UNIVERSITY
— OF —
JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : MINING / METALLURGY*
SUBJECT	:	**CORROSION III**
CODE	:	**TK31-1**
DATE	:	SSA EXAMINATION 9 JANUARY 2017
DURATION	:	(X PAPER) 11:30 - 14:30
WEIGHT	:	60 : 40
FULL MARKS	:	90
TOTAL MARKS	:	93
EXAMINER	:	MR G A COMBRINK
MODERATOR	:	MR J PROZZI
NUMBER OF PAGES	:	3 PAGES
INSTRUCTIONS	:	ALL THE ANSWERS MUST BE COMPLETED IN THE EXAM SCRIPT
REQUIREMENTS:	:	ONE ANSWER SCRIPT ONE POCKET CALCULATOR **NO** CORRECTION FLUID SHALL BE USED

QUESTION 1

1.1.   After a slight rain shower, a drop of water rests on the surface of a flat piece of bare (un-coated) mild steel forming a basic corrosion cell. Schematically explain the corrosion processes under the drop of water on the bare metal surface and give typical half reactions that occur on the steel surface. Explain why the regions that are anodic become anodic in nature and also why the regions that become cathodic become cathodic.   (15)

1.2.   What would have been the effect of the water had the mild steel first been painted with an effective and complete organic coating before getting wet. (Think about a vehicle standing outside exposed to the natural elements.)   (3)

[18]

QUESTION 2

Name the two generic types of paint coatings .and explain their curing (drying) mechanism by means of making drawings.   **[10]**

QUESTION 3

3.   A flat piece of steel on a structure that has been exposed to industrial air and that has been painted before has after 10 years' service, a surface area equivalent to 40% of the total exposed surface has suffered from coating failure leaving this area previously coated bare and exposed directly to the environment. Thus it needs to be recoated as part of the structure's maintenance plan. There are also some welding repairs that need to be done on this surface before it can go back into service.

3.1.   How do you go about recoating this surface (your planning and materials etc. what do you do first and what last etc.)?   (5)

3.2.   Explain BRIEFLY what surface preparation you will use and why.   (5)

3.3.   Give generic names to the various layers of that you will apply.   (5)

3.4.   How does a typical organic coating effect prevent corrosion? (i.e. Explain the mechanism of fighting corrosion!)   (10)

[25]

QUESTION 4

4. In a laboratory a piece of low carbon steel with dimensions 40 mm wide by 25mm long by 2mm thick is exposed to aerated ASW (artificial sea water i.e. salty water) and is allowed to rust. As a result of the rusting process, the DC electrical current measured between it as the anode and a platinum counter electrode (cathode) is 15μA.

4.1. Using this information calculate how much of another bare flat piece of similar composition and condition low carbon steel that's 200mm wide by 200mm high by 1mm thick will be left over after spending 10 years lying in aerated sea water. [Given that Faradays law : W=Zit/nF, (The mol mass of the mild steel can be taken as 56g/mol, F= 96500 C/mol, the charge on an electron is 1.6×10^{-19} C and Avogadro's number N_{AV} is 6.022×10^{23} /mole.) and SG steel =7.8]   (6)

4.2. If the Direct Current electrical current in the initial lab test been found to be 90 μA (instead of 15μA) will there still be some steel left after 20 years?   (4)

4.3. Using the data calculated in 4.2 as well as the data given at the end what would the corrosion rate in microns per year (mpy) be of the steel exposed to the sea water now be? (base you answer on the originally exposed area)   (4)

4.4. One seldom finds that the corrosion rate of steel in ASW is exactly the same as what one finds in nature, why is this so?   (4)

[18]

Info that you may use: Faradays law : W=Zit/nF, (The mol mass of the mild steel can be taken as 56g/mol, F= 96500 C/mol, the charge on an electron is 1.6×10^{-19} C and Avogadro's number N_{AV} is 6.022×10^{23} /mole.) and SG steel =7.8]

QUESTION 5

Explain the two methods of Cathodic Protection and give 4 instances where it can be used explaining why the medium is suitable for Cathodic Protection.   (10)
Draw the Evans diagram showing how Cathodic protection is done and the effect on the electrochemistry of the structure being protected.   (10)

[20]

Total Marks	[93]
Full Marks	[90]