UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACCALAURIUS TECHNOLOGIAE *MINING ENGINEERING*
SUBJECT	:	**MINING TECHNICAL SERVICES IVA**
CODE	:	**MTLA411**
DATE	:	WINTER SSA EXAMINATION 2015 15 JULY 2015
DURATION	:	(SESSION 2) 11:30 - 14:30
WEIGHT	:	60% OF FINAL MARK
TOTAL MARKS	:	100

EXAMINER	:	MR H STRAUSS
MODERATOR	:	MR D J McDOUGALL
NUMBER OF PAGES	:	6

INSTRUCTIONS	:	ANSWER ALL QUESTIONS
REQUIREMENTS	:	INFORMATION BOOKLET (TO BE HANDED IN) ONE SCRIPT (SECOND ON REQUEST) BOOKLETS AND GRAPHS MUST BE HANDED IN

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INSTRUCTIONS TO CANDIDATES:

READ THE QUESTIONS THOROUGHLY BEFORE YOU START
ANSWER ALL THE QUESTIONS
SHOW ALL CALCULATIONS AND SI UNITS
(NONE SHOWN = NO MARKS)
DO NOT USE CORRECTION FLUID, NEITHER A PENCIL, NOR A RED PEN
HAND IN ALL YOUR CHARTS AS WELL AS THE BOOKLET
DO YOUR OWN WORK – EARN YOUR MARK WITH PRIDE

QUESTION 1

1.1 What is meant by the term "heat load"? (1)
1.2 Name the four major heat sources that affects a mines heat load. (2)
1.2 List five factors that affect the heat load of a mine. (5)
1.3 List four disorders that may affect someone who is exposed to high temperatures, and describe the disorder that you regard as the most severe in terms of its effects on the human body. (5)
1.4 List three factors that affect the heat tolerance of a human being. (3)

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QUESTION 2

The tabulation below shows the data collected from measurements taken in a refrigeration plant. Using this data, calculate the following:

Item	Value	Unit
Evaporator water flow rate	45	kg/s
Evaporator water temperature in	21.6	^{0}C
Evaporator water temperature out	4.5	^{0}C
Bulk air cooler water temperature in	5.6	^{0}C
Bulk air cooler water temperature out	16.8	^{0}C
Evaporator refrigerant temperature	-2	^{0}C
Condenser refrigerant temperature	38	^{0}C
Compressor motor current	79	A
Compressor motor voltage	6.6	kV
Power factor	0.93	
Compressor motor efficiency	90%	%

2.1 Plant duty. (2)
2.2 Carnot COP. (2)
2.3 Overall compressor COP. (2)
2.4 Net actual compressor COP. (2)
2.5 Positional efficiency. (2)
2.6 Overall cycle Efficiency. (2)
2.7 Actual cycle efficiency. (2)

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QUESTION 3

If the Bulk Air Cooler in Question 2 was situated underground, and the positional efficiency was 50%, calculate:

3.1 The heat exchange in the bulk air cooler. (2)

3.2 The monthly cost of pumping the cooling water used in this bulk air cooler back to surface, given an overall pumping efficiency of 78%, an electricity tariff of R0,66/kWh, and a pumping head of 2 300m. (4)

3.3 If an air stream of 150kg/s enters this bulk air cooler at a wet bulb temperature of 24°C and a barometric pressure of 105kPa, what is the wet bulb temperature of the air leaving the bulk air cooler? (3)

[9]

QUESTION 4

4.1 The following measurements have been taken at a methane intersection in a coal mine:

Roadway inclination	Horizontal
Roadway dimensions	6,5m wide and 3,8m high
Methanometer reading	6,4%
Air velocity	2,2m/s

4.1.1 Show with an engineering analysis that layering should be anticipated. (3)

4.1.2 Estimate the length of the layer that could manifest under these conditions. (2)

4.1.3 Present a sound solution to prevent the occurrence of a layer. (3)

4.3 List six conditions that must be present for a coal dust explosions to be possible.
(Hint: "Coal dust must be …). (3)

[11]

QUESTION 5

5.1 Name four categories of instruments that may be used in Rock Engineering for the purpose of monitoring, and give an example for each. (8)

5.2 Differentiate between measured data, and derived data obtained from rock engineering monitoring – use clear examples. (4)

5.3 It is known that support laboratory test data is not necessarily representative of the underground performance of support units. Why is this, and how is it rectified? (6)

5.4 Given the following rock properties, calculate the distance between a detected seismic event, and the seismometer, where the difference in arrival times between the p-, and s-waves was recorded as 10ms.

Rock Density = 2 750kg/m^3
Young's modulus = 70GPa
Poisson's Ratio = 0,21
UCS = 210MPa
MRMR = 56 (5)

5.5 You have been tasked to design a support system for a deep tabular stoping operation, of which the details are tabulated below. Present your detailed solution. (7)

Stope width	110cm
Dip	14°
Rock density	2 750kg/m^3
Depth (mean)	2 650m
Face configuration	Underhand, maximum lead of 6m
Stress fracturing	Face – parallel ($\alpha = 60°$, $\beta = 56°$, friction angle of 38°).
Support units	180kN, 30cm thick.
Head boards	1m in length – oriented along strike
Pre-conditioning	Face – perpendicular
MRMR	Not done
RQD	69%
Fall out height	70cm

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QUESTION 6

6.1 The support design in coal mining of a "thick weak roof" should ideally be based on "beam creation".
What are the alternatives if this option is not possible? (3)

6.2 Resin-based capsules are popularly used for the support of coal mine excavations. Why should the resin not be disturbed during the "holding" period? (3)

6.3 When designing a support system based on beam suspension, what is the main difference in procedure between designing for resin point anchors, and mechanical anchors? (2)

6.4 You have to design a support system for an underground coal mining section. The immediate roof is made up of two layers as follows:

Layer	Description	Thickness (m)
Top	Sandstone.	0,8
Bottom	Laminations (25mm) of Mudstone and Sandstone (alternating layers).	0,5

You intend using mechanical anchors with 16mm diameter stems that have a yield strength of 450Mpa. Tests have shown that the anchors slip at a load of 40kN.
Conduct a full design sequence (using a safety factor of 1,5) and make recommendations regarding the bolt spacing and length. (12)

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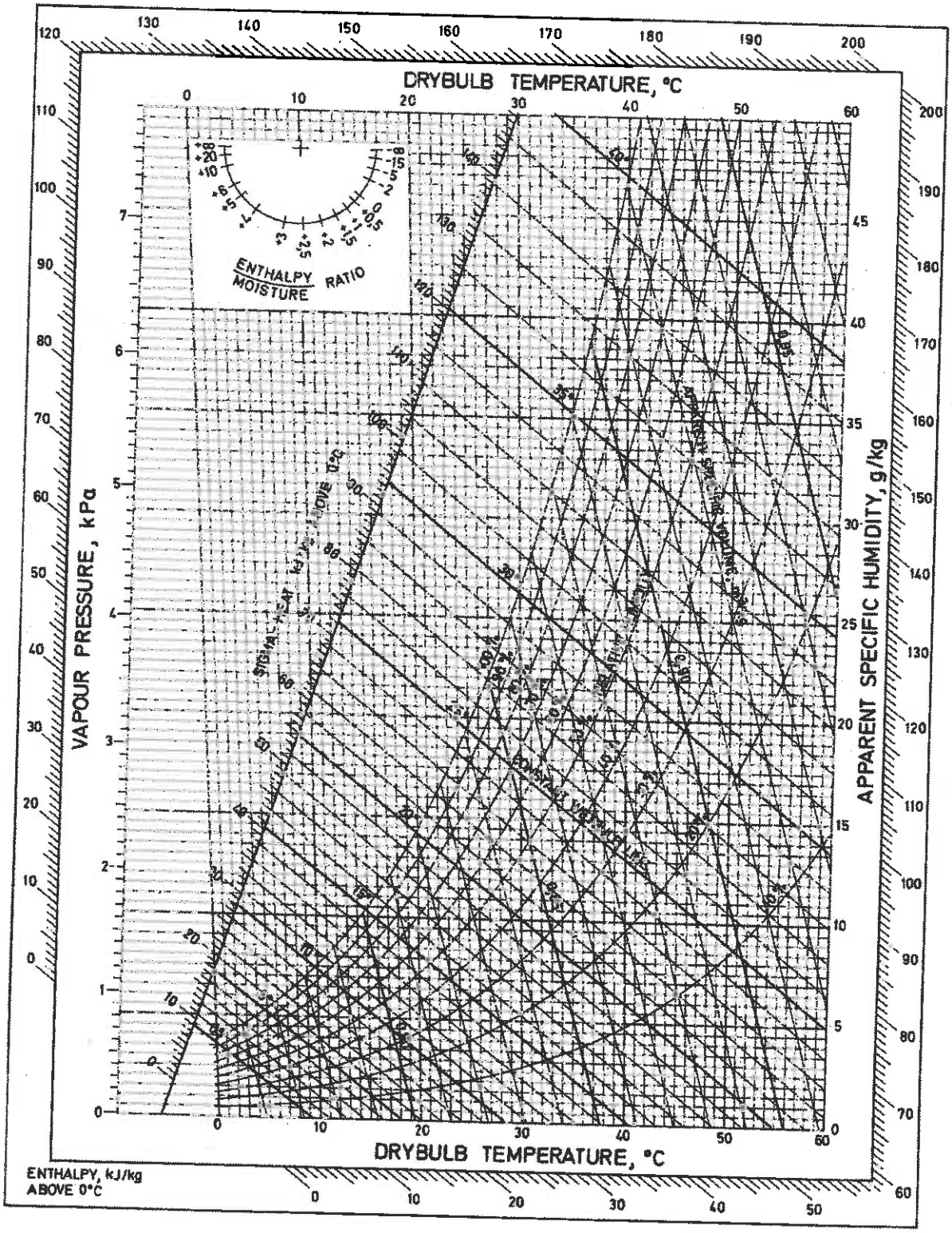
TOTAL **[100]**

105,0 kPa


DRYBULB TEMPERATURE, °C
ENTHALPY / MOISTURE RATIO
VAPOUR PRESSURE, kPa
APPARENT SPECIFIC HUMIDITY, g/kg
DRYBULB TEMPERATURE, °C
ENTHALPY, kJ/kg ABOVE 0°C