



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF BIOLOGICAL & PHYSICAL SCIENCES
UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF EDUCATION
SCIENCE
1ST YEAR 2ND SEMESTER 2013/2014 ACADEMIC YEAR
REGULAR

COURSE CODE: SCH 104

COURSE TITLE: BASIC ANALYTICAL CHEMISTRY I

EXAM VENUE: LAB 3

STREAM: (BEd. Science)

DATE: 21/08/14

EXAM SESSION: 9.00-11.00AM

TIME: 2.00 HOURS

Instructions:

- 1. Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

Section A This section contains ONE COMPULSORY question

QUESTION 1 (Compulsory -30 marks)

- a) Briefly explain each of the following terms: (7 marks)
- Precision in measurement
 - Limiting reagent
 - Derived units
 - Common ion effect
 - Co-precipitation
 - Theoretical yield
 - Fractional precipitation
- b) Write K_{sp} expression for Ag_2CrO_4 . (1 mark)
- c) The solubility product of $Mg(OH)_2$ is $3.4 \times 10^{-11} \text{ mol}^3\text{L}^{-3}$. Calculate the solubility of the hydroxide. (6 marks)
- d) Explain methods used in determination of end-points in fractional precipitation. (4 marks)
- e) Determine the molecular mass of tetraphosphorous decoxide, P_4O_{10} and hence,
- Write the conversion factor that relates grams of P_4O_{10} to moles of P_4O_{10} . (2 marks)
 - Determine the mass in kg of 8.8×10^4 mol of the oxide. (3 marks)
- f) The experimental yield in any chemical process is normally less than the theoretical yield. Briefly explain. (4 marks)
- g) The mass of a sample of a chemical is measured in four triplicates and reported as 2.302, 2.294, 2.314, and 2.296. Calculate and report the mean so as to communicate the uncertainty in the measurement process. (3marks)

Section B: This section contains FOUR questions. Answer ONLY TWO questions.

Question two

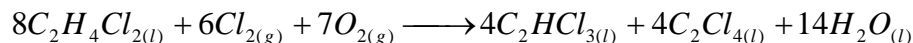
- a) A solution is made by dissolving 8.20 g of Na_3PO_4 in water and diluting the mixture to 100.0 mL. What is the molarity of the solution? (3 marks)
- b) Disulphide dichloride, S_2Cl_2 , is used in vulcanization of rubber. It can be formed from the reaction of S with Cl_2 . What mass of S_2Cl_2 that contains 123.8 g of S? (3 marks)
- c) Briefly explain applications of solubility products. (2 marks)
- d) Solubility of $AgCl$ is $1.5 \times 10^{-3} \text{ gL}^{-1}$. Calculate its solubility product. (RFM of $AgCl$ is 143.3). (4 marks)
- e) The mass of a hydrogen atom is estimated to be $1.67 \times 10^{-18} \text{ } \mu\text{g}$. What is its mass in pounds? (1 lb = 453.6 g) (4 marks)
- f) The K_b value of NH_3 , which is a weak base, is 1.8×10^{-5} . Determine the degree of dissociation, α , of NH_3 , and hence the concentration of ammonia molecules, $[NH_3]$ in 0.1 M $NH_{3(aq)}$ solution. (4 marks)

Question three

- a) What is the volume in mL of 1 M AgNO_3 is necessary to precipitate all the phosphate from 25.00 mL of 0.500 M Na_3PO_4 ? (5 marks)
- b) Melamine is a compound used in making melamine-formaldehyde resins used in very hard surface materials such as FormicaTM. It contains 28.11% carbon, 4.80% hydrogen and 66.634% nitrogen, and it has a molecular mass of 126.121. What is the molecular formula of melamine? (5 marks)
- c) When AgNO_3 is added to a solution containing both 0.1 M chloride, Cl^- , and 0.1 M iodide, I^- , ion, determine how complete the first ion precipitate with Ag^+ ions before the second ion reacts with Ag^+ ions to precipitate. (5 marks)
(Take solubility products of AgCl and AgI to be $1.2 \times 10^{-10} \text{ mol}^2\text{L}^{-2}$ and $1.7 \times 10^{-16} \text{ mol}^2\text{L}^{-2}$, respectively)
- d) The acceleration of an object is stated as 32.2 ft/s^2 . Convert it into in/hr^2 . (1 ft = 12 inches) (5 marks)

Question four

- a) What is the volume of 6 M HCl , which is necessary to dissolve and neutralize 31.564 g of solid $\text{Al}(\text{OH})_3$? (3 marks)
- b) Tetrachloroethene, C_2Cl_4 , often called perchloroethylene (perc), is a colorless liquid used in dry cleaning. It can be formed in several steps from the reaction of dichloroethane, chlorine and oxygen according to the equation:



Calculate the maximum mass of perchloroethylene that can be formed from 23.75 kg of dichloroethane. (5 marks)

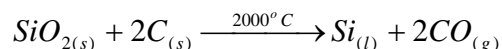
- c) Considering precipitation of CuS , $K_{\text{sp}(\text{CuS})} = 8.5 \times 10^{-45}$, and FeS , $K_{\text{sp}(\text{CuS})} = 8.5 \times 10^{-45}$, from 0.01 M solution of metal ions in 0.25 M HCl , explain how almost complete precipitation of Cu^{2+} ions from a mixture with Fe^{2+} using sulphide precipitation is possible. (6 marks)
- d) Calculate the solubility of Ag_2CrO_4 in:
- 0.001 M AgNO_3 (3 marks)
 - 0.01 M AgNO_3 (2 marks)
 - Briefly account for the differences in the solubility of Ag_2CrO_4 in (a) and (b) above. (1 marks)

Question five

- a) How many mL of 2 M NaOH are necessary to neutralize 25.0 ML of 5 M phosphoric acid, H₃PO₄?

(3 marks)

- b) Electronic grade silicon (EG) is used in electronics industry is purified form of metallurgical grade silicon, which is made from the reaction of silica, SiO₂, with carbon in form of coke at 2000 °C according to the equation:



If 1000 mol of carbon are heated with 550 mL of SiO₂,

- Determine the maximum number of moles of metallurgical grade silicon that can be formed. (4 marks)
 - Identify the excess reagent in this reaction. (1 mark)
 - Briefly explain why the reagent in (6) b) above was the one chosen to be in excess. (2 marks)
- c) Naturally occurring sample of copper consist of 69.17% copper-63, which has atomic mass of 62.9295598 a.m.u. and 30.83% copper-65, which has atomic mass of 64.927792 a.m.u. Calculate the relative atomic mass of copper. (3 marks)
- d) Briefly discuss factors that affect solubility of a substance. (4 marks)
- e) When excess KCN solution is added to a solution containing Cd(II) ions, a white precipitate is initially formed and it dissolves in excess KCN to form a colorless solution, which precipitates with H₂S gas. However a similar solution prepared using Cu(II) ions in place of Cd(II) ions do not precipitate with H₂S gas. Briefly explain. (3 marks)

-END-

Element	Symbol	Atomic no.	Atomic weight	Element	Symbol	Atomic no.	Atomic weight
Actinium	Ac	89	(227)	Mercury	Hg	80	200.59
Aluminium	Al	13	26.981 539	Molybdenum	Mo	42	95.94
Americium	Am	95	(243)	Neodymium	Nd	60	144.24
Antimony	Sb	51	121.75	Neon	Ne	10	20.179 7
Argon	Ar	18	39.948	Neptunium	Np	93	(237)
Arsenic	As	33	74.921 59	Nickel	Ni	28	58.69
Astatine	At	85	(210)	Niobium	Nb	41	92.906 38
Barium	Ba	56	137.327	Nitrogen	N	7	14.006 74
Berkelium	Bk	97	(247)	Nobelium	No	102	(255)
Beryllium	Be	4	9.012 182	Osmium	Os	76	190.2
Bismuth	Bi	83	208.980 37	Oxygen	O	8	15.999 4
Boron	B	5	10.811	Palladium	Pd	46	106.42
Bromine	Br	35	79.904	Phosphorus	P	15	30.973 762
Cadmium	Cd	48	112.411	Platinum	Pt	78	195.08
Caesium	Cs	55	132.905 43	Plutonium	Pu	94	(244)
Calcium	Ca	20	40.078	Polonium	Po	84	(209)
Californium	Cf	98	(251)	Potassium	K	19	39.098 3
Carbon	C	6	12.011	Praseodymium	Pr	59	140.907 65
Cerium	Ce	58	140.115	Promethium	Pm	61	(145)
Chlorine	Cl	17	35.452 7	Protactinium	Pa	91	231.035
Chromium	Cr	24	51.996 1	Radium	Ra	88	226.025 4
Cobalt	Co	27	58.933 20	Radon	Rn	86	(222)
Copper	Cu	29	63.546	Rhenium	Re	75	186.207
Curium	Cm	96	(247)	Rhodium	Rh	45	102.905 50
Dysprosium	Dy	66	162.50	Rubidium	Rb	37	85.467 8
Einsteinium	Es	99	(254)	Ruthenium	Ru	44	101.07
Erbium	Er	68	167.26	Samarium	Sm	62	150.36
Europium	Eu	63	151.965	Scandium	Sc	21	44.955 910
Fermium	Fm	100	(257)	Selenium	Se	34	78.96
Fluorine	F	9	18.998 403 2	Silicon	Si	14	28.085 5
Francium	Fr	87	(223)	Silver	Ag	47	107.868 2
Gadolinium	Gd	64	157.25	Sodium	Na	11	22.989 768
Gallium	Ga	31	69.723	Strontium	Sr	38	87.62
Germanium	Ge	32	72.61	Sulphur	S	16	32.066
Gold	Au	79	196.966 54	Tantalum	Ta	73	180.947 9
Hafnium	Hf	72	178.49	Technetium	Tc	43	(97)
Helium	He	2	4.002 602	Tellurium	Te	52	127.60
Holmium	Ho	67	164.930 32	Terbium	Tb	65	158.925 34
Hydrogen	H	1	1.007 94	Thallium	Tl	81	204.383 3
Iodine	I	53	126.904 47	Thulium	Tm	69	168.934 21
Indium	In	49	114.82	Thorium	Th	90	232.038 1
Iridium	Ir	77	192.22	Tin	Sn	50	118.710
Iron	Fe	26	55.847	Titanium	Ti	22	47.88
Krypton	Kr	36	83.80	Tungsten	W	74	183.85
Lanthanum	La	57	138.905 5	Uranium	U	92	238.028 9
Lawrencium	Lr	103	(260)	Vanadium	V	23	50.941 5
Lead	Pb	82	207.2	Xenon	Xe	54	131.29
Lithium	Li	3	6.941	Ytterbium	Yb	70	173.04
Lutetium	Lu	71	174.967	Yttrium	Y	39	88.905 85
Magnesium	Mg	12	24.305 0	Zinc	Zn	30	65.38
Manganese	Mn	25	54.938 05	Zirconium	Zr	40	91.224
Mendelevium	Md	101	(258)				