
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2006/2007
*Peperiksaan Semester Kedua
Sidang Akademik 2006/2007*

April 2007

EBB 160/3 – Engineering Physical Chemistry of Materials *EBB 160/3 – Kimia Fizikal Bahan Kejuruteraan*

Time: 3 hours
Masa: 3 jam

Please ensure that this paper consists of NINE printed pages before you proceed with the examination.

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

This paper contains SEVEN questions.

Kertas soalan ini mengandungi TUJUH soalan.

Answer FIVE questions. If a candidate answers more than five questions only the first five questions answered in the answer script would be examined.

Jawab LIMA soalan. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.

Answer to each and every question must start on a new page.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

All questions must be answered in English.

Jawab semua soalan dalam Bahasa Inggeris.

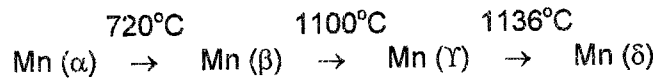
- [b] Discuss the validity of the following statements:
- (i) Unless otherwise specified, the standard state of an element i customarily chosen to be at a pressure of 1 atm and in the most stable structure of that element at the temperature at which it is investigated.
 - (ii) However it is possible to choose as a standard state one that does not correspond to the most stable form of the species under consideration.
 - (iii) The standard state may also correspond to a virtual state, one that cannot be physically obtained but that can be theoretically defined and for which properties of interest can be calculated.

Bincangkan kesahihan pernyataan-pernyataan dibawah:

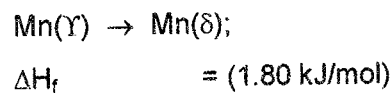
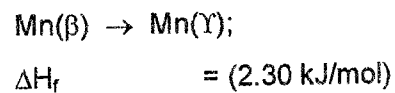
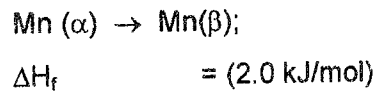
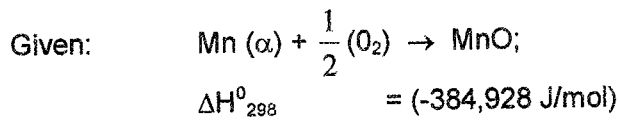
- (i) *Melainkan jika dinyatakan, keadaan piawai bagi sesuatu elemen i lazimnya dipilih pada satu tekanan 1 atm dan pada struktur yang paling stabil bagi elemen tersebut pada suhu yang mana ia dikaji atau diselidiki.*
- (ii) *Bagaimanapun adalah mungkin untuk memilih keadaan piawai bagi sesuatu spesis yang tidak berada pada bentuk yang paling stabil pada keadaan yang dipertimbangkan*
- (iii) *Keadaan piawai juga boleh merujuk kepada keadaan maya, sesuatu yang tidak boleh dicapai secara fizikal tetapi boleh didefinisikan secara teori dan sifat-sifat tersebut boleh dikira.*

(40 markah)

2. The transformation in manganese can be represented as:



Calculate the heat of reaction when Mn (δ) is oxidized by pure oxygen to form MnO at 1200°C (1473 K).



$$C_{P, \text{Mn}(\alpha)} = (21.59 + 15.94 \times 10^{-3} T \text{ J/K/mol})$$

$$C_{P, \text{Mn}(\beta)} = (34.85 + 2.76 \times 10^{-3} T \text{ J/K/mol})$$

$$C_{P, \text{Mn}(\gamma)} = (44.77 \text{ J/K/mol})$$

$$C_{P, \text{Mn}(\delta)} = (47.28 \text{ J/K/mol})$$

$$C_{P, \text{MnO}} = (46.44 + 8.12 \times 10^{-3} T - 3.68 \times 10^5 T^{-2} \text{ J/K/mol})$$

$$C_{P, \text{O}_2} = (29.96 + 4.184 \times 10^{-3} T - 1.67 \times 10^5 T^{-2} \text{ J/K/mol})$$

3. Calculate the entropy change of the system and the surrounding for the isothermal freezing of one mole of supercooled liquid copper at 900°C ($1,173\text{ K}$) when the surroundings are also at the same temperature. Assume that C_p for liquid copper also holds good for supercooled liquid copper.

Given: Melting point of copper = $1,083^{\circ}\text{C}$ ($1,356\text{ K}$)
Heat of fusion of copper at m.p. = ($12,970\text{ J/mol}$)

$$C_{p,\langle\text{Cu}\rangle} = (22.64 + 6.28 \times 10^{-3} T \text{ J/K/mol})$$

$$C_p\{\text{Cu}\} = (31.38 \text{ J/K/mol})$$

Kirakan perubahan entropi bagi sistem dan persekitaran bagi pembekuan 1 mol cecair Kuprum terdingin lampau pada suhu 900 C apabila persekitaran berada pada suhu yang sama. Andaikan C_p bagi cecair kuprum juga boleh diterimapakai untuk cecair kuprum terdingin lampau.

Diberi: Takat lebur bagi kuprum = $1,083^{\circ}\text{C}$ ($1,356\text{ K}$)
Haba lakuran bagi kuprum pada takat lebur = ($12,970\text{ J/mol}$)

$$C_{p,\langle\text{Cu}\rangle} = (22.64 + 6.28 \times 10^{-3} T \text{ J/K/mol})$$

$$C_p\{\text{Cu}\} = (31.38 \text{ J/K/mol})$$

(100 markah)

4. The densities of liquid and solid bismuth are 10.0 g/c.c. and 9.673 g/c.c. respectively at the normal melting point 270°C (543 K). The heat of fusion is 2.633 kcal/mole.
Calculate the melting point of bismuth under a pressure of 100 atm. Atomic weight of bismuth is 209. 1 cal = 41.293 c.c. : atm

Ketumpatan bagi cecair dan pepejal bismut adalah 10.0 g/c.c. dan 9.673 g/c.c. pada takat lebur biasa 270°C (543 K). Haba pelakuran adalah 2.633 kcal/mole. Tentukan takat lebur bagi bismut dibawah tekanan 100 atm. Berat atom bismut ialah 209.

(100 markah)

5. The dissociation of CO₂ is given by:



Find the oxygen pressure for a mixture of 75% CO₂ 25% CO (pressure 1 atm) at 1000°K and at 1500°K. Will the mixture be oxidizing or reducing for (a) Fe₂O₃ at 1500°K, which has oxygen pressure of about 10⁻² atm? (b) For FeO at 1500°K, which has oxygen pressure 10⁻¹² atm?

Penguraian CO₂ diberikan sebagai:



Cari tekanan oksigen bagi campuran 75% CO₂ 25%CO (tekanan 1 atm) pada 1000 K dan pada 1500 K. Adakah campuran tersebut pengoksidaan atau penurunan bagi (a) Fe₂O₃ pada 1500 K, (b) FeO dengan tekanan oksigen sebanyak 10⁻¹² atm?

(100 markah)

6. The concentration of sulphur in pig iron after desulphurization with a basic slag at 1470°C (1743 K) at various intervals of time is as follows:

Time, min	:	0	9	20	40	64
(Time, s	:	0	540	1200	2400	3840)
Conc. Of sulphur,						
g/cm ² of interface	:	8.71	5.74	3.02	1.00	0.275

Show that the desulphurization is a first-order reaction.

Kepekatan sulfur dalam keluli selepas proses penyahsulfur dengan jermang bebas pada 1470°C (1743 K) pada pelbagai sela masa adalah seperti berikut:

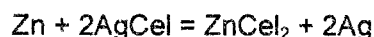
<i>Masa, min</i>	:	0	9	20	40	64
<i>(Masa, s</i>	:	0	540	1200	2400	3840)

<i>Kepekatan sulfur</i>						
<i>g/cm² of interface</i>	:	8.71	5.74	3.02	1.00	0.275

Tunjukkan bahawa proses penyahsulfur merupakan tindakbalas tertib pertama.

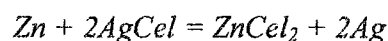
(100 markah)

7. [a] The D.g.e. of a cell having the following reaction:



at atmospheric pressure is 1.005 V at 25°C (298 K) and 1.015 V at 0°C (273 K). Assuming the temperature coefficient of e.m.f. to be constant, calculate the change in enthalpy for the reaction at 25°C (298 K).

D.g.e. bagi satu sel mempunyai tindakbalas berikut:



pada tekanan atmosfera ialah 1.005 V pada 25 C (298 K) dan 1.015 V pada 0°C (273 K). Andaikan pekali suhu bagi e.m.f adalah malar. Hitungkan perubahan entalpi bagi tindakbalas tersebut pada suhu 25 C.

(70 markah)

- [b] Calculate the potential, at 25°C of a cell consisting of a an SCE attached to the negative terminal of the voltmeter and a silver wire electrode attached to the positive terminal. The silver wire electrode is dipping in a solution $1.29 \times 10^{-3} \text{ M Ag}^+$. Standard potential for $\text{Ag}^+ + e = \text{Ag}$ is 0.799V on hydrogen scale. SCE has potential 0.244V on hydrogen scale.

Hitungkan upaya pada suhu 25°C bagi sel yang mengandungi SCE yang disambungkan kepada terminal negatif pada meter voltan dan elektrod wayar Ag disambungkan kepada terminal positif. Elektrod wayar Ag direndam dalam larutan $1.29 \times 10^{-3} \text{ M Ag}^+$. Keupayaan piawai bagi $\text{Ag}^+ + e = \text{Ag}$ is 0.799V pada skala hidrogen. SCE mempunyai keupayaan 0.244V dalam skala hidrogen.

(30 markah)