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 **Friday, 8th November 2013 p.m.**

Instructions

1. This paper consists of sections A, B and C.
2. Answer **all** the questions in sections A and B and **three (3)** questions from section C.
3. Non programmable calculators may be used.
4. Cellular phones are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).

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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) What must be known in order to calculate the energy used by an electrical appliance?
A Power and current. B Power and resistance. C Current and time of operation.
D Voltage and resistance. E Power and time of operation.

(ii) A good electric conductor is one that
A has low conductance B is always made of copper C has few free electrons
D has constant voltage E has minimum voltage drop.

(iii) The capacity of a cell is measured in
A watt-hour B megawatt C ampere D ampere-hour E voltage.

(iv) Electronic device that convert d.c power to a.c power is called
A converter B inverter C rectifier D transformer E generator.

(v) What will happen when two objects one with high temperature and the other with low temperature are placed together?
A Temperature will flow from low to high body
B The higher body will gain while the lower body will loose temperature
C Temperature will flow from high body to low body
D The higher body will loose while the lower body will gain temperature
E Each body will retain its original temperature.

(vi) Which controls should be adjusted for an oscilloscope to display the wave form of a.c supply?
A Y-shift then X-time base. B X- time base then Y-shift. C Y-shift then Y-gain.
D X-time base then Y-gain. E Y-gain then Y-shift.

(vii) The armature of a d.c. series machine has a resistance of 0.1 Ω and is connected to 230 V supply. If it is running as a generator giving 80 A, then generated e.m.f will be
A 238 V B 224 V C 230 V D 400 V E 380 V.

(viii) An atom is said to be ionized when any one of its orbiting electron
A is raised to a higher orbit B is partially removed C comes to the ground state
D is completely removed E jumps from one orbit to another.

(ix) A chemical compound whose chemical action causes a current to flow is
A electron B an impurity C an electrolyte
D ions E solvent.

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(x) Which parameter on a transformer can be measured by using short circuit test?

A Windage losses. B Hysteresis losses. C Eddy current losses.
D Copper losses. E Friction losses.

SECTION B (30 Marks)

Answer **all** questions in this section.

2. A battery consists of two cells joined in parallel. If each cell has an e.m.f of 1.5 V and internal resistance of 5Ω, what current will flow through an external resistance of 5Ω?

3. (a) When is the armature of a d.c motor likely to get overheated?
   (b) How can the direction of rotation of motor be reversed?

4. (a) Briefly explain two functions of cathode ray tube.
   (b) Mention two deflection systems of cathode ray tube.

5. The field coil of a motor has a resistance of 200 Ω at 20^0C. Find the resistance of the coil when the motor temperature increases to 40^0C. Temperature coefficient of the conductor is $0.004\Omega/\Omega^0C$.

6. (a) State Ohm's law.
   (b) Define the following terms as used in measuring instruments:
      (i) Shunt resistor
      (ii) Multiplier resistor.

7. (a) Define the term *rectification*.
   (b) Give two main advantages of half wave rectifier.

8. (a) State a Coulomb's law.
   (b) At what velocity must a conductor 75 mm long cut a magnetic field of flux density 0.6 tesla, if an e.m.f of 9 V is to be induced in it. Assume the conductor, the field and the direction of motion are mutually perpendicular.

9. A four pole wave connected armature has 51 slots with 12 conductors per slot and is rotated at 900 r.p.m. If the useful flux per pole is 25 mWb, calculate the value of the generated e.m.f.

10. (a) State two particles consisted in the nucleus of an atom.
    (b) Explain how positive ions can be created between atoms.

11. An electric cattle consumes 3 kW at 240 V supply. Calculate the current and the resistance of the heating element.

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SECTION C (60 Marks)

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

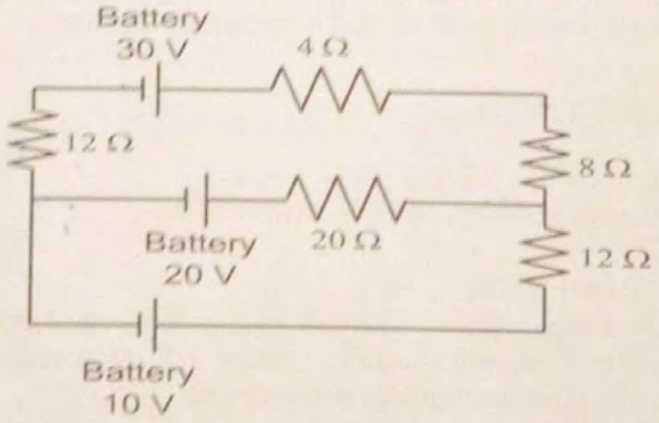
12. (a) Define the following terms and state how they are related.
    (i) Specific heat capacity
    (ii) Quantity of heat
    (iii) Temperature **(04 marks)**

    (b) 2000 g of lead at 100^0C are dropped into a copper vessel containing 300 g of water at 0^0C and rapidly stirred. If the final temperature attained by the vessel and its contents is 16^0C, calculate the heat capacity of copper vessel. Take specific heat capacity of lead as $0.13\,J/g^0K$ or $130\,J/kg^0K$. **(06 marks)**

    (c) Draw a diagram which demonstrates the magnetic, heating and chemical effects of electric current. Describe how the effects are achieved. **(10 marks)**

13. (a) Define the following terms as used in electric networks.
    (i) Circuit
    (ii) Node
    (iii) Branch **(03 marks)**

    (b) Find the magnitude and direction of currents in each of the batteries shown in Figure 1.



(08 marks)

Figure 1

    (c) (i) Differentiate between linear and nonlinear resistors.
    (ii) A potential difference of 250 V is applied to a copper field at a temperature of 15^0C, and the current is 5A. What will be the mean temperature of the coil when the current has fallen to 4 A, the applied voltage being the same as before? Assume $\alpha_0 = \frac{1}{234.5}$ per ^{0}C. **(09 marks)**

14. (a) Define the following terms:
    (i) Luminous flux
    (ii) Luminous intensity **(02 marks)**

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(b) (i) State two laws of illumination.

(ii) An office 18 m by 43 m requires an illumination at desk level of 330 lux. The mounting height of the lamps above desk level will be 2 m. The following alternatives are suggested.

- 80 W fluorescent lamps giving 4800 lumens when new.
- 150 W tungsten filament lamps, giving 1950 lumens when new.

Calculate the number of lamps needed for each alternative, assuming a coefficient of utilization of 0.6 and a maintenance factor of 0.85. **(08 marks)**

(c) The average luminous output of an 80 W fluorescent lamp 1.5 meter in length and 3.5 cm diameter is 3300 lumens. Calculate its average brightness. If the auxiliary gear associated with the lamp consumes a load equivalent to 25% of the lamp, calculate the total energy consumed for running a twin unit for 2500 hours. **(10 marks)**

15. (a) Mention two types of transformer tests that are commonly used and briefly explain the function of each. **(02 marks)**

(b) The core of a 100 kVA, 1100/550 V, 50 Hz single phase core type transformer has a cross section of 20 cm x 20 cm. Find the

(i) number of high voltage and low voltage turns per phase.

(ii) e.m.f per turn if the maximum core density is not to exceed 1.3 tesla. Assume a stacking factor of 0.9 **(08 marks)**

(c) A 150 kVA single phase transformer has a core loss of 1.5 kW and a full load Cu loss of 2 kW.

(i) Calculate the efficiency of the transformer at full load 0.8 power factor lagging.

(ii) Calculate the efficiency of the transformer at one half load at unit power factor.

(iii) Determine the secondary current at which the efficiency is maximum, if the secondary voltage is maintained at its rated value of 240 V. **(10 marks)**

16. (a) Enumerate three methods in which low power factor can be improved or minimized. **(03 marks)**

(b) A 200 V, 50 Hz single phase induction motor consumes 1 kW at 0.7 power factor. Calculate the size of the capacitance to be placed in parallel with the motor to change the power factor to unit. **(07 marks)**

(c) A coil having a resistance of 15 Ω and an inductance of 0.5 H is connected in series with a capacitance of 50 μF. Find the

(i) impedance of the electric circuit.

(ii) current flowing, when 250 V at 50 Hz is supplied across the circuit.

(iii) power factor of the circuit. **(10 marks)**

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