Chamber of Mines of South Africa

EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 3 PLANNING, APPLIED ECONOMICS AND TECHNICAL LITERATURE **SUBJECT CODE: COMMEC P3** **EXAMINATION DATE:** 11 MAY 2017 **TIME**: 14:30 – 17:30	**EXAMINER:** M. Coelho **MODERATOR:** M. Beukes **TOTAL MARKS:** 100 **PASS MARK:** 60%

NUMBER OF PAGES: 6

SPECIAL REQUIREMENTS:

THIS IS NOT AN **OPEN BOOK EXAMINATION**.

INSTRUCTIONS TO CANDIDATES:

1. Answer all questions **legibly** in English.
2. Write your **ID number** on the outside cover of each book used and on any graph paper or other loose sheets handed in.

NB: Your name **must not** appear on any answer book or loose sheets.

3. Show all calculations **and check calculations on which the answers are based.**
4. Hand-held electronic calculators may be used for calculations.
5. Write **legibly** in ink on the **right-hand page** only – **left hand pages will not be marked**.
6. Illustrate your answers by means of sketches or diagrams wherever possible.
7. Answers must be given to an accuracy which is typical of practical conditions.

   NB Ensure that the correct unit of measure (SI unit) are recorded as marks will be deducted from answers if the incorrect unit is used. (even if the calculated value is correct).
8. In answering the questions, full advantage should be taken of your practical experience as well as data given and clearly state any assumptions you make.
9. Please note that you are not allowed to contact your examiner or moderator regarding this examination.
10. Cell phones are **NOT** allowed in the examination room.

QUESTION 1

The ventilation requirements for a coal mine with sparse methane must be determined. The following aspects should be considered:

- *Mining Method*: Bord and Pillar
- *Road width*: 7 m
- *Seam Height*: 3 m
- *Pillars sizes*: 10 x 10 m
- *Air velocity – conveyor belt*: 2 m/s
- *Air velocity – intake road*: 2,5 m/s
- *Air velocity – return road*: 5 m/s
- *Air velocity – downcast shaft*: 8 m/s
- *Air velocity – up cast shaft*: 10 m/s
- *Standard Panel length*: 1,2 km
- *Assume air utilisation*: 80 %
- *Air commitments*: 100 m^3/s
- *Design velocity in last through road*:1,5 m/s
- *Production ton/continuos miner/month*: 60 000 t
- *Production /year*: 4 320 000 t

1.1 Calculate the total area per road (1)

1.2 Calculate the volume required for the conveyor road (1)

1.3 Calculate the volume required for the return road (1)

1.4 Calculate the volume required for the intake road (1)

1.5 Calculate the volume required in the last through road? (1)

1.6 Number of continuous miner sections required? (2)

1.7 Calculate the total volume required for the mine? (4)

1.8 The diameter of the downcast shaft? (2)

1.9 The diameter of the up cast shaft? (2)

1.10 Calculate the friction pressure loss in the downcast shaft? (2)

1.11 Calculate the pressure loss in the intake roadways per km? (3)

[20]

QUESTION 2

2.1 Define the following:

2.1.1 Simple Interest (1)

2.2.2 Compound interest (1)

2.2.3 Present value (1)

2.2 Compile a technical specification for a new main surface fan (10)

2.3 Considering the performance of the South African currency, what measures would you recommend if the fan you specified must be paid for in US $? (2)

[15]

QUESTION 3

3.1 Mine management have decided to deepen its existing vertical shaft by 400 m to establish 4 additional production levels. For sinking the 7 m diameter shaft a force exhaust system will be used. A minimum air volume of 16 m^3/s will be required at shaft bottom to ensure a 30 minute re-entry period directly after the blast.

3.1.1 What is the maximum distance from the shaft bottom that the exhaust intake can be carried to ensure a 30-minute re-entry period? Discount over breaking of the rock in this calculation and assume 6 air changes. (7)

3.2 The management of a mine plans to deepen its existing shaft system by 600 m to establish 5 new additional production levels to mine 150 000 tons per month from the deepened section.

Additional information:

- Sinking rate is 6 m per 24 hours
- Shaft diameter is 7 m plus 10% over break to accommodate the concrete lining.

- 24 day month
- The rock density is 2,78 kg/m^3
- Each level will be considered as a separate ventilation district.
- The planned production will split evenly from each production level.
- Average air density over the five levels is 1,2 kg/m^3

3.2.1 What average service water flow rate will be required during the development of
3.2.1.1 The shaft,
3.2.1.2 The production levels, if the expected consumption is 1,77-ton water per ton of rock mined? (7)
3.2.2 If a design rate of 5,0 kg/s is planned, what size should the intake and return airways be designed to accommodate the desired flow rate? (6)

[20]

QUESTION 4

On a small mine the normal consumption of new 570 mm ventilation pipes is 150 m per year 760 mm pipes are not normally used.

To maintain current production levels, it is necessary to develop a 1 380 m long tunnel to intersect with the existing workings. This development will take 12 months to complete. It is to be exhaust ventilated. The fans and ventilation pipes required for this development will be purchased prior to the project commencement.

Two alternative options being considered for this project are the following:

- A - To use a 570 mm diameter column 76% of which can be reclaimed for normal mining use on completion of the project (the development phase).
- B - To use a 760 mm diameter column 75% of which can be sold on completion of the project at 28% of the initial purchase cost.

Determine which scheme would be the most economical over 8 years and make suitable

recommendations to management, based on your practical experience. *(Hint calculate the total owning cost (T.O.C) for each scheme)*

Assume the following:

- The cost of a new 570 mm pipe is R 800/meter
- The cost of a new 760 mm pipe is R 1 100/meter
- The air quantity exhausted from the face of the tunnel must be 4,5 m^3/s
- There is no leakage
- The air density is 1,2 kg/m^3
- The capital cost of development fans is R 2 500/air kW
- The overall efficiency of these fans is 70%
- Annual electrical power costs are R 12 000/kW
- Friction factor of pipes is 0.0037 Ns^2/m^4
- The PV of R1/year over one year at 15% is R0,870
- The PV of R1/year over eight years at 15% is R4,487

[25]

QUESTION 5

Comment on and discuss the content of the article related to mine environmental control and occupational hygiene, which have appeared in the following publications:

PLEASE NOTE - ADDRESS ONLY *ONE* OF THE FOLLOWING TWO TECHNICAL PUBLICATIONS:

5.1 An analysis of airflow patterns around a longwall shearer with a proposed modified spray system for dust control

(Y.P. Chugh, A. Chandna,H. Gurley- Southern Illinois University Carbondale ,October/December Volume 69 No 4)

Use the following headings in your answer:

1. Abstract
2. Introduction
3. Authors hypotheses and research goals

4. CFD modelling of a typical chassis spray block
5. Analysis of a typical single block chassis spray system
6. Analysis of the proposed spray system
7. Dust suppression studies
8. Summary observations
9. Concluding remarks

OR

5.2 XLP/ULP On-reef mechanised mining method by ventilation on demand as a concept

(J. Venter – BBE Consulting, M.B. Diedericks – Anglo American Platinum
October/December Volume 69 No 4)

Use the following headings in your answer:

1. Abstract
2. Introduction
3. Extra low and ultra low profile (XLP/ULP) mining methodology
4. Ventilation design criteria and methodology
5. Ventilation on demand overview
6. Ventilation requirement comparison for a typical XLP mining stope block
7. Ventilation requirements applying ventilation on demand
8. Method comparison – conventional ventilation and ventilation on demand
9. Financial impact of ventilation on demand
10. Ventilation infrastructure
11. Operating cost
12. Discussion
13. Conclusion

[20]

TOTAL MARKS: [100]