



Electrical engineering manager of underground coal mines
CEE1 – Electrical engineering applied to coal mines

Candidate no.: _____

Legislation to be assessed

Unless otherwise stated all references to Act and Regulations are to:

- *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*
- *Explosives Act 2003*
- *Explosives Regulation 2024*

Exam details

Region: New South Wales

Venue: Tocal College

Room: North Court

Start date/time: Wednesday 24 September 2025 8:50am

End date/time: Wednesday 24 September 2025 12:00pm

Duration: 03:10

Instructions to candidates

- Answers are to be written in the allocated spaces within this booklet **ONLY**
- Answers must be written in pen however, drawings may be completed in pencil
- This booklet is not to be altered in any way, pages are not to be added or removed
- Additional space is provided at the end of the paper. Please label which question the answer relates to.
- It is expected that the candidates will present their answers in an engineering manner, making full use of diagrams, tables, and schematics appropriate, and showing full workings in calculations. **Poor legibility in diagrams and handwriting**

may affect the candidate being deemed non-competent

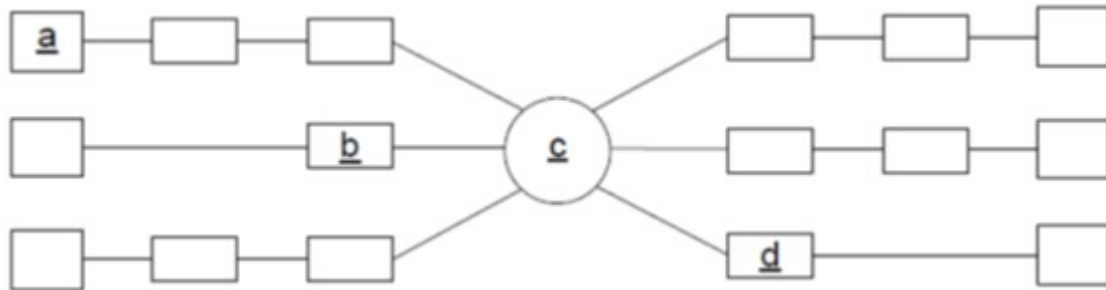
- **All 10 (ten) questions are to be attempted.** All questions are of equal value.
- If a question is identified as **ESSENTIAL**, the candidate must get the set number of marks to pass the question. If they do not pass these **ESSENTIAL** question(s), they do not pass this paper
- **You must pass the essential question and obtain a total of 60 marks to pass this paper**

Marking Sheet

Q #	Marks	Available Marks	Marked by <i>initials</i>	Summary comments to justify
1		10		
2		10		
3		10		
4		10		
5		10		
6		10		
7		10		
8		10		
9		10		
10		10		
Paper Total		100		<i>Marks checked by</i>

Question 1

(ESSENTIAL QUESTION) You must obtain 6 marks or more to pass this question and this paper.



A) What type of risk assessment is depicted above? (0.5 mark)

B) Identify what each of the lettered elements represent? (2 marks)

a)

b)

c)

d)

C) Define the term “Critical Control”? (0.5 marks)

D) List 4 (four) preventive controls that you would have in place at your underground coal mine to eliminate or minimise the risk an electric arc occurring in the hazardous zone?

Give examples of these controls. (4 marks)

E) List 3 (three) mitigating controls that you would have in place at your underground coal mine to minimise or reduce the severity or outcome of an electric arc occurring in the hazardous zone?

Give examples of these controls. (3 marks)

Question 2

You are the Electrical Engineering Manager at an underground coal mine. You have received a phone call from an electrician who advises that following a breakdown on a continuous miner, they inadvertently lost a bolt and attempted to use a replacement bolt with a different thread pitch. This has resulted in the threads being damaged in the bolt hole of the main enclosure, which now needs to be repaired.

A) What standards are applicable to this repair? (1 mark)

B) If you choose to use a Repair Service facility (RSF), how would you assess the RSF is capable of carrying out the work? (2 marks)

C) What information/documentation would you supply to the RSF? (2 marks)

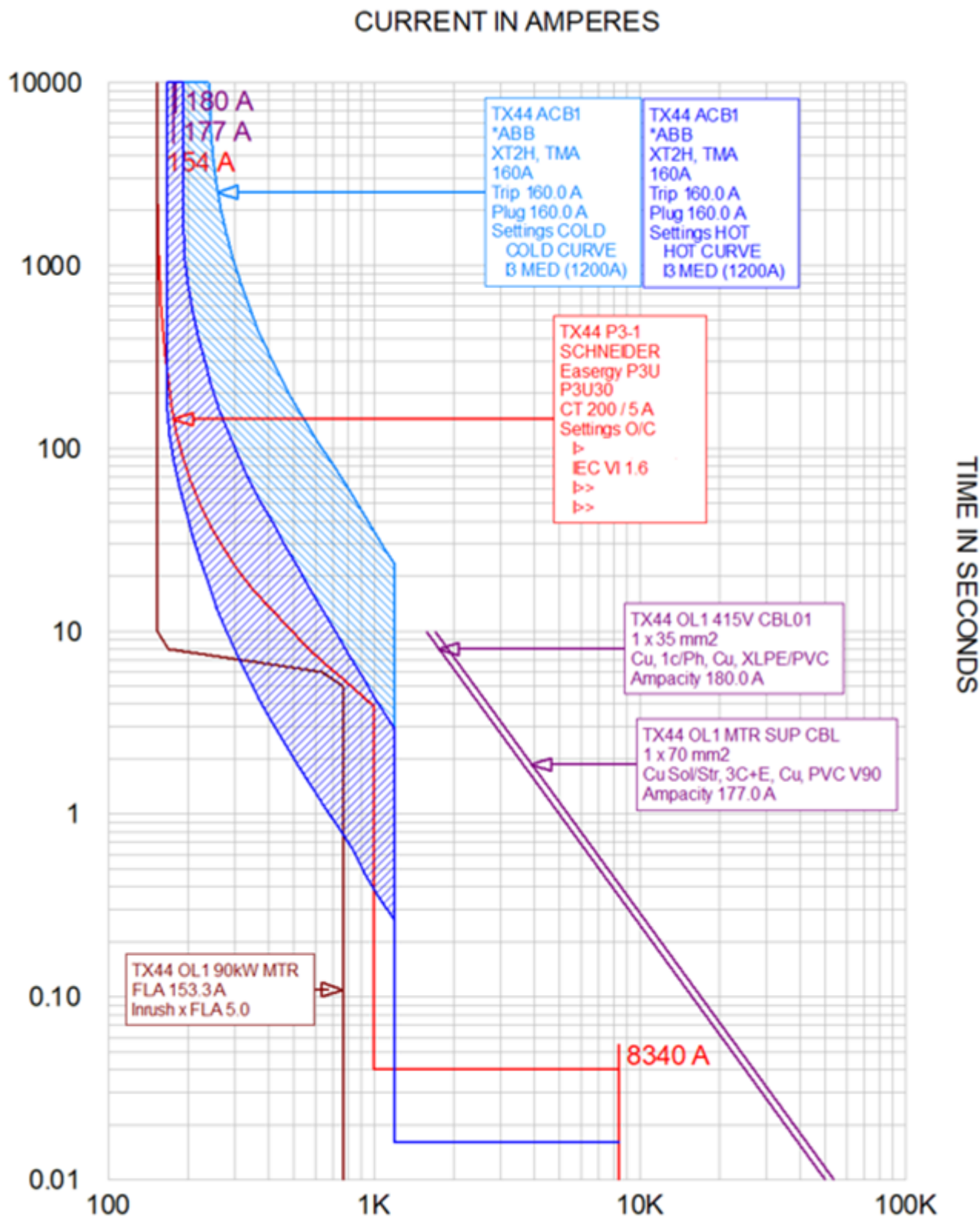
D) What actions would you take after the repairs had been completed? (2 marks)

E) How would you monitor the repair is effective until a permanent repair can be carried out? (1 mark)

F) What would your long term actions be? (2 marks)

Question 3

Review the below TCC curve for a dewatering pump starter installation.



A) What is the supply voltage of the modelled pump motor? (0.5 mark)

B) What is the rated full load current of the modelled pump motor? (0.5 mark)

C) What is the rated power of the modelled pump motor? (0.5 mark)

D) What is the modelled inrush current and duration of the pump motor? (0.5 mark)

E) Are the modelled pump motor details acceptable for this application? (1 mark)

Explain your answer.

F) What is the $I_{>}$ pickup current for the protection device P3-1? (0.5 mark)

G) What protection curve has been selected protection device P3-1? (0.5 mark)

H) What is the $I_{>>}$ short time pickup current for the protection device P3-1? (0.5 mark)

I) What is the $I_{>>}$ short time delay for the protection device P3-1? (0.5 mark)

J) Explain the difference between the two TX44 ACB1 curves? (2 marks)

K) Write a brief assessment of the overall protection and TCC curve model for this dewatering pump starter installation, including its suitability or criteria to be reviewed if needed. (3 marks)

Question 4

You are reviewing the proposed replacement of an existing substation to allow for repairs to the transformer tank. The substation has the following connected equipment:

- Conveyor system comprising of 2×160 kW conveyor motors (320 kW total)
- Dewatering system comprising of 2×90 kW submersible pumps and 1×75 kW centrifugal pump

The old substation is a 1500 kVA, 11 kV/1.1 kV transformer with 6% impedance and protected by a 600 A circuit breaker. The replacement substation available is a 1000 kVA, 11 kV/1.1 kV transformer with 6% impedance and protected by a 400 A circuit breaker.

Operational assumptions / formulas:

- Conveyor motors are started sequentially and each draw $6 \times \text{FLC}$ during startup. After starting, each motor briefly settles to 20% of FLC before the second motor is started.
- In worst case scenarios, the conveyor has been observed to operate at 130% FLC for 30 seconds during start up.
- Pump motors are intended to start sequentially and each draw $4 \times \text{FLC}$ during startup and once operational run 80% FLC during normal operation.
- $I_{\text{rated}} = S / (\sqrt{3} \times V)$
- $I_{\text{sc}} = I_{\text{rated}} / (Z_{\%} / 100)$
- $I_{\text{sc}} = S / (\sqrt{3} \times V \times (Z_{\%} / 100))$
- $I_{\text{FLC}} = P / (\sqrt{3} \times V \times \eta \times \text{PF})$
- assume $\eta = 0.9$ and $\text{PF} = 0.85$
- $\% \text{Voltage Drop} = (I_{\text{total}} / I_{\text{sc}}) \times 100$

A) Calculate the maximum prospective short circuit current at the 1.1 kV terminals of the replacement transformer. (2 marks)

B) Assess whether the replacement transformer can sustain the starting load and ongoing operational loads without causing voltage drop or overcurrent trips beyond acceptable or unmanageable limits.

Show all your working and assumptions. (6 marks)

C) Identify at least 2 (two) electrical protection devices or settings that should be considered and are required to manage the above installation.

Justify your choices. (2 marks)

Question 5

Mining cables used for underground coal operations in reeling and trailing applications are designed to be “fit for purpose” for their duty in a particularly harsh environment.

A) Draw a typical cross-sectional diagram of a “type 275.1 Trailing Cable” and identify 3 (three) critical design features of the cables internal cores, insulation and screening. (3 marks)

B) For a “type 275.1 Trailing Cable”, what does the “.1” indicate? (0.5 mark)

C) Describe 2 (two) of the primary design features of the cable construction and summarise the electrical engineering reasons for the features. (2 marks)

D) List 4 (four) of the eight pre-repair tests which need to be carried out on every mining cable when sent to a licensed repair workshop? (2 marks)

E) What equipment would you typically find this cable installed on, in an underground operation? (0.5 mark)

F) What is meant by the term 'symmetrical' with respect to cables and why is this important? What are the risks associated with non-symmetrical cables? (2 marks)

Question 6

You are the Electrical Engineering Manager at a large Underground Coal Mine. During an inspection of the mines workshop welding bays with your ESHR, you find the equipment standards shown below:



A) What concerns if any do you have about the condition of the depicted welding equipment? (1 mark)

B) Detail your approach to addressing the identified issues. (2 marks)

[illegible][illegible]

E) If the equipment was required to be powered by a generator, list 4 (four) requirements that you would specify for compliance of the installation. (2 marks)

Question 7

Your mine has identified the requirement for a new underground booster fan.

You are aware that there are legislated requirements for the design, registration and commissioning of this fan.

A) The *Registration of Booster Fans Design Order 2022* defines specific requirements for the design of Booster Fans:

i) All booster fans used in underground coal mines must be designed in accordance with which document? (1 mark)

ii) Where a design does not fully comply with this document, what must be demonstrated by the designer? (1 mark)

B) What information must be provided to the Resources Regulator in an application for Design Registration? (2 marks)

C) Schedule 3 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 defines High Risk Activities.

i) What specifically is the High Risk Activity in relation to Booster Fans in underground coal mines. (1 mark)

ii) Who must be notified of the High Risk Activity? (1 mark)

iii) List 4 (four) items that must be provided as part of this High Risk Activity notification. (2 marks)

D) What is the difference between a Design Alteration and a Design Amendment?

Give an example of each scenario? (2 marks)

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Question 8

You are the Electrical Engineering Manager for an underground coal mine which includes a surface Coal Handling and Preparation Plant.

A) What is a Hazardous Area Classification and why is it required for reclaim tunnels? (2 marks)

B) Who is responsible for ensuring that Hazardous Area Classifications are completed and documented for reclaim tunnels? (0.5 mark)

C) What is the definition of each of the Zones 20, 21, and 22 in Group III hazardous areas? (3 marks)

Zone 20

Zone 21

Zone 22

D) What is meant by a Zone 22NE classification in a reclaim tunnel walkway? (0.5 mark)

E) A CHPP electrical coordinator has recently installed new lighting equipment in a reclaim tunnel classified as Zone 21. During a routine inspection, you discover that the installed lights do not have dust-tight IP rated enclosures.

What are the electrical safety implications of this finding, and what immediate and longer-term actions should you take as the Electrical Engineer? (3 marks)

F) Describe the impact of incorrect or outdated Hazardous Area Classification on electrical safety in reclaim tunnels? (1 mark)

Question 9

Safety Bulletin SB25-04 was recently released by the NSW Resources Regulator. The bulletin related to Electric shocks in the mining industry.

A) What was the general “issue” being raised to industry by the Safety Bulletin? (1 mark)

B) What were the “key focus areas for review” associated with this Safety Bulletin? (2 marks)

C) What would your immediate actions be at your operation upon receiving the associated Safety Bulletin? Explain who you would involve. (2 marks)

D) Considering the “key focus areas for review” associated with this Safety Bulletin, write a short term and medium term action plan to put in place at your mine? (2 marks)

Short Term:

Medium Term:

E) The ‘*Supervision Practice Standard for Apprentices in the Electrical Industry*’ defines three categories of supervision, and specifies the minimum level of supervision required for specific tasks.

i) Describe the level of supervision required for a 3rd year electrical apprentice to carry out an electrical isolation. (1 mark)

ii) Explain the difference between ‘General Supervision’ and ‘Broad Supervision’ under this Standard. (2 marks)

Question 10

You are the Electrical Engineering Manager of an underground coal mine. Following recent industry safety events, you are undertaking a review of control measures at your site in relation to arc flash.

A) Identify the 2 (two) key factors which determine the amount of energy released in an Arc Flash event. (1 mark)

B) Which of these factors has the most effect on the amount of energy released in an Arc Flash event, and why? (1 mark)

C) Explain what electrical system parameters will affect each of the factors identified in part (A). (4 marks)

D) Your arc flash studies have identified an arc flash rating of 13 cal/cm^2 within a 1m boundary of the switchgear at a legacy substation.

Explain what Arc Flash PPE you would require (including PPE Category). (2 marks)

E) AS/NZS 61439.1 defines several different 'form' ratings for switchboard design.

Explain the difference between Form 3B and Form 4B, using diagrams in your answer. (2 marks)

END OF QUESTIONS

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**Electrical engineering manager of underground coal mines
CEE2 – Legislation and Australian Standards applicable to underground
mines**

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Question 1

(ESSENTIAL QUESTION) You must obtain 6 marks or more to pass this question and this paper.

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 marks)

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 marks)

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 marks)

D) Is there a waiting period? (2 marks)

If so:

i) What is it?

ii) What steps are required to reduce it?

Question 2

(ESSENTIAL QUESTION) You must obtain 6 marks or more to pass this question and this paper.

A) Regarding the management of risk, Section 17 of the Act imposes what duty on whom? (1.5 marks)

Section 18 of this Act states:

reasonably practicable, in relation to a duty to ensure health and safety, means that which is, or was at a particular time, reasonably able to be done in relation to ensuring health and safety, taking into account and weighing up all relevant matters including...

B) What are five 'relevant matters' defined in Section 18 that must be weighed up when considering what is 'reasonably practicable'? (5 marks)

[illegible]

Question 3

Your mine has placed an order for a new 11/1.05kV 2.5MVA Development Substation.

You find out that the supplier is a new business, and this is the first underground substation they've ever built.

Section 34 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 defines several legislative obligations regarding the design, installation and commissioning of the substation.

A) What are design requirements for the Switchgear? (2 marks)

B) What Electrical Protection must be provided on the outlets? (3 marks)

(Note: these outlets may be used to supply flexible reeling or trailing cables)

C) In what circumstances is 'earth fault' protection permitted instead of 'earth leakage' protection? (1 mark)

D) What must be done prior to the substation being first energised at the mine? (1 mark)

E) What information about the substation must be shown on the plans of electrical installations at the mine? (2 marks)

Question 4

A) The fundamental principles of AS3000 describe the 3 (three) major types of risk. What are they? (3 marks)

B) There are 4 (four) methods of Basic Protection. What are they? (2 marks)

C) Under Section 8.3.3 *Mandatory Tests*, the specific mandatory tests are listed for Low Voltage installations. List and describe the purpose of each test. (5 marks)



Question 5

AS/NZS 2290.1 2021 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) Under which section of the NSW Work Health and Safety (Mines and Petroleum Sites) Regulations is compliance with this standard mandated? (0.5 mark)

B) According to this standard, name 4 (four) types of records that should be included in a verification dossier? (1 mark)

C) Who is responsible for identifying the competencies required for personnel responsible for the maintenance of equipment? (0.5 mark)

The diagram on the left shows a cross-section of a flange with a central opening. The flange has a thickness C . The opening has a diameter D_1 and a depth D_2 . The length of the flange is L . The flange is labeled "Flange".

The graph on the right shows the "MAXIMUM ALLOWABLE DEPTH OF CORROSION $D_1 + D_2$ " on the Y-axis (ranging from 0 to 0.25) versus the "CLEARANCE BETWEEN FLAMEPROOF FACES C " on the X-axis (ranging from 0 to 0.30). The graph is divided into three regions based on the length L :

- For $L \leq 12.5$, the maximum allowable depth of corrosion is 0.025.
- For $12.5 < L < 25$, the maximum allowable depth of corrosion is 0.075.
- For $L \geq 25$, the maximum allowable depth of corrosion is 0.25.

[illegible]

Decide if you will return the machine to service and provide a justification. (3 marks)

[illegible]

What will you do upon receiving this information? Detail the items you will need to confirm.
(3 marks)

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

Question 6

A) According to AS/NZS IEC 60079.0, for what type of environment is Group I electrical equipment specifically designed to operate in? (1 mark)

B) According to AS/NZS IEC 60079.0, what type of hazardous environment is Group II electrical equipment designed to operate in? (1 mark)

C) Give a practical example of where you would likely find Group II Equipment in use? (1 mark)

D) According to AS/NZS IEC 60079.0, what type of hazardous environment is Group III electrical equipment designed to operate in? (1 mark)

E) Which explosion protection technique, as defined in AS/NZS IEC 60079.0, is primarily based on the principle of containing an internal explosion to prevent ignition of the surrounding atmosphere? (1 mark)

F) Which explosion protection technique, as defined in AS/NZS IEC 60079.0, is based on limiting electrical energy to prevent ignition of a hazardous atmosphere? (1 mark)

G) Describe the attributes that are designed to prevent the ignition of an explosive atmosphere for type of protection Ex 'e'. (2 marks)

H) Describe the attributes that are designed to prevent the ignition of an explosive atmosphere for type of protection Ex 'm'. (2 marks)

Question 7

You are the Electrical Engineering Manager at an underground coal mine when you are advised by an electrician that “We have had an unplanned movement on a shuttle car”.

The initial information is that the shuttle car was selected to move outbye, however the shuttle car moved in the inbye direction approximately 1m before running into the back of the continuous miner. Another worker was standing between the Continuous Miner and the Shuttle Car at the time, and had to take evasive action to avoid any injury. The Shuttle Car operator applied the brake and then shut down the machine.

A) What steps will you now take with respect to this incident? (2 marks)

B) What are your responsibilities under legislation? (2 marks)

C) Who and how would you notify in respect to this situation? (2 marks)

D) Who would you involve in the incident investigation? (2 marks)

E) What key areas would your investigation focus on? (2 marks)

Question 8

Clause 76 (3) of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 states “*The mine operator of an underground coal mine must ensure that methane monitoring plant is provided at the mine that...*”

A) There are five requirements, please identify at least 4 (four). (4 marks)

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

B) Section 76(6) of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 states “*The mine operator of an underground coal mine must ensure each face machine in use at the mine is equipped with a continuous methane monitor that...*”

There are three requirements, please state the requirements for (a), (b), (c). (3 marks)

(a) gives an audible or visible alarm if:

(b) cuts the supply of power to the face machine if:

(c) cuts the supply of power to the face machine if:

i)

ii)

C) Based on the above Section 76(6), and with your understanding of the definition of *face machine* from Schedule 15 Dictionary of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022, would the following equipment be expected to have continuous methane monitoring equipment fitted? Justify your answers. (3 marks)

Mobile Roof Bolter:

Longwall Shearer:

Continuous Miner:

Question 9

You are the Electrical Engineering Manager at an underground coal operation that includes a large coal handling and preparation plant. The CHPP is in the process of procuring a fleet of new diesel-powered machines. You are referencing AS/NZS 4871.6 to assist in developing the technical specification for these new machines.

A) Section 2.2 General Arrangement, Control and Protection states 15 (fifteen) specific requirements. Identify 4 (four) of these requirements and provide details of each requirement. (4 marks)

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

B) Section 2.3.2 Protection Devices states that protection devices shall automatically interrupt a circuit in the event of a circuit fault or overload. There are 5 (five) specific fault conditions listed. Identify 4 (four) of these requirements. (2 marks)

C) Section 2.3.4 Unprotected circuits states that an electrical protection device need not be provided if either impractical or the operation of that protection device results in an alternative risk of greater magnitude.

Provide an example of when you would accept the application of this clause. (1 mark)

D) Section 2.3.4 Unprotected circuits states that if an electrical protection device is not provided on a circuit, then effective measures shall be taken to minimise the risk of circuit failure.

There are 9 (nine) measures mentioned in the standard. Identify 3 (three) control measures and provide details of each. (3 marks)

Question 10

Review the simple intrinsically safe system assessment:

<u>Item</u>	<u>IS interface</u>	<u>IS Field Device</u>
Equipment Group	I	I
Level of Protection	Ia	Ib
Temp Classification		T2
Ambient Temp	-20 to +50	0 to +80
Parameter Comparison		
Voltage	Uo = 28V	Ui = 30V
Current	Io = 100mA	Ii = 50mA
Power	Po = 700mW	Pi = 450mW
Cable Comparison		
Capacitance	Co = 15uF	Ci = 10uF
Inductance	Lo = 4.5mH	Li = 10uH
L/R		

A) What is the overall Equipment Group of the System achieved? (1 mark)

B) What is the overall Level of Protection of the System achieved? (1 mark)

C) What is the maximum permitted capacitance of the connecting cable? (1 mark)

D) What is the maximum permitted inductance of the connecting cable? (1 mark)

E) For a cable with a specified capacitance of 100nF/m, what is the maximum permissible cable length? (3 marks)

F) Based on an evaluation of voltage, current and power parameters, can the field device be utilised with the IS interface? Justify your answer. (3 marks)

END OF QUESTIONS

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