.

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**(8 marks)**

**Total 18 marks**

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4. (a) Identify and briefly describe the function of any THREE parts identified on the drill press shown in Figure 4.

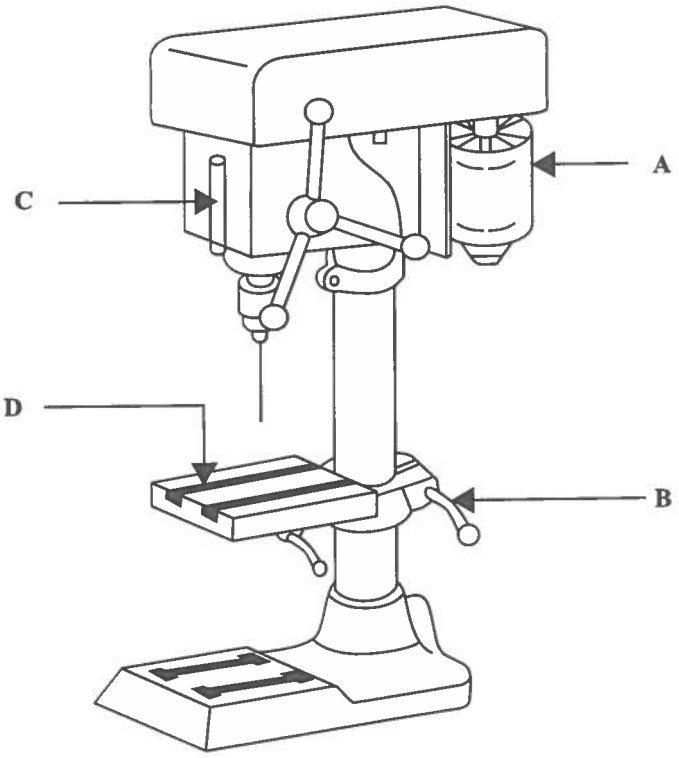



**Figure 4. Drill press**

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**(6 marks)**

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(b) Calculate the gears required to cut a screw with 8 threads per 25 mm on a lathe with a leadscrew of 5 threads per 25 mm. Interpret your calculation.

**(6 marks)**

(c) Describe the sequential steps for using pop-rivets to assemble a plywood seat to a metal frame.

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**(6 marks)**

**Total 18 marks**

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5. Keys are fasteners which are used to hold components together and to transfer power from one component to another.

(a) Complete the following table by naming and sketching TWO types of keys. State ONE advantage and ONE disadvantage of EACH type.

| Name | Sketch | Advantage | Disadvantage |
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**(8 marks)**

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(b) In order to distinguish your work from the competition in your area, you have decided to add a decorative element, such as twists, to the legs of the tables which you fabricate. A sample of a twisted half-inch metal bar is shown in Figure 5.

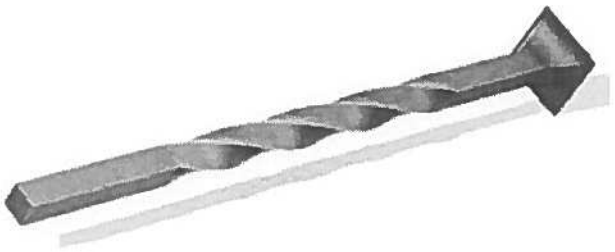


**Figure 5. Twisted half-inch metal bar**

With the aid of sketches, list the FIVE steps required to produce only the twisted portion of the metal bar as shown in Figure 5.

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**(10 marks)**
**Total 18 marks**

**END OF TEST**

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

## EXTRA SPACE

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**Question No.** ☐

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## CANDIDATE'S RECEIPT

### INSTRUCTIONS TO CANDIDATE:

1. **Fill in all the information requested clearly in capital letters.**

TEST CODE: | 0 | 1 | 3 | 7 | 3 | 0 | 2 | 0 |

SUBJECT: INDUSTRIAL TECHNOLOGY
OPTION B – MECHANICAL ENGINEERING TECHNOLOGY – Paper 02

PROFICIENCY: TECHNICAL

REGISTRATION NUMBER: | | | | | | | | | | |

FULL NAME: _____
**(BLOCK LETTERS)**

Signature: _____

Date: _____

2. **Ensure that this slip is detached by the Supervisor or Invigilator and given to you when you hand in this booklet.**

3. **Keep it in a safe place until you have received your results.**

### INSTRUCTION TO SUPERVISOR/INVIGILATOR:

Sign the declaration below, detach this slip and hand it to the candidate as his/her receipt for this booklet collected by you.

I hereby acknowledge receipt of the candidate's booklet for the examination stated above.

Signature: _____
Supervisor/Invigilator

Date: _____

