



CHAMBER OF MINES OF SOUTH AFRICA

MEMORANDUM

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – CERTIFICATE IN MINE ENVIRONMENTAL CONTROL - PAPER 4 SUBJECT CODE: COMMEC4 EXAMINATION DATE: 13 OCTOBER 2017 TIME: 14:30 – 17:30	EXAMINER: R A Rabaji MODERATOR: A R Nundlall TOTAL MARKS: [100] PASS MARK: 60%
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Examination Instructions:

This examination question paper consists of **3** pages

1. Answer all **5** 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

Model Answers:-

Question 1.1

- (a) Removal of liquid fuel storage by delivering on surface
Removal of tyre storage
- (b) Use less flammable oils
Install enclosed braking system on vehicles
- (c) Install fire detection and suppression system
Ventilation system that routes air from hazardous area to return
Route fuel hoses or hydraulic from surface
- (d) Training of personnel in firefighting procedures
Planned task observations and inspections
- (e) Provision of self-contained self-rescuers
Enforce wearing of all protective gear (spats, gloves etc.)

Question 1.2

• Carbon monoxide (CO)	30ppm
• Carbo dioxide (CO ₂)	5000ppm
• Sulphur dioxide (SO ₂)	2ppm
• Aldehydes	2ppm
• Nitric oxide (NO)	25ppm
• Nitrogen dioxide (NO ₂)	3ppm

Question 1.3

The required clean air flowrate for the operation of the engine is = $115\text{kW} \times 0.075\text{m}^3/\text{s}$ per rated kW = $8.625\text{m}^3/\text{s}$

The maximum CO release rate at the exhaust of the engine, at which point the engine must be serviced is,

The OEL for CO is 30ppm, at 30ppm the rate of release of CO into the mine air is $8.625\text{m}^3/\text{s} \times (30/1000000) = 0.000259\text{m}^3/\text{s}$. As the percentage of the air consumed/emitted by the engine, this is $(0.000259\text{m}^3/\text{s} / 0.30\text{m}^3/\text{s}) \times 100 = 0.0863\%$ or 863ppm. This means that a maximum rate of release of 863ppm CO can be allowed from the engine exhaust to keep the CO below 30ppm, while maintaining the ventilation flow rate at $0.075\text{m}^3/\text{s}$ per rated kW of engine power

Question 2.1

The occupational hygienist

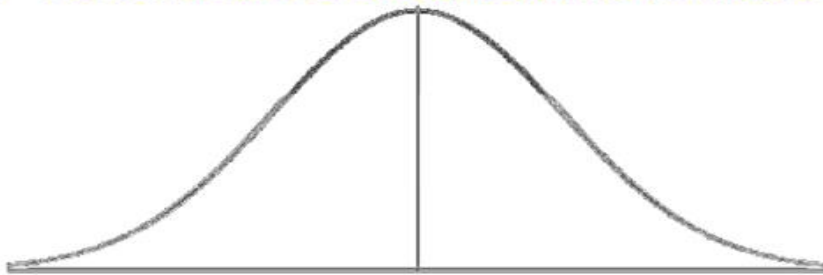
- Easy to cross reference sampling results and exposures
- Keep records of all sampling results for all employees
- To easily transfer these results to medical practitioner
- To notify the medical practitioner of excessive exposure in order to ensure speedy diagnosis and treatment

The occupational medical practitioner

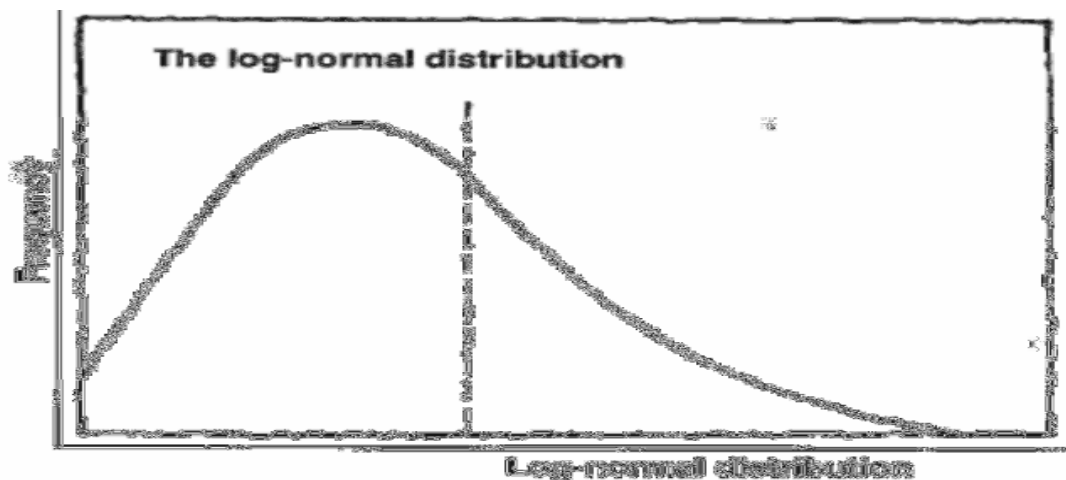
- Directly transfer sampling and exposure results to a surveillance record
- Quickly notify the occupational hygienist of medical problems or ill health, to allow investigations
- Compile regular reports as required
- Keep records of medical surveillance

Answer

i) The normal curve is bell-shaped and has the mean at the centre.



The log-normal curve has a long tail, and the mean is normally to the right of the highest point



Question 2.2

- a) The body
- b) Recommendatory
- c) Two way
- d) A summary of the points that emerge
- e) An explanatory note at the bottom of the page
- f) 40 years
- g) In a very long report
- h) One paragraph
- i) Bibliography
- j) CAD

Question 3 (a)

- Number of persons exposed
- Results of exposure
- Place of exposure
- Time of exposure
- Possible cause or causes of exposure
- Reason for cause of exposure
- Preventative measures that should have been taken
- Whether a breach of Regulations was the cause of exposure.
- Preventative measures taken to avoid another such exposure.
- Sketch of place of occurrence.
- Prevailing conditions at time of exposure.
- Latest ventilation report (if applicable)
- Time when the environmental control department was notified

Question 3 (b)

- Variations in ventilating current
- Different working methods i.e. bord and pillar or long walling
- Strata movement
- Variations in barometric pressure
- Permeability of the strata
- The petrographic constituents of coal
- The colloidal structure of coal

Question 4 (a)

Convert the gas flow rates from litres/second to m³/s

CO 2.0 l/s = 0.002m³/s

NO 1.1 l/s = 0.0011m³/s

NO₂ 0.1l/s = 0.0001 m³/s

CO₂ 100l/s = 0.1 m³/s

Use the formula to determine the required dilution quantity for each gas:

$$Q = \left\{ \frac{Q_1 \times 10^6}{MAC - N} - Q_1 \right\}$$

Where Q is the required dilution quantity, Q₁ is the gas flow quantity, MAC is the maximum allowable concentration (OEL) and N is the gas concentration in the dilution air

Solving for CO:
$$Q = \left\{ \frac{0.002\text{m}^3/\text{s} \times 10^6}{30 - 0} - 0.002 \right\} = 66.7\text{m}^3/\text{s}, \text{ No} = 44 \text{ m}^3/\text{s},$$

CO₂ = 20.3ppm, NO₂ = 33.3 m³/s

Question 4 (b)

- i) 95%
- ii) Histogram

Question 4 (c)

- i) Hydrocyanic acid gas is can be found where acid mine water is in contact with tailings containing cyanide residue or the burning of some plastics. It is a chemical asphyxiant acting on the nervous system and can produce death very quickly
- ii) Phosgene is produced when some refrigerants bum. It is extremely toxic
- iii) Aldehydes are formed from incomplete combustion of hydrocarbons and are commonly found in diesel exhaust. They are irritating to the nose, eyes, throat, and skin, and act as an irritant poison in the lungs.
- iv) Chlorine is used to disinfect water. It is a powerful irritant and causes lung oedema.
- v) Hydrogen sulphide is often associated with stagnant water. It is flammable and toxic, affecting several different systems in the body including the nervous systems. It can quickly deaden the sense of smell.

Question 5(a)

- i) When the locomotive is standing still

$$= \frac{0.25 \times 0.3}{100} \text{ m}^3/\text{s of CO}$$

$$= 0.0008 \text{ m}^3/\text{s of CO}$$

% CO on the return side of the locomotive

$$= \frac{\text{total quantity CO}}{\text{Total quantity mixture}} \times 100$$

$$= \frac{0.0008}{10.0} \times 100$$

$$= 0.0075\%$$

N.B The total quantity at $10.0 \text{ m}^3/\text{s}$ includes the $0.3 \text{ m}^3/\text{s}$ exhausted by the locomotive as this $0.3 \text{ m}^3/\text{s}$ is drawn from the general air stream

- ii) The locomotive is travelling at 2.5 km/h in the same direction as the ventilation
Velocity of the air in the haulage

$$= \frac{\text{distance}}{\text{time}} = \frac{2500}{3600} = 0.6944 \text{ m/s}$$

So the velocity of air over the loco

$$(0.833 - 0.6944) \text{ m/s} = 0.1389 \text{ m/s}$$

The quantity of air flowing over the loco

$$0.1389 \times 12.0 = 1.67 \text{ m}^3/\text{s}$$

So the CO on the return side of the locomotive

$$= \frac{\text{total quantity CO}}{\text{Total quantity mixture}} \times 100$$

$$= \frac{0.0075}{1.67} \times 100 = 0.449\%$$

- iii) The locomotive is travelling at 8 km/h in the opposite direction as the ventilation

Velocity of the air in the haulage

$$\text{Speed of loco at } 8 \text{ km/h} = \frac{8000 \text{ m}}{3600 \text{ s}} = 2.22 \text{ m/s}$$

Air speed = 0.833m/s

So the quantity of air over the loco

$$(2.22 + 0.833)\text{m/s} \times 12.0\text{m}^2 = 36.63\text{m}^3/\text{s}$$

So the CO on the return side of the locomotive

$$= \frac{\text{total quantity CO}}{\text{Total quantity mixture}} \times 100$$

$$= \frac{0.0075}{36.63} \times 100$$

$$= \underline{0.0205\%}$$

Question 5(b)

Any of the following can be listed

- The assessment must be practical and realistic
- All affected parties must be involved in the process
- Use a systematic approach to adequately address all hazards and risks
- Aim to first identify the major risks
- Gather and analyse the relevant information before starting
- Start by identifying the major hazards
- Assess the risks from these hazards by looking at existing controls
- Look and record what happens in the workplace
- Include all persons at risk as well as visitors and contractors
- Record all observations in writing with any assumptions and reasons