



UNIVERSITY
OF
JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY
NATIONAL DIPLOMA: BIOTECHNOLOGY
NATIONAL DIPLOMA: FOOD TECHNOLOGY

MODULE CHEMISTRY 1A3E/1XA2
CET1A3E/CET1XA2

CAMPUS DFC

JUNE EXAMINATION

DATE: 5/6/2018

SESSION: 12:30-15:30

ASSESSOR:

DR SP MALINGA

INTERNAL MODERATOR:

DR LN DLAMINI

DURATION 3 HOURS

MARKS: 147

NUMBER OF PAGES: 8
PAGES

INSTRUCTIONS: MULTIPLE CHOICE QUESTIONS OF PART A AND PART B MUST BE ANSWERED IN SEPARATE MULTIPLE CHOICE ANSWER SHEETS. MAKE SURE YOU MARK EACH SHEET CLEARLY. CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT).

THIS QUESTION PAPER MUST BE PLACED INSIDE YOUR ANSWER BOOK UPON HANDING IN.

REQUIREMENTS: 2 x UJ MULTIPLE CHOICE ANSWER SHEETS.
1 x EXAMINATION BOOK.

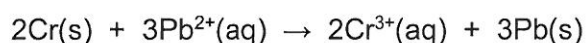
PART A – GENERAL CHEMISTRY
INSTRUCTIONS – SECTION 1

1. **Clearly mark your multiple choice answer sheet: GENERAL CHEMISTRY**
 2. Write your name and fill out your student number on the multiple choice answer sheet.
 3. Do not fold or staple the multiple choice answer sheet.
 4. Indicate each answer clearly by blocking out the chosen letter, preferably with a **soft pencil** although pen can be used.
 5. Only **one** answer per question is correct. There will be no negative marking to penalise incorrect answers, but if you enter more than one choice per question you will receive zero for that question.
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SECTION 1 – MULTIPLE CHOICE

1. Select the strong acid from the list below:
A. HNO_2
B. CH_3COOH
C. HNO_3
D. NH_4^+
2. The pH of the solution of 0.0142 M $\text{Ca}(\text{OH})_2$ is:
A. 1.55
B. 1.85
C. 12.15
D. 12.45
3. Which of the following are conjugate acid-base pairs?
A. H_2SO_4 ; SO_4^{2-}
B. H_2SO_3 ; HSO_3^{2-}
C. HClO_4 ; ClO_3^-
D. CH_3NH_3^+ ; CH_3NH_2

4. Given the equation:



which is the correct reduction half-reaction?

- A. $\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Pb(s)}$
- B. $\text{Pb}^{2+}(\text{aq}) \rightarrow \text{Pb(s)} + 2\text{e}^-$
- C. $\text{Cr(s)} \rightarrow \text{Cr}^{3+}(\text{aq}) + 3\text{e}^-$
- D. $\text{Cr(s)} + 3\text{e}^- \rightarrow \text{Cr}^{3+}(\text{aq})$

-
5. The oxidation number of Mn in Mn_2O_7 is:
- A. +14
B. +7
C. +6
D. +12
6. The pH of a mixture containing 50.00 mL of 0.125 M HCl and 50.00 mL of 0.125 M KOH is:
- A. 12.62
B. 10.33
C. 7.00
D. 2.73
7. Which one of the following equations is a redox equation?
- A. $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \longrightarrow \text{BaSO}_4(\text{s})$
B. $\text{Ba}(\text{s}) + \text{Cl}_2(\text{g}) \longrightarrow \text{BaCl}_2(\text{s})$
C. $\text{BaCO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \longrightarrow \text{Ba}^{2+}(\text{aq}) + \text{CO}_2(\text{g})$
D. $\text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{K}_2\text{CO}_3(\text{aq}) \longrightarrow \text{BaCO}_3(\text{s}) + 2\text{KNO}_3(\text{aq})$
8. The pH of an aqueous solution changes from 5.20 to 8.60. What has happened to the hydronium ion concentration?
- A. increased
B. decreased
C. become zero
D. did not change
9. The molar H^+ concentration of a solution with a pH of 9.9 is:
- A. $5.65 \times 10^{-11} \text{ M}$
B. $1.26 \times 10^{-10} \text{ M}$
C. $2.82 \times 10^{-5} \text{ M}$
D. $3.23 \times 10^{-4} \text{ M}$
10. The reaction between calcium hydroxide and ammonium chloride is best described as a(n):
- A. combination reaction
B. precipitation reaction
C. redox reaction
D. acid-base reaction
11. What do we call the reaction of an acid with a base?
- A. oxidation
B. neutralisation
C. amphoteric
D. reduction
12. A substance which ionizes completely in solution is called a:
- A. non-electrolyte
B. weak electrolyte
C. strong electrolyte
D. none of the above

[12 x 2,5 = 30]

4/....

SECTION 2 – LONG QUESTIONS**QUESTION 1**

- 1.1 Calculate the pH **AND** pOH for each of the following:
- 1.1.1 1.52 g of HNO₃ in 575.00 mL of solution [Molar mass (g mol⁻¹): HNO₃ = 63.0119] (6)
- 1.1.2 5.251 × 10⁻⁴ M of KOH (4)
- 1.1.3 3.893 × 10⁻⁵ M of [H⁺] (3)
- 1.2 A 0.100 M solution of chloroacetic acid (ClCH₂COOH) is 11.05% ionized. Using this information, calculate [ClCH₂COO⁻], [H⁺], [ClCH₂COOH] and K_a for chloroacetic acid (7)
- 1.3 Calculate the K_a (acid-dissociation constant) of a 0.020 M solution of niacin (C₆H₅NO₂) at a pH of 3.26. (9)
- 1.4 The active ingredient in aspirin is acetylsalicylic acid (HC₉H₇O₄), a monoprotic acid with K_a = 3.3 × 10⁻⁴ at 25°C. What is the pH of a solution obtained by dissolving two extra-strength aspirin tablets, containing 500 mg of acetylsalicylic acid each in 250 mL of water? [Molar mass (g mol⁻¹): HC₉H₇O₄ = 180.157] (12)

[41]**QUESTION 2**

- 2.1 In an analysis 1.2278 g of antacid powder was weighed and 29.61 mL of 1.0360 M HCl were added to neutralise the antacid. If excess HCl required 27.35 mL of 0.5034 M NaOH for neutralisation, calculate the %(w/w) OH⁻ in the powder. [Molar mass OH⁻: 17.007 g mol⁻¹] (6)
- 2.2 Consider the following redox equation occurring in an acidic medium and answer the question below:
- $$\text{Cr}_2\text{O}_7^{2-} + \text{C}_2\text{O}_4^{2-} \longrightarrow \text{Cr}^{3+} + \text{CO}_2$$
- 2.2.1 Identify the reducing agent in the above half reactions **AND** define the term reducing agent. (3)
- 2.2.2 Calculate the oxidation number of Cr in Cr₂O₇²⁻. (2)
- 2.2.3 Balance each half reaction and classify each as a reduction or oxidation. (4)
- 2.2.4 Write the overall balanced redox equation. (3)

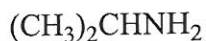
[18]

PART B – ORGANIC CHEMISTRY**INSTRUCTIONS – SECTION 1**

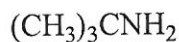
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SECTION 1 – MULTIPLE CHOICE

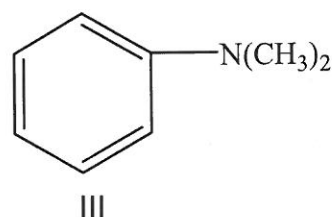
1. Which of the following compounds has the highest solubility in water?
A. $\text{CH}_3\text{CH}_2\text{-O-CH}_2\text{CH}_2\text{CH}_3$
B. $\text{CH}_3\text{CH(OH)CH}_2\text{CH}_2\text{CH}_3$
C. $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$
D. $\text{CH}_3\text{CH(OH)CH(OH)CH}_2\text{CH}_3$
2. Classify each of the following amines as primary, secondary or tertiary.



I

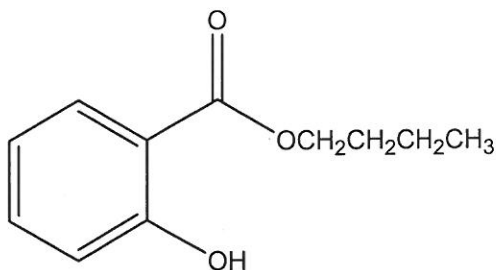


II



- A. I Primary, II Primary, III Tertiary
 - B. I Primary, II Secondary, III Secondary
 - C. I Primary, II Tertiary, III Secondary
 - D. I Secondary, II Primary, III Tertiary
3. The reaction of 2-pentanol with KMnO_4 to form pentanone is called:
A. Substitution
B. Addition
C. Oxidation
D. Elimination

4. The compound pyridine (C_4H_9N) is an example of a:
- A. cyclic ester
 - B. heterocyclic amine
 - C. tertiary alcohol
 - D. cyclic amide
5. The names of the acid and alcohol used to prepare the following compound is:



- A. butanoic acid and phenol
 - B. benzoic acid and butanol
 - C. butanoic acid and 2,2-dihydroxybenzene
 - D. 2-hydroxybenzoic acid and butanol
6. Which compound shows hydrogen bonding?
- A. CH_3CH_3
 - B. CH_3OCH_3
 - C. CH_3CH_2OH
 - D. CH_3CH_2Cl
7. Ethers show constitutional (structural) isomerism with:
- A. aldehydes
 - B. alcohols
 - C. ketones
 - D. carboxylic acid
8. Propanal and propanone can be distinguished by:
- A. the Tollen' Test
 - B. the Lucas Test
 - C. their solubility in water
 - D. All of the above
9. Which of the following classes of compounds contain a carbonyl carbon?
- (i) Aldehydes (ii) Alcohols (iii) Phenols (iv) Ketones
- A. (i), (iv)
 - B. (i), (iii)
 - C. (i), (ii)
 - D. (i), (iii), (iv)

10. Compounds of the type R_3C-OH are referred to as alcohols.

- A. secondary
- B. quaternary
- C. primary
- D. tertiary

[10 x 2= 20]

c

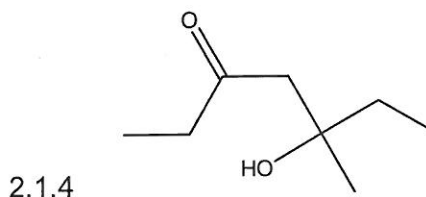
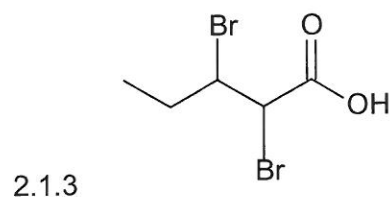
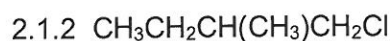
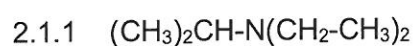
SECTION 2 – LONG QUESTIONS**QUESTION 1**

1.1 Draw the **bondline** structures which correspond with the given names.

- 1.1.1 2,2-dimethyl-1,3-heptanediol (3)
1.1.2 isopropyl 4-methylpentanoate (3)
1.1.3 1,5- pentanedioic acid (3)
1.1.4 3-pentenal (3)
1.1.5 formaldehyde (3)

[15]**QUESTION 2**

2.1 Name the following compounds according to IUPAC rules:



(11)

2.2 Explain together with a diagram why butanol is more soluble in water than butane (6)

2.3 Arrange the following compounds according to their expected boiling points, starting with lowest boiling point first and explain your answer. (6)

Diethyl ether, sec-Butyl alcohol, pentane

[23]

UNIVERSITY OF JOHANNESBURG

Department of Applied Chemistry

1		H 1.0079		Atomic Number		2		He 4.0026		Atomic Weight		2		He 4.0026	
3		Li 6.941		4		Be 9.0122									
11		Na 22.990		12		Mg 24.305									
19		K 39.098		20		Ca 40.078									
37		Rb 85.47		38		Sr 87.62									
55		Cs 132.91		56		Ba 137.33									
87		Fr (223)		88		Ra 226.03									

21		Sc 44.956		22		Ti 47.88		23		V 50.942		24		Cr 51.996		25		Mn 54.938		26		Fe 55.847		27		Co 58.933		28		Ni 58.69		29		Cu 63.546		30		Zn 65.39	
39		Y 88.906		40		Zr 91.224		41		Nb 92.906		42		Mo 95.94		43		Tc (98)		44		Ru 101.07		45		Rh 102.91		46		Pd 106.42		47		Ag 107.87		48		Cd 112.41	
57		La 138.91		72		Hf 178.49		73		Ta 180.95		74		W 183.85		75		Re 186.2		76		Os 190.2		77		Ir 192.22		78		Pt 195.08		79		Au 196.97		80		Hg 200.59	
89		Ac 227.03																																					

5		B 10.811		6		C 12.011		7		N 14.007		8		O 15.999		9		F 18.998		10		Ne 20.179	
13		Al 26.982		14		Si 28.086		15		P 30.974		16		S 32.064		17		Cl 35.453		18		Ar 39.948	
31		Ga 69.723		32		Ge 72.61		33		As 74.922		34		Se 78.96		35		Br 79.904		36		Kr 83.80	
49		In 114.82		50		Sn 118.71		51		Sb 121.75		52		Te 127.60		53		I 126.90		54		Xe 131.29	
81		Tl 204.38		82		Pb 207.2		83		Bi 208.98		84		Po (209)		85		At (210)		86		Rn (222)	

58		Ce 140.12		59		Pr 140.91		60		Nd 144.24		61		Pm 146.92		62		Sm 150.36		63		Eu 151.97		64		Gd 157.25		65		Tb 158.93		66		Dy 162.50		67		Ho 164.93		68		Er 167.26		69		Tm 168.93		70		Yb 173.04		71		Lu 174.97	
90		Th 232.04		91		Pa 231.04		92		U 238.03		93		Np 237.05		94		Pu (244)		95		Am (244)		96		Cm (247)		97		Bk (247)		98		Cf (251)		99		Es (252)		100		Fm (257)		101		Md (258)		102		No (259)		103		Lr (260)	