



Regional
NSW

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

EXAMINATION: MECHANICAL ENGINEERING MANAGER

EXAM PAPER: CME1 – Mechanical engineering practices applicable to underground coal mines

DATE: Wednesday 3rd August, 2022 – 8:50 am to 12:00 pm

EXAMINATION FOR CERTIFICATE OF COMPETENCE TO BE A MECHANICAL ENGINEERING MANAGER OF UNDERGROUND COAL MINES

Issued under the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*

INSTRUCTIONS TO CANDIDATES:

Unless otherwise stated all references to Act and Regulations 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 2014

Candidates shall be seated in the exam room no later than 8:40 am 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 three (3) blank pages included at the end of the paper. Ensure the question you are answering is clearly marked.

All ten (10) questions are to be attempted. All questions are of equal value.

Candidates will be marked as competent, or not yet competent. If a question is identified as **ESSENTIAL** then then the candidate must be deemed competent in that question in order to be deemed competent in the exam. If a part of a question is identified as **ESSENTIAL** then the candidate must be deemed competent in that part in order to be deemed competent in that question.

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	Competent	Not yet competent	Assessed by <i>Name</i>	Comments to justify, as necessary
1	a	Elements				
	b					
	Verdict					
2	a					
	b					
	c					
	d					
	Verdict					
3	a - j					
	Verdict					
4	a					
	b					
	c					
	Verdict					
5	a					
	b					
	c					
	d					
	Verdict					
6	a					
	b					
	c					
	d					
	Verdict					

Question Number		Essential	Competent	Not yet competent	Assessed by <i>Name</i>	Comments to justify, as necessary
7	a					
	b					
	c					
	d					
	Verdict					
8	a					
	b					
	Verdict					
9	a	Elements				
	b					
	c					
	Verdict					
10	a					
	b					
	Verdict					
PAPER	Verdict					<i>Marks checked by:</i>

If marking is reviewed under approved processes, then examiner is to record details:

Date	Examiner	Questions reviewed	Marks changed	Details/justification, as necessary
Eg. 2/8/19	Andrew Palmer	All	Q1 – 4 (previously 5)	Found one more criteria

b. Without disturbing the incident scene, for a collision incident list five (5) items of information you would make note of for each of the following investigation areas to assist you in assessing the root cause prior to notifying the relevant authorities.

People

	C NYC
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Equipment

	C NYC
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Environment

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Question 2 – Conveyors

Conveyor belts have been used in coal mining for many years for efficient bulk materials handling

- a. Identify three (3) methods for tensioning a conveyor belt system

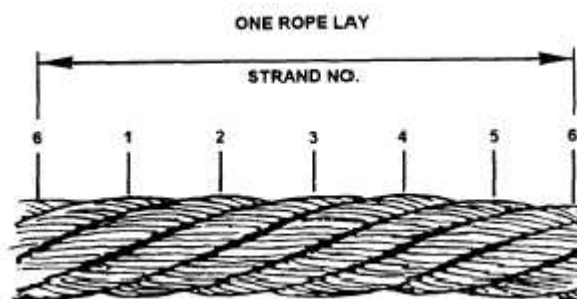
C NYC

- b. For one (1) tensioning method identified above, name the tensioning method, and provide a neat sketch of the configuration of significant components

C NYC

Question 3 – Multiple choice

- a. When testing open joints on the inlet or exhaust system of a diesel engine system, what is the maximum thickness of the feeler gauge that should be used?
- Less than 0.5mm
 - Less than 0.3mm
 - Less than 0.2mm
 - Less than 0.1mm
- b. What factors influence the braking capacity of rubbered tyred mobile plant?
- Tyres with aggressive tread pattern
 - Increasing brake system pressure
 - Decreasing load carrying capacity
 - Dust suppression watering on roads
 - All of the above
- c. Which standards define anti static properties the conveyor and conveyor components shall conform to?
- Grade S in AS4606
 - Grade E in AS1332
 - AS1333
 - Any of the above
- d. Any conveyor which can run away due to the effect of gravity shall be provided device(s) which will automatically prevent runaway. Where a hazard to people exists then:
- the anti-runaway device shall be capable of holding 150% of the load
 - the two anti-runaway device shall be capable of independently holding 100% of the load
 - the two anti-runaway device shall be capable of cumulatively holding 150% of the load
 - the two anti-runaway device shall be capable of independently holding 150% of the load
- e. The rope shown in the picture below is of what construction?








- Right hand ordinary lay
- Right hand Langs lay
- Left hand ordinary lay
- Left hand Langs lay

- f. Of the following items of plant used in underground mining which has the highest operating fluid pressures
- i. Longwall powered roof support
 - ii. In seam gas drill rig
 - iii. Common rail diesel engine LHD
 - iv. Continuous miner
- g. What minimum distance in standards should gas fuel cylinders be stored away from fuel bays, fuel outlets and/or mobile equipment under repair:
- i. 5m
 - ii. 10m
 - iii. 15m
 - iv. 20m
- h. LPG bulk storage tanks as a minimum require inspection:
- i. Monthly
 - ii. Annually
 - iii. Every four (4) years
 - iv. At time of manufacture
- i. According to MDG28 what are the recommended methane (CH₄) detector set points for alarm and trip in reclaim tunnels
- i. 0.25% alarm and stop coal feed, 1% trip power to non explosion protected equipment
 - ii. 0.5% alarm and stop coal feed, 1% trip power to non explosion protected equipment
 - iii. 0.5% alarm and stop coal feed, 1.25% trip power to non explosion protected equipment
 - iv. 0.5% alarm and stop coal feed, 1.5% trip power to non explosion protected equipment
- j. What does the term freeboard refer to with respect to belt conveyors?
- i. The distance the pulley shell is wider than the conveyor belt to allow for some belt misalignment
 - ii. The distance fixed steel work is away from the edge of the conveyor belt to prevent contact during belt wander/misalignment
 - iii. The distance between the centre of the carry belt and the underside of the roof or fixed infrastructure
 - iv. The distance the belt is wider than the conveyed product to prevent lumps rolling off the side

Question 4 – Hydraulics

- a. For the following table of hydraulic schematic symbols draw a line to link the symbol to the correct component description

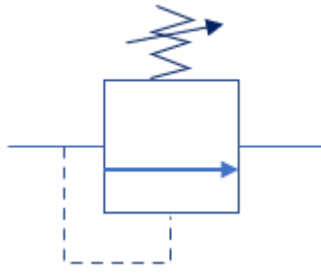
Large square or rectangle			Visible indicator or orifice
Large circle			Connectors (hoses, pipes, etc)
Diamond			Rotary motion (pump/motor)
Small circle			Pressure / flow control valve
Intersecting lines			Fluid conditioning device

C NYC

- b. Draw the hydraulic schematic symbol for an open center, three position, lever operated, spring return, directional control valve

C NYC

c. Explain the operation of the hydraulic component depicted by the following schematic symbol



C NYC

Sitting in the centre of the desk when you arrive is a copy of the annual structural Integrity report dated yesterday, identifying 100 different defects in the following categories:

- Five (5) of Critical ranking
 1. Reject bin support leg has been struck by a reject truck (unreported)
 2. Spirals support beams have lost 50% of their cross sectional area
 3. External sheeting purlins on the plant feed surge bin are almost non existent
 4. External sheeting is loose and flapping in high winds
 5. Underpans are missing on the skyline feed conveyor above the CHPP access road
- Twenty (20) of High ranking
- Seventy (70) of Moderate ranking
- Five (5) of Low ranking

b. Based on the above summary what should your top four (4) immediate actions be?

	C NYC
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c. What defect items would you prioritise?

	C NYC
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Question 7 – Winders

Work Health and Safety (Mines and Petroleum Sites) Regulation Clause 5 (a) (iii) identifies winders as a principal hazard that may result in multiple deaths from a single incident. Mine shafts and winding systems NSW Code of Practice was released by the Resources Regulator in 2019 to assist mines identify potential hazards and develop controls to safely manage their winders.

- a. Draw the basic layout for a Koepe friction winder, and identify all the components from the following list using the letter associated with each

- A. Head sheave
- B. Cage
- C. Counterweight
- D. Head rope
- E. Balance rope
- F. Guide rope
- G. Cheese weight

b. What are the factor of safety requirements for the following single line components?

i. Non threaded _____

ii. Threaded _____

	C NYC
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c. What is the factor of safety required for drum winder rope when...?

i. Newly installed _____

ii. Prior to discard (minimum) _____

	C NYC
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d. Technical Reference Guide: Powered winding systems, Part 4: Ropes, section 5 identifies nine (9) potential causes of rope deterioration that may either individually or cumulatively result in the rope being required to be discarded. Identify five (5) of these.

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Question 9 – Safety critical systems

Essential Elements

The mining industry continues to have reportable incidents with regards to the failure of safety critical systems on mobile plant, and a number of safety alerts have been issued.

- a) For a standard rear dump haul truck identify four (4) safety critical systems. **Two of these safety critical systems are considered essential answers and must be included. If they are not included the candidate will be deemed not yet competent for the question.**

	C NYC
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- b) Select two (2) of the safety critical systems you identified above, and for each one describe three (3) possible modes of failure.

c) As the Mechanical Engineering Manager you are reviewing your management systems for mobile plant. List ten (10) controls you will ensure you have in place to minimise the potential for incidents involving the failure of safety critical systems.

Question 10 – Short answer

a) True or false. Place a 'X' in the box to indicate your answer

		Question	True	False
1		The lower explosive limit (LEL) of methane in air is 4.8%		
2		The locking ring on an earth moving tyre is designed to protect people from rim ejection		
3		Entanglement includes a persons body part being caught and drawn into rotating machinery		
4		Belt wander switches are designed to protect people from being struck by material being ejected from a moving conveyor belt		
5		Fail to safe pnueamatically applied brake systems are designed to apply if there is a loss of system air pressure		
6		Floats in the wet scrubber of an underground diesel engine system (DES) maintain the water level so that combustion flames can not exit the vehicles exhaust system into the mine atmosphere		
7		'WLL' on lifting equipment such as monorail beams identifies the working load limit for a vertical point load to the beam		
8		The factor of safety for hydraulic hose assemblies is 4:1		
9		Australian Standard AS1851-2005 states the best practice for maintaining fire protection systems and equipment is that extinguishers should be inspected every 6 months		
10		Safety chains from a collar at the drift winder rope attachment to a dolly car are designed to maintain control of the dolly car in the event of rope failure		

C NYC

- b) Pick the standards. NSW Code of Practice: Mechanical engineering control plan section 8.2 identifies reference documents including Australian Standards and guidelines. Select the corresponding Australian Standard number from the list table below to match the Standard title in the answer table, and write the standard number beside it

Australian Standards

AS 1418	AS 1554	AS 1657	AS 1755	AS 1851
AS 2030	AS 2294	AS 2550	AS 2865	AS 3000
AS 4024.3611	AS 4041	AS 4100	AS 4603	AS 5062

Answer table

AS Number	Australian Standard Title
	Conveyors – Belt conveyors for bulk materials handling
	Fire protection for mobile and transportable equipment
	Pressure piping
	Structural steel welding
	Fixed platforms, walkways, stairways, and ladders – design, construction, and installation
	Steel structures
	Cranes including hoists and winches
	Earth moving machinery – protective structures - general
	Cranes – safe use
	Confined spaces

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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



Regional
NSW

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

EXAMINATION: MECHANICAL ENGINEERING MANAGER

EXAM PAPER: CME 2 – Legislation and standards applicable to
underground coal mines

DATE: Wednesday 3rd August, 2022 – 1:10 pm to 3:20 pm

**EXAMINATION FOR CERTIFICATE OF COMPETENCE TO BE A MECHANICAL
ENGINEERING MANAGER OF UNDERGROUND COAL MINES**

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	b	Essential			
	c	Essential			
	d	Essential			
	Verdict				
2	a				
	b				
	c				
	d				
	Verdict				
3	a				
	b				
	c				
	d				
	Verdict				
4	a				
	b				
	c				
	d				
	Verdict				
5	a				
	b				
	c				
	Verdict				

Question Number		Essential	Competent	Not yet competent	Assessed by <i>Name</i>	Comments to justify, as necessary
6	a					
	b					
	c					
	Verdict					
7	a					
	b					
	c					
	Verdict					
8	a					
	b					
	c					
	d					
	Verdict					
9	a					
	b					
	c					
	d					
	Verdict					
10	a					
	b					
	c					
	d					
	Verdict					
PAPER	Verdict					<i>Marks checked by:</i>

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Question 1 – Role of Mechanical Engineer and MECP

Essential

The candidate must be assessed as competent for this question in order to be considered as being competent for the entire exam

The role of the Mechanical Engineering Manager

Work Health and Safety (Mines and Petroleum Sites) Regulation

Schedule 10 Part 2 Underground coal mines

Clause 5 Mechanical engineering manager

1) The statutory functions of a Mechanical Engineering Manager are:

- a. To _____ the mechanical engineering standards and procedures forming part of the mining operations at a mine
- b. To supervise the _____ of mechanical plant at the mine

a. What are the four (4) requirements in relation to clause 1) a. above?

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b. What are the four requirements in relation to clause 1) b. above?

	C NYC
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Question 2 – Stockpiles and reclaim tunnels

Work Health and Safety (Mines and Petroleum Sites) Regulation

87 Ventilation _____

(1) This clause applies to the following items of plant—

(a) any component of the ventilation system of an underground coal mine,

(b) _____ used at an underground coal mine or in a reclaim tunnel at a coal mine.

(2) The regulator may, by notice published in the Gazette, identify an item of plant to which this clause applies and specify the testing and certification process for determining whether the item of plant is _____

(3) The mine operator of a coal mine must ensure that an item of plant specified in a notice under this clause is not used at the mine unless it has been tested and certified in accordance with the notice.

a. According to Clause 87 (1) (b) what items of plant are referred to, and what must they be?

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b. Very few Australian Standards are specifically referred to in the Work Health and Safety (Mines and Petroleum Sites) Regulation. Schedule 2 (2) (4) (c) refers to which Australian Standard?

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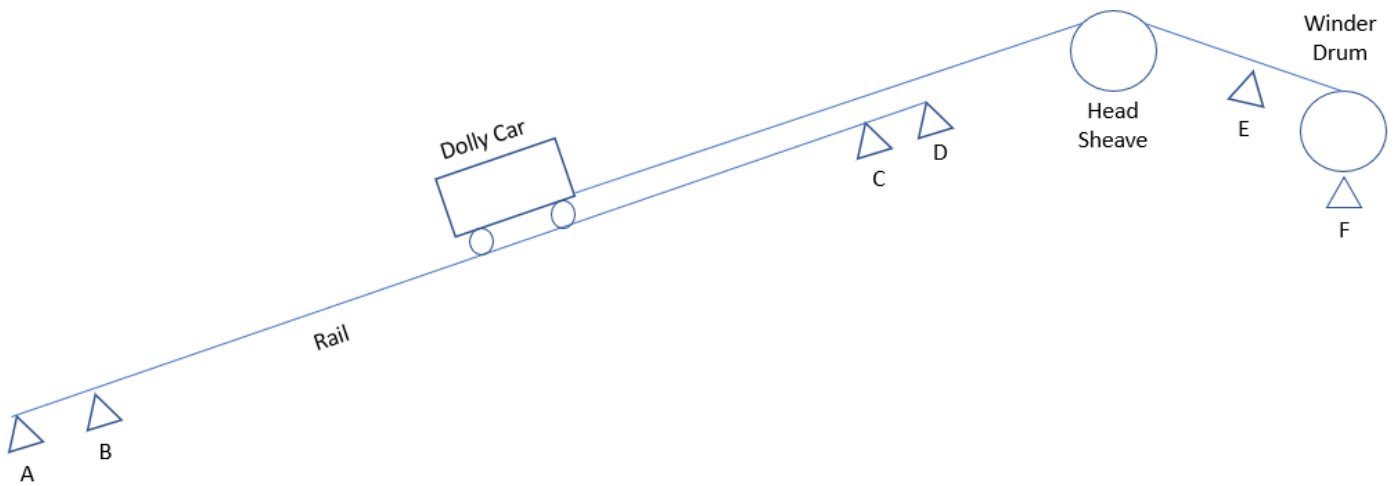
MDG28 Safety requirements for coal stockpiles and reclaim tunnels

- c. Section 3.1.4 refers to dozer engulfment. List six (6) risks of harm to the dozer operator in relation to the stockpile draw down points.

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- d. Section 3.2.1 identifies recommended minimum controls for dozers working on coal stockpiles. List six (6) mitigative controls required

	C NYC
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b. Identify the following limit switch / monitoring device denoted on the attached drawing

A -

B -

C -

D -

E -

F -

C NYC

WHS(MPS) Schedule 1

3 Mine shafts and winding systems

The following matters must be considered in developing the control measures to manage the risks associated with mine shafts and winding systems—

- (a) the potential for instability and loss of integrity of the shaft,
- (b) the potential for fires in underground operations, the shaft or winder areas,
- (c) the potential for any unintended or uncontrolled movement of conveyances within the shaft,
- (d) the potential for a conveyance to fall down the shaft,
- (e) the potential for failure of, or damage to, equipment and control measures, including the following—
 - (i) control measures that are intended to prevent any shaft conveyance from overwind, excessive acceleration or deceleration, unsafe or excessive speeds or uncontrolled movement,

Question 5 – WHS Act – Missing words

a. Fill in the missing words for Section 3 Object

(1) The main object of this Act is to provide for a balanced and nationally consistent framework to secure the health and safety of workers and workplaces by—

- (a) protecting workers and other persons against harm to their health, safety and welfare through the _____ of risks arising from work or from specified types of substances or plant, and
- (b) providing for _____ workplace representation, consultation, co-operation and issue resolution in relation to work health and safety, and
- (c) encouraging unions and employer organisations to take a constructive role in promoting improvements in work health and safety practices, and assisting persons conducting businesses or undertakings and workers to achieve a _____ working environment, and
- (d) promoting the provision of advice, information, _____ in relation to work health and safety, and
- (e) securing compliance with this Act through effective and appropriate compliance and _____, and
- (f) ensuring appropriate _____ of actions taken by persons exercising powers and performing functions under this Act, and
- (g) providing a framework for _____ and progressively higher standards of work health and safety, and
- (h) maintaining and strengthening the national harmonisation of laws relating to work health and safety and to facilitate a consistent national approach to work health and safety in this jurisdiction.

b. 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 a _____ 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 _____ 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 _____ of workers arising from the conduct of the business or undertaking.

C NYC

c. 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 _____ 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 _____ of the person conducting the business or undertaking relating to health or safety at the workplace that has been notified to workers.

C NYC

Question 6 – Safety Bulletin SB22-04 Hand injuries



**NSW
Resources
Regulator**

SAFETY BULLETIN

DATE: MARCH 2022

Hand injuries (including fingers and thumbs)

This safety bulletin provides safety advice for the NSW mining industry.

Issue

The NSW Resources Regulator has noted an increase in the number of reported injuries involving hands within the mining sector. One hundred and forty-one hand injuries were reported to Regulator during 2021. Hands, fingers and thumbs being caught, crushed, jammed and/or pinched was the most common cause of injury. While some injuries such as minor lacerations were treated with sutures or glue, some more serious hand injuries resulted in fractures, tendon or nerve damage. Some workers suffered injuries requiring surgery and ongoing specialist care. Nine workers had one or more fingers amputated over the past 12 months.

Mining and hand injuries

Operational and maintenance tasks can be highly complex and intricate tasks that require workers to place their hands within or near equipment that has sharp edges, pinch points or can move. In addition, mine workers undertaking these tasks also needs to manage:

- working near moving and rotating equipment
- load shifting during parts removal and change out
- underground environments with limited light
- undertaking tasks in tight awkward positions with restricted visual capacity.

Workers were wearing gloves in most incidents, and on some occasions workers were not aware they had suffered an injury until they had removed their gloves.

a. In relation to hand injuries identify four (4) specific notification requirements under Work Health and Safety (Mines and Petroleum Sites) Regulations Clause 178.

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b. What injury to the hand is specifically excluded from Clause 178?

C	NYC
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c. With consideration to the hierarchy of controls, and the obligations of both Mine Operators and workers, describe seven (7) actions you would implement to minimise the potential for hand injuries.

Question 7 – 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?

	C NYC
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b. What requirements are placed on the nature of consultation?

	C NYC
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C NYC

c. What is the primary difference between the high potential incident events identified in Clause 128 (5) (a), which refers to events in Clause 179 (a), and the dangerous incidents identified in Clause 179

C NYC

d. Apart from the incident type events described in Clause 179 (a) there are twenty one (21) additional incidents that have to be reported in Clause 128 (5). List three (3).

C NYC

c. Codes of Practice

	C NYC
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d. Australian Standard

	C NYC
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Question 10 – Diesel exhaust emissions

53 Exhaust emissions and fuel standards

- (1) The mine operator of an underground mine must ensure that—
 - (a) exhaust emissions from diesel engines located underground are regularly sampled and analysed, and
 - (b) the results of that sampling and analysis are compared with the baseline exhaust emissions for the particular diesel engine when the engine was new (or as new), and
 - (c) the engine is regularly maintained so that emissions from the engine are as low as is reasonably practicable, having regard to those baseline exhaust emissions.
- (2) The mine operator of an underground mine must ensure that any fuel used at the mine—
 - (a) is supplied in accordance with the Fuel Quality Standards Act 2000 of the Commonwealth and the Fuel Standard (Automotive Diesel) Determination 2001 made under that Act, or
 - (b) is supplied in accordance with a fuel standard that has been varied by an approval under that Act by the Minister administering that Act.
- (3) The mine operator of an underground mine must ensure that any fuel referred to in subclause (2)(b) or fuel additives used at the mine do not increase the health and safety risks to workers at the mine—
- (4) Comparison load testing on underground diesel engines at various load points must be used to determine whether a fuel or fuel additive increases the health and safety risks to workers at the mine under subclause (3).

Diesel exhaust was identified as a carcinogen to humans in June 2012 by the International Agency for Research on Cancer.

- a. Describe four (4) types of gas tests, and the frequency that they are completed, you have implemented to meet the requirements of Clause 53 (1)

C NYC

- d. What are the raw and diluted diesel emission gas limits for diesel exhaust specified in MDG 29 Guideline for the management of diesel engine pollutants in underground environments? Complete the following table:

Contaminant	Raw Exhaust Limits	Diluted (General Body) Limits
Carbon Monoxide		
Nitrous Oxide		
Nitrogen Dioxide		
DPM Elemental Carbon		

	C NYC
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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