Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	PHYSICAL CHEMISTRY
COURSE CODE	:	DAS 12303
PROGRAMME	:	DAU
EXAMINATION DATE	:	JUNE 2017
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	PART A : ANSWER **ALL** QUESTIONS
		PART B : ANSWER **TWO (2)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

PART A

Q1 (a) $2\ SO_3(g) \rightleftharpoons 2\ SO_2(g) + O_2(g)$

The equilibrium constant K_p for the given reaction is 1.8×10^{-5} at 350 °C. Calculate the value of K_c.

(5 marks)

(b) $A + B \rightleftharpoons C + D$

For the given reaction, the equilibrium constant is 49.0 at a certain temperature. If 0.40 mol each of A and B are placed in a 2.00-L container at that temperature, determine the concentrations of all species are present at equilibrium.

(10 marks)

(c) Explain Le Châtelier's principle. Relate this principle to help us maximize the yields of reactions.

(5 marks)

Q2 (a) Aqueous solutions of most protic acid and bases exhibit certain properties. List **TWO (2)** properties of each acids and bases.

(4 marks)

(b) The concentration of H^+ ions in a bottle of *tapai* was 3.2×10^{-4} M right after removed. Only half of the *tapai* was consumed. The other half, after it had been standing open to the air for a month, was found to have a hydrogen ion concentration equal to 1.0×10^{-3} M. Calculate the pH of the *tapai* on these two conditions.

(6 marks)

(c) The pH of a 0.10 M solution of formic acid (HCOOH) is 2.39.

(i) Determine the concentration of hydrogen ion, H^+

(3 marks)

(ii) Calculate the value of K_a of the acid.

(7 marks)

Q3 (a) Copper and iron (generally in the form of steel) are two of the many metals used in designing machine with electrochemistry method. Using standard reduction potentials in **Table Q3 (a).**

(i) Write half – reaction for anode and cathode.

(6 marks)

(ii) Determine the cell potential, $E°_{cell}$ for a galvanic cell composed of copper and iron. Assume standard conditions.

(2 marks)

(iii) Compose the cell diagram for the above galvanic cell.

(2 marks)

(b) Given 2 half – reactions

$Ni^{2+}(aq) + 2e \rightleftharpoons Ni(s)$ $E° = -0.25$ V

$Cr^{3+}(aq) + 3e \rightleftharpoons Cr(s)$ $E° = -0.74$ V

(i) Show the electrode reaction for this electrochemical series.

(3 marks)

(ii) Compute the overall cell reaction giving a balanced equation.

(3 marks)

(iii) Calculate the cell potential, E when $[Ni^{2+}] = 1x10^{-3}$ M and $[Cr^{3+}] = 2.0\times10^{-3}$ M

(4 marks)

PART B

Q4 (a) Determine:

(i) The mass in grams of 4.44×10^{23} atoms of Pb.

(1 mark)

(ii) The number of Ag atoms in 1.0×10^{-8} g sample.

(1 mark)

(b) (i) Determine the mass of $NaHCO_3$ present in 15.0 mL of 0.20 M $NaHCO_3$ solution.

(5 marks)

(ii) Find the volume of the solution in (i) required to prepare 500.0 mL of 0.05 M $NaHCO_3$ solution.

(3 marks)

(c) Calculate the average atomic mass of titanium on the basis of the following percent composition and isotopic mass data below:

Ti-46 = 7.93 % ; 45.953amu.
Ti-47 = 7.28 % ; 46.952 amu.
Ti-48 = 73.94 % ; 47.948 amu.
Ti-49 = 10.85% ; 48.948amu.

(10 marks)

Q5 (a) A neutral atom of a certain element has 12 electrons (without consulting a periodic table).

(i) Write the ground state electron configuration of element.

(3 marks)

(ii) Classify the element.

(2 marks)

(iii) Determine whether this element is paramagnetic or diamagnetic.

(2 marks)

(iv) Write a complete set of quantum numbers for each of the electrons.

(3 marks)

(b) Specify the group and period of the following elements with electron configuration:

(i) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

(2 marks)

(ii) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$

(2 marks)

(c) Specify which of the following elements expected to have the greatest electron affinity and explain why.

H, K, Co, S, Cl

(2 marks)

(d) Arrange the following isoelectronic O^{2-}, F^-, Na^+, Mg^{2+} in order of:

(i) Increasing ionic radius

(2 marks)

(ii) Increasing ionization energy

(2 marks)

Q6 (a) Draw the resonance structures of boron trifluoride, BF_3 and show the formal charges of each atom.

(10 marks)

(b) Suppose you want to fill a pressurized tank having a volume of 4.00 L with oxygen enriched air for use in diving, and you want the tank to contain 50.0 g of O_2 and 150 g of N_2. Determine the mole fraction and total gas pressure have to be at 25 °C.
($R = 0.0821$ L atm $K^{-1}mol^{-1}$)

(10 marks)

Q7 (a) 3.358 kJ of heat was added to a calorimeter that contains 50.00 g of water. The temperature of the water and the calorimeter, originally at 22.34 °C, increases to 36.74 °C. Calculate the heat capacity of the calorimeter in J/°C. Given the specific heat of water is 4.184 J/g.°C

(10 marks)

(b) 2.61 grams of dimethyl ether, CH_3OCH_3, is burned at constant pressure, 82.5 kJ of heat is given off.

$$CH_3OCH_3(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$$

(i) Find ΔH for the reaction.

(7 marks)

(ii) Determine the process of this reaction and state your reasons.

(3 marks)

~ END OF QUESTION ~

FINAL EXAMINATION

SEMESTER/SESSION	:	SEM II/2016/2017	PROGRAMME	:	DAU
COURSE NAME	:	PHYSICAL CHEMISTRY	COURSE CODE	:	DAS 12303

Formulae

1. Number of moles = $\frac{MV}{1000}$
2. $pH = - \log [H^+]$
3. $pH + pOH = 14$
4. $P_1V_1 = P_2V_2$
5. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
6. $PV=nRT$

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/2016/2017 PROGRAMME : DAU
COURSE NAME : PHYSICAL CHEMISTRY COURSE CODE : DAS 12303

List of chemical elements

Atomic No.	*Atomic Sym.*	*Atomic Weight*	*Name*	*Atomic No.*	*Atomic Sym.*	*Atomic Weight*	*Name*
1	1.01	Hydrogen	H	31	69.72	Gallium	Ga
2	4.00	Helium	He	32	72.64	Germanium	Ge
3	6.94	Lithium	Li	33	74.92	Arsenic	As
4	9.01	Beryllium	Be	34	78.96	Selenium	Se
5	10.81	Boron	B	35	79.90	Bromine	Br
6	12.01	Carbon	C	36	83.80	Krypton	Kr
7	14.01	Nitrogen	N	37	85.47	Rubidium	Rb
8	16.00	Oxygen	O	38	87.62	Strontium	Sr
9	19.00	Fluorine	F	39	88.91	Yttrium	Y
10	20.18	Neon	Ne	40	91.22	Zirconium	Zr
11	22.99	Sodium	Na	41	92.91	Niobium	Nb
12	24.31	Magnesium	Mg	42	95.94	Molybdenum	Mo
13	26.98	Aluminum	Al	43	98.00	Technetium	Tc
14	28.09	Silicon	Si	44	101.07	Ruthenium	Ru
15	30.97	Phosphorus	P	45	102.91	Rhodium	Rh
16	32.07	Sulfur	S	46	106.42	Palladium	Pd
17	35.45	Chlorine	Cl	47	107.87	Silver	Ag
18	39.95	Argon	Ar	48	112.41	Cadmium	Cd
19	39.10	Potassium	K	49	114.82	Indium	In
20	40.08	Calcium	Ca	50	118.71	Tin	Sn
21	44.96	Scandium	Sc	51	121.76	Antimony	Sb
22	47.87	Titanium	Ti	52	127.60	Tellurium	Te
23	50.94	Vanadium	V	53	126.90	Iodine	I
24	52.00	Chromium	Cr	54	131.29	Xenon	Xe
25	54.94	Manganese	Mn	55	132.91	Cesium	Cs
26	55.85	Iron	Fe	56	137.33	Barium	Ba
27	58.93	Cobalt	Co	57	138.91	Lanthanum	La
28	58.69	Nickel	Ni	58	140.12	Cerium	Ce
29	63.55	Copper	Cu	59	140.91	Praseodymium	Pr
30	65.39	Zinc	Zn	60	144.24	Neodymium	Nd

FINAL EXAMINATION

SEMESTER/SESSION	:	SEM II/2016/2017	PROGRAMME	:	DAU
COURSE NAME	:	PHYSICAL CHEMISTRY	COURSE CODE	:	DAS 12303

List of chemical elements

Atomic No.	*Atomic Weight*	*Name*	*Sym.*	*Atomic No.*	*Atomic Weight*	*Name*	*Sym.*
61	145.00	Promethium	Pm	91	231.04	Protactinium	Pa
62	150.36	Samarium	Sm	92	238.03	Uranium	U
63	151.96	Europium	Eu	93	237.00	Neptunium	Np
64	157.25	Gadolinium	Gd	94	244.00	Plutonium	Pu
65	158.93	Terbium	Tb	95	243.00	Americium	Am
66	162.50	Dysprosium	Dy	96	247.00	Curium	Cm
67	164.93	Holmium	Ho	97	247.00	Berkelium	Bk
68	167.26	Erbium	Er	98	251.00	Californium	Cf
69	168.93	Thulium	Tm	99	252.00	Einsteinium	Es
70	173.04	Ytterbium	Yb	100	257.00	Fermium	Fm
71	174.97	Lutetium	Lu	101	258.00	Mendelevium	Md
72	178.49	Hafnium	Hf	102	259.00	Nobelium	No
73	180.95	Tantalum	Ta	103	262.00	Lawrencium	Lr
74	183.84	Tungsten	W	104	261.00	Rutherfordium	Rf
75	186.21	Rhenium	Re	105	262.00	Dubnium	Db
76	190.23	Osmium	Os	106	266.00	Seaborgium	Sg
77	192.22	Iridium	Ir	107	264.00	Bohrium	Bh
78	195.08	Platinum	Pt	108	277.00	Hassium	Hs
79	196.97	Gold	Au	109	268.00	Meitnerium	Mt
80	200.59	Mercury	Hg				
81	204.38	Thallium	Tl				
82	207.20	Lead	Pb				
83	208.98	Bismuth	Bi				
84	209.00	Polonium	Po				
85	210.00	Astatine	At				
86	222.00	Radon	Rn				
87	223.00	Francium	Fr				
88	226.00	Radium	Ra				
89	227.00	Actinium	Ac				
90	232.04	Thorium	Th				

FINAL EXAMINATION

SEMESTER/SESSION	:	SEM II/2016/2017	PROGRAMME	:	DAU
COURSE NAME	:	PHYSICAL CHEMISTRY	COURSE CODE	:	DAS 12303

Table

Reduction reaction	Standard Reduction Potential
$Zn^{2+} + 2\,e^- \longrightarrow Zn$	-0.7630
$Fe^{2+} + 2\,e^- \longrightarrow Fe$	-0.4400
$2\,H^+ + 2e^- \longrightarrow H_2$	0.0000
$Cu^{2+} + 2\,e^- \longrightarrow Cu$	+0.3370
$Fe^{3+} + e^- \longrightarrow Fe^{2+}$	+0.7710
$Ag^+ + e^- \longrightarrow Ag$	+0.7994

Table Q3 (a)