

BACHELOR OF CONSTRUCTION ENGINEERING EXAMINATION, 2018

(1st Year, 1st Semester)

CHEMISTRY

Time: Three hours

Full Marks: 100

(50 marks for each part)

Use a separate answer script for each part

PART – I

Answer Q. no. 1 and any two from the rest.

1.
 - (a) With an ionic half equation of your choice clearly explain information provided by such equations with regard to either oxidation or reduction 2
 - (b)(i) Create the expression for the electrode potential $\phi_{\text{MnO}_4^-/\text{Mn}^{2+}}$ for the reaction

$$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}. \quad [\text{Given } \phi_{\text{MnO}_4^-/\text{Mn}^{2+}}^0 = 1.507 \text{ V}]. \quad 2$$
 - (ii) What would be the effect of pH on $\phi_{\text{MnO}_4^-/\text{Mn}^{2+}}^0$ during the course of the reaction. 1½
 - (c)(i) What is the value of ΔG for a system at equilibrium? 1
 - (ii) From the expression $\Delta G = \Delta G^0 + RT \ln K$, where terms have their usual meaning derive the equilibrium constant of any reaction. 2
 - (d) pH is a temperature dependent parameter. Explain. 2
 - (e) What is spectroscopy? Why has spectroscopy become an essential component of chemical investigations today. (1½ + 2)
 - (f) What information do we get from UV-Vis and IR spectroscopy with regard to a particular molecule. 2
 - (g) What are alloy steels? Give an example with proper composition. 2

- 2.
- (a) Explain why an oxidation of Fe^{2+} by KMnO_4 in an acidic medium containing Cl^- requires certain modifications for a proper estimation. What are these modifications? Why the same is not required when the oxidizing agent is $\text{K}_2\text{Cr}_2\text{O}_7$? 2 + 2 + 1
- (b) Define pH of an aqueous solution. Why was such a parameter introduced to express the strength of hydrogen ions in solution? 1 + 2
- (c) With the help of a suitable diagram discuss the different types of electronic transitions possible for a certain molecule. Indicate energies involved and the region of the electromagnetic spectrum where it occurs. 2 + 2
- (d) What are carbon steels? Discuss the three different types with an application of each. 1 + 3
- 3.
- (a) What is Zimmermann Reinhardt solution? When is it used and how is it useful? 1½ + 1 + 2
- (b) Why is H_3PO_4 added when Fe^{2+} is estimated using $\text{K}_2\text{Cr}_2\text{O}_7$ in an acidic medium? 1½
- (c) Deduce the Ostwald dilution law for the dissociation of a weak base and state its significance. 3 + 1
- (d) In UV-Vis spectroscopy how does $\pi \rightarrow \pi^*$ transition help one to distinguish between isolated and conjugated double bonds? 5
- (e) What is "Stainless Steel"? 1
- 4.
- (a) Define ionic product of water (K_w) and show that it is dependent on temperature. (1 + 1)
- (b) What is a buffer solution? Derive the Henderson equation for an acidic buffer. Explain mechanism of buffer action on this buffer when H^+ and OH^- are separately added to it. (1 + 2 + 1½ + 1½)
- (c) A solution is 0.4 (M) with respect to acetic acid and sodium acetate. Calculate the pH of the solution. What will be the change in pH if 10 ml of 1 (N) NaOH is added to 1 litre of this solution. [Given K_a for acetic acid at 25°C is 1.8×10^{-5} ; neglect change in volume upon adding NaOH]. (1 + 2½)
- (d) Define any three of the following: 1½ × 3 = 4½
- (i) Spectrum (ii) Absorbance (iii) Stretching vibration
- (iv) Nitriding of Steel (v) Annealing of Steel

Name of the Examination: B. CONS. ENGG. 1ST YR 1ST SEM. EXAM.-2018

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PART-II

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Answer *any five* questions

5×10

1. a) What is Portland cement? Discuss briefly about the raw materials for the manufacture of cement.
 b) Draw a diagram of a rotary kiln used for the manufacture of Portland cement by dry process. describe the process and discuss the various reactions taking place in the furnace. 3+7

2. a) Compare dry process and wet process for the manufacture of cement.
 b) Discuss briefly about the characteristics of the constitutional compounds in cement.
 c) What do you mean by soundness of cement? 4+4+2

3. Match the following

10

<u>Group A</u>	<u>Group B</u>
i) Vinsol resin	a) Workability agent
ii) Calcium Chloride	b) High ultimate strength
iii) Calcium lignosulfonate	c) Air-entrainment agent
iv) Calcium stearate	d) Cement + Sand + Water
v) Bentonite clay	e) Cement + Sand + Coarse aggregate + Water
vi) Mortar	f) Accelerator
vii) Concrete	g) Flash set
viii) Aluminum powder	h) Gas forming agent
ix) Tricalcium aluminate	i) Retarder
x) Tricalcium silicate	j) Water repelling agent

4. a) Calculate temporary, permanent and total hardness of a water sample having

$\text{CaSO}_4 \equiv 136 \text{ mg/l}$

$\text{KCl} \equiv 212 \text{ mg/l}$

$\text{NaHCO}_3 \equiv 78 \text{ mg/l}$

$\text{Mg}(\text{HCO}_3)_2 \equiv 146 \text{ mg/litre}$

$\text{MgCl}_2 \equiv 190 \text{ mg/litre}$

$\text{Ca}(\text{HCO}_3)_2 \equiv 162 \text{ mg/litre}$

$\text{CaCl}_2 = 222 \text{ mg/litre}$

Given atomic weight: Ca = 40, Mg = 24, Na = 23, K = 39, Cl = 35.5, C = 12, H = 1, O = 16, S = 32

b) Calculate amount of lime (80% pure) and soda (95% pure) required for treatment of 10,000 litre of water whose analysis is as follows:

$\text{CaSO}_4 \equiv 34.0 \text{ ppm}$

$\text{MgSO}_4 \equiv 60.0 \text{ ppm}$

$\text{NaHCO}_3 \equiv 78 \text{ ppm}$

$\text{Mg}(\text{HCO}_3)_2 \equiv 73 \text{ ppm}$

$\text{Ca}(\text{HCO}_3)_2 \equiv 40.5 \text{ ppm}$

$\text{CaCl}_2 = 55.0 \text{ ppm}$

5+5

5.a) Write advantages of zeolite method for the treatment of water.

b) Compare lime-soda process and zeolite process for softening of water.

4+6

6. a) What do you mean by carbonaceous ion exchangers? Write its advantages.

b) Write a note on alkalinity.

c) Draw structure of EDTA, Ca-complex of EDTA and indicator used in EDTA titration for the determination of hardness of water.

3+4+3