



mineral resources
& energy

Department:
Mineral Resources and Energy
REPUBLIC OF SOUTH AFRICA

MINE ENGINEER'S CERTIFICATE OF COMPETENCY EXAMINATION

MINES AND WORKS PLANT ENGINEERING

DATE: 08 NOVEMBER 2021

TOTAL MARKS: 100
TO PASS: 50

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

INSTRUCTIONS:

- This question paper consists of **SEVEN** pages including cover page.
- Questions 1 to 3 in SECTION A are **COMPULSORY** – answer all of them.
- Choose and answer **ANY 2** questions in SECTION B. The examiner will only mark the first 2 questions you have answered.
- All answers are to be presented in a neat and readable manner. Papers will not be marked if not readable.
- Restrict the use of highlighters.
- Do not use a red pen.
- Read the instructions on the front page of your answer book carefully.
- No cellular phones and any other related devices shall be allowed in the examination venue.
- The use of computers, laptops and any other related devices is prohibited.

Section A: Compulsory Questions

Question 1

The attached load of a double drum rock winder operating in a 22° inclined shaft was increased to 7 tons. The vertical depth from the bank to the loading box is 300 m.

Calculate:

(a) The diameter and the braking strength of the simple triangular strand rope given the mass per metre run is $4\,500\,d^2$ kg/m and the breaking strength $7,2 \times 10^5 d^2$ kN where d = diameter of the rope in metres. (7)

(b). The daily hoisting capacity, given: (7)

Maximum constant speed	5 m/s
Acceleration and deceleration rate	0,5 m/s ²
Loading and tipping time	35 s
Maintenance	1 hour/day
Pay load per skip	4 tons

(c) The maximum emergency deceleration rate for an emergency stop in order to overrun the rope tension. (6)

Total: 20

Question 2

- (a) You are an engineer at a mine. You have a major breakdown in the plant and two shafts, which feed into the plant, are on stop as a result of the breakdown. Amongst other tasks, a vertical lift, using 2 slings, has to be conducted, and the following is the information you have available at your disposal:

Sling height: 2,44 meters

Sling length: 3.66 meters

Weight of the lift: 6 tons

Vertical SWL of each sling: 3 tons at 90 degrees

- (i) Using the information provided, determine if the slings are adequately rated to support the weight to be lifted. (14)
- (ii) Why would a rigger prefer a 60 degrees sling angle to sling angles of less than 30 degrees, when doing vertical lifts? (6)

Total: 20

Question 3

1. Discuss the advantages and disadvantages of earthing the neutral conductor of a three-phase system. (6)
2. Discuss the influence on the electrical distribution network if the neutral is earthed in more than one points. (3)
3. The underground haulage of a mine and some rooms and passages on surface are equipped with 60 W incandescent globes. One of the energy saving drives of the mine is to replace the incandescent globes with LED lights. The cost to change a globe is R15-00 for either and it includes travelling time from globe to globe.

Data:

Quantity of incandescent lights	1 580
Power output of LEDs	5 W
Power factor of LED	0,503
Price per energy unit	R 0.45/kWh
Price per apparent power unit	R 22.50/kVA
Lamp life of a LED	10 000 hours
Lamp life incandescent	1 000 hours
Price of an incandescent	R 2.45
Price of a LED	R 24.00

- Calculate the cost in replacing the incandescent globes with the LED's (7)
- What will the impact be on the total electrical account? (1)
- Propose some feasible ways to save energy on the mine. (3)

Total: 20

[Section A: Total = 60 marks]

Section B: Answer only 2 Questions

Question 4

A 4,27 m diameter autogenous mill has a circulating load of 300 t/h of solids of relative density 2,7 in the form of pulp at a relative density of 1,8. The pulp is discharged into a sump where it is diluted to a relative density of 1,25 and then pumped 20 m vertically and 15 m horizontally through a 350 mm diameter pipe to a cyclone.

Calculate the:

- (a) critical speed of the mill in r/min (7)
- (b) water addition in the sump in l/s (6)
- (c) power of the pump motor to elevate the pulp to the cyclone (7)

Total: 20

Question 5

You are an engineer on a high production shaft and your maximum demand is 150 MW when operating at a power factor of 0.8 lagging and your load factor currently is 40 %. Most of the machines used on the shaft are large machines i.e, pump motor is rated at 4 MW. Smallest rating is 2 MW. You need to improve on your electrical consumption. If you install power factor equipment and an improvement to .95 is realised. You also improve your load factor to 70%. The maximum demand charge is R20 per KVA the energy charge is 63 cents per unit consumed.

- 1). Define Power Factor? (2)
- 2). Define Load Factor? (2)
- 3). What will the savings be if you improve the power factor to .95 with an load factor of 40% per year. (4)
- 4). Define Demand and diversity factor? (4)
- 5). In doing power factor correction there are 3 methods or methodologies to implement. Name all three and the significance it has to the electrical power system. (8)

Total: 20

Question 6

A chairlift installation must convey 450 persons per hour up a 30° incline shaft through a vertical height of 180 m by means of chairs suspended from chain driven carriers running on a rail circuit. Both landings are level and 22 m long. The velocity of the traction chain is 1,2 m/s and its mass is 7,30 kg/m and the mass of the safety rope is 1,5 kg/m. The mass of each carrier is 5 kg while that of a chair is 12kg.

- a) Assume an appropriate friction factor and calculate the total pull in the chains at the driving sheave and the bottom sheave when the up-going chairs are loaded. [15]
- b) Describe how the spin is taken out from the chairlift rope. [5]

Total: 20

Question 7

1. A three-phase, four wire 380 V underground electrical distribution system consists of a three-phase load of 100 kW at a power factor of 0,8 and three single-phase loads of 30, 40, and 59 kW respectively. Determine the current in each of the FOUR conductors. (10)

2. The delivery of a sludge pump must be varied by changing the slip-ring motor speed to 50% of the speed when the slip rings are short circuited with a 4% slip. Calculate the additional star connected resistance to be connected to the slip rings to achieve the decrease in speed. The three-phase 8-pole slip-ring motor is rated at 750 kW. The star-connected rotor winding has a resistance of 0,1 Ω /phase and a standstill leakage reactance of 0,5 Ω /phase. The frequency is 50 Hz. (10)

[Total: Section B = 40]

[Total Section A and Section B = 100 marks]