Chamber of Mines of South Africa

MEMORANDUM

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – INTERMEDIATE CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 5 **SUBJECT CODE: COMIMEC** **EXAMINATION DATE: 16 OCTOBER 2017** **TIME**: 14:30 – 17:30	**EXAMINER: Ms. S Wheeler** **MODERATOR: Prof C Badenhorst** **TOTAL MARKS:** [100] **PASS MARK:** (60%)

NUMBER OF PAGES:

SPECIAL REQUIREMENTS:

THIS IS NOT AN **OPEN BOOK EXAMINATION**. THERE IS NO FORMULA HANDOUT

INSTRUCTIONS TO CANDIDATES:

1. Answer all FIVE 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 A fan is located in the centre of a large flat area free of obstructions. Measurements taken on the surface of an imaginary hemisphere of radius 5 meter centred at the fan indicated sound pressure of 0.8Pa.

Indicate all assumptions made and calculate:

1.1.1 the sound pressure level on the surface of the hemisphere, and

1.1.2 the sound power level of the fan. **(10)**

Assumptions:-

- *The ground is a perfect reflector*
- *All the acoustic energy radiated by the fan flows through the surface of the hemisphere*
- *Density = 1.2kg/m³*
- *If the duty of the fan does not change materially the sound power level is assumed to be constant.* *(2)*

1.1.1 $SPL = 10 \log \frac{(pressure)^2}{(2 \times 10^{-5})^2}$ dB

$SPL = 10 \log \frac{(0.8)^2}{4 \times 10^{-10}}$ dB

$= 10 \times 9.20$

$= 92dB$

1.1.2 $= \frac{p^2}{Wc}$

$= \frac{0.8^2}{1.2 \times 344}$

$=0.00155W/m^2$

The surface area of a hemisphere of radius 5m

$= 2\ 5^2$

$157m^2$

The acoustic power is therefore $0.00155 \times 157 = 0.2435W$

$SWL = 10 \log \frac{Power}{10^{-12}}$

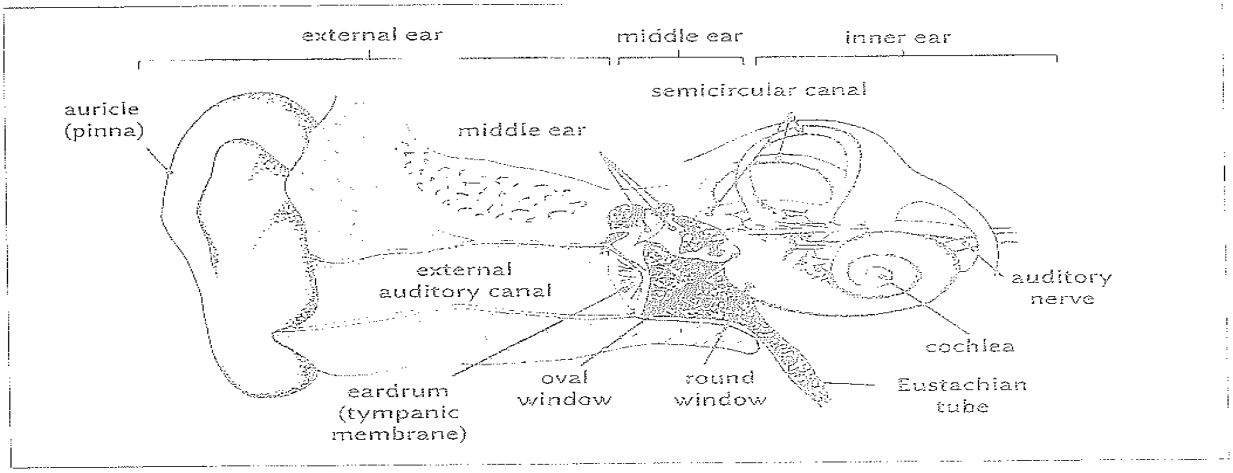
$= 10 \log \frac{0.2435}{}$

10^{-12}

$= 10 \times 11.39$

$= 114dB$

1.2 Describe, with the aid of a simple sketch, the anatomy of the human ear. (4)



1.3 Describe the physiology of: (6)

1.3.1 The outer ear

The outer ear consists of the pinna, ear canal and the ear drum or tympanic membrane. The outer ear functions to direct and enhance sound waves into the ear and provides some protection to the middle ear.

1.3.2 The middle ear

The middle ear (tympanic cavity) is an air filled cavity between the tympanic membrane and bony capsule of the inner ear. It contains the ossicular chain and muscles as well as the opening of the Eustachian tube. The middle ear transmits and enhances mechanical vibration from outer to inner ear.

1.3.3 The inner ear

The inner ear is a fluid filled labyrinth within the temporal bone. It contains the sensory mechanism of both auditory and vestibular systems. Here, mechanical vibration is converted to neural stimulation for hearing and balance.

QUESTION 2

2.1 List four (4) symptoms of fatigue and four (4) causes giving rise to fatigue. (8)

Symptoms

- *A subjective feeling of weariness*
- *Sluggish thinking*
- *Reduced awareness*
- *Poor and slow perception*
- *An unwillingness to work (loss of motivation) and*
- *A general decline in bodily and mental performance.*

Causes

- *High intensity and long duration of physical or mental work*
- *Environmental stressors, e.g. noise and heat*
- *Physical problems, worries and conflicts*
- *Pains and illnesses*
- *Circadian rhythm stress, and*
- *Poor or inadequate nutrition*

2.2 List four (4) physiological effects of exposure to vibration (4)

- *Vibration seriously affects visual perception & psychomotor performance. Visual acuity is adversely affected, as the image in the visual field becomes blurred and unsteady. Worst in the range of 10 to 30 Hz.*
- *The skeletal, circulatory, muscle and respiratory systems are affected to a lessor extent.*
- *Mental performance is adversely affected.*
- *Breathing is affected in the range 1 to 4Hz.*

- *Pains in the chest, abdomen, rattling of the jaw, muscular reactions and severe discomfort occur from 4 to 10Hz.*
- *Backache from 4 to 10Hz.*
- *Muscular tension, headaches, eyestrain, throat pain, disturbance of speech, intestinal irritation and bladder all occur between 10 and 20 Hz.*

(Any four)

2.3 List three (3) considerations for the optimal design of working conditions with regard to worker well-being, performance, safety and health. (3)

- *The physical size of people and its implications*
- *The cardiovascular systems and its limitations on work*
- *The major musculoskeletal system and its limitation on material handling,*
- *The minor musculoskeletal systems and its limitations on fine work, manipulation and dexterity.*
- *Environmental factors such as noise, illumination and thermal comfort.*

2.4 Define the condition “Sick Building Syndrome” and list three (3) symptoms associated with this syndrome. (5)

Sick building syndrome is a condition where occupants of a building, area, room or work place experience acute health effects that seem to be related to the time spent in the particular work area or building.

Symptoms include headaches, eye, nose and throat irritation, a dry cough, dry or itchy skin, dizziness and nausea, difficulty in concentrating and fatigue.

(Any three)

[20]

QUESTION 3

3.1 Define the following terms (5)

3.1.1 Atelectasis

Incomplete expansion, usually caused by occlusion (blockage of the bronchus) by a plug of mucus

3.1.2 Inspiratory capacity

Maximum volume by which the lung can be increased by maximum inspiration from a mid-position.

3.1.3 Nystagmus

An involuntary movement of the eyeball, usually caused by subjecting the eye for long periods to unaccustomed movement. It results in headaches, dizziness and fatigue and in an occupational sense is most commonly diagnosed amongst miners.

3.1.4 Teratogens

These cause abnormalities in the unborn fetus. The abnormalities are not transferable to subsequent generations.

3.1.5 Anthropometry

The measurement of human dimensions

3.2 List four (4) factors that you would consider when designing illumination systems. (4)

- *All objects and major surface in the visual field should as far as possible be equally bright*
- *Where brightness contrasts occur, objects in the middle of the field should be less than three times as bright as objects towards the outer edges*
- *Contrasts between the middle field and the outer filed should be less than ten fold*
- *The working field should be brightest in the middle*
- *Excessive contrasts are less bothersome at the top of the field*

- *Light sources should not contrast with the background at a ratio greater than 20:1, and*
- *The maximum range of brightness contrast should not exceed 40:1.*

3.3 List six (6) factors that can affect skin absorption rate (3)

- *Temperature*
- *Perspiration*
- *Concentration*
- *Skin surface are exposed*
- *Anatomical region*
- *Damage to the skin (abrasions and lesions)*
- *Barriers*

3.4 What do the following acronyms stand for? (5)

3.4.1 NNR

National Nuclear Regulator

3.4.2 TWARQC

Time Weighted Average Respirable Quartz Concentration

3.4.3 MOHAC

Mining Occupational Health Advisory Committee

3.4.4 HEG

Homogeneous Exposure Group

3.4.5 LC_{50}

Lethal Concentration 50%

3.5 List three (3) methods of testing noise-producing appliances (3)

- *Free-field testing*
- *Reverberant field testing*
- *Semi-reverberant field testing*
- *Duct testing*

(Any 3) **[20]**

QUESTION 4

4.1 How much fresh air containing 0.45mg/m^3 of dust should be mixed with 14.6m^3/s of air containing 2.30mg/m^3 of dust to reduce the dust concentration to 1.5mg/m^3? (6)

- *Let X – quantity fresh air required*

Then (14.6 x 2.30) + (X x 0.45) = (14.6 x X(1.5)

33.58 + 0.45X = 1. + 21.9

33.58 – 21.9 = 1.5 X – 0.45X

11.68 = 1.05 X

1.05X = 11.68 /1.05

X = 11.12m^3/s

4.2 Name the two ways hazardous chemical substances may be classified. (2)

- *Classification according to physical properties*
- *Classification according to toxicological effects*

4.3 List the sixteen headings that apply on a Material Safety Data Sheet (8)

- *Date*
- *Company details*
- *Product identification (chemical formula, common name and synonyms)*
- *Composition (hazardous components)*
- *Hazard identification (types of hazards, eg. Flammability, explosibility, toxicity)*
- *First aid measures*
- *Firefighting measure*
- *Accidental release measures*
- *Handling and storage*
- *Exposure controls (OEL, PPE requirements)*
- *Physical and chemical properties*
- *Stability and reactivity*
- *Toxicological information*
- *Ecological information*
- *Disposal considerations*
- *Transport information*

4.4 Dust control is based on a threefold approach, name and briefly describe each of the approaches. (9)

- *Engineering Controls*

Which are aimed at engineering out the hazard either by initial design specification, or by applying methods of substitution, isolation or ventilation.

- *Prevention of formation*
- *Prevention of liberation at source*
- *Dilution by ventilation*
- *Filtration or other mechanical means of removal.*

- *Administrative control*

  Which relies on managing the time (duration) of exposure by means of scheduling activities. In addition, good practice such as hazard recognition and good working practices resort under this heading.

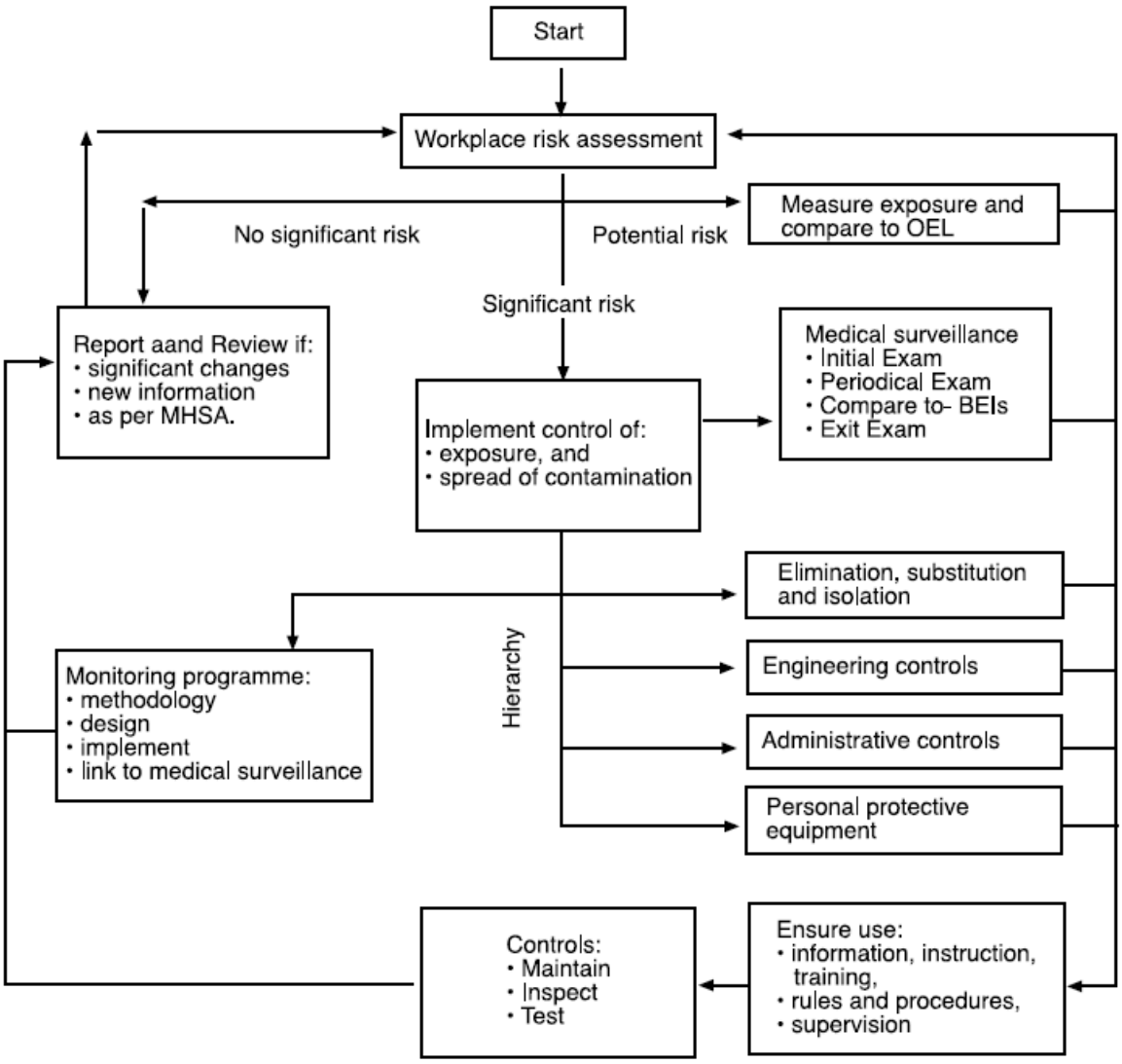
- *Personal Protective Equipment (PPE)*

  Which employees are required to wear to protect them from contaminants in their environment, is the other method whereby exposures can be reduced. This approach is usually adopted when it is not feasible to render the work environment free of occupational health hazards. The use of PPE should be considered as a last resort.

[25]

QUESTION 5

5.1 Summarise an Occupational Health programme by means of a flow chart. (15)



TOTAL MARKS: [100]