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FORM TP 2012068

MAY/JUNE 2012

CARIBBEAN EXAMINATIONS COUNCIL

**SECONDARY EDUCATION CERTIFICATE
EXAMINATION**

ELECTRICAL AND ELECTRONIC TECHNOLOGY

Paper 02 – Technical Proficiency

2 hours 40 minutes

10 MAY 2012 (p.m.)

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of **THREE** sections. Candidates **MUST** answer **NINE** questions.
SECTION A: You must answer **ALL FIVE COMPULSORY** questions 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. All working must be **CLEARLY** shown.
4. Use sketches where necessary to support your answers.
5. You may use a silent, electronic calculator.

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

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01317020/F 2012



Candidates MUST answer NINE questions, ALL FIVE from Section A, THREE from Section B and ONE from Section C.

SECTION A

Candidates MUST answer ALL FIVE questions in this section.

Each question is worth EIGHT marks.

1. (a) Name TWO types of electrical measuring instruments used in electrical circuits. (2 marks)
- (b) Give TWO methods that are used to dampen the oscillations of the pointer in an analog measuring instrument. (2 marks)
- (c) Sketch the connection diagram of a multirange (2 ranges) moving-coil instrument used as
- (i) an ammeter (2 marks)
- (ii) a voltmeter. (2 marks)

Total 8 marks

2. (a) State how the current in a d.c. (direct current) circuit, is related to the
- (i) applied voltage (1 mark)
- (ii) electrical resistance. (1 mark)
- (b) Figure 1 and Figure 2 show three resistors connected in two circuit combinations.

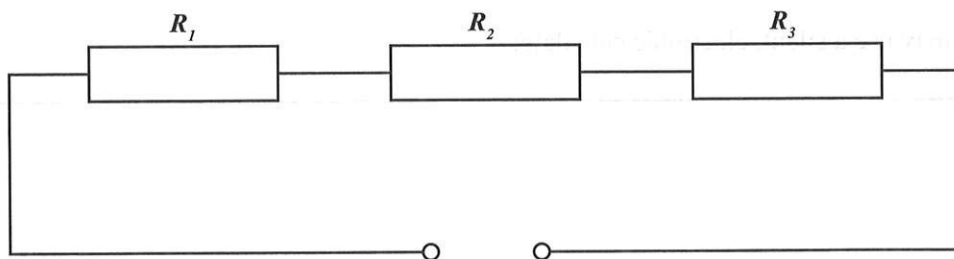


Figure 1

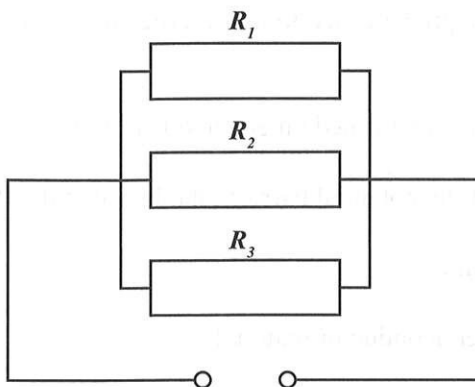


Figure 2

Write the formula for total resistance in the circuit of

- (i) Figure 1 **(1 mark)**
- (ii) Figure 2. **(1 mark)**
- (c) Sketch the circuit of a potential divider and briefly explain its operation. **(4 marks)**

Total 8 marks

3. (a) Name TWO types of energy that may be directly converted into electrical energy. **(2 marks)**
- (b) State how secondary cells are connected in a battery to increase the
- (i) terminal voltage **(1 mark)**
 - (ii) current capacity. **(1 mark)**
- (c) (i) Explain how polarization reduces the overall efficiency of cells.
- (ii) Describe how the depolarizer **increases** the efficiency of a Leclanché primary cell. **(4 marks)**

Total 8 marks

4. (a) (i) Name the process used to join P-type and N-type semiconductor materials. **(1 mark)**
- (ii) Name the area formed on either side of the junction formed in (a). **(1 mark)**
- (b) Give the value of the potential barrier established at the P-N junction for
- (i) germanium
- (ii) silicon semiconductor material. **(2 marks)**
- (c) Explain briefly the operation of a semiconductor diode when it is
- (i) forward biased **(2 marks)**
- (ii) reverse biased. **(2 marks)**

Total 8 marks

5. (a) Name TWO electromotive forces that are induced in a double-wound transformer. **(2 marks)**
- (b) Name TWO materials that are used to insulate laminated iron stampings from each other in the construction of transformer cores. **(2 marks)**
- (c) Explain briefly the increase in primary current that results from an increase in secondary current in a double-wound transformer. **(4 marks)**

Total 8 marks

SECTION B

Candidates MUST attempt THREE questions from this section.

Each question is worth 20 marks.

6. (a) Figure 3 shows two transistors connected in an electronic circuit. They are labelled A and B.

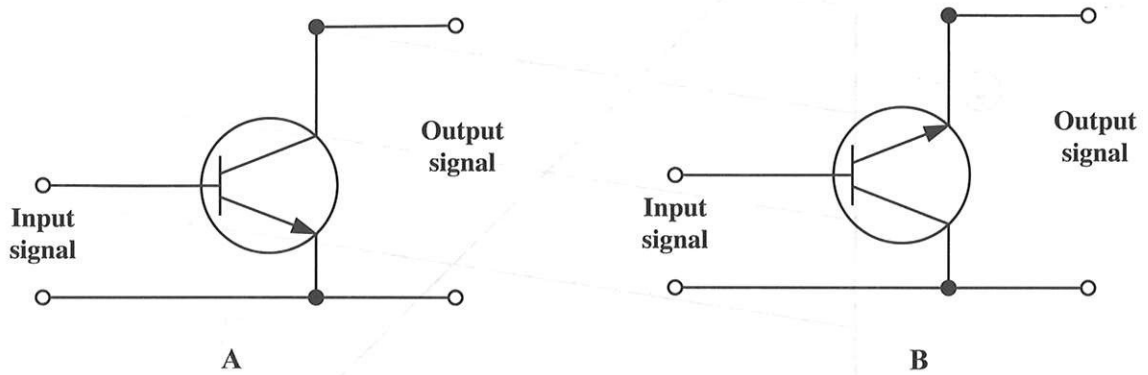


Figure 3

Give the name of EACH transistor connection, using the labels A and B. **(2 marks)**

(b) Figure 4 shows the family of curves for a transistor.

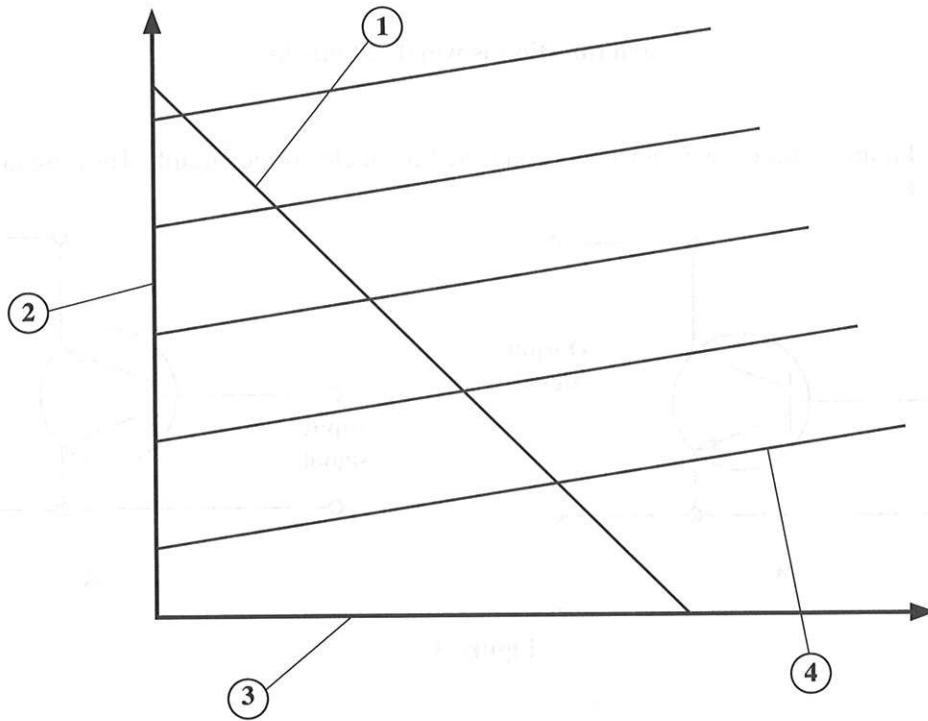


Figure 4

In your answer booklet write the numbers ①, ②, ③ and ④. Next to EACH number, name the characteristic represented in the diagram. **(4 marks)**

(c) Figure 5 shows an NPN transistor amplifier.

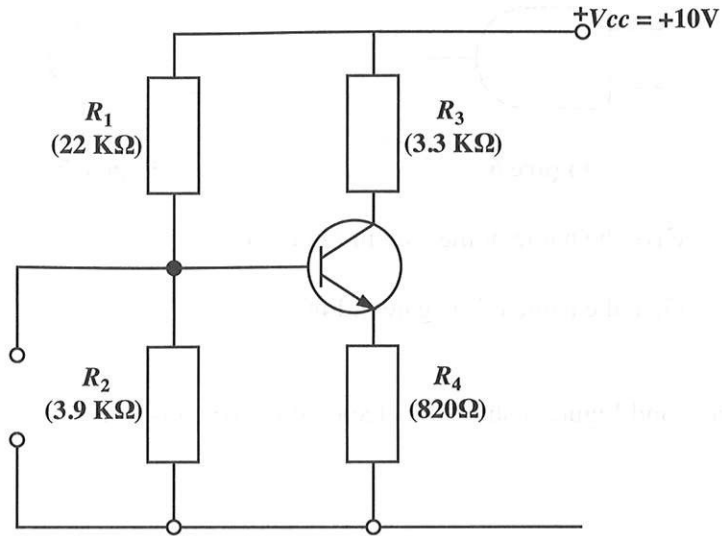


Figure 5

Assuming the transistor to be silicon, and $I_E = I_C$, calculate the

- (i) current through the potential divider (3 marks)
- (ii) base voltage (V_B) (3 marks)
- (iii) emitter voltage (V_E) (3 marks)
- (iv) emitter current (I_E) (3 marks)
- (v) collector voltage (V_C). (2 marks)

Total 20 marks

7. (a) Figure 6 and Figure 7 both show logic gates.

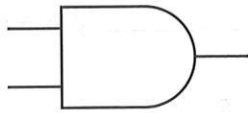


Figure 6

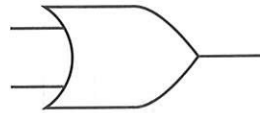
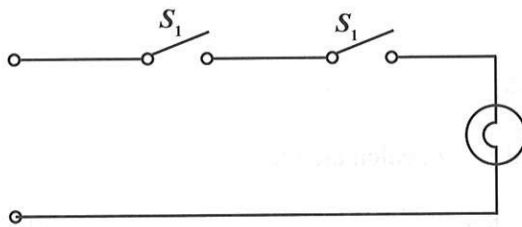


Figure 7

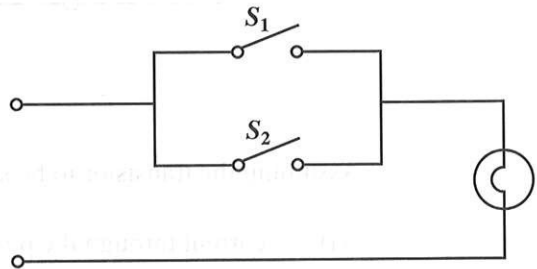
- (i) Give the name of the gate in Figure 6. (1 mark)
- (ii) Give the name of the gate in Figure 7. (1 mark)

(b) Figure 8 and Figure 9 show the electrical equivalents of two logic circuits, labelled P and Q.



P

Figure 8



Q

Figure 9

- (i) Name the logic equivalent for EACH figure, using the labels. (2 marks)
- (ii) Develop truth tables for EACH logic equivalent circuit identified in Figure 6 and Figure 7 using the labels. (14 marks)
- (iii) Name TWO electronic devices that perform switching functions in logic circuits. (2 marks)

Total 20 marks

8. (a) Figure 10 shows three d.c. motor connections labelled W, X and Y.

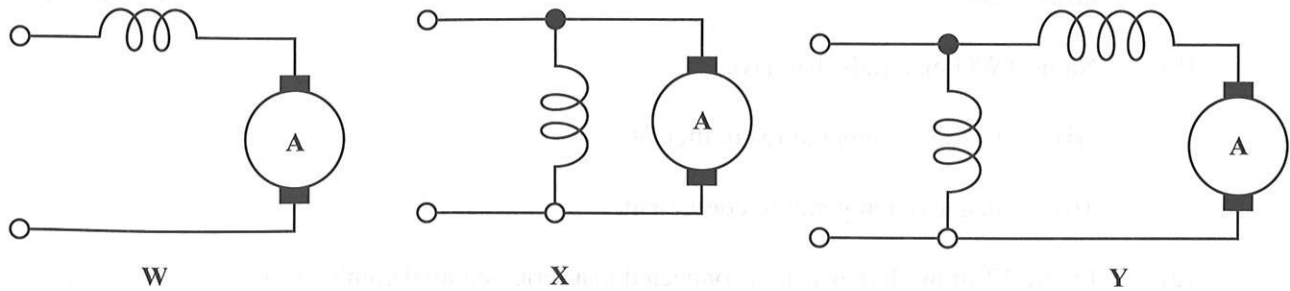


Figure 10

Write down any TWO of the letters W, X and Y and give the name of the connection by EACH letter. (2 marks)

(b) Figure 11 below shows a motor circuit. Its parts are labelled 1, 2, 3 and 4.

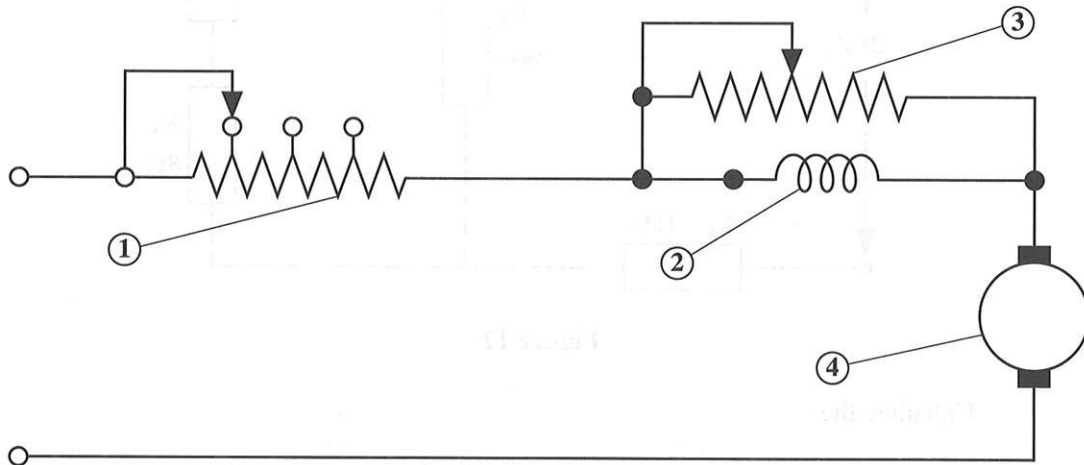


Figure 11

In your answer booklet write the numbers ①, ②, ③ and ④. Beside EACH number, write the name of the part of the motor indicated. (4 marks)

- (c) A d.c. motor with a terminal voltage of 100 V has an armature resistance of 0.2 ohm, and an armature current of 20 A. Calculate the
- (i) armature volt drop (3 marks)
 - (ii) back e.m.f. (3 marks)
 - (iii) power loss in the armature (3 marks)
 - (iv) power supplied to the motor (2 marks)
 - (v) electrical energy when the motor is in use for 20 hours. (3 marks)

Total 20 marks

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9. (a) Name TWO factors that affect the resistance of an electrical cable used in an electrical installation. **(2 marks)**
- (b) Name TWO materials that have a
- (i) positive temperature coefficient **(2 marks)**
 - (ii) negative temperature coefficient. **(2 marks)**
- (c) Figure 12 shows five resistors connected in a series-parallel combination across a 20 V d.c. supply.

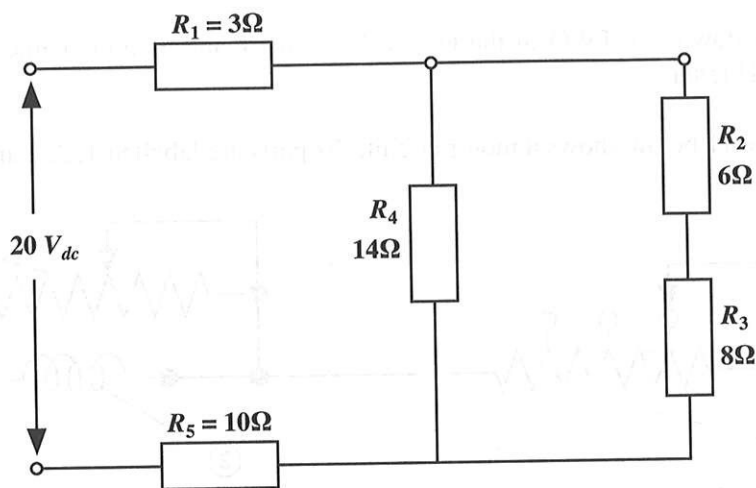


Figure 12

Calculate the

- (i) equivalent resistance of the parallel combination (R_2 , R_3 and R_4) **(3 marks)**
 - (ii) total resistance of the circuit **(3 marks)**
 - (iii) total current **(3 marks)**
 - (iv) total power dissipated. **(3 marks)**
- (d) Sketch the series equivalent circuit of Figure 12. **(2 marks)**

Total 20 marks

SECTION C

Candidates MUST answer ONE question from this section.

Each question is worth 20 marks.

10. (a) Give TWO methods used to effect a reduced voltage at the terminals of a 3-phase motor at starting. (2 marks)
- (b) Give the name of EACH type of connection shown in Figure 13 (a) and Figure 13 (b), using labels.

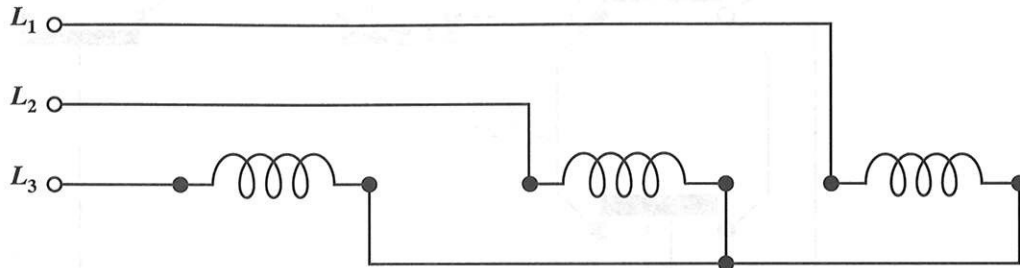


Figure 13 (a)

(2 marks)

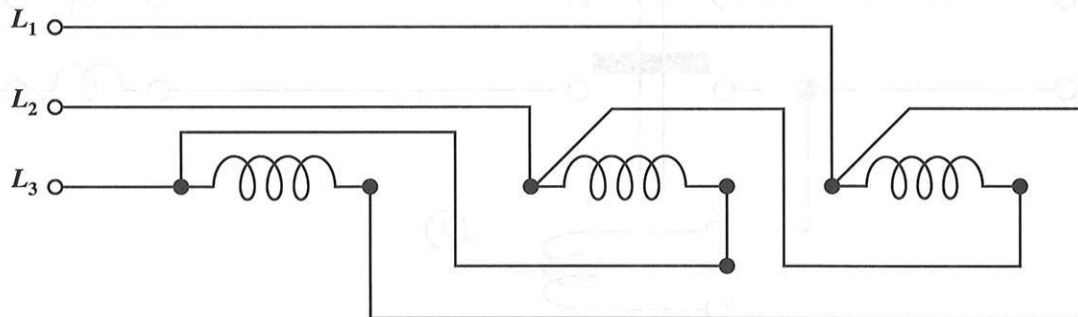


Figure 13 (b)

- (c) Briefly explain how a STAR-DELTA motor starter connects the winding in a 3-phase motor to obtain a reduced voltage at START, and the rated voltage on RUN. (4 marks)

- (d) Figure 14 shows a direct-on-line motor starter. Its parts are labelled by the numbers 1, 2, 3, 4, 5 and 6.

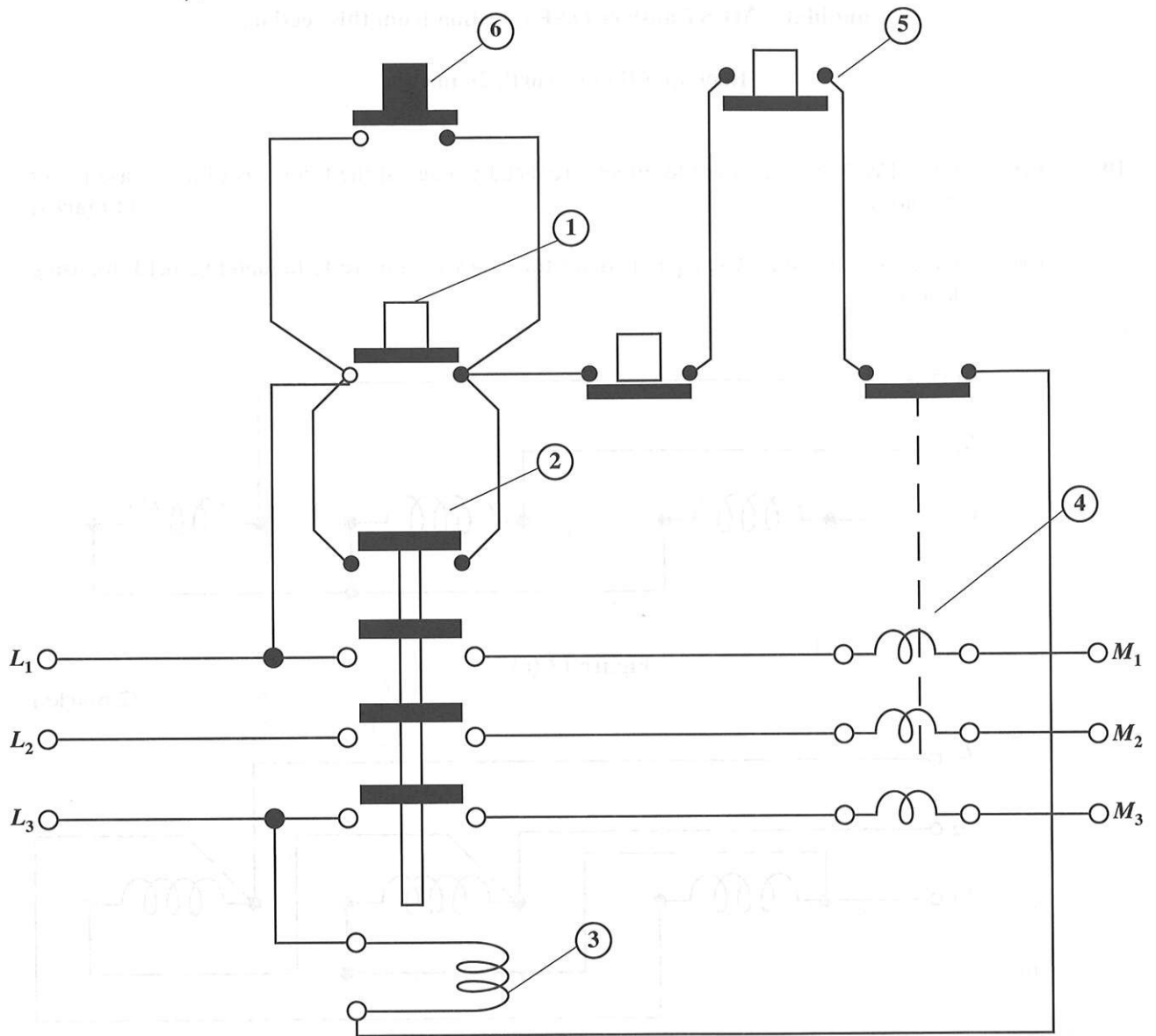


Figure 14

- (i) In your answer booklet list the numbers ①, ②, ③, ④, ⑤ and ⑥. Beside EACH number write the name of that part of the starter indicated. (6 marks)
- (ii) Briefly explain how EACH part of the starter numbered ②, ③ and ④ operates. (6 marks)

Total 20 marks

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11. (a) Name TWO tests that are performed on a new installation to verify the electrical soundness of the installation. **(2 marks)**
- (b) Identify TWO measuring instruments that are used to perform electrical tests on a new installation. **(2 marks)**
- (c) Name TWO ways in which users of portable electric equipment are protected from electric shock. **(2 marks)**

- (d) Figure 15 shows the connection of the electrical components labelled 1 to 5 in a domestic electrical installation.

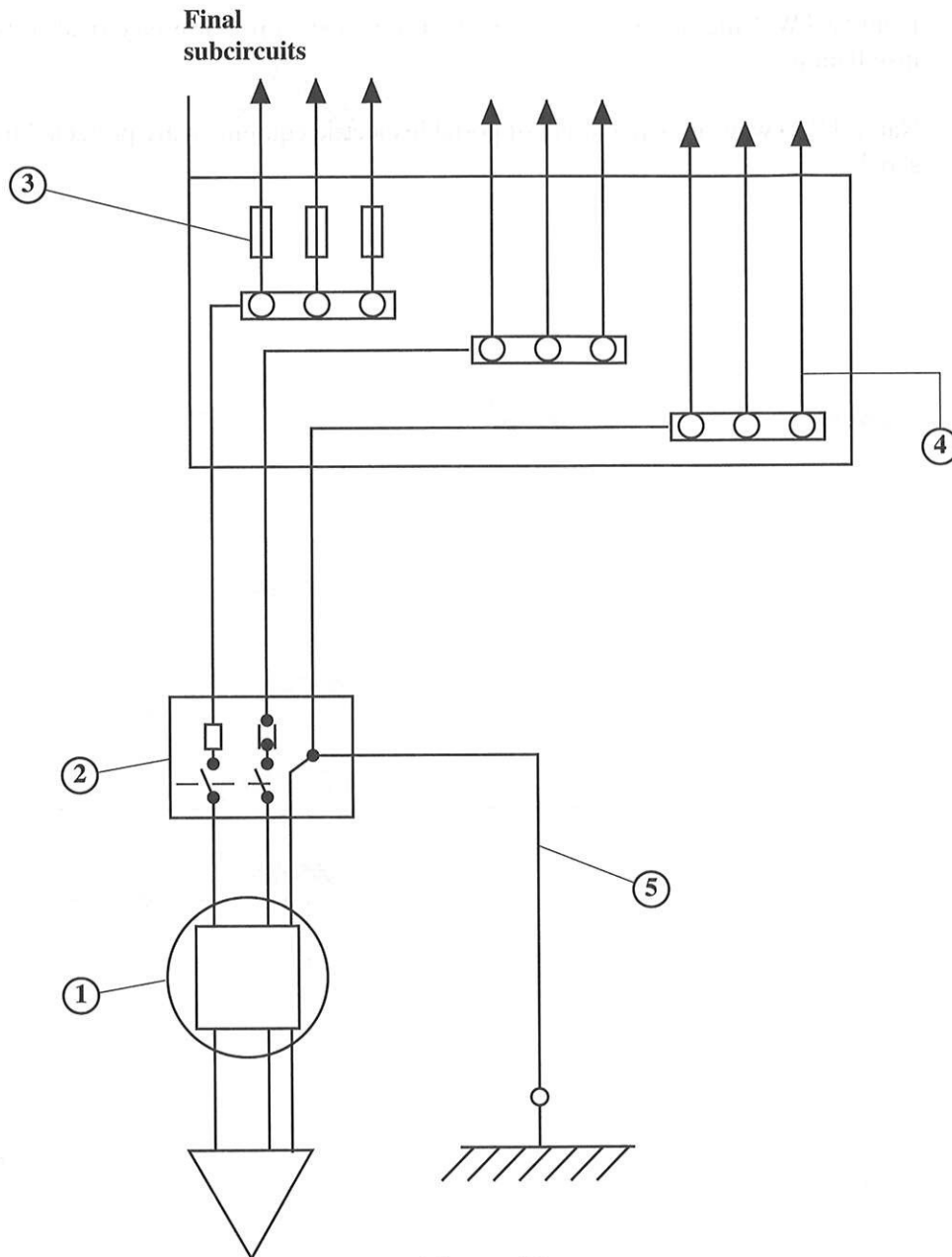


Figure 15

- (i) In your answer booklet, write any FOUR of the numbers ①, ②, ③, ④ and ⑤ and beside EACH selected number, write the name of the electrical component(s) it identifies. (4 marks)
- (ii) Briefly explain the function performed by EACH of the components labelled ①, ②, ③, ④ and ⑤ in the installation. (10 marks)

Total 20 marks

END OF TEST

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