

Minerals Council South Africa



EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 4 SUBJECT CODE: COMMEC4 EXAMINATION DATE: 7 OCTOBER 2022 TIME: 14:30 – 17:30 (3 HOURS)	EXAMINER: M. R Melk MODERATOR: R A Rabaji TOTAL MARKS: [100] PASS MARK: 60%
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Examination Instructions:

This examination question paper consists of **4** pages

FORMULA HANDOUT IS AVAILABLE

1. Answer all **4** questions in *English*.
2. Put your identification 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 your answers are based**.
4. Hand-held electronic calculators may be used for calculations only.
5. Write in ink on the **right-hand page** only – the left-hand page 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 units 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.
9. Please note that you are not allowed to contact your examiner or moderator regarding this examination.
10. This is **NOT** an open book examination but the approved formula hand out may be used.
11. Cell phones are **NOT** allowed in the examination room

QUESTION 1

1.1. Write the following abbreviation in full

- 1.1.1. RM- Risk Management
- 1.1.2. IDHL- Immediately dangerous to health and life
- 1.1.3. OEL- Occupational Exposure Limit
- 1.1.4. HAZOP- Hazard and Operability Analysis
- 1.1.5. OMP- Occupational Medical Practitioner
- 1.1.6. HEG- Homogenous Exposure Group
- 1.1.7. HBA-Hazardous Biological Agent
- 1.1.8. GHS- Global Harmonised System
- 1.1.9. OAE- Otoacoustic Emission
- 1.1.10 NIHL- Noise Induced Hearing Loss (half a mark per point)

(5)

1.2. Risk based medical surveillance is required in terms of section 12 and 13 of the MSHA, briefly describe in detail how your mine will link occupational hygiene exposure data with employee medical surveillance?

Section 12 of the MSHA requires the employer to conduct occupational hygiene measurement and allocate exposures to all employees to be linked to medical surveillance .

Occupational hygienist is legally appointed to ensure:

- Easy to cross-reference sampling results to exposure
- **Link exposures to individual employees (create hygiene register)**
- **Allocate HEG average to employees within the HEG**✓
- Establish electronic data to be made readily available to create risk based medical surveillance✓
- Transfer exposure to the OMP for linkage to medical data system
- **To notify the OMP about exceedance for speedy diagnoses and treatment**✓
- Submit reports as required
- **Carry-out 11.5 investigation on affected employees**✓
- Fill in record of hazardous work for employee exiting the employment✓

Section 13 of the MSHA requires the employer to establish the system of medical surveillance which is appropriate considering the health hazards to which the employees may be exposed to

- OMP to ensure data provided by Occupational Hygienist is directly transferred sampling and exposure to surveillance record to be linked to medical surveillance program.
- Linkage will ensure that when employee present himself for medical, the hazards he is exposed to are readily available for the employee. ✓
- Quickly notify the OH of medical problem or ill health, to allow quick investigation✓
- Compile regular reports as required (submit annual medical report)
- Keep records of medical surveillance✓
- Report to the Provincial Office any occupational disease incidence✓
- Submit affected employees for compensation (10) ✓

1.3. Chapter 9 of the MSHA Regulations describes the mine environmental engineering responsibilities: Briefly discuss the requirements

1.3.1 Use of compressed air

Compressed air is not to be used in a manner that can endanger the health and safety of employees✓✓

Compressed air is not used to clean the body or clothes worn by any person✓

1.3.2 Early warning system

Early warning systems are installed in areas with potential fire or explosion risk which can lead to irrespirable atmosphere✓✓

1.3.3. Ventilation control device

Control devices which have the potential for electrical static discharge comply to:

SABS standard specification 1287 (part 1 & 2) ✓✓

Are of anti-static characteristics when used to prevent ignition of gases, dust and vapours✓✓

1.3.4. Working place where work has ceased

Access control at worked out areas✓✓

(10)

[25]**QUESTION 2****2.1. Briefly describe what happens when methane is ignited? (10)**

- First, the temperature of 600 degree Celsius has to be reached for methane gas to be ignited of more than 2 bars is possible✓
- A blue running flame will be produced✓
- If this flame is not confined, it can reach a speed of 10 metres per second✓
- When it is confined, it can reach a flame of 340 metres per second✓
- The temperature of ignited methane can reach 2500 degrees Celsius✓
- It also ignites coal dust✓
- It disturbs ventilation✓
- It leads to suffocation when the proportion of methane is greater than that of oxygen✓
- Causes death and damage to equipment✓

2.2. Fire and explosion prevention control in coal mines:

The prevention, early and reliable detection, control and suppression of mine fires are critical elements in safeguarding the lives and livelihood of mine workers. Explain in detail how you will prevent, detect, and combat fires. (10)

- Ignition source prevention✓✓
- Monitoring✓✓
- Ventilation✓✓
- Stone dusting✓✓
- Explosion barriers✓✓
- Fire escape procedure✓✓ (any 5 of the points discussed)

2.3. Fill in the missing words✓

- a. Intrinsically safe equipment to be used inside the confined space is at **24v** ✓

- b. The most violent percentage of methane gas is at **(9.5%)**; and the maximum percentage of methane at a mine face which must not be exceeded is **(1.4%)**
- c. A temperature of **600 degree celcius** must be reached for methane gas to be ignited
- d. The minimum quantity of methane required to start coal dust explosion is only **0.4%** of pure methane, if this is diluted to remain within an explosible concentration, it will form a volume of about 4m³ (at 10% concentration)
- e. An explosion resistant stopping is a seal designed to withstand a static Pressure typically of **140 kPa** **(5)**

[25]

QUESTION 3

- 3.1. Suppose that the following nine asbestos readings (fibres/ml) have been found in a brake-shoe workshop:

4.7	4.32	2.2	7.2	6.5
1.7	8.4	3.1	5.1	

Determine the following:

3.1.1. The arithmetic mean:

$$=(4.7+4.3+2.2+7.2+6.5+1.7+8.4+3.1+5.1)/9$$

$$=43.3/9$$

$$=4.8 \text{ fibres/ml}$$

3.1.2. The median : $n+1/2$

$$9+1/2 = 4.7 \text{ f/ml} \quad (2)$$

3.1.3. Ranking of 2 is **2.2 f/ml** **(2)**

3.1.4. 90th percentile = $90/100 \times 9 = 8.1 \text{ f/ml of air}$ **(2)**

3.1.5. Geometric mean= nth root of

$$(1.7 \times 2.2 \times 3.1 \times 4.3 \times 4.7 \times 5.1 \times 7.2 \times 8.4) = 4.27 \quad (2)$$

- 3.2 Interpret the above as per legislative requirement of MHSA (Why is this important and how will you use the above in terms of reporting) **(5)**

Arithmetic Mean of 4.8 f/ml is allocated to all the employees within the HEG, this value shows that the average mean allocated to the HEG is more than the OEL of 0.1f/ml of air; controls are required to reduce the level to below the OEL. ✓

Median of 4.7f/ml is the number in the centre of the data and it not usually affected by the outlier, there's always equal numbers before and after the mean✓

Ranking shows the relationship between the scores - 2.2f/ml is the second ranked number of the data set✓

90th percentile of 7.44f/ml of air is the value used for re-classification of the HEG at the beginning of the year and it shows that the HEG is an A-HEG as it is above the OEL of 0.1 f/ml of air✓

Geometric mean measure changes in the rate of growth-✓

- 3.3 Suppose that the CO monitoring results for the factory workers are 30,40,60,20 and 70 ppm. What is the average deviation, standard deviation, and the variance of their exposure?

3.3.1. Average deviation : $(30-44)+(40-44)+(60-44)+(20-44)+(70-44)/5$

$$= -14+-4+16+-24+26/5$$

$$=0/5$$

$$=0✓✓✓✓ (1 \text{ point for calculating the mean})$$

3.3.2. Variance

$$=(30-44)^2+(40-44)^2+(60-44)^2+(20-44)^2+(70-44)^2/5$$

$$= 196+16+256+576+676/5$$

$$= 1720/5$$

$$= 344✓✓✓$$

Standard deviation: square root of the variance =344

$$\text{Standard deviation} = 18.5✓✓✓$$

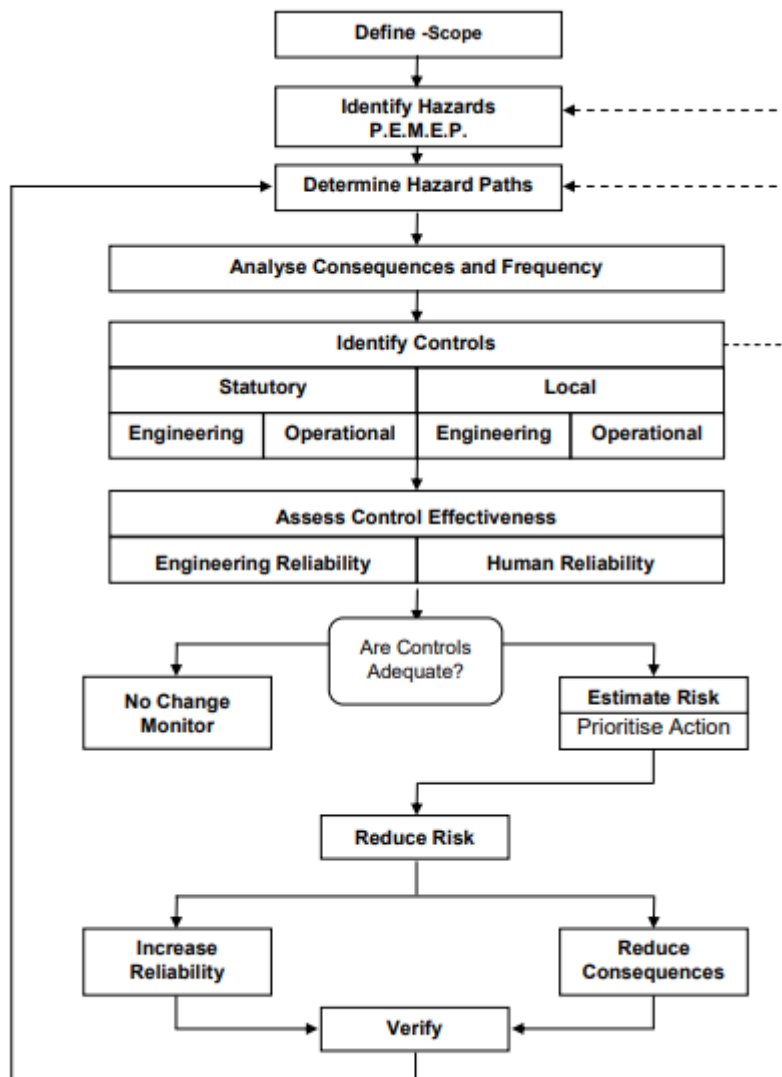
(10)

[25]

QUESTION4

4.1. Draw a schematic diagram of the Risk Control process

(10)



4.2. Discuss the critical elements of the process

(5)

The Risk Control Process ensures that:

4.2.1 . The measures put in place to reduce risk are carried out ✓

4.2.2 .Other latent hazards can now be identified ✓

4.2.3. Corrective action is taken without delay ✓

4.2.4. The risk profile is regularly updated✓

4.2.5. Dealing with major hazards emmediately✓

- 4.3. =Diesel emitting equipment operates in a development area underground. The following hazards on the table below are measured in the general atmosphere.

Provide the missing information from the table below as numbered in your examination script. (10)

Gas	Characteristic	SG	Where to measure	OEL/STEL
CO	4.3.1- odourless, colourless, flammable and burns in air	4.3.2- 0.9667	4.3.3-roof	4.3.4: 30 ppm
H ₂ S	4.3.5- colourless, flammable, rotten egg smell	4.3.6- 1.18	4.3.7-footwall	4.3.8: 10 ppm
HCHO	4.3.9- pungent, colourless, suffocating odour	4.3.10- 0.815	4.3.11-roof	4.3.12: 10ppm
C ₄ H ₁₀	4.3.13- colourless gas with faint petroleum-like odour	4.3.14: 0.601	4.3.15: roof	4.3.16: 600 ppm
CO ₂	4.3.17-colourless, odourless, non-flammable and slightly toxic	4.3.18- 1.53	4.3.19- footwall	4.3.20: 5000 ppm

(Half a mark allocated per point therefore 20/2=10 marks)

[25]

Total marks for question paper [100]