

V2-ET 30 - Electrician Theory Examination Marking Schedule

- Notes:
- (1 mark) means that the preceding statement/answer earns 1 mark.
 - This schedule sets out the accepted answers to the examination questions. A marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.
 - Symbols and terms - alternatives
Power W or P
Voltage V or E or U
Phase Active
 - Key to abbreviated terms:
EA Electricity Act 1992
ER Electricity Regulations 1997
AS/NZS Australia and New Zealand Joint Standard
NZS New Zealand Standard
AS Australian Standard
ECP New Zealand Electrical Code of Practice
GK General Knowledge
 - Those parts of an answer that are under-lined indicate the parts required to be covered by a candidate.

QUESTION 1

- (a) (i) The CT secondary must be short-circuited. (1 mark)
- (ii) Any ONE of:
- To prevent a high voltage developing in the circuit.
 - To prevent damage to the CT accuracy through core saturation (1 mark)
- (b) • Current (load)
• Length of run, or similar (2 marks)
- (c) (i) Any ONE of:
- Disconnect semi-conductor devices
 - Bridge out between phase and neutral
 - Apply a 250V d.c. test voltage (1 mark)
- (ii) The voltage of the test instrument may be too high and may destroy or damage the electronic devices. (1 mark)

(d) (i) Any ONE of:

- To stress the insulation at a voltage above 325V a.c. (or peak a.c. voltage).
- To stress the insulation at a voltage of twice the r.m.s voltage of 250V.

(1 mark)

(ii) Any ONE of:

- To ensure capacitive or inductive reactance does not influence the test result.
- A constant maximum voltage is a more stringent test than the momentary peaks of an a.c. waveform.

(1 mark)

(e) $pf = \frac{\text{Watts}}{\text{Volt Amps}}$

(1/2 mark)

$= \frac{30000}{\sqrt{3} \times 406 \times 57}$

(1 mark)

$= 0.748$

(1/2 mark)

(f) Any TWO of:

- Fire hazard due to fittings or cables overheating
- Flash over on switchboards due to inadequate kA rating of protective devices
- Personal injury if people are in the vicinity of failing fittings or cables..

(2 marks)

(g) (i) Any ONE of:

- One phase was still live.
- All phases were live at the same voltage (that is, paralld)

(1 mark)

(ii) The electrician did not test between each phase and remote earth.

(1 mark)

(h) Any ONE of:

To ensure that in the event of a fault:

- The fault rating of the protection devices is adequate to safely interrupt a circuit.
- The impedance of the fault loop is low enough to operate protective devices in 0.4s.

(2 marks)

(i) To discharge a large capacitor

(2 marks)

$$(j) R_2 = \frac{R_1 \times L_1}{L_2}$$

(1/2 mark)

$$= \frac{100 \times 100}{500}$$

(1/2 mark)

$$= 20M\Omega$$

(1 mark)

QUESTION 2

(a) The description has to include:

- Using the prove-test-prove method to ensure load side of the switch is isolated. (1 mark)
- Attaching a danger tag to the main switch. (1/2 mark)

(b) • An insulation resistance tester (1/2 mark)

- 500V d.c. test voltage (1/2 mark)

(c) The test method described has to show:

- The MEN link and main neutral disconnected. (1 mark)
- All switches and circuit breakers in the "ON" position (1 mark)
- Bridging between each phase and neutral in turn. (1/2 mark)
- Testing between each phase/neutral and earth. (1/2 mark)
- A minimum of 1 M Ω test value for the installation (1/2 mark)

(d) The actions have to show:

- Disconnecting the water heater: (1 mark)
- Retesting the installation as per (c) above. (1 mark)
- A minimum of 1 M Ω test value for the installation (1/2 mark)
- Testing between phase/neutral and earth of the water heater. (1 mark)
- A minimum value of 10,000 Ω for the water heater. (1/2 mark)

QUESTION 3

- (a) (i) • Where 0.1 second line intersects with 100A line (1 mark)
- The fuse curve is that for 16A. (1 mark)
- (ii) • It shows that the higher the fault current (1 mark)
- the lower the time it takes the fuse to trip. (1 mark)

The example has to demonstrate this.

For example: 50A flowing in the 20A fuse would take about 18 seconds to blow. 100A flowing in the 20A fuse would take about 0.3 seconds.

(2 marks)

- (b) (i) The fusing current is 30A (accept between 25A and 32A) (½ mark)
- (ii) The fusing current 40A (accept between 32A and 50A) (½ mark)
- (c) The protective device nearest the fault operates, before any other protective device. (1 mark)
- (d) To provide short-circuit protection for the circuit (1 mark)
- as the thermal overload is not designed for this type of protection. (1 mark)

QUESTION 4

(a) Blue phase

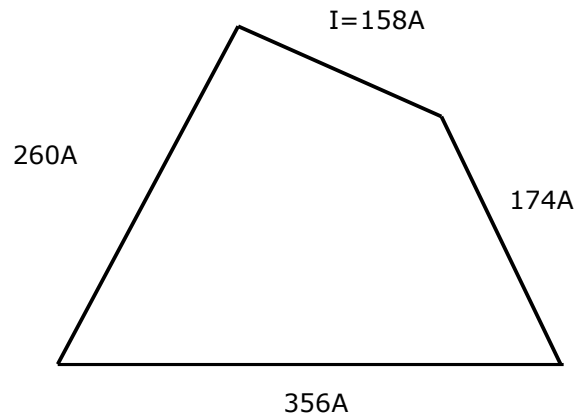
$$\begin{aligned} I &= \frac{P}{V} && \text{(1/2 mark)} \\ &= \frac{82000}{230} && \text{(1/2 mark)} \\ &= 356.62\text{A} && \text{(1 mark)} \end{aligned}$$

Red phase

$$\begin{aligned} I &= \frac{P}{V} && \text{(1/2 mark)} \\ &= \frac{60000}{230} && \text{(1 mark)} \\ &= 260.89\text{A} \end{aligned}$$

White phase

$$\begin{aligned} I &= \frac{P}{V} && \text{(1/2 mark)} \\ &= \frac{40000}{230} && \text{(1 mark)} \\ &= 174.13\text{A} \end{aligned}$$



- 1/2 mark for each correct current (2 marks)
- $I = 158\text{A}$ (accept any answer between 155 and 165A) (1 mark)

(b) Any TWO of:

- Avoids premature fuse failure on heaviest loaded phase
- Reduces voltage drop on the neutral and the associated highest loaded phase
- Reduces current rating of cables, switchgear or fittings.

(2 marks)

QUESTION 5

- (a) (i) • The impedance of the neutral and earth are equal. (1 mark)
- Therefore, the neutral must have a high resistance joint (1 mark)
- (ii) Any ONE of:
- It has taken half of the load, as the earth usually takes a small percentage of then load
 - The impedance of the circuit to earth is low. (1 mark)
- (b) • It has an MEN link between the neutral and earth busbars
- It is connected to earth via an earth electrode
 - It can be the closest switchboard to the point of supply (3 marks)
- (c) Any TWO of:
- Capacity of the supply source
 - Transformer impedance.
 - Circuit impedance or length of cable run or distance from the transformer to the switchboard
 - Supply voltage.
 - The cut-off characteristic of the protective device. (2 marks)
- (d) Any TWO of:
- At the star point of the distribution transformer
 - Another point along the distribution line
 - At the consumers premises. (2 marks)

QUESTION 6

$$(a) \text{ Sec. } V_{PH} = \frac{\text{Sec } V_L}{\sqrt{3}} \quad (1/2 \text{ mark})$$

$$= \frac{415}{\sqrt{3}} \quad (1/2 \text{ mark})$$

$$= 239.6 \text{ volts} \quad (1 \text{ mark})$$

$$\text{Turns ratio} = \frac{11000}{239.6} \quad (1/2 \text{ mark})$$

$$= 45.9 \text{ to } 1 \quad (1/2 \text{ mark})$$

$$\text{Sec } I_L = 3.03 \times 45.9 \quad (1/2 \text{ mark})$$

$$= 139.08\text{A} \quad (1 \text{ mark})$$

$$(b) 3.03 \times \sqrt{3} = 5.25 \quad (1/2 \text{ mark})$$

$$\text{VA} = \frac{\sqrt{3} \times PV_L \times PI_L}{1000} \quad (1/2 \text{ mark})$$

$$= \frac{\sqrt{3} \times 11000 \times 5.25}{1000} \quad (1/2 \text{ mark})$$

$$= 100 \text{ kVA} \quad (1 \text{ mark})$$

$$(c) (i) \text{ kVA} = \frac{100 \times 100}{5} \quad (1/2 \text{ mark})$$

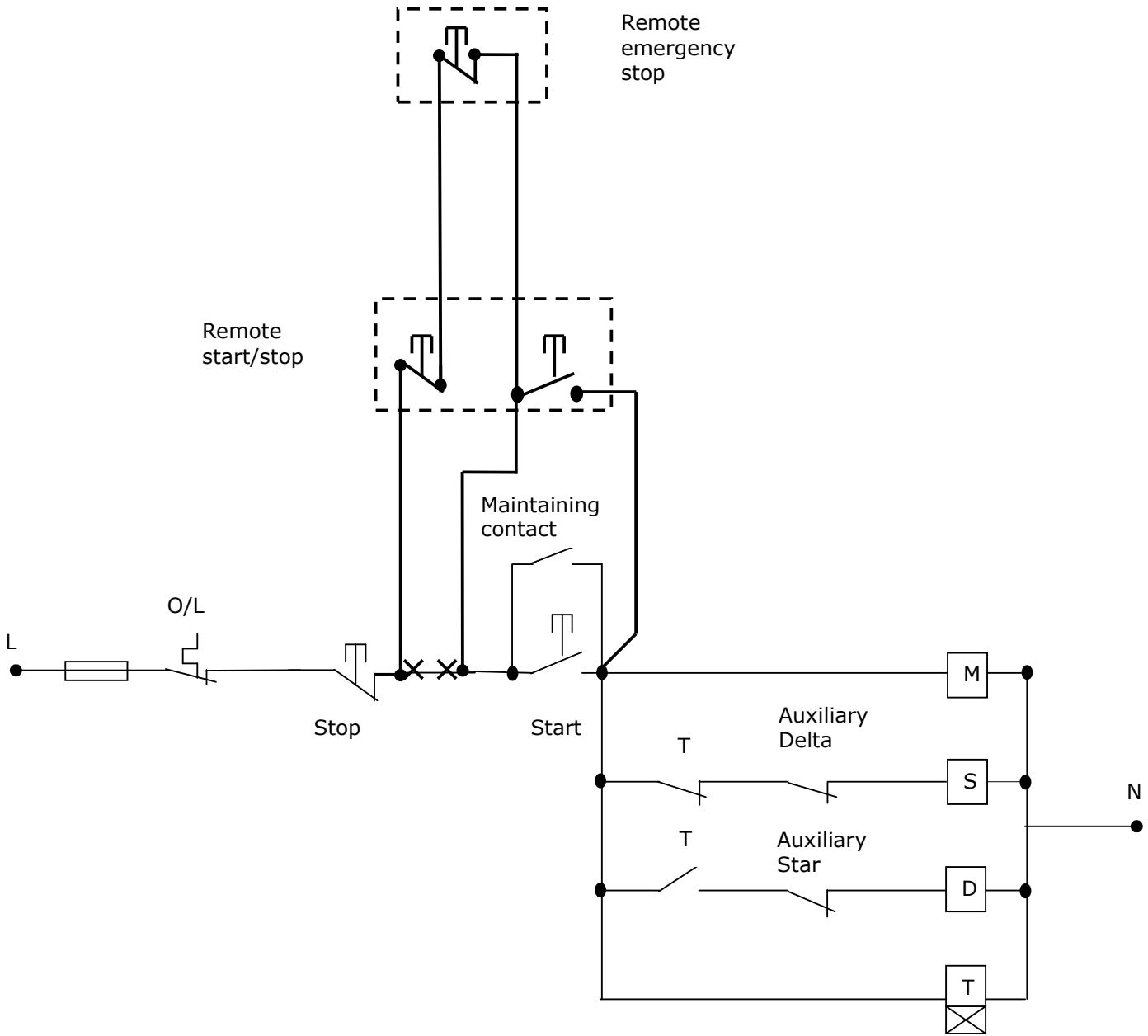
$$= 2000 \text{ kVA} \quad (1 \text{ mark})$$

$$(ii) \text{ ISC} = \frac{2000}{\sqrt{3} \times 415} \quad (1/2 \text{ mark})$$

$$= 2782\text{A} \quad (1 \text{ mark})$$

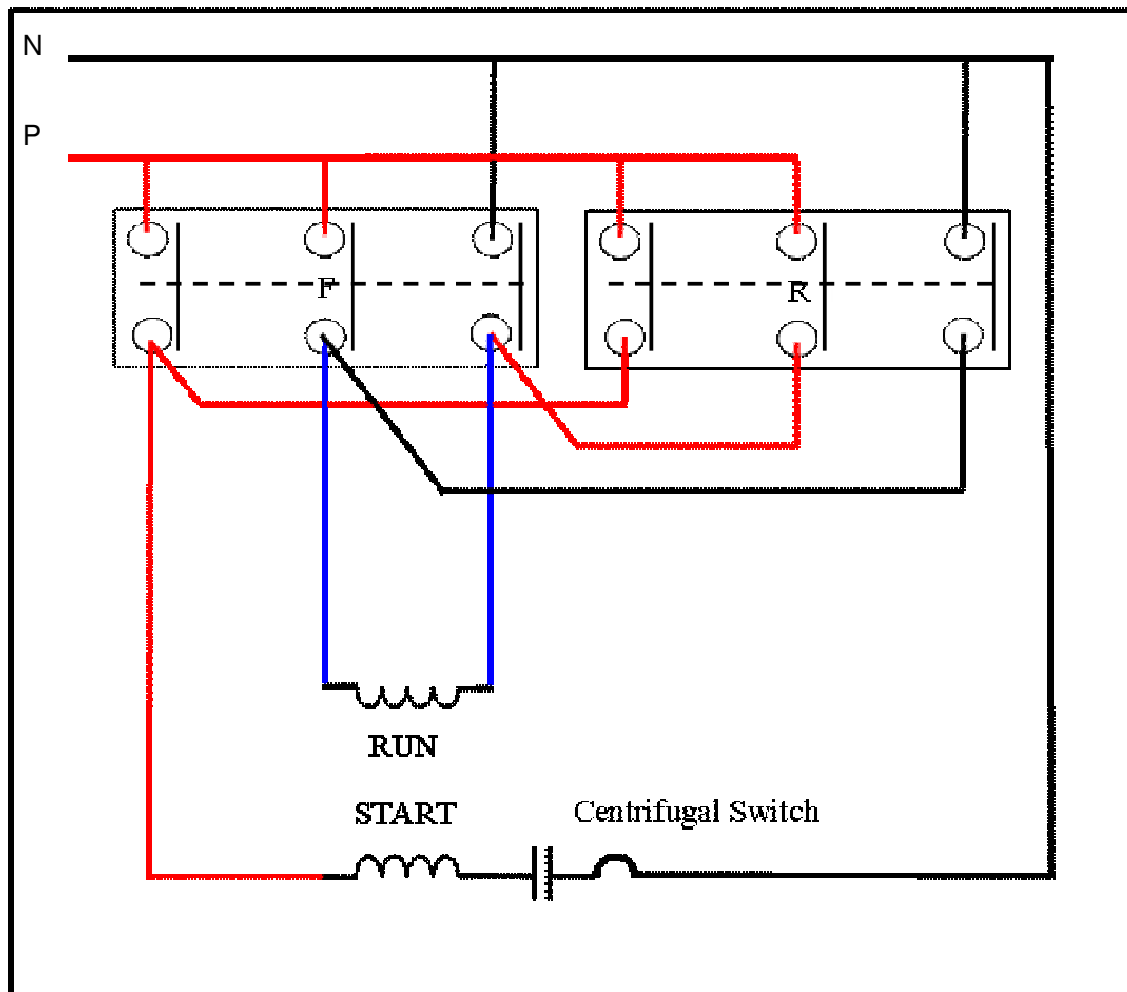
Question 7

(a)



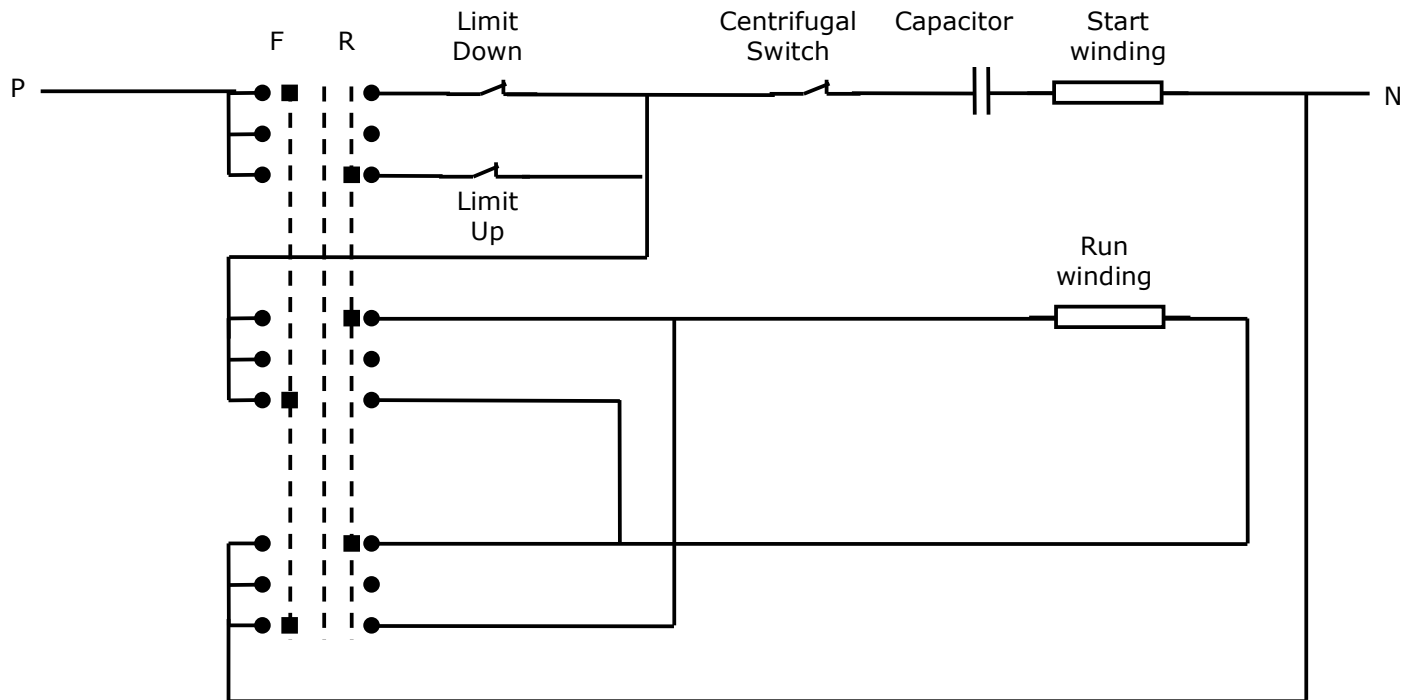
- Five conductors correctly connected. (2½ marks)
- One conductor removed (½ mark)
- Working circuit (1 mark)

(b) Automatic starter



- Start winding correct – forward and reverse (2 marks)
- Run winding correct – forward and reverse (2 marks)
- Capacitor and centrifugal switch correctly connected (1 mark)
- Complete working circuit (1 mark)

Manual Starter



- Start winding correct – forward and reverse (2 marks)
- Run winding correct – forward and reverse (2 marks)
- Capacitor and centrifugal switch and limit switches correctly connected (1 mark)
- Complete working circuit (1 mark)

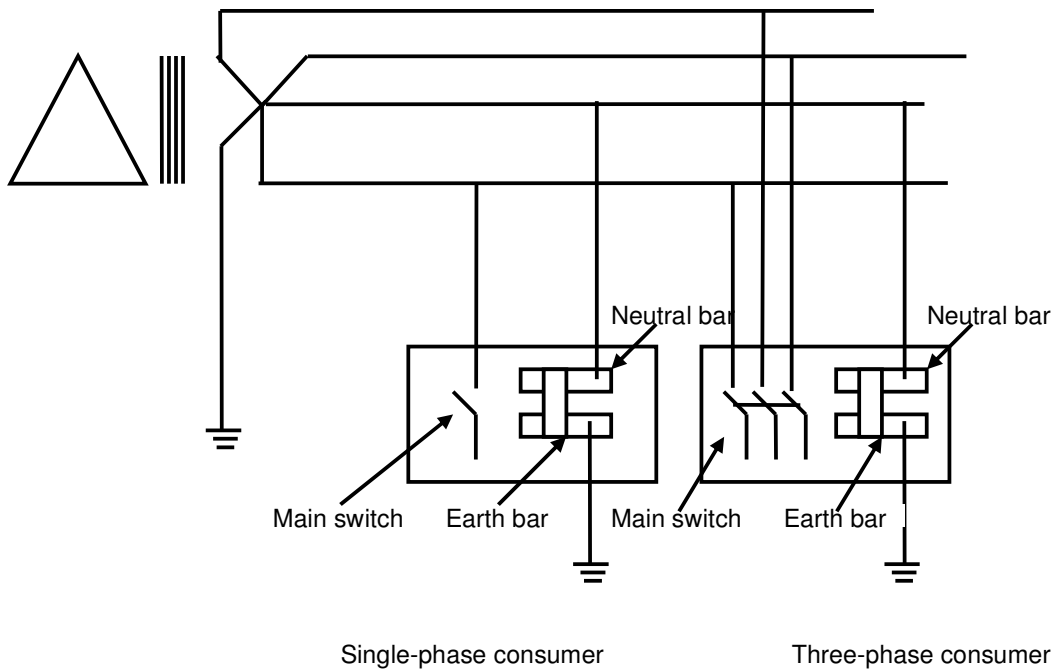
Question 8

- (a) (i) Where there is a possibility of personal danger through the supply being restored. (1 mark)
- (ii) Where equipment is faulty or damaged and using that equipment would cause damage or injury. (1 mark)
- (iii) Any THREE of:
- Make sure the correct isolating switch is tagged.
 - Make sure the switch is in the "OFF" position before it is tagged
 - Fasten the Danger Tag securely so that it will not come off.
 - Test to ensure isolation has taken place.
 - Appropriate details are entered on the tag (3 marks)
- (b) • "Isolated" means that the motor has been:
- deliberately disconnected from the electricity supply and (1 mark)
 - precautions taken to prevent reconnection (1 mark)
- "Switched off" means that the electricity ceases to be supplied to the motor (1 mark)
- (c) • The test instrument is checked to be operating correctly on a known live source.
- The equipment is tested to confirm (or otherwise) that it is isolated.
 - The test instrument is again checked on a known live source to ensure it still operates correctly. (1½ marks)
- (d) Test between each phase and earth. (½ mark)

QUESTION 9

- (a) • Rewireable fuses are not rated for more than 1 kA
or
Rewireable fuses will not safely rupture under the stated fault conditions (1 mark)
- MCBs are rated for 3 to 6kA
or
MCBs will safely open under the stated fault conditions (1 mark)
- (b) (i) A bi-metal strip heats up and distorts (1 mark)
The distortion operates a trip mechanism that opens the breaker (1 mark)
- (ii) • A strong magnetic field is created in the coil (1 mark)
- The field attracts a trip mechanism that operates and opens the breaker. (1 mark)

(c)



- Star point earthed (1 mark)
- For each switchboard - an earthing conductor connected to the earth bar. (1 mark)
- For each switchboard - an MEN link between the neutral bar and earth bar. (1 mark)
- For each switchboard - a neutral conductor between the neutral bar and the distribution neutral. (1 mark)