LIST OF SELECTED CONSTANT VALUES
SENARAI NILAI PEMALAR TERPILIH

Ionisation constant for water at 25°C *Hasil darab ion bagi air pada 25°C*	K_w	=	1.0×10^{-14} mol^2 dm^{-6}
Molar volume of gases *Isipadu molar gas*	V_m	=	22.4 dm^3 mol^{-1} at STP
		=	24 dm^3 mol^{-1} at room temperature
Speed of light in a vacuum *Laju cahaya dalam vakum*	c	=	3.0×10^8 m s^{-1}
Specific heat of water *Muatan haba tentu air*		=	4.18 kJ kg^{-1} K^{-1}
		=	4.18 J g^{-1} K^{-1}
		=	4.18 J g^{-1} °C^{-1}
Avogadro's number *Nombor Avogadro*	N_A	=	6.02×10^{23} mol^{-1}
Faraday constant *Pemalar Faraday*	F	=	96500 C mol^{-1}
Planck's constant *Pemalar Planck*	h	=	6.6256×10^{-34} J s
Rydberg constant *Pemalar Rydberg*	R_H	=	1.097×10^7 m^{-1}
		=	2.18×10^{-18} J
Molar of gas constant *Pemalar gas molar*	R	=	8.314 J mol^{-1} K^{-1}
		=	0.08206 L atm mol^{-1} K^{-1}
Density of water *Kenumpatan air*	ρ	=	1 g cm^{-3}
Freezing point of water *Takat beku air*		=	0.00 °C
Vapour pressure of water at 25°C *Tekanan wap air*	P_{H_2O}	=	23.8 torr

UNIT AND CONVERSION FACTOR

VOLUME *Isipadu*	1 L	=	1 dm^3
	1mL	=	1 cm^3
ENERGY *Tenaga*	1 J	=	1 kg m^2 s^{-2} = 1 N m = 1×10^7 erg
	1 calorie	=	4.184 Joule
	1eV	=	1.602×10^{-19} J
PRESSURE *tekanan*	1 atm	=	760 mmHg = 760 torr = 101.325 kPa = 101325 N m^{-2}
OTHERS *Lain-lain*	1 Faraday (F)	=	96 500 C coulomb
	1 Newton (N)	=	1 kg m s^{-2}

RELATIVE ATOMIC MASSES OF SELECTED ELEMENTS

Element	Symbol	Proton number	Relative atomic mass
Aluminum	Al	13	27.0
Antimony	Sb	51	121.8
Argon	Ar	18	40.0
Arsenic	As	33	74.9
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
Cadmium	Cd	48	112.4
Calcium	Ca	20	40.1
Carbon	C	6	12.0
Cerium	Ce	58	140.1
Cesium	Cs	55	132.9
Chlorine	Cl	17	35.5
Chromium	Cr	24	52.0
Cobalt	Co	27	58.9
Copper	Cu	29	63.6
Fluorine	F	9	19.0
Gold	Au	79	197.0
Helium	He	2	4.0
Hydrogen	H	1	1.0
Iodine	I	53	126.9
Iron	Fe	26	55.9
Krypton	Kr	36	83.8
Lead	Pb	82	207.2
Lithium	Li	3	6.9
Magnesium	Mg	12	24.3
Manganese	Mn	25	54.9
Mercury	Hg	80	200.6
Neon	Ne	10	20.2
Nickel	Ni	28	58.7
Nitrogen	N	7	14.0
Oxygen	O	8	16.0
Phosphorus	P	15	31.0
Platinum	Pt	78	195.1
Potassium	K	19	39.1
Protactinium	Pa	91	231.0
Radium	Ra	88	226.0
Radon	Rn	86	222.0
Rubidium	Rb	37	85.5
Scandium	Sc	21	45.0
Selenium	Se	34	79.0
Silicon	Si	14	28.1
Silver	Ag	47	107.9
Sodium	Na	11	23.0
Strontium	Sr	38	87.6
Sulphur	S	16	32.1
Tin	Sn	50	118.7
Tungsten	W	74	183.9
Uranium	U	92	238.0
Zinc	Zn	30	65.4

1. a) **FIGURE 1** shows the mass spectrum for Neon. The relative atomic mass of Neon is 20.18. Determine the values of a and b.

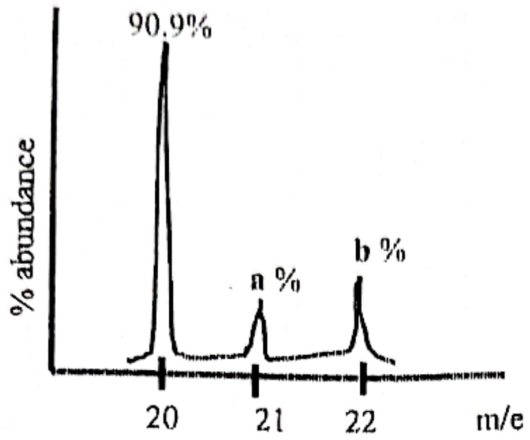

FIGURE 1

[3 marks]

b) In an experiment, 500 mL of oxalic acid solution is prepared by dissolving 11.0 g of hydrated oxalic acid, $C_2H_2O_4.2H_2O$ in water. The solution has a density of 1.10 gmL^{-1}. Calculate the:

i. molarity oxalic acid solution.

ii. mole fraction of oxalic acid in the solution.

(Relative molecular mass of hydrated oxalic acid $C_2H_2O_4.2H_2O$: 126)

[7 marks]

c) Balance the redox equation in a basic solution.

$$MnO_4^- + C_2O_4^{2-} \rightarrow MnO_2 + CO_3^{2-}$$

[4 marks]

d) An iodine pentafluoride, IF_5 sample is prepared by reacting 120.00 g of manganese iodide, MnI_2 with an equal mass of fluorine according to the equation below:

$$2MnI_2(s) + 13F_2(g) \rightarrow 4IF_5(l) + 2MnF_3(s)$$

The mass of IF_5 obtained was 80.50 g. Calculate the percentage yield of IF_5 produced.

(Relative molecular mass MnI_2 : 308.7, F_2 : 38 , IF_5 : 221.9, MnF_3 : 111.9)

[7 marks]

2. a) **FIGURE 2** shows the **Paschen** series of hydrogen emission spectrum.

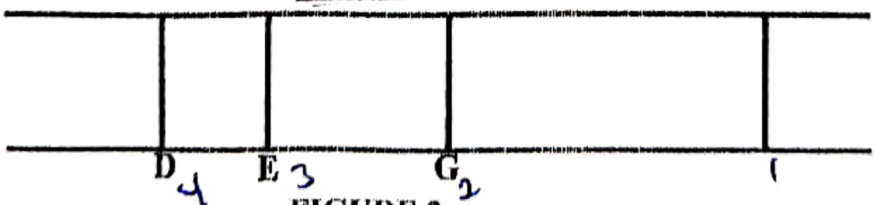

FIGURE 2

i. Draw the electronic transition of lines **D**, **E** and **G** on the energy level diagram of the hydrogen atom.

ii. Calculate the wavelength of the line with the highest energy.

[5 marks]

b) The sets of quantum numbers represent the three outermost electrons in an atom, are given in TABLE 1 below:

$n = 3$	$l = 0$	$m = 0$	$s = +\frac{1}{2}$
$n = 3$	$l = 0$	$m = 0$	$s = -\frac{1}{2}$
$n = 3$	$l = 1$	$m = -1$	$s = +\frac{1}{2}$

TABLE 1

i. Draw the orbital diagram of **J**.
ii. Write the electronic configuration of J^{3+}.
iii. Name the quantum number that determines the orientation of the orbital in space.
iv. Draw the shape(s) of orbital(s) occupied by the electron(s) with the highest principal quantum number in **J**.

[5 marks]

3. a) Consider the species below—
NH_2^- ion and NH_3 molecules.
Using VSEPR theory:
i. Determine the molecular geometry of both species.
ii. Explain the difference of H-N-H angle in NH_2^- and NH_3.

[8 marks]

b) Xenon, Xe is a dense, colourless, and odourless inert gas. It is an element of period 5 and group 18 in the periodic table. The reaction between xenon and fluorine, F forms xenon difluoride XeF_2. Describe the hybridisation process and draw the overlapping of orbitals for the bonding in XeF_2.

[9 marks]

4. a) i. Acetone is widely used as a nail polish remover. A sample of liquid acetone is placed in a 3.0 L flask and vaporised by heating to 95°C at 1.02 atm. The vapour filling the flask at this temperature and pressure weighs 5.87 g. Calculate the density and molar mass of acetone.

[4 marks]

ii. What is the effect on the volume of 1 mol of an ideal gas if pressure is tripled at constant temperature? [1 mark]

b) Explain the following observation in term of vapour pressure and intermolecular forces.

"Ethanol (CH_3CH_2OH) boils at 78°C whereas ethanethiol (CH_3CH_2SH) boils at 36°C"

[4 marks]

5. a) Nitrogen dioxide, NO_2 decomposes according to the following reaction equation:

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

A sample of 0.04167 M NO_2 is placed in a 60.0 L vessel at 300 °C. Equilibrium is established when 15 % of NO_2 has decomposed. Calculate K_c for this reaction at 300 °C.

[6 marks]

b) Consider the reaction at equilibrium below in a container with a piston.

$$2NO_2(g) + 7H_2(g) \rightleftharpoons 2NH_3(g) + 4H_2O(g) \qquad \Delta H = -93\ kJ$$

Based on the reaction above:

i. Predict the equilibrium position when 0.20 mol of argon is added at constant pressure.

ii. State the change in K_c value when temperature decreases.

[3 marks]

6. a) A buffer solution contains 0.125 M of propanoic acid, CH_3CH_2COOH, and 0.094 M of sodium propanoate, CH_3CH_2COONa. Calculate:

i. the pH of CH_3CH_2COOH solution if there was no salt present.

ii. the pH of this buffer solution.

[Given K_a for $CH_3CH_2COOH = 1.3 \times 10^{-5}$]

[8 marks]

b) The molar solubility of AgCl in water is 1.26×10^{-6} M. Calculate molar solubility of AgCl in 6.5×10^{-3} M $AgNO_3$ solution. Compare both values of the molar solubilities. Explain.

[Given K_{sp} for AgCl = 1.6×10^{-10}]

[6 marks]

-END OF QUESTION PAPER-

"Successful people are not gifted; they just work hard, then succeed on purpose."