

This question paper consists of 7 pages.

Programmable calculators may NOT be used.

CLOSED-BOOK EXAMINATION

09:00–12:00

6 June 2016 (X-Paper)

(8190306)

PLANT ENGINEERING: MINES AND WORKS

COMPETENCE

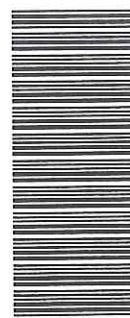
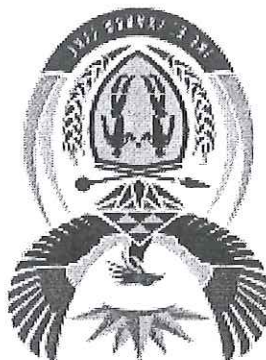
NATIONAL CERTIFICATE: ENGINEERING CERTIFICATE OF

JUNE EXAMINATION

N1610(E)(J6)H

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

higher education
& training



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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
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. SECTION A is COMPULSORY and must be answered by ALL the candidates.
2. Answer any TWO questions in SECTION B.
3. Read ALL the questions carefully.
4. Number the answers according to the numbering system used in this question paper.
5. Rule off across the page on completion of each question.
6. Show ALL the calculations.
7. Examination results will be disqualified if the candidate had not been accepted by the Commission of Examiners prior to the examination.
8. Candidates arriving 30 minutes late will NOT be allowed to sit for the examination. NO candidate writing the examination may leave the examination room before ONE hour after commencement has elapsed.
9. Write neatly and legibly.

SECTION A

ALL questions in this section are compulsory.

QUESTION 1

You are an appointed shaft engineer on a deep-level production shaft. The man winder brakes were recently upgraded to the new Escort Mk 5 braking system. After the final commissioning of the winder the driver complained that there was something wrong with the brakes because they were functioning unevenly. You have to investigate the complaint.

- 1.1 Where is the most obvious place you would look for the fault? (4)
- 1.2 In simple terms, what TWO programmable inputs does the Escort controller need to perform its function? Write down a simple formula to reinforce your answer. (6)
- 1.3 Explain the function of the Escort controller. (4)
- 1.4 Draw a typical speed/distance graph of what you expect to see from an Escort braking system. (4)
- 1.5 What is the function of the voting cards in the Escort controller? (2)

QUESTION 2

You are an engineer on the shaft and you need to upgrade your consumer substation with new vacuum magnetic-actuated breakers. You are writing the specifications for the switching gear and you need to decide what current transformers to specify. You have to cater for metering as well as protection circuitry. You have decided to use feeder differential protection for the feeders and ordinary overcurrent and earth-fault protection for your transformers.

2.1

What type of current transformers (CTs) will you specify for the following protection situations:

2.1.1

Differential protection

2.1.2

Transformer protection

2.2

What is meant by the knee point of a current transformer?

2.3

In QUESTION 2.1 you have made a selection on the type of current transformer you are specifying.

What are the fundamental differences between these current transformers? (4)

QUESTION 3

- 2.4 One of the considerations when selecting CTs depends on the accuracy. Name FOUR factors which will influence the accuracy of a current transformer. (4)
- 2.5 Indicate the differences of the current transformers by means of a graph. (4)

[20]

- 3.1 You have just been appointed in a new shaft section of the mine. It has occurred to you that the closest refuge chamber for employees in that section is over 1 km away. What interim measures can you make to ensure the health and safety of personnel? (4)

- 3.2 You have also just been made aware that employees at the bottom most portion of that section do not have a second escape. (4)

- 3.2.1 What is meant by a second escape? (2)

- 3.2.2 What provisions will you make to protect the health and safety of employees working in that area of the mine? (4)

- 3.3 As a responsible person of the mine transport workshop you must decide whether a cracked steel fuel tank may be repaired by electric arc welding or not. Give reasons for your decision. (6)

[20]

TOTAL SECTION A: 60

SECTION B

Answer only TWO questions in this section

QUESTION 4

4.1

A slimes dam return pump station is equipped with four pumps driven by 55 kW, 3-phase, 550 V, 0.83 power-factor motors. Water is valuable and in short supply and pumps cannot be stopped for any reason. Repairs are done by replacing a pump with a spare one as fast as possible. The power to the pump station is supplied with a 4-core, 150 mm², 1 000 V, 750 m long PVC SWA cable, buried for the whole distance. The water shortage could be eased during the rainy season if a fifth pump could be added.

Decide whether a fifth pump could be added to the supply without overloading the cable or replacing it. Develop a proposal supported by the necessary calculations that could be presented to the chief engineer.

(10)

4.2

As sectional engineer of an underground section you are required to introduce a vehicle avoidance system (VDS) to the vehicles and personnel at your mine. At the meeting with the various suppliers of vehicle avoidance systems the suppliers discussed electromagnetic interference.

4.2.1

What is electromagnetic interference?

(2)

4.2.2

What dangers does this introduce in a mine?

(3)

4.2.3

How is it detected and what tests must be carried out by the suppliers of this VDS equipment?

(2)

4.2.4

What other equipment items affect the VDS?

(3)

[20]

QUESTION 5

5.1

Briefly explain the cause of heat generation in plain bearings.

(3)

5.2

State THREE ways of reducing the generation of heat in a plain bearing.

(3)

5.3

Briefly explain how running hot can cause a plain bearing to seize.

(2)

5.4

What causes seizure of a metal-to-metal plain bearing?

(2)

5.5

State FIVE causes of vibrations and their prevention in main ventilation fans.

(10)

[20]

QUESTION 6

6.1 The following information was obtained for an underground mining area that is to be cooled by chilled service water and air heat exchangers:

Mass of rock mined 85 000 t/month
 Mass ratio of service water to mined rock 2,5 : 1
 Temperature difference of the chilled water across the refrigeration plant 19° C
 Temperature difference of the chilled water across the heat exchangers 17° C
 Quantity of refrigeration to cool the air 12 200 kW
 Quantity of refrigeration to cool the mined rock 6 280 kW

Determine the following:

- 6.1.1 The quantity of chilled service water (2)
 6.1.2 The quantity of chilled water to cool the air (2)
 6.1.3 The total quantity of chilled water to be provided (3)
 6.1.4 The capacity of the refrigeration plant (3)

6.2

The following are particulars of a three-throw single-acting belt-driven plunger pump used to elevate the settled slime up a vertical shaft:

Diameter of plunger 120 mm
 Length of stroke 270 mm
 Speed of pump 1,66 rev/second
 Relative density of the solids 2,7
 Relative density of the slime 1,12
 Diameter of pipe line 150 mm
 Depth of shaft 1 000 m
 Volumetric efficiency 95%
 Pump efficiency 48%

Determine the following:

- 6.1.1 The mass of dry solids pumped in kg/s (8)
 6.1.2 The power of the electric driving motor (2)

[20]

QUESTION 7

7.1

The power supply in a mine was extended from an existing underground 6,6 kV substation to two mini-substations. The mini-substations are 400 kVA each and have a number of gate-end boxes in two different working areas. Each mini-substation is supplied separately from a joint box at the split in the haulage and the joint box is supplied with a single feeder cable from a 6,6 kV substation. The mining process consists of drilling, blasting, scraping into slope chutes and transport by train.

7.2

Describe SIX tests required before switching on to ensure the safety of operating personnel and to ensure the dependability of the power supply after an earth fault has occurred on one of the machines. (6 × 2) (12)

A 4,8 MW, 11 kV, separately excited motor, drawing 5,333 MVA at a 0,9 power factor leading drives a 50 000 m³/h air compressor and is connected in parallel with a process plant drawing 5 MW at a 0,8 power factor lagging. Besides thermal overload protection, describe the function of FOUR other electrical protection devices you would expect to find installed to safeguard the compressor motor. (4 × 2) (8)

TOTAL:**100****[20]**

(8)

