



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

ELECTRICAL INSTALLER THEORY **EXAMINATION**

14 November 2015

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.

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

- (a) State **ONE** reason why the metal frame of a Class I electrical appliance is connected to a protective earthing conductor.

(2 marks)

- (b) State **TWO** factors that determine the **severity** of electric shock upon the human body.

(2 marks)

(1) _____

(2) _____

- (c) (i) State the maximum permitted rated residual current of an RCD installed for **personal protection in a domestic electrical installation**.

(1 mark)

- (ii) State the maximum permitted rated residual current of an RCD installed for **personal protection in a medical-electrical installation**.

(1 mark)

(turn over)

Question 1 continued

- (d) In the New Zealand MEN system the **neutral is earthed** at the star point of a transformer; on the distribution system; and at the main switchboard of an electrical installation.

State **TWO** reasons why the **neutral is earthed** in the New Zealand MEN system.

(2 marks)

(1) _____

(2) _____

- (e) (i) State **TWO** types of fault for which MCB protection is installed. (1 mark)

(1) _____

(2) _____

- (ii) Explain the term **AC 80** as found on a HRC fuse cartridge. (1 mark)

(turn over)

Question 1 continued

- (f) State **ONE** reason why a **run capacitor** is fitted to a single-phase induction motor.

(2 marks)

- (g) A 230V/240V electric heater is rated at 2 kW when operated at 230V. The heater incorporates one 26.45Ω element.

Calculate the power output of the heater when supplied at **240V**.

(2 marks)

- (h) A worker is using a 230V, Class I electrical appliance with a portable residual current device (PRCD).

The PRCD has operated. Explain why the worker **does not** sustain a severe electric shock.

(2 marks)

(turn over)

Question 1 continued

- (i) Draw a power triangle that shows VAR, VA, W and a lagging phase angle (Φ).

(2 marks)

- (j) (i) Which device provides the starting torque in a single-phase capacitor-start induction motor?

(1 mark)

- (ii) How is the device stated in (j)(i) connected?

(1 mark)

(turn over)

Question 2

- (a) The figure below represents the metal frame of a 230V, Class I, portable electrical appliance.

Draw and label the supply to the components in the appliance.

Draw and label the following components within the metal frame:

- A fuse that protects the appliance.
- A single-pole switch that controls the appliance.
- Element 1 is 50Ω and is connected closest to the switch.
- Element 2 is 20Ω and Element 3 is 50Ω . These elements are connected in parallel. This parallel group is connected in series with Element 1.

(5 marks)



Metal frame of the Class I Electrical Appliance

(turn over)

Question 2 continued

- (b) Calculate the **power dissipated** by the Class I portable electrical appliance when it is operating at **230V**.

(5 marks)

(turn over)

Question 3 continued

(b) The motor has been isolated, the isolator replaced and the motor disconnected.

(i) State **ONE** method of ensuring that the isolation remains effective while the motor is being repaired.

(1 mark)

(ii) State **TWO** actions that must be taken to ensure that the work area is safe to be left unattended.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 3 continued

(c) The motor has been repaired and is ready to be reconnected

(i) State the **TWO** instrument tests that need to be carried out on the motor before it is reconnected.

(2 marks)

(1) _____

(2) _____

(ii) State what action a registered electrical installer needs to take to ensure that it is safe to reconnect the motor.

(1 mark)

(turn over)

Question 4

- (a) Draw and label a diagram of a MEN distribution system showing **only** the **neutral and earthing arrangements** between a delta-star-connected 11 kV/400 V supply transformer and a single-phase consumer switchboard
(4 marks)

(turn over)

Question 4 continued

- (b) State **TWO** factors that determine the level of the prospective short-circuit current in an electrical installation.

(2 marks)

(1) _____

(2) _____

- (c) The protective devices on the switchboard of an electrical installation are **rated lower** than the level of prospective short-circuit current of the installation.

Describe **TWO** conditions that could occur in the installation when a high fault current occurs.

(4 marks)

(1) _____

(2) _____

(turn over)

Question 5

(a) Two registered electrical installers are carrying out electrical repairs on the same refrigeration plant.

(i) State **ONE** reason why each installer attaches their own **danger tag** to the point of isolation of the refrigeration plant.

(2 marks)

(ii) State **THREE** actions each installer must take when attaching their own **danger tag** to the isolation point of the refrigeration plant.

(3 marks)

(1) _____

(2) _____

(3) _____

(b) Describe the circumstances where an **out-of-service tag** is used.

(1 mark)

(turn over)

Question 5 continued

- (c) State the **TWO** reasons why the prove test prove method of voltage testing for isolation is used.

(2 marks)

(1) _____

(2) _____

- (d) You are doing a polarity test at the supply side of a three-phase main switch to see if the switchboard is isolated.

Between which terminals would you test to clearly establish that isolation (or otherwise) has taken place.

(1 mark)

- (e) An electrical installer intends to isolate a faulty permanently-connected three-phase electric motor, but has withdrawn the wrong HRC fuses for that motor on the factory switchboard.

State **ONE** dangerous condition that could occur because the electrical installer withdrew the wrong HRC fuses – other than the faulty motor remaining live.

(1 mark)

(turn over)

Question 6 continued

(b) A 400V, three-phase induction motor is controlled by a DOL starter. When started, the motor draws 90A and produces 200% full-load torque.

(i) Calculate the starting current if the same motor is started with a star/delta starter.

(2 marks)

(ii) Calculate the percentage (%) of starting torque if the same motor is started with an auto-transformer starter with an 80% tap.

(2 marks)

(c) Explain the term ramp time as it relates to an a.c. variable speed controller.

(1 mark)

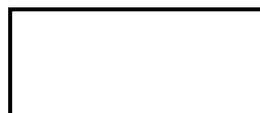
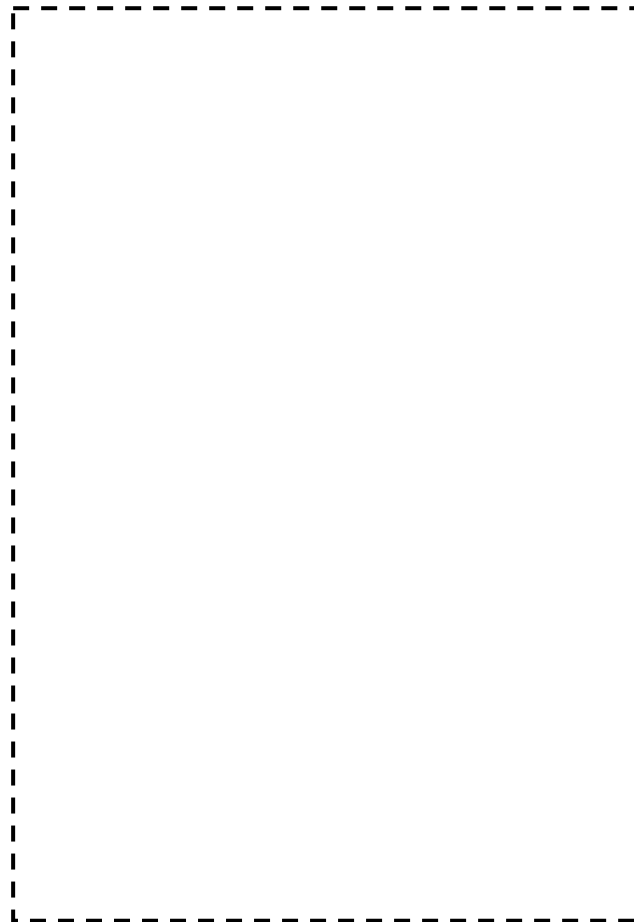
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Question 7

- (a) Draw and label a circuit diagram of a single-phase, 230V RCD used for personal protection. Include the Class I electrical equipment as the load.

The RCD must include all the components necessary to allow the RCD to be deemed **electrically safe**.

(4 marks)



Class I electrical equipment

(turn over)

Question 7 continued

- (b) A Residual Current Circuit Breaker (RCCB) is installed for the protection in a single-phase final subcircuit.

State the **ONE** reason why is it necessary to have additional electrical protection in that circuit?

(1 mark)

- (c) Explain why Portable Residual Current Devices (PRCDs) used in New Zealand are voltage dependent.

(2 marks)

- (d) State the reason why Type **AC** RCDs are prohibited from being used in New Zealand.

(1 mark)

(turn over)

Question 7 continued

- (e) The phase and neutral on the supply side of a single phase RCD have been transposed.

Would the RCD operate if it detected an earth leakage fault on the circuit that the RCD protects? State a reason to support your answer.

(1 mark)

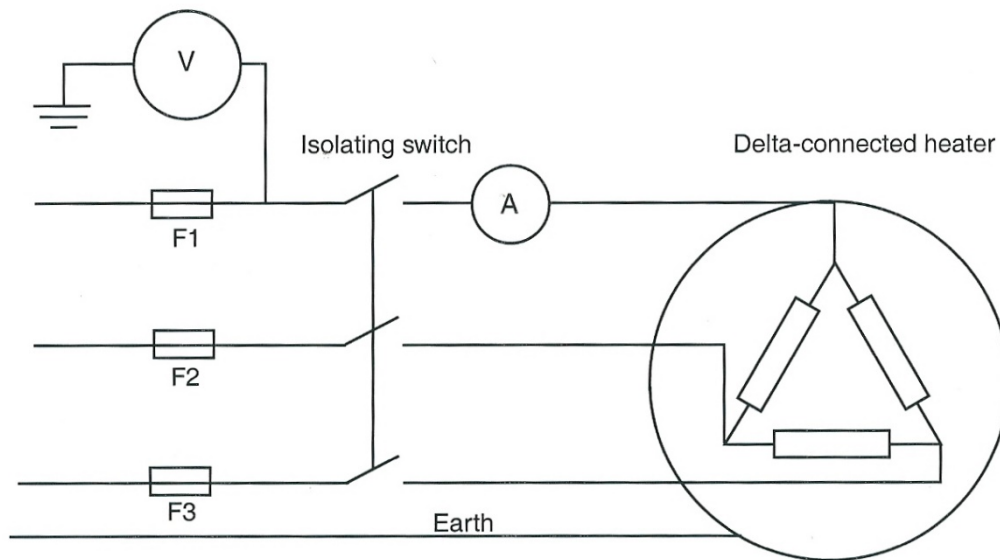
- (f) Would an RCD operate if there was a short between neutral and earth on the final subcircuit that the RCD protects? State a reason to support your answer.

(1 mark)

(turn over)

Question 8

- (a) The figure below is a delta-connected heater supplied from a 400V, three-phase supply.



Each element has a resistance of 20Ω

- (i) Use the information in the introduction to calculate the reading on the ammeter **when the heater is fully operational.** (4 marks)

(turn over)

Question 8 continued

- (ii) Use the information in the introduction to calculate the reading on the ammeter **if Fuse F3 was removed and the heater was switched on.**

(4 marks)

- (iii) State the minimum size HRC fuses that would be used to protect the heater.

(1 mark)

- (b) A heater is rated at 2 kW when operating at 230V.

- (i) What effect will a voltage drop of 5% have on the resistance of the heater elements?

(½ mark)

- (ii) By how much will the power dissipated by the heater change if the voltage drops 5%.

(½ mark)

(turn over)

Question 9

- (a) State what is meant by the term **testing** as it applies to electrical work.
(2 marks)

- (b) You are using a **clip-on (clamp) ammeter** to measure the current drawn by a **live** electrical appliance.

- (i) State where on the appliance the clip-on (clamp) ammeter should be used.
(1 mark)

- (ii) State the reason why the clip-on (clamp) ammeter is not clamped around the flexible cord of the appliance.
(1 mark)

(turn over)

Question 9 continued

- (c) State **ONE** reason why an ohmmeter **is not** used to carry out an insulation resistance test on a 230V final subcircuit.

(1 mark)

- (d) A multi-function test instrument is being used to measure voltage and current values of a live 230V electrical appliance.

State **THREE** precautions relating to the **test instrument** that will ensure personal safety.

- Note:
1. All the necessary safety equipment (overalls, rubber mats etc.) is available.
 2. Set procedures are available.
 3. All conductive items (e.g., rings) have been removed.

(3 marks)

(1) _____

(2) _____

(3) _____

(turn over)

Question 9 continued

- (e) You are using a voltmeter to measure the voltage on an electrical appliance. If the appliance switch was closed, what would be the **main effect** of connecting the voltmeter in series with the switch?

(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		
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TOTAL		