UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELORS OF TECHNOLOGY MINING ENGINEERING
SUBJECT	:	**MINING TECHNICAL SERVICES 4B**
CODE	:	**MTLB411**
DATE	:	FINAL SUMMATIVE ASSESSMENT 12 NOVEMBER 2019
DURATION	:	3 HOURS
WEIGHT	:	60% OF FM
TOTAL MARKS	:	100

EXAMINER	:	MR H STRAUSS
MODERATOR	:	MR DJ McDOUGALL
NUMBER OF PAGES	:	8 PAGES

INSTRUCTIONS	:	QUESTION PAPERS MUST BE HANDED IN
REQUIREMENTS	:	1 SCRIPT, SECOND ON REQUEST TRACING PAPER

INSTRUCTIONS TO CANDIDATES:

WRITE YOUR STUDENT NUMBER ON THE FRONT PAGE OF YOUR QUESTION PAPER BEFORE YOU ANSWER ANY QUESTIONS.

ANSWER ALL THE QUESTIONS.

SHOW ALL CALCULATIONS AND ASSUMPTIONS.

HAND IN YOUR QUESTION PAPER WITH YOUR SCRIPT.

QUESTION 1

1.1 List the six steps of the process leading to spontaneous combustion of coal. (3)

1.2 Answer "True" or "False" to the following statements:

NB: Don't guess – wrong answers get a mark of -1.

1.2.1 The presence of pyrite may accelerate spontaneous combustion. (1)

1.2.2 As the particle size decreases and the exposed surface area increases, the tendency of coal towards spontaneous combustion decreases. (1)

1.2.3 Lower rank coals are more susceptible to spontaneous combustion than higher rank coals. (1)

1.2.4 The critical air quantity is that quantity that is sufficient to prevent a heat build-up. (1)

1.3 What is the purpose of test holes drilled with buffer blasting? (2)

1.4 What precaution is associated with these test holes and why? (2)

1.5 Explain the following:

1.5.1 Reactive ground. (2)

1.5.2 Hot spot. (2)

1.6 Explain the following terms:

1.6.1 Heat load. (2)

1.6.2 Auto compression. (2)

1.6.3 Thermal storage. (2)

1.6.4 Positional efficiency. (2)

1.6.5 Useful work. (2)

1.6.6 Entropy. (3)

1.6.7 Isentropic. (2)

[30]

QUESTION 2

2.1 A dump truck with a power rating of 210kW hauls a load of 18t along a horizontal roadway at a speed of 8km/h. Given that the truck has an overall efficiency of 30%, estimate its contribution to the heat load. (3)

2.2 The intake air stream into a stoping section has a temperature of 29/34°C at a barometric pressure of 102,5kW. The quantity was measured as 36m^3/s. It is required to lower the wet bulb temperature of this air stream to 22°C by installing a cooling car that uses chilled service water. If the temperature increase in the cooling water is 11°C, estimate the mass flow rate of water that will be required. (6)

2.3 Measurements that have been recorded at a refrigeration plant are tabulated below.

Evaporator water circuit	
Mass flow (kg/s)	126
Temperature in (°C)	18,6
Temperature out (°C)	4,5
Condenser water circuit	
Mass flow (kg/s)	152
Temperature in (°C)	22,9
Temperature out (°C)	38,8
Compressor Motor	
Voltage (kV)	6,6
Current (A)	182
Power factor	0,92
Estimated efficiency	93%

2.3.1 Conduct a heat balance and comment on the result. (5)

2.3.2 Calculate the net actual compressor COP. (2)

2.3.3 Calculate the overall compressor COP. (2)

2.3.4 Calculate the monthly electrical power cost to run this compressor. Assume a tariff of 139c/kWh. (2)

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<u>QUESTION</u> 3

3.1 A 40m high slope with a face angle of 45° is to be excavated in overburden soil with a unit weight of 24kN/m^3, a cohesive strength of 30kPa, and a friction angle of 28°.

3.1.1 Using the attached chart that is appropriate for the groundwater condition determine the factor of safety of the slope. (3)

3.1.2 If a factor of safety of 1,2 was required, what slope angle would be allowable? (3)

3.2 You are the manager of a large quarry, and two sections of your quarry have lately been plagued by instabilities. You are, therefore, required to analyse the report for each of the slopes given below, and summarise your conclusions regarding the causes of instabilities associated with each. (17)

Slope A	Bench height: 28m; Bench dip angle: 54°; Slope direction: 070°			
Discontinuities:	Dip	DDIR	Other data:	
Joint set 1	68°	028°	Rock density	2 650kg/m^3
Joint set 2	47°	042°	Cohesion on all planes	32kN/m^2
Fault A	57°	082°	Ground water	Nil
Slope B	Bench height: 31m; Bench dip angle: 55°; Slope direction: 278°			
Discontinuities:	Dip	DDIR	Other data: Same as for Slope A.	
Fault B	54°	292°		
Fault C	54°	252°		
No anchor support used in any of the slopes. No tension cracks have been observed. The friction angle of all discontinuities is 30°.				

3.3 Present a solution to eliminate at least one of the instabilities that you have identified. (3)

3.4 Mention four methods used to monitor the stability of slopes in surface mines. (4)

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QUESTION 4

4.1 You are required to evaluate the stability of a CM bord and pillar layout. You have the following data:

Depth to seam floor	105m
Seam height	4m
Road width	6m
Pillar width (w_1)	13m
Pillar length (w_2)	14m
Turnout angle	70°

4.1.1 Evaluate the stability of underground excavations. (8)

4.1.2 Evaluate the stability of the overlying surface. (4)

4.2 You have been called to analyse the cause of a fall of ground incident in a small chrome mine. You have been given the data below:

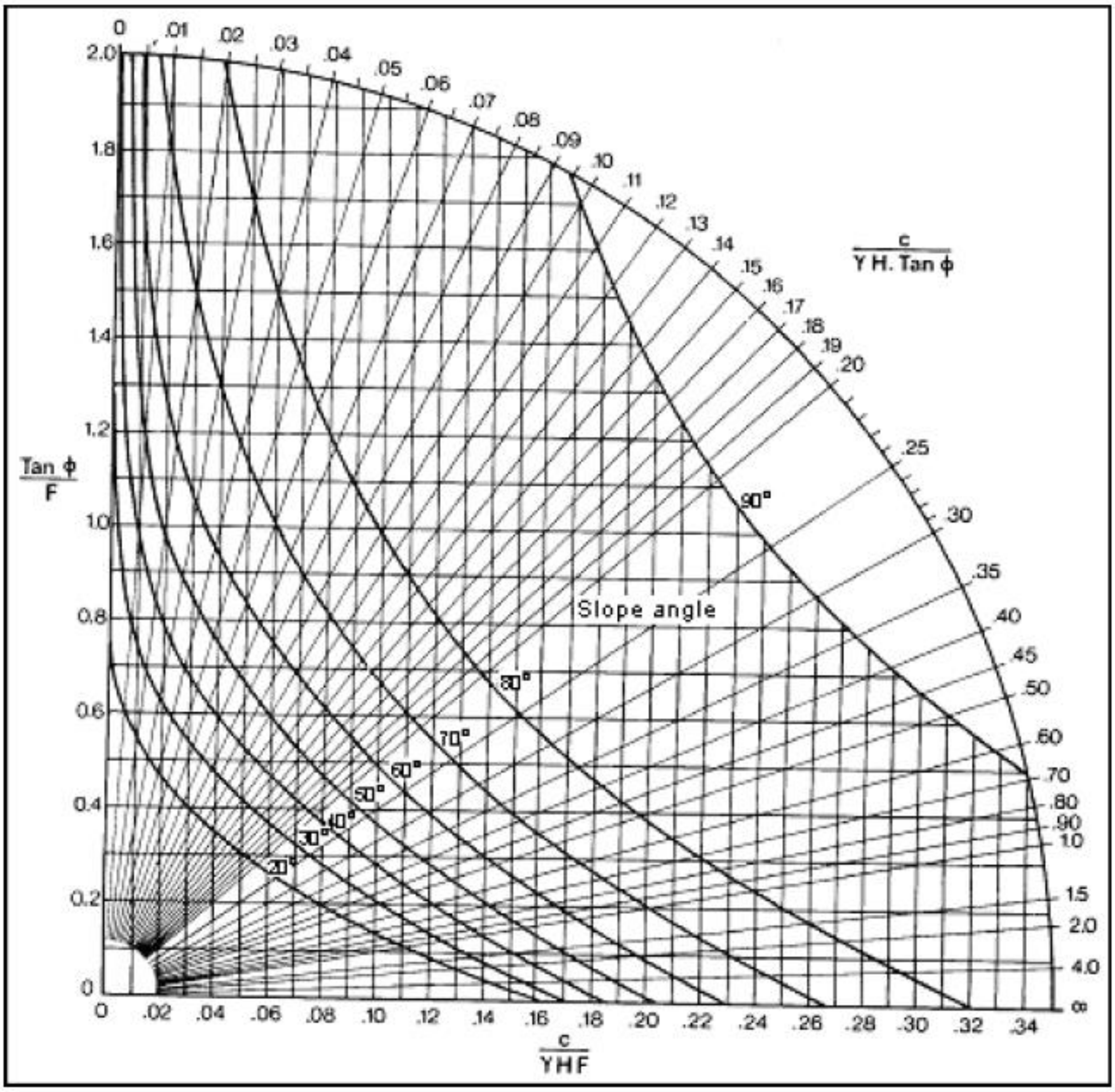
Mining depth	400m
Mining method	Room & pillar
Stope width	2,8m
Dip	horizontal (0°)
Pillar dimensions	6 x 7m
Room width	6m
UCS	190MPa
Overburden density	3 200kg/m^3

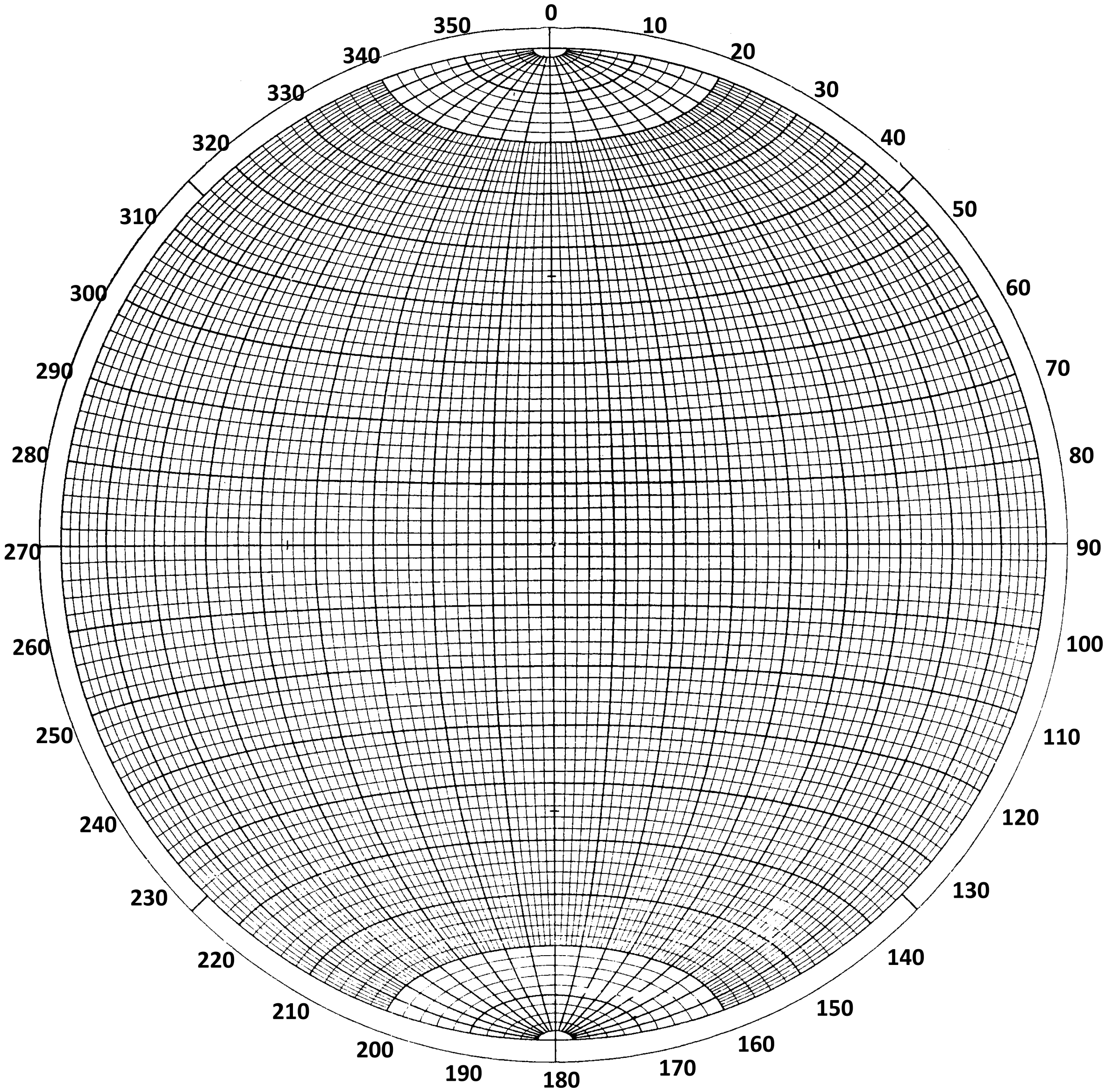
Present your analysis and conclusion. (8)

[20]

TOTAL **[100]**

Appendix A

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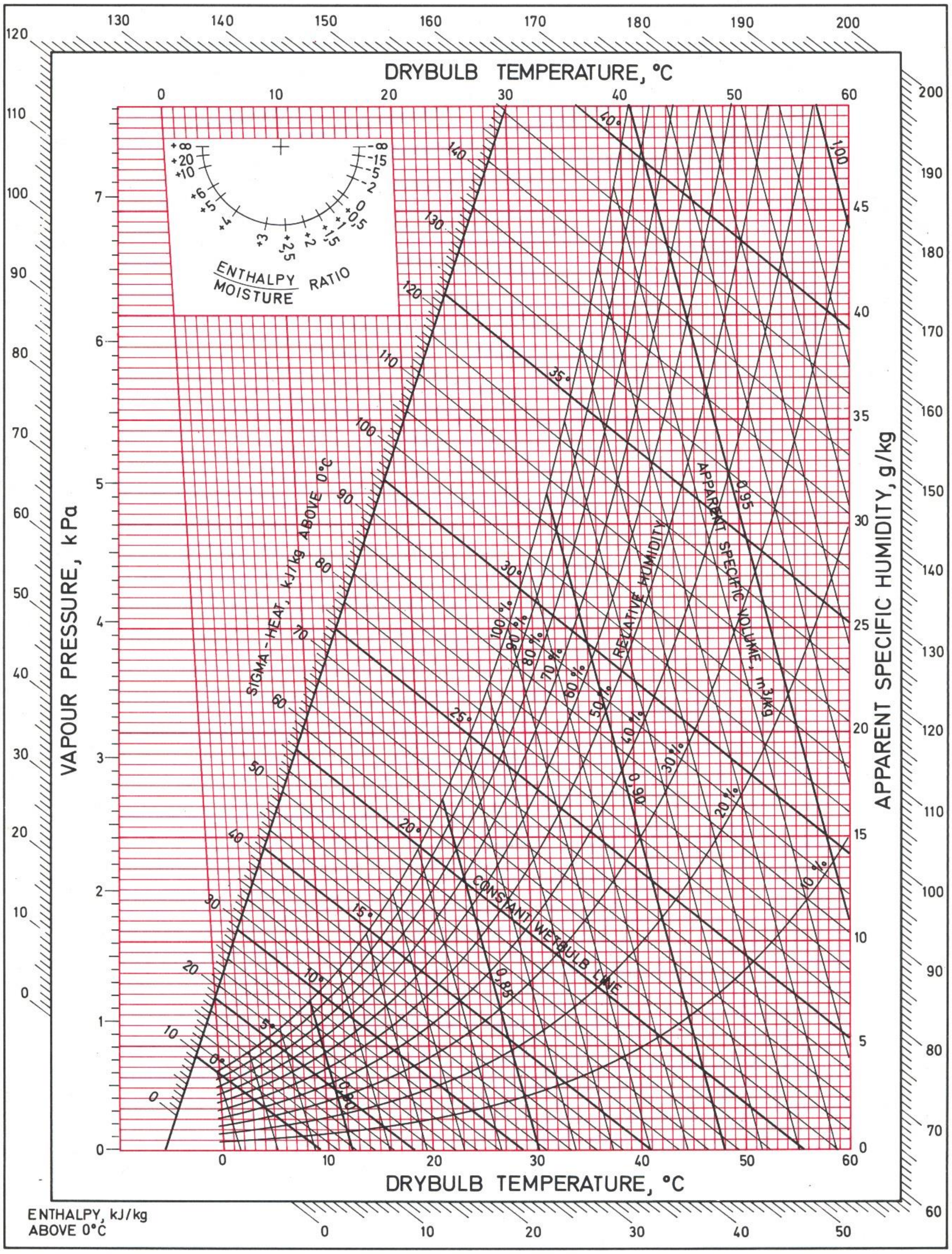
102,5 kPa


DRYBULB TEMPERATURE, °C
VAPOUR PRESSURE, kPa
APPARENT SPECIFIC HUMIDITY, g/kg
ENTHALPY / MOISTURE RATIO
SIGMA-HEAT, kJ/kg ABOVE 0°C
RELATIVE HUMIDITY
APPARENT SPECIFIC VOLUME, m3/kg
CONSTANT WETBULB LINE
ENTHALPY, kJ/kg ABOVE 0°C