
UNIVERSITI SAINS MALAYSIA

Final Examination
Academic Session 2008/2009

April 2009

JIK 101 – GENERAL CHEMISTRY I
[KIMIA AM I]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains NINE printed pages before you begin the examination.

Answer **FIVE** questions. You may answer **either** in Bahasa Malaysia or in English.

All answers must be written in the answer booklet provided.

Each question is worth 20 marks and the mark for each sub question is given at the end of that question.

Sila pastikan bahawa kertas peperiksaan ini mengandungi SEMBILAN muka surat yang bercetak sebelum anda memulakan peperiksaan ini.

*Jawab **LIMA** soalan. Anda dibenarkan menjawab soalan **sama ada** dalam Bahasa Malaysia atau Bahasa Inggeris.*

Setiap jawapan mesti dijawab di dalam buku jawapan yang disediakan.

Setiap soalan bernilai 20 markah dan markah subsoalan diperlihatkan di penghujung subsoalan itu.

...2/-

1. (a) A solution is prepared by dissolving 0.132 g $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ in 275 mL water. Calculate the concentration of hydroxide ions in this solution.

Suatu larutan telah disediakan dengan melarutkan 0.132 g $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ dalam 275 mL air. Kira kepekatan ion hidroksida dalam larutan ini.

[4 marks]

- (b) Draw and label the orbitals represented by these quantum numbers :

(i) $n = 5, \ell = 1$

(ii) $n = 4, \ell = 2$

Lukis dan label orbital-orbital yang diwakilkan oleh nombor kuantum yang berikut :

(i) $n = 5, \ell = 1$

(ii) $n = 4, \ell = 2$

[4 marks]

- (c) Lithopone is a brilliant white pigment used in water based paints. It is a mixture of BaSO_4 and ZnS , produced by the reaction between $\text{BaS}_{(\text{aq})}$ and $\text{ZnSO}_{4(\text{aq})}$. How many grams of Lithopone will be produced in the reaction of 315 mL of 0.275 M ZnSO_4 and 285 mL of 0.315 M BaS ?

Lithopone merupakan suatu pigmen putih yang digunakan dalam cat berasaskan air. Ia adalah campuran BaSO_4 dan ZnS , yang dihasilkan daripada tindak balas antara $\text{BaS}_{(\text{ak})}$ dan $\text{ZnSO}_{4(\text{ak})}$. Berapa gram Lithopone akan dihasilkan daripada tindak balas 315 mL 0.275 M ZnSO_4 dan 285 mL 0.315 M BaS ?

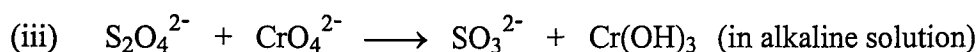
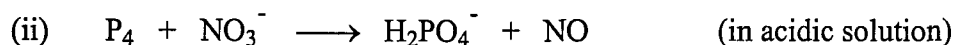
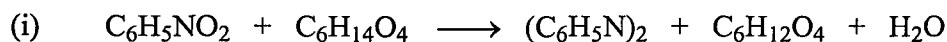
[6 marks]

- (d) Prepare notes on the hydrogen spectrum (provide suitable diagrams to explain your answers).

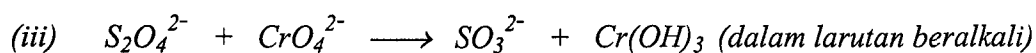
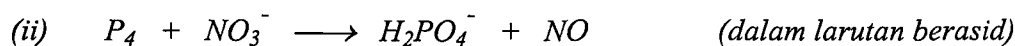
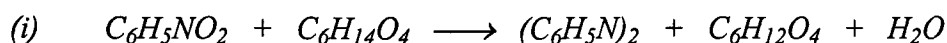
Sediakan nota tentang spektrum hidrogen (berikan rajah-rajah yang sesuai untuk menjelaskan jawapan anda).

[6 marks]

2. (a) Balance the following chemical equations. The complete steps must be shown.

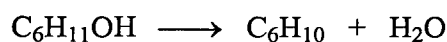


Imbangkan persamaan-persamaan kimia yang berikut. Langkah-langkah yang lengkap mestilah ditunjukkan.



[15 marks]

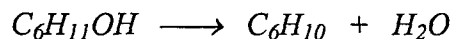
- (b) Consider the following reaction :



If 100 g of $C_6H_{11}OH$ yields 64.0 g of C_6H_{10} , calculate :

- the theoretical yield of the reaction
- the percentage yield of the reaction
- the mass of $C_6H_{11}OH$ that would produce 100 g of C_6H_{10} if the percentage yield is that determined in part (ii)

Pertimbangkan tindak balas yang berikut :



Jika 100 g $C_6H_{11}OH$ menghasilkan 64.0 g C_6H_{10} , kira :

- hasil teoretis tindak balas ini*
- peratus hasil tindak balas ini*
- jisim $C_6H_{11}OH$ yang akan menghasilkan 100 g C_6H_{10} jika peratus hasil adalah sama dengan nilai yang didapati dalam bahagian (ii).*

[5 marks]

...4/-

3. (a) Briefly explain the differences for each pair of the following definitions :

- (i) Electronegativity and electron affinity
- (ii) Electrostatic force and London dispersion force

Terangkan secara ringkas perbezaan bagi setiap pasangan istilah berikut :

- (i) *Keelektronegatifan dan daya elektron*
- (ii) *Daya elektrostatik dan daya penyerakan London*

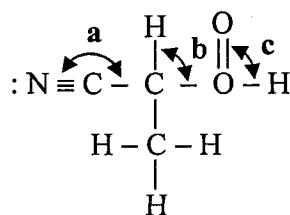
[8 marks]

(b) Draw the resonance structures for the HNO_3 molecule and SO_3^{2-} ion. Show all the formal charges (if any).

Lukiskan struktur resonans bagi molekul HNO_3 dan ion SO_3^{2-} . Tunjukkan semua cas formal (jika ada).

[6 marks]

(c)



- (i) How many σ and π bonds are in this molecule?
- (ii) What are the approximate values of the bond angles labelled **a**, **b** and **c**?
- (iii) What hybrid orbitals are used by the central atom at each of these angles?

- (i) *Berapa jumlah ikatan σ dan ikatan π di dalam molekul ini?*
- (ii) *Apakah nilai anggaran bagi sudut ikatan bertanda **a**, **b**, dan **c**?*
- (iii) *Jenis orbital hibrid apakah yang digunakan oleh atom pusat bagi setiap sudut **a**, **b** dan **c** ini?*

[6 marks]

4. (a) Based on the Bohr model of the atom, determine the electron transition in a H atom, starting from the orbit $n=7$, that will produce IR radiation of wavelength 2170 nm.

Berdasarkan model Bohr untuk atom, tentukan peralihan elektron dalam atom H, bermula dari orbit $n=7$, yang akan menghasilkan sinaran infra-merah yang mempunyai jarak gelombang 2170 nm.

[6 marks]

- (b) A hydrocarbon that is 82.7% C and 17.3% H by mass has a density of 2.33 g L^{-1} at $23 \text{ }^\circ\text{C}$ and 0.982 atm. Determine the molecular formula of this hydrocarbon.

Suatu hidrokarbon yang mengandungi 82.7% C dan 17.3% H mengikut jisim mempunyai ketumpatan 2.33 g L^{-1} pada $23 \text{ }^\circ\text{C}$ dan 0.982 atm. Tentukan formula molekul hidrokarbon ini.

[6 marks]

- (c) Draw an outline of the Periodic Table. By using arrows, show the increasing trend of the following properties across (horizontally and vertically) the whole of the Periodic Table. Explain your answers.

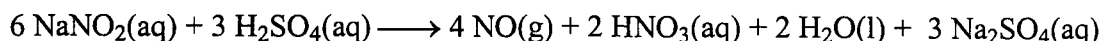
- (i) metallic character
- (ii) first ionisation energy
- (iii) electron affinity
- (iv) atomic radius (metallic radius for metals and covalent radius for non metals)

Lakarkan suatu Jadual Berkala, dengan menggunakan anak panah, tunjukkan tren meningkat sifat-sifat yang berikut merentasi (arah melintang dan menegak) keseluruhan Jadual Berkala. Jelaskan jawapan anda.

- (i) ciri kelogaman
- (ii) tenaga pengionan pertama
- (iii) cita electron
- (iv) jejari atom (jejari logam untuk logam dan jejari kovalen untuk bukan logam)

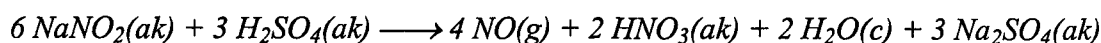
[8 marks]

5. (a) Nitrogen oxide can be generated in the laboratory by the following reaction :



Calculate the volume of 0.646 M aqueous NaNO_2 solution that should be used to generate 5.00 L of NO at a temperature of 20°C and a pressure of 0.970 atm.

Nitrogen oksida boleh dijanakan di dalam makmal melalui tindak balas yang berikut :



Kira isipadu larutan 0.646 M NaNO_2 yang perlu digunakan untuk menjana 5.00 mL NO pada suhu 20°C dan tekanan 0.970 atm.

[6 marks]

- (b) An aqueous solution is 0.556 M in NaCl and 0.245 M in KCl . If 100 mL of this solution is allowed to evaporate completely, calculate the mass of the residue.

Suatu larutan akueus mempunyai kepekatan 0.556 M NaCl dan 0.245 M KCl . Jika 100 mL larutan ini dibiarkan tersejat, kira jisim bahan yang tertinggal.

[4 marks]

- (c) A piece of Zn is dissolved in 50.00 mL of 1.035 M HCl solution. At the end of the reaction, the concentration of the 50.00 mL sample is redetermined, and found to be 0.812 M HCl . Calculate the mass of the piece of Zn .

Sekeping Zn telah dilarutkan dalam 50.00 mL larutan 1.035 M HCl . Setelah tindak balas selesai, kepekatan sampel 50.00 mL itu telah ditentukan semula dan didapati ianya 0.812 M HCl . Kira jisim kepingan Zn .

[4 marks]

- (d) Give short answers to the following questions.
- (i) Deduce the complete symbol for a nuclid that contains 10 electrons, 14 neutrons and 13 protons.
 - (ii) Arrange the following atoms and ions according to an increasing first ionisation energy: Ne, Na, P, Ar and K.
 - (iii) Give the possible values for ℓ and m_ℓ when $n=5$.
 - (iv) Name the element that has the electronic configuration $[\text{Ar}]4s^13d^5$.
 - (v) Characterise the four quantum numbers for the last electron in Co^{3+} and O^{2-} .

Berikan jawapan ringkas bagi soalan yang berikut.

- (i) *Deduksikan simbol yang lengkap bagi nuklid yang mengandungi 10 elektron, 14 neutron dan 13 proton.*
- (ii) *Susunkan atom dan ion yang berikut mengikut turutan tenaga pengionan pertama yang meningkat: Ne, Na, P, Ar dan K.*
- (iii) *Berikan nilai yang mungkin bagi ℓ dan m_ℓ apabila $n=5$.*
- (iv) *Namakan unsur yang mempunyai konfigurasi elektron $[\text{Ar}]4s^13d^5$.*
- (v) *Perincikan keempat-empat nombor kuantum bagi elektron yang terakhir pada Co^{3+} dan O^{2-} .*

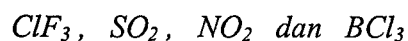
[6 marks]

6. (a) Given the following compounds :



- (i) Derive Lewis structure for ClF_3 and NO_2 .
- (ii) Which of the compounds do not obey the octet rule?
- (iii) Which of compound(s) is (are) nonpolar molecules?

Diberikan sebatian-sebatian seperti berikut :



- (i) *Terbitkan struktur Lewis bagi molekul ClF_3 dan NO_2 .*
- (ii) *Sebatian / sebatian-sebatian manakah yang tidak mengikuti peraturan oktet?*
- (iii) *Sebatian / sebatian-sebatian manakah yang tidak polar?*

[10 marks]

- (b) (i) Starting with an orbital diagram of a chlorine atom, describe the steps needed to construct hybrid orbitals that are appropriate to describe the bonding in ClF_3 .
- (ii) State the type of hybrid orbital, electron domains geometry and molecular geometry of ClF_3 ?
- (i) *Bermula dengan gambarajah orbital atom klorin, tunjukkan langkah-langkah yang diperlukan untuk membentuk orbital hibrid yang sesuai bagi menjelaskan pengikatan dalam ClF_3 .*
- (ii) *Nyatakan jenis orbital hibrid, geometri elektron domain dan geometri molekul bagi ClF_3 ?*

[10 marks]

List of Constants and Relative Atomic Masses

Senarai Jisim Atom Relatif dan Pemalar

Ag	=	107.8	I	=	126.9
Al	=	27.0	K	=	39.1
B	=	10.8	Li	=	6.9
Ba	=	137.3	Mg	=	24.3
Be	=	9.0	Mn	=	54.9
Br	=	80.0	N	=	14.0
C	=	12.0	Na	=	23.0
Ca	=	40.1	O	=	16.0
Cl	=	35.5	P	=	31.0
Cr	=	52.0	Pb	=	207.2
Cu	=	63.5	S	=	32.0
F	=	19.0	Sb	=	121.8
Fe	=	55.8	Si	=	28.1
H	=	1.01	Xe	=	131.3
He	=	4.0	Zn	=	65.4
Hg	=	200.6			

R	=	0.08206 L atm mol ⁻¹ K ⁻¹	or	8.3144 J mol ⁻¹ K ⁻¹
e	=	1.602 C		
m _e	=	9.11 × 10 ⁻³¹ kg		
h	=	6.626 × 10 ⁻³⁴ Js (or kg m ² s ⁻¹)		
a ₀	=	0.529 Å		
c	=	3.00 × 10 ⁸ ms ⁻¹		

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