THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

082 ELECTRICAL ENGINEERING SCIENCE
(For Both School and Private Candidates)

TIME: 3 Hours ***Wednesday, 7th October 2009 p.m.***

Instructions

1. This paper consists of sections A, B and C.
2. Answer **all** questions in sections A and B and **three (3)** questions from section C.
3. Electronic calculators are **not** allowed in the examination room.
4. Cellular phones are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).
6. Whenever necessary use the following constants

   Permitivity of free space, $\varepsilon_o = 8.854 \times 10^{-12}$ F/m.

   Resistivity of copper may be taken as 1.7 μΩ.mm.

   Specific heat capacity of water = 4.18 kJ/kgK.

   1 Faraday = 96,500 Coulombs.

   1 hp = 746 Watts.

This paper consists of 7 printed pages.

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SECTION A (10 Marks)

Answer **all** questions in this section.

1. For each of items (i) -- (x) choose the correct answer from among the given alternatives and write its letter beside the item number.

(i) Which of the following materials can be used for making cable sheaths?
- A Lead
- B Copper
- C Aluminium
- D Cast iron
- E Carbon.

(ii) Why should the oil used in a transformer be free from moisture?
- A Moisture will reduce the density of the oil which is slightly undesirable
- B Moisture will reduce the dielectric strength of the oil and hence insulation is weakened
- C Moisture will reduce the lubricating property of the oil
- D Moisture will develop rust
- E Moisture will reduce viscosity of the oil which will affect the cooling system.

(iii) Which of the following instruments can be used to measure only a.c currents?
- A Moving iron instruments
- B Electrodynamics instruments
- C Induction type instruments
- D Hotwire instruments
- E Permanent magnet ammeter instrument.

(iv) Which of the following circuits having a voltage source will produce more current?
- A 5 volts across a 5 Ω resistance
- B 5 volts across two 5 Ω resistances in series
- C 5 volts across two 5 Ω resistances in parallel
- D 500 volts across a 1 MΩ resistance
- E 5 volts across two 50 Ω resistances in parallel.

(v) Which of the following will need the highest level of illumination?
- A Proof reading
- B Bed rooms
- C Hospital wards
- D Railways platforms
- E Shopping centres.

(vi) If the frequency of power supply in a pure capacitive circuit is doubled, the current will

A be reduced to half
B double
C remain the same
D increase by four
E decrease by four.

(vii) The residual magnetism of a d.c shunt generator can be regained by

A connecting the shunt field to a battery
B running a generator on no load for sometime
C earthing the shunt field
D reversing the direction of the generator
E interchanging the polarities of the main pole.

(viii) Which statement is true?

A The electromotive force around a closed path is equal to the conduction current plus electric displacement through any surface bounded by the path.
B The electromotive force around a closed path is equal to the time derivative of the electric displacement through any surface bounded by the path.
C The total electric displacement through the surface enclosing a volume is not equal to the total charge within the volume.
D The net magnetic flux emerging through any closed surface is zero.
E The electromotive force around a closed path is equal to the charges flowing through any surface bounded by the path.

(ix) It is preferable to start d.c series motor with some mechanical load

A since it may develop excessive speed and damage itself
B otherwise it will not run at no load
C because a little load will act as a starter to the motor
D to prevent mechanical vibrations
E to provide strength.

(x) Which of the following items is the indication of a fully discharged cell?

A Gassing
B Colour of the plate
C Specific gravity
D Breaking of the plate
E Both gassing and colour of the plate.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. State Lens's law and Fleming's right hand rule.

3. A circuit consists of a resistance of 20 Ω, an inductance of 0.05 H connected in series. A supply of 230 V at 50 Hz is applied across the circuit. Find the current, power factor and the power consumed by the circuit. Draw the vector diagram.

4. A 4-pole, 1500 r.p.m d.c generator has a lap wound armature, having 32 slots and 8 conductors per slot. If the flux per pole is 0.04 Wb. Calculate the e.m.f induced in the armature. What would be the e.m.f induced, if the winding is wave connected?

5. A 100 kVA, 50 Hz single phase transformer has a turn's ratio of 1000/250. The primary winding is connected to 500 V, 50 Hz supply. Find the secondary open circuit voltage and the maximum value of the flux in the core.

6. A moving coil instrument has a resistance of 5 Ω and gives a full scale reading of 50 mA. Calculate the:
   (a) Shunt resistance required to increase the range of 200 A.
   (b) Series resistance required to use it as a voltmeter of range 0-750 V.
   (c) Power consumed in both cases.

7. An incandescent filament lamp is suspended 1.8 meters above a level work-bench. The lamp is fitted with a reflector such that the luminous intensity in all directions below the horizontal is 400 cd. Calculate the:
   (a) Illumination at a point A on the surface of the bench immediately below the lamp.
   (b) Illumination at the bench position 0.9 meter from A in a straight line.

8. Give three (3) advantages and three (3) disadvantages of alkaline cell over the lead acid cell.

9. Give three (3) similarities and three (3) differences between magnetic and electric circuits.

10. Draw the circuit for single phase half wave rectifier. Also draw its input and output wave form for two periods.

11. An aluminium conductor has resistance of 3.6 Ω at 20 °C. Find its resistance at 50 °C, if temperature coefficient of resistance of aluminium is 0.00403/ °C at 20 °C.?

SECTION C (60 Marks)

Answer **three (3)** questions from this section.

12. (a) Define the following terms as applied in transformers.

(i) Voltage regulation

(ii) Transformation ratio.

(b) What is the purpose of oil in the transformer?

(c) A single phase, 20 kVA transformer has 1000 primary turns and 2500 secondary turns. The net cross sectional area of the core is 100 cm^2. When the primary winding is connected to 500 V, 50 Hz supply, calculate the:

(i) Maximum value of the flux density in the core.

(ii) Voltage induced in the secondary winding.

(iii) Primary and secondary full load current.

13. (a) How can the power factor of an inductive circuit be improved?

(b) A circuit consists of three branches connected in parallel as shown in Figure 1. If the circuit is connected across a 230V, 50 Hz supply, calculate the total current, power and power factor of the circuit.

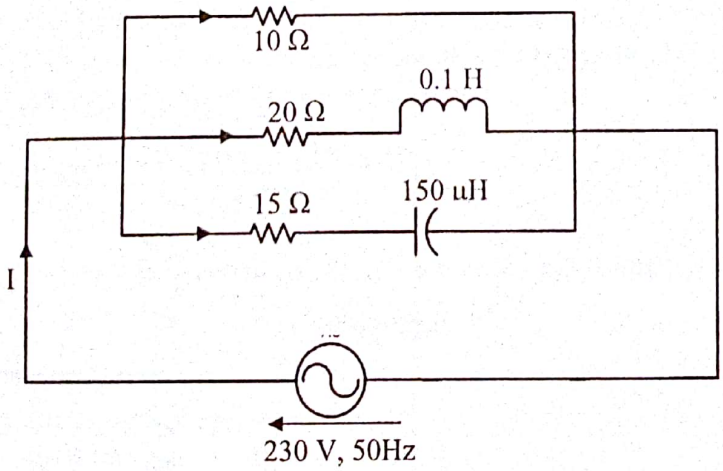

Figure 1

14. (a) Define the following terms.

(i) Brightness

(ii) Illumination

(iii) Luminous intensity

(iv) Luminous flux

(v) Lumen.

(b) A light fitting producing luminous intensity of 1600 candela in all directions below the horizontal is suspended 40m above the floor. Calculate the illumination produced at point P just below the lamp and a point Q 2.5 m away from P.

15. (a) Define the following terms as used in measurements and instrumentation.

(i) Instrument

(ii) Accuracy

(iii) Precision

(iv) Resolution

(v) Sensitivity

(vi) True value.

(b) Figure 2 shows how an ammeter and voltmeter are used to check the resistance of a resistor marked 1 kΩ. Calculate the value of the resistance from the instrument readings, then comment on your results. Neglect ammeter resistance.

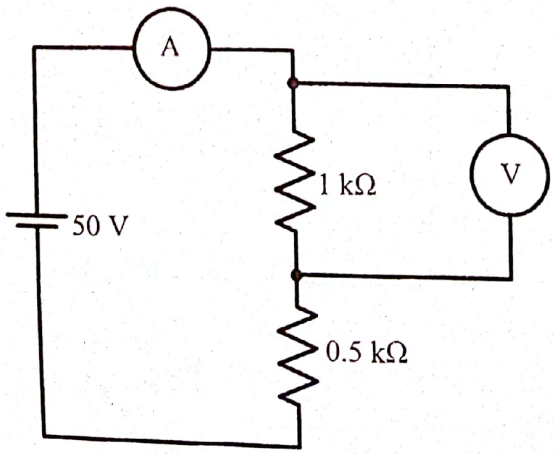

Figure 2

15. (a) State Ohm's law.

(b) Give two (2) limitations of Ohm's law.

(c) With reference to Figure 3, use Kirchhoff's laws to find the branches current of the circuit.

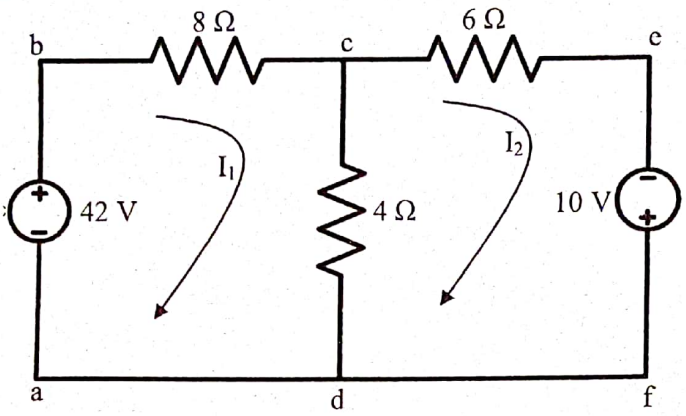

Figure 3