



**KOLEJ MATRIKULASI KEDAH**  
**BAHAGIAN MATRIKULASI**  
**KEMENTERIAN PENDIDIKAN MALAYSIA**

**PRA PSPM 1**  
**SEMESTER II, SESI 2023/2024**

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**KIMIA**  
**2 jam**

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU**

**ARAHAN KEPADA CALON:**

Kertas ini mengandungi 6 soalan. Jawab semua soalan.

**TABLE OF RELATIVE ATOMIC MASSES**

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	208.0
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
Cerium	Ce	58	140.1
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	121.8
Strontium	Sr	38	87.6
Sulphur	S	16	32.1
Uranium	U	92	238.0
Tungsten	W	74	183.9
Zinc	Zn	30	65.4

### LIST OF SELECTED CONSTANT VALUES

Ionization constant for water at 25°C	$K_w$	$= 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$
Molar volume of gases	$V_m$	$= 22.4 \text{ dm}^3 \text{ mol}^{-1}$ at STP $= 24 \text{ dm}^3 \text{ mol}^{-1}$ at room condition
Speed of light in a vacuum	$c$	$= 3.0 \times 10^8 \text{ m s}^{-1}$
Specific heat of water		$= 4.18 \text{ kJ kg}^{-1} \text{ K}^{-1}$ $= 4.18 \text{ J g}^{-1} \text{ K}^{-1}$ $= 4.18 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$
Avogadro's number	$N_A$	$= 6.02 \times 10^{23} \text{ mol}^{-1}$
Faraday constant	$F$	$= 96500 \text{ C mol}^{-1}$
Planck constant	$h$	$= 6.63 \times 10^{-34} \text{ J s}$
Rydberg constant	$R_H$	$= 1.097 \times 10^7 \text{ m}^{-1}$ $= 2.18 \times 10^{-18} \text{ J}$
Molar of gases constant	$R$	$= 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ $= 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$
Density of water	$\rho$	$= 1 \text{ g cm}^{-3}$
Freezing point of water		$= 0.00 \text{ }^\circ\text{C}$ $= 273.15 \text{ K}$
Vapour pressure of water at 25°C	$P_{\text{H}_2\text{O}}$	$= 23.76 \text{ torr}$

### UNIT AND CONVERSION FACTOR

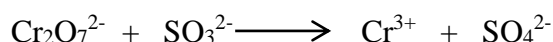
VOLUME	$1 \text{ L} = 1 \text{ dm}^3$ $1 \text{ mL} = 1 \text{ cm}^3$
ENERGY	$1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2} = 1 \text{ N m} = 1 \times 10^7 \text{ erg}$ $1 \text{ calorie} = 4.184 \text{ J}$ $1 \text{ eV molecule}^{-1} = 96.7 \text{ kJ mol}^{-1}$
PRESSURE	$1 \text{ atm} = 760 \text{ mmHg} = 760 \text{ torr} = 101\,325 \text{ Pa} = 101\,325 \text{ N m}^{-2}$
TEMPERATURE	$0^\circ\text{C} = 273.15 \text{ K}$
OTHERS	$1 \text{ Faraday (F)} = 96\,500 \text{ Coulomb}$ $1 \text{ Newton (N)} = 1 \text{ kg m s}^{-2}$

Answer **all** questions.

- 1 (a) Neon, Ne consists of 90.51%  $^{20}\text{Ne}$ , 0.27%  $^{21}\text{Ne}$  and 9.22%  $^{22}\text{Ne}$ . The isotopic masses for these three isotopes are 19.99 amu, 20.99 amu and 21.99 amu, respectively. Calculate the relative atomic mass of Ne.

[3 marks]

- (b) The following reaction takes place in acidic medium.



Write the balanced equation for the above reaction.

[3 marks]

- (c) A saline solution is prepared by dissolving 3.0 g of NaCl in water and is transferred to 250 mL volumetric flask. The density of the solution is 1.18g/mL. Calculate the molality of NaCl solution.

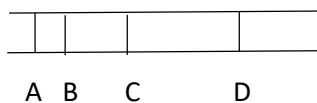
[5 marks]

- (d) In experiment, 1.46g of magnesium is added into 160 mL of 0.50 M hydrochloric acid. The products formed are magnesium chloride solution and hydrogen gas.

- (i) Write a balanced chemical equation for the above reaction.
- (ii) Determine the limiting reactant.
- (iii) Calculate the percentage yield if 672 mL of hydrogen gas is obtained at STP.

[10 marks]

- 2 (a) **FIGURE 1** shows the series of hydrogen emission spectrum in visible region.



**FIGURE 1**

- (i) Calculate the energy emitted to produce the third line in the series.
- (ii) Explain the formation of line D.
- (iii) Which line corresponds to the shortest wavelength?

[6 marks]

- (b) Given below are the sets of quantum number for the highest energy electrons in atom X.

$$(3, 1, 0, +1/2) , (3, 1, -1, +1/2)$$

- (i) Write the electronic configuration of atom X.
- (ii) State the number of electrons in orbital of atom X with azimuthal quantum number,  $l=0$ .
- (iii) Draw the shapes of orbitals occupied by the valence electrons.

[4 marks]

- 3 (a) An atom Y has 6 valence electrons. Y reacts with fluorine gas to form  $\text{YF}_2$  and  $\text{YF}_6$  compounds. For each compound,
- (i) draw the Lewis structure.
  - (ii) predict the electron pair arrangement and the molecular geometry.
  - (iii) draw the molecular geometry and state the bond angle.
  - (iv) predict the type of hybridization of the Y atom.

[12 marks]

- (b) **TABLE 1** shows the boiling points for several elements in the third period of periodic table.

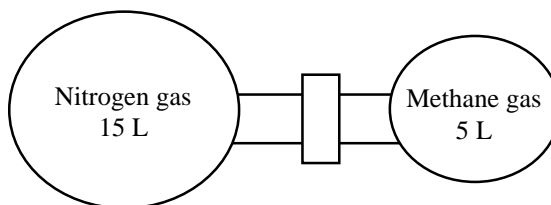
Element	Na	Mg	Al	Si	P	S
Boiling Point ( $^{\circ}\text{C}$ )	890	1120	2350	2680	281	445

**TABLE 1**

- (i) Based on the structure of the elements, explain why the boiling point rises from Na to Al.
- (ii) Explain why Si has the highest boiling point.

[5 marks]

- 4 (a) **FIGURE 2** shows two spheres with each volume of 5 L and 15 L are joint with a valve. Both spheres are filled with methane,  $\text{CH}_4$  at pressure of  $2 \times 10^5 \text{ Nm}^{-2}$  and nitrogen,  $\text{N}_2$  at a pressure of  $8 \times 10^5 \text{ Nm}^{-2}$  respectively. The valve is then opened and the gases are let to mix. Ignoring the volume taken by the valve, calculate the final pressure of the mixture at room temperature.



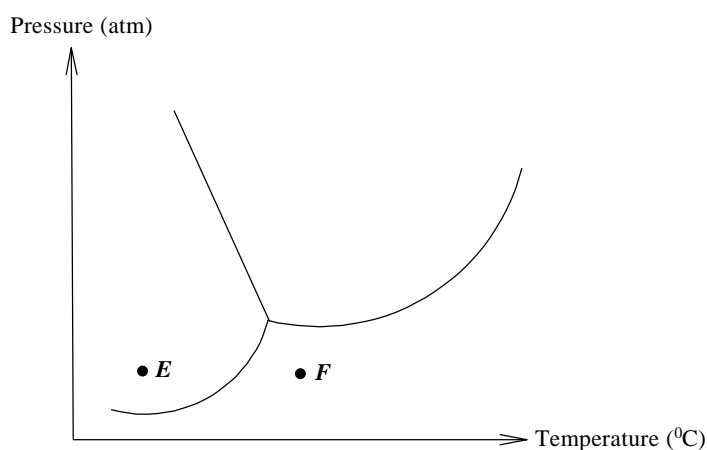
**FIGURE 2**

[5 marks]

- (b) Give **ONE** difference between amorphous and crystalline solid.

[1 mark]

- (c) **FIGURE 3** shows the phase diagram of  $\text{H}_2\text{O}$ .

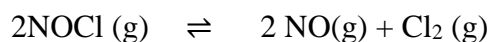


**FIGURE 3**

- Compare the solid-liquid equilibrium line of  $\text{H}_2\text{O}$  and  $\text{CO}_2$ .
- Explain the anomalous behavior of  $\text{H}_2\text{O}$ .
- State the condition of the kinetic energy of the water vapour when changing the phase from point *F* to *E*.

[3 marks]

- 5 (a) Consider a reaction below:

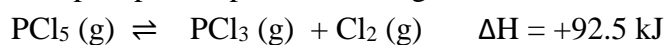


A 2.0 L flask contains 5.0 atm of NOCl was heated to 120°C. Analysis of the mixture at equilibrium shows that 1.25 atm Cl<sub>2</sub> was present.

- (i) Calculate the partial pressure of NOCl and NO at equilibrium.
- (ii) Calculate the equilibrium constant, K<sub>p</sub>.

[5 marks]

- (b) The decomposition of phosphorus pentachloride gas, PCl<sub>5</sub>, is as follows:



Explain the effect on the amount of PCl<sub>3</sub> if

- (i) the temperature is decreased.
- (ii) argon gas is added at constant pressure

[4 marks]

- 6 (a) Write the equation for the ionization of 0.5 M aqueous solution of CH<sub>3</sub>NH<sub>2</sub> and calculate its pH value. Given K<sub>b</sub> for CH<sub>3</sub>NH<sub>2</sub> is 3.7 x 10<sup>-4</sup>.

[8 marks]

- (b) The solubility of PbSO<sub>4</sub> in water is 0.038 gL<sup>-1</sup>. Calculate the

- (i) molar solubility of PbSO<sub>4</sub>.
- (ii) solubility product, K<sub>sp</sub> of PbSO<sub>4</sub>.
- (iii) solubility of PbSO<sub>4</sub> in 0.01 M Pb<sup>2+</sup> solution.

[6 marks]