Minerals Council South Africa

EXAMINATION

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 3 **SUBJECT CODE: COMMEC3– ECONOMICS, PLANNING AND TECHNICAL LITERATURE** **EXAMINATION DATE:** 11 OCTOBER 2018 **TIME**: 14:30 – 17:30	**EXAMINER:** M. Coelho **MODERATOR:** M. Beukes **TOTAL MARKS:** 100 **PASS MARK:** 60%

NUMBER OF PAGES: 7

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 **[25]**

A desktop study on a coal mine extension is underway. You are the ventilation engineer and are required to determine the ventilation requirements. The mine will produce 360 000t of coal per month and it is assumed that there will be 1 stone works (SW) and 2 abandoned panels (AP). (Density is assumed 1.2 kg/m^3)

The ventilations criteria as required by the mine are as follows:

Last through road (LTR) velocity for continuous miner (CM) sections	= 1.5 m/s
LTR velocity for stone works sections	= 1.0 m/s
LTR velocity for abandoned panel sections	= 0.5 m/s
Total number of CM sections	= 6
Bord width	= 7.2 m
Seam height	= 3.9 m
Air utilisation factor for CM, AW and AP sections	= 80 %
Downcast shaft velocity	= 10 m/s
Upcast shaft velocity	= 20 m/s

Assume an additional 20% quantity requirement for overall mine commitments

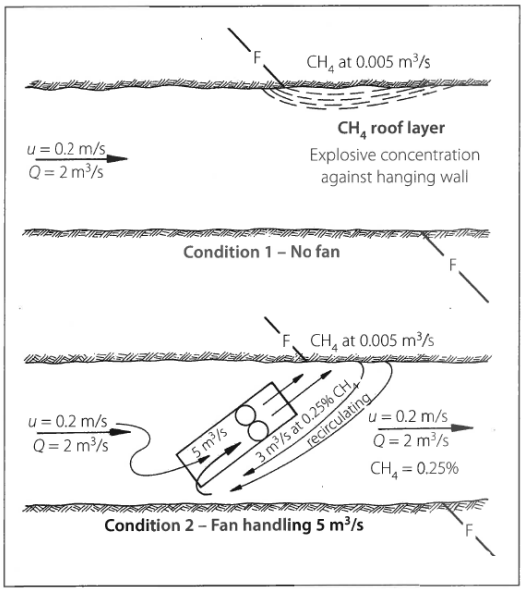
Assume 30% overall mine leakage

1.1 Calculate the total CM section volume requirements (3)
1.2 Calculate SW requirements (2)
1.3 Calculate AP requirements (3)
1.4 Calculate total mine volume requirements (3)
1.5 Calculate downcast shaft diameter (2)
1.6 Due to ground conditions 2 upcast shaft are required calculate the diameter of each (3)
1.7 What is the purpose of methane content and release sampling? (2)
1.8 What measures would you take if the methane content is 50% higher than the mines average? (3)
1.9 Indicate arithmetically and comment on the impact of increasing volume on air power (4)

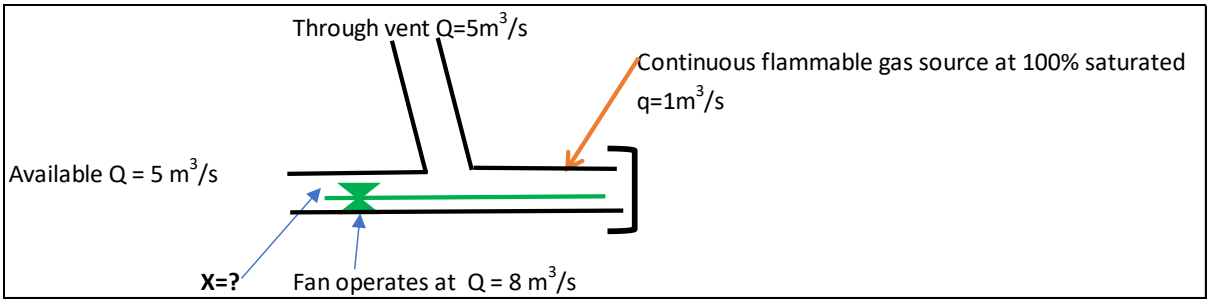
QUESTION 2 **[17]**

2.1 Define recirculation and provide four examples with a brief explanation of the undesirable and dangerous consequences of thereof? (9)

2.2 With reference to the figure below which depict methane layering in a coal mine explain why recirculation is beneficial in the dispersion of methane layering with a high velocity air jet (4)



2.3 The figure below shows a fan recirculating in a development end and the presence of a continuous flammable gas source

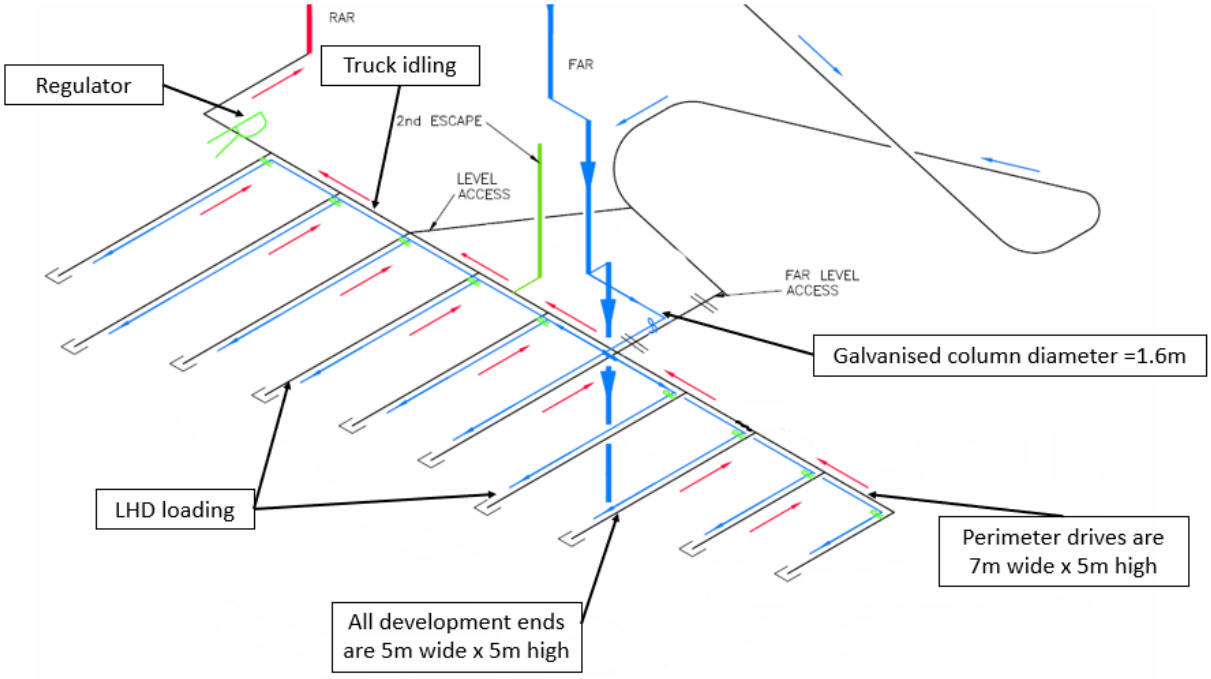


2.3.1 Calculate the maximum concentration (%) of the flammable gas at point X (2)

2.3.2 What is the gas concentration (%) in the recirculation portion after 2 air changes (2)

QUESTION 3 **[23]**

You are the consulting ventilation engineer for the extension of an existing mine to access a new 1500 m deep zinc deposit that will be exploited using the sub-level open stoping method accessed from a single decline. The figure below indicates a typical production section with a single fan and column supplying 10 development ends with air. Air is regulated to each development end using in-line regulators. Air intakes from the Fresh Air Raise (FAR) and decline which then returns via the Return Air Raise (RAR) (Density is = 1.2 kg/m^3 and assumed consistent throughout the mine)



A level will have 2 x 150 kW LHD operating in the development ends with a maximum of 1 per development end and 1 x 500 kW truck which will operate as far as the perimeter drive. It is required that a development end face should have a velocity of not less than 0.2 m/s.

3.1 Calculate the volume requirements at point of application for diesel dilution for the LHD and truck operating assuming a dilution factor of 0.06 m^3/s per rated kW. (2)

3.2 Calculate the volume requirement per level that will need to be supplied by a fan in tight circuit positioned on each level, assume 10% column leakage (4)

3.3 If the total airway lengths for a level is 389 m. Determine the fan duty? (4)

3.4 Calculate the total volume requirements if there are 4 production levels, 25% commitments and 15% leakage in the mine (4)

3.5 Calculate the diesel heat load components for the mine factoring in 20% additional heat added from the secondary fleet (i.e. drill-rigs, UV, graders, etc.), using a diesel heat factor of 1.5 x rated kW and a machine utilisation of 70% (5)

3.6 Calculate the cooling capacity of the downcast air using a surface wet bulb temperature of 18 and a reject temp of 29°C (2)

3.7 How much refrigeration is required if the following other heat loads exists (2)

- Broken and surrounding rock = 3100 kW
- Auto compression = 6300 kW
- Auxiliary fans = 836 kW
- Equipment (pumps, conveyors, sub-stations, etc.) = 3800 kW

QUESTION 4 **[20]**

4.1 Differentiate between primary and secondary ventilation systems (6)

4.2 List 4 aspects that are typically form part of a design criteria document that is prepared early in the design process (4)

4.3 Discuss the characteristics of the optimisation phase in mine project planning (5)

4.4 Discuss the considerations of the ventilation requirements for crusher station (5)

QUESTION 5 **[15]**

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:

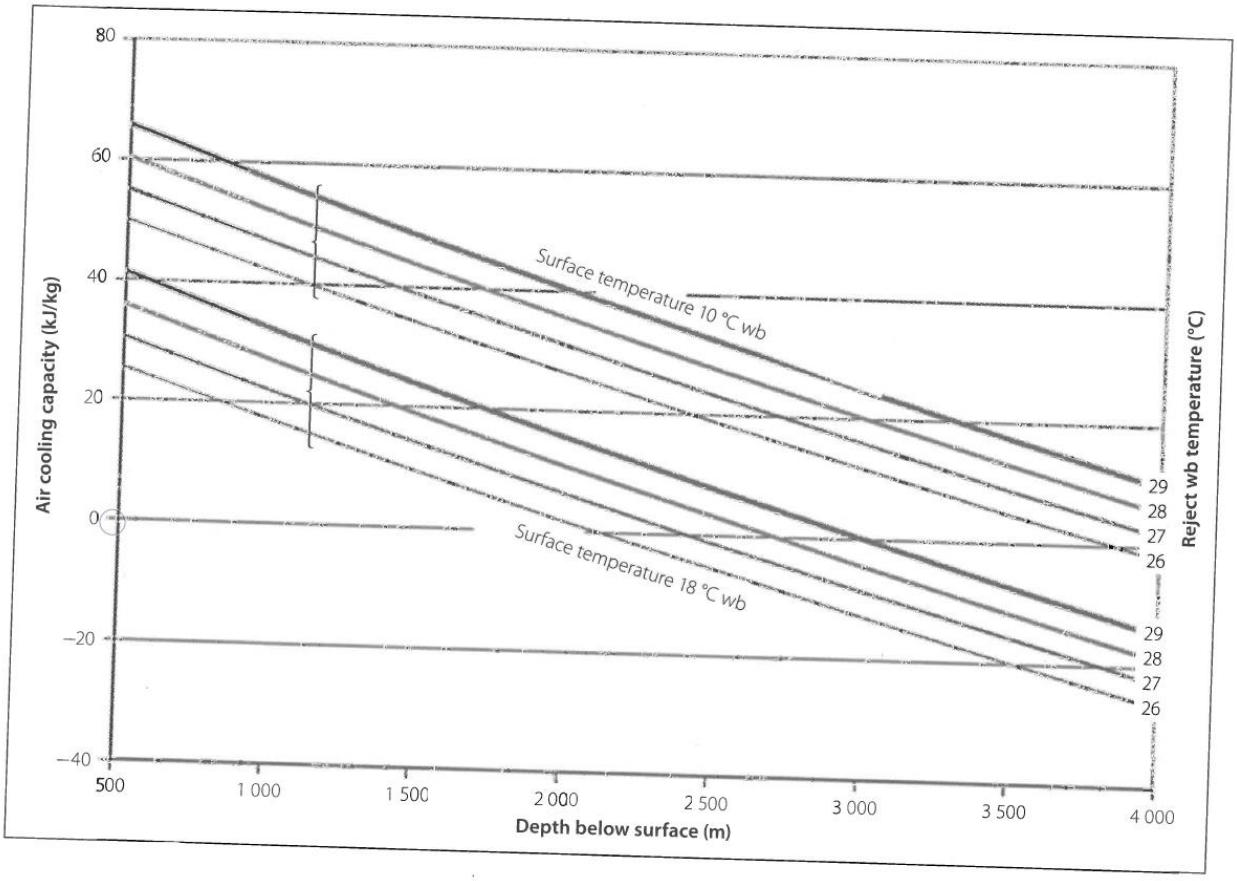
5.1 Using continuous real time monitoring to monitor the effectiveness of manual and engineering controls for proactive management of airborne pollutants at Kopanang Mine (L. Kleyhans, L. Smith and M. Beukes – Anglo Gold Ashanti, April/June Volume 71 No 2)

OR

5.2 Block cave mine ventilation optimisation techniques

(M. Hooman, W. Marx and F.H von Glehn – BBE Consulting, January/March Volume 71 No 1)

TOTAL MARKS: [100]


Air cooling capacity (kJ/kg)
80
60
40
20
0
−20
−40
Surface temperature 10 °C wb
Surface temperature 18 °C wb
29
28
27
26
29
28
27
26
Reject wb temperature (°C)
500
1 000
1 500
2 000
2 500
3 000
3 500
4 000
Depth below surface (m)