PART A / *BAHAGIAN A*

(1). (a). Briefly explain the TWO types of the state variable. Give ONE example for each type of state variable.

Terangkan secara ringkas DUA jenis pembolehubah keadaan. Berikan SATU contoh untuk setiap pembolehubah keadaan tersebut.

(4 marks/*markah*)

(b). Briefly explain the difference between heat and work

Terangkan secara ringkas perbezaan antara haba dan kerja

(4 marks/*markah*)

(c). Two moles of an ideal gas are compressed isothermally and reversibly at 298 K from 1 atm to 200 atm. Calculate q, w, ΔU , and ΔH .

Dua mol gas ideal dimampatkan secara isoterma dan berbalik pada 298 K daripada 1 atm hingga 200 atm. Hitung q, w, ΔU , dan ΔH .

(6 marks/*markah*)

(d). Calculate the enthalpy for this reaction:
Kirakan entalpi untuk tindakbalas berikut:

$$2CO_2(g) + H_2O(g) \rightarrow C_2H_2(g) + 5/2O_2(g)$$

…3/-

Given the following thermochemical equations:
Diberikan persamaan termokimia seperti berikut:

$C_2H_2(g) + 2H_2(g) \rightarrow C_2H_6(g)$ $\Delta H° = -94.5$ kJ

$H_2O(g) \rightarrow H_2(g) + 1/2O_2(g)$ $\Delta H° = 71.2$ kJ

$C_2H_6(g) + 7/2O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$ $\Delta H° = -283$ kJ

(6 marks/*markah*)

(2). (a). Explain why the polarity of water is useful in explaining solvation process and why the hydration shell of sodium larger than potassium?
Terangkan mengapa kekutuban air berguna dalam menerangkan proses pelarutan dan mengapa petala hidrasi natrium lebih besar daripada kalium

(6 marks/*markah)*

(b). If 10.0A were passed through a lead storage cell for 1.50h during charging process, determine how much $PbSO_4$ would decompose? Given molecular weight of $PbSO_4$ is 303.25g and number of moles of electron is 2.

Jika 10.0A telah disalurkan melalui sel storan plumbum selama 1.50h semasa proses mengecasan, tentukan berapa banyak $PbSO_4$ akan mengurai?Di beri berat molekul $PbSO_4$ ialah 303.25g dan bilangan mol elektron ialah 2.

(6 marks/*markah)*

…4/-

The chemical reaction for the Daniell cell is

$$Zn(s)+Cu^{2+}(aq)\rightarrow Zn^{2+}(aq)+Cu(s)$$

Tindak balas kimia untuk sel Daniell adalah

$$Zn(s)+Cu^{2+}(ak)\rightarrow Zn^{2+}(ak)+Cu(s)$$

Given $\Delta G^o/(kJ/mol^{-1})=0$ for Zn(s) and Cu(s), -147.06 for Zn^{2+} (aq), and 65.49 for Cu^{2+}(aq).

Diberi $\Delta G^o/(kJ/mol^{-1})=0$ untuk Zn(s) and Cu(s), -147.06 untuk Zn^{2+} (ak), dan 65.49 for Cu^{2+}(ak)

(i). Calculate the cell potential and discuss the spontaneity of the reaction under standard conditions.

Kirakan potensi sel dan bincangkan tindak balas spontan di bawah keadaan piawai.

(4 marks/*markah)*

(ii). If the temperature coefficient for the chemical reaction is $3.38x10^{-4}$ volt/^{o}C, estimate the change in entropy and enthalpy for the reaction at standard condition.

Jika pekali suhu untuk tindak balas kimia adalah $3.38x10^{-4}$ volt/^{o}C, anggarkan perubahan entropi dan entalpi bagi tindak balas pada keadaan standard.

(4 marks/*markah)*

(3). (a). Identify the half-life unit of k, then fill in the blank

Kenalpastikan unit bagi separa hayat k dan Isikan tempat kosong

(6 marks/*markah)*

Order of Reaction **Tertib Tindakbalas, n**	**Half-Life**	**Unit of *k***
0	**$t_{½}$ =**	
1	**$t_{½}$ =**	
2	**$t_{½}$ =**	

(b). The first order reaction 2A→2B + C is 35% complete after 325s

Tindakbalas tertib pertama 2A→2B + C 35% lengkap selepas 325s

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(i). Find the k_A for reactant A, and *k* for the overall reaction.

Kirakan k_A untuk bahan tindakbalas A, dan k untuk tindakbalas keseluruhan

(6 marks/*markah)*

(ii). How long will it take for the reaction to be 70% and 90% complete respectively.

Masa diambil untuk melengkapi 70% dan 90% tindakbalas masing-masing.

(8 marks/*markah)*

…6/-

PART B / *BAHAGIAN B*

(4). (a). The First Law of Thermodynamics states that the total energy of the system and the surroundings are conserved. Briefly discuss the limitations of the First Law of Thermodynamics which need to be justified by the Second Law of Thermodynamics.

Undang-undang Pertama Termodinamik menyatakan bahawa jumlah tenaga ystem dan persekitarannya dipelihara. Apakah batasan Hukum Termodinamik Pertama yang perlu dijelaskan oleh Undang-undang Kedua Termodinamik.

(6 marks/*markah*)

(b). Tin (Sn) transforms from grey to white tin at 286 K. The heat of transformation (ΔH_t) has been measured as 2.1 kJ/mol.

Timah (Sn) bertukar dari kelabu ke timah putih pada 286 K. Haba transformasi (ΔH_t) telah diukur iaitu 2.1 kJ / mol.

$$\text{Sn (grey, 286 K)} \rightarrow \text{Sn (white, 286 K)}$$

(i). Calculate the entropy change of the system (Tin).
Kirakan perubahan entropi dalam ystem tersebut (Timah).

(2 marks/*markah*)

(ii). Calculate the entropy change of the surroundings.
Kirakan perubahan entropi persekitaran.

(2 marks/*markah*)

(iii). Calculate the total entropy change of the universe (system + surroundings).

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Kirakan perubahan entropi keseluruhan semesta (sistem + persekitaran)

(2 marks/*markah*)

(c). Zinc melts at 420 ^{o}C and its standard entropy at 25 ^{o}C is 41.63 J/K/mol. Calculate the standard entropy of zinc at 750 ^{o}C.

Zink cair pada 420 ^{o}C dan entropi piawainya pada 25 ^{o}C ialah 41.63 J/K/mol. Kirakan entropi piawai zink pada 750 ^{o}C.

$$C_{p,Zn(s)} = 22.38 + 10.04\ x\ 10^{-3} TJK^{-1}mol^{-1}$$

$$C_{p,Zn(l)} = 31.38\ JK^{-1}mol^{-1}$$

(8 marks/*markah*)

(5). (a). Briefly explain the importance of Gibbs-Helmholtz equation.

Terangkan secara ringkas kepentingan persamaan Gibbs-Helmholtz.

(6 marks/*markah*)

(b). Calculate the standard entropy change of the following reaction at 727 ^{o}C.

Kira perubahan entropi piawai bagi tindak balas berikut pada suhu 727 ^{o}C.

$$2Al + {}^{3}/_{2}\ O_2 = Al_2O_3$$

ΔS^{O}_{298} = - 313.26 J/K/mol

…8/-

Given / *Diberi*:

Melting point of aluminium / *Takat lebut aluminium* = 659 ^{o}C

Heat of fusion of aluminium at the melting point / *Haba pelakuran aluminium pada takat lebur* = 10,460 J/mol

C_{p,Al_2O_3} = 105.19 J/K/mol

C_{p,O_2} = 31.67 J/K/mol

$C_{p,Al(solid)}$ = 28.28 J/K/mol

$C_{p,Al(liquid)}$ = 29.29 J/K/mol

(8 marks/*markah*)

(c). Calculate the equilibrium constant for the following reaction at 750 ^{o}C.

Kira pemalar keseimbangan untuk tindak balas berikut pada suhu 750 ^{o}C.

$$NiO + H_2 = Ni + H_2O$$

Given / *Diberi*:

$$Ni + \frac{1}{2}O_2 = NiO \; ; \quad \Delta G^O = -244{,}555 + 98.53\,T\,J$$

$$H_2 + \frac{1}{2}O_2 = H_2O \; ; \quad \Delta G^O = -246{,}438 + 54.81\,T\,J$$

(6 marks/*markah*)

(6). (a). The resistance of a conductivity cell was 702 Ω when filled with 0.01M KCl (κ=1.4087 x 10^{-3} Scm^{-1}). Determine the cell constant of this cell.

Rintangan bagi satu sel kekonduksian yang berisi 0.01M KCl (κ=1.4087 x 10^{-3} Scm^{-1}) adalah 702 Ω. Kirakan sel konstant bagi sel ini.

(5 marks/*markah)*

(b). In the same cell, estimate the molar conductivity of the solution if it is calibrated using a 0.01 M CH_3COOH solution and had a resistance of 6920 Ω.

Dalam sel yang sama, kirakan kekonduksian molar larutan jika ia dikalibrasi dengan menggunakan larutan 0.01 M CH_3COOH yang mempunyai rintangan sebanyak 6920 Ω .

(5 marks/*markah)*

(c). During the charging of the lead storage cell, the following reaction takes place:

$$2PbSO_4(s) + 2H_2O(l) \rightarrow Pb(s) + PbO_2(s) + 2H_2SO_4(aq)$$

Given n=2, ΔG^o_{298}= -813.14 for $PbSO_4$ (s), -237.129 for H_2O(l), 0 for Pb(s), -217.33 for PbO_2(s), and -744.53 for H_2SO_4(aq).

Semasa mengecas sel storan plumbum, tindak balas berikut berlaku:

$$2PbSO_4(s) + 2H_2O(l) \rightarrow Pb(s) + PbO_2(s) + 2H_2SO_4(ak)$$

Diberi n=2, ΔG^o_{298}= -813.14 for $PbSO_4$ (s), -237.129 for H_2O(l), 0 for Pb(s), -217.33 for PbO_2(s), dan -744.53 for H_2SO_4(ak).

…10/-

(i). Calculate the change of Gibbs free energy and E^o for this reaction.

Hitung perubahan tenaga bebas Gibbs dan E^o untuk tindak balas ini.

(5 marks/*markah)*

(ii). Predict is this reaction spontaneous under standard conditions, or is an outside source of energy required for it to proceed?

Ramalkan samaada tindakbalas ini adalah spontan di bawah keadaan standard, atau sumber tenaga luar perlu untuk diteruskan?

(5 marks/*markah)*

(7). (a). The reaction $2DI \rightarrow D_2 + I_2$ has the k = 1.2 x 10^{-3} $dm^3mol^{-1}s^{-1}$ at 660K, and E_a = 177 kJ/mol. Calculate the k at 720K for this reaction.

Sesuatu tindakbalas $2DI \rightarrow D_2 + I_2$ mempunyai $k = 1.2 \times 10^{-3}$ $dm^3mol^{-1}s^{-1}$ pada 660K, dan E_a = 177 kJ/mol. Hitungkan k pada 720K untuk tindakbalas ini .

(10 marks/markah)

(b). The rate constant for the decomposition of N_2O_5 at 45°C is 5.0 x 10^{-4} s^{-1}. If activation energy of this reaction is 102 $kJmol^{-1}$ at 45°C, calculate the collision frequency of the reaction at 45°C.

Pemalar kadar untuk penyahkomposisi N_2O_5 pada 45^oC adalah 5.0 x 10^{-4} s^{-1}. Jika tenaga pengaktifan tindakbalas adalah 102 kJmol^{-1} pada 45^oC, kirakan kekerapan pelanggaran tindakbalas pada 45^oC.

(10 marks/*markah)*

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