UNIVERSITI SAINS MALAYSIA

Final Examination
2015/2016 Academic Session

May/June 2016

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.

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** 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.

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

1.   (a)   Give a brief description by providing an example for each of the following
             (i)   ionic solid
             (ii)   covalent solid
             (iii)   metallic solid

             Berikan huraian ringkas beserta satu contoh bagi setiap yang berikut;
             (i)   pepejal ionik
             (ii)   pepejal kovalen
             (iii)   pepejal logam

                                                                    (6 marks/*markah*)

      (b)   Draw the Lewis structures for the following molecules and ions
             Lukiskan struktur-struktur Lewis bagi molekul-molekul dan ion-ion yang berikut
             (i) H_2S
             (ii) NO^+
             (iii)   HCOOH
             (iv) CO_3^{2-}

                                                                    (8 marks/*markah*)

      (c)   Write the resonance structures for SO_3 and NO_3^-
             Lukiskan struktur-struktur resonans bagi SO₃ dan NO₃⁻

                                                                    (6 marks/*markah*)

2.   (a)   Assume that the amount of lead in drinking water is 0.025 mg L^{-1}. Express this concentration in molarity, molality, ppm and ppb. Given that the molar mass of lead is 207.2 g mol^{-1} and the density of water is 1.00 g cm^{-1}.
             Andaikan bahawa jumlah plumbum dalam air minuman adalah 0.025 mg L⁻¹. Nyatakan kepekatan ini dalam kemolaran, kemolalan, ppm dan ppb. Diberikan jisim molar plumbum adalah 207.2 g mol⁻¹ dan ketumpatan air adalah 1.00 g cm⁻¹.

                                                                    (4 marks/*markah*)

(b) How many milliliters of concentrated nitric acid, HNO_3 70% (wt/wt) are required to prepare 1 liter of 0.250 M solution? The molar mass and density of HNO_3 are 63.0 g mol^{-1} and 1.36 g cm^{-1} respectively.

Berapa mililiter dari larutan asid nitrik pekat, HNO$_3$ 70 % (wt/wt) yang diperlukan untuk menyediakan 1 liter larutan berkepekatan 0.250 M? Jisim molar dan ketumpatan HNO$_3$ adalah masing-masing 63.0 g mol^{-1} dan 1.36 g cm^{-1}.

(6 marks/*markah*)

(c) How many milliliters of 0.250 M of HNO_3 prepared in Q2 (b) will react with 10 mL of 0.15 M solution of NaOH?

Berapa mililiter dari larutan 0.250 M HNO$_3$ yang disediakan dalam Q2 (b) akan bertindak balas dengan 10 mL larutan NaOH berkepekatan 0.15 M ?

(6 marks/*markah*)

(d) What is the normality of an eighteen-molar solution of sulphuric acid, H_2SO_4?

Apakah kenormalan bagi lapan belas molar larutan asid sulfurik, H$_2$SO$_4$?

(4 marks/*markah*)

3. (a) Discuss briefly why BeH_2 molecule has a zero dipole moment although the Be-H bonds are polar.

Bincangkan dengan ringkas mengapa molekul BeH$_2$ tidak mempunyai momen dwikutub walaupun ikatan Be-H adalah polar.

(4 marks/*markah*)

(b) Derive the relative molecular orbital energy level diagram for the C_2^+ ion. Give the ground state electron configuration, bond order and magnetic properties of the ion. Compare the relative stability of C_2 and C_2^-.

Terbitkan gambar rajah paras tenaga orbital molekul relatif untuk ion C$_2^+$. Berikan konfigurasi elektron pada keadaan asas, tertib ikatan serta sifat kemagnetan ion tersebut. Bandingkan kestabilan relatif C$_2$ dan C$_2^-$.

(8 marks/*markah*)

(c) Derive the structure and state the shape of the following species by using the VSEPR method.

Terbitkan struktur dan nyatakan bentuk spesis yang berikut dengan menggunakan kaedah VSEPR.

    (i) OCl_2

    (ii) ClO_3^+

    (iii) ICl_3

    (iv) NH_2^-

(8 marks/*markah*)

4. (a) Name the following compounds:

Namakan sebatian-sebatian berikut:

    (i) $Ba(OH)_2$

    (ii) H_2SO_4

    (iii) H_2SO_3

    (iv) NH_4NO_3

    (v) $Sn(CO_3)_2$

(5 marks/*markah*)

(b) Write the formula for the following compounds:

    (i)   perchloric acid

    (ii)   chlorous acid

    (iii)   diphosphorus pentoxide

    (iv)   chromium (III) phosphite

    (v)   zinc cyanide

Tuliskan formula bagi sebatian-sebatian berikut:

(i)   asid perklorik

(ii)   asid klorus

(iii)   difosforus pentoksida

(iv)   kromium (III) fosfit

(v)   zink sianida

(5 marks/*markah*)

(c)   0.24 g of sample of compound was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage of the compound by weight.

0.24 g sampel sebatian mengandungi 0.096 g boron dan 0.144 g oksigen. Kira peratusan bagi sebatian tersebut mengikut jisim.

(5 marks/*markah*)

(d)   When 3.0 g of carbon is burnt in 8.0 g of oxygen, 11.0 g of carbon dioxide is produced. What is the mass of carbon dioxide will be formed when 3.0 g of carbon is burnt in 50.0 g of oxygen? Which law of chemical combination will govern your answer?

Apabila 3.0 g karbon dibakar dengan kehadiran 8.0 g oksigen, sebanyak 11.0 g karbon dioksida dihasilkan. Berapakah jisim karbon dioksida yang akan terbentuk apabila 3.0 g karbon dibakar dengan kehadiran 50.0 g oksigen? Apakah undang-undang gabungan kimia yang akan membuktikan jawapan anda ?

(5 marks/*markah*)

5.   (a)   An electron emits a photon that contain 5.05×10^{-19} J of energy. What is the wavelength (in nm) of the corresponding light? What colour is this photon?

Satu elektron mengeluarkan foton yang mengandungi tenaga sebanyak 5.05×10^{-19} J tenaga. Apakah jarak gelombang (dalam nm) cahaya tersebut? Apakah warna bagi foton ini?

(6 marks/*markah*)

(b) Give answers to the following questions:

(i) Write the electron configuration of the element with the atomic number of 26.

(ii) Write the ground state electron configuration of Fe.

(iii) Explain the electron configuration of Chromium, Cr.

(iv) How many possible values are there for angular momentum quantum number (l) and magnetic quantum number (m_1) when the principal quantum number, $n = 4$.

Berikan jawapan bagi setiap soalan berikut:

(i)   Tuliskan konfigurasi elektron bagi unsur dengan nombor atom 26.

(ii)   Tuliskan konfigurasi elektron bagi Fe pada keadaan asas.

(iii)   Terangkan konfigurasi elektron bagi kromium, Cr.

(iv)   Berapakah nilai yang mungkin bagi nombor kuantum momentum angular (l) dan nombor kuantum magnetik (m₁) apabila nombor kuantum prinsipal, n = 4.

(10 marks/*markah*)

(c) Describe TWO (2) important ideas of the Bohr model.
Terangkan DUA (2) idea penting bagi model Bohr.

(4 marks/*markah*)

6. (a) Name and discuss two properties of non-metals that make them unsuitable for use in electrical wiring.
Namakan dan bincangkan dua sifat bagi bukan logam yang tidak sesuai digunakan di dalam pendawaian elektrik.

(4 marks/*markah*)

(b)   Use the list of elements below to answer the following questions.

Na, Ni, N, Mg, Rb, B

(i)   Choose the two elements which would have the most similar chemical properties. Explain.

(ii)   Which of the elements is the most reactive metal?

(iii)   Which of the elements is the most reactive non-metal?

(iv)   Which element has the highest electronegativity? Explain.

Gunakan senarai unsur di bawah bagi menjawab soalan-soalan berikut.

Na, Ni, N, Mg, Rb, B

(i)   Pilih dua unsur yang mempunyai sifat kimia yang paling serupa. Jelaskan.

(ii)   Unsur logam manakah yang paling reaktif?

(iii)   Unsur bukan logam manakah yang paling reaktif?

*(iv)   Unsur manakah yang mempunyai keelektronegatifan yang paling tinggi. Jelaskan.*
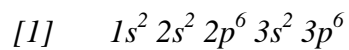
(6 marks/*markah*)

(c)   (i)   Define ionisation energy.

(ii)   Three atoms have the electron configurations shown below:

[1] $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6$

[2] $1s^2\, 2s^2\, 2p^6\, 3s^1$

[3] $1s^2\, 2s^2\, 2p^6\, 3s^2$
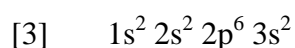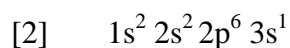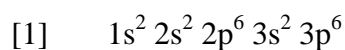
Which of the three atoms has the highest first ionisation energy and which has the highest second ionisation energy. Explain.

(i)   Takrifkan tenaga pengionan.

(ii)   Tiga atom mempunyai konfigurasi elektron seperti berikut:

[1] $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

[2] $1s^2\ 2s^2\ 2p^6\ 3s^1$

[3] $1s^2\ 2s^2\ 2p^6\ 3s^2$
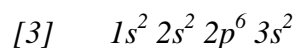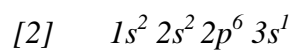
Atom yang manakah mempunyai tenaga pengionan pertama yang paling tinggi dan atom manakah yang mempunyai tenaga pengionan kedua yang paling tinggi. Jelaskan.

(6 marks/*markah*)

(d)   Write a balanced equation for the following reactions:

(i)   Xenon reacts with fluorine (three equations).

(ii)   Fluorine reacts with water.

Tuliskan persamaan seimbang bagi tindak balas berikut:

(i)   Xenon bertindak balas dengan fluorin (tiga persamaan)

(ii)   Fluorin bertindak balas dengan air.

(4 marks/*markah*)

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 C $\times$ 10^{-19} C

m_e = 9.11 $\times$ 10^{-31} kg

1 amu = 1.66 $\times$ 10^{-27} kg

h = 6.626 $\times$ 10^{-34} J s

1 J = 1 kg m^2 s^{-2}

a_o = 0.529 Å

c = 3.00 $\times$ 10^8 m s^{-1}

N_A = 6.022 $\times$ 10^{23} mol^{-1}

1 atm = 760 mm Hg

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