Final Examination
2017/2018 Academic Session

May/June 2018

JIK102 – General Chemistry II
[Kimia Am II]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains **TEN** 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 **SEPULUH** 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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1. (a). What is the difference between:

(i). heat and temperature

(ii). work and energy

(iii). kinetic energy and potential energy

(iv). heat capacity and specific heat

(v). internal energy change and enthalpy change

Apakah berbezaan antara:

(i). haba dan suhu

(ii). kerja dan tenaga

(iii). tenaga kinetik dan tenaga keupayaan

(iv). kapasiti haba dan haba spesifik

(v). perubahan tenaga dalaman dan perubahan entalpi

[10 marks/*markah*]

(b). When 1.50 g of magnesium metal is allowed to react with 200 mL of 6.00 M aqueous HCl, the temperature rises from 25.0 ^{o}C to 42.9 ^{o}C. Calculate ΔH (in kilojoules) for the reaction, assuming that the heat capacity of the calorimeter is 776 J/^{o}C, that the specific heat of the final solution is the same as that of water (4.18 J/g.^{o}C), and the density of the solution is 1.00 g/mL.

Apabila 1.50 g logam magnesium bertindak balas dengan 200 mL, 6.00 M HCl akueus, suhu meningkat dari 25.0 ^{o}C kepada 42.9 ^{o}C. Kirakan ΔH (dalam kilojoule) untuk tindak balas tersebut, andaikan kapasiti haba kalorimeter tersebut ialah 776 J/^{o}C, haba spesifik untuk larutan akhir adalah sama dengan air (4.18 J/g.^{o}C) dan ketumpatan larutan ialah 1.00 g/mL.

[10 marks/*markah*]

2. (a). What are the basic assumptions of the kinetic molecular theory?
Apakah andaian-andaian asas bagi teori molekul kinetik?

[5 marks/*markah*]

(b). Chlorine gas was prepared by the oxidation of NaCl with MnO_2 and below is the equation:
Gas klorin telah disediakan dengan mengoksidakan NaCl dengan MnO_2 dan di bawah merupakan persamaannya:

$$2\ NaCl\ (s) + 2\ H_2SO_4\ (l) + MnO_2\ (s) \longrightarrow Na_2SO_4\ (s) + MnSO_4\ (s) + 2\ H_2O\ (g) + Cl_2\ (g)$$

Assume that the gas produced is saturated with water vapor at a partial pressure of 28.7 mm Hg and that it has a volume of 0.597 L at 27 ^oC and 755 mm Hg pressure.

(i). What is the mole fraction of Cl_2 in the gas?

(ii). How many grams of NaCl were used in the experiment? (Assuming complete reaction).

Andaikan bahawa gas yang terhasil adalah tepu dengan wap air pada tekanan separa 28.7 mm Hg dan mempunyai isipadu 0.597 L pada suhu 27 ^oC dan tekanan 755 mm Hg.

(i). Apakah pecahan mol Cl_2 dalam gas?

(ii). Berapa gram NaCl yang digunakan di dalam eksperimen ini? (Andaikan tindak balas lengkap).

[10 marks/*markah*]

(c). The surface temperature of Venus is about 1050 K and the pressure is about 75 earth atmospheres. Assuming that these conditions represent a Venusian "STP", what is the standard molar volume (in litres) of a gas on Venus?

Suhu permukaan Kejora adalah 1050 K dan tekanannya adalah 75 atmosfera bumi. Andaikan keadaan ini mewakili "STP" planet Kejora, apakah isipadu molar piawai (dalam liter) gas di Kejora?

[5 marks/*markah*]

3. (a). Bromine has triple point temperature (T_t) = -7.3 ^oC, triple point pressure (P_t) = 44 mm Hg, critical temperature (T_c) = 315 ^oC and critical pressure (P_c) = 102 atm. The density of the liquid is 3.1 g cm^{-3}, and the density of the solid is 3.4 g cm^{-3}. Sketch a phase diagram for bromine and label all points of interest.

Bromin mempunyai suhu titik tigaan (T_t) = -7.3 ^oC, tekanan titik tigaan (P_t) = 44 mm Hg, suhu kritikal (T_c) = 315 ^oC dan tekanan kritikal (P_c) = 102 atm. Ketumpatan cecair ialah 3.1 g cm^{-3}, dan ketumpatan pepejal ialah 3.4 g cm^{-3}. Lakarkan gambar rajah fasa untuk bromin dan labelkan semua titik yang penting.

[10 marks/*markah*]

(b). Refer to the bromine phase diagram you sketched in 3. (a)., determine what phases are present under the following conditions:

Rujuk kepada gambar rajah fasa bromin yang telah anda lakarkan di 3. (a), tentukan fasa yang wujud di bawah keadaan berikut:

(i). T = -10 ^oC, P = 0.0075 atm

(ii). T = 25 ^oC, P = 16 atm

[4 marks/*markah*]

(c). Iodine has melting point, 113.5 °C and boiling point, 184.4 °C. State the phase change under the following conditions at 1.0 atm pressure.

(i). The temperature of a solid sample is maintain at 113.5 °C while heat is added.

(ii). The temperature of a sample is decreased from 452 K to 389 K.

Iodin mempunyai takat lebur, 113.5 °C dan takat didih, 184.4 °C. Nyatakan perubahan fasa di bawah keadaan berikut pada tekanan 1.0 atm.

(i). Suhu sampel pepejal dikekalkan pada 113.5 °C sementara haba ditambahkan.

(ii). Suhu sampel dikurangkan dari 452 K kepada 389 K.

[6 marks/*markah*]

4. (a). Calculate the equilibrium concentrations of H_2, I_2 and HI at 700 K if the initial concentrations are $[H_2]$ = 0.100 M and $[I_2]$ = 0.200 M. The equilibrium constant (K_c) for the reaction $H_2\,(g) + I_2\,(g) \rightleftharpoons 2\,HI\,(g)$ is 57.0 at 700 K.

Kirakan kepekatan keseimbangan bagi H_2, I_2 dan HI pada suhu 700 K sekiranya kepekatan awal ialah $[H_2]$ = 0.100 M dan $[I_2]$ = 0.200 M. Pemalar keseimbangan (K_c) untuk tindak balas $H_2\,(g) + I_2\,(g) \rightleftharpoons 2\,HI\,(g)$ ialah 57.0 pada 700 K.

[10 marks/*markah*]

(b). At 500 K, K_c is equal to 0.575 for the reaction $PCl_5\,(g) \rightleftharpoons PCl_3\,(g) + Cl_2\,(g)$. What is the value of K_p at the same temperature?

Pada 500 K, K_c adalah bersamaan dengan 0.575 untuk tindak balas $PCl_5\,(g) \rightleftharpoons PCl_3\,(g) + Cl_2\,(g)$. Apakah nilai K_p pada suhu yang sama?

[4 marks/*markah*]

(c). Consider the following equilibrium:
Pertimbangkan persamaan berikut:

$$Ag^+(aq) + Cl^-(aq) \rightleftharpoons AgCl\ (s)$$

Use the Le Chatelier's principle to predict how the amount of solid silver chloride will change when the equilibrium is perturbed by:

(i). Adding NaCl

(ii). Adding $AgNO_3$

(iii). Adding NH_3, which reacts with Ag^+ to form the complex ion, $Ag(NH_3)_2^+$

Gunakan prinsip Le Chatelier untuk menjangkakan bagaimana jumlah pepejal argentum klorida akan berubah apabila keseimbangan diganggu oleh:

(i). Penambahan NaCl

(ii). Penambahan $AgNO_3$

(iii). Penambahan NH_3, yang bertindak balas dengan Ag^+ untuk membentuk ion kompleks, $Ag(NH_3)_2^+$

[6 marks/*markah*]

5. (a). Draw all possible isomers of a compound with molecular formula C_5H_{10} that comprise one π bond.

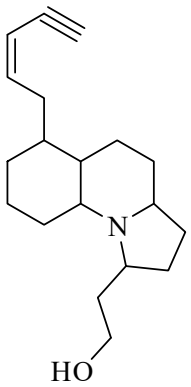
Lukiskan semua isomer yang mungkin bagi suatu sebatian berformula molekul C_5H_{10} yang mengandungi satu ikatan π.

[10 marks/*markah*]

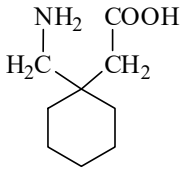
(b). Identify the functional groups in each of the following molecules.

Kenalpasti kumpulan-kumpulan berfungsi dalam setiap molekul-molekul berikut.

(i). Gephyrotoxin



(ii). Gebapentin



[6 marks/*markah*]

(c). Predict the products of the following acid-base reactions.

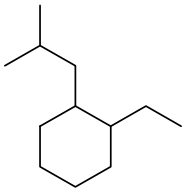
Ramalkan hasil tindak balas-tindak balas asid-bes berikut.

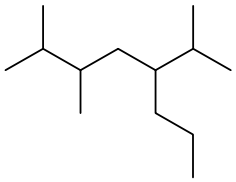
(i). $CH_3CH_2OH + {}^{-}NH_2 \rightleftharpoons$

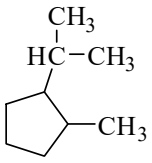
(ii). $CH_3\overset{\overset{O}{\|}}{C}-OH + {}^{-}OH \rightleftharpoons$

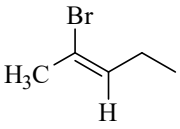
[4 marks/*markah*]

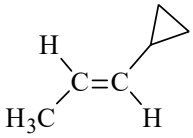
6. (a). Name the following compounds according to the IUPAC system.
Namakan sebatian-sebatian berikut mengikut sistem IUPAC.

(i). 

(ii). 

(iii). 

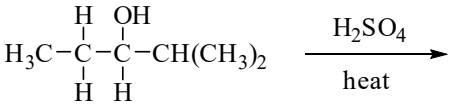
(iv). 

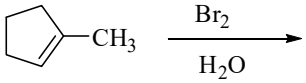
(v). 

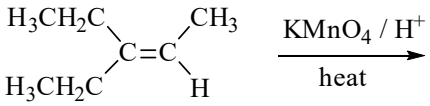
[10 marks/*markah*]

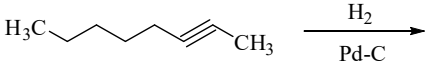
(b). Draw the structure of the major product of the following reactions.
Lukiskan struktur hasil utama bagi tindak balas-tindak balas berikut.

(i). $H_2C{=}CHCH_2CH_2CH_3 \xrightarrow{HCl}$

(ii). 

(iii). 

(iv). 

(v). 

[10 marks/*markah*]

APPENDIX

FUNDAMENTAL CONSTANTS

Atomic mass unit	1 amu	=	$1.66053873 \times 10^{-24}$ g
	1 g	=	$6.02214199 \times 10^{23}$ amu
Avogadro's number	N_A	=	$6.02214199 \times 10^{23}$ mol^{-1}
Boltzmann's constant	k_b	=	$1.3806503 \times 10^{-23}$ J K^{-1}
Electron charge	e	=	$1.602176462 \times 10^{-19}$ C
Faraday's constant	F	=	9.64853415×10^{4} C mol^{-1}
Gas constant	R	=	0.082058205 L atm K^{-1} mol^{-1}
		=	8.31447 J K^{-1} mol^{-1}
		=	8.314 Pa m^3 K^{-1} mol^{-1}
		=	8.314×10^{-2} L bar K^{-1} mol^{-1}
Mass of electron	m_e	=	5.485799×10^{-4} amu
		=	$9.10938188 \times 10^{-28}$ g
Mass of neutron	m_n	=	1.0086649 amu
		=	$1.67492716 \times 10^{-24}$ g
Mass of proton	m_p	=	1.0072765 amu
		=	$1.67262158 \times 10^{-24}$ g
Pi	π	=	3.1415927
Planck's constant	h	=	$6.62606876 \times 10^{-34}$ J s
Rydberg Constant	R_H	=	3.28984×10^{15} s^{-1} (Hz)
Specific heat capacity	C_p	=	4.19 J g^{-1} K^{-1}
Speed of light	c	=	2.99792458×10^{8} m s^{-1}

CONVERSIONS

Energy	1 J	=	1 kg m^2 s^{-2}
	1 J	=	0.2390 cal
	1 cal	=	4.184 J
	1 eV	=	1.602×10^{-19} J

Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 83.798
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.294
55 Cs Cesium 132.905	56 Ba Barium 137.328	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.085	79 Au Gold 196.967	80 Hg Mercury 200.592	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [278]	110 Ds Darmstadtium [281]	111 Rg Roentgenium [280]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [289]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]

Lanthanide Series	57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.243	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967
Actinide Series	89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]

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