



Candidate Code No.	
For Board Use Only	
Result	Result
Date	Date
Int	Int

ELECTRICIAN'S THEORY EXAMINATION

23 JUNE 2007

QUESTION AND ANSWER BOOKLET

Time Allowed: Three hours

INSTRUCTIONS – READ CAREFULLY

You have 10 minutes to read this paper but do not start writing until you are told to do so by the supervisor.

Write your Candidate Code Number in the box provided above. Your name must NOT appear anywhere on this paper.

Answer all questions.

The pass mark for this examination is 60 marks.

Use a pen for written answers. **Do not** use a pencil or a red pen.

Drawing instruments and pencils may be used when diagrams are required. Marks are allocated on the basis of correctness.

Do not use correcting fluid or correcting tape.

For calculation questions all workings, including formulae, must be shown to gain full marks. Show answers to THREE significant figures.

Non-programmable calculators may be used.

Warning – You could get 0 marks for any question, or part of a question, if you show anything hazardous or dangerous in your answer.

Candidates are not permitted to use any Act, Regulation, Standard, Code of Practice, Handbook or other reference text in this examination.

PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM.

(turn over)

Question 1

Each part of this question is worth 2 marks.

- (a) List **TWO** types of earth electrode that may be used to connect an MEN system to the mass of earth.

(1) _____

(2) _____

- (b) Why do three phase induction motors run smoother and quieter than single-phase induction motors?

- (c) Why is it important that an RCD is tripped at regular intervals?

- (d) State **ONE** reason why the secondary terminal voltage of a transformer is less at full load than it is with no load.

(turn over)

Question 1 continued

(e) After completing repairs to a Class I electric drill, the following tests need to be carried out. State the value for each test and whether that value is a minimum or maximum value.

(i) Insulation resistance test between live supply conductors and accessible metal parts.

(1 mark)

(ii) A protective earthing conductor test between the earth pin of the supply plug and the earthed accessible metal.

(1 mark)

(f) Describe **ONE** acceptable method of discharging a large capacitor before disconnection from a circuit that has already been isolated.

(g) An ohmmeter is to be used to measure the resistance of a plug-in heater designed for use on 230V/240V a.c. supply. When connected to the heater's flexible cord plug-top the ohmmeter gives a reading of 24 ohms.

(i) What value of current would the heater draw if it is plugged into a 240V a.c. supply?

(1½ marks)

(ii) Would the power (watts) the heater dissipates be more or less when supplied at 240V rather than 230V?

(½ mark)

(turn over)

Question 1 continued

- (h) How is the direction of rotation changed in a single-phase capacitor-start motor?

- (i) Other than environmental, list **TWO** factors that determine the cross-sectional area of a cable used to supply a three-phase induction motor.

(1) _____

(2) _____

- (j) What is meant by the term "inverse time-current characteristic" in relation to fuses and circuit breakers?

(turn over)

Question 2

(a) Sketch and label a simple diagram to represent an MEN distribution system showing:

- A delta-star-connected 11 kV/400 V supply transformer including output lines
- A single-phase consumer including main switch, and neutral and earth bar connections
- A three-phase consumer including main switch, and neutral and earth bar connections
- All earthing arrangements.

(5 marks)

(turn over)

Question 2 continued

- (b) State **TWO** reasons why an MEN system is used in New Zealand. (2 marks)

(1) _____

(2) _____

- (c) State **TWO** main differences between an MEN switchboard and a distribution switchboard? (2 marks)

(1) _____

(2) _____

- (d) What type of switchboard must be the first switchboard (closest to the point of supply) in an MEN electrical installation? (1 mark)

(turn over)

Question 3

(a) Sketch and label a circuit diagram of an RCD used for personal protection that includes the following components:

- Sensing coil/toroid
- Tripping device
- Test circuit (push button and resistor)
- Active, neutral and earth conductors.
- Class I equipment load

(4 marks)

(turn over)

Question 3 continued

- (b) Describe the operation of the RCD circuit when there is a phase to earth fault

(4 marks)

- (c) Explain the following terms:

(2 marks)

PRCD _____

RCBO _____

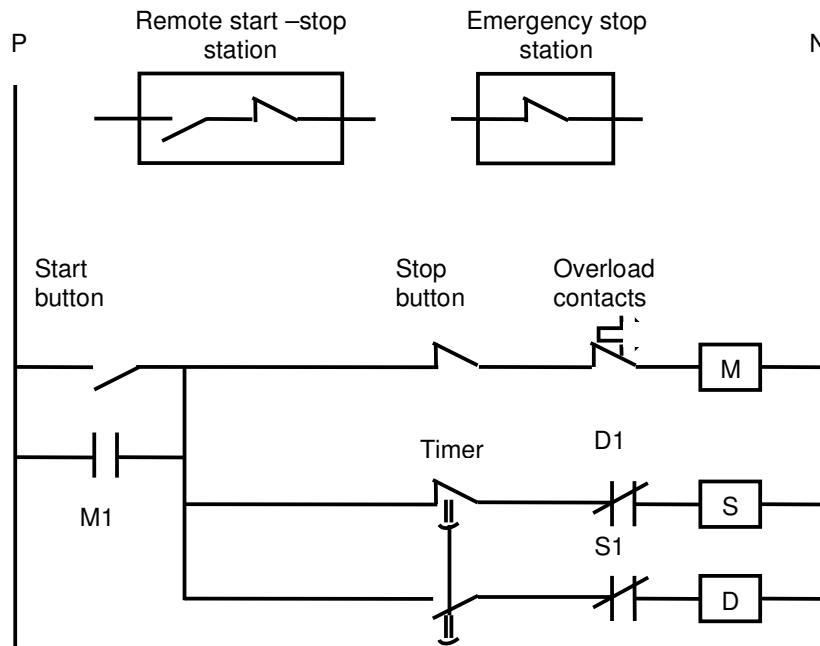
(turn over)

Question 4

- (a) The figure below shows a motor control circuit. On the diagram, make the appropriate wiring alterations to connect the remote stop-start and emergency stop stations.

(3 marks)

Note: Indicate the removal of any part of the circuit like this - ~~XXXXX~~



(turn over)

Question 4 continued

- (b) A three-phase, 8 kW induction motor connected to a 400 V, 50 Hz, three-phase supply has a power factor of 0.81 and an efficiency of 84% when fully loaded.

Calculate:

- (i) The input power

(2 marks)

- (ii) The input kVA

(2 marks)

(turn over)

Question 4 continued

(iii) The line current

(2 marks)

(c) State **ONE** reason why reduced-voltage starting of a large three-phase induction motor may be required.

(1 mark)

(turn over)

Question 6

A 20A MCB protects a circuit consisting of multiple plug sockets supplying various electrical appliances in an office. The MCB has tripped. When the MCB is reset, it trips again when the supply is restored to the circuit.

You have established that the MCB is not faulty and is correctly rated for the circuit.

- (a) State the **THREE** possible causes of the MCB tripping for the second time. (3 marks)

(1) _____

(2) _____

(3) _____

- (b) For each of the possible causes you have stated in (a), state:

- What action you would take to establish that this is the cause.
- The action you would take to fix the problem.

- (i) Possible cause No. 1 (2 marks)

Action taken to establish that this is the cause.

Remedial action taken or recommended

(turn over)

Question 6 continued

(ii) Possible cause No. 2

(2 marks)

Action taken to establish that this is the cause.

Remedial action taken or recommended

(iii) Possible cause No. 3

(3 marks)

Action taken to establish that this is the cause.

Remedial action taken or recommended

(turn over)

Question 7

- (a) Draw and label the circuit diagram of a wattmeter connected to measure the power of a load by using a current transformer and a voltage transformer.

(5 marks)

- (b) A 150 kVA, three-phase, delta-star-connected step-down transformer has a phase-turns ratio of 27.5 to 1. The primary is connected to a 6.6 kV, three-phase supply, and the transformer is fully loaded.

- (i) Calculate the secondary phase voltage.

(1½ marks)

(turn over)

Question 7 continued

(ii) Calculate the secondary line voltage.

(1½ marks)

(iii) Calculate the primary line current.

(2 marks)

(turn over)

Question 8

A three-phase, 400 V, star-connected lathe draws 27 A from the supply and is protected by 32 A motor-rated fuses. A fault of 14Ω has occurred between one line and the machine frame while the machine was operating. Assume the protective earthing conductor resistance is 0Ω .

(a) Calculate the total current in the faulty line

(2 marks)

(b) Show by calculation the effect, if any, that this fault would have on circuit protection.

(3 marks)

(turn over)

Question 8 continued

- (c) If the earth continuity resistance to the machine was $10\ \Omega$ and the same $14\ \Omega$ fault occurred between the line and the machine frame, explain in detail, including calculations, what hazard is presented to the user.

(5 marks)

(turn over)

Question 9

- (a) State **THREE** technical advantages that electronic starters have over electro-mechanical starters (for example, an auto-transformer starter).
(3 marks)

(1) _____

(2) _____

(3) _____

- (b) A three-phase induction motor is started by a star/delta starter. State **TWO** reasons why interlocks are used in the starter.
(2 marks)

(1) _____

(2) _____

- (c) A three-phase induction motor is started by an auto-transformer starter.
- (i) What would be the main advantage of this starter over a star/delta starter?
(1 mark)

(turn over)

Question 9 continued

- (ii) The auto-transformer has tapplings of 40%, 60% and 80%. State the reason why the 40% tapping should be chosen first.

(2 marks)

- (iii) If the motor fails to start satisfactorily on the 40% tapping, what action should be taken and why?

(2 marks)

For Candidate's Use

In the box, write the number of **EXTRA** sheets you have used. Write **NIL** if you have not used any

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Questions Answered	Marks	
1		
2		
3		
4		
5		
6		
7		
8		
9		
TOTAL		