WRITE ALL YOUR WORK IN THE ANSWER BOOK PROVIDED
EVERY ANSWER SHOULD INCLUDE ALL WORKINGS, NECESSARY
DIAGRAMS AND FORMULAE.

START EACH ANSWER ON A FRESH PAGE.

Answer any **FIVE** Questions

1.  A 6 pole 3-phase delta connected induction motor is connected to a 400V 50Hz supply. The
    motor operates at lagging power factor of 0.8. This motor is used to drive a goods lift, having
    total load of 120kg, at a rate of 3.3m/sec. For full load conditions the efficiency of the lift and
    the motor is 80% and 85% respectively. The slip frequency is 2Hz. Take force of gravity as
    9.81N/kg.

    For full load conditions calculate:
    a)  The output and input power of the motor                    **(6 marks)**
    b)  The line current drawn from the supply                     **(3 marks)**
    c)  The current in each winding                                **(2 marks)**
    d)  The synchronous speed                                      **(2 marks)**
    e)  The rotor speed                                            **(4 marks)**
    f)  The output torque of the motor                             **(3 marks)**

2a. With lead-acid storage batteries, what are the causes of:

    i.    sulphating of plates                                     **(2 marks)**
    ii.   buckling of plates                                       **(2 marks)**
    iii.  disintegration of plates                                 **(2 marks)**

b.  A battery of cells of total emf 40 volts and total internal resistance 2 ohms is connected in
    parallel with a second battery of 44 volts and internal resistance 4 ohms. A load resistance of
    6 ohms is connected across the ends of the parallel circuit.

    i.    draw a neat circuit diagram show all the components and indicate clearly the current
          directions.                                              **(2 marks)**
    ii.   calculate the current in battery A.                      **(4 marks)**
    iii.  calculate the current in battery B                       **(4 marks)**
    iv.   the current in the load resistance and its direction.    **(4 marks)**

3a. Draw circuit diagrams of :
    i.    A short shunt DC Generator                               **(2 marks)**
    ii.   A Long Shunt DC Generator                                **(2 marks)**
    iii.  Draw the curves of the terminal voltage against the current output of a level
          compound and an over compound DC Generator.              **(2 marks)**

b.  A long shunt generator (Ra=0.05ohms, Rse = 0.06ohms, Rsh = 12ohms) supplies a load of
    98A at a p.d. of 240V. Determine the armature current and the value of the generated EMF.
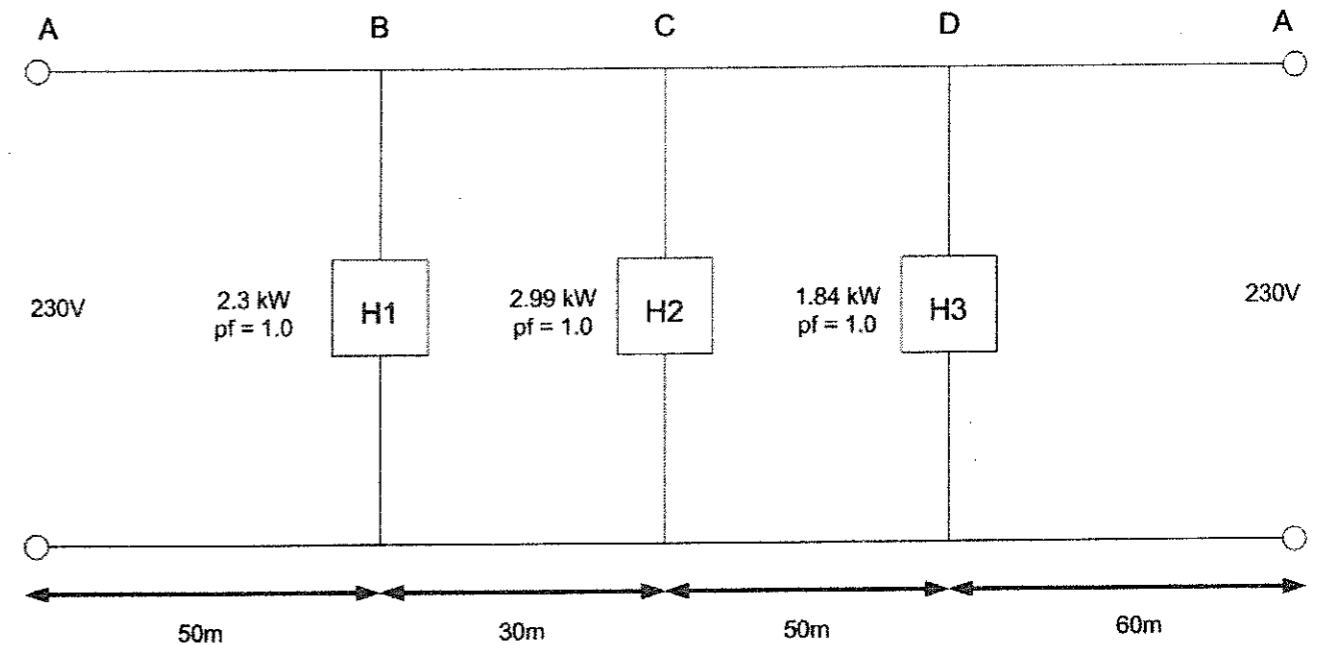                                                                   **(7 marks)**

c.  A short shunt generator (Ra = 0.1ohm, Rse = 0.12 ohm, Rsh = 240 ohms) generates a total
    EMF of 245 Volts when the armature current is 50 A. Determine the terminal voltage for this
    load.                                                          **(7 marks)**

4.  A number of 13A single-phase sockets are wired as a ring circuit and fed from a consumer
    unit having a supply voltage of 230V 50Hz. The circuit is protected by a 32A MCB.

    Three (3) electric heaters are connected to this ring circuit as shown. The resistance of a
    single conductor is 0.02ohms/100m.

    Calculate:
    a)  The resistance in each branch                              **(4 marks)**
    b)  The current in each branch                                 **(9 marks)**
    c)  The voltage drop in each branch                            **(4 marks)**
    d)  The voltage across each load                               **(3 marks)**



5.  A parallel circuit consists of two branches. Branch A has a pure inductance of 120mH and
    Branch B has 25µf capacitance, The supply to the circuit is 230V, 50Hz. Determine:

    (a) The Branch currents in A & B.                             **(4 marks)**
    (b) The supply current.                                       **(3 marks)**
    (c) Impedance of the parallel circuit.                        **(2 marks)**
    (d) The power consumed.                                       **(3 marks)**
    (e) Draw the phasor diagram.                                  **(4 marks)**
    (f) What is the resonant frequency of the parallel circuit. (hint: since R is negligible you can
    use the series circuit resonant formula).                    **(4 marks)**

6.    A 20kVA, single-phase double - wound, 50Hz, 400/230Volts step-down transformer gave the following test results:-

Open-circuit test 400Volts applied to primary: power taken 220Watts;
Short-circuit test: power required to circulate full load current in short-circuit secondary 240Watts. Calculate:

(a) The full load efficiency assume the power factor to be unity.          **(5 marks)**
(b) The full load terminal voltage if the transformer having 5% regulation and with an open secondary voltage of 230V          **(5 marks)**
(c) If the 20kVA transformer is energized continuously for 15 hours (assume unity power factor), calculate its All-day efficiency,          **(5 marks)**
(d) If the double wound transformer is replaced by an auto-transformer, describe the operation and precautions to be taken according to the I.E.E. regulations.          **(5 marks)**

# END OF PAPER

# EXAMINATION FOR THE ISSUE OF A LICENCE TO ACT AS WIREMAN - LICENCE 'B'

## June 2012

## Paper I (Theory)

## Time Allowed: 3 Hrs