

**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 95 CHIEF ENGINEER REG. III/2 (UNLIMITED)

041-33 - ELECTROTECHNOLOGY

THURSDAY, 21 OCTOBER 2010

0915 - 1215 hrs

Examination paper inserts:

--

Notes for the guidance of candidates:

- | |
|---|
| <ol style="list-style-type: none">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. (a) For the circuit shown in Fig Q1, calculate EACH of the following:
 - (i) the current through the $12\ \Omega$ resistor; (8)
 - (ii) the p.d. across each resistor. (3)
- (b) Calculate the voltage V_{AB} , if the $12\ \Omega$ resistor is now removed from the circuit. (5)

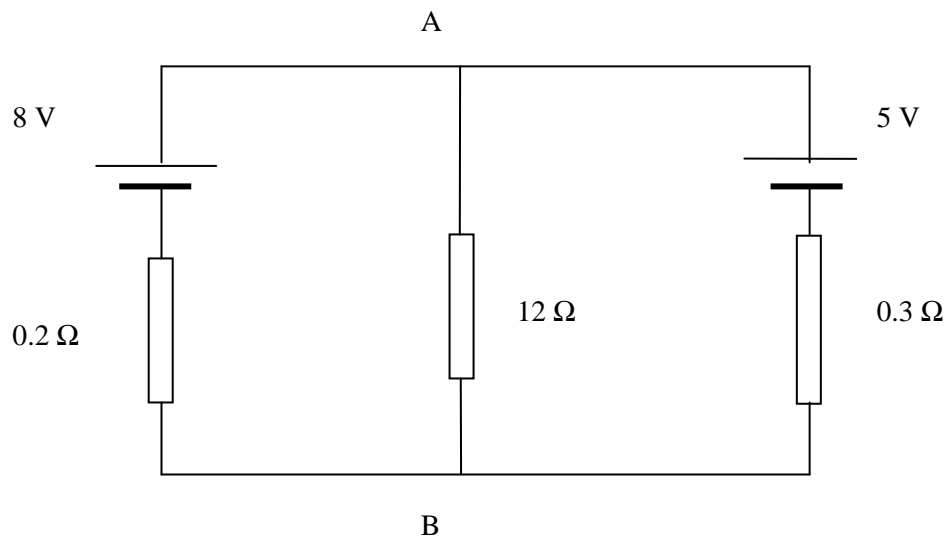


Fig Q1

2. The V/I characteristic of a non-linear circuit element is shown in Table Q2.

This non-linear element is connected in series with a paralleled pair of resistors of $40\text{ k}\Omega$ and $80\text{ k}\Omega$ and the overall circuit is connected to 110 V d.c.

Determine EACH of the following:

- (a) the current in the non-linear resistor; (8)
- (b) the effective resistance of the non-linear resistor; (3)
- (c) the current in the $80\text{ k}\Omega$ resistor. (5)

V (volts)	40	60	80	100	120	140
I (mA)	0.65	1.05	1.55	2.20	3.20	4.70

Table Q2

3. A $220\ \Omega$ resistor is connected in series with a coil of resistance R and inductance L across a $240\text{ V }50\text{ Hz}$ supply.

The p.d. across the $220\ \Omega$ resistance is 110 V and across the coil is 200 V .

Calculate EACH of the following:

- (a) the supply current; (3)
- (b) the resistance of the coil; (5)
- (c) the inductance of the coil; (5)
- (d) the power factor of the coil. (3)

4. The p.d. between base and emitter for the transistor shown in Fig Q4 is 0.4 V and the steady state output voltage is 6 V. The base current is negligible.

Calculate EACH of the following:

- (a) the p.d. between the base and earth; (4)
 (b) the collector current; (4)
 (c) the value of the load resistor R_L ; (4)
 (d) the power dissipated in the 180Ω resistor; (2)
 (e) the power dissipated in the transistor. (2)

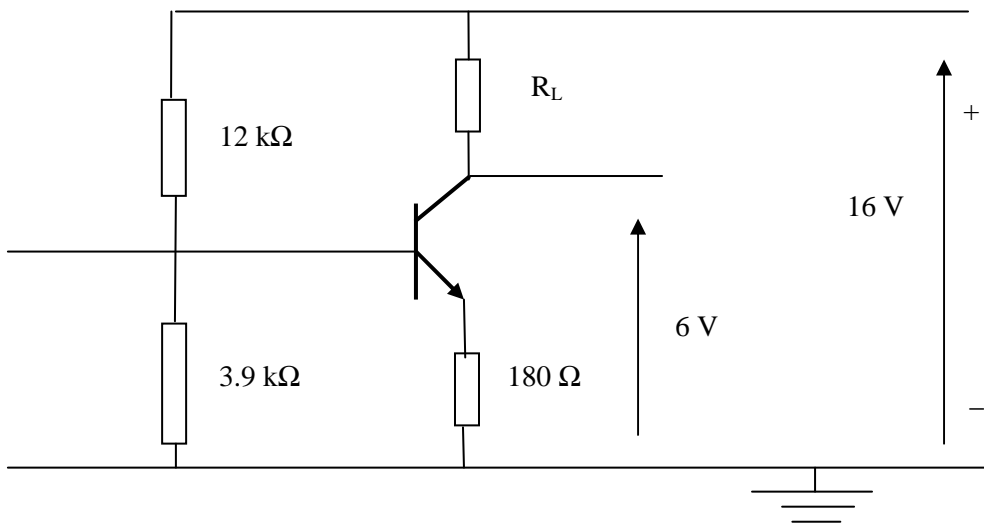


Fig Q4

5. A star connected unbalanced three phase load is connected to a four wire supply with a phase voltage of 240 V a.c. The resistive loads in each of the three phases are as follows:

Red to neutral 40Ω ; yellow to neutral 50Ω ; blue to neutral 60Ω .

Determine EACH of the following:

- (a) the current in each phase; (3)
 (b) the current in the neutral wire; (7)
 (c) the phase angle between the neutral current and the voltage V_{RN} . (6)

6. A 3ph 440 V 60 Hz 8 pole induction motor runs at a power factor of 0.85 lag and drives a load of 8 kW at a speed of 14.4 rev/sec. The stator loss is 1 kW and the rotational losses (windage and friction) amount to 0.8 kW.

Calculate EACH of the following:

- (a) the synchronous speed; (3)
 - (b) the rotor copper loss; (5)
 - (c) the input power to the motor; (4)
 - (d) the motor current. (4)
7. With reference to a 3 phase a.c. synchronous motor:
- (a) sketch a simple construction diagram of stator and rotor; (4)
 - (b) explain the operating principle of the motor; (4)
 - (c) explain how start up and shaft reversal are effected; (4)
 - (d) state how the motor may be operated at a wide range of power factors from lag to lead. (4)
8. With reference to a Ward Leonard motor control system for powering a d.c. capstan motor from a 3 phase a.c. supply:
- (a) sketch a circuit diagram for the arrangement; (7)
 - (b) explain how the speed of the capstan motor is varied; (5)
 - (c) state TWO advantages and TWO disadvantages of the Ward Leonard system of motor control. (4)
9. (a) Explain the term *power factor correction*. (3)
- (b) State TWO advantages of p.f.. correction. (4)
 - (c) Explain, with the aid of a circuit diagram, how power factor correction can be effected using capacitors in a three phase circuit. (5)
 - (d) State ONE method, other than the use of capacitors, by which power factor correction can be effected. (4)