SEAGOING ENGINEER OFFICER CLASS 1

CERTIFICATE OF COMPETENCY

ELECTROTECHNOLOGY

Time allowed: 3 hours

INSTRUCTIONS : -

This paper consists of NINE questions where

Candidates are required to attempt ANY SIX questions.

All questions carry equal marks.

Pass marks: 50 %

CANDIDATES ARE NOT ALLOWED TO WRITE ON OR DEFACE THIS PAPER

This paper consists of this page and Five other printed pages.

Notes to Candidates:-

i) Write down your name in the top right-hand corner on the first page of the answer sheets.

ii) Write down the question number in the top left-hand corner on each page.

iii) Answer each question on a new page.

iv) No need to copy the questions' details onto the answer sheets.

v) Switch off all your mobile phones and communication devices when in the examination room.

vi) Return all the question paper(s), the used and unused answer sheets before leaving the examination room.

vii) Do not disturb other candidate(s) in the examination room.

viii) Do not attempt to take any photos or recordings of any question papers and/or answer sheets.

ix) The progress of the examination is being recorded by close-circuit television (CCTV) and voice recorders in the examination room.

If the above rules from item v) to viii) are infringed, candidates will be regarded as having failed the examination as a whole and will not be accepted for re-examination for such period as may be decided by the Director.

考生注意事項：-

i) 在答題紙首頁右上角寫上姓名。

ii) 在每頁答題紙的左上角標明回答的問題題號。

iii) 每一條問題另開新頁作答。

iv) 不需要抄寫問題到答題紙上。

v) 進入試場後，把手機及所有通信設備關閉。

vi) 離開試場前，交回所有試卷、所有用過和未用過的答題紙及草稿紙。

vii) 試場內不可干擾其他考生。

viii) 切勿嘗試拍攝或錄取任何試卷或答案。

ix) 考試期間試場內會有閉路電視(CCTV)和錄音系統進行記錄。

如果違反上述 v) 至 viii) 規則，即當作所有考試不及格，以及在處長決定的期間內不得重考。

1.   For the circuit shown in Fig. 1, the voltage between the base and the emitter may be taken constant at 0.7 V when the transistor is conducting, and the base current ignored as negligible.

    (a)   the collector current;

    (b)   the voltage at the emitter, the base and the collector, all with respect to earth voltage; and
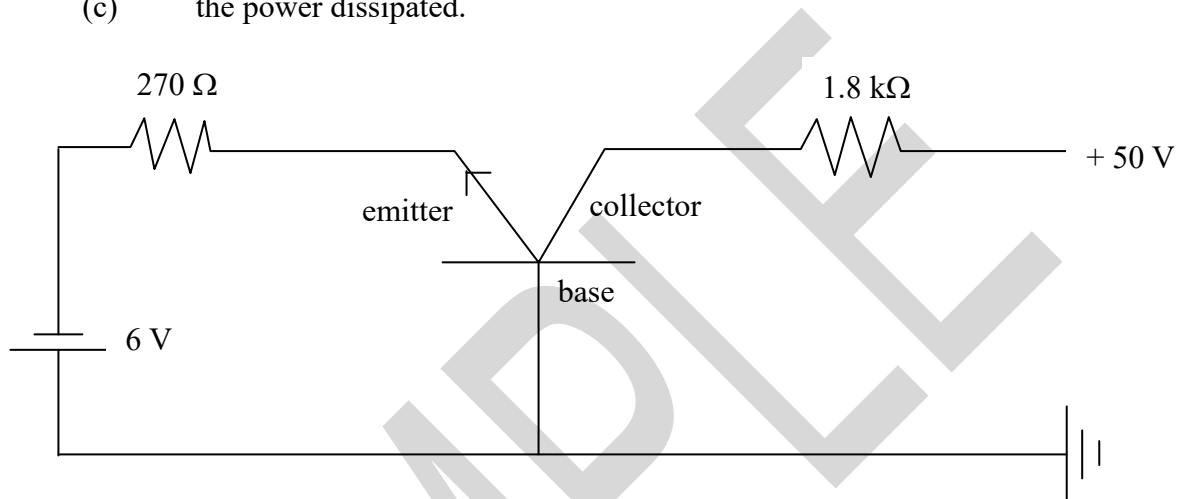
    (c)   the power dissipated.

Fig. 1

2.   A d.c. machine has an armature resistance of 0.2 Ω and a field winding resistance of 0.3 Ω.   When the field is separately excited by a current of 60 A and the machine is driven as a generator at 13.33 rev/s, the open circuit voltage is observed to be 400 V. Estimate the steady state speed and the armature current when the machine is driven as a series-connected motor on a 500 V d.c. supply developing a torque of 50 Nm.

It may be assumed that in both cases the magnetic field is unsaturated, i.e. the magnetic flux is proportional to the field current.

3.   With the aid of a sketch, describe the operation of a fluorescent lamp.

Explain the effect if the operating voltage fell below normal.   Compare the ability of fluorescent lamps to withstand shock and vibration with that of incandescent lamps.

4. Sketch the circuit diagram of a half wave rectifier using a 230/40 V 50 Hz transformer, and incorporate a large reservoir capacitor of 2,500 µF for smoothing purpose. Determine:

(a) the minimum value required for the peak inverse voltage of the rectifier diodes used in the circuit, and

(b) the peak to peak value of the ripple voltage for the circuit when delivering a small current of 250 mA.

5. The magnetic circuit shown in Fig. 2 is the arrangement for the overload trip of a starter. The gaps are set for 25 per cent overload current. If the armature of the trip lifts when the flux density in the air gap is 0.8 Tesla and the relative permeability of the steel of the magnetic circuit is 2,140 at this flux density. Determine the full-load current of the motor for which the starter is designed. Neglect leakage and fringing. The cross-section of the magnetic circuit can be taken as being uniform throughout and the permeability of air taken as $4\pi \times 10^{-7}$ H/m.
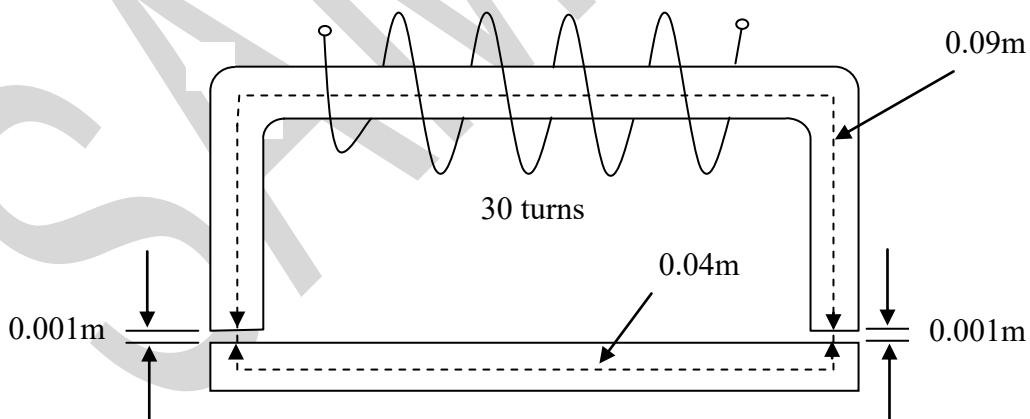

Fig. 2

6. A d.c. shunt wound machine gives an output of 100 kW at 440 V when run as a generator at 20 rev/s. The resistances of the armature and the shunt field are 0.05 Ω and 200 Ω respectively.

When the machine is run as a motor on a 440 V supply, the input power is 100 kW and the iron and mechanical losses total 3.24 kW.

With the machine operating as a motor, determine:

(a)　　the motor speed;

(b)　　the output power; and

(c)　　the motor efficiency.

7. (a) Two networks shown in Fig. 3(a) and Fig. 3(b) are electrically equivalent as regard to the resistance between points A and B, and between A and C.
Find Ra, Rb and Rc in term of R1, R2 and R3.

(b) Hence show that a single equivalent resistance between points P and Q of the network in Fig. 3(c) is 25 Ω.
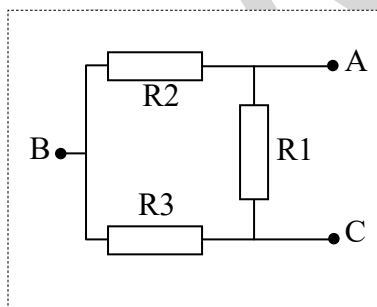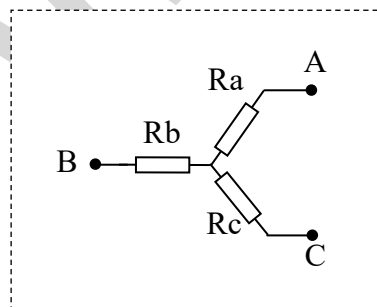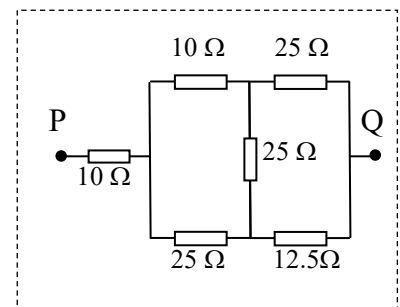
Fig. 3(a)　　　　**Fig. 3(b)**　　　　**Fig. 3(c)**

8. Two 3 phase star-connected alternators share a load of 210 kW at power factor 0.75 lagging, in the ratio 2:3. The line voltage is 2.2 kV. If the current load on the first machine (i.e. the machine supplying the lesser power) is 28 A.

Determine :

(a) the current loading on the second machine; and

(b) the power factors at which each of the machines are operating.

9. With the aid of sketches, explain the principles upon which the operation of the following aids to arc suppression in d.c. circuit breakers depend:

(a) Magnetic blow out coils; and

(b) Arc chutes.

State how short circuit may develop in a lead-acid battery and how this can be detected.

State five causes why the rated capacity of a lead acid battery may fall off in service.

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