CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – MARINE ENGINEER OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 78 (as amended) **CHIEF ENGINEER REG. III/2 (UNLIMITED)**

041-33 - ELECTROTECHNOLOGY

THURSDAY, 14 JULY 2016

0915 - 1215 hrs

Examination paper inserts:

Notes for the guidance of candidates:

1. Non-programmable calculators may be used.
2. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook
Graph paper

ELECTROTECHNOLOGY

Attempt SIX questions only.

All questions carry equal marks.

Marks for each part question are shown in brackets.

1. In the network shown in Fig Q1 the meter indicates 2 mA in the direction shown.

   Determine EACH of the following:

   (a) the resistance of the meter; (8)

   (b) the reading on the meter if the 1.5 kΩ and the 2 kΩ resistors are interchanged. (8)

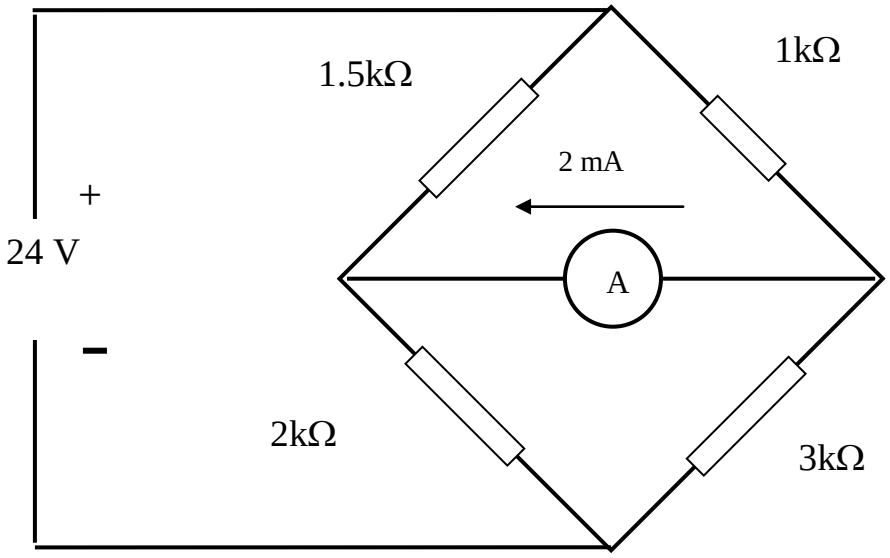

Fig Q1

2. A non-linear resistor whose characteristic is given by:

$I = 0.1\ V^2$ where 'I' is the current in mA and 'V' is the voltage in volts

is connected in series with a 680 Ω resistor to a 16 V d.c. supply.

Determine EACH of the following:

(a) the voltage across each element; (6)

(b) the circuit current; (4)

(c) the value to which the linear resistance must be changed to give equal voltages across the two elements; (4)

(d) the circuit current for the condition in Q2(c). (2)

3. In the two-stage voltage amplifier shown in Fig Q3 both the npn and pnp transistors have high current gains. Transistor T_1 has a base-emitter volt drop of 0.7 V and transistor T_2 has a base-emitter volt drop of 0.3 V.

Calculate EACH of the following:

(a) the voltage between collector and emitter for each transistor; (12)

(b) the power dissipated in each transistor. (4)

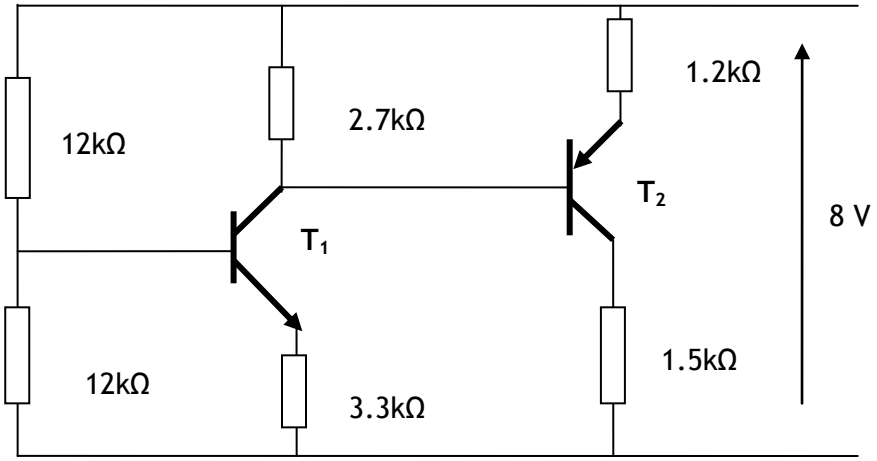

Fig Q3

4. A 220 Ω resistor is connected in series with a coil of resistance *R* and inductance *L* across a 240 V, 50 Hz supply.

The p.d. across the 220 Ω resistance is 110 V and across the coil is 200 V.

Calculate EACH of the following:

(a) the supply current; (2)

(b) the resistance of the coil; (6)

(c) the inductance of the coil; (5)

(d) the power factor of the coil. (3)

5. A 440 V/110 V step down transformer is rated at 60 kVA full load output. The iron loss is 4 kW and the full load copper loss is 6 kW.

Calculate EACH of the following:

(a) the kVA output at which maximum efficiency is achieved; (8)

(b) the efficiency at 50 kW output and 0.85 p.f (8)

6. Three identical coils each of inductance 0.1 H and resistance 30 Ω are connected in delta to a three phase supply of 440 V, 50 Hz.

Three identical capacitors are now connected in star to the same supply to raise the p.f. to 0.9 lag.

Calculate EACH of the following:

(a) the value of each capacitor; (8)

(b) the percentage reduction in line current; (4)

(c) the KVA taken by the capacitors. (4)

7. (a) Explain, with the aid of a circuit diagram, the principle of operation of the wound rotor induction motor. (8)

(b) State TWO advantages of the wound rotor induction motor. (4)

(c) State TWO disadvantages of the wound rotor induction motor. (4)

8. (a) Explain what is meant by the term *single phasing*. (6)

(b) Explain the probable effect of single phasing on a delta connected squirrel cage induction motor on 75% full load. (4)

(c) State ONE method by which a motor can be protected against the effects of single phasing. (6)

9. (a) Sketch the circuit diagram for an uncontrolled three phase bridge rectifier, indicating the current path for one complete cycle for one phase. (8)

(b) Sketch the output waveform for the circuit described in Q9(a). (3)

(c) If a smoothing capacitor is added to the circuit described in Q9(a), explain why less capacitance is required for the three phase rectifier set than for an equivalent single phase rectifier of the same capacity for the same acceptable level of *ripple* voltage at the output. (5)