



PAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF HEALTH AND APPLIED SCIENCES
DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	LEVEL: 5
COURSE CODE: GNC502S	COURSE NAME: GENERAL CHEMISTRY 1B
SESSION: JANUARY 2019	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
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INSTRUCTIONS	
<ol style="list-style-type: none">1. Answer ALL the questions.2. Write clearly and neatly.3. Number the answers clearly4. All written work must be done in blue or black ink and sketches can be done in pencil5. No books, notes and other additional aids are allowed	

THIS QUESTION PAPER CONSISTS OF 11 PAGES (Including this front page and attachments)

QUESTION 1: Multiple Choice Questions

[50]

- There are 25 multiple choice questions in this section. Each question carries 2 marks.
- Answer ALL questions by selecting the letter of the correct answer.
- Choose the best possible answer for each question, even if you think there is another possible answer that is not given.

1. In the reaction between copper oxide (CuO) and carbon monoxide (CO), the reducing agent

is:

- A. CuO
- B. CO
- C. Cu
- D. CO₂

2. In which of the following unbalanced reactions does chromium undergo oxidation?

- A. $\text{Cr}^{3+} \rightarrow \text{Cr}$
- B. $\text{Cr}^{3+} \rightarrow \text{Cr}^{2+}$
- C. $\text{Cr}^{3+} \rightarrow \text{Cr}_2\text{O}_7^{2-}$
- D. None of the above

3. The oxidation number of each chromium atom in $\text{Cr}_2\text{O}_7^{2-}$ is:

- A. +5
- B. +6
- C. +7
- D. +12

4. For which of the following chemical changes does the heat of reaction (ΔH) correspond to a heat of formation ($\Delta H_{\text{formation}}$)?

- A. $\text{N (g)} + 3 \text{ H (g)} \rightarrow \text{NH}_3 \text{ (g)}$
- B. $\text{N}_2 \text{ (g)} + 3 \text{ H}_2 \text{ (g)} \rightarrow 2 \text{ NH}_3 \text{ (g)}$
- C. $\text{C (g)} + \text{O (g)} \rightarrow \text{C}$
- D. $\frac{1}{2} \text{ N}_2 \text{ (g)} + \frac{3}{2} \text{ H}_2 \text{ (g)} \rightarrow \text{NH}_3 \text{ (g)}$

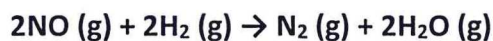
5. The pH of a 1.25×10^{-3} M NaOH is:

- A. 7.00
- B. 2.90
- C. 11.10
- D. 10.90

6. Which of the following describes the relationship between $[H_3O^+]$ and $[OH^-]$

- A. $[H_3O^+][OH^-] = 14.00$
- B. $[H_3O^+] + [OH^-] = 14.00$
- C. $[H_3O^+][OH^-] = 1.0 \times 10^{-14}$
- D. $[H_3O^+] + [OH^-] = 1.0 \times 10^{-14}$

7. In the reaction:



Which of the following is true regarding the relative molar rates of disappearance of the reactants and the appearance of the products?

- I. N_2 appears at the same rate that H_2 disappears.
 - II. H_2O appears at the same rate that NO disappears.
 - III. NO disappears at the same rate that H_2 disappears.
- A. I only .
 - B. I and II only .
 - C. I and III only.
 - D. II and III only.

8. For the reaction $2A + B \rightarrow C$, experimental data were collected for three trials:

Experiment	[A] (M)	[B] (M)	Initial Rate Appearance of C (M sec ⁻¹)
1	0.40	0.20	5.5×10^{-3}
2	0.80	0.20	5.5×10^{-3}
3	0.40	0.40	2.2×10^{-2}

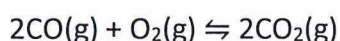
What is the rate law of the reaction?

- A. Rate = $k[A][B]$
- B. Rate = $k[A]^0[B]^2$
- C. Rate = $k[A]^2[B]^2$
- D. Rate = $k[A]^2[B]^0$

9. For a reaction $A + B \rightarrow C + D$, the energy of activation and enthalpy change of reaction were found to be 80 kJmol^{-1} and $+ 20 \text{ kJmol}^{-1}$, respectively. What is the value of the activation energy for the reverse reaction?

- A. $+ 60 \text{ kJmol}^{-1}$
- B. $+ 100 \text{ kJmol}^{-1}$
- C. $- 80 \text{ kJmol}^{-1}$
- D. $+ 20 \text{ kJmol}^{-1}$

10. Write the appropriate equilibrium constant expression K_c for the following reaction:



- A. $K_c = k[\text{CO}]_2[\text{O}_2]$
- B. $K_c = [\text{CO}_2] / [\text{CO}] [\text{O}_2]$
- C. $K_c = [\text{CO}]^2 [\text{O}_2] / [\text{CO}_2]$
- D. $K_c = [\text{CO}_2]^2 / [\text{CO}]^2 [\text{O}_2]$

11. The statement that the first ionization energy for an oxygen atom is lower than the first ionization energy for a nitrogen atom is:

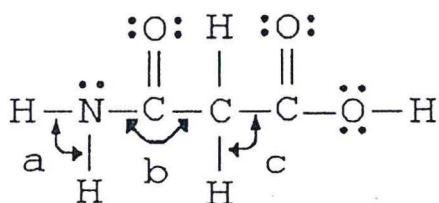
- A. Inconsistent with the general trend relating changes in ionization energy across a period from left to right and due to the fact that oxygen has one doubly occupied 2p orbital and nitrogen does not.
- B. Consistent with the general trend relating changes in ionization energy across a period from left to right because it is harder to take an electron from an oxygen atom than from a nitrogen atom.

- C. Consistent with the general trend relating changes in ionization energy across a period from left to right because it is easier to take an electron from an oxygen atom than from a nitrogen atom.
- D. Inconsistent with the general trend relating changes in ionization energy across a period from left to right and due to the fact that the oxygen atom has two doubly occupied 2p orbitals and nitrogen has only one.
12. Which of the following ground-state electron configurations corresponds to an atom that has the most negative value of the electron affinity?
- A. $1s^2 2s^2 2p^6 3s^1$
- B. $1s^2 2s^2 2p^6 3s^2 3p^5$
- C. $1s^2 2s^2 2p^6 3s^2 3p^2$
- D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$
13. What species has the electron configuration $[\text{Ar}]3d^2$?
- A. Mn^{2+}
- B. Cr^{2+}
- C. V^{3+}
- D. Fe^{3+}
14. A nonpolar bond will form between two _____ atoms of _____ electronegativity.
- A. different, opposite
- B. identical, different
- C. different, different
- D. identical, equal
15. How many different types of resonance structures can be drawn for the ion SO_3^{2-} where all atoms satisfy the octet rule?
- A. 1
- B. 2
- C. 3
- D. 4
16. Which two bonds are least similar in polarity?
- A. Al-Cl and I-Br
- B. O-F and Cl-F
- C. B-F and Cl-F
- D. I-Br and Si-Cl

17. The electron domain and molecular geometry of BrO_2^- is _____.

- A. tetrahedral, trigonal planar
- B. trigonal planar, trigonal planar
- C. trigonal pyramidal, seesaw
- D. tetrahedral, bent

18. The bond angles marked a, b, and c in the molecule below are about _____, _____, and _____, respectively.



- A. $90^\circ, 90^\circ, 90^\circ$
- B. $120^\circ, 120^\circ, 109.5^\circ$
- C. $109.5^\circ, 120^\circ, 109.5^\circ$
- D. $109.5^\circ, 90^\circ, 120^\circ$

19. The molecular geometry consists of _____.

- I. a nonbonding pair of electrons
- II. a single bond
- III. a multiple bond

- A. I only
- B. II only
- C. I, II, and III
- D. II and III

20. PCl_5 has _____ electron domains and a _____ molecular arrangement.

- A. 6, trigonal bipyramidal
- B. 6, seesaw
- C. 5, square pyramidal
- D. 5, trigonal bipyramidal

21. The electron-domain geometry of the AsF_5 molecule is trigonal bipyramidal. The hybrid orbitals used by the As atom for bonding are _____ orbitals.

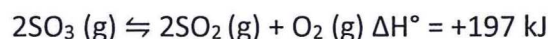
- A. sp^2d^2
- B. sp^3
- C. sp^3d^2
- D. sp^3d

22. How many isomers are possible for C_5H_{12} ?
- A. 1
 - B. 2
 - C. 3
 - D. 4
23. Which of the following compounds does not contain a C=O bond?
- A. Ketones
 - B. Aldehydes
 - C. Esters
 - D. Ethers
24. What radioactive element is used to diagnose medical conditions of the heart and arteries?
- A. cobalt-60
 - B. thallium-201
 - C. radium-226
 - D. thorium-234
25. What happens to the mass number and the atomic number of an element when it emits gamma radiation?
- A. The mass number remains unchanged while the atomic number decreases by one.
 - B. The mass number and atomic numbers remain unchanged.
 - C. The mass number remains unchanged while the atomic number increases by one.
 - D. The mass number decreases by four and the atomic number decreases by two.

End of Section A

SECTION B:**[50]****QUESTION 1****[8]**

In the reaction:



What will happen to the number of moles (**increase, decrease or remain the same**) of SO_3 in equilibrium with SO_2 and O_2 in each of the following cases

- Oxygen gas is added. (2)
- The pressure is increased by decreasing the volume of the reaction container (2)
- The temperature is decreased. (2)
- Gaseous sulphur dioxide is removed. (2)

QUESTION 2**[12]**

2.1 Find the oxidation numbers of the indicated atom in each of the following:

- S in SO_4^{2-} (2)
- N in NO_2^- (2)
- Cr in $\text{K}_2\text{Cr}_2\text{O}_7$ (2)

2.2 Balance the following half reactions:

- $\text{CrO}_4^{2-}(\text{aq}) \rightarrow \text{Cr}(\text{OH})_3(\text{s})$ in basic medium (3)
- $\text{HNO}_2(\text{aq}) \rightarrow \text{NH}_4^+(\text{aq})$ in acidic medium (3)

QUESTION 3**[5]**

Calculate the pH of the following strong acid solutions:

- $1.35 \times 10^{-3} \text{ M HCl}$ (1)
- 0.425 g HClO_4 in 2.00 L solutions (2)
- 5.00 mL of 1.00 M HCl diluted to 0.500 M. (2)

QUESTION 4**[10]**

4.1 Consider the molecule phosphorous pentachloride.

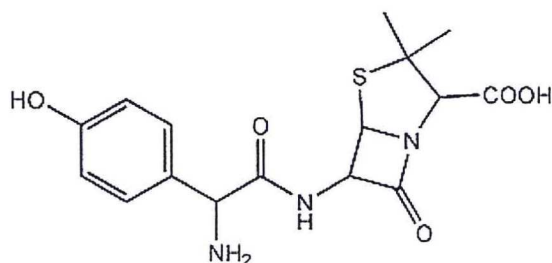
- Draw the most dominant Lewis structure of the molecule. (2)
- State if the structure in (a) obeys the octet rule. (1)
- State the molecular geometry of the molecule. (1)
- State the hybridization on the central atom. (1)
- State the bonding angle between the central atom and peripheral atoms. (1)

4.2 Arrange the bonds in each of the following sets in order of increasing polarity.

- a. C-F; O-F and Be-F (2)
b. O-Cl; S-Br and C-P (2)

QUESTION 5 [10]

5.1 Amoxicillin is a common antibiotic used to treat many different types of bacterial infections and the structure is shown below. Identify the functional groups in the molecule. (5)



5.2 Draw the skeletal structures of the following hydrocarbons.

- a.
$$\begin{array}{c} \text{CH}_3\text{CH}_2 \quad \text{CH}_2\text{CH}_3 \\ | \quad | \\ \text{CH}_3\text{CCH}_2\text{CH} \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$$
 (1)
- b.
$$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\text{CH}_2\text{CH}_2\text{CCH}_3 \\ | \\ \text{CH}_3\text{CHCH}_2\text{CH}_3 \end{array}$$
 (1)
- c. 2,5,6-trimethylnonane (1)
d. 3-propyl-4,5-dimethyldecane (1)
e. 1-ethyl-3-methylcyclohexane (1)

QUESTION 6 [5]

Gold-198 has a half-life of 2.69 days. What is the activity (in curies) of a 0.86 mg sample?

THE END

GOODLUCK

USEFUL CONSTANTS:

Gas constant, $R = 8.3145 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$
 $= 0.083145 \text{ dm}^3 \cdot \text{bar} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$
 $= 0.08206 \text{ L atm mol}^{-1} \cdot \text{K}^{-1}$

$1 \text{ Pa} \cdot \text{m}^3 = 1 \text{ kPa} \cdot \text{L} = 1 \text{ N} \cdot \text{m} = 1 \text{ J}$

$1 \text{ atm} = 101\,325 \text{ Pa} = 760 \text{ mmHg} = 760 \text{ torr}$

Avogadro's Number, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Planck's constant, $h = 6.626 \times 10^{-34} \text{ Js}$

Speed of light, $c = 2.998 \times 10^8 \text{ ms}^{-1}$

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18														
1 H 1.00794	2 He 4.00260	3 Li 6.941	4 Be 9.01218	5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.179	11 Na 22.9898	12 Mg 24.305	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.06	17 Cl 35.453	18 Ar 39.948														
19 K 39.0983	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.8														
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.6	53 I 126.9	54 Xe 131.29														
55 Cs 132.905	56 Ba 137.33	57 Lu 174.967	58 Hf 178.49	59 Ta 180.948	60 W 183.85	61 Re 186.207	62 Os 190.2	63 Ir 192.22	64 Pt 195.08	65 Au 196.967	66 Hg 200.59	67 Tl 204.383	68 Pb 207.2	69 Bi 208.908	70 Po (209)	71 At (210)	72 Rn (222)														
87 Fr (223)	88 Ra 226.025	89 Ac 227.028	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Uun (269)	111 Uuu (272)	112 Uub (269)	113 Uuq (269)	114 Uuh (269)	115 Uuq (269)	116 Uuh (269)	117 Uuh (269)	118 Uuo (269)

Lanthanides:

57 La 138.906	58 Ce 140.12	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 161.930	68 Er 167.26	69 Tm 166.934	70 Yb 173.04
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Actinides:

89 Ac 227.028	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)
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