PROGRAM	:	**BEng. Tech (Mining)** **BEng. Tech (Mine Surveying)**
SUBJECT	:	**Mining Surface 2A**
SUBJECT CODE	:	**SMMMNA2**
EXAMINATION	:	**FINAL SUMMATIVE EXAMINATION**
DATE	:	**01 JUNE 2019**
DURATION	:	**180 MINUTES**
TOTAL MARKS	:	**120**

EXAMINER	:	**Maelani Chauke**
MODERATOR	:	**Mr. Hein Strauss**
NUMBER OF PAGES	:	**9 PLUS FORMULAE SHEET**

INSTRUCTIONS:

1. **PLEASE** answer **ALL** questions
2. A question means all the sub-questions that appear under the heading of that question. All the sub-questions must be kept together under the heading of a specific question
3. Number all questions, and associated sub-questions **CLEARLY**
4. A formulae sheet is herein attached
5. The use of a calculator is permissible
6. All the relevant rules of the University of Johannesburg shall apply

Question 1

1.1 Relative to a comparable underground mine, the capital and operational costs of the surface are generally lower than that of the underground mine. Comment on the reasonableness or unreasonableness of the statement. Typically, which aspects of an operational mine would justify the reasonableness or unreasonableness (i.e. correctness or incorrectness) of the statement?

(10)

1.2 Calculate the average basic production costs (Tp1; Tp2; and Tp3) and the economic limit for the stripping ratio (Slim) based on the following mine data.

Ore reserves mined year 1 = 2mt

Ore reserves mined year 2 =3mt

Ore reserves mined year 3 = 5mt

Ore mining costs year 1 and 2 =R180/t

Ore mining costs year 3 = R220/t

Waste mine year 1 = 5mt

Waste mined year 2 = 8mt

Waste mined year 3 = 9mt

Waste mining cost year 1 and 2 =R260/t

Waste mining cost year 3 = R280/t

If the underground ore mining cost was R300/t, what implications would it hold for the development of the mine?

(20)

[30]

Question 2

2.1 List and describe at least three classifications of ore reserves suitable for surface mining

(6)

2.2 Describe in words and give diagrammatical representations of the following surface mining methods:

2.2.1 Open pit mining

2.2.2 Strip mining

2.2.3 Terrace or Quarry mining

Your answers should in each case, explain considerations such as the direction of mining advance; overburden material; waste removal and waste dumping; backfilling; characteristics of benches; typical equipment used; etc.

(18)

2.3 Explain the following terms with the aid of sketches, as they apply to an open-pit operation.

2.3.1 Overall slope angle (2)

2.3.2 Bench height (2)

2.3.3 Bench slope (2)

[30]

Question 3

3.1 List the range of machines that are currently available for surface mine drilling

(4)

3.2 List, and explain three factors that determine (i.e. or primarily influence) the choice of a specific rotary drilling model

(6)

3.3 For drilling overburden at a strip mine in the Witbank area, 250mm tricone button drill bit was suggested. The overburden material comprises siltstone and sandstone with compressive strengths of 110MPa and 135MPa respectively. The total overburden is 20m which the upper 6m is siltstone

3.3.1 Find the maximum pulldown that the can be applied on the drill bit

3.3.2 Given the rotation tempo of 80rpm which is constant throughout drilling the hole, if the maximum pulldown is applied, how long will it take to drill the hole?

3.3.3 If the drilling pattern comprises 60 boreholes and there is a pullout time of 2 minute, a travelling time of 3 minute and a positioning time of 1 minute between the holes, calculate the time it will take to drill the pattern (assume single-pass drilling)

(10)

[20]

Question 4

4.1 Why is carefully engineered blasting a requirement in modern surface mine operations? Justify your answer

(6)

4.2 Define Powder Density Factor (PDF)

(2)

4.3 A borehole 300mm in diameter (D) and 12m in length (L) is filled with ANFO having a density (p_e) of 0.8 g/$cm3$

Given:

- Amount of energy liberated in a form of heat (ANFO): 912 calories per gram of ANFO
- Velocity of detonation (VOD) for ANFO is of the order of 4529 m/second
- To convert kilocalories into kilojoules, multiply by a factor of 4.184

4.3.1 Calculate the explosive volume in the column

(4)

4.3.2 Calculate the mass of explosive in the column

(2)

4.3.3 Calculate the energy released

(2)

4.3.4 Calculate the time required for the entire column of explosive to detonate

(2)

4.3.5 Calculate the power generated

(2)

[20]

Question 5

5.1 What are mine haul roads used for? In your own words, explain the objectives of mine haul road design

(8)

5.2 A typical 250t truck is laden to 400t GVM. Calculate the following:

5.2.1 The load on each back wheel (assume 4 wheel on dual assembly)

State your assumptions

(4)

5.2.2 Calculate the load on each front wheel

(2)

5.3 List the advantages and disadvantages of a double tyre system on trucks

(6)

[20]

GRAND TOTAL MARKS = 120

FORMULA SHEET

PROGRAM	:	**BEng. Tech Mining**
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1. **The basic production cost (Tp) can be calculated as**:

   Tp = A+ S B;

   where

   A: The unit costs associated with excavating one unit of ore and it's transport to the edge of the pit

   B: The unit costs associated with excavating one unit of waste material

   S: Stripping ratio

2. **Slim – the break even stripping ratio) is given by**:

   S (Lim) = (U – A)/B

   A: The unit costs associated with excavating one unit of ore and it's transport to the edge of the pit

   B: The unit costs associated with excavating one unit of waste material

   S(lim): Stripping ratio (Limit)

   U: The unit cost of one unit of ore through underground mining

3. Predicting the powder density factor (PDF)

PREDICTING THE POWDER FACTOR (PDF)

$$PDF = 94.6\log\left[\frac{3{,}3\rho.Tan(\phi + i).\sqrt[3]{\sigma_c}\left(\frac{d}{100}\right)^2}{115 - RQD}\right] + 540$$

Where:

PDF	=	Powder factor (g/BCM)
P	=	Rock density (t/m^3)
Φ	=	Friction angle of rock joint (°)
i	=	Angle of roughness of rock joint (°)
d	=	Bore hole diameter (mm)
σ_c	=	Compressive strength of rock (MPa)
RQD	=	Rock quality designated according to Deere's classification (%)

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FORMULAE SHEET

MINING SURFACE 2A
CODE: SMMMNA2

PRODUCTION POTENTIAL OF TRICONE ROTARY DRILLS

[A] Penetration tempo is given by:

$$P_s = \frac{0.1275\,Ww}{\sigma_c^2\, d^{0,9}} \quad \text{.........} \quad (1)$$

Where:

P_s = penetration tempo (m/hr)
σ_c = compressive strength (MPa)
w = revolutions per minute
W = pulldown (kg)

OR

$$P_s = \frac{6.23 \times 10^{-6}\, Ww\,(61 - 28\log_{10}\sigma_c)}{d} \quad \text{....} \quad (2)$$

Valid only to a limit of $\sigma_c = 150\,MPa$

[B] The drill power (P_d) (kW) and torque (for rotation motor – (P_{td}) (kNm) requirements:

$$P_d = \frac{0.0311\, dw \left[\frac{W}{453.4}\right]^{1.5}}{\sigma_c} \quad \text{......} \quad (3)$$

$$P_{td} = 9{,}55\,\frac{P_d}{w} \quad \text{.........} \quad (4)$$

[C] Maximum pulldow (W_{max}) (kg)

$$W_{max} = 570 \times 10^3\, d^2 \quad \text{..........} \quad (5)$$

Formula valid only for a button-type drill-bits mounted on a tricone system