THE OPEN UNIVERSITY OF SRI LANKA

B.Sc Degree Programme — Level 4

Assignment III (Test) — 2010/2011

CMU 2220 — Concepts in Chemistry

MCQ Answer Sheet: Mark a cross (×) over the box that corresponds to the most suitable answer.

Reg. No.

FOR EXAMINER'S USE ONLY		
Answers	No.	Marks
Correct		
Wrong		—
Unmarked		0.0
Total		

1	a	b	c	d	e	2	a	b	c	d	e	3	a	b	c	d	e	4	a	b	c	d	e
5	a	b	c	d	e	6	a	b	c	d	e	7	a	b	c	d	e	8	a	b	c	d	e
9	a	b	c	d	e	10	a	b	c	d	e	11	a	b	c	d	e	12	a	b	c	d	e
13	a	b	c	d	e	14	a	b	c	d	e	15	a	b	c	d	e	16	a	b	c	d	e
17	a	b	c	d	e	18	a	b	c	d	e	19	a	b	c	d	e	20	a	b	c	d	e
21	a	b	c	d	e	22	a	b	c	d	e	23	a	b	c	d	e	24	a	b	c	d	e
25	a	b	c	d	e																		

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CMU 2220 — Concepts in Chemistry

1 hour

4th April 2011 (Monday)   4.00 p.m. — 5.00 p.m.

⊠ Answer all 25 questions (25 x 4 = 100 marks)

⊠ Choose the most correct answer to each of the questions and mark this answer with an "X" on the answer script in the appropriate box.

⊠ Use a **PEN** (not a PENCIL) in answering.

⊠ Any answer with more than **one** "X" marked will be considered as an *incorrect* answer.

⊠ Marks will be deducted for incorrect answers (0.6 per wrong answer).

⊠ The use of a non-programmable electronic calculator is permitted.

⊠ Cellular phones are **not** allowed.

⊠ Please write your mailing address on the back of the MCQ answer sheet.

Gas constant (R)	=	$8.314 \ JK^{-1}mol^{-1}$
Avogadro constant (N_A)	=	$6.023 \times 10^{23} \ mol^{-1}$
Faraday constant (F)	=	$96,500 \ Cmol^{-1}$
Planck constant (h)	=	$6.63 \times 10^{-34} \ Js$
Velocity of light (c)	=	$3.0 \times 10^8 \ ms^{-1}$
Protonic charge (e)	=	$1.602 \times 10^{-19} \ C$
Standard atmospheric pressure	=	$10^5 \ Pa \left(Nm^{-2} \right)$
$Log_e (X)$	=	$2.303 \ Log_{10} (X)$

1. Which of the following descriptions will most adequately describe the process of condensation of water vapour to liquid water at its standard boiling point?
   (a) reversible process
   (b) isobaric process
   (c) isothermal process
   (d) univariant phase transformation
   (e) isobaric and isothermal process

2. The SI unit for entropy of a thermodynamic system is

   (a) $J K$ (b) $J K^{-1}$ (c) $J K^{-1} mol^{-1}$

   (d) $J mol^{-1}$ (e) $K mol^{-1}$

3. What best describes the process where the equation $\Delta S = q_{rev} / T$ is applicable?
   (a) reversible process
   (b) isothermal process
   (c) isobaric process
   (d) reversible isothermal process
   (e) reversible isobaric process

4. For a spontaneous process which one of the following expressions will NOT apply?

   (a) $dS_{system} > Dq_{rev} / T$ (b) $dS_{isolated} > Dq_{rev} / T$ (c) $dA_{P,T} < 0$

   (d) $dG_{P,T} < 0$ (e) $dU = Dq + Dw$

5. The equation $\Delta S = nC_{p,m} \ln\left(\dfrac{T_2}{T_1}\right) + nR \ln\left(\dfrac{P_1}{P_2}\right)$ can be applied for a system with change

   of state from state A (P_1, T_1) to state B (P_2, T_2) of

   (a) an ideal gas only at constant pressure
   (b) an ideal gas only at constant temperature
   (c) any gaseous system under all conditions
   (d) any homogeneous system at constant pressure
   (e) any homogeneous system under all conditions

6. Which one of the following is referred to as a fundamental thermodynamic equation
   (a) $H = U + PV$ (b) $G = H + TS$ (c) $PV = nRT$
   (d) $dA = -PdV - SdT$ (e) $G - A = H - U$

7. The variation of the standard enthalpy change $\left(\Delta H^0\right)$ of a reaction with temperature at constant pressure is given by the
   (a) Clausius Clapeyron equation
   (b) Kirchoff's equation
   (c) Gibbs Helmholtz equation
   (d) Maxwell relationship
   (e) Clapeyron equation

When one mole of liquid water is converted to one mole of water vapour at 373 K, under a pressure of 101.325 kPa, the work done on the system is −3.098 kJ. The enthalpy of vapourization of water absorbed by the system is 40.82 kJ mol⁻¹.

8. The value of change in internal energy (ΔU) in kJ would be,
   (a) 43.91   (b) −43.91   (c) 37.72
   (d) −37.72   (e) −40.82

9. What is the entropy change?
   (a) zero   (b) −40.82 J K⁻¹   (c) 109 J K⁻¹mol⁻¹
   (d) −109 J K⁻¹mol⁻¹   (e) 40.82 J K⁻¹

10. The Gibbs free energy change is
    (a) zero   (b) 5kJ   (c) 10 kJ
    (d) 15 kJ   (e) 20 kJ

11. What is the Maxwell relationship that can be derived from the equation
    $dG = VdP - SdT$?

    (a) $(\partial P / \partial T)_V = (\partial S / \partial V)_T$

    (b) $(\partial V / \partial T)_P = -(\partial S / \partial P)_T$

    (c) $(\partial T / \partial V)_S = -(\partial P / \partial S)_V$

    (d) $(\partial T / \partial S)_V = (\partial V / \partial P)_T$

    (e) $(\partial V / \partial T)_T = -(\partial S / \partial P)_P$

12. The Clausius Clapeyron equation can be applied to
    (i)   any univariant phase transformation.
    (ii) a process involving melting and fusion only.
    (iii) a process involving vapourization and sublimation only.

    The correct statement/s out of (i), (ii) and (iii) above is/are
    (a) Only (i)   (b) Only (ii) and (iii).   (c) All (i), (ii) and (iii)
    (d) Only (iii)   (e) Only (ii)

13. What is the change in entropy that occurs when $(n/2.303)$ mol of gaseous neon
    $(C_{V,m} = 3R/2)$ is subjected to a ten fold increase in thermodynamic temperature followed by a ten fold increase in the initial volume.
    (a) 2.0 nR   (b) 2.5 nR   (c) 3.0 nR
    (d) 3.0 nR   (e) 0

14. Chemical potential (μ) is least accurately described by which of the following statements?
    (i)   An intensive thermodynamic property
    (ii) Partial molar Gibbs free energy
    (iii) Partial molar free energy
    (iv) An extensive thermodynamic property

    The correct statements out of (i), (ii), (iii) and (iv) above are
    (a) Only (i) and (ii).   (b) Only (i) and (iii).   (c) Only (i), (ii) and (iii)
    (d) Only (ii) and (iv).   (e) Only (iii) and (iv).

15. The pressure coefficient of the chemical potential in a closed system, defined as
    $\left(\dfrac{\partial \mu_i}{\partial P}\right)_{T,n_j}$, is equal to

    (a) $-\bar{G}_i$ (b) $-\bar{S}_i$ (c) $-\bar{H}_i$
    (d) $\bar{S}_i$ (e) $\bar{V}_i$

16. Which of the following statements is true?
    (a) Entropy is an intensive property but a state function
    (b) Entropy is an extensive property and non state function
    (c) Molar entropy is an extensive property but not a state function
    (d) Entropy is an extensive property and a state function
    (e) Molar entropy is an intensive property but not a state function

17. For a particular chemical reaction $\Delta H^0 = +70\,kJ$ and $\Delta S^0 = +210\,JK^{-1}$. The temperature at which this reaction would become spontaneous is,
    (a) below $60.3°C$ (b) above $333.3°C$ (3) above $60.3°C$
    (d) below $333.3°C$ (e) at $0°C$

18. Which of the following statement is in accordance with the third law of thermodynamics?
    (a) The absolute entropy of a pure substance decreases with increasing temperature.
    (b) The change in entropy of the universe must be positive for a spontaneous process.
    (c) At absolute zero the value of entropy becomes zero for pure crystalline substances.
    (d) The entropy of the universe is constant.
    (e) The entropy change of any transformation does not approach zero as the temperature becomes zero.

19. The correct relation between change in free energy in a reaction and the corresponding equilibrium constant K is given by,

    (a) $\Delta G = RT\ln(K)$ (b) $-\Delta G = RT\ln(K)$ (c) $\Delta G^0 = RT\ln(K)$
    (d) $-\Delta G^0 = RT\ln(K)$ (e) $\Delta G = -R\ln(K)$

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20 A colligative property is one which depends on the
   (a) arrangement of particles
   (b) number of particles
   (c) nature of particles
   (d) mass of particles
   (e) number and nature of particles

21. For a particular process at $450\,K$, $\Delta G = -5.2\,kJ$ and $\Delta H = -43.7\,kJ$. If the process is carried out reversibly, the amount of useful work that can be performed is
   (a) $-48.9\,kJ$ (b) $-5.2\,kJ$ (c) $-43.7\,kJ$ -
   (d) $-38.5\,kJ$ (e) $+43.7\,kJ$

22. For a process doing P–V work, the change in Gibbs free energy (ΔG) when one mole of an ideal gas is expanded isothermally from a volume V to 2V at a temperature of T is

   (a) $-RT\ln(2)$ (b) $RT\ln(2)$ (3) $RT\ln(K)$

   (d) $-RT\ln(20)$ (e) $R\ln(2)$

Use the data given below in answering the questions 23 – 25.
For a reaction at 1000K, the value of ΔH° is positive and ΔS° is negative.

23. What can you say about the spontaneity of the reaction at constant pressure?
   (a) spontaneous   (b) non spontaneous   (c) reversible
   (d) no reaction   (e) irreversible

24. With the rise of temperature the equilibrium constant will
   (a) increase   (b) decrease   (c) be zero
   (d) not change   (e) be constant

25. The value of equilibrium constant at 1000K is
   (i) greater than one
   (ii) less than one
   (iii) equal to one

   The correct statement/s out of (i), (ii) and (iii) above is/are
   (a) Only (i).   (b) Only (ii)   (c) Only (iii).
   (d) Only (i) and (iii)   (e) Only (ii) and (iii).