ESTB 2010

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

ELECTRICAL WORKERS REGISTRATION BOARD

ELECTRICAL SERVICE TECHNICIAN "B" EXAMINATION

26 November 2005

QUESTION AND ANSWER BOOKLET

Time Allowed: Two 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 in this paper.

Answer all questions.

The pass mark for this examination is 60 marks.

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

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.

Non-programmable calculators may be used.

It is recommended that the reference source for your answers be included in the space provided if a question can be answered from the Act, Regulations, Standard or Code of Practice. However, just stating a reference only will earn no marks.

For calculation questions all workings, including formulae, must be shown to gain full marks. Show all working to TWO decimal places.

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

You may need to use the following documents in this examination:

- The Electricity Act 1992 and amendments or The Electricity Act 1992 reprint dated 19 August 2005.
- The Electricity Regulations 1997 and the Electricity Amendment Regulations 1999, Electricity Amendment Regulations 2002 and the Electricity Amendment Regulations 2003; or

  The Electricity Regulations Compilation 2003 and the Electricity Amendment Regulations 2003; or

  The Integrated Electricity Regulations 1997 or

  The Electricity Regulations 1997 reprint dated 5 September 2005.
- AS 1939 supplement 1 – 1990; AS/NZS 3000:2000 (including amendments 1, 2, 3 and A); NZS 3019 (Int):2002 or NZS 3019:2004; AS/NZS 3760:2001 or AS/NZS 3760:2003.
- ECP 34 and ECP 54.

PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM

(turn over)

Question 1

(a) (i) State the formula for determining the power rating of an electrical appliance when the resistance and rated voltage of an electrical appliance is known.

(1 mark)

_____

(ii) If an electrical appliance is supplied at a constant voltage, what will decrease if the resistance of the appliance increases?

(1 mark)

_____

(b) Explain how the direction of rotation can be reversed for a capacitor start induction motor.

(2 marks)

_____

_____

(c) Refer to the Electricity Regulations and state what is meant by the term earthed

(2 marks)

_____

_____

_____

_____

Ref: ……..

(d) Refer to AS/NZS 3000 and state what is meant by the term Class I electrical equipment?

(2 marks)

_____

_____

_____

_____

Ref: ……..

(turn over)

Question 1 continued

(e) A circuit-breaker is used as back-up protection for a motor. The circuit breaker has the rating 6 kA, 16A. Briefly explain what each of these terms mean.

(2 marks)

6kA _____

_____

_____

16A _____

_____

_____

(turn over)

Question 2

(a) Explain how the direction of rotation can be reversed for a three phase squirrel cage induction motor

(2 marks)

_____

_____

(b) Describe how the direction of rotation can be reversed for a Universal (series) motor

(2 marks)

_____

_____

(c) Rewirable fuses and HRC cartridge fuses may be found on switchboards. What is the main purpose of a fuse?

(2 marks)

_____

_____

(d) An ohmmeter gives a reading of 24 ohms when used to measure the resistance of a plug-in heater designed for use on 230V/240V a.c. supply. If the heater draws 10 amps when plugged into a 240 V supply:

(i) Will the current increase or decrease when the heater is plugged into a 230 V supply?

(1 mark)

_____

(ii) Will the power dissipated increase or decrease when the heater is plugged into a 230 V supply?

(1 mark)

_____

(turn over)

Question 2 continued

(e) A single-phase capacitor start motor hums and fails to rotate on the bench when the supply is connected. It reaches full load speed when the rotor is assisted by hand spinning. State **TWO** possible causes for this fault.

(2 marks)

(1) _____

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(2) _____

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(turn over)

Question 3

(a) A three-phase induction motor is controlled by a DOL starter with a 230V control circuit. Sketch and label a diagram of the control circuit that includes the following components.

- A fuse
- Stop button
- Start button
- A remote stop/start station.
- Hold in contact (maintaining contact)
- Thermal overload relay contact
- A 230V coil

Note: You do not need to draw the main contacts or the motor.

(6 marks)

(turn over)

Question 3 continued

(b) The figure in (ii) below represents the terminal block on an old three-phase induction motor that is to be reconnected to a star-delta starter. There are no markings on the terminal block to indicate which pair of terminals are the ends of a winding.

(i) Describe the procedure you would carry out to identify the terminals of each motor winding. Include in your description the type of instrument you would use.

(2 marks)

_____

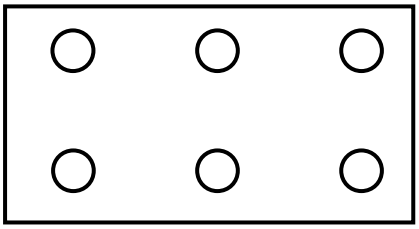
_____

_____

_____

(ii) Mark on the terminal block the winding connections. Draw the incoming supply and connections so the motor could be started direct-on-line in delta.

(2 marks)



(turn over)

Question 4

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

- What action you would take to establish that this is the cause.
- The remedial action you would take or recommend to the Supervisor.

(7 marks)

(i) Possible cause No. 1

Action taken to establish that this is the cause.

_____

_____

_____

Remedial action taken or recommended

_____

_____

_____

(ii) Possible cause No. 2

Action taken to establish that this is the cause.

_____

_____

_____

(turn over)

Question 4 continued

Remedial action taken or recommended

_____

_____

_____

(iii) Possible cause No. 3

Action taken to establish that this is the cause.

_____

_____

_____

Remedial action taken or recommended

_____

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(turn over)

Question 5

(a) A single phase Class I isolating transformer has been installed to supply 230V a.c. to a bottle washing machine in a dairy factory. The transformer's primary and secondary connections are both **fixed wired.**

(i) Draw a labelled circuit diagram showing the supply to the isolating transformer, the secondary output wiring and the connections to the bottle washing machine (but not the machine itself).

- The primary includes protection and is controlled by a single pole switch.
- The secondary includes protection and is controlled by a double pole switch.

(5 marks)

(ii) Describe how this transformer will protect the machine operators from an electric shock to earth.

(2 marks)

_____

_____

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_____

(turn over)

Question 5 continued

(b) An isolating transformer is constructed with two socket outlet terminals to permit the use of two or more electrical appliances. The socket outlet earth terminals are required to be bonded together, but they must not be earthed. Explain why this bonding is necessary.

(3 marks)

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(turn over)

Question 6

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

- Sensing coil/toroid
- Block diagram of the tripping device
- Test circuit (push button and resistor)
- Phase, neutral and earth conductor.

(4 marks)

(b) Refer to NZS 3019 and state:

(i) The maximum time in which an RCD used for personal protection must operate at its rated residual current.

(1 mark)

_____

Ref: ……

(ii) The maximum time in which an RCD used for personal protection must operate at five times its rated residual current.

(1 mark)

_____

Ref: ……

(turn over)

Question 6 continued

(c) Briefly explain how a Residual Current Device (RCD) detects an earth fault and disconnects the supply from an electrical appliance.

(4 marks)

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(turn over)

Question 7

(a) Refer to the Electricity Regulations and state the Standard to which a **portable electric water heater** must be tested following completion of repairs?

(1 mark)

_____

(b) Refer to the Standard required in (a) above and complete the table by stating:

(i) The type of instrument required for each test,

(ii) The appropriate minimum or maximum value of the test result which is acceptable to comply.

(4 marks)

Type of test	**(i) Type of instrument required**	**(ii) Test result**
Earthing continuity		
Insulation resistance test		

Ref: ……

(turn over)

Question 7 continued

(c) Refer to the Standard required in (a) above and briefly describe **FIVE** of the specific checks that should be carried out visually.

(5 marks)

(1) _____

_____

(2) _____

_____

(3) _____

_____

(4) _____

_____

(5) _____

_____

Ref: ……

(turn over)

Question 8

A three phase 400V induction motor that is controlled by a star/delta starter has been removed from an industrial machine for cleaning and checking. Before reconnecting the motor to the machine, tests need to be carried out to ensure it is safe to connect.

(a) Describe how you would carry out an insulation resistance test. Identify the type of instrument used, the test voltage and any minimum or maximum test values that are applicable.

(6 marks)

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_____

(b) If the motor has thermistors embedded in the windings to provide protection against overheating, what changes to the insulation resistance test procedure you described in (a) above would you make.

(2 marks)

_____

_____

_____

_____

(turn over)

Question 8 continued

(c) What precautions would you take before reinstalling the motor in the industrial machine?

(2 marks)

_____

_____

_____

_____

(turn over)

Question 9

Note:Read <u>the entire</u> question, including parts (a) and (b), before answering.

A single-phase electric hot water cylinder in a small factory is to be replaced. The cylinder is supplied by an HRC fuse on a three-phase switchboard and a lockable isolating switch is located adjacent to the cylinder.

You have been requested by the Supervisor to:

- Disconnect the element, control thermostat and wiring from the cylinder.
- Ensure that another electrical service technician can safely connect the new cylinder.

You need to carry out the work in such a manner that ensures your own safety, the safety of others in the factory and the electrical service technician who is to connect the new cylinder.

(a) Describe how you will isolate the cylinder and wiring to ensure it is safe to disconnect. (6 marks)

(1) _____

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_____

(2) _____

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(3) _____

_____

_____

_____

(4) _____

_____

_____

_____

(turn over)

Question 9 continued

(b) After you have done the disconnection, what would you do to ensure that:

- The cylinder can be reconnected using the existing wiring.
- The work area is safe to be left unattended.

(4 marks)

(1) _____

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(2) _____

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(3) _____

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(4) _____

_____

_____

(turn over)

Question 10

(a) State **TWO** reasons why a neutral conductor is required in the cable supplying a three-phase electrical appliance which has heating loads that draw different values of current on each of the phases.

(4 marks)

(1) _____

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(2) _____

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(b) Under what circumstance would a three phase load operate satisfactorily on an MEN supply without a neutral conductor?

(1 mark)

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(c) Refer to the Electricity Regulations and state what meant by the term <u>MEN system?</u>

(2 marks)

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_____

_____

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Ref: ……..

(turn over)

Question 10 continued

(d) State **TWO** reasons why the neutral in the MEN system is multiple-earthed.

(2 marks)

(1) _____

_____

_____

(2) _____

_____

_____

For Candidate's Use

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

For Examiner's Use Only		
Questions Answered	**Marks**	
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL		