



**FACULTY OF ENGINEERING AND ENVIRONMENT**

**DEPARTMENT OF MINING ENGINEERING**

**EXPLOSIVES ENGINEERING**

**EMN 2109**

**Final Examination Paper**

**NOVEMBER 2023**

This examination paper consists of 5 pages

**Time Allowed: 3 hours**

**Total Marks: 100**

**Examiner's Name: MS C MACHADU**

**INSTRUCTIONS**

1. Answer **ALL FOUR (4)** questions
2. Each question carries **25** marks

**Additional Requirements**

Calculator

**MARK ALLOCATION**

<b>Question 1 to 4</b>	<b>Total 25 marks each</b>
<b>Part Questions</b>	<b>As shown in each part question</b>
<b>Total Attainable</b>	<b>100 marks</b>

## QUESTION 1

- a) What is the name given to the set of rules stipulated by legislation that govern the use of explosives? [2]
- b) Define the following :
- i. Fiery mine
  - ii. Misfire
  - iii. Over break
  - iv. Socket
  - v. Contraband [10]
- c) Distinguish the following:
- d)
- i. Wet and dry blasting agents
  - ii. Heavy ANFO and prilled ANFO
  - iii. Deflagration and detonation
  - iv. High and low explosives [8]
- e) You are a holder of a blasting license and you are delegated by the mine manager to escort the driver of the ANFO utility truck to the magazine. Once explosives have been loaded onto the vehicle of conveyance it is your mandate to inspect the vehicle before take-off. List any 5 things you are to take note of in relation to the **conditions and construction** of the conveyance vehicle as stipulated by law. [5]

## QUESTION 2

- a) State the application of the following in drilling:
- i. Water [2]
  - ii. Oil [2]
  - iii. Compressed air [2]
- b) State 4 things you should check for prior to using an explosive. [4]

- c) The cycle times of wagon drill rig, DOB14, were recorded as shown in Table 1 below. The drill rig has 6 steel rods that are 6m in length.

Table 1: Cycle times for DOB14 between 08:00-09:00am on second sandstone S8025

<b>Cycle time \ mins</b>	<b>Coupling time\min</b>	<b>Depth \ meters</b>	<b>Penetration rate (meters\min)</b>	<b>Repositioning time\mins</b>
14.35	1.46	7.9		-
13.02	1.02	7.0		0.45
12.09	-	6.0		0.27
12.50	-	6.0		0.32

- i. Fill in the table under the column labelled “**Penetration rate**” with values corresponding to each cycle time. [8]
- ii. Briefly explain why row 5 and 6 have no values recorded under the column labelled “**Coupling time**”. [2]
- iii. On a sandstone bench, an average of 10 boreholes are drilled per hour by DOB14. Briefly describe any 5 factors that could have contributed to the underperformance of DOB14. [5]

### QUESTION 3

- a) According to legislation under the explosive regulations :
  - i. At a mine other than a coal mine, primary or main blasting shall take place when?[2]
  - ii. What is meant by re-entry time? [1]
  - iii. State the minimum re-entry times for surface mines and underground mines. [2]
- b) You are a mining engineer at Hwange Colliery mine and the mine wants to procure a new drill rig. The mine manager delegates you to make a requisition for a new drill machine at Stores. Which type of drilling machine would you select (state the brand and mechanisation used)?  
Also note the criteria or factors to be considered upon selection to justify your answer. [10]

- c) Given that specific gravity (s.g.) of coal is 1.32 .Using a burden and spacing of 6.2m and 7.1m respectively, and an average depth of 5m.
- i. Calculate the tonnage of coal blasted on a bench with 78 holes. [5]
  - ii. To reach a target of 30 000 tonnes from one blast using the same parameters in (i).  
How many holes must be drilled? [5]

#### QUESTION 4

Table 2: Burden and spacing used on different rocks

Rock type	Spacing	Burden
Sandstone	4.6	4.0
Fireclay	6.5	5.6
Shale	7.1	6.2
Coal	7.1	6.2

A bench with 160 holes with an average depth of 12m and a hole diameter of 191mm needs to be blasted. An option of bulk emulsion with a density of 1.1 kg/m<sup>3</sup> and prilled ANFO with a density of 0.9kg/m<sup>3</sup> can be used.Using this data and making reference to Table 2,answer the following stating any assumptions used :

- a) Calculate the metre rise for:
  - i. Prilled ANFO [2]
  - ii. Bulk emulsion [2]
  
- b) Calculate the following for sandstone, fireclay and shale:
  - i. Bank cubic metres to be blasted. [6]
  - ii. Amount of explosives required given a powder factor of 1.15kg/m<sup>3</sup> in the case of ANFO . [6]

- c) Using an average depth of 10m and 3.5kg pre-packed bulk emulsion cartridges on coal, calculate:
- i. Bank cubic meters to be blasted. [2]
  - ii. Amount of explosives required using a powder factor of  $1.4\text{kg/m}^3$ . [2]
- d) Briefly explain :
- i. Why pre-packed emulsion is favoured over bulk emulsion on coal. [2]
  - ii. Which blast design would you use on coal, justify your answer. [3]

**END OF EXAMINATION**