



mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

MINE ENGINEER'S CERTIFICATE OF COMPETENCY EXAMINATION

MINES AND WORKS - PLANT ENGINEERING

DATE: 12 NOVEMBER 2018

TOTAL MARKS: 100

TO PASS: 50

TIME ALLOWED: 3 HOURS
(09H00 to 12H00)

NOTE:

- This question paper consists of **NINE** pages including cover page **PLUS** the **MD1 Form** of **TEN** pages which must be handed in with answer book.
- Section A, Questions 1 to 3 are **COMPULSORY**. Section B, choose 2 questions of your choice.
- All answers are to be presented in a neat and decipherable manner. Papers will not be marked if not decipherable.
- The use of highlighters is not allowed.
- Do not use a red pen.
- Read the instructions on the front page of your answer book carefully.
- No cellular phones shall be allowed in the examination venue.
- The use of computers, laptops and palmtops are prohibited.
- The use of programmable calculators are not allowed.

Section A – All question in this section are compulsory [60]

Question 1

You have been appointed as the vertical transport engineer responsible for all the vertical transport systems and shafts on the mine this includes the ore passes, conveyors and loading silos. The engineer in the position before you upgraded the winders and auxiliary equipment and systems.

The shaft is a circular shaft with four winders. Two Multi rope Man winders and two multi rope rock winders. The configuration is one man and one rock winder on the eastern side and the other two on the western side.

He submitted the necessary documentation to the Department of Mineral Resources. The department send the documentation back with queries. You gathered the correct information and you need to resubmit the documentation.

It is required from you to give a true reflection of the documentation required. Make sure that all the necessary information is correct and submitted timeously.

Information collected by you:

Winder permit	=	9786 ✓
Rope lubrication	=	Automatic controlled
Depth of the shaft	=	Sheave to shaft bottom 2700 m
Length of wind	=	2200m
Mass of attachments	=	950 kg
Mass of conveyance	=	2200 kg
Conveyance used	=	4 Deck Aluminium
Persons per deck	=	40
Mass of inspection conveyance	=	1000 kg
Winder electrical system	=	24 pulse Converter system
Winder Brake system	=	Escort Mark vii hydraulic brake system with emergency
Winder signalling System	=	Belltronic system one for each compartment
Winder event recorder	=	Incorporated into the electronic bell recording system

Winder bell recorder = Electronic bell recorder System
 Speed Controller = Electronic Speed Distance Controller
 Shaft Configuration = Circular shaft 4 compartments

Rope 7410

Rope installed:	West Man Underlay	West Man Overlay
Name or number of compartment in which ropes are used		
Coil number of rope installed	156443-002	156443-001
Name of manufacturer	Haggle Rand	Haggle Rand
Date of manufacture	30 June 2016	28 June 2016
Date rope was put on	29 October 2017	29 October 2017
Length of ropes	m 2800	2800
Diameter	mm 63	63
Mass per metre	kg 16.910	16.910
Construction of rope	COMPOUND TRIANGULAR STRAND 6X34(16/12/6+3T)/F	COMPOUND TRIANGULAR STRAND 6X34(16/12/6+3T)/F
Layer, type and length	mm RHL 478.40	RHL 478.40
Number of strands	6	6
Number of wires in strand	34(16/12/6+3T)	34(16/12/6+3T)
Diameter of all the wires used	mm 3.65, 3.10, 2.70, 2.00	3.65, 3.10, 2.70, 2.00
Class of heart of rope	Fibre	Fibre
Class of strand core	Plaited core	Plaited core
Tensile grade of the steel for all wires	MPa 1960	1960
Actual breaking force of rope (when new)	3251	3269
Place of test	CSIR	CSIR
Certificate number	256941	256941

Given:

Blank Document to be completed for submission (MD1)

- 1) Correctly complete the given documentation for submission to the DMR:
 All the calculations done need to be shown in your Answer book.
 MARK THIS CLEARLY (8)
- 2) Why should you give the correct information on the documentation and what significance does it have. (2)
- 3) In the regulations it states that you need a winder event recorder. Why do you think this is necessary, explain in a short description how you think this system will help you the engineer and what is its common name. (2)
- 4) What would the static and capacity factors be that you need to include in the documentation. Use relevant information to determine this? (6)
- 5) How would you test the ultimate protection device? (2)

[20]

Question 2

You are appointed on a new shaft and you need to install two turbo air compressors for reticulating the shaft with compressed air.

Data of compressor one.

10 MW induction motor

Starting method = Auto transformer

Data of compressor two

5.2 MW synchronous motor used.

Excitation method = Brushless Excitation

Starting method = Auto transformer.

Each compressor will feed from its own meter panel but the reticulation system should be such that you will be able to feed both compressors from either side.

- 1) Draw the power circuit of the 10 MW motor auto transformer starters. (5)
- 2) Calculate the amount of cables to be installed to feed the 10 MW compressor to deal with the Starting and Running amps. Cables sizes that can be selected are 300mm² or 185mm² PILCSWA or XLPE cable. (10)
- 3) There is an alternative method in starting the 10 MW compressor this is by using a reactor starter. By means of a drawing indicate how you will install the reactor starter? (5)

[20]

Question 3

- 3.1 In which year were the current occupational health milestones set? (1)
- 3.2 In which month and year are the milestone target set for? (2)
- 3.3 What percentage of all exposure measurements is referred to for prevention of lung diseases? (1)
- 3.4 What is the milestone level set for crystalline silica? (2)
- 3.5 What is the milestone level for platinum dust respirable particulate? (2)
- 3.6 Mention three diseases in which no new cases will occur for previously unexposed individuals. (3)
- 3.7 What is the meaning of “previously unexposed individual”? (2)
- 3.8 What milestone for sound pressure is not to be exceeded? (2)
- 3.9 What standard shift threshold is not to be exceeded for sound pressure? (1)
- 3.10 By when should this standard shift threshold not be exceeded? (1)
- 3.11 As an Engineer what systems can you put in place to ensure achievement of these milestones (3)

[20]

Section B – Choose only TWO questions in this section [40]

Question 4

4.1 You are an engineer in charge of machinery in a coal mine underground operation. Machines in your section are no longer safe to use, accidents are on the rise, as a result, and it is also becoming extremely un-economical to keep the machines in operation. The only other alternative available is to replace the machines.

The table below details costs and revenues associated with the project to replace the machines, and thus improve safety and operational performance in your section.

Cost of capital: 12%

Year	Costs	Revenue	Discount Factors
0	R 150,000,000		
1		R 80,000,000	1.12
2		R 70,000,000	1,2544
3		R 60,000,000	1,405
4		R 45,000,000	1,574
5		R 45,000,000	1,762
TOTAL			

Motivate your decision to replace the machines, using the above information. 10)

Hint: Calculate NPV and explain why the decision to replace the machines is the right decision, given what the company is going through.

4.2 You are an engineer in charge of a boiler section. You have recently been experiencing a lot of priming with your boilers, which resulted in the cracking of your boiler cylinders and covers, which put the safety of employees at risk.

4.2.1 List 4 main causes of priming in boilers. (2)

4.2.2 List 4 indications of priming in boilers.

(2)

4.2.3 List and describe the 3 ways in which corrosion occurs in steel boilers.

(6)

[20]

Question 5

You have been appointed as the Services engineer in a shaft. Capital has been approved and you need to ensure the power supply feeding the expansion project is adequate. You have located three 10 MW 22 / 11 kV Dd1 ONAN Transformers in the Capital store. The shaft is fed from the utility (ESKOM) and the supply transformer is a 15 MW YD 11 transformer. There is a NEC installed on the utility side with a rating of 300 A for 10 sec.

Your installation underground should be two operational transformers and one spare. The spare should be so positioned such that it can be switched without any effort to feed either of the operational transformers if either one is out of commission. The operational transformers has one NEC per transformer installed. Your configuration should also cater for adequate redundancy.

5.1 The transformer in the utility yard feeding the mine is a Yd 11. Why would they install a Yd11 transformer and does it have an advantage for you as the customer? (2)

5.2 To reach your power requirement what changes to the utility transformer would you request the utility to make to their transformer. Also, explain your request? (5)

5.3 You must make changes to your transformer as well, what changes would you make to the three transformers to ensure the power requirement are reached? You need to keep the transformers as you have space restrictions in the transformer bay. Motivate your answer by a neatly drawn sketch of the changes.

(6)

5.4 Draw a single line diagram to show your installation configuration and explain your answer why this configuration?

(7)

[20]

Question 6

On a spring-applied hydraulic-release brake engine of a winding plant, two helical compression springs are nested, one inside the other. Both springs have the same free length $G = 80 \times 10^9 \text{ Pa}$.

Dimensions	Spring A	Spring B
Number of active coils	12	18
Wire diameter	16 mm	12 mm
Mean coil diameter	100 mm	70 mm

6.1. Determine the compression required for a braking force of 15kN

(4)

6.2 Calculate the load carried by each spring

(8)

6.3 Explain, with the aid of sketches, where losses occur in centrifugal pumps and describe what can be done to minimize such losses.

(8)

[20]

Question 7

7.1 State the beneficial features gained by using pilot circuit system on a coal mine flexible supply cable, use a sketch to explain this.

(14)

7.2 Explain the purpose of the rectifier in the pilot circuit.

(6)

[20]

TOTAL [100]