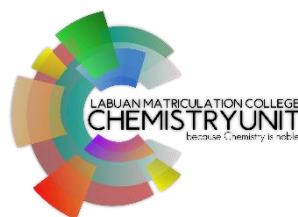


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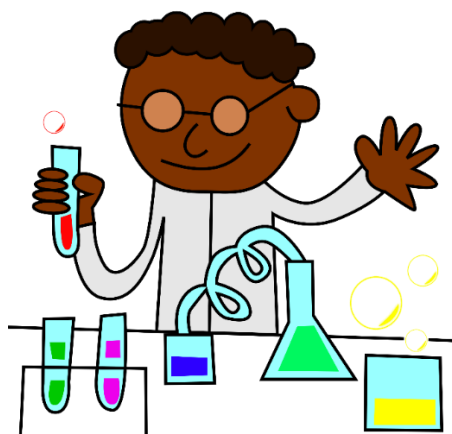
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LABUAN MATRICULATION COLLEGE
GEAR UP YOUR POTENTIAL

CHEMISTRY

2 hour



For Lecturer Used Only	
Question 1	/ 21
Question 2	/ 10
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Question 4	/ 9
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Question 6	/ 14
Total Marks	/ 80

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

This question paper consists of 6 questions. Answer all questions.

RELATIVE ATOMIC MASSES OF SELECTED ELEMENTS

Element	Symbol	Proton Number	Relative Atomic Mass
Aluminium	Al	13	27.0
Silver	Ag	47	107.9
Argon	Ar	18	40.0
Arsenic	As	33	74.9
Gold	Au	79	197.0
Barium	Ba	56	137.3
Beryllium	Be	4	9.0
Bismuth	Bi	83	209.0
Boron	B	5	10.8
Bromine	Br	35	79.9
Iron	Fe	26	55.9
Fluorine	F	9	19.0
Phosphorus	P	15	31.0
Helium	He	2	4.0
Mercury	Hg	80	200.6
Hydrogen	H	1	1.0
Iodine	I	53	126.9
Cadmium	Cd	48	112.4
Potassium	K	19	39.1
Calcium	Ca	20	40.1
Carbon	C	6	12.0
Chlorine	Cl	17	35.5
Cobalt	Co	27	58.9
Krypton	Kr	36	83.8
Chromium	Cr	24	52.0
Copper	Cu	29	63.6
Lithium	Li	3	6.9
Magnesium	Mg	12	24.3
Manganese	Mn	25	54.9
Sodium	Na	11	23.0
Neon	Ne	10	20.2
Nickel	Ni	28	58.7
Nitrogen	N	7	14.0
Oxygen	O	8	16.0
Platinum	Pt	78	195.1
Lead	Pb	82	207.2
Protactinium	Pa	91	231.0
Radium	Ra	88	226.0
Radon	Rn	86	222.0
Rubidium	Rb	37	85.5
Selenium	Se	34	79.0
Cerium	Ce	58	140.1
Cesium	Cs	55	132.9
Silicon	Si	14	28.1
Scandium	Sc	21	45.0
Tin	Sn	50	118.7
Antimony	Sb	51	122.0
Strontium	Sr	38	87.6
Sulphur	S	16	32.1
Uranium	U	92	238.0
Tungsten	W	74	183.8
Zinc	Zn	30	65.4

LIST OF SELECTED CONSTANT VALUES

Ionisation constant for water at 25 °C	K_w	=	$1.00 \times 10^{-4} \text{ mol}^2 \text{ dm}^{-6}$
Molar volume of gases	V_m	=	22.4 dm ³ mol ⁻¹ at STP = 24 dm ³ mol ⁻¹ at room temperature
Speed of light in a vacuum	c	=	$3.0 \times 10^8 \text{ m s}^{-1}$
Specific heat of water		=	4.18 kJ kg ⁻¹ K ⁻¹ = 4.18 J g ⁻¹ K ⁻¹ = 4.18 J g ⁻¹ °C ⁻¹
Avogadro's number	N_A	=	$6.02 \times 10^{23} \text{ mol}^{-1}$
Faraday constant	F	=	$9.65 \times 10^4 \text{ C mol}^{-1}$
Planck's constant	h	=	$6.6256 \times 10^{-34} \text{ J s}$
Rydberg constant	R_H	=	$1.097 \times 10^7 \text{ m}^{-1}$ = $2.18 \times 10^{-18} \text{ J}$
Ideal gas constant	R	=	8.314 J mol ⁻¹ K ⁻¹ = 0.08206 L atm mol ⁻¹ K ⁻¹
Density of water at 25°C	ρ	=	1 g cm ⁻³
Freezing point of water		=	0.00 °C
Vapour pressure of water at 25°C	P_{water}	=	23.8 torr

UNIT AND CONVERSION FACTOR

Volume	1 liter = 1 dm ³ 1 mL = 1 cm ³
Energy	1 J = 1 kg m ² s ⁻² = 1 N m = 10 ⁷ erg 1 calorie = 4.184 Joule 1 eV = 1.602 x 10 ⁻¹⁹ J
Pressure	1 atm = 760 mmHg = 760 torr = 101.325 kPa = 101325 N m ⁻²
Others	1 Faraday (F) = 96500 coulomb 1 newton (N) = 1 kg m s ⁻²

Answer **all** questions.

1. (a) Element **A** with atomic number 91, has 140 neutrons and 89 electrons. Write the isotopic notation for element **A**.

[1 mark]

(b)

Isotopes	Isotopic Masses (u)	Natural abundance
^{50}B	49.9658	1.8432
^{52}B	52.0056	35.5042
^{53}B	52.9867	4.0254
^{54}B	54.0021	1.00

Table 1

Element **B** has four naturally occurring isotopes, and their masses and natural abundances are shown in **Table 1** above. Calculate the average atomic mass of element **B**.

[2 marks]

- (c) Suberic acid is a colourless crystalline solid used in drug syntheses and plastics manufacture. The molar mass of suberic acid is 174 g mol^{-1} .
- (i) Suberic acid consists of 55.16% of carbon, 8.05% of hydrogen and 36.79% of oxygen. Determine the empirical formula and molecular formula of suberic acid.
- (ii) 20.0 g of suberic acid is dissolved in water to produce 500ml of solution with density 1.27 g ml^{-1} . Determine the molality of the solution.

[10 marks]

- (d) The reaction between 20 g of calcium nitride, Ca_3N_2 and 30 g of water produces calcium hydroxide and ammonia.

- (i) Write the chemical equation for the above reaction.
- (ii) Determine the limiting reactant.
- (iii) If the percentage yield of calcium hydroxide is produced from the above reaction is 72.35% with theoretical yield of 30 g, calculate the actual yield of calcium hydroxide formed.

[8 marks]

2. (a) A line with a wavelength of 410.2 nm was observed in the Balmer series of the emission spectrum of hydrogen.

- (i) Calculate its frequency.
- (ii) Determine the initial and final values of the energy levels associated with this emission.
- (iii) State the region of the electromagnetic spectrum in which the line is found.

[5 marks]

- (b) An element **D** has proton number of 14

- (i) Write the electronic configuration of an element **D**.
- (ii) Draw the shape of orbitals for the valence electron.
- (iii) What rule is used to arrange the 13th and 14th electron in element **D**?

[5 marks]

3. (a) Thiocyanic acid, HSCN, is an unstable gas that is used as a seed treatment for barley, cotton, corn and oats, and as a fungicide.

- (i) Draw the Lewis structure of the three resonance structures of thiocyanate ion, SCN^- .
- (ii) Determine the most plausible structure and give your reason.

[8 marks]

- (b) Oxygen difluoride, OF_2 is a colourless poisonous gas.

- (i) Describe the hybridisation of central atom in OF_2 .
- (ii) Draw and state the molecular geometry of OF_2 .
- (iii) Predict the polarity of OF_2 .

[7 marks]

- (b) Explain why calcium has a higher boiling point than potassium.

[2 marks]

4. (a) A certain mass of fluorine gas is added to a vessel of 865 ml containing 1.3 g of argon gas. The gas pressure is increased from 811.5 mmHg to 1365.2 mmHg. Assuming the temperature remains constant, and that the fluorine gas does not react with argon gas, calculate the mass of the added fluorine gas.

[5 marks]

- (b) Butanal, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ and butanol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ are amongst the chemical compound that exist in liquid phase. Explain which compound has a higher vapour pressure?

[4 marks]

5. (a) Oxidation of sulphur dioxide to sulphur trioxide is a reversible reaction.



In one experiment, at 750 °C, an equilibrium was achieved in a closed vessel with partial pressures of SO_2 , O_2 and SO_3 are 0.27, 0.40 and 0.32 atm respectively.

- (i) Calculate the equilibrium constant, K_p .
(ii) Determine the initial pressures of SO_2 and O_2 .

[6 marks]

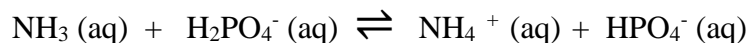
- (b) The equilibrium for the formation of ammonia gas, NH_3 , is represented by the equation:



Explain the effect on the amount of NH_3 and the value of K_p if the temperature is decreased.

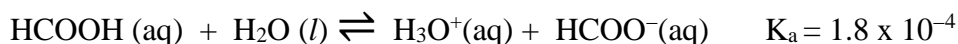
[3 marks]

6. (a) Identify the Bronsted-Lowry acid-base and their conjugates pair in the equation below.



[2 marks]

- (b) Formic acid, HCOOH, is the irritant that causes the body's reaction to ant stings. The ionisation of formic acid is as follows:



- (i) Calculate the concentration of HCOO^- ion in 0.186 M solution of HCOOH.
(ii) What is the pH of this solution?

[5 marks]

- (c) A student is asked to prepare a buffer solution at pH 9.6 using 50.00 mL of 0.25 M propylamine, $\text{C}_3\text{H}_7\text{NH}_2$ and propylammonium chloride, $\text{C}_3\text{H}_7\text{NH}_3\text{Cl}$. The K_b value of $\text{C}_3\text{H}_7\text{NH}_2$ is 4.7×10^{-4} .

- (i) Calculate the mass propylammonium chloride required to prepare the buffer solution.
(ii) Write the chemical equation of the buffering effect when a small amount of HCl and NaOH is added into the buffer solution respectively.

[7 marks]

END OF QUESTION PAPER