071305T4EIN

Electrical Installation Level 5

ENG/OS/EI/CC/02/5/A

Apply Electrical Principles

March /April 2023

Time: 3 Hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

WRITTEN ASSESSMENT
3 Hours

INSTRUCTIONS TO THE CANDIDATE

*This paper consists of **THREE** sections **A**, **B** and **C**.*

*Answer all questions in section **A** and B and any **TWO** questions in section **C** in the answer booklet provided.*

Marks for each question are indicated in brackets.

Do not write in the question paper.

You are allowed to use a non-programmable scientific calculator.

*Answer the questions in **English**.*

This paper consists of EIGHT (8) printed pages.

Candidate should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A: (20 MARKS)

*Answer **all** the questions in this section by selecting the correct answer. Each question carries*

1Mark.

1. The following are applications of lightning arresters, except_____.

    A. Transformer equipment.

    B. Rotating machines.

    C. Electric cookers.

    D. Power substations.

2. When the length of a conductor is doubled and the area of cross-section remains the same, what happens to its resistance?

    A. Remains the same.

    B. Will be doubled.

    C. Will become half.

    D. Will increase by four times.

3. Which of the following relays is used to protect a transformer from faults occurring inside it?

    A. Current relay.

    B. Frequency relay.

    C. Buchholz relay.

    D. Overcurrent relay.

4. Which one of the following is the SI unit of electric current?

    A. Volt.

    B. Joule.

    C. Ampere.

    D. Ohm.

5. Which of the following statement is true for an ideal voltage source?

    A. A large value of electromotive force.

    B. A small value of electromotive force.

    C. Zero source resistance.

    D. Infinite source resistance.

6. In earthing system, the abbreviation PME stands for_____?

    A. Principle Method of Earthing.

    B. Protective Means Earthing.

    C. Protective Multiple Earthing.

    D. Primary Means of Earthing.

7. For which of the following applications is a DC motor preferred, over an AC motor?

    A. Low-speed operation.

    B. High-speed operation.

    C. Variable speed operation.

    D. Fixed speed operation.

8. A 2 kVA transformer has iron losses of 150 W and full-load copper loss of 250 W. The maximum efficiency of the transformer would occur when the total loss is _____.

    A. 450 W.

    B. 400 W.

    C. 250 W.

    D. 300W.

9. Which of the following statements best describes Ohm's Law?

    A. Applied voltage is directly proportional to resistance provided temperature and other physical factors remains constant.

    B. Applied voltage is directly proportional to current provided temperature and other physical factors remains constant.

    C. Applied voltage is directly proportional to resistance provided current and temperature remains constant.

    D. Applied voltage is directly proportional to temperature of a conductor provided current and resistance remains constant.

10. The capacitance of a capacitor is measured in _____?

    A. Watts.

    B. Henry.

    C. Siemens.

    D. Farads.

11. Which of the following describes the purpose of earthing electrical appliances?

    A. To provide safety against electrical shocks.

    B. To ensure that the appliances work properly.

    C. To ensure that appliances get full voltage.

    D. To ensure that the appliances get full current.

12. The full-load speed of a 6-pole, 50 Hz induction motor is 950 rpm. The half-load speed will be nearly equal to_____?

    A. 990 rpm.

    B. 1800 rpm.

    C. 475 rpm.

    D. 975 rpm.

13. Faraday's Law of electromagnetic induction is related to_____?

    A. The e. m. f of a chemical cell.

    B. The e. m. f of a generator.

    C. The current flowing in a conductor.

    D. The strength of a magnetic field.

14. A capacitor C which is charged to V volts is discharged through a resistor of R ohms. Which of the following statement is false?

    A. The initial current flowing is given by V/R.

    B. The voltage drop across the resistor is equal to the capacitor voltage.

    C. The time constant of the circuit is CR seconds.

    D. The current grows exponentially to a final value given by V/R.

15. When **three** 3Ω resistors are connected in parallel, the total resistance is _____.

    A. 3 Ω.

    B. 9 Ω.

    C. 1 Ω.

    D. 0.333 Ω.

16. In order to improve the power factor of equipment operating at a lagging power factor, a capacitor is connected_____.

    A. In series with the equipment.

    B. In parallel with the equipment.

    C. In series-parallel with the equipment.

    D. In parallel-series with the equipment.

17. A lightening arrester provides_____.

    A. A low impedance path between line and ground, during operation.

    B. A high impedance path between line and ground, during operation.

    C. A low resistance path between line and ground, during operation.

    D. A high resistance path between line and ground, during operation.

18. Which of the following statements is **true** for a purely inductive circuit?

    A. Apparent power is zero.

    B. Relative power is zero.

    C. Actual power is zero.

    D. Both relative and apparent powers are zero.

19. The time constant of a circuit having an inductance of 100 mH connected in series with a resistance of 4 Ω is_____.

    A. 25 milliseconds.

    B. 400 Seconds.

    C. 0.4 Seconds.

    D. 40 Seconds.

20. A heater is rated as 240V a.c., 10kW. What does the value 240V refer to?

    A. Average Value.

    B. RMS Value.

    C. Peak Value.

    D. Instantaneous Value.

SECTION B (40 MARKS)

*Answer **ALL** questions in this section.*

21. State f**our** factors that affect the resistance of a conductor. (4 marks)

22. State any **two** advantages of high power factor. (2 marks)

23. A 12 V battery is connected across a load having a resistance of 40Ω. Determine the:

    a) Current; (2 marks)

    b) Power Consumed. (2 marks)

24. The armature of a D.C machine has a resistance of 0.25Ω and is connected to a 300V supply.

    Calculate the e.m.f generated when it is running as:

    a) A generator giving 100A; (3 marks)

    b) A motor taking 80A. (2 marks)

25. A transformer has a rated output of 200 kVA at a power factor of 0.8. Determine the rated power

    output and the corresponding reactive power. (5 marks)

26. State the **three** factors that affect the capacitance of a parallel plate capacitor. (3 marks)

27. Name any **three** components of an earthing system. (3 marks)

28. List **three** components used for power factor correction. (3 marks)

29. A 400kVA single phase transformer has a full load copper loss of 2.5kW and an iron loss of 2kW.

    Determine the efficiency at full load and 0.85 power factor. (4 marks)

30. Outline **three** advantages of using an auto transformer over a double–wound transformer.

    (3 marks)

31. List the **four** essential parts of a DC machine. (4 marks)

SECTION C (40 marks)

*Answer any **TWO** questions from this section.*

32. a) List the four types that determine the force acting on a current-carrying conductor in a magnetic field. (4 marks)
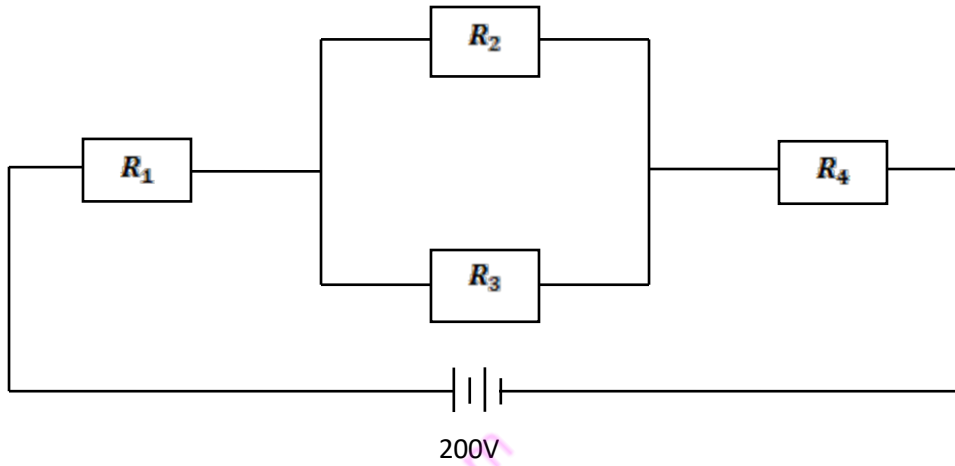
b) Figure 1 shows an electric circuit.

Figure 1

Given the following values; $R_1 = 1\Omega, R_2 = 2\Omega, R_3 = 6\Omega \ and \ R_4 = 2.5\Omega$,

Determine the:

   i.   Total circuit resistance; (3 marks)

   ii.   Supply current; (2 marks)

   iii. Current flowing through the resistor R_2; (3 marks)

   iv. Potential difference across resistor R_4; (2 marks)

  c) Explain the **three** effects of an electric current. (6 marks)

33. a) State Kirchhoff's laws. (4 marks)

b) **Figure 2** shows an electric circuit. Determine the branch currents in the circuit using the Kirchhoff's current law. (10 marks)
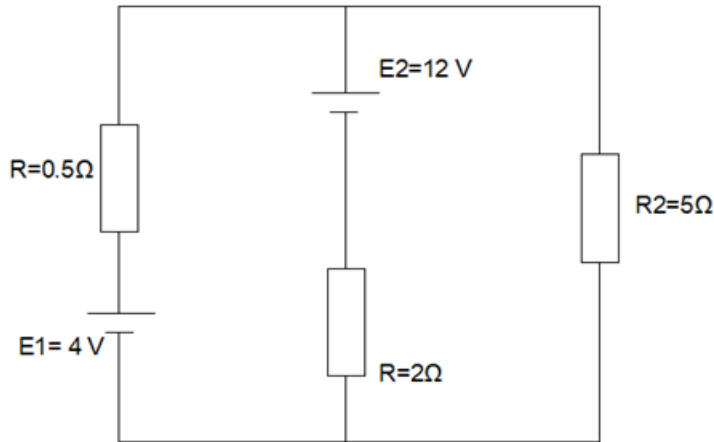

Figure 2

c) The resistance of copper wire, 40m in length and having a resistivity of 0.002×10^{-6} Ωm is $0.25Ω$. Determine the radius of the wire. (4 marks)

d) List the any **two** types of iron losses in transformers. (2 marks)

34. a) Define the following terms as used in AC supply: (4 marks)

   i. Period;

   ii. Frequency;

   iii. Amplitude;

   iv. Phase.

b) An alternating voltage is given by the expression V= 239 sin (100πt – 0.25) volts. Determine the:

   i. Peak to peak voltage; (2 marks)

   ii. R.M.S voltage; (2 marks)

   iii. Frequency; (2 marks)

   iv. Phase angle. (2 marks)

c) Explain any **four** types of lightening arrestors. (8 marks)

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