

BOWEN UNIVERSITY, IWO, OSUN STATE
 COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE
 INDUSTRIAL CHEMISTRY PROGRAMME
 B.SC DEGREE 2019/2020 FIRST SEMESTER EXAMINATION

Course Code: CHM 101 Courses Title: General Chemistry 1
 Date: 28/01/2020 Time Allowed: 2 1/2 hours

INSTRUCTIONS: (a) Answer all questions
 (b) Write the correct option in the box below

NAME.....
 MATRIC NUMBER.....
 PROGRAMME.....

USEFUL PHYSICAL CONSTANTS

Gas constant, R	=	8.314 J mol ⁻¹ K ⁻¹ = 0.0821 L atm mol ⁻¹ K ⁻¹
Avogadro's number, N _A	=	6.023 x 10 ²³ mol ⁻¹
Relative atomic mass of chlorine,	=	35.5
Relative atomic mass of hydrogen	=	1.008
Relative atomic mass of Barium, Ba	=	137.3
Relative atomic mass of nitrogen	=	14.0
Relative atomic mass of fluorine	=	18.998
Relative atomic mass of oxygen	=	16.00
Relative atomic mass of carbon	=	12.0
Relative atomic mass of sodium	=	23.0
Relative atomic mass of aluminium	=	27.0
Molar volume at s.t.p	=	22.4 dm ³

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
31.	32.	33.	34.	35.	36.	37.	38.	39.	40.
41.	42.	43.	44.	45.	46.	47.	48.	49.	50.
51.	52.	53.	54.	55.	56.	57.	58.	59.	60.

1. What is the mass of 1.505×10^{23} molecules of CO₂?
 A. 11g B. 22g C. 44g D. 88g
2. The number of protons in P³⁻ is
 A. 15 B. 16 C. 17 D. 18
3. Which of the following particles determines the chemical properties of an element?
 A. Proton B. Electron C. Neutron D. Ion

4. Calculate the number of molecules in 1g of hydrogen gas.
 A. 3.01×10^{23} B. 6.02×10^{23} C. 1.20×10^{24} D. 1.505×10^{23}
5. The lone pair: shared pair of electrons in an ammonia molecule is
 A. 1:2 B. 2:1 C. 1:3 D. 3:1
6. The sum of the lone pair and shared pair of electrons in a water molecule is
 A. 1 B. 2 C. 3 D. 4
7. The number of atoms in 0.5g of hydrogen gas is
 A. 3.01×10^{23} B. 6.02×10^{23} C. 1.20×10^{24} D. 1.505×10^{23}
8. Which of the following gases does not have a single bond?
 A. HCl B. O₂ C. H₂ D. Cl₂
9. What mass of aluminium oxide is produced when 9.2 g of aluminium reacts completely with oxygen?
 $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$
 A. 0.17 g B. 173 g C. 17.30 g D. 17 g
10. $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$ are
 A. Isomers B. Isotones C. Isobars D. Isotopes
11. A radioactive decay equation is given below:
 $^{214}_{82}\text{Pb} \rightarrow ^{214}_{83}\text{Bi} + \text{X}$. X represents
 A. Alpha particle B. Beta particle C. Gamma particle D. X particle
12. $^{214}_{82}\text{Pb}$ and $^{214}_{83}\text{Bi}$ are
 A. Isomers B. Isotones C. Isobars D. Isotopes
13. Cobalt-60 disintegrates to give nickel-60. Calculate the fraction of the sample that remains after 15 years (λ for cobalt-60 is 0.13 yr^{-1})
 A. 7/100 B. 7/50 C. 14/50 D. 2/100
14. Atoms of the same elements with different atomic numbers are called
 A. Isomers B. Isotones C. Isobars D. Isotopes
15. The type of bond in HCl is
 A. Ionic bond B. Covalent bond C. Dative bond D. Metallic bond
16. How many lone pairs of electron are there in a molecule of methane?
 A. 0 B. 1 C. 2 D. 4
17. The volume occupied by 3.01×10^{23} molecules of a gas at s.t.p is
 A. 11.2 dm³ B. 22.4 dm³ C. 44.8 dm³ D. 5.6 dm³
18. How many neutron does $^{214}_{83}\text{Bi}$ contains?
 A. 297 B. 83 C. 121 D. 214

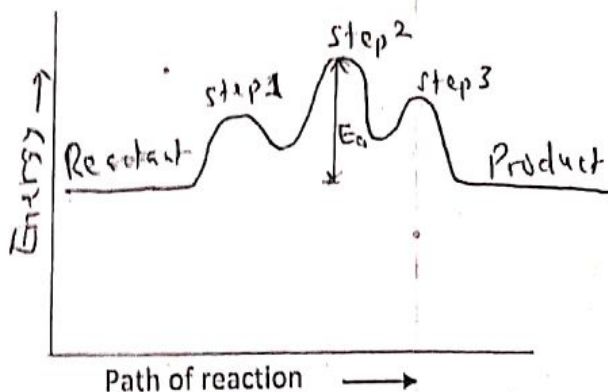
19. The mass of 1.204×10^{24} molecules of nitrogen gas is
 A. 7 g B. 14 g C. 28 g D. 56 g
20. How many electrons are present in F^- ?
 A. 8 B. 9 C. 10 D. 11
21. Which of the following represents equilibrium constant?
 A. Concentration equilibrium constant for a reaction B. Weak acid and weak base dissociation constant
 C. Reaction of strong acid with water D. Options A and B represent equilibrium constant
22. The value of K_p at 35°C for the reaction of $2\text{NO}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons 2\text{NOCl}(\text{g})$ is $3.2 \times 10^{-3} \text{ atm}^{-1}$. Calculate the value of K_c at the same temperature.
 A. 0.809 Lmol^{-1} B. 0.0809 Lmol^{-1} C. 0.0911 Lmol^{-1} D. 0.089 molL^{-1}
23. At a certain temperature, K for the reaction $3\text{C}_2\text{H}_2(\text{g}) \rightleftharpoons \text{C}_6\text{H}_6(\text{g})$ is 5. If the equilibrium concentration of C_2H_2 is 0.7 mol/L , what is the concentration of C_6H_6 ?
 A. 0.343 mol/L B. 0.49 mol/L C. 1.72 mol/L D. 1.37 mol/L
24. Which of the following will change the equilibrium constant for a given reaction mixture?
 A. Increase or decrease of pressure B. Changing temperature
 C. increase or decrease in concentration D. Increase or decrease in volume
25. At 28°C , 1 mole of acetic acid reacted with 1 mole of ethanol until equilibrium was established. The equilibrium mixture was found to contain 0.333 mol of unused acid. Calculate the equilibrium constant of the reaction at the same temperature.
 A. 1 B. 2 C. 3 D. 4

Consider the reaction between t-butylbromide and a base at 55°C .

$(\text{CH}_3)_3\text{CBr}_{(\text{aq})}$	+	$\text{OH}^-_{(\text{aq})}$	\longrightarrow	$(\text{CH}_3)_3\text{COH}_{(\text{aq})}$	+	$\text{Br}^-_{(\text{aq})}$
	Expt 1	Expt 2		Expt 3	Expt 4	Expt 5
$[(\text{CH}_3)_3\text{CBr}] \text{ mol/L}$	0.50	1.0		1.5	1.0	1.0
$[\text{OH}^-] \text{ mol/L}$	0.050	0.050		0.050	0.10	0.20
Rate (mol/L.s)	0.0050	0.010		0.015	0.010	0.010

Use the above to answer questions 26 - 28

26. What is the order of the reaction with respect to both $(\text{CH}_3)_3\text{CBr}$ and OH^- ?
 A. 1, 1 B. 1, 0 C. 2, 1 D. 0, 1
27. Write the rate expression for the reaction.
 A. $R = k[(\text{CH}_3)_3\text{CBr}][\text{OH}^-]$ B. $R = k[(\text{CH}_3)_3\text{CBr}]$
 C. $R = k[(\text{CH}_3)_3\text{CBr}]^2[\text{OH}^-]$ D. $R = k[\text{OH}^-]$
28. Calculate the rate constant at 55°C .
 A. 0.02 s^{-1} B. 0.01 s^{-1} C. 0.03 s^{-1} D. 0.04 s^{-1}
29. Plutonium-240 (Pu-240) is a byproduct of the nuclear reaction that takes place in a reactor. It takes one thousand years for 10.0 % of a 4.60-g sample to decay. What is the half life of Pu-240?
 A. $6.60 \times 10^3 \text{ y}$ B. $2.10 \times 10^4 \text{ y}$ C. $3.50 \times 10^6 \text{ y}$ D. $3.4 \times 10^4 \text{ y}$
- Consider a reaction plot for a reaction mechanism with a three-step mechanism.



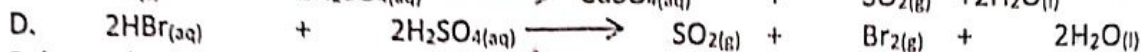
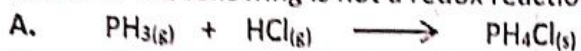
30. Which of the following is the rate determining step?
 A. Step 1 B. Step 2 C. Step 3 D. None of the above
31. All the following are true of rate determining step in a reaction mechanism except
 A. The overall rate of the reaction cannot exceed that of the slowest step.
 B. If that step is by far the slowest step, its rate will approximately be equal to that of the overall reaction
 C. The slowest step in a mechanism is ordinarily the one with the lowest activation energy
 D. The slowest step in a mechanism is ordinarily the one with the highest activation energy
32. Lactic acid $C_3H_6O_3$, is a weak organic acid present in both sour milk and buttermilk. It is also a product of carbohydrate metabolism and is found in the blood after vigorous muscular activity. A buffer was prepared by dissolving lactic acid, HLac, ($K_a = 1.4 \times 10^{-4}$), and sodium lactate, $NaC_3H_5O_3$, NaLac. Calculate the pH of the buffer if it is made up of 34.6 g of NaLac dissolved in 550.0 mL of a 1.20 M aqueous solution of HLac (Assume no volume change after addition of NaLac)
 A. 3.52 B. 4.65 C. 1.23 D. 3.43
33. What is the conjugate base of HNO_2 ?
 A. HNO_3 B. NO C. NO_2^- D. NO_2
34. Consider barium hydroxide, a white, powdery substance. A student prepared a solution of $Ba(OH)_2$ by dissolving 4.23 g of $Ba(OH)_2$ in enough water to make 455 mL of solution. What is the pH of the student's solution?
 A. 13.04 B. 3.13 C. 12.43 D. 13.74
35. Unpolluted rain water has a pH of about 5.5. Acid rain has been shown to have a pH as low as 3.5. Calculate the $[H^+]$ ratio of acid rain to unpolluted rain.
 A. 100 B. 0.01 C. 0.001 D. 0.1
36. Calcium phosphate, $Ca_3(PO_4)_2$, is a sparingly soluble mineral, large quantities of which are used to make commercial fertilizer. Given that the solubility product, K_{sp} , of $Ca_3(PO_4)_2$ is $1.0 \times 10^{-33} \text{ mol}^5\text{dm}^{-15}$, determine the concentration of Ca^{2+} in equilibrium with the solid if $[PO_4^{3-}] = 5 \times 10^{-5} \text{ mol dm}^{-3}$.
 A. $7 \times 10^{-9} \text{ mol dm}^{-3}$ B. $3 \times 10^{-4} \text{ mol dm}^{-3}$ C. $2.4 \times 10^{-5} \text{ mol dm}^{-3}$ D. $4.5 \times 10^{-8} \text{ mol dm}^{-3}$
37. Barium fluoride, BaF_2 , is used in metallurgy as a welding and soldering agent. Its K_{sp} is 1.8×10^{-7} . What is its solubility?

- A. $3.6 \times 10^{-3} \text{ moldm}^{-3}$ B. $3 \times 10^{-4} \text{ moldm}^{-3}$ C. $2.4 \times 10^{-5} \text{ moldm}^{-3}$ D. $4.5 \times 10^{-8} \text{ moldm}^{-3}$

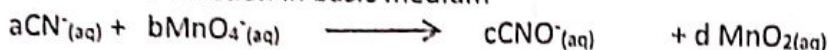
38. Determine the oxidation number of S in $\text{Na}_2\text{S}_2\text{O}_3$.

- A. +1 B. +2 C. +3 D. -2

39. Which of the following is not a redox reaction?



40. Balance the reaction in basic medium



and determine $\frac{a+b}{c+d}$

- A. 1 B. 4 C. 5 D. 7

41. Inorganic Chemistry involves the study of all, but one:

- A. Synthesis B. Elements C. Structures D. Extraction

42. All the following except one contributed to the development of the modern periodic table:

- A. Hund A. Bohr C. Mendeleef D. Mosley

43. All the following except one is a defect of the Mendeleef's periodic table

- A. He arrange all elements according to their atomic numbers
B. The anomalous position of Hydrogen
C. He placed coinage metals (Cu, Ag, Au) alongside with alkali metals
D. The position of Lanthanides

44. The modern periodic law states that

- A. All periods are equal
B. The properties of elements are a periodic function of their atomic numbers
C. Metals are cable of releasing electrons
D. Atomic masses are responsible for isotopic behaviours

Use these elements Al, Si, P, Cl to answer questions 45 to 47:

45. Which of them would have the smallest atomic size?

- A. Al B. Si C. P D. Cl

46. Which of these elements would have the highest electro-negativity value?

- A. Al B. Si C. P D. Cl

47. The electronic configuration of Si is

- A. $1\text{S}^2, 2\text{S}^5, 2\text{P}^5$ B. $1\text{S}^2, 2\text{S}^2, 2\text{P}^6, 3\text{S}^2, 3\text{P}^2$ C. $1\text{S}^2, 2\text{S}^2, 2\text{P}^6, 3\text{S}^2$ D. $1\text{S}^2, 2\text{S}^2, 2\text{P}^6, 3\text{S}^2, 3\text{P}^1$

48. Which of the following is true of ionization energy on the periodic table?

- A. It has no specific trend B. It increases with atomic number along the periods
C. It decreases down the group D. Options (A) & (C)

49. Which of the following is correct of the ionic size of Cl^- ?

- A. It is smaller than the atomic size of Cl B. It is indescribable C. It is bigger than that of Br^- D. All of the above

50. Halogens can be regarded as:

- A. Salt formers B. Group 7 elements C. Have high electronegativity values
D. All the above
51. Which of the following is true of an s orbital?
A. It contains 2 electrons maximally B. it is on every energy level C. It is spherical in shape D. All of the above
52. The type of hybridization, bond angle and shape molecule in BeF_2 are
A. sp^2 , 180° & linear B. sp hybridization, 120° & planar C. none of the above
D. sp^4 , 100° & triangular

Use the following electronegativity values in the following table to answer questions 53 to 55.

Symbols of Elements	H	Li	Be	B	C	N	O	F
Electronegativity Values	2.1	1.0	1.5	2.0	2.5	3.1	3.5	4.1

53. The type of bond that will exist between H and F is A. covalent bond B. Ionic bond
C. Coordinate bond D. None of the above
54. The type of bond that will exist between two different atoms of O is called
A. Hydrogen bond B. Covalent bond C. Ionic bond D. Dative bond
55. State the trend of the electronegativity values of these elements:
A. It can form a sinusoidal wave B. It is irregular between some of the elements
C. It increases as the atomic number increases D. It forms a regular pattern

Use Carbon and Graphite to answer questions 56 to 58.

56. They are both naturally occurring allotropes of
A. Sulphur B. Carbon C. Oxygen D. all of the above
57. Diamond is the hardest substance known in nature because
A. It exhibits sp^3 hybridization with each carbon covalently bonded to four other carbons in a tetrahedron forming a strong crystal structure
B. It exhibits sp^2 hybridization with each carbon atom covalently bonded to three other carbon atoms in a trigonal planar shape forming a strong crystal structure
C. none of the above D. The statement is false
58. Graphite is a good conductor of heat and electricity because
A. It is a metal B. It possesses delocalizable electrons with which it does so
C. False statement D. its crystal structure usually interchanges
59. f block elements are
A. Lanthanides & Actinides B. Inner transition elements C. Rare earth elements
D. All of the above
60. A group on the periodic table can be defined as the vertical arrangement of elements whose atoms have the same outer-most electronic configuration.
A. True B. False C. True for only transition metals D. True for alkali metals