



Regional
NSW

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

EXAMINATION: ELECTRICAL ENGINEERING MANAGER
EXAM PAPER: CEE1 – Electrical engineering applied to coal mines
DATE: 4 September 2024 – 08:50am – 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 08:45am 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.

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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
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EXAMINATION BOOKLET

Paper	Question Number	Essential	Candidate Score	Assessed by <i>Name</i>	Comments to justify, as necessary
CEE1	1	Essential 6/10 Required	/10		
	2		/10		
	3		/10		
	4		/10		
	5		/10		
	6		/10		
	7		/10		
	8		/10		
	9		/10		
	10		/10		
2024	Verdict		TOTAL	/100	<i>Marks checked by:</i>

Question 1 – Portable Apparatus

ESSENTIAL

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

You have been employed as the Electrical Engineering Manager at a Green fields Coal Mine. You are developing your Electrical Engineering Control Plan.

- i. Describe the steps that you would take in developing procedures for the use of Test Instruments?

	/ 2
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- ii. What are the minimum equipment compliance requirements for of Portable Electrical Plant to be used in the hazardous zone of an underground coal mine?

	/ 2
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iii. You are aware that insulation test instruments may cause sparking when discharging. Does this affect whether they are permitted to be used in the Hazardous Zone of an Underground Coal Mine? Why? / Why not?

	/ 1
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iv. What level of methane in the general body of air would prohibit the use of Portable Electrical Plant in a hazardous zone?

	/ 1
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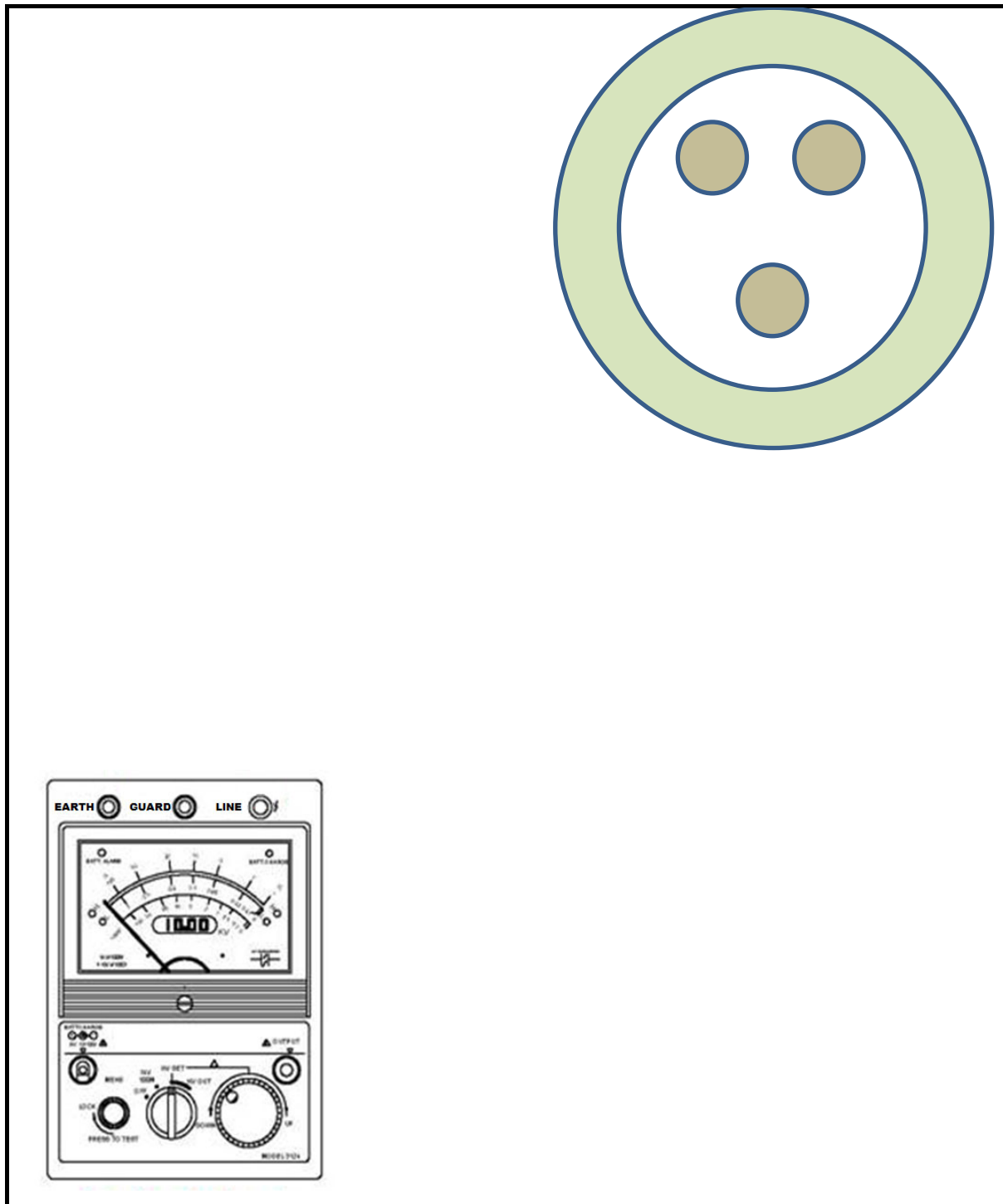
v. Under the Mine's inspection plan, how would you determine the required inspection frequency when Portable Electrical Plant is in use in the Hazardous Zone?

	/ 1
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vi. Describe the process of testing the insulation resistance of a cable using a 2 wire portable insulation tester including connections?

	/ 1
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vii. Utilise the drawing below to describe the process of testing the earth continuity of a cable, using diagrams and calculations to explain steps.



/ 2

Question 2 – Earthing

You have taken up the role of statutory electrical engineer at an old coal mining operation and it has been brought to your attention through a recent incident that there is no system in place for the life cycle maintenance of your earthing systems on site.

You are unable locate any detail on the original design of the earthing system onsite.

The site is supplied from the Supply Authority with 290A earth fault limitation at 66kV.

The site has 2 x 15MVA transformers 66kV/11kV, each fitted with 10A earth fault limitation.

The 2 transformers can be run in 3 different modes:

1. 1 x transformer supplying the entire 11kV bus (bustie closed) with second transformer powered and on standby (11kV Secondary Side CB open).
2. 2 x transformers supplying half of the 11kV bus each (bustie open).
3. 2 x transformers supplying the entire 11kV bus (bustie closed).

The transformers are supplying all the site loads – via 10 x 11kV feeders:

- i. 2 x 11kV feeders are connected in as ring feeder for the CHPP.
- ii. 8 x 11kV feeders are radially connected, with 4 of those feeders supplying 1.5MVA 11/0.433kV kiosk substations (each with 5A earth fault limitation).

a. What are the two legislated risks that an effective earthing system must minimise?

	/ 2
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b. What steps would you take to develop a life cycle strategy?

	/ 2
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c. Who would you consult in this process?

	/ 1
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d. From your Risk Assessment, what would you develop?

	/ 1
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e. What would be a suitable method for testing the effectiveness of your earth grids?
How does this test work?

	/ 2
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f. How will you determine the allowable touch voltage?

	/ 1
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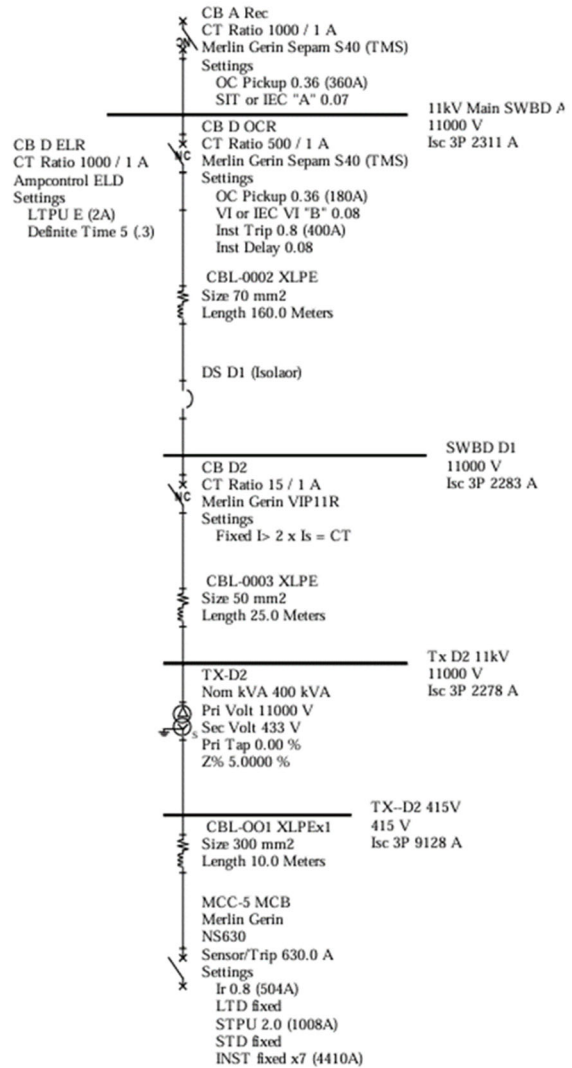
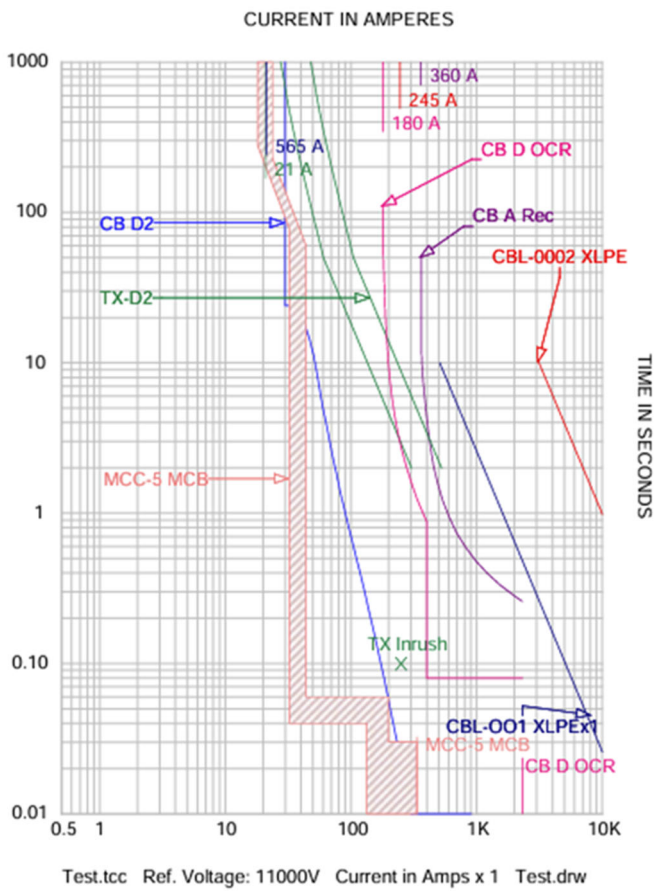
g. Which mode would you base your maximum earth fault protection settings on? Why?

	/ 1
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Question 3 – Protection & Arc Flash

a. From the time current curve below, nominate the operating times for the following protection devices to operate at a fault current of 1000 amps at 11kV:

- CB D2
- CB A Rec
- CB D OCR



b. Explain how current limiting fuses reduce the energy delivered to an arc fault.

	/ 2
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c. Above what current rating does a switchboard require protection against internal arcing fault?

	/ 1
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d. Describe the Arc Flash PPE that you would require for an Arc Rating of 10 cal/cm².

	/ 1
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e. Your Supply Authority notifies you that they are conducting future works which will increase your incoming fault level by approximately 50%.

i. What are your concerns?

	/ 2
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ii. What actions could you take to manage the risks with your legacy equipment?

	/ 1
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Question 4 - Calculations

The following questions relate to a parallel transformer installation with two transformers 20MVA 66/11kV with 5% impedance. A bus tie is also installed on the secondary side. A load is supplied from the bus via a cable that that is 800m in length and has an impedance of $0.39 + j0.1\Omega$ per km. The declared fault level on the line side of the transformers is 375MVA.

- a. What are the advantages of installing two 20MVA transformers instead of one 40 MVA transformer?

	/ 1
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- b. What are some of the disadvantages of installing two 20MVA transformers instead of one 40MVA transformer?

	/ 1
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- c. How is voltage regulation achieved when operating parallel transformers?

	/ 1
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d. Draw the typical mining substation circuit described above using Australian Standard symbols. Show all the necessary hardware and protection devices you would require on this substation. Provide any assumptions made.

	/ 3
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e. Calculate the fault level at the end of the cable when the bus tie is both open and closed. Use a base of 5MVA for your calculation

	/ 2
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f. Under normal operating conditions, in what position would you want to see the bus tie? Explain the advantages and disadvantages.

	/ 1
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g. What labelling/signage would you want on your substation fence/gates?

	/ 1
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Question 5 – Lightning

Your site is installing a new metal clad crib hut facility (two huts) that will also have a heavy vehicle park up area for haul trucks. The power supply for the crib hut facility is provided by a generator.

- a. What Australian Standard would you review for information relating to lightning risks in mining?

	/ 1
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- b. Detail your approach to ensure the risk of lightning is controlled adequately.

	/ 2
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- c. Detail three lightning related hazards and typical controls you would implement in the design or operation to mitigate the risk of lightning at this installation.

	/ 3
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d. Draw and explain the rolling sphere protection method in the below space.

	/ 3
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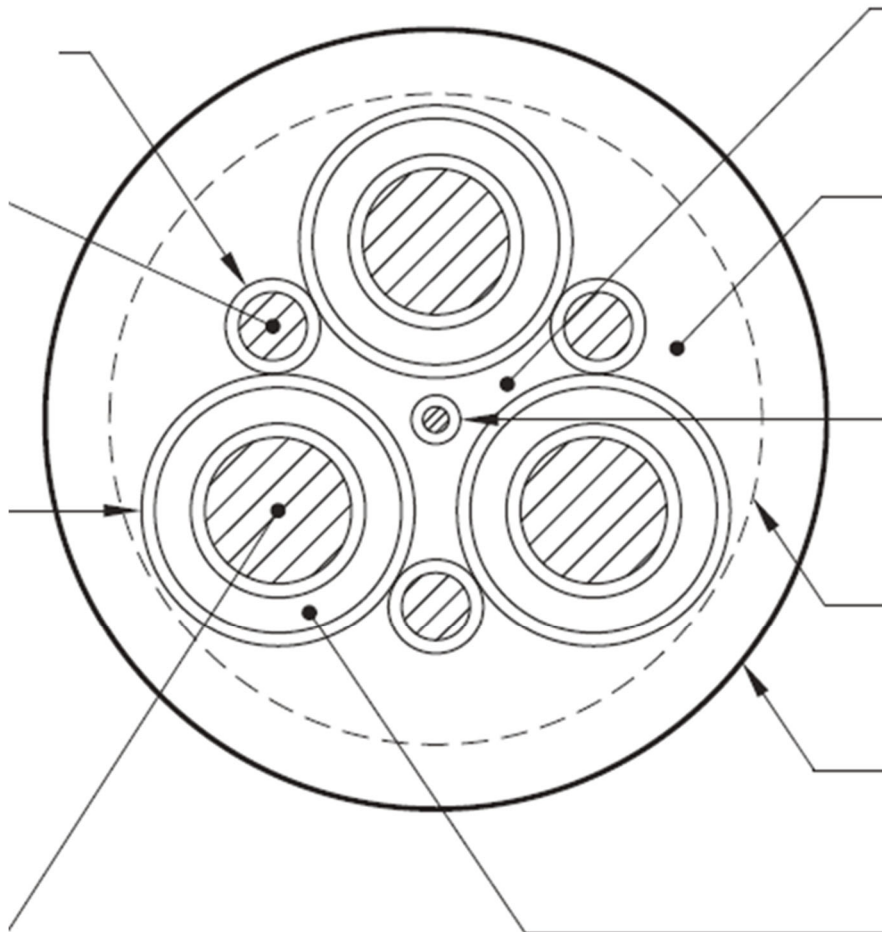
e. What is the maximum earth impedance for lightning protection?

	/ 1
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Question 6 - Cables

a. Using the words below label the following diagram of a Type 241 cable.

Note: Using the allocated numbers against the diagram will be acceptable.



1. Semiconductive elastomer covering
2. Semiconductive elastomer insulation screen
3. Semiconductive elastomer cradle separator
4. Semiconductive elastomer for core assembly
5. Earth conductor
6. Central pilot core
7. Reinforcement
8. Elastomeric outer sheath
9. Insulation
10. Power Conductor

b. You are the Electrical Engineering Manager for an Underground coal mine and you have just received a supply of development mining equipment including cables for the use in a new cut and flit panel. What Markings would you expect to find on the shuttle car cables?

	/ 1
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c. If the cables supplied had no exterior markings on them, but you project team had a certificate from the manufacturer that stated they complied with the requirements of AS1802. Could you use them in a hazardous zone? If not describe the steps you would undertake to resolve the situation and what you would put in place to manage cable purchases?

	/ 2
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d. The Project team advises you that the current production panel is utilising cables from the same manufacturer, what will be your **short and long term** steps for managing the situation?

	/ 2
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Question 7 – Welders & Generators

You have recently commenced as the Electrical Engineering Manager at a large Underground Coal Mine. During an initial inspection of the mines workshop welding bays, you find the equipment standards shown below:



- a. What concerns if any do you have about the condition of the depicted welding equipment?

	/ 1
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- b. Detail your approach to addressing the identified issues.

	/ 2
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c. You are developing a welding training package for your site, what are the main topics that you would include?

/ 2

d. Provide examples of the different welding environment categories as defined in AS1674.2.

/ 3

e. If the equipment was required to be powered by a generator, list 4 requirements that you would specify for compliance of the installation.

/ 2

Question 8 – Winders

- a. The commissioning (or recommissioning) of a Powered Winding System is a High Risk Activity under the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022.

What information must you include in your High Risk Activity notification?

	/ 3
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- b. Explain the differences between a *Design Alteration* and a *Design Amendment*:

	/ 2
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c. What is the level of independence required between:

i. The Ultimate Safety Circuit and Primary Safety Circuit.

	/ 1
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ii. The Primary Safety Circuit and Secondary Safety Circuit.

	/ 1
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d. It is a condition of every registration that a five-yearly safety audit must be carried out from the date of registration. What are the three requirements of this safety audit?

	/ 3
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Question 9 – Explosion Protection & HAC

Part A – Hazardous Areas

You are the Electrical Engineering Manager for an underground coal mine which includes a surface Coal Handling and Preparation Plant. The CHPP uses bins for handling ROM Coal and Product Coal. You are unable to find any information relating to hazardous areas at the CHPP.

a. At the CHPP, where might you expect to find:

ii. Group II Hazardous Areas

	/ 0.5
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iii. Group III Hazardous Areas

	/ 0.5
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b. You wish to clearly identify all Hazardous Areas at the CHPP.

i. Who would you engage to provide this information to you?

	/ 1
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ii. What information would they require from you?

	/ 1
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c. Once you receive this information in Question B, what would be your next steps in updating your Safety Management System?

	/ 2
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Part B – Explosion Protected Electrical Equipment

You are inspecting a conveyor installation in a return airway of the underground mine. You observe that the area is illuminated with lights which have the following approval number: 'MDA EXD 17052'. There is no IECEx, AUSEx or ANZEx certification number.

a. Where would you search to determine whether the lights manufactured under that MDA Certificate are permitted to be used in that area?

	/ 1
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b. When does the MDA scheme expire?

	/ 1
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c. On further inspection, you identify that the lights were manufactured in December 2022. What are your concerns on finding this information?

	/ 1
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d. On further inspection, you identify a conveyor intercom unit which has the following markings:

MDA Exi 10220

IECEX TUV 04.5678X Ex 'ia' I

Can this continue to be used in the hazardous zone beyond the MDA Scheme expiry date? Why / why not?

	/ 1
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e. On further inspection, you identify an intrinsically safe barrier inside the conveyor substation. The barrier supplies intrinsically safe power to a push-button start/stop station located in the hazardous zone. The barrier has the following markings:

MDA Exi 10220

ATEX 7700X

[Ex 'ia'] IECEX TSA 21.6789X IIC T4

Can this continue to be used in the hazardous zone beyond the MDA Scheme expiry date? Why / why not?

	/ 1
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Question 10 – Functional Safety

An over-pressure protection system is to be installed on a longwall pump station at your mine. Over pressurising of the hydraulic system due to malfunction of the pump control system is seen as a hazardous event with the potential for serious injury and/or death to workers if not adequately controlled.

- a. Use the risk graph method of AS61508.5 - 2011 Examples of methods for the determination of safety integrity levels to determine the Safety Integrity Level (SIL) required of the over-pressure protection system for the longwall pump station at your mine – refer to Figure E.2 & Table E.1 below:

You may assume that:

- Over-pressurisation due to a malfunction of the pump control system is an infrequent event.
- Only one (1) such event has been recorded across the company’s five (5) mines in the last year.
- Workers are infrequently in proximity of the pump station and hydraulic system and when they are, it is only for short durations.
- Pressure relief valves are also installed on the pump station and hydraulic system as an additional layer of protection. Many of the hydraulic parts and lines are also guarded.

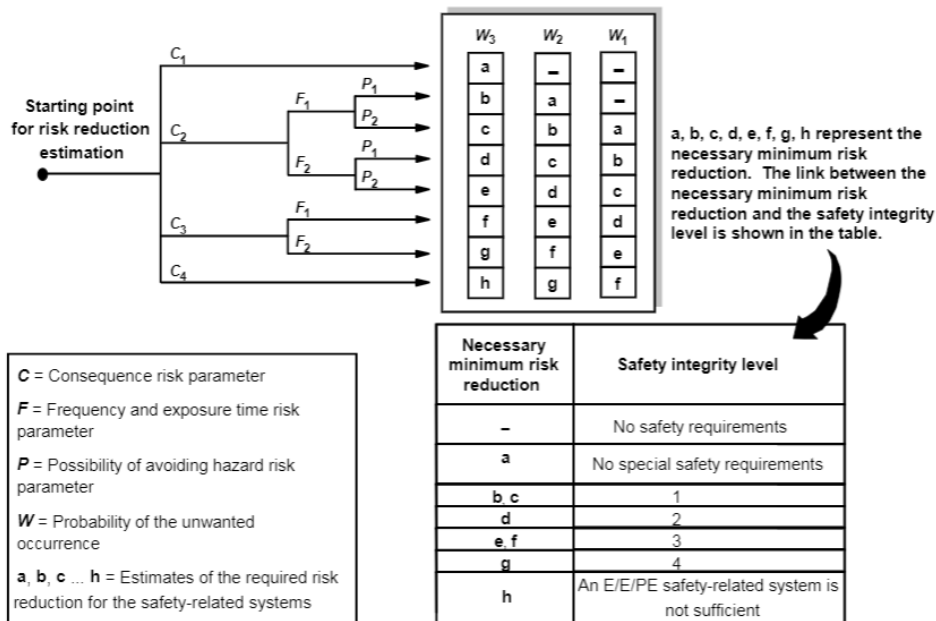


Figure E.2 – Risk graph – example (illustrates general principles only)

Table E.1 – Example of data relating to risk graph (Figure E.2)

Risk parameter		Classification	Comments
Consequence (C)	C ₁	Minor injury	<p>1 The classification system has been developed to deal with injury and death to people. Other classification schemes would need to be developed for environmental or material damage</p> <p>2 For the interpretation of C₁, C₂, C₃ and C₄, the consequences of the accident and normal healing shall be taken into account</p>
	C ₂	Serious permanent injury to one or more persons; death to one person	
	C ₃	Death to several people	
	C ₄	Very many people killed	
Frequency of, and exposure time in, the hazardous zone (F)	F ₁	Rare to more often exposure in the hazardous zone	3 See comment 1 above.
	F ₂	Frequent to permanent exposure in the hazardous zone	
Possibility of avoiding the hazardous event (P)	P ₁	Possible under certain conditions	<p>4 This parameter takes into account</p> <ul style="list-style-type: none"> – operation of a process (supervised (i.e. operated by skilled or unskilled persons) or unsupervised); – rate of development of the hazardous event (for example suddenly, quickly or slowly); – ease of recognition of danger (for example seen immediately, detected by technical measures or detected without technical measures); – avoidance of hazardous event (for example escape routes possible, not possible or possible under certain conditions); – actual safety experience (such experience may exist with an identical EUC or a similar EUC or may not exist).
	P ₂	Almost impossible	
Probability of the unwanted occurrence (W)	W ₁	A very slight probability that the unwanted occurrences will come to pass and only a few unwanted occurrences are likely	<p>5 The purpose of the W factor is to estimate the frequency of the unwanted occurrence taking place without the addition of any safety-related systems (E/E/PE or other technology) but including any other risk reduction measures</p> <p>6 If little or no experience exists of the EUC, or the EUC control system, or of a similar EUC and EUC control system, the estimation of the W factor may be made by calculation. In such an event a worst case prediction shall be made</p>
	W ₂	A slight probability that the unwanted occurrences will come to pass and few unwanted occurrences are likely	
	W ₃	A relatively high probability that the unwanted occurrences will come to pass and frequent unwanted occurrences are likely	

b. Is the over-pressure protection system a “low demand” or “high demand” safety function? Explain your reasoning.

	/ 2
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c. Should the over-pressure protection system be designed to be independent of the pump control system? Explain why, or why not.

	/ 2
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- d. Sometime after the over-pressure protection system is installed the Longwall Superintendent wants to extend its proof-testing interval.

Explain the potential effect of this on the safety integrity of the over-pressure protection system and overall plant safety.

	/ 2
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- e. How would you determine the proposed increase in proof-testing interval is allowable, given the original SIL allocation?

	/ 2
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End of Questions

SPARE PAGE FOR ANY ADDITIONAL DRAWINGS

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

END OF PAPER



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NSW

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

EXAMINATION: ELECTRICAL ENGINEERING MANAGER

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

DATE: 4 September 2024 – 12:50pm – 4:00pm

DURATION: 3 hours (excluding 10 minutes reading time)

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	8		/10		
	9		/10		
	10		/10		
2024	Verdict		TOTAL	/100	<i>Marks checked by:</i>

Question 1 – Work Health and Safety (Mines and Petroleum Sites)

Regulation 2022

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

Schedule 10 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 outlines the Statutory functions of the mine Electrical Engineering Manager (UG) and Electrical Engineer (O/C).

- a. What are the statutory functions of the Electrical Engineering Manager (UG)?

	/ 3
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Schedule 2 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 outlines the requirements for the Electrical Engineering Control Plan.

- b. The Electrical Engineering Control Plan must set out control measures for which key risks?

	/ 2
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Schedule 3 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 lists specific requirements for Electrical work on energised electrical equipment.

c. Is this work permitted at a Coal Mine? If so under what conditions?

	/ 3
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d. Is there a waiting period?

If so:

- i. What is it?
- ii. What steps are required to reduce it?

	/ 2
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Question 2 – AS3000

- a. What is the touch voltage limits below which an automatic disconnection of supply does NOT need to occur to achieve compliance to AS3000.

	/ 1
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- b. What are the six (6) mandatory tests for low voltage systems as defined in AS3000 Section 8.3?

	/ 3
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- c. What is the minimum permissible Insulation Resistance for Low Voltage circuits?

	/ 1
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- d. What is the maximum permissible Earth Continuity for any earthing or bonding conductor?

	/ 1
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e. Under what circumstances must Earth Fault Loop Impedance testing be carried out?

	/ 1
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f. Describe the key differences between Class I and Class II equipment.

	/ 2
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g. Why are 2-Pole circuit breakers mandatory for single phase circuits on IT earthed Low Voltage supplies?

	/ 1
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Question 3 – AS3007

- a. AS/NZS 3007 requires compliance with three Australian standards for high voltage installations, what are they?

	/ 1
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- b. Electrical interlocking systems which prevent access to energised electrical enclosures must be designed in accordance with AS 4024.1501, AS 62061 or ISO 13849-1. What does this mean?

	/ 1
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- c. Explain how Overload and Short Circuit protection must be coordinated in regard to the breaking capacity of protective devices.

	/ 1
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- d. A means shall be provided to isolate all circuits above what voltage?

	/ 1
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e. What controls must be implemented to manage the risks associated with Remote Control of mobile mining machinery?

	/ 1
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f. What are the requirements for the design of off-load tap changers in transformers for transportable substations?

	/ 1
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g. Over Head Lines (OHLs) and their associated equipment should be placed so that normal mining operations can be carried out without affecting the safety integrity of the OHL.

Outline your requirements for routing of OHL's:

	/ 1
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h. Where a relocatable building is designed for use on a TN system, but only an IT system is available, what must be done to connect the electricity supply to the building?

	/ 1
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i. What are the requirements for a 'closed electrical operating area'?

	/ 1
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j. Where an earth fault current limitation device is not continuously rated, how must it be protected?

	/ 1
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Question 4 – AS4871

a. AS/NZS 4871 – is the standard for what?

	/ 1
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b. There are six (6) parts to the AS/NZS 4871 Series.
What does each part cover?

	/ 3
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c. List four (4) risks associated with the use of Variable Speed Drives (VSDs) in underground coal mines, and the possible controls for each risk.

	/ 2
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d. If an isolation switch is not rated for fault make / fault break, or fault make / load break, can it be used on your site?
Why? Why not?

	/ 2
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e. What are the requirements for Belt Splicing equipment regarding:

i. Earth Leakage protection for hand-held equipment.

	/ 0.5
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ii. Continuity of the Earth Connection.

	/ 0.5
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iii. Resetting of short circuit and earth leakage protection.

	/ 0.5
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iii. The plug connecting the platen cable to the platen.

	/ 0.5
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Question 5 – AS/NZS 2290.1

AS/NZS 2290.1 2014 Electrical equipment for coal mines – Introduction, inspection and maintenance sets out requirements for the inspection and maintenance of electrical equipment designed for use in hazardous areas in and around underground coal mines.

- a. The standard outlines requirements on how to confirm that Equipment from storage is suitable for use prior to installation in a hazardous zone. Please list the documentation that needs to be obtained where equipment has been kept in storage prior to going in to service?

	/ 2
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- b. What time frame does the standard recommend for the AS3800 overhaul for Portable apparatus, specifically Machine remote controllers?

	/ 1
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- c. What time frame does the standard require for Motors and Cable reels to be overhauled?

	/ 1
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e. Where would you find the legislated requirement to ensure electrical plant used in a hazardous zone is maintained in accordance with AS/NZS 2290.1?

	/ 1
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f. Explain the process you would follow to extend the in-service life of a Continuous Miner past the nominal four (4) year overhaul period.

	/ 3
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Question 6 – AS 60079 Series

- a. AS/NZS IEC 60079.0:2019 Explosive Atmospheres Part 0: Equipment – General Requirements:

All Ex Equipment is allocated an ‘Equipment Group’.

Explain your understanding of each of the below groups:

- Group I: _____
- Group II: _____
- Group III: _____

Fill in the blanks:

According to the standard, Group I Electrical Equipment maximum surface temperatures shall not exceed:

_____ on any surface where coal dust can form a layer,
_____ where coal dust is not likely to form a layer

	/ 2
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- b. AS/NZS IEC 60079.1:2015 Explosive Atmospheres Part 1: Equipment protection by flameproof enclosure ‘d’:

Fill in the blanks:

According to the standard the definition of a flameproof enclosure ‘d’ is: an enclosure in which the parts which can ignite an explosive gas atmosphere are placed and which can _____ the pressure developed during an _____ of an explosive mixture, and which prevent the _____ of the explosion to the explosive gas atmosphere _____ the enclosure.

According to the standard the width of a flameproof joint ‘L’ is defined as: The _____ through a flameproof joint from the _____ to the _____ of an enclosure.

According to the standard - in the case of holes for screws or studs which do not pass through the walls of flameproof enclosures, the remaining thickness of the wall of the flameproof enclosures shall be at least _____ of the nominal diameter of the screw or stud with a minimum of _____ mm

According to the standard, when a test of the ability of an enclosure to withstand pressure is conducted, it is considered satisfactory if:

The enclosure suffers no _____ or _____ invalidating the type of protection. In addition, the joints shall in no place have been permanently enlarged.

/ 2

- c. AS/NZS IEC 60079.11:2024 Explosive Atmospheres Part 11: Equipment protection by intrinsic safety 'i':

Fill in the blanks:

According to the standard, the definition of intrinsic safety 'i' is:

The type of protection based on the _____ of _____ within equipment and of interconnecting wiring exposed to the explosive atmosphere to a level _____ that which can cause ignition by either sparking or heating.

According to the standard, the definition of _____ is:

Electrical components or combination of components of _____ construction with well-defined electrical parameters that is compatible with the intrinsic safety of the circuit in which it is used.

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- d. AS/NZS IEC 60079.25:2022 Explosive Atmospheres Part 25: Intrinsically safe electrical systems:

Review the simple intrinsically safe system assessment:

<u>Item</u>	<u>I.S. Interface</u>	<u>I.S. Field Device</u>
Equipment group	I	I
Level of protection	Ib	Ia
Temperature classification		T4
Voltage	Uo: 28V	Ui: 30V
Current	Io: 93mA	Ii: 120mA
Power	Po: 650mW	Pi: 1W
Capacitance	Co: 103nF	Ci: 3nF
Inductance	Lo: 8 mH	Li: 2mH
L/R Ratio	Lo/Ro: 54uH/Ohm	

- i. What is the equipment group of the intrinsically safe system?

- ii. What level of protection does the intrinsically safe system achieve?

iii. What is the maximum permitted capacitance of the connecting cable to be used?

iv. What is the maximum permitted inductance of the connecting cable to be used?

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e. For a cable with the following parameters, what is the maximum permissible cable length?

<u>Item</u>	<u>I.S. Parameters</u>
Capacitance	100nF/km
Inductance	100mH/km

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Question 7 – AS 3800

This question covers AS/NZS3800 and Licencing requirements under the Workplace Health and Safety (Mines and Petroleum Sites) 2022 Regulations.

- 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?

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

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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?

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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?

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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?

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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?

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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 contactor, overload, or control and monitoring equipment, with a replacement of a different type and dimensions, what should be done?

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

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Question 8 – WHS Act – Duty of care, Duty of workers

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

(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 illness or _____ of workers arising from the conduct of the business or undertaking.

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

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.

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Question 9 – AS 2081

You are the Manager of Electrical Engineering at an underground mine. During an inspection of a development section, you observe an electrician splitting a back-to-back. Upon discussion with the electrician, he indicates that he is relying on the EC circuit for isolation.



a. From the scenario described above what issues can you identify?

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b. What would your immediate course of action be?

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c. In the event that the EC circuit did operate, but one phase remained energised - explain what protection should trip.

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d. What is the maximum typical setting for EC in an underground mine.

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e. Describe a scenario where you would consider adjusting/changing EC settings? Explain why.

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f. From the scenario described what would be 3 long term actions you would implement?

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Question 10 – AS 2067

- a. What is the minimum clearances for exposed 11kV conductors between:
- Phase to Earth
 - Phase to Phase

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AS/NZS2067 Section 6.5

- b. List three (3) possible controls that could be incorporated into the design phase of a new High Voltage switchroom to protect personnel from the dangers resulting from Arc Faults.

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AS/NZS2067 Section 6.7.1.2

- c. List two hazards that could lead to fire and/or explosion in a High Voltage substation, and describe suitable controls for each.

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d. Which Australian Standard provides the requirements for the design of overhead power lines?

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e. Which Australian Standard provides guidance on the effects of current in human beings?

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AS/NZS2067 Section 8.2

f. Describe the performance requirements you would expect for surface High Voltage substation earth grid to achieve the following three fundamental requirements:

i. Safety of People

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ii. Protection of Equipment

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iii. Support Operational Security

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AS/NZS2067 Section 8.4.4

g. What are your considerations in regard to the following aspects when designing the earth grid to manage step and touch voltage during an earth fault?

i. Earth Fault Current

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ii. Earth Fault Duration

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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