UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACCALAUREUS TECHNOLOGIAE *MINING ENGINEERING*
SUBJECT	:	**MINING TECHNICAL SERVICES IVB**
CODE	:	**MTLB411**
DATE	:	SUMMER EXAMINATION 2015 9 NOVEMBER 2015
DURATION	:	(SESSION 2) 12:30 - 15:30
WEIGHT	:	60% OF FINAL MARK
TOTAL MARKS	:	100

EXAMINER	:	MR H STRAUSS
MODERATOR	:	MR DJ McDOUGALL
NUMBER OF PAGES	:	9

INSTRUCTIONS	:	BOOKLETS AND CHARTS TO BE HANDED IN.
REQUIREMENTS	:	ONE EXAMINATION SCRIPT, SECOND ON REQUEST.
	:	INFORMATION BOOKLET (SUPPLIED BY EXAMINER).
	:	TRACING PAPER (SUPPLIED BY EXAMINER).

INSTRUCTIONS TO CANDIDATES:

ANSWER ALL QUESTIONS
SUBMIT ALL CHARTS AND PLOTS WITH YOUR SCRIPT
DO NOT USE CORRECTION FLUID
DO YOUR OWN WORK – BE PROUD

QUESTION 1

1.1 You are starting up a new stope in a deep mine, and indications are that the intake air to the stope will have to be cooled at the stope intake. You plan to install a heat exchanger here that uses chilled water to cool down the air. The stope is in the format of a mini-longwall from level to level, i.e. one continuous face advancing in one direction, and the level spacing is 55m with a dip of 12°. The geothermal heat load is 3,5kW per meter length of face. There are no other significant heat sources in the stope. The intake air stream of 25m³/s in the cross cut below has a temperature of 31/34°C at a barometric pressure of 105kPa. You require a maximum wet bulb temperature in the return air on the level above of 29°, and you may assume that the pressure here is the same as on the level below. Given that the temperature change of the chilled water in the heat exchanger is 13°C, estimate how much chilled water would be required. (5)

1.2 What monthly pumping cost could be associated with this cooling arrangement, given that the water is pumped back to surface from a depth of 2 600m, and that static pumping head is 120% of the pumping height. The overall pumping efficiency is 84%, and the electrical power tariff is 72c/kWh. Assume a 30,5 day month. (3)

1.3 Two air streams flow together at a point underground where the barometric pressure is 105kPa. Air stream 1 has a volumetric flow of 23m³/s, and a temperature of 24/28°C. Air stream 2 has a volumetric flow of 47m³/s, and a temperature of 27/32°C. Estimate the wet and dry bulb temperatures of the combined air stream. (4)

[12]

QUESTION 2

The measurements taken at a refrigeration plant using R134a are tabulated below.

Condenser outlet	Given as point A on the chart attached.
Evaporator refrigerant temperature	0°C
Evaporator water flow rate	86kg/s
Evaporator water temperature in	16°C
Evaporator water temperature out	3°C
Condenser water flow rate	102kg/s
Condenser water temperature in	18°C
Condenser water temperature out	34°C
Compressor motor voltage	6,6kV
Compressor motor current	140A
Power factor	0,94
Compressor motor efficiency	95%

Assume that no heat is lost or gained during expansion.

2.1 Using the water circuits, conduct a heat balance for this circuit and comment on the result. (4)

2.2 Estimate the following values:

2.2.1 Refrigerant mass flow. (2)
2.2.2 Compressor outlet temperature. (2)
2.2.3 Carnot COP. (1)
2.2.4 Net Actual Compressor COP. (2)
2.2.5 Overall Compressor COP. (2)
2.2.6 Both Cycle Efficiencies. (2)
2.2.7 Efficiency of compression. (1)

2.3 Complete and submit the PH diagram plot. (2)

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QUESTION 3

3.1 Write notes on the prevention of spontaneous combustion in collieries under the following headings:

3.1.1 Tailings (plant rejects). (2)

3.1.2 Coarse reject (discard). (3)

3.1.3 Spoil heaps in strip mining. (3)

3.1.4 Product (coal). (3)

3.1.5 Shape and orientation of stockpiles and dumps. (3)

3.1.6 Highwalls at surface mines. (3)

3.2 Explain the term "water gas". (3)

[20]

QUESTION 4

4.1 You are planning a small coal mining operation that will require access via a vertical shaft with a diameter of 5m and a maximum depth of 240m. Because of the small scale of the operation, the shaft will be conventionally excavated, and only reinforced with concrete lining where required, (i.e. where reliability might be a concern). The geotechnical detail of the shaft position is tabulated below.

Depth range	Description		
Surface to -40m	Soil & weathered sandstone. Q = 0,01		
-40 to -80m	Alternating sandstone layers. Q = 3. Weathering = moderate.		
	Jointing	Dip	DDIR
	JS_1	47^o	040^o
	JS_2	62^o	076^o
-80 to -180m	Massive dolerite. Q = 30.		
-180 to -200m	Shear zone. Q = 0,4. Weathering = severe.		
	Jointing	Dip	DDIR
	JS_1	55^o	010^o
	JS_2	64^o	241^o
	JS_3	76^o	187^o
-200 to -240m	Massive dolerite. Q = 30.		

Make recommendations regarding the support spacing requirements within the ranges delineated in the table, as well as the use of concrete lining where required. (10)

4.2 You plan to mine a coal seam at a depth (to the seam floor) of 74m, using conventional bord and pillar methods. The seam height is 3,5m. You envisage a layout of 9m x 9m pillars, with a bord width of 6,3m.

4.2.1 Estimate the impact of subsidence on the surface of the mine. (4)

4.2.2 Calculate the maximum tilt. (2)

4.2.3 Calculate the maximum tensile and compressive strain. (4)

4.2.4 Describe the after-effects of sub surface erosion. (5)

[25]

QUESTION 5

5.1 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°.				

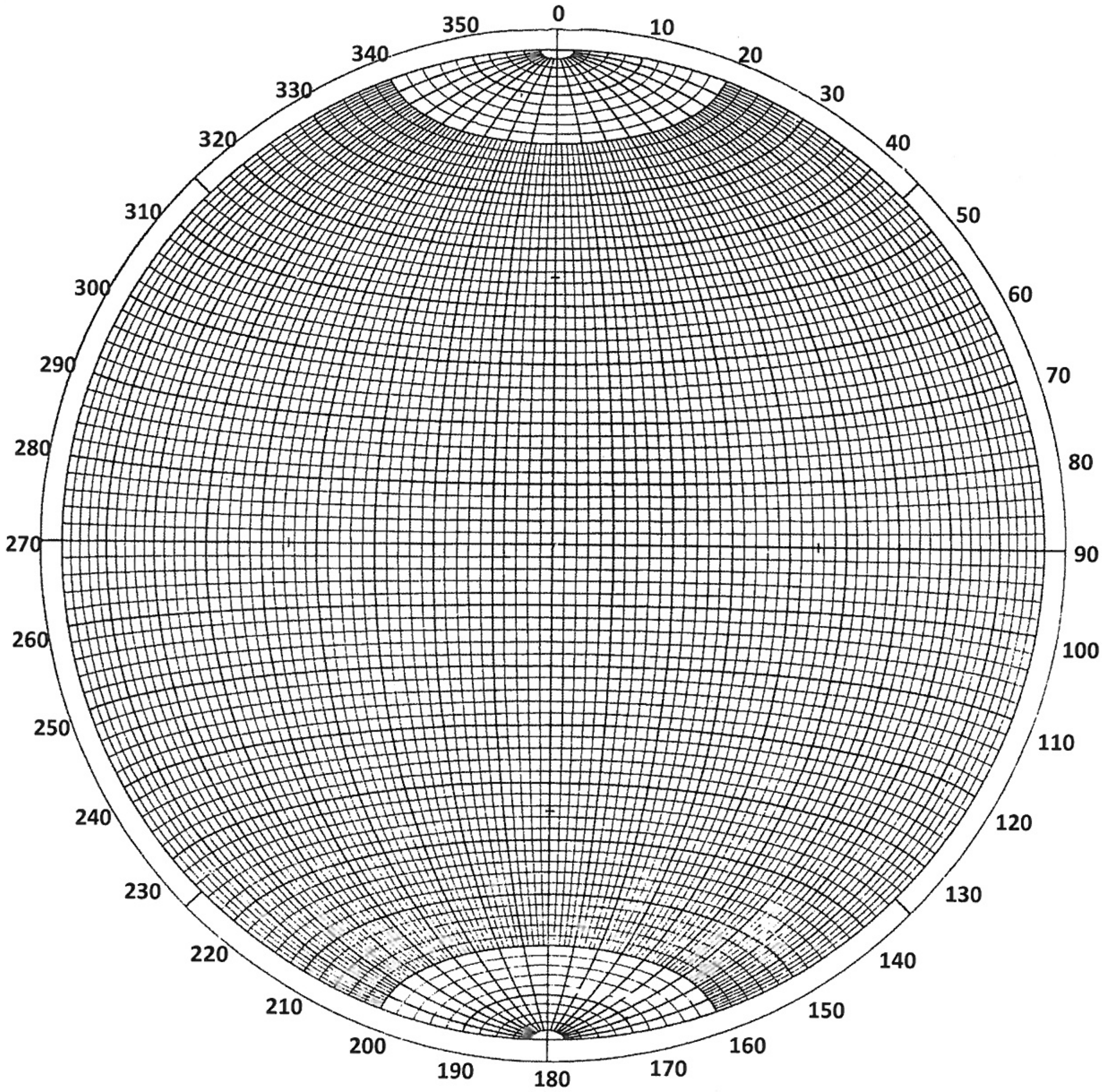
5.2 Present a solution to eliminate at least one of the instabilities that you have identified. (3)

5.3 You have to establish a waste dump that will be situated very close to a public road, therefore requiring a Safety Factor of at least 2. Your plan is that the dump should reach a final height of 45m. Estimate the maximum slope angle that you would be able to employ. The dump material has a unit weight of 20kN/m^3, an internal friction angle of 32°, and a cohesion of 17kPa. Use the chart attached as Appendix A. (3)

5.4 If you decide to use a slope angle of 45°, what would the maximum height of the dump be? (2)

[25]

TOTAL **[100]**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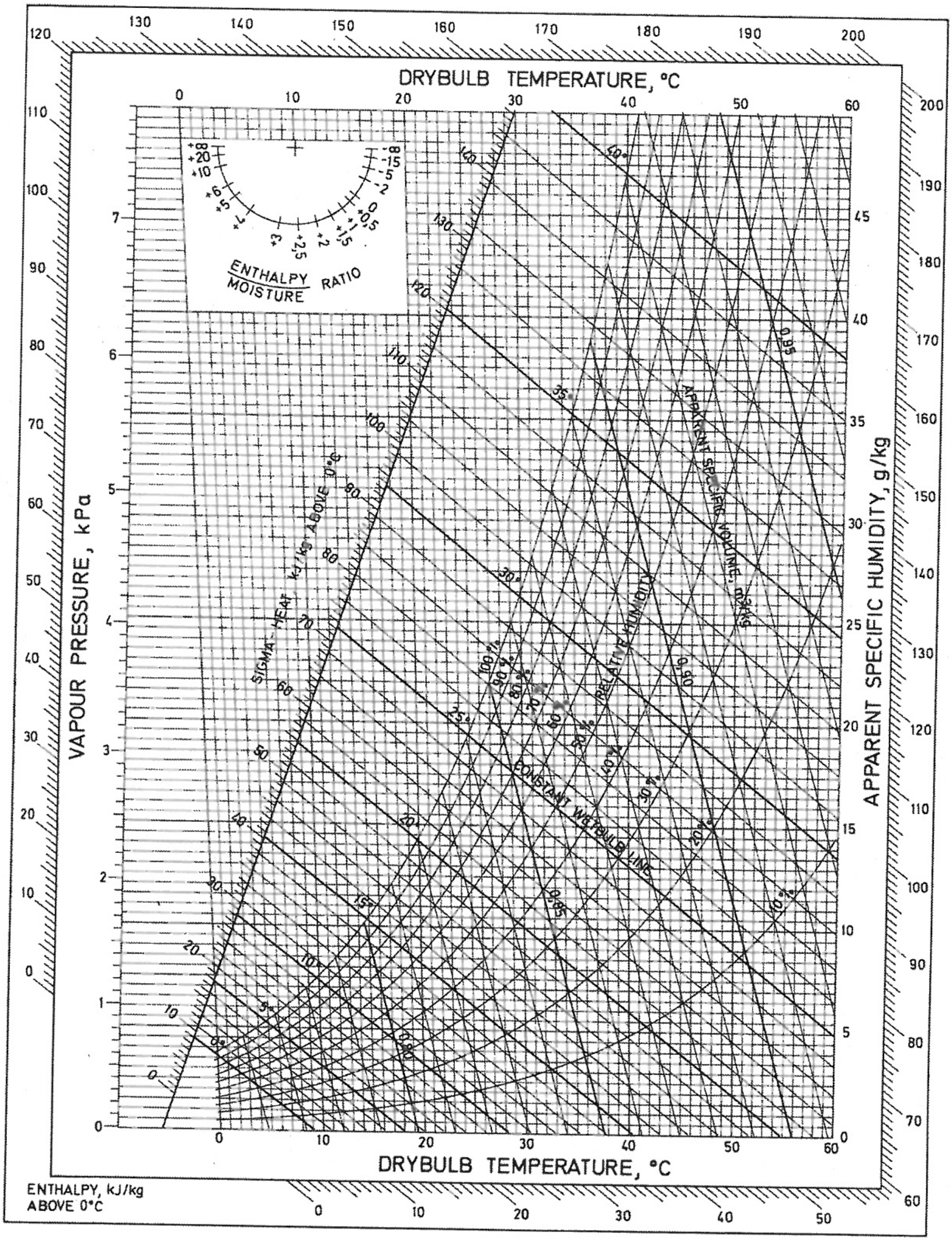
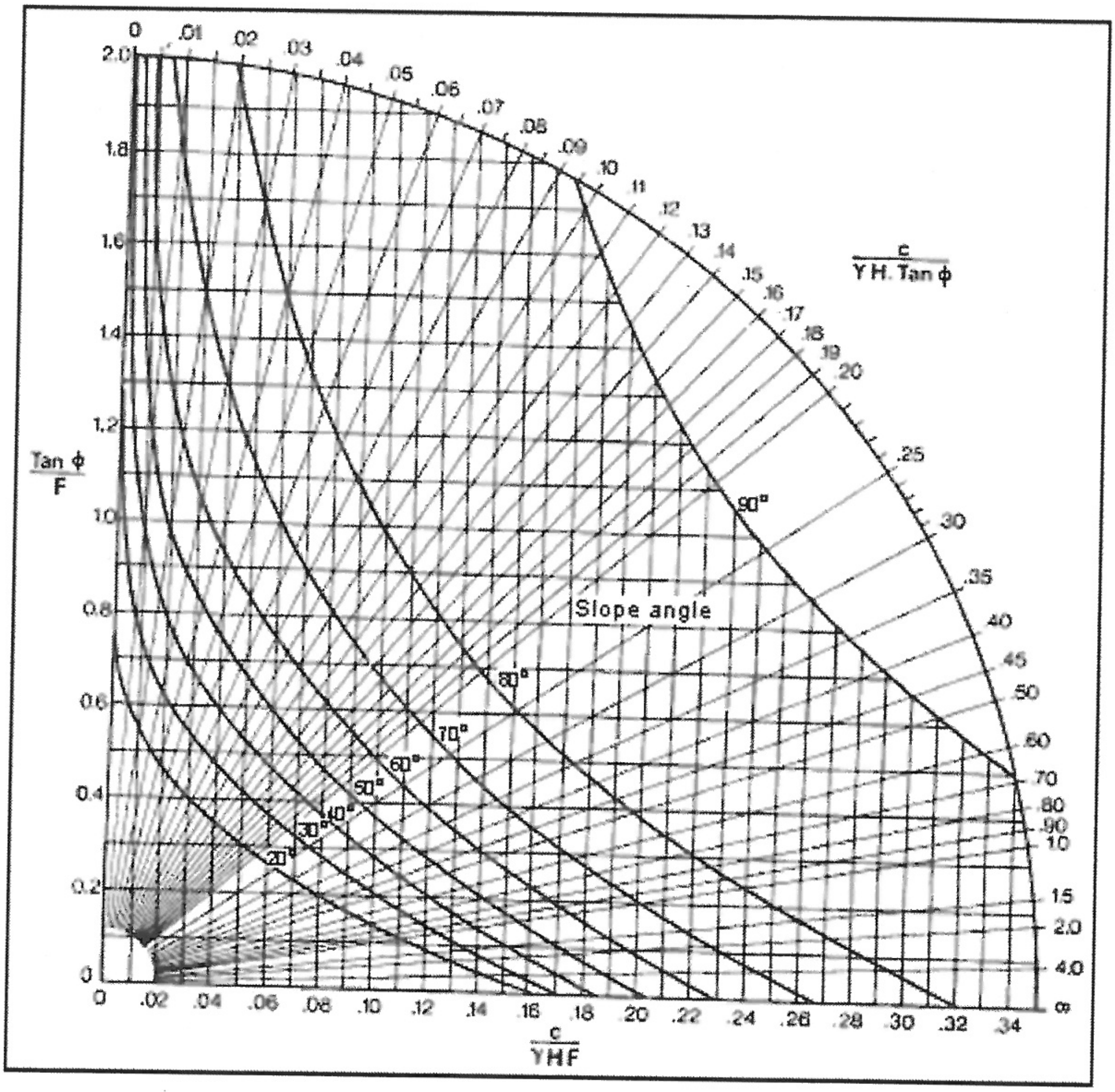

DRYBULB TEMPERATURE, °C
VAPOUR PRESSURE, kPa
APPARENT SPECIFIC HUMIDITY, g/kg
ENTHALPY / MOISTURE RATIO
SIGMA - HEAT kJ/kg ABOVE 0°C
APPARENT SPECIFIC VOLUME, m³/kg
RELATIVE HUMIDITY
CONSTANT WETBULB LINE
ENTHALPY, kJ/kg ABOVE 0°C

Appendix A.

Submit if used. Student No ……………………………………..



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