

Electrical Power Protection and Plant Commissioning Engineer (Joint)

SAMPLE Practice Assessment for BOTH Distribution and Transmission Voltages

Knowledge Assessment Details

The live assessment consists of 20 short answer questions with 5 questions for each of the 4 topic areas shown below. Each of these topic areas will contain 1 **safety critical question**.

The 4 topic areas are as follows:

1. A comprehensive understanding of electrical power systems
2. Understands protection, control and telemetry equipment and the impact on the electrical network of its operation
3. Understands high voltage electrical network operations and topologies
4. Understands the application of Electricity Supply Standards, regulations and policies

The live assessment has a maximum duration of 2 hours 30 minutes. Consequently, each topic area should take approximately 30 – 35 minutes to complete with each short answer question taking approximately 6 minutes to answer. You are advised to start with the safety critical questions and spend more time on them if required. Not passing a safety critical question will result in an overall fail.

Each topic area is marked out of 40 marks.

To attain a Pass, the apprentice must:

- Score at least 65% (104 marks)
- Must achieve 5 marks in each of the four safety-critical questions.

To attain a Distinction, the apprentice must meet the Pass criteria AND:

- Score at least 90% (144 marks)

- **DO NOT DETACH**
- Spare paper for to use for calculations or working out

Section 1: A comprehensive understanding of electrical power systems

Practice Q1

- a) i) Draw a simple diagram of a ring power circuit. [1 mark]



- ii) Draw a simple diagram of a radial power circuit. [1 mark]



b) i) Describe the design principles of ring power circuits. [2 marks]

ii) Describe the design principles of radial power circuits. [2 marks]

c) i) Identify one **advantage** of a radial power circuit. [1 mark]

ii) Identify one **disadvantage** of a radial power circuit. [1 mark]

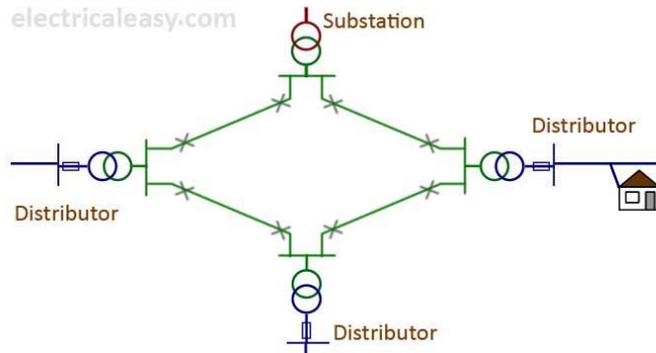
Total 8 marks

	Mark	Max
a)		2
b)		4
c)		2
Total		8

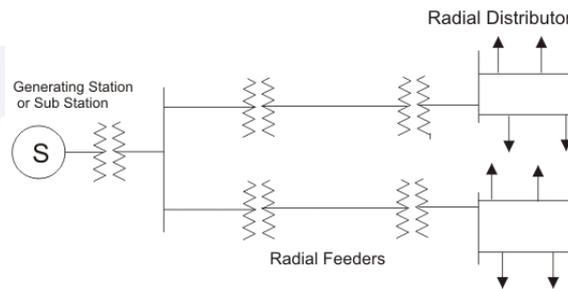
Mark Scheme:

Q1

- a) i) **A simple diagram** demonstrating the design principles of ring circuits (1 mark)
 Note: this diagram is for assessors only. The diagram provided by the apprentice will be simpler.



- ii) **A simple diagram** demonstrating the design principles of radial circuits (1 mark)
 Note: this diagram is for assessors only. The diagram provided by the apprentice will be simpler.



- b) i) **A technical description of design principles of ring circuits**, 1 mark each to a maximum 2 marks:
- Designed to make a ring of the main circuit with more than one potential feed (1 mark)
 - Provides ability to feed from either direction in the circuit (1 mark)
 - Provides ability to make open / interconnection points in the circuit (1 mark)
- ii) **A technical description of design principles of radial circuits**, 1 mark each to a maximum 2 marks:
- Designed to make a single feed linear circuit (1 mark)
 - Provides ability to feed from either direction in the circuit (1 mark)
 - Provides ability to make open / interconnection points in the circuit (1 mark)

- c) i) **Identification of one advantage of a radial circuit, 1 mark:**
- Reduced costs of construction and maintenance as only a single supply (1 mark)
 - Simpler fault-finding process because only a single one direction supply (1 mark)
 - Cost effective option for supplies to remote locations (1 mark)
- ii) **Identification of one disadvantage of a radial circuit, 1 mark:**
- Limited network flexibility for the restoration / isolation of customer supplies as no option to backfeed (1 mark)
 - Potentially takes longer to restore supplies and more customers adversely affected as whole feed must be isolated (1 mark)

These answers are not exhaustive, and all submitted responses should be considered on their merit.

Section 2: Understands protection, control and telemetry equipment and the impact on the electrical network of its operation

Practice Q2

- a) Describe the purpose of voltage transformers (VT) found in power substations. [2 marks]

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Sample Assessment
Questions and Mark Scheme

- b) Explain the typical process which occurs when a voltage transformer (VT) is activated by a fault on the network. [4 marks]

You may use a diagram to support your explanation.

Note: Full marks can be achieved without a diagram.



c) List **two** types of voltage transformer (VT) found in power substations. [2 marks]

Total 8 marks

	Mark	Max
a)		2
b)		4
c)		2
Total		8

Mark Scheme:

Q2

- a) **Technical description of purpose of voltage transformers (VT) in a power substation**, 1 mark each to maximum 2:
- To reduce the voltage to a manageable level for the equipment being used (1 mark)
 - To monitor and control the transformer automatic voltage regulating relay (AVR) which controls the tap changer (1 mark)
 - To supply power to volt meters and watt meters (1 mark)
- b) **Technical explanation of the process which occurs when a voltage transformer (VT) is activated by a fault**, 1 mark each to maximum 4:
- Voltage transformers can be used to measure the residual voltage (1 mark) of a three-phase system (1 mark) during single phase faults (1 mark)
 - During normal operating conditions, the sum of the three-phase voltage (1 mark) is zero but in case of single-phase fault, the condition changes (1 mark) and a residual voltage is produced (1 mark)
 - Suitable diagram to support explanation (1 mark)
- c) **Types of voltage transformer (VT) listed**, 1 mark each to maximum 2:
- Capacitor VT (1 mark)
 - Single Phase VT (1 mark)
 - Inductive VT (1 mark)

These answers are not exhaustive, and all submitted responses should be considered on their merit.

Section 3: Understands high voltage electrical network operations and topologies

Practice Q3 This question is safety critical

Transmission systems employ Delayed Auto-Reclose (DAR) technology and distribution systems employ Auto-Reclose (AR) technology.

- a) State the purpose of the Auto-Reclose system, relevant to your network. [1 mark]

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- b) Explain a typical cycle of operation of the Auto-Reclose system, [6 marks]
relevant to your network.

You may use a diagram to support your explanation.

Note: Full marks can be achieved without a diagram.





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c) Identify one **advantage** that Auto-Reclose technology provides. [1 mark]

Total 8 marks

	Mark	Max
a)		1
b)		6
c)		1
Total		8

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Mark Scheme:

Q3

a) **The purpose of DAR or AR, 1 mark:**

To provide fast and efficient network protection (1 mark)

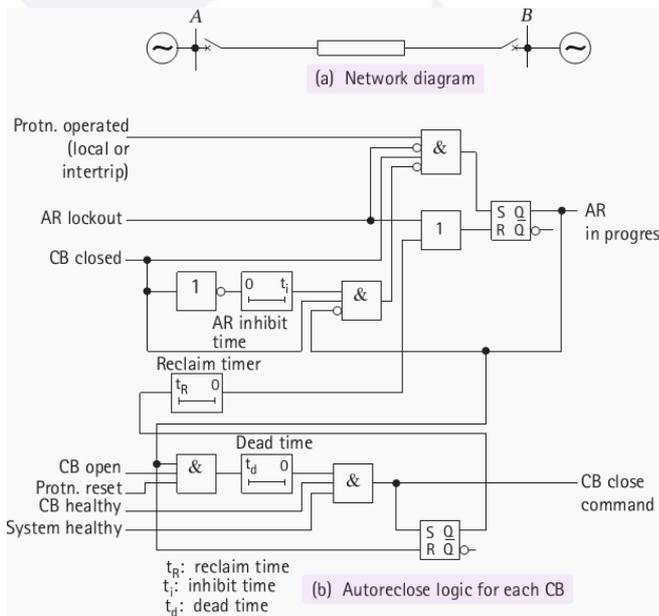
b) **Explanation of a typical cycle of operation, 1 mark each to a maximum 6:**

In the example below, if it were decided to charge the line initially from station A, the dead time in the auto-reclose relay at A would be set at, say, 5 seconds (1 mark), while the corresponding timer in the auto-reclose relay at B would be set at, say, 15 seconds (1 mark). The circuit breaker at A would then reclose after 5 seconds (1 mark) provided that voltage monitoring relays at A indicated that the busbars were alive (1 mark) and the line dead (1 mark).

With the line recharged (1 mark), the circuit breaker at B would then reclose with a synchronism check (1 mark), after a 2 second delay imposed by the synchronism check relay element (1 mark).

If for any reason the line fails to 'deadline charge' from end A (1 mark), reclosure from end B would take place after 15 seconds (1 mark). The circuit breaker at A would then be given the opportunity to reclose with a synchronism check (1-mark).

1 mark for suitable diagram [diagram may be simple or may include information about a typical cycle of operation which can be awarded marks as identified above]



- c) **Advantage that Auto-Reclose technology provides**, 1 mark each to a maximum of 1:
- To prevent loss of power (1 mark)
 - To detect temporary or permanent faults (1 mark)
 - To provide quick and efficient restoration of supplies (1 mark)
 - Simplifies control circuits in comparison with single-phase schemes (1 mark)
 - Delayed auto-reclosing improves the chances of a reclosure being successful in comparison to the case of high-speed reclosing (1 mark)

These answers are not exhaustive, and all submitted responses should be considered on their merit.

Section 4: Understands the application of Electricity Supply Standards, regulations and policies

Practice Q4

The Electricity at Work Regulations 1989 apply to all electrical systems and equipment and require precautions to be taken against the risk of death or personal injury from electricity in work activities.

- a) Describe the general requirements of Regulation 11 relating to the means of protection from excess current. [7 marks]



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Sample Assessment
Questions and Mark Scheme

- b) Identify **one** of the specified conditions, stated in Regulation 14, which [1 mark] must be met before live work could be considered on or near live conductors.

Total 8 marks

	Mark	Max
a)		7
b)		1
Total		8

Mark Scheme:

Q4

- a) **Description of Regulation 11 requirements for the protection of electrical systems from excess current**, 1 mark for each requirement to a maximum 7 marks:

The regulations require that systems and parts of systems be protected against the effects of short circuits and overloads if these would result in currents which would otherwise result in danger.

- The regulations state the means of protection is likely to be in the form of fuses or circuit breakers controlled by relays (1 mark), or it may be provided by some other means capable of interrupting the current or reducing it to a safe value (1 mark)
- That a means of preventing danger to be provided in anticipation of excess current (1 mark)
- That in principle, every main circuit should be protected at its origin (1 mark), i.e. at the source end of the circuit (1 mark)
- That when considering a means of protection, consideration must be given to a number of factors, including:
 - the nature of the circuits (1 mark)
 - type of equipment to be protected (1 mark)
 - the short-circuit energy available in the supply (the fault level) (1 mark)
 - the nature of the environment (1 mark)
 - whether the system is earthed or not (1 mark)

- b) **Regulation 14 requirements which must be met before live work could be considered on or near live conductors**, to a maximum 1:

Identification of one of the following principles.

- it is unreasonable in all the circumstances for it to be dead (1 mark)
- it is reasonable in all the circumstances to be at work on or near it while it is live (1 mark)
- suitable precautions, including where necessary the provision of suitable protective equipment (1 mark), are taken to prevent injury (1 mark)

These answers are not exhaustive, and all submitted responses should be considered on their merit.