



Final Examination
2017/2018 Academic Session

May/June 2018

JK101 – 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 (5)** questions. Answer the questions in English. You may also answer the questions in Bahasa Malaysia, but not a mix of both languages.

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.

In the event of any discrepancies in the exam questions, the English version shall be used.

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

*Jawab **LIMA (5)** soalan. Jawab soalan-soalan dalam Bahasa Inggeris. Anda juga dibenarkan menjawab soalan dalam Bahasa Malaysia, tetapi campuran antara kedua-dua bahasa ini tidak dibenarkan.*

Setiap jawapan mesti dijawab di dalam buku jawapan yang disediakan.

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

Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.

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Answer **FIVE (5)** questions.

Jawab **LIMA (5)** soalan.

1. Write an essay to describe the prominent trends observed in the periodic table. The following trends must be discussed:

- (a). atomic size/atomic radius
- (b). ionization energy
- (c). electron affinity
- (d). electronegativity
- (e). metallic and non-metallic properties

Tulis suatu esei untuk menerangkan tren utama yang dapat diperhatikan dalam jadual berkala. Tren berikut mestilah dibincangkan:

- (a). saiz atom/jejari atom
- (b). tenaga pengionan
- (c). afiniti elektron
- (d). keelektronegatifan
- (e). sifat logam dan bukan logam

(20 marks/markah)

2. (a). Derive the Lewis structure for the following species:

Terbitkan struktur Lewis bagi spesies berikut:

- (i). BH_2^-
- (ii). NI_3
- (iii). ClF_4^+
- (iv). SF_5^-

(8 marks/markah)

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- (b). How many resonance structures can be drawn for CO_3^{2-} ? Show the Lewis structures for each.

Berapa struktur resonans yang boleh dilukis bagi CO_3^{2-} ? Tunjukkan struktur Lewis bagi setiap satu.

(3 marks/markah)

- (c). Discuss briefly the polarisation in the PH_3 and NH_3 molecules. Predict which molecule will have the greater dipole moment.

Bincangkan dengan ringkas kekutuban pada molekul PH_3 dan NH_3 . Ramalkan molekul yang manakah akan mempunyai momen dwikutub yang lebih besar.

(5 marks/markah)

- (d). Predict the polarisation of carbon monoxide and carbon dioxide molecules. Support your answer with illustrations.

Ramalkan kekutuban molekul karbon monoksida dan karbon dioksida. Sokong jawapan anda dengan ilustrasi.

(4 marks/markah)

3. (a). Give a brief description of the following:
- (i). ionic solid and their characteristics.
 - (ii). covalent network solids and their characteristics.

Berikan huraian ringkas perkara yang berikut:

- (i). pepejal ionik dan sifat-sifatnya.
- (ii). pepejal rangkaian kovalen dan sifat-sifatnya.

(4 marks/markah)

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- (b). Use the Valence Shell Electron Pair Repulsion method to derive the structure and state the shape of the following species:

Gunakan kaedah Penolakan Pasangan Elektron Petala Valens untuk menerbitkan struktur dan menyatakan rupa bentuk spesies berikut:

- (i). NO_3^-
- (ii). HCN
- (iii). SOF_4
- (iv). IF_6^+

(8 marks/markah)

- (c). Derive the relative molecular orbital energy level diagram for the F_2 molecules. Give the ground state electron configuration, bond order and magnetic properties of the molecule. Compare the relative stability of this molecules to F_2^+ and F_2^- .

Terbitkan gambar rajah paras tenaga orbital molekul relatif untuk molekul F_2 . Berikan konfigurasi elektron keadaan asas, tertib ikatan dan sifat kemagnetan molekul tersebut. Bandingkan kestabilan relatif molekul ini dengan F_2^+ dan F_2^- .

(8 marks/markah)

4. (a). The blue color of the sky results from the scattering of sunlight by air molecules. The blue light has a frequency of about 7.5×10^{14} Hz.

- (i). Calculate the wavelength, in nm, associated with this radiation.
- (ii). Calculate the energy, in joules, of a single photon associated with this frequency.

Warna langit biru terbentuk daripada cahaya matahari yang diserakkan oleh molekul udara. Cahaya biru mempunyai frekuensi kira-kira 7.5×10^{14} Hz.

- (i). *Kira panjang gelombang, dalam nm, yang berkaitan dengan sinaran ini.*
- (ii). *Kira tenaga, dalam joule, suatu foton tunggal yang berkaitan dengan frekuensi ini.*

(6 marks/markah)

...5/-

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- (b). Give answers to the following questions:
- (i). Give the electron configuration of Mg^{2+} .
 - (ii). Explain which of the following substances would be drawn most strongly by a magnetic field; TiCl_4 or FeCl_2 .
 - (iii). Explain which of the following elements have the highest ionisation energy:
B; Be; N; O
 - (iv). State the Pauli exclusion principle.

Berikan jawapan bagi setiap soalan yang berikut:

- (i). *Berikan konfigurasi elektron bagi Mg^{2+} .*
- (ii). *Jelaskan antara sebatian berikut yang akan ditarik paling kuat oleh medan magnet; TiCl_4 atau FeCl_2 .*
- (iii). *Jelaskan antara unsur yang berikut yang mempunyai tenaga pengionan tertinggi:*
B; Be; N; O
- (iv). *Nyatakan prinsip penyingkiran Pauli.*

(8 marks/markah)

- (c). For each of the following, give the subshell designation, the allowable m_ℓ values, and the number of orbitals.

Bagi setiap yang berikut, berikan rekabentuk sub-petala, nilai m_ℓ yang dibenarkan, dan bilangan orbital.

- (i). $n = 2, \ell = 0$
- (ii). $n = 3, \ell = 2$
- (iii). $n = 5, \ell = 1$

(6 marks/markah)

...6/-

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5. (a). When pentane C_5H_{12} , is burned in excess oxygen, the products of the reaction are $CO_2(g)$ and $H_2O(l)$. Write a balanced equation for this combustion.

Apabila pentana C_5H_{12} , dibakar dengan oksigen berlebihan, produk tindak balas adalah $CO_2(g)$ dan $H_2O(c)$. Tulis persamaan seimbang untuk pembakaran ini.

(3 marks/markah)

- (b). A sample of copper sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$ (molar mass of $CuSO_4 \cdot 5H_2O$ is $249.68 \text{ g mol}^{-1}$) contains 3.782 g of Cu. How many grams of oxygen are in this sample?

Sampel tembaga sulfat pentahidrat, $CuSO_4 \cdot 5H_2O$ (jisim molar $CuSO_4 \cdot 5H_2O$ ialah $249.68 \text{ g mol}^{-1}$) mengandungi 3.782 g Cu. Berapa gram oksigen dalam sampel ini?

(3 marks/markah)

- (c). Analysis of a compound yields the following percent composition by weight: 65.03% Ag, 15.68% Cr, 19.29% O. What is the simplest formula of this compound?

Analisis suatu sebatian menghasilkan komposisi peratus mengikut berat: 65.03% Ag, 15.68% Cr, 19.29% O. Apakah formula yang paling ringkas untuk sebatian ini?

(4 marks/markah)

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- (d). A crystalline solid is known to contain only C, H and O. A sample of this compound weighing 0.4647 g is burned with excess oxygen, which completely converts all the carbon to gaseous CO_2 and all the hydrogen to liquid H_2O . These products are trapped separately and weighed. It is found that the mass of CO_2 produced is 0.8653 g and the mass of H_2O is 0.1767 g.
- (i). What is the empirical formula of the compound?
- (ii). In a separate experiment the molar mass of the compound was determined to be $142.11 \text{ g mol}^{-1}$. What is the molecular formula of the compound?

Suatu pepejal hablur diketahui mengandungi hanya C, H dan O. Sampel sebatian ini yang beratnya 0.4647 g dibakar dengan oksigen berlebihan, yang menukarkan semua karbon ke gas CO_2 dan semua hidrogen ke cecair H_2O dengan lengkap. Hasil ini diperangkap secara berasingan dan ditimbang. Didapati bahawa jisim CO_2 dan H_2O yang dihasilkan adalah 0.8653 g dan 0.1767 g.

- (i). *Apakah formula empirikal sebatian itu?*
- (ii). *Dalam eksperimen yang berasingan jisim molar sebatian telah ditentukan sebagai $142.11 \text{ g mol}^{-1}$. Apakah formula molekul sebatian itu?*

(10 marks/markah)

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6. (a). State *Avogadro's Law*.
Nyatakan Hukum Avogadro.
(3 marks/markah)
- (b). Give **THREE (3)** assumptions of the kinetic theory of gases.
Berikan TIGA (3) andaian teori kinetik gas.
(6 marks/markah)
- (c). Give **TWO (2)** reasons why real gases deviate from ideal gas behaviour.
Berikan DUA (2) sebab mengapa gas sebenar menyimpang dari tingkah laku gas unggul.
(4 marks/markah)
- (d). How many moles of gas are present in a sample containing 1.8×10^{24} atoms of chlorine at STP?
Berapa banyak mol gas yang hadir dalam sampel yang mengandungi 1.8×10^{24} atom klorin pada STP?
(3 marks/markah)
- (e). How many litres of water can be made from 34 grams of oxygen gas and 6.0 grams of hydrogen gas at STP? What is the limiting reactant for this reaction?
Berapa banyak liter air yang dihasilkan dari 34 gram gas oksigen dan 6 gram gas hidrogen pada STP? Apakah reaktan penghad untuk tindak balas ini?
(4 marks/markah)

APPENDIX

List of Relative Atomic Masses and Constants

Senarai Jisim Atom Relatif dan Pemalar

Element	Atomic Number	Atomic Mass	Element	Atomic Number	Atomic Mass
Ag	47	107.8	Hg	80	200.6
Al	13	27.0	I	53	126.9
Ar	18	39.9	K	19	39.1
B	5	10.8	Li	3	6.9
Ba	56	137.3	Mg	12	24.3
Be	4	9.0	Mn	25	54.9
Br	35	80.0	N	7	14.0
C	6	12.0	Na	11	23.0
Ca	20	40.1	Ne	10	20.2
Cl	17	35.5	O	8	16.0
Cr	24	52.0	P	15	31.0
Cu	29	63.5	Pb	82	207.2
F	9	19.0	S	16	32.0
Fe	26	55.8	Sb	51	121.8
Ge	32	72.6	Si	14	28.1
H	1	1.0	Xe	54	131.3
He	2	4.0	Zn	30	65.4

R	=	0.08206 L atm mol ⁻¹ K ⁻¹ or 8.3144 J mol ⁻¹ K ⁻¹
e	=	1.602 × 10 ⁻¹⁹ C
m _e	=	9.11 × 10 ⁻³¹ kg
1 amu	=	1.66 × 10 ⁻²⁷ kg
h	=	6.626 × 10 ⁻³⁴ J s
1 J	=	1 kg m ² s ⁻²
a ₀	=	0.529 Å
c	=	3.00 × 10 ⁸ m s ⁻¹
N _A	=	6.022 × 10 ²³ mol ⁻¹
1 atm	=	760 mm Hg

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