NON-NATIONAL CERTIFICATE:
ENGINEERING CERTIFICATE OF COMPETENCY

PLANT ENGINEERING: MINES AND WORKS

(8190306)

4 June (X-Paper)
09:00 – 12:00

CLOSED-BOOK EXAMINATION

Only non-programmable calculators may be used.

This question paper consists of 6 pages.
DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NON-NATIONAL CERTIFICATE:
ENGINEERING CERTIFICATE OF COMPETENCY
PLANT ENGINEERING: MINES AND WORKS
TIME: 3 HOURS
MARKS: 100

NOTE: If you answer more than the required number of questions, only the required number of questions will be marked. All work you do not want to be marked, must be clearly crossed out.

INSTRUCTIONS AND INFORMATION

1. Answer QUESTION 1, 2 and 3 in SECTION A and any TWO questions in SECTION B.

2. ALL the calculations must be shown.

3. NO marks will be given for calculations in which the steps cannot be clearly followed or for work completed in pencil.

4. Candidates are expected to make reasonable assumptions where necessary and these, together in any formulae used, must be clearly stated.

5. RULE OFF on completion of each question BEFORE starting the answer to a new question paper.

6. Number the answers correctly according to the numbering system used in this question paper.

7. This is NOT an open-book examination. Candidates are NOT allowed to use any notes, textbooks, references books or cellphones during the examination.

8. Candidates who were NOT accepted by the Commission, will be disqualified.

9. NO candidates may enter the examination room more than HALF AN HOUR after the start of the examination and NO candidate may leave the examination room before ONE HOUR has elapsed.

10. Cellphones are NOT allowed in the examination room.

11. Write neatly and legibly.
SECTION A

QUESTION 1

As an engineer, you find that after the installation of a new set of ropes, a long and a short rope have been installed. Winder details were as follows:

Number of layers – 4  
Drum diameter – 4.25 m  
Rope diameter – 45 mm

ONE of the skips stopped 600 mm from the loading station.

1.1 What is the total rope length that needs to be removed?  \hspace{1cm} (8)
1.2 How would you, as the engineer, check that the amount of rope that is to be cut off is of the correct length?  \hspace{1cm} (5)
1.3 The construction of a rope is: 6X33(15/12/6A)F. What does this terminology mean?  \hspace{1cm} (7) [20]

QUESTION 2

Most electrical coal mine machines operating at the face are fed by a flexible trailing cable through a socket and plug.

2.1 Draw a circuit diagram to illustrate the standard pilot circuit and pilot switch commonly used in conjunction with this type of feed.  \hspace{1cm} (9)
2.2 What are the benefits of using this type of pilot circuit?  \hspace{1cm} (4)
2.3 What is the purpose of the rectifier in the pilot circuit?  \hspace{1cm} (3)
2.4 Sketch and describe the composition of a flexible trailing cable commonly used in coal mines.  \hspace{1cm} (4) [20]
QUESTION 3

You are appointed as an engineer on a mine. You are informed during the morning shift that the rock hoist conveyance got stuck in the shaft and the automatic winder paid rope out to the conveyance causing a slack rope condition. The rope formed a corkscrew on top of the conveyance, about the width of the conveyance itself.

What are the steps you would follow to remedy the situation and what do you need to do before putting the winder back into production? [20]

TOTAL SECTION A: 60

SECTION B

Answer only TWO questions in this section.

QUESTION 4

A clear water centrifugal pump installation in a gold plant has a negligible suction head. The pump delivers 220 m³/h through a delivery pipe that is 30 m long, 156 mm in diameter and has a vertical lift of 26 m. The friction factor for the pipe, is 0.01.

Approximately midway along the length of the delivery pipe, a short pipe branches out from the delivery pipe. The branch pipe which is closed by means of a valve is at an elevation of 12 m above the centrifugal pump.

The valve is opened to a position where the discharge at the end of the delivery pipe is reduced to 135 m³/h and 100 m³/h of water flow through the branch pipe. At flow rates of 220 m³/h and 235 m³/h the pump efficiency is 78% and 77% respectively.

Determine the following:

4.1 The power required to drive the pump while the valve in the branch pipe is fully closed

4.2 The power required to drive the pump while the discharge from the branch pipe is 100 m³/h. Assume that the loss in the branch pipe is negligible

[10] [10] [20]

QUESTION 5

Wet ore is fed into a mill at a rate of 140 t/h together with cyclone underflow pulp at 75 t/s. The wet ore contains 5% moisture by mass. The density of the dry ore in the cyclone underflow pulp is 2.7 and 1,817 t/m³, respectively.

Calculate the amount of water which should be added to the mill discharge sump in t/s to bring the relative density of the sump discharge to 1,225.

[20]
QUESTION 6

6.1 What safety measures would you insist on during the excavation of a foundation pit 10 m long by 6 m wide by 10 m deep? The soil is reasonably firm.  

6.2 Describe with the aid of sketches the safety guards you would fit at the pulleys and drive of a belt conveyor for the protection of operating attendants and maintenance personnel.  

QUESTION 7

7.1 List the essential features necessary to make an internal combustion engine suitable for use in a hazardous area in a mine.  

7.2 A load haul dumper is used in an inclined shaft. Identify the hazards associated with this operation and quantify the risks in terms of the probability of them happening and in terms of their consequences.  

Describe ways and means to either remove the risk or to manage it without sacrificing safety.  

7.3 Discuss the qualities of diesel fuel which makes it suitable in terms of health to be used underground in a mine or a confined space.  

QUESTION 8

8.1 You are appointed under Regulation 2.13.3.1 as engineer to a smelting plant. On this plant waste heat from the furnace is used to generate steam as prime mover to a synchronous generator, used for power factor correction in order to limit electricity costs from Eskom.  

Describe the typical synchronizing procedure that would have to be followed and final settings required to ensure safe synchronisation of the motor and describe the actual power factor correction and power beneficial characteristics.  

8.2 Discuss the advantages and disadvantages of earthing the neutral conductor of an electrical system.  

8.3 What are the dangers of an open circuit on the secondary of an installed operating current transformer?
QUESTION 9

9.1 Develop a complete risk management programme based on SIX identified hazards in a horizontal shaft transport system. (15)

9.2 Describe how you, as a member of senior management team on the mine, would start to introduce a new safety culture into the mine. (5)

TOTAL SECTION B: 40
GRAND TOTAL: 100