# CARIBBEAN EXAMINATIONS COUNCIL

## CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

**24 MAY 2018 (p.m.)**

M1801370020

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

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

SUBJECT INDUSTRIAL TECHNOLOGY
OPTION A – ELECTRICAL AND ELECTRONIC TECHNOLOGY – Paper 02

PROFICIENCY TECHNICAL

REGISTRATION NUMBER

SCHOOL/CENTRE NUMBER

NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

DATE OF BIRTH

SIGNATURE _____

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FORM TP 2018078

TEST CODE 01370020

MAY/JUNE 2018

CARIBBEAN EXAMINATIONS COUNCIL

# CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

## INDUSTRIAL TECHNOLOGY

## OPTION A – ELECTRICAL AND ELECTRONIC 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) A 60 Ω fixed resistor is connected in series with a 40 Ω resistor, and a 12 $V_{dc}$ source is connected across these two resistors.

(i) Produce a neat sketch of the series circuit.

**(2 marks)**

(ii) Using the sketch drawn in (a) (i), show how a multimeter should be correctly connected to measure the voltage-drop across the 40 Ω resistor. **(2 marks)**

(iii) Calculate how much current (I) will flow through the resistors.

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**(2 marks)**

(iv) Calculate the expected voltage-drop across the 40 Ω resistor.

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**(2 marks)**

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(b) (i) State the names of the meters that are used to measure EACH of the following:

DC voltage: .....

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AC current: .....

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Resistance: .....

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Electric power: .....

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**(4 marks)**

(ii) State how the direction of conventional current flow compares with that of electron theory.

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**(2 marks)**

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(c) A technician requires a 50 Ω resistor, but only has two 100 Ω resistors available. Design a circuit that demonstrates how the two resistors could be combined to give the required 50 Ω resistance. For the circuit, use $V_{dc}$ = 12 V. You are expected to show the method for calculating the required resistance.

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**(4 marks)**

**Total 18 marks**

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**2.** (a) A regulated, variable-output d.c. power supply consists of four basic sub-circuits.

(i) Using the following block diagram, label EACH block to show the correct order of the four sub-circuits for the power supply.



**(4 marks)**









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(ii) State the function of any TWO of the sub-circuits identified in (a) (i) **on page 8**, for the d.c. power supply.

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**(2 marks)**

(b) (i) On the block diagram in (a) (i) **on page 8**, sketch a 110 $V_{rms}$ sinusoidal input voltage waveform as it passes through EACH sub-circuit and moves towards the output d.c. voltage of the power supply. **(5 marks)**

(ii) Name the test instrument that is used to show a visual display of the voltage waveform at any point in the circuit.

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**(1 mark)**

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(c) Figure 1 shows the plan of a meeting room which has three entrance/exit points, 1, 2, 3, and two lamps (not drawn to scale).

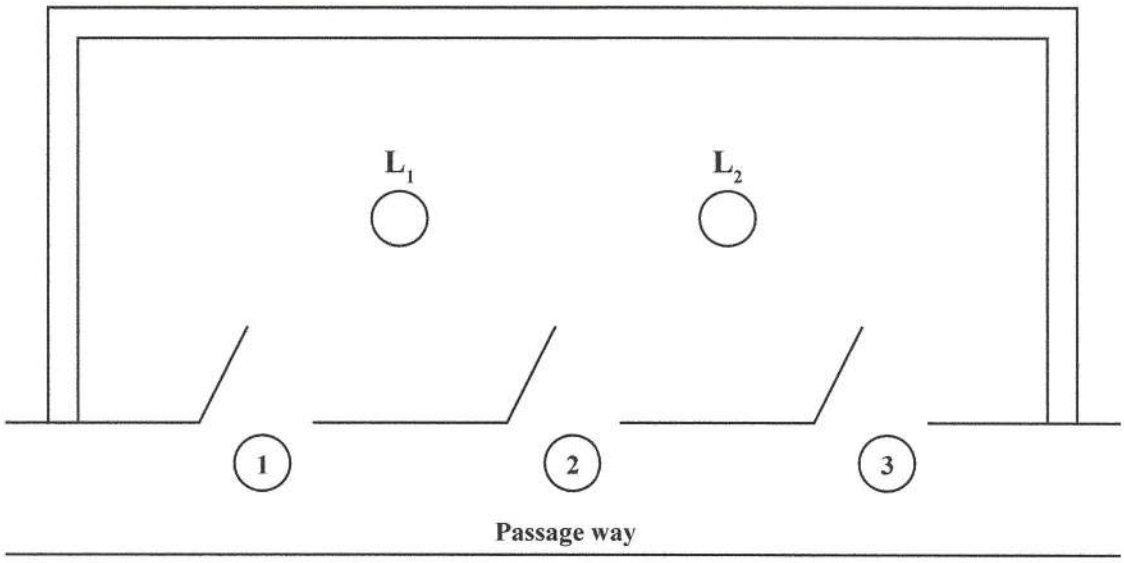



**Figure 1. Meeting room (not drawn to scale)**

(i) Using Figure 1, design a three-way switching circuit that may be used to turn all the room lights on/off from EACH entrance/exit point. **(3 marks)**

(ii) On the drawing in (c) (i), label the type of switch to be installed at EACH of the three entrance/exit points. **(3 marks)**

**Total 18 marks**

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**3.** (a) Figure 2 shows a typical control circuit for starting and reversing a three-phase motor with several electrical components labelled.

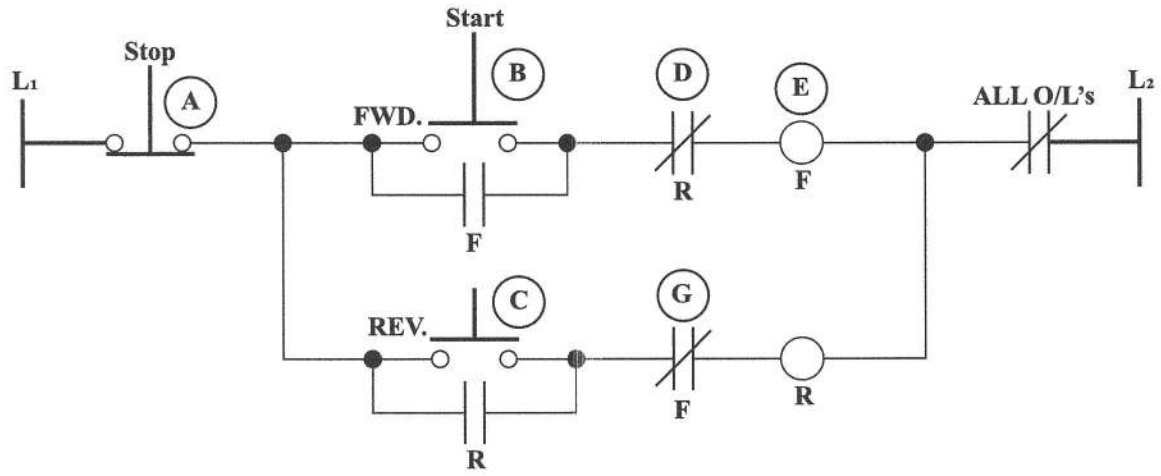



**Figure 2. A typical control circuit for starting and reversing a three-phase motor**

(i) Name EACH of the electrical components labelled (A), (B), (C), (D), (E) and (G) in the circuit in Figure 2.

A .....

B .....

C .....

D .....

E .....

G .....

**(6 marks)**



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(ii) Explain how any THREE of the electrical symbols named in (a) (i) **on page 11** functions.

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**(6 marks)**

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(b) Outline the steps of procedure to be used to allow the three-phase motor in Figure 2 to run

(i) in the FORWARD direction

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**(3 marks)**

(ii) in the REVERSE direction.

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**(3 marks)**

**Total 18 marks**

4. (a) (i) List FOUR tests that should be conducted on a new electrical installation before it is energized.

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**(4 marks)**

(ii) State TWO reasons why any ONE of the tests identified in (a) (i) is conducted.

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**(2 marks)**

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(b) A homeowner observes that a specific circuit breaker repeatedly trips.

(i) Suggest TWO reasons why the circuit breaker repeatedly trips.

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**(2 marks)**

(ii) Explain how EACH of the problems identified in (b) (i) can be corrected.

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**(4 marks)**

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(c) A technician needs to join two lengths of cable to make an extended cable.

Outline the steps of procedure for making an electrically sound and mechanically strong soldered joint using the two lengths of cable.

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**(6 marks)**

**Total 18 marks**

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**5.** (a) (i) Sketch the logic-symbol for a 2-input AND gate.

**(1 mark)**

(ii) With the aid of a diagram, describe how single pole single throw (SPST) switches may be used to represent the operation of a 2-input AND gate.

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**(2 marks)**

(iii) State the mathematical expression for the output, Y, of this logic gate.

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**(1 mark)**

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(b) (i) Sketch the logic symbol for a 2-input OR gate.

**(1 mark)**

(ii) Draw the truth table for the 2-input OR gate sketched in (b) (i).

**(2 marks)**

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(iii) With the aid of a diagram, describe how single pole single throw (SPST) switches may be used to represent the operation of a 2-input OR gate.

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**(2 marks)**

(iv) State the mathematical expression for the output, Y, of this logic gate.

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**(1 mark)**

(c) Given that the output, Y, of a logic circuit is 'high' when the two inputs, A and B, are BOTH 'high', and also when the two inputs, B and C, are BOTH 'high'

(i) draw the truth-table for this combinational logic circuit

**(3 marks)**

(ii) design a logic circuit that meets the criteria for this combinational logic circuit.

**(3 marks)**

(iii) What is the minimum number of logic gates that may be used to design the operation stated in (c)?

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**(1 mark)**

(iv) State the mathematical expression for output, Y, of this logic circuit.

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**(1 mark)**

**Total 18 marks**

**END OF TEST**

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

## EXTRA SPACE

**If you use this extra page, you MUST write the question number clearly in the box provided.**

**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 | 0 | 0 | 2 | 0 |

SUBJECT: INDUSTRIAL TECHNOLOGY
OPTION A – ELECTRICAL AND ELECTRONIC 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: _____

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