Minerals Council South Africa

EXAMINATION

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 3	**EXAMINER:** M. Coelho
SUBJECT CODE: COMMEC3– ECONOMICS, PLANNING AND TECHNICAL LITERATURE	**MODERATOR:** B.A. Doyle
EXAMINATION DATE: 9 MAY 2019	**TOTAL MARKS:** 100
TIME: 14:30 – 17:30	**PASS MARK:** 60%

NUMBER OF PAGES: 8

SPECIAL REQUIREMENTS:

THIS IS NOT AN **OPEN BOOK EXAMINATION. FORMULA HANDOUT IS AVAILABLE**
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 **[17]**

1.1 Discuss the impact of air speeds and nominal carrying capacities for intake and return airways and upcast and downcast shafts. (6)

1.2 Provide typical air design speeds for:

1.2.1 Intake airways

1.2.2 Return airways

1.2.3 Vertical unequipped shafts

1.2.4 Vertical equipped shafts (4)

1.3 With the aid of a sketch show the generic theoretical phases of introducing mine cooling. (5)

1.4 Give two (2) requirements of a good technical report. (2)

QUESTION 2 **[33]**

A desktop study for a new mining project in Africa to exploit the zinc/copper rich orebody using a sub - level caving method is to be undertaken. You are the consulting ventilation engineer and it is required to determine the ventilation and cooling requirements. The table below indicates the production ramp up and diesel fleet phase in for the period 2020 to 2025.

				2020	2021	2022	2023	2024	2025
Production									
Stope tonnes broken	ktpm			125	153	189	189	189	189
Development tonnes broken	ktpm			70	55	55	55	59	56
Total tonnes broken	ktpm			195	208	244	244	248	245
MRBD	m			430	470	540	580	620	660
Diesel Fleet	**Type**	**Rated kW**							
Sandvik (TH663)	Truck	565	No. of units	8	9	9	9	11	11
Sandvik (LH621)	LHD	352	No. of units	9	9	10	10	12	12
Jumbo Sandvik (DD421)	Drill Rig	110	No. of units	2	2	3	3	4	4

2.1 What is the diesel dilution factor that can be applied when ultra-low sulphur (10ppm) diesel and Tier IV engines are used for the diesel fleet? (1)

Please note for all the questions that follow use 0.06m^3/s per rated kW at point of application. Density is assumed to be 1.0 kg/m^3.

2.2 The orebody will be accessed from a 6.5m wide x 5.0m high **twin** ramp system from surface. During cleaning operations at each ramp development a truck and LHD will operate at the ramp development face. Calculate the fan intake volume requirements for total ramp development (Include 20% leakage). (3)

2.3 During stoping activities only the LHD will operate at the face as the truck will remain in the last point of through ventilation. Calculate the volume required for stoping activities if 3 levels will be active. (3)

2.4 Footwall and ore drive development on a typical level will consist of a LHD, drill rig and truck. The truck will not enter beyond the last point of through ventilation. Calculate the fan intake air volume requirements for level development? (Include 20% leakage). (2)

2.5 What is the total air volume required if there are 4 active development levels? (1)

2.6The following commitments need to be accounted for

- Workshop = $50m^3/s$
- Crusher ventilation system = $40m^3/s$

From the above calculate the total air volume required for the mine assuming a 10% primary system leakage. (3)

2.7 If the maximum ramp design velocity is 6m/s, determine if there is additional intake infrastructure required. (5)

2.8 Calculate the diesel fleet heat load for the year 2025. Use the following work rate factors: (4)

- 1.5 x rated kW for LHDs
- 1.2 x rated kW for trucks
- 0.25 x rated kW for drill rigs

2.9 Calculate the heat from rock use a factor of 10kW/ktpm for year 2025. (2)

2.10 Calculate the effect of auto compression. (3)

2.11 Calculate the total mine heat load if other sources of heat in year 2025 amounts to 3928 kW. (2)

2.12 Calculate the shortfall of cooling capacity of ambient air, for 2025, using a factor of 8.9 kJ/kg. (2)

2.13 Calculate the amount of air cooling required for 2025. (2)

Question 3 **[15]**

The mean dust count on a mine is 185 particles per ml and the annual dust levy for this mine is R 3 660 000, which remains constant for the 10 year time period. The dust levy varies directly as the (mean dust count)^2. Three alternative schemes are proposed below, which is the most economical scheme:

Scheme 1

To accept the situation as it stands.

Scheme 2

To spend R 2 000 000 now and R 500 000 per year on better dust control to reduce the mean dust count to 160 particles per ml.

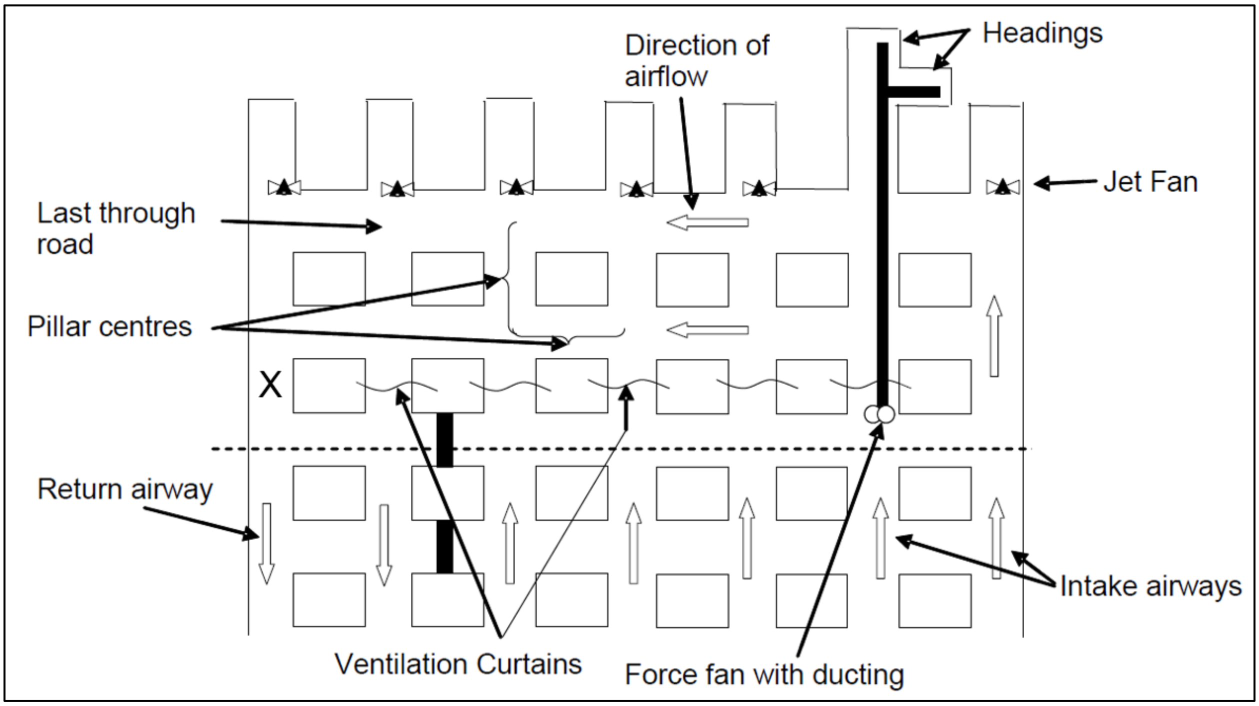
Scheme 3

To spend R 1 000 000 per year on better dust control to reduce the mean dust count to 165 particles per ml.

The life of mine is 10 years and the present value of R 1 per year over 10 years at 12% interest is R 5.65. Which is the most economical scheme?

QUESTION 4 **[20]**

Thick dolerite intrusions have necessitated the establishing of an independent satellite ventilation shaft system which will serve 3 mechanical mine bord and pillar sections. The sketch below shows a typical section layout:



The following information is given:

Planned production rate	60 000 tons/month/section
Shifts per month	72
Bord dimensions	6.5m W x 3m H
Pillar centres	30m
Number of roadways per section	7
Number of headings per roadway during first split development	2
Minimum air quantity required in headings	$0.15 m^3/s/m^2$ of heading
Total leakage and air commitments	$90 m^3/s$
Minimum design last through road velocity	1.0 m/s
Number of last through roads open	2

The method of ventilation employs auxiliary fans and ducting to be used during the first split development (apply a factor of 1.8 per heading to cater for duct leakages and to prevent recirculation at fans).

4.1 Calculate the air quantity to be supplied for:

4.1.1 Heading ventilation for the first split development

4.1.2 Assuming that ventilation controls are airtight at the face state the quantity of air at x

4.1.3 Total air quantity per section assuming 80% section air utilisation (12)

4.2 Determine the total air quantity required for this ventilation district and calculate the respective circular shaft sizes using the following optimum air velocities

- Downcast velocity 8m/s
- Upcast velocity 12m/s (8)

QUESTION 5 **[15]**

Elaborate on the capital development section in the article related to mine environmental control and occupational hygiene, which appeared in the following publication

"Block cave mine ventilation optimisation techniques" by M. Hooman, W. Marx and F.H von Glehn – BBE Consulting, January/March Volume 71 No 1

The authors discuss ventilation optimisation techniques during the capital development phase. There are several aspects that need to be included in ventilation planning of block cave mining; elaborate on their key findings in the article. (15)

NB! Elaborate on this section of the paper only

TOTAL MARKS: [100]