

**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, 29 MARCH 2012

0915 - 1215 hrs

Examination paper inserts:

Worksheet Q3

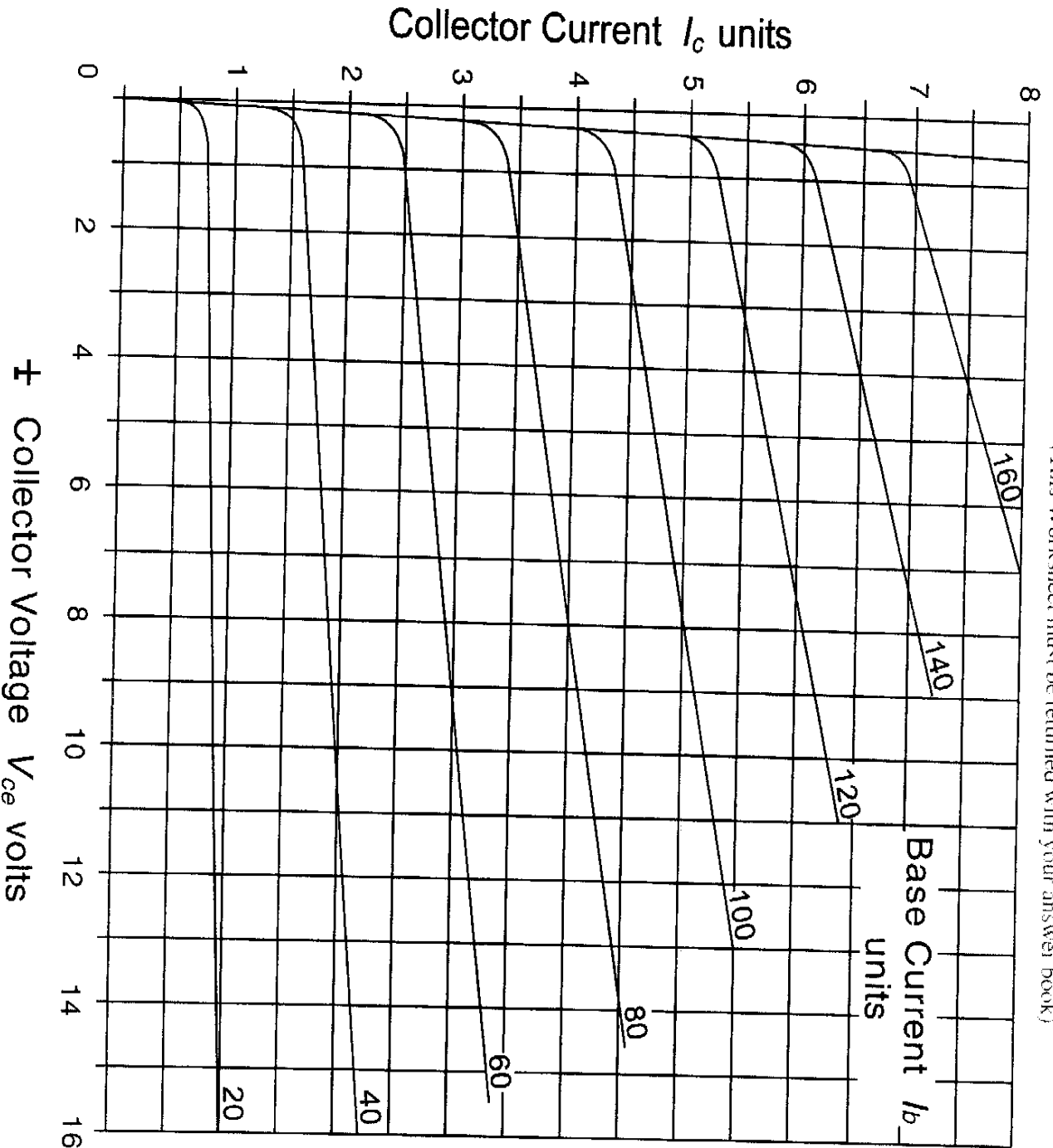
Notes for the guidance of candidates:

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

(This Worksheet must be returned with your answer book)



**COMMON EMITTER
TRANSISTOR
CHARACTERISTICS**

TYPE	SCALE FACTORS per unit value of	
	I_b	I_c
1. Small Si	1 μ A	1 mA
2. Power Si	1 mA	1 A

ELECTROTECHNOLOGY

Attempt SIX questions only.

All questions carry equal marks.

Marks for each part question are shown in brackets.

1. A two core cable is 400 metres long and is fed at each end with 240 V d.c. Three loads are connected to the distributor.

- 120 A at 80 metres
- 80 A at 160 metres
- 100 A at 280 metres

All distances are measured from the same end of the distributor.

If the resistance of the twin cable (go and return) is $0.001 \Omega/\text{metre}$, calculate EACH of the following:

(a) the current supplied at each end of the distributor; (6)

(b) the p.d. at each load point; (6)

(c) the total power lost in the distributor cable. (4)

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 silicon heavy power transistor with the characteristics given in Worksheet Q3 is operated from a 12 V supply and has a maximum power rating of 18 W.
- Plot the 18 W power dissipation curve on the characteristics. (5)
 - Determine the minimum safe collector load resistance for the transistor. (4)
 - If the transistor is biased at the base with 80 mA and a sinusoidal signal of +/- 40 mA is applied to the base, calculate EACH of the following:
 - the variation in collector current; (2)
 - the corresponding variation in collector voltage; (2)
 - the a.c. power output of the transistor. (3)
4. A coil of inductance 0.1 H has a power factor of 0.7 and is connected in parallel with a capacitor 'C' across 120 V, 60 Hz supply.
- Calculate EACH of the following:
- the resistance of the coil; (3)
 - the value of the capacitor if the total current is 4 A at a leading power factor; (7)
 - the power factor of the combined circuit; (3)
 - the kVA for the combined circuit. (3)
5. A three phase star connected load has three identical legs each comprising a 40 Ω resistor in series with a 100 μF capacitor. It is supplied at 415 V, 50 Hz from a three wire supply.
- Calculate EACH of the following:
- the current in each phase; (4)
 - the current in each phase if due to a fault the red phase lead becomes disconnected; (6)
 - the current in each phase if the red phase becomes short circuited. (6)

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

Calculate EACH of the following:

- (a) the kVA output at which maximum efficiency will be achieved; (8)
- (b) the efficiency at 50 kW output and 0.85 p.f. (8)
7. (a) State the main reason why switchboard instruments are supplied via instrument transformers from the power circuits which they monitor. (4)
- (b) Explain why it is hazardous to open circuit a current transformer whilst its primary is still energised. (4)
- (c) Sketch a circuit diagram showing an ammeter, a voltmeter and a wattmeter only fed from a single phase supply via current and voltage transformers. (4)
- (d) An ammeter, a voltmeter and a wattmeter monitoring a single phase supply read 40 A, 240 V and 8 kW respectively.
- Calculate the power factor of the circuit. (4)
8. (a) Explain the term *power factor correction*. (4)
- (b) State TWO advantages of improving the power factor of a distribution system. (6)
- (c) Explain TWO methods by which the power factor of a power distribution system can be raised. (6)
9. (a) List the various losses which occur in the squirrel cage motor on load. (4)
- (b) State, with reasons, which of these losses are:
- (i) independent of load and speed; (4)
- (ii) dependent on load; (4)
- (iii) dependent on speed. (4)