

**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 MANAGEMENT ENGINEER REG. III/2 (UNLIMITED)

040-33 - ELECTROTECHNOLOGY

THURSDAY, 29 MARCH 2018

0915 - 1215 hrs

Examination paper inserts:

Worksheet Q9

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

ELECTROTECHNOLOGY

Attempt SIX questions only.

All questions carry equal marks.

Marks for each part question are shown in brackets.

1. For the circuit shown in Fig Q1, calculate EACH of the following:
- (a) the current through the $10\ \Omega$ resistor; (10)
 - (b) the p.d. across EACH of the following:
 - (i) the $0.1\ \Omega$ resistor; (2)
 - (ii) the $0.2\ \Omega$ resistor; (2)
 - (iii) the $10\ \Omega$ resistor. (2)

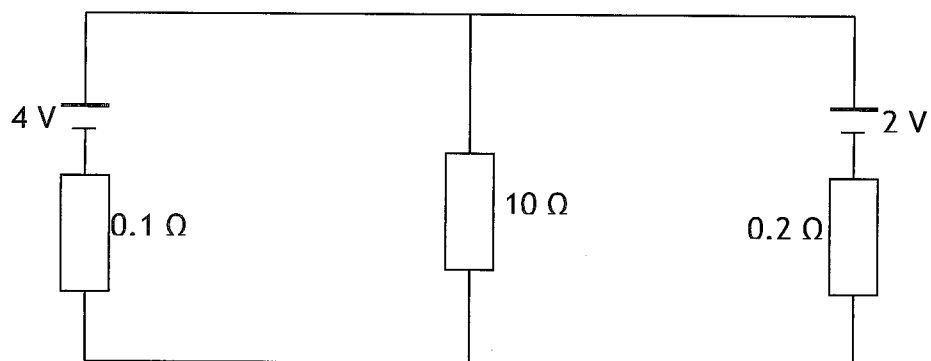


Fig Q1

2. A capacitor of $100 \mu\text{F}$ is charged from a 120 V d.c. supply via a $100 \text{ k}\Omega$ resistor for 4 seconds.

(a) Calculate EACH of the following:

(i) the time constant of the circuit; (2)

(ii) the voltage to which the capacitor has charged after 4 seconds. (4)

(b) A second capacitor of $80 \mu\text{F}$ is now charged for 4 seconds from the same supply via the same $100 \text{ k}\Omega$ resistor. Both charged capacitors are now connected in parallel.

Calculate EACH of the following:

(i) the final steady state voltage across the pair of capacitors; (6)

(ii) the total energy stored in the two capacitors. (4)

3. A three phase, 4 wire, unbalanced load draws the following currents with reference to V_{RN} :

- $I_{RN} = 5 \text{ A } \angle 0^\circ$
- $I_{YN} = 8 \text{ A } \angle -150^\circ$
- $I_{BN} = 3 \text{ A } \angle 85^\circ$

Calculate EACH of the following:

(a) the current in the neutral line; (7)

(b) the angular position of the neutral current with reference to V_{RN} ; (2)

(c) the total power dissipated by the load if it is connected to a 415 V supply. (7)

4. A three-phase, 6 pole, 380 V , 60 Hz induction motor has a line current of 80 A at a power factor of 0.8 lag with a shaft speed of 19 rev/s . The iron losses are 2 kW , the stator copper loss is 1 kW and the windage and friction loss is 1.5 kW .

Calculate EACH of the following:

(a) the slip; (3)

(b) the rotor copper loss; (5)

(c) the shaft output power; (5)

(d) the efficiency. (3)

5. A three phase, 440 V a.c. generator supplies the following loads:

- a star connected load of 33 kVA and power factor 0.9 leading
- a delta connected load of 40 kW and power factor 0.85 lagging
- miscellaneous loads of 23 kVA and power factor 0.8 lagging

Calculate EACH of the following:

- (a) the kVA supplied by the generator; (10)
- (b) the generator current; (2)
- (c) the phase currents for the star and delta connected loads. (4)

6. A 250 kVA single phase transformer has iron losses of 1.8 kW. The full load copper loss is 2 kW.

Calculate EACH of the following:

- (a) efficiency at full load, 0.8 p.f. lag; (6)
- (b) kVA supplied at maximum efficiency; (4)
- (c) maximum efficiency at 0.7 p.f. lag. (6)

7. With reference to a shaft-driven generator:

- (a) state TWO advantages; (2)
- (b) state ONE disadvantage; (1)
- (c) sketch a labelled diagram of a shaft-driven generator system which employs a frequency converter; (8)
- (d) describe the operation of the system sketched in Q7(c). (5)

8. (a) State the conditions necessary to *turn on* and *turn off* a thyristor ('SCR'). (4)
- (b) Describe the operation of the circuit shown in Fig Q8. (8)
- (c) Sketch the voltage waveform across the load for EACH of the following trigger delay angles:
- (i) 60° ; (2)
- (ii) 120° . (2)

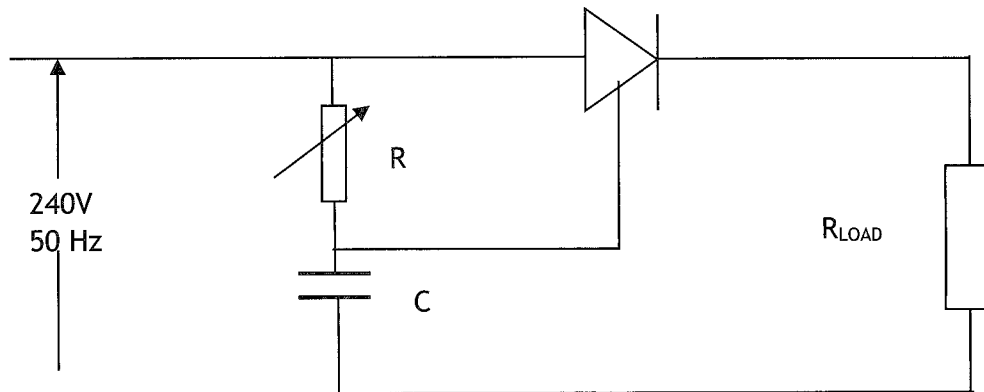
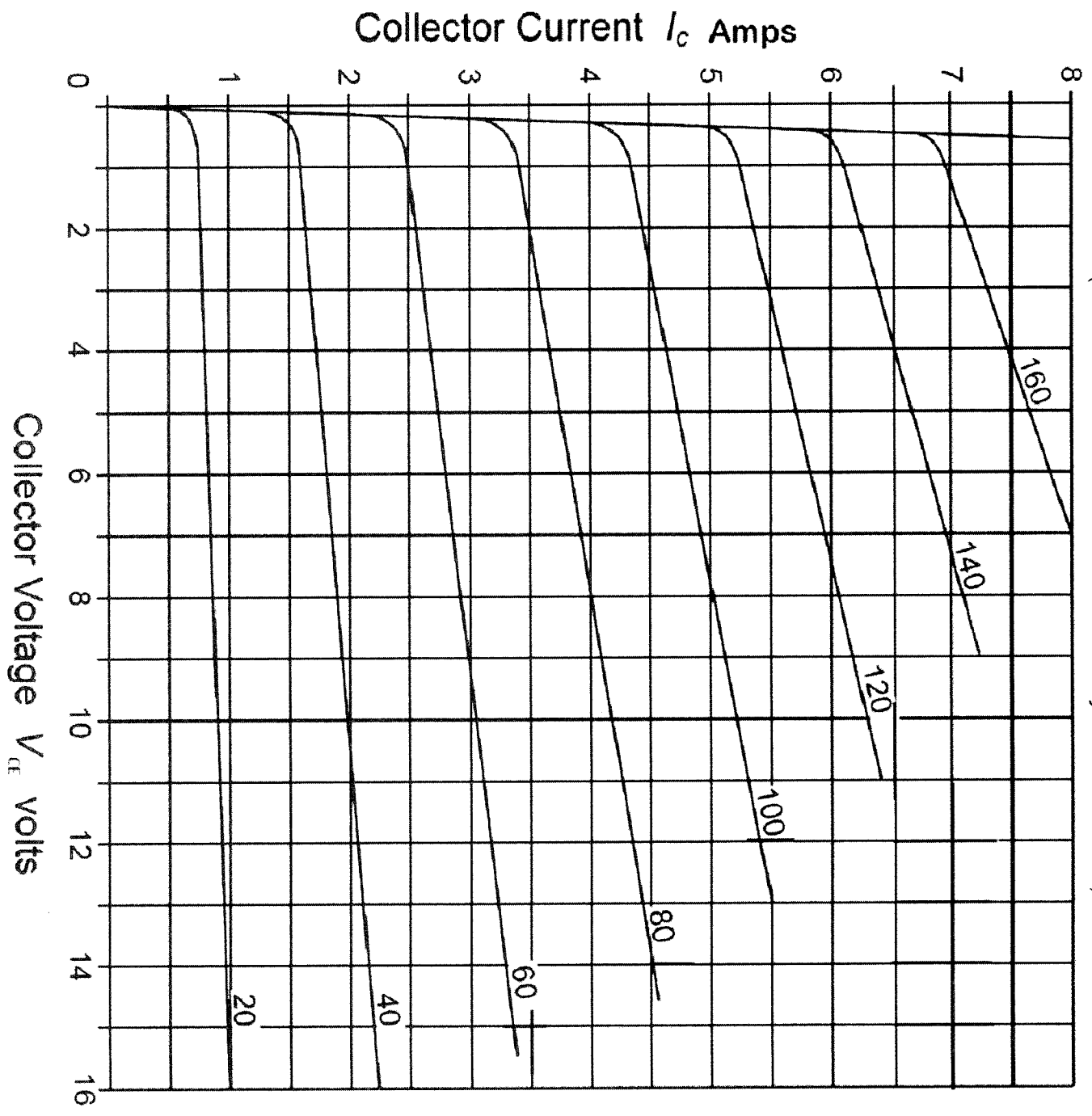


Fig Q8

9. A transistor with the characteristics shown on Worksheet Q9 is used in a common emitter amplifier circuit with a 14 V d.c. supply and a $2\text{ k}\Omega$ resistive load. The base bias current is 80 mA for a sinusoidal input signal current of $\pm 60\text{ mA}$.
- (a) Draw the load line on Worksheet Q9. (2)
- (b) Determine the values of the collector d.c. voltage and current. (4)
- (c) Determine the R.M.S. values of EACH of the following: (4)
- (i) the a.c. load current; (4)
- (ii) the a.c. output voltage. (4)
- (d) Calculate the a.c. signal current gain of the amplifier. (2)

(This Worksheet must be returned with your answer book)



Candidate's Name

Examination Centre