Chamber of Mines of South Africa

# EXAMINATION PAPER

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| **SUBJECT:** OCCUPATIONAL HYGEINE<br>CHAMBER OF MINES OF SOUTH AFRICA – CERTIFICATE IN MINE ENVIRONMENTAL CONTROL<br>PAPER 5<br>**SUBJECT CODE: COMMEC**<br>**EXAMINATION DATE: 15 MAY 2017**<br>**TIME**: 14:30 – 17:30 | **EXAMINER: JJ van Staden**<br>**MODERATOR: C Badenhorst**<br>**TOTAL MARKS:** [100]<br>**PASS MARK:** (60%) |

**NUMBER OF PAGES:** 12

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.
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**

1.1 Which of the following (if any) is the correct unit to express a result for a vibration measurement? (1)

a. m/s
b. $m/s^{-2}$
c. $m/s^{2}$
d. $m/s^{3}$

1.2 What are the main ill-health effects associates with exposure to asbestos fibres? (3)

1.3 What are the main routes of entry of a toxin into the human body? (3)

1.4 What sampling methods can be used for sampling isocyanates? (2)

1.5 What is meant by the term “breakthrough” when describing sorbent tubes and when is it said to occur? (2)

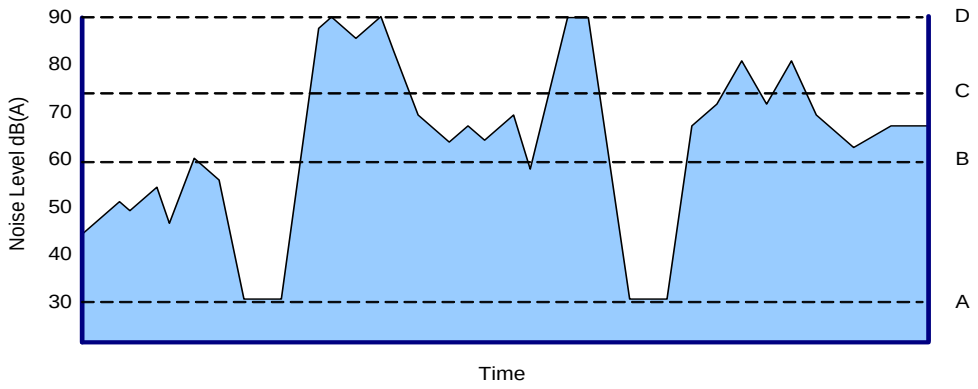
1.6 What types of substances are associated with short term exposure limits (2)

1.7 List the disadvantages or limitations of direct reading instruments which one should consider when using these type of instruments for occupational hygiene measurements? (7)

**[20]**

## QUESTION 2

2.1 Which of the broken lines (A, B, C or D) represents the Equivalent Continuous Sound Level (Leq) (2)




2.2 Define each term definition below. (12)

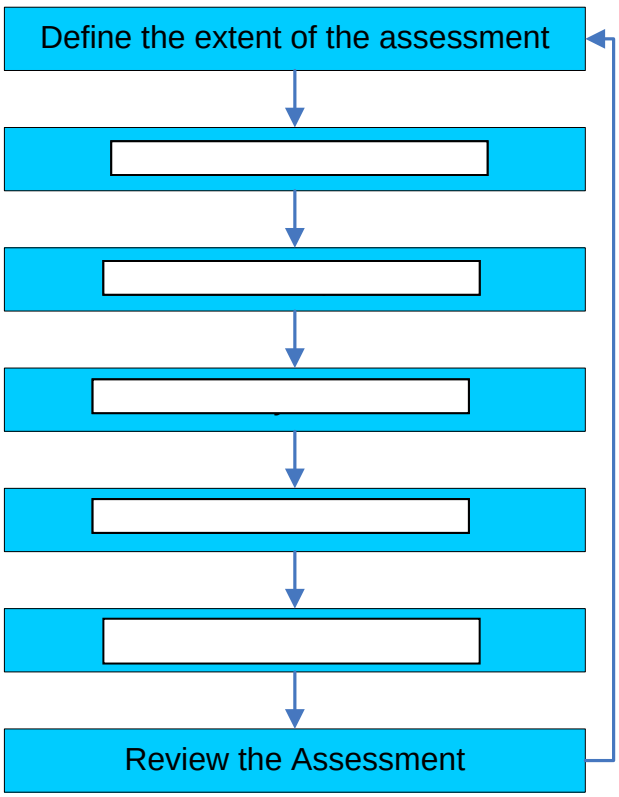
| **Term** | **Definition** |
|---|---|
| Vapour | |
| Mist | |
| Fume | |
| Dust | |
| Aerosol | |
| Fibre | |

2.3 In each of the following pairs indicate which generally involves the **larger** particles

| | | | |
|---|---|---|---|
| 1 | Fume or dust | | |
| 2 | Diesel Particulate Matter or cement dust | | |
| 3 | Respirable particles or inhalable particles | | |
| 4 | Mist or spray | | |
| 5 | Viruses or bacteria | | |

(5)

2.4 Fill in the missing stages of the risk assessment process




(5)

2.5 An employee has presented to the company doctor showing signs of metal fume fever as a result of exposure to zinc fumes from the welding of galvanised steel.

You are the Occupational Hygienist at this plant and have been asked by the chairman of the site SHE Committee to investigate and provide assistance. Describe in detail how you would sample for zinc. Apart from zinc, would you consider other analysis of the samples you collect? (6)

**[30]**

**QUESTION 3**

3.1 A worker is exposed to 1350 ppm for 1 hour, 220 ppm for 2 hours and 50 ppm for 5 hours of the same contaminant. What is his 8 hour TWA exposure? (4)

3.2 The average concentration of an airborne contaminant measured over an 8 hour period is 12 ppm. It is assumed that a worker is exposed to this concentration for the whole of a 10 hour shift. Calculate his TWA using the simple approach (direct proportional). Explain why this may not be satisfactory for protecting the health of the worker. (4)

3.3 A worker is exposed to 10 mg/m3 for 6 hours during a 12 hour shift. If there was not further exposure what is the 8 hour-TWA exposure? (3)

3.4 A sample result of 5 $mg/m^3$ total inhalable dust was obtained using a sampling pump calibrated at 2.0 L/min. Following the survey, you discover that the pump was actually running at 1.8 L/min. What was the correct dust concentration? (4)

3.4 A worker is only exposed to lead 3 times during his 8 hour shift. The results from the air samples taken during these periods were as follows:

0.1 $mg/m^3$ for 1 hour
0.2 $mg/m^3$ for 2 hours
0.15 $mg/m^3$ for 3 hours

What is his 8 hour TWA exposure (assuming that there was no exposure during the remainder of the shift)? (5)

**[20]**

**QUESTION 4**

4.1 Pitot tubes are generally not considered reliable with velocities less then: (1)

a) 10 $ms^{-1}$
b) 7 $ms^{-1}$
c) 5 $ms^{-1}$
d) 3 $ms^{-1}$

4.2 "Adequate control" of a contaminant applies when: (1)

a) A point when it is considered that the process is under control
b) An exposure threshold cannot be established for the contaminant
c) A threshold can be established and the exposure level of the contaminant is below that threshold
d) The time weighted average (TWA) exposure standard is achieved but the short term exposure limit (STEL) is sometimes exceeded

4.3 In the control of carbon monoxide from a LPG powered forklift truck, which is the most appropriate from an occupational hygiene perspective? (1)

a) Regular maintenance
b) Fit all trucks with a catalytic converter
c) Replace with electric powered forklift trucks
d) Install a LEV system

4.4 The "best" option of controlling exposure to dust emissions from addition of a powder to a mixture is: (1)

a) Issue respiratory protective equipment
b) Improve the local exhaust ventilation
c) Add the substance as pellet form rather than as a fine powder
d) Improve supply of fresh air to the area

4.5 In the design of a process that contains a known human carcinogen, which of the following is not appropriate? (1)

a) High reliability, high containment valves
b) High pressure transfer of materials between plant vessels
c) Integral decontamination of lines and plant
d) Automated process control with in line sampling

4.6 Which of the following is the most appropriate for the control of carcinogens? (1)

a) Total enclosure
b) Substitution with alternative
c) Monitor to ensure exposure is below the OEL
d) Minimise number of people involved

4.7 Which of the following measures will increase the risk of airborne dust exposure during a powder handling process? (1)

a) Process enclosure
b) Increasing particle size
c) Decreasing particle size
d) Local exhaust ventilation

4.8 Which of the following is least effective at minimising the risk of skin absorption during solvent cleaning operations?

(1)

a) Automating the process
b) Barrier creams
c) Use of water based substitute cleaner
d) Impervious gloves

4.9 In a plastics mixing process, fine powder is fed into a reaction vessel by pouring. A lot of fine dust is produced in the process. To improve control the powder is introduced in pelletised form. This form of control is an example of: (1)

a) Elimination
b) Substitution
c) Modification of the process
d) Administrative control

4.10 Control of exposure to a solvent from a vapour-degreasing tank is best achieved by: (1)

a) LEV for components removed from tank
b) Ventilation of workshop
c) Lip extraction
d) Respiratory protective equipment

4.11 A maintenance worker must enter an empty reactor vessel for cleaning, inspection and lining repair. In the absence of continuous ventilation and testing of the air in the vessel, what should an occupational hygienist recommend? (1)

a) An organic vapour respiratory for the worker and a helper with a life line within earshot
b) Performance of the work at night with prior notice to the Emergency Response Unit
c) Flushing the tank with a suitable organic solvent before the worker enters
d) A SCBA and fixed life line for the worker and a helper directly outside the tank

4.12 Which of the following is the preferred technique for assessing the performance of an extract hood once capture performance has been established? (1)

a) Measurement of face velocity
b) Measurement of velocity pressure inside the hood
c) Measurement of static pressure immediately downstream of the hood
d) Measurement of capture velocity at the source of contaminant

4.13 The static pressure measured upstream from a fan is -600 Pa and the total pressure is 1000 Pa. What is the velocity pressure? (1)

a) 400 Pa
b) 600 Pa
c) 1000 Pa
d) 1600 Pa

4.14 A fan is operating at a speed of 860 rpm and a volume flow of 4.5 $m^3s^{-1}$. If the fan speed is reduced to 780 rpm the new volume flow is: (1)

a) 4.95 $m^3s^{-1}$
b) 4.08 $m^3s^{-1}$
c) 4.26 $m^3s^{-1}$
d) 4.00 $m^3s^{-1}$

4.15 At entry to an exhaust fan, the total pressure equals 400 Pa and the static pressure equals -800 Pa. What is the velocity pressure? (1)

a) -400 Pa
b) 400 Pa
c) -1200 Pa
d) 1200 Pa

4.16 The best means of having an instant check that an extract system is operating correctly at the extract point is by: (1)

a) Measuring the face velocity at the extract hood
b) Checking the duct velocity downstream of the extract point
c) Using a smoke tube
d) Observing the reading on a fixed manometer attached to the ductwork just after the extract point

4.17 The typical capture velocity required for solvents evaporating from degreasing tanks, paint dipping or drying is: (1)

a) 0.3 - 0.5 $ms^{-1}$
b) 0.5 – 1.0 $ms^{-1}$
c) 1.0 – 2.5 $ms^{-1}$
d) 2.5 – 10 $ms^{-1}$

4.18 The transport velocity for a heavy metal dust is typically: (1)

a) 5 $ms^{-1}$
b) 12 $ms^{-1}$
c) 25 $ms^{-1}$
d) 50 $ms^{-1}$

4.19 Velocity of air is 30 $ms^{-1}$ in ductwork. What is the velocity pressure? (Assume normal temperature and pressure conditions) (1)

a) 180 Pa
b) 540 Pa
c) 1080 Pa
d) 2600 Pa

4.20 The minimum face velocity for a fume cupboard should be: (1)

a) 0.3 $ms^{-1}$
b) 0.5 $ms^{-1}$
c) 0.7 $ms^{-1}$
d) 1.0 $ms^{-1}$

4.21 The velocity pressure measured in a duct was 225 Pascals. The velocity was: (1)

a) 15.0 $ms^{-1}$
b) 19.4 $ms^{-1}$
c) 22.5 $ms^{-1}$
d) 31.7 $ms^{-1}$

4.22 A spray booth has face dimensions of 2 metres by 2.5 metres. The face velocity is 0.6 metres per second. The volume flow through the booth is: (1)

a) 2.8 $m^3s^{-1}$
b) 3.0 $m^3s^{-1}$
c) 3.6 $m^3s^{-1}$
d) 4.0 $m^3s^{-1}$

4.23 Push-pull systems are often used on which of the following operations? (1)

a) Welding
b) Grinding
c) Large open surface tanks
d) Spraying isocyanate based paints

4.24 Air is passing through a duct of cross-sectional area 0.04 $m^2$ at a rate of 1 $m^3$ $s^{-1}$. If the static pressure is - 300 Pascals, what is the total pressure in the duct? (1)

a) – 375 Pascals
b) 75 Pascals
c) 375 Pascals
d) 675 Pascals

4.25 During a thorough examination and test it is found that the static pressure upstream of a particular point has fallen significantly from the initial examination and test. The static pressure downstream of that same point has gone up significantly. This signifies there is a: (1)

a) Leak in the system between the two test points
b) Blockage upstream of both test points
c) Blockage between the two test points
d) Blockage downstream of both test points

4.26 Air is passing through a duct of 0.2 m diameter pipe. The flow rate is 1.5 $m^3$ $s^{-1}$ and the static pressure is -165 Pascals. What is the total pressure to the nearest 5 Pa? (1)

a) 800 Pascals
b) 1000 Pascals
c) 1200 Pascals
d) 3000 Pascals

4.27 For a particular process, the quantity of air required to control a substance by a small hood requires a face velocity of 5 $ms^{-1}$ per second. If a larger hood was to be installed will the required hood face velocity necessary to achieve the same air quantity be: (1)

a) More than 5 $ms^{-1}$
b) Less than 5 $ms^{-1}$
c) The same
d) None of the above

4.28 Which of the answers to the following question is incorrect? (1)

Respiratory protective devices (respirators) are designed to provide protection against one or more of the following hazards:

a) Deficiencies in oxygen
b) Particulate contaminants
c) Gaseous and vapour contaminants
d) Permeation of solvents

4.29 What is the required minimum protection factor for a contaminant where the airborne concentration is 1.5 mg $m^{-3}$ and the OEL is 0.1 mg $m^{-3}$? (1)

a) 1.5
b) 15
c) 150
d) 1500

4.30 Pre filters are usually added to combination particulate and gas/vapour filters to:

(1)

a) Remove small particles
b) Extend the life of the main particulate filter
c) Remove contaminants that may affect the gas/vapour filter
d) None of the above

**[30]**

**TOTAL MARKS: [100]**