UNIVERSITY OF JOHANNESBURG

PROGRAM	NATIONAL DIPLOMA *CHEMICAL ENGINEERING*
SUBJECT	**CHEMICAL PLANT 3A**
CODE	**ACPA 321**
DATE	: WINTER EXAMINATION 2016 6 JUNE 2016
DURATION	: (SESSION 1) 08:30 - 11:30
TOTAL MARKS	168
FULL MARKS	168

EXAMINER	PROFESSOR PETER OLUBAMBI
MODERATOR	Dr H. RUTTO
NUMBER OF PAGES	4

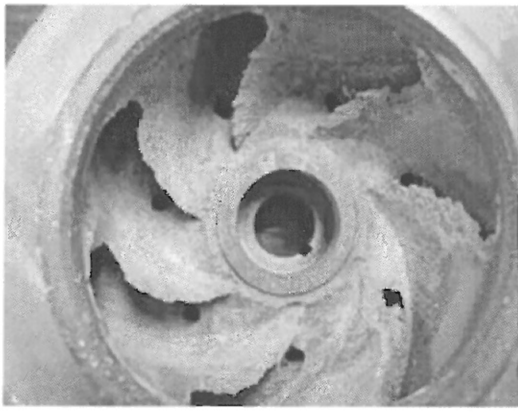
INSTRUCTIONS	NON-PROGRAMMABLE CALCULATORS PERMITTED (ONLY ONE PER CANDIDATE) SHOW ALL UNITS IN CALCULATIONS!!! ANSWER ALL THE QUESTIONS.

CHEMICAL PLANT 3A

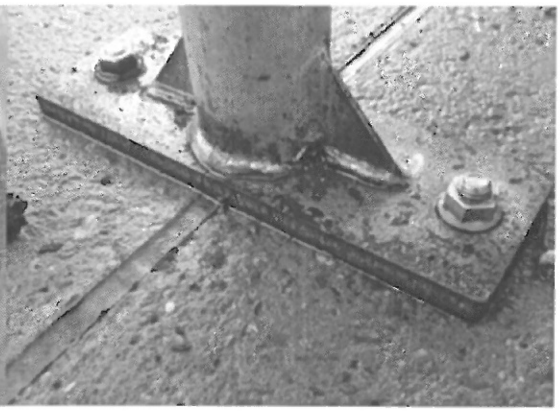
ACPA321

QUESTION ONE

After several months in industrial operation, a particular plant observed some of the components (the samples below) have been damaged by corrosion attack. The samples were brought to the Advanced Materials and Corrosion Technology Research Laboratory of the Department of Chemical Engineering for analysis.



Sample 1



Sample 2

Using your knowledge of materials engineering, materials design and corrosion engineering;

a. Identify the form of corrosion is occurring in these samples (4)
b. Give reasons for the answers in (a) above (8)
c. Describe the forms of corrosion that occurred in these samples. (12)
d. Suggest and discuss how you will prevent this form of corrosion. (10)

[34]

QUESTION TWO

2.1. List the two main properties of Titanium (2)

2.2 With a detailed sketch, describe the load-extension relationship for low carbon steel (15)

2.3 A bar of thickness 15 mm and having a rectangular cross-section carries a load of 120 kN. Determine the minimum width of the bar to limit the maximum stress to 200 MPa. The bar, which is 1.0 m long, extends by 2.5 mm when carrying a load of 120 kN. Determine the modulus of elasticity of the material of the bar. (10)

[27]

QUESTION THREE

3.1 Define corrosion and give four typical examples of corrosion (10)

3.2 Why is extractive metallurgy the reverse of corrosion? (4)

[14]

QUESTION FOUR

4.1 List four intermediate and fine grinding equipment (8)

4.2 Two models of mills (Ball Mill and Tube Mill) with milling capacities of 4.81 and 5.84 Kwh/tonnes respectively were recently developed by De-G Minerals Pty.

A. Assuming Bond's theory is applied, calculate the work index

i. When the ball mill is used to reduce 23,000-micron sized iron ore to 600 micron (5)

ii. When the tube mill is used to reduce 1,800 micron sized iron ore to 230 micron (5)

.B. Assuming a work index of 13.08 was obtained for both mills during laboratory testing for reducing the same sizes of ore, calculate the efficiencies of the two newly developed mills. (10)

[28]

QUESTION FIVE

A belt conveyor 0.75 m wide and running at a speed of 1.81 m/s carries material of bulk density 0.9 t/m^3 up a gradient of 1 in 30 and then horizontally at the rate of 300 t/h. Determine the maximum length of incline permissible if the maximum working stress in the 5 ply cotton belting is 5.25 kN/m ply, for a horizontal section length of 50 m. The mass of moving parts of the empty conveyor is 50 kg/m, the idler friction coefficient is 0.03, and the two drum drive head has non-slip ratio of 6.8 to 1. (20)

[20]

QUESTION SIX

6.1 With the aid of a diagram, explain the mechanisms of froth flotation using the concept of particle bubble attachment and detachment. (20)

6.2 A water treatment plant has a flow rate of 0.6 m^3/sec. The settling basin at the plant has an effective settling volume that is 20 m long, 6 m tall and 3 m wide. Will particles that have a settling velocity of 0.004 m/sec be completely removed? If not, what percent of the particles will be removed? How big would the basin need to be to remove 100% of the particles that have a settling velocity of 0.004 m/sec? (10)

[30]

QUESTION SEVEN

7.1 What is a crystal? Define a unit cell (5)

7.2 Calculate the radius of a tantalum atom, given that Ta has a BCC crystal structure, a density of 16.6 g/cm^3, and an atomic weight of 180.9 g/mol. (10)

[15]