

- (f) (i) Open circuit in the run winding (1 mark)
- (ii) Any ONE of:
- Open circuited capacitor
 - Open-circuited centrifugal switch
- (1 mark)
- (g) (i) One element is open circuited
- (ii) The same. In both switch positions only one element is working. (2 marks)
- (h) $20 \times 2 = 40A$ (accept answers between 32A and 40A) (2 marks)
- (i) (i) A rise in temperature in the motor windings. (1 mark)
- (ii) Any ONE of:
- A sustained overload
 - The loss of one phase
- (1 mark)
- (j) • = $230 - (230 \times 5\%)$ (1 mark)
- = 218.5 V (1 mark)
- ER53(3)(b)

Question 2

- (a) (A) Control fuses (1/2 mark)
- (B) Hold-in contact (1/2 mark)
- (C) Coil (1/2 mark)
- (D) Overload auxiliary contact (1/2 mark)
- (E) Start buttons (1/2 mark)
- (F) Stop buttons (1/2 mark)
- (G) Overload device (1/2 mark)
- (H) Main contact (1/2 mark)
- (b) 400V (1 mark)
- (c) • The motor would not start. (1/2 mark)
- The control circuit is open. (1/2 mark)
- (d) • The motor would start. (1/2 mark)
- The contactor would drop-out as soon as the pressure is released from the start button. (1/2 mark)
- The control circuit cannot be maintained because the auxiliary contact is open (1 mark)
- (e) • The motor would not start. (1/2 mark)
- The control circuit is open. (1/2 mark)
- (f) Thermistor (1 mark)

Question 3

- (a)
 - Overload caused by too many appliances in use.
 - A faulty appliance
 - A faulty circuit. (3 marks)

- (b) (i) Overload caused by too many appliances in use.

Action taken to establish that this is the cause

- Total up the rating of appliances from their name-plates (1 mark)

Remedial action taken or recommended

- Recommend that that fewer appliances be used. (1 mark)

- (ii) A faulty appliance.

Action taken to establish that this is the cause

- Carry out an insulation resistance test of each appliance in turn to establish which is faulty. (1 mark)

Remedial action taken or recommended

- Repair the faulty appliance or send away for repair. (1 mark)

- (iii) A faulty circuit.

Action taken to establish that this is the cause

Solution 1

- Disconnect circuit at switchboard.
- Carry out an insulation resistance test of the circuit to establish fault. (2 marks)

Solution 2

Remove fuses from carrier and attach an Out-of-Service tag or Danger Tag to circuit.

Remedial action taken or recommended

- Recommend a registered electrician be engaged to repair the fault. (1 mark)

Question 4

(a) Test: No.1 Protective earthing conductor test
Instrument Instrument that can accurately read values of 1Ω or less
Result 1Ω maximum
ASZS 3760: 2001: 2.3.3.1
AS/NZS 3760: 2003: 2.3.3.1
(3 marks)

Test No. 2 Insulation resistance test
Instrument Insulation resistance tester
Result $1\text{ M}\Omega$ minimum
AS/NZS 3760: 2001: 2.3.3.2
AS/NZS 3760: 2003: 2.3.3.2, Table
(3 marks)

- (b) (i) • Test between each phase after disconnecting the load (1 mark)
• Test between each phase and earth. (1 mark)

(ii) From AS/NZS 3000:2000: Table 3.5
• Any colour except green, green/yellow black and light blue (phases). (1 mark)
• Green or green/yellow (earth) (1 mark)

or

From AS/NZS 3000:2007: Table 3.4

- Any colour except green, green/yellow black and light blue (phases).
- Green/yellow (earth)

or

From AS/NZS 3000:2007: Figure 3.2

- Red, white, dark blue (phases).
- Green (earth)

Question 5

- (a) • The supply would be short-circuited. (1 mark)
- A safety hazard – flash burns.
or
Meter and/or appliance components would be damaged. (1 mark)
- (b) If 0 volt reading is obtained it could lead to the conclusion that the appliance is not live, where in fact parts of it are live because the appliance load is open circuited (by a switch or element) (2 marks)
- (c) • Ensure the correct instrument for the conditions is used.
• Inspect instrument, clips, leads and probes to ensure they are in good condition.
• Ensure correct function and range is selected on the instrument.
• Ensure leads are correctly connected. (4 marks)
- (d) Any FOUR of:
- Insulation resistance test
 - Continuity of conductors
 - Verification of polarity
 - Continuity of Earthing
 - Live load test.
 - Correct circuit connections
- (2 marks)

Question 6

(a) Any TWO of:

- Attach a danger tag to the isolator.
- Lock the isolator in the off position.
- Open and lock the MCBs
- Disconnect the cables at the load side of the isolator

(2 marks)

(b) • To ensure that the test meter/instrument - is operating correctly. (1/2 mark)

- To ensure that the circuit has been isolated before it is worked on. (1/2 mark)

(c) To ensure an isolated circuit remains isolated until the person who attached the tag changes the status of the circuit.

(2 marks)

(d) • When two persons are working simultaneously on the machine. (1 mark)

- When one person is working on machine and the supervisor has also placed his tag, e.g., an "Out of Service" tag.

(1 mark)

(e) Any THREE of:

- Lock open the MCBs
- Attach a safety warning tag to the open MCBs
- Disconnect the circuit (at the switchboard or at the isolator)
- Access permit or hold card system

(3 marks)

Question 7

(a) Any FOUR of:

- Number of cores
- Colour Coding
- Mechanical strength if weight is to be supported?
- Sheath suitable for the environment
- Cord shape

(4 marks)

(b) (i) Voltage is dropped as the load current passes through the conductor resistance

(1 mark)

- (ii) • Use a flexible cord with an increased cross-sectional area
- Reduce the length of the cord

(1 mark)

(1 mark)

(c) Table 3.5 of AS/NZS 3000:2000

Earth/bonding	Green/yellow
Neutral	Black
Active	Red

or

Earth/bonding	Green
Neutral	Light blue
Active	Any colour except green/yellow, green, black, light blue

or

Table 3.4 of AS/NZS 3000:2007

Earth/bonding	Green/yellow
Neutral	Black or light blue
Actives	Any colour other than except green, yellow, green/yellow, black or light blue

(3 marks)

Question 8

(a) Any THREE of:

- Loss of one phase
- Imbalance in the winding resistance (damaged winding)
- Mechanical damage in the motor (rotor or bearings)
- Increase in load that the motor is driving.

(3 marks)

(b) (i) Any TWO of:

- Removal of ventilation fan or fan cowling.
- Blocked ventilation ports
- Additional covers that block ventilation ports
- Fan blades broken

(2 marks)

- (ii) • The hold-in contacts are stuck in the open position
• There is foreign matter preventing the core from closing.

(2 marks)

(iii) Any TWO of:

- Mechanical overload
- Loss of one line or circuit
- Seized motor
- Open circuited rotor
- Bearing fault (poling)
- Open circuited rotor bars
- One of the windings has been reversed when being connected

(2 marks)

(c) Any ONE of:

- Less mechanical strain put on motor shaft and bearings.
- Reduced starting current and voltage drop

(1 mark)

Question 9

- (a) Phase to Phase = 400V or alternatively L1-L2, L1-L3, L2-L3 = 400V
Phase to Neutral = 230V or alternatively L1-N, L2-N, L3-N = 230V
Phase to Earth = 230V or alternatively L1-E, L2-E, L3-E = 230V
Neutral to Earth = 0 V
(2 marks)
- (b) "Multiple Earthed Neutral System" or "MEN System" means a system of supply of electricity in which the neutral is connected to earth
(a) at the source of supply; and
(b) at points on the supply system; and
(c) at every electrical installation connected to that system.
(2 marks)
Ref: ER 2
- (c) • The final subcircuit neutral conductor provides the return path from the loads back to the distribution transformer for the resultant "out-of-balance" current from the three phases
• The neutral conductor is required to ensure that the potential across each single phase load is 230V with respect to earth.
(2 marks)
- (d) Any ONE of:
- When the load on each phase is identical there is no resulting "out-of-balance" so a neutral is not required.
 - Where the load is delta-connected (for example, a motor)
- (2 marks)
- (e) (i) 50Hz
(1 mark)
(ii) 325 volts
(1 mark)