



Regional
NSW

CANDIDATE NUMBER: _____ **(write in from your letter)**

EXAMINATION: ELECTRICAL ENGINEERING MANAGER
EXAM PAPER: CEE1 – Electrical engineering applied to coal mines
DATE: Wednesday 13th September 2023 – 08:50pm – 12:00pm
DURATION: 3 hours (excluding 10 minutes reading time)

**EXAMINATION FOR CERTIFICATE OF COMPETENCE TO BE AN ELECTRICAL
ENGINEERING MANAGER OF UNDERGROUND COAL MINES**

Issued under the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2022*

INSTRUCTIONS TO CANDIDATES:

Unless otherwise stated all references to Act, Regulations and standards are to the
Work Health and Safety Act 2011

Work Health and Safety Regulation 2017

Work Health and Safety (Mines and Petroleum Sites) Act 2013

Work Health and Safety (Mines and Petroleum Sites) Regulation 2022

Australian/New Zealand Standards (the standards)

Candidates shall be seated in the exam room no later than 09:00am for exam instructions.
10 minutes reading time is allowed prior to the start of the examination. Candidates can use a **highlighter only** to mark points of importance during the reading time, but may not begin answering the questions. You must NOT use any other writing item during the reading time such as a pen.

After reading time is over place your identification number only, **NOT** your name, on the cover of this paper at the commencement of the exam. Electronic aids may not be used, apart from a non-programmable calculator.

It is expected that candidates will present their answers in an engineering manner, making full use of diagrams, tables, and schematics as appropriate, and showing full workings in calculations. **Poor legibility in diagrams and handwriting** may affect the candidate being deemed competent.

Provide answers in point form wherever appropriate. If you are unable to fit your answers in the available space use the two (2) blank pages included at the end of the paper. Ensure the question you are answering is clearly marked.

All six (6) questions are to be attempted. All questions are of equal value.

Candidates will be marked, and determined as competent, or not yet competent. If a question is identified as **ESSENTIAL**, then the candidate must get the set number of marks to pass the question. The candidate will be required to achieve at least **60%** and **pass** the **ESSENTIAL** questions to pass this paper.

This examination is a **closed book** examination and no reference material may be used during the exam. Reference material will be provided in the exam paper as applicable.

EXAMINATION BOOKLET

Question Number	Essential	Candidate Score	Total Marks	Assessed by <i>Name</i>	Comments to justify, as necessary
1	A(i)	Essential			
	B(i)	Essential			
	B(ia)	Essential			
	B(iib)	Essential			
	B(iaa)	Essential			
	B(iiib)	Essential			
	subtotal			/ 10	
2	A				
	B				
	C				
	D				
	E				
	F				
	subtotal			/ 10	
3	A(i)				
	A(ii)				
	A(iii)				

Question Number		Essential	Candidate Score	Total Marks	Assessed by <i>Name</i>	Comments to justify, as necessary
	B(i)					
	B(ii)					
	C(i)					
	C(ii)					
	C(iii)					
	subtotal			/ 10		
4	A	Essential				
	B	Essential				
	C	Essential				
	D	Essential				
	E	Essential				
	subtotal	Essential		/ 10		
5	A					
	B					
	C					
6	A					
	B					
	C					
	subtotal			/ 10		
PAPER	Verdict		TOTAL	/ 60		<i>Marks checked by:</i>

Question 1 – Earthing

ESSENTIAL

Candidates must get 6 out of 10 marks to pass this question

You are the Electrical Engineering Manager for an underground coal mine, located in an area that is known to have high lightning activity during storm seasons.

Your site is required to establish a new surface infrastructure area which incorporates the following infrastructure:

- Administration Buildings, Bathhouse, Workshop and Carpark.
- Ventilation Shaft 1:
 - Ventilation: Intake
 - Lining: Steel
 - Access: Friction Winding System (Personnel & Materials)
- Ventilation Shaft 2:
 - Ventilation: Return
 - Lining: Steel
- 66/11kV Substation
 - 66kV Supply: Overhead Power Lines
 - 11kV Supply: XLPE Cables
 - Transformers: 2 x 20/25MVA KNAF DYN11 Transformers
 - Earthing: IT (10A NER per transformer)
- Surface-to-Seam Services via steel-lined boreholes, including:
 - Borehole 1: 11kV power supply cable (240mm² XLPE)
 - Borehole 2: 11kV power supply cable (240mm² XLPE)
 - Borehole 3: Intrinsically Safe Phones, Tube Bundle, Fibre Optics

Part A – General

- i. List four (4) Australian Standards that are relevant to this installation. 2 marks

	/ 2
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Part B – Earthing

i. What are the two (2) legislated requirements for an effective earthing system?

2 marks

	/ 2
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ii. The project team has lead time issues on your preferred cable supplier for the 11kV supply cables and has found an alternative brand of cable with a shorter lead time. You review the cable and found that it is XLPE 11/6.35kV SWA.

a. What would be your concerns about using the cable? Why?

1 mark

	/ 1
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b. What considerations would you need to include in your testing standards regarding insulation testing of XLPE cables?

2 marks

	/ 2
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iii. Assume that the two transformers can be connected in parallel on the secondary side using a bus-tie circuit breaker.

a. In the event that this bus-tie is closed, what is the impact to your earth fault current limitation? 1 mark

	/ 1
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b. For this installation, what would be your maximum permissible earth fault protection setting on the 11kV network underground and why? 2 marks

	/ 2

Question 2 – Lightning

Refer to the scenario information in Question 1 above.

A. In the above scenario (outlined in Question 1), list three (3) risks you are concerned about associated with lightning. 1 mark

	/ 1

B. What steps would you undertake over the lifecycle of this project in order to satisfy your concerns and your obligations in regard to the risks associated with lightning? 2 marks

	/ 2

C. What controls could you implement in your earthing system to mitigate the risks (for both personnel and equipment) associated with lightning? 2 marks

	/ 2
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D. You have informed your project team that segregation of the 'surface' and 'underground' earth grids is required, but they require guidance from you as to how this could be achieved.

For each item of infrastructure included in this overall project, how might you expect this segregation to be achieved in practice? 2 marks

i. Intake Shaft

ii. Return shaft

iii. High Voltage Cables

iv. Steel Lined Boreholes

	/ 2
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E. The project team has suggested a 500 millimetre segregation distance between the 'surface' earth grid and the 'underground' earth grid. 2 marks

i. What are your concerns regarding this distance? Explain your reasoning.

ii. Where would you require the 'underground' earth grid to be located? Explain your reasoning.

	/ 2
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F. What is the maximum best practice earth impedance of a lightning down-conductor as required under AS/NZS 1768? 1 mark

	/ 1
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Question 3 – Powered Winding Systems

Part A: General

i. What registration(s) must a Powered Winding System have?

1 mark

	/ 1
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ii. Which documents apply to the design of a Powered Winding System (*'design order'*)?

1 mark

	/ 1
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iii. Fill out the following table with the four (4) safety circuits required by the above standard.

2 marks

Circuit Description	Safety Circuit	Required SIL Rating
Name of Protective Function	Ultimate/ Primary/ Secondary	0 / 1 / 2 / 3 / 4

	/ 2
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Part B: Incident Management

The surface electrician at your site has informed you that the vertical shaft Powered Winding System at your site has malfunctioned as follows:

- *A Deputy was carrying out a shaft inspection with the winder in 'shaft inspection' mode, allowing the cage to be driven manually.*
- *The Deputy then pressed the 'Cage Up' button, but the cage went down instead of up.*
- *The Deputy repeated this several times, and each time the cage went in the incorrect direction (down instead of up) until eventually it reached its normal docking point at pit bottom and stopped as per normal.*
- *The Deputy has safely exited the cage and reported the fault.*
- *None of the safety circuits have malfunctioned.*
- *Neither the Deputy, or any other person, were exposed to a risk to their health and safety during the event.*

- i. Is this a notifiable incident? If so, under which Section of the Work Health & Safety (Mines and Petroleum Sites) Regulation 2022? 1 mark

	/ 1
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- ii. Justify your answer to Question B.i. 1 mark

	/ 1
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Part C Registration Process

Your mine has a legacy vertical shaft friction winding system which is scheduled for upgrade in the next 12 months.

The upgrade will incorporate:

- Replacement of the legacy control system and safety circuit controllers to use modern technology.
- Replacement of the single 2MW DC Drive motor with 2 x 1.3MW DC Drive Motors.
- New Variable Speed Drive (VSD) systems.
- Increase in payload weight from 16T to 20T.

You determine that the above changes are sufficient to affect health and safety such that it constitutes an 'altered' design.

- i. What registration process must be undertaken before the Powered Winding System can be returned to normal operation? 1 mark

	/ 1
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- ii. List two items that must be supplied in the above process. 1 mark

	/ 1
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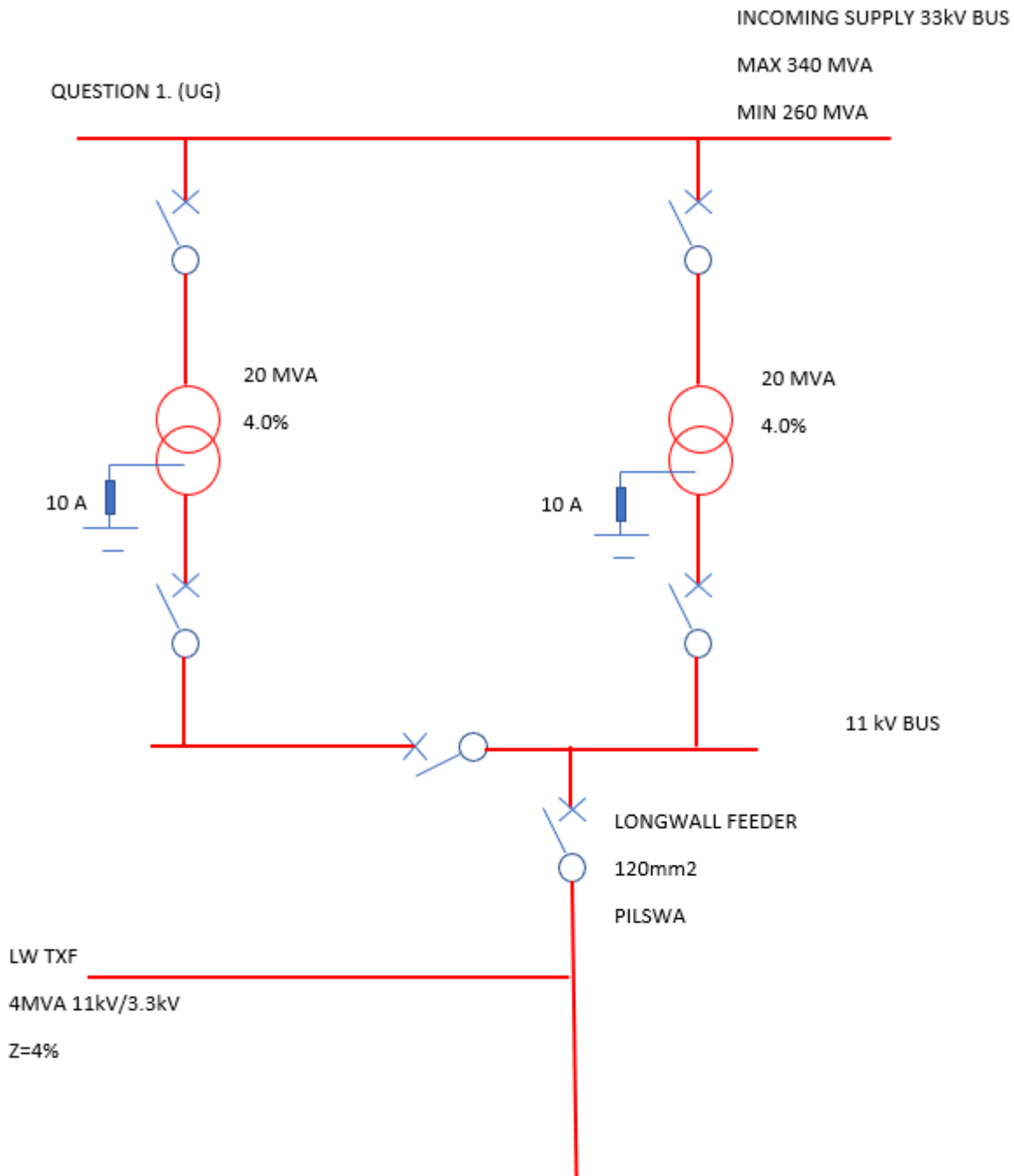
- iii. Prior to commissioning the upgraded Powered Winding System, what Regulatory notification must be made? What information must be provided? 2 marks

	/ 2
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Question 4 – Protection

Essential

Candidates must get 7 out of 10 marks to pass this question



You are the Electrical Engineering Manager at an Underground Mining Operation that wishes to expand its production by the introduction of a Longwall Mining Method.

There is an existing cable that runs from the surface switchboard to the beginning of the first Longwall Block. The cable is 120mm² PILSWA and is 200 metres long.

The length of the Longwall panel is such that the cable from the Longwall Panel Entry to the Longwall Substation is 1500 metres.

The Longwall Transformer is 4MVA 11kV / 3.3kV 4% Z with an inrush of 10 x FLC.

The planned extraction area is for 10 Longwall Panels, each requiring an additional 250 metres of cable in the Mains.

Impedance of 120mm² PILSWA cable can be assumed as 0.191842 Ω/km.

- A. Assuming all circuit breakers are closed, what is the maximum prospective earth fault on the Longwall Feeder? 1 mark

	/ 1
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- B. Calculate the maximum fault level at the longwall transformer and explain at what stage this would occur. 3 marks

	/ 3
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- C. Calculate the minimum fault level at the longwall transformer and explain at what stage this would occur. 2 marks

	/ 2
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D. What rating does the High Tension end of the transformer need to be designed to?

1 mark

	/ 1
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E. Nominate the protection settings for Longwall Feeder CB ANSI Code 51P.....
ANSI Code 50P.....

Justify your answer.

3 marks

	/ 3
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Question 5 – Arc Flash

You have just attained your Practicing Certificate and have accepted an offer as Manager of Electrical Engineering at an Underground Coal Mine in another district.

On your first underground visit at your new mine, you visit the development panel. The development panel is a “Super Unit” and has two continuous miner units.

Upon arrival at the section, you notice the Panel Substation is supplying a “Crib Room” facility located in the same cut through and supplied with power from a 150Amp restrained type receptacle on the substation. The installation gives you cause for concern as to the rating of the crib room enclosure when connected to the panel transformer in this manner.

Panel Substation.

2.5MVA 11kV / 1/05kV Z= 3.8% IP55 rated.

Crib Room Enclosure.

Supplied by 35mm² Type 241.1 cable 15mts long fitted with restrained plugs at both ends.

Enclosure houses a 5kVA transformer 1kV / 240 V 3Phase with 2 Amp Earth Fault Limitation to the star point.

Enclosure has a single door, Form 1 and is hinged on one side. There is a Tee style handle on the other.

The Circuit Breaker is a small frame but does not have a visible label.

- A. What steps would you need to perform to confirm that the crib room equipment is suitable for the power supply? Explain your answer. 4 marks

	/ 4
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You identify that the power system exceeds the breaking capacity of the crib room circuit breaker.

B. What steps can you take to enable the equipment to operate within its rating?

3 marks

	/ 3
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You have a concern over the effects of an internal arcing event in the crib room enclosure.

C. In terms of an arcing event inside of the enclosure, what risks exist for operators of the crib room enclosure and what steps would you take to address these risks?

3 marks

	/ 3
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Question 6 – Power Calculation

The mine you are working at has had an electrical fault on one of the main conveyor motors. This conveyor is a dual drive configuration with 2 X 500kW 415v motors. The spare motor onsite was found in an unserviceable condition and will require a week to be turned around at the motor workshop before it can be reinstalled

One formula for calculating the power needed for the conveyor is:

Power to move the load horizontally (kW) = $2.72 \times L \times F \times (C+46) / 1000$

Power to move empty belt (kW) = $14.6 \times F \times G \times (C+46) \times S / 1000$

Power to elevate or lower the load (kW) = $2.72 \times L \times H / 1000$

where:

Maximum loading (L)	4,500 tph
Conveyor length (centre distance) (C)	1000 m
Belt width (W)	1,400 mm
Idler friction factor (F)	0.02
Inertial Factor (G)	68
Nett change in elevation (H)	+ 30 m
Belt Speed (S)	5 m/sec

A. Calculate the power required to operate the conveyor at full load 3 marks

B. With the remaining 500kw motor on the conveyor, the production department has recommended that the reduced coal transfer 3000tph coal that can be transported until the spare motor is returned to site, is this possible? 4 marks

	/ 4
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C. Draw a vector diagram showing apparent power, true power and reactive power at full load for the single conveyor motor. 3 marks

	/ 3
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SPARE PAGE FOR ANY ADDITIONAL DRAWINGS

END OF QUESTIONS

**BLANK PAPER TO WRITE ANSWERS THAT YOU COULD FIT INTO THE SPACE
PROVIDED – INDICATE QUESTION NUMBER AT START OF ANSWER**

END OF PAPER



Regional
NSW

CANDIDATE NUMBER: _____ **(write in from your letter)**

EXAMINATION: ELECTRICAL ENGINEERING MANAGER

EXAM PAPER: CEE2 – Legislation and Australian Standards applicable to underground mines

DATE: Wednesday 13th September 2023 – 12:50pm – 4:00pm

DURATION: 3 hours (excluding 10 minutes reading time)

**EXAMINATION FOR CERTIFICATE OF COMPETENCE TO BE AN ELECTRICAL
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1	A				
	B(i)				
	B(ii)				
	B(iii)				
	B(iv)				
	C(i)				
	C(ii)				
	C(iii)				
	D(i)				
	D(ii)				
	subtotal			/ 10	
2	A				
	B				
	C				
	D				
	subtotal			/ 10	

Question Number		Essential	Candidate Score	Total Marks	Assessed by <i>Name</i>	Comments to justify, as necessary
3	Part A A					
	B(i)					
	B(ii)					
	B(iii)					
	Part B A					
	B					
	subtotal			/ 10		
4	A					
	B					
	C					
	D					
	E					
	F					
	subtotal			/ 10		
5	A	Essential				
	B	Essential				
	C	Essential				
	D	Essential				

Question Number		Essential	Candidate Score	Total Marks	Assessed by <i>Name</i>	Comments to justify, as necessary
	E	Essential				
	F	Essential				
	G	Essential				
	H	Essential				
	subtotal	Essential		/ 10		
6	A	Essential				
	B(i)	Essential				
	B(ii)	Essential				
	B(iii)	Essential				
	subtotal	Essential		/ 10		
7	subtotal			/ 10		
8	A					
	B					
	C					
	D					
	subtotal			/ 10		
9	A					
	B					
	C					
	subtotal			/ 10		

Question Number		Essential	Candidate Score	Total Marks	Assessed by <i>Name</i>	Comments to justify, as necessary
10	A					
	B					
	subtotal			/ 10		
11	A					
	B					
	C					
	D					
	E					
	subtotal			/ 10		
12	A					
	B					
	C					
	subtotal			/ 10		
PAPER	Verdict		TOTAL	/ 120		<i>Marks checked by:</i>

Question 1 – ASNZS 2081

A. AS/NZ 2081:2011- Electrical Protection devices for Mines and Quarries. What are the key objectives of this standard? 2 marks

	/ 2
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B. According to the standard, what is the definition of

i. Back-up protection 1 mark

	/ 1
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ii. Earth fault current 1 mark

	/ 1
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iii. Earth leakage current 1 mark

	/ 1
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iv. Operating time

1 mark

	/ 1
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C. The time current curve TCC below represents the protection coordination between two CB's Q1 and Q2

i. Nominate the expected operating times for Q1 for a load of 75 Amps. 0.5 mark

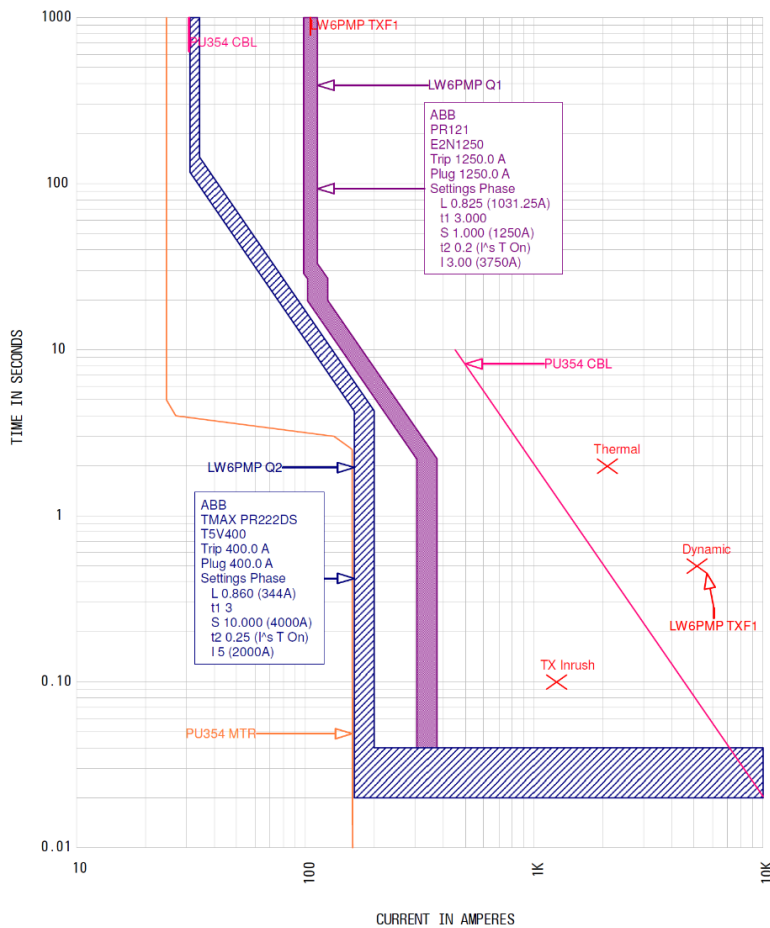
	/ 0.5
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ii. Nominate the expected operating times for Q2 for a load of 250. 0.5 mark

	/ 0.5
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iii. What does the pink line (PU345 CBL) represent in the TCC below? 1 mark

	/ 1
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D. Over time the connected loads have changed from the original design, Q1 and Q2 circuit breakers are now simultaneously seeing a current flow of 140A.

i. What does the protection system rely on at this load for protection grading? 1 mark

	/ 1
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ii. What would you do to address the new load case? 1 mark

	/ 1
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Question 2 – EX ‘e’ Increased safety

A. List two (2) applications where Ex ‘e’ equipment is commonly found in the underground and/or surface areas of a mine: 1 mark

	/ 1
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B. Describe the principles of the Ex ‘e’ (Increased Safety) category of explosion protection techniques: 2 marks

	/ 2
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C. List four (4) characteristics of Ex ‘e’ (Increased Safety) equipment, and how they are achieved in practice: 4 marks

	/ 4
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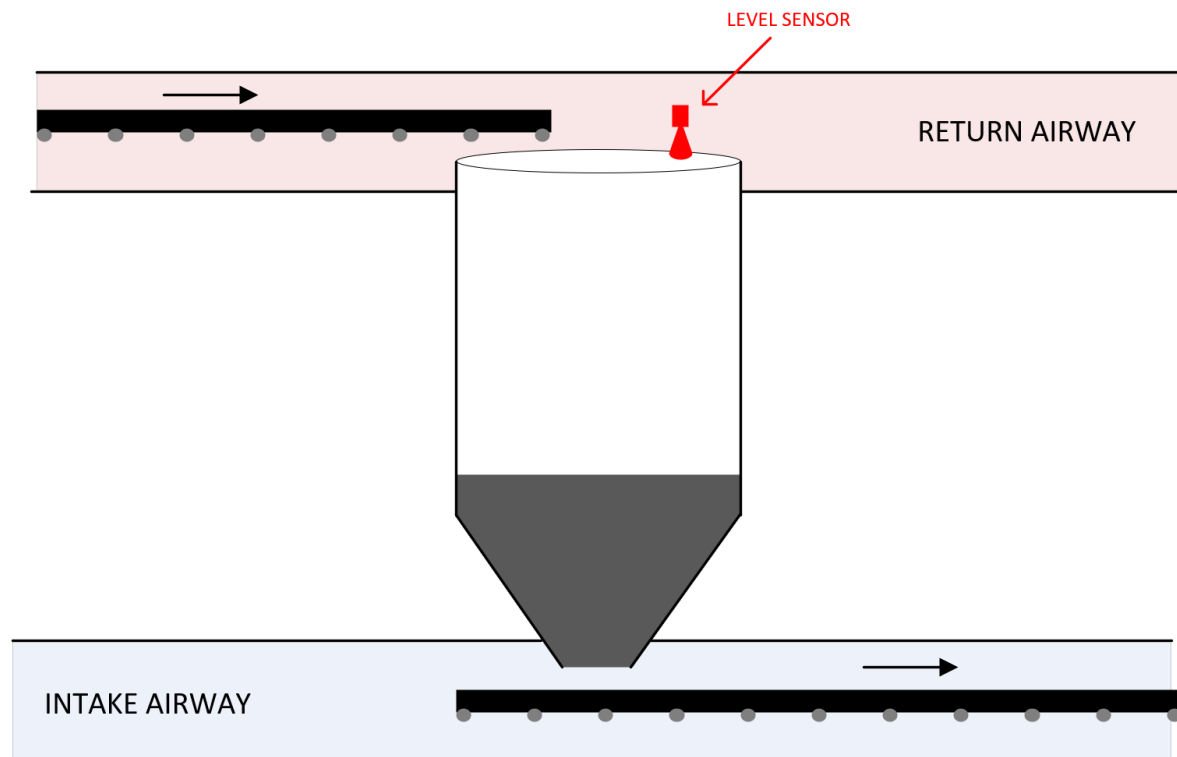
D. You identify an Ex ‘e’ enclosure which is installed in a fixed location in a return airway of your underground mine. It is in service and being used to power intrinsically safe level sensors and critical equipment.

What are the AS 2290.1 maintenance requirements for this Ex ‘e’ enclosure? 3 marks

Question 3 – Exemptions & functional safety

You are the Electrical Engineering Manager of an underground coal mine which utilises an underground coal bin as part of the Coal Clearance system. The top of the bin is located in a return airway of the mine, while the bottom (discharge) of the bin is located in an intake airway. A level sensor is used at the top of the bin to control the level of coal in the bin, ensuring that a 'plug' always remains to segregate the return airway from the intake airway.

The level sensor is therefore critical to ensure that there is no short-circuit of the mine ventilation system.



The level sensor has started to fail and requires replacement.

In your investigations, you discover that the level sensor is certified as 'MDA Ex 'd' 1234'.

You are unable to find a suitable Group 1 certified replacement level sensor.

A supplier has recommended an alternative level sensor with the following certification:

IECEX TSA 19.0123X Ex'ia' IIC

Part A - Exemptions

A. Can the proposed level sensor be used in this application? Why / Why not? 1 mark

	/ 1
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B. Assume that the proposed sensor cannot be used, and that an exemption would be required to operate the sensor in this application.

i. To which section of the WHS (MPS) Regulation 2022 would you require an exemption? 1 mark

	/ 1
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ii. What five (5) Matters would you need to satisfy in making the application?
Work Health & Safety Regulation 2017 – Sec. 685 2.5 marks

	/ 2.5
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iii. List a brief description and/or example of how each of the above factors would apply in this application 2.5 marks

	/ 2.5
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Part B – Functional safety

Given the safety critical nature of the level sensor, you decide that it should be a functional safety certified device.

- A. Based on the process in either AS61508 or AS4024, list two factors that you would need to consider when determining the required SIL or PL: 2 marks

	/ 2
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- B. What functional safety process would need to be completed before placing the level sensor into operation as a safety device? 1 mark

	/ 1
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Question 4 – Power transformer and oil sampling

- A. Regarding transformer oil sampling, what is a SOT? 1 mark

	/ 1
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- B. Regarding transformer oil sampling, what is a DGA? 1 mark

	/ 1
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C. Hydrogen, Oxygen, Methane, Acetylene are examples of gases typically identified in a DGA, list 2 other common gases that may be identified. 1 mark

	/ 1
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D. Briefly describe what Furan Analysis on transformer oil is used to indicate: 2 marks

	/ 2
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E. Briefly describe how the typical Buchholz transformer protection device operates: 2 marks

	/ 2
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F. List eight (8) items that you require to be listed on a power transformer nameplate. 3 marks

	/ 3
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Question 5 – AS/NZS3800

Essential

Candidates must get 6 out of 10 marks to pass this question

Work Health and Safety (Mines and Petroleum Sites) Regulations 2022.

- A. According to Workplace Health and Safety (Mines and Petroleum Sites) 2022 Regulations - Who is responsible for ensuring that explosion-protected plant is not used at an underground coal mine unless all reasonable steps to ensure the overhaul or repair of the plant was carried out under, and in accordance with, a licence? 1 mark

	/ 1
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- B. Can a workshop located in Queensland overhaul Ex d (flameproof) electrical equipment for a NSW UG coal mine? 1 mark

	/ 1
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- C. Can a workshop with a licence to overhaul Ex d (flameproof) equipment overhaul an item of equipment marked Ex(d)(e)(m) for a NSW UG coal mine? 1 mark

	/ 1
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- D. Can a mine operator allow the manufacturer of a piece of explosion-protected electrical equipment, to overhaul the equipment if the OEM does not have a licence? 1 mark

	/ 1
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- E. According to AS/NZS3800:2020 – Where an overhaul facility overhauls an item of Group 1 explosion protected equipment against its certification documents, and manufactures specification, how should this equipment be marked? 1 mark

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	/ 1
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F. According to AS/NZS3800:2020 – When a pressure test is required, and a reference pressure is stated on a certificate of conformity for an item of Ex d (flameproof) plant, what pressure should the enclosure be tested at, and for how long? 1 mark

	/ 1
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G. According to AS/NZS3800:2020 – Where it is proposed to alter an Ex d enclosure by replacing an internal component such as a power contactors, overload, or control and monitoring equipment, with a replacement of a different type and dimensions, what should be done? 2 marks

	/ 2
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H. According to AS/NZS3800:2020 – What should be included in the job report prepared for the end user? 2 marks

	/ 2
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Question 6 – Use of plant in hazardous zone Work Health and Safety (Mine Petroleum Sites) Regulations 2022

Essential

Candidates must get 6 out of 10 marks to pass this question

A. Fill in the blanks. 4 marks

- a) The mine operator of an underground coal mine must ensure electrical plant used in a hazardous zone- (1 mark)
- a. Is _____, and
 - b. has _____.
- b) Electrical plant has an explosion-protection level suitable for use in a hazardous zone at a coal mine, but only if the concentration of methane in the general body of the air in the zone is less than 1.25% by volume, if— (2 mark)
- a. it has a _____ or is _____, and
 - b. it meets at least 1 of the following requirements—
 - i. equipment protection level _____, as defined in Australian and New Zealand Standard AS/NZS 60079.0:2019 Explosive atmospheres—Part 0: Equipment—General requirements,
 - ii. plant that is intrinsically safe, _____, as defined in Australian and New Zealand Standard AS/NZS 60079.0:2019 Explosive atmospheres—Part 0: Equipment—General requirements.
- c) Departmental approved plant means plant that- (1 mark)
- a. was _____, and
 - b. was specified in the Explosion Protected Electrical Apparatus Approvals List as issued by the Department of Trade and Investment, Regional Infrastructure and Services on _____ and continues to be specified in the list as amended from time to time

	/ 4
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B. Short answers.

- i. The mine operator of an underground coal mine must ensure electrical plant used in a hazardous zone is maintained in accordance with which legislated standard. 1 mark

	/ 1
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ii. A valid certificate of conformity means a certificate of conformity issued under what? 1 mark

	/ 1
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iii. Write a short summary to your mine operator highlighting the current and future matters to be considered regarding your departmental approved plant in use underground at your coal mine. 4 marks

	/ 4
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Question 7 – Multiple Choice Question

Circle the correct answer for the following questions and fill the designated table for question 10 (1 mark for each question)

1. AS2081 specifies performance requirements for protection devices intended for use with electrical supply networks utilising:
 - a) IT Networks
 - b) MEN Networks
 - c) IT and MEN Networks
 - d) TT networks

2. Which protection device is not covered by AS2081?
 - a) Instantaneous overcurrent
 - b) Earth fault current limiting devices.
 - c) Earth continuity protection devices.
 - d) Earth fault protection devices.
 - e) Earth fault lockout protection devices.
 - f) NER integrity protection devices.

3) Resistive Earth Fault Current Limiting devices shall comply with the following temperature ratings “For all other installations, the maximum temperature rise shall not exceed ___?___ after the application of rated phase-to-earth voltage for rated time.”

- a) 150 C
- b) 200 C
- c) 300 C
- d) 350 C

4) If the resistance between a pilot core and the earth falls below what value will the device initiate the tripping or prevent the closure of the circuit interrupting device?

- a) 45Ω
- b) 100Ω
- c) 500Ω
- d) 1000Ω

5) What is the maximum delay between the detection of an earth continuity fault (open circuit or short circuit) and the disconnection of power from the circuit?

- a) 20mS
- b) 50mS
- c) 100mS
- d) 500mS

6) The protection device shall be designed to ensure that the thermal ratings of its components and assemblies are not exceeded during an earth fault current equal to ___?___ times the maximum earth fault tripping set point of the device maintained for a duration of at least 2.5 s.

- a) two
- b) five
- c) ten
- d) twenty

7) Earth fault lockout protection devices shall be designed to prevent energisation of the circuit interrupting device when the insulation resistance of any active conductor to earth is below:

- a) 10 k Ω
- b) 100 k Ω
- c) 1 M Ω
- d) 2 M Ω

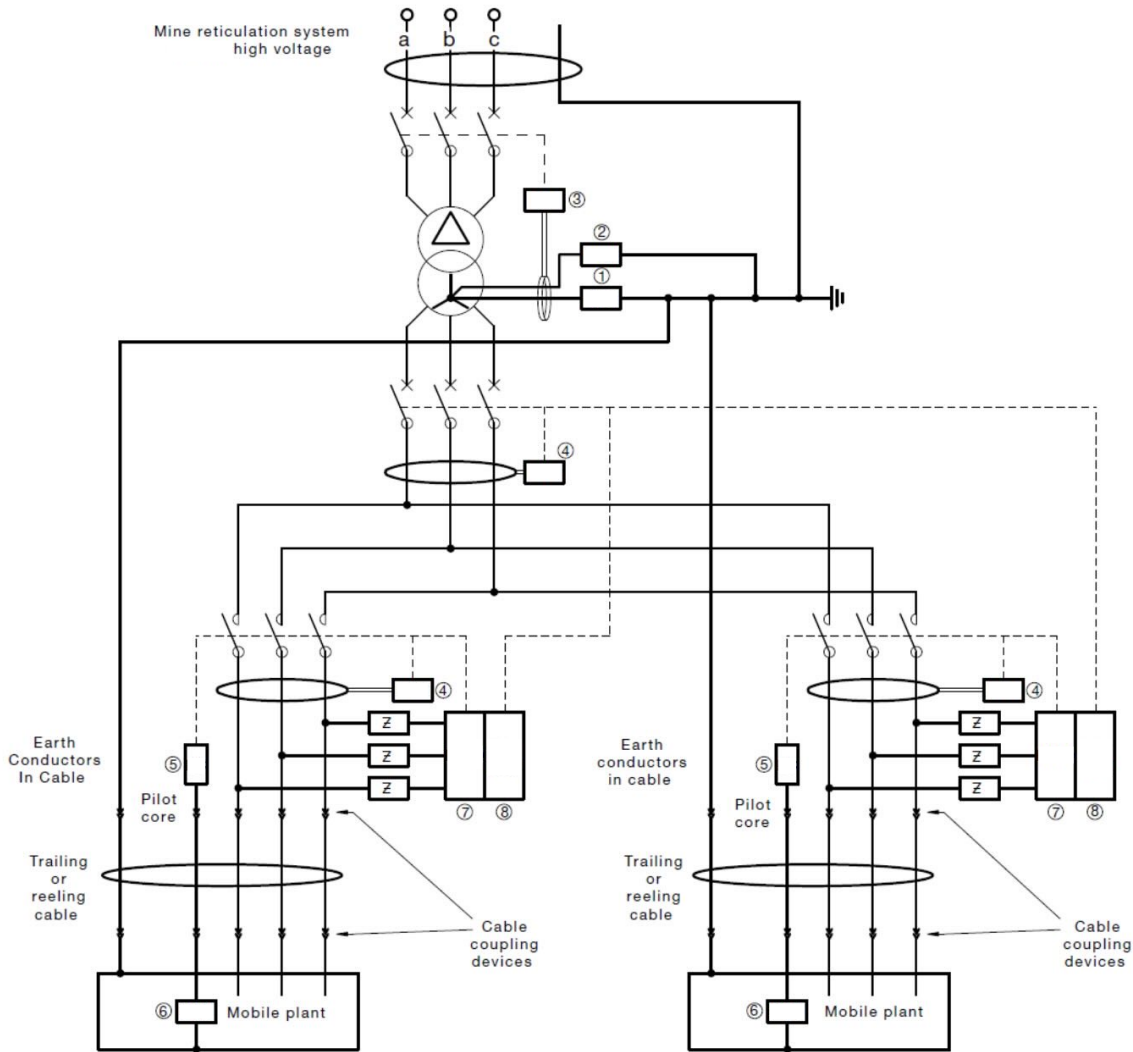
8) The protection device shall be designed to initiate a trip of an _____ circuit interrupting device if a voltage exceeding 25 V a.c. or 60 V d.c. is detected on any phase on the load side of the circuit interrupting device when it is expected to be in the _____ position.

- a) upstream, closed
- b) upstream, open
- c) downstream, closed
- d) downstream, open

9) A _____?_____ in the resistance of the NER will result in an increase in the earth fault current. This will result in a corresponding _____?_____ in prospective touch or step potentials under fault conditions.

- a) decrease, increase
- b) decrease, decrease
- c) increase, increase

10) Match the numbers from (1) to (8) with the labels



	Letter that corresponds to the number above		
1)		a)	Frozen Contact Protection
2)		b)	Earth Continuity Protection
3)		c)	Earth Fault Lockout protection
4)		d)	Series neutral earth leakage protection
5)		e)	Core Balance earth leakage protection
6)		f)	Neutral connected Impedance (NER)
7)		g)	Pilot (Earth Continuity) termination unit
8)		h)	NER integrity protection

Question 8 – Work Health and Safety (Mines and Petroleum Sites) Regulation 2022

Principal Hazards

There is a risk of fatalities and serious injury in all parts of the mining sector that requires everyone to be vigilant and proactive in meeting their responsibilities. Learning from experience, preventing devastating reoccurrences, and improving the health and safety of all people working in the industry is a profound way of acknowledging and recognising all those that have been affected by mining safety incidents throughout history.

A. What is the meaning of a “Principal Hazard”?

2 marks

	/ 2
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B. List seven (7) of the Principal Hazards (mining).

3 marks

	/ 3
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C. Name two (2) PHMPs that would require input from the site Electrical Engineering Manager during development to ensure a comprehensive evaluation of risk. 2 marks

	/ 2
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D. Explain why the electrical engineering manager is required during development to ensure a comprehensive evaluation of risk. 3 marks

	/ 3
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Question 9 – WHS Act – Consultation

Work Health and Safety Act Part 5 Division 2 Consultation with workers places duties on the Operator (PCBU) of a coal mine to engage in consultation, and includes the following sections:

- 46. Duty to consult with other duty holders
- 47. Duty to consult with workers
- 48. Nature of consultation
- 49. When consultation is required

A. What requirements are placed on the PCBU to consult with workers? 4 marks

	/ 4
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B. What requirements are placed on the nature of consultation?

4 marks

	/ 4
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C. When is consultation required?

2 marks

	/ 2
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Question 10 – WHS Act – Duty of care, Duty of workers

A. Fill in the missing words for Section 19 Primary duty of care

6 marks

(1) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, the health and safety of—

(a) workers engaged, or caused to be engaged by the person, and

(b) workers whose activities in carrying out work are influenced or directed by the person, while the workers are at work in the business or undertaking.

(2) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.

(3) Without limiting subsections (1) and (2), a person conducting a business or undertaking must ensure, so far as is reasonably practicable—

(a) the provision and maintenance of _____ without risks to health and safety, and

(b) the provision and maintenance of safe _____, and

(c) the provision and maintenance of safe _____, and

(d) the safe use, handling, and storage of _____, and

(e) the provision of adequate _____ for the welfare at work of workers in carrying out work for the business or undertaking, including ensuring access to those _____, and

(f) the provision of any _____, _____, _____ or _____ that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the conduct of the business or undertaking, and

(g) that the health of workers and the conditions at the workplace are monitored for the purpose of preventing _____ or _____ of workers arising from the conduct of the business or undertaking.

B. Fill in the missing words for Section 28 Duties of workers

4 marks

While at work, a worker must—

(a) take _____ for his or her own health and safety, and

(b) take _____ that his or her
_____ or _____ do not adversely affect the
health and safety of _____, and

(c) comply, so far as the worker is reasonably able, with any
_____ that is given by the
person conducting the business or undertaking to allow the person to comply with this Act,
and

(d) co-operate with any _____ or _____ of the person
conducting the business or undertaking relating to health or safety at the workplace that has
been notified to workers.

	/ 4
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Question 11 – Introduction to site

You have taken up the role of Electrical engineering manager at an underground operation, which includes a CHPP and Train load facility. It has been brought to your attention there is no process for introducing equipment to your site.

To add to this, you have been provided with an estimation that there are 50 items which have gone through no process of introduction to site before being put into operation.

The equipment ranges from stockpile dozers to battery powered welders and many things in between.

A. Explain the steps you would take to address the current situation with the legacy plant.

3 marks

	/ 3
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B. Explain what process you would implement to rectify the identified failure. 2 marks

	/ 2
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C. The WHS(M&Ps) Regulation 2022 Schedule 2 part 3 – Electrical engineering control plan lists 5 risks that the control plan must set out the control measures for. Name four (4) that are relevant for the introduction of plant. 2 marks

	/ 2
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D. From an electrical perspective, list five (5) items on the mobile plant you would focus on in the development of the introduction to plant inspection plan. 2 marks

	/ 2
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E. What standard will provide guidance on the electrical installations on mobile plant? 1 mark

	/ 1
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Question 12 – Switchboards

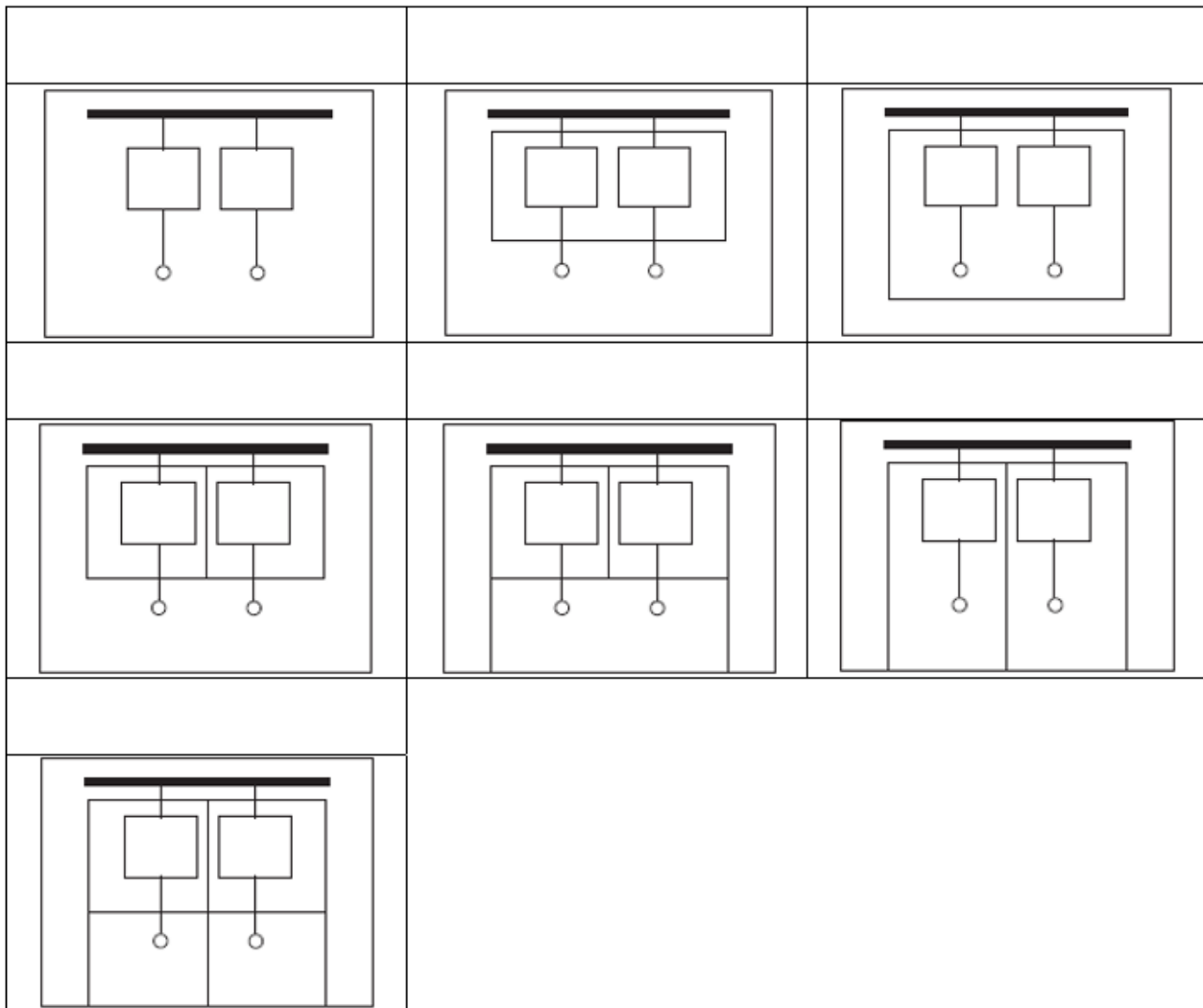
You are required to install a number of low-voltage switchboards for a new project that is supplied by a TN earthing system.

A. Detail the Australian Standards you would use within the specification along with a short summary of their relevance to switchboard specification. 4 marks

	/ 4
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B. The AS/NZS 61439 series describes forms of internal separation for switchboards.

Label the form of separation as described in the AS/NZS 61439 series against each of the below diagrams. 3.5 marks



/ 3.5

C. Can you describe three differences between a Form 1 and Form 4b board? 2.5 marks

END OF QUESTIONS

**BLANK PAPER TO WRITE ANSWERS THAT YOU COULD FIT INTO THE SPACE
PROVIDED – INDICATE QUESTION NUMBER AT START OF ANSWER**

END OF PAPER