

PRACTICE PAPERS CHEMISTRY OLYMPIADS

STAGE – 2

Paper – 07 Part – C

TIME: 1HR 30MIN

MAX MARKS: 180

- Attempt all the Questions.
- All questions carry +3 for right answer and -1 for wrong answer.
- Use of Calculator is allowed.

PERIODIC TABLE OF THE ELEMENTS

1 1A																		18 8A					
1 H 1.008												13 B 10.81	14 C 12.01	15 N 14.01	16 O 16.00	17 F 19.00	2 He 4.003						
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18						
11 Na 22.99	12 Mg 24.31	3 B 10.81	4 C 12.01	5 N 14.01	6 O 16.00	7 F 19.00	8 Ne 20.18	9 Na 22.99	10 Mg 24.31	11 Al 26.98	12 Si 28.09	13 P 30.97	14 S 32.07	15 Cl 35.45	16 Ar 39.95								
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80						
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3						
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)						
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 Ds (281)	111 Rg (272)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (289)	116 Lv (293)	117 Ts (294)	118 Og (294)						
58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0										
90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)										

Name:

Correct Questions =

Wrong Questions =

Unattempt Questions =

Marks =

Lab Problem 1

You have been given two ionic solutions, 0.10 M unknown salt, MCl_x solution and 0.10 M sodium solution, Na_zY . Devise and carry out an experiment to determine the identity of the unknown metal cation and the unknown anion in these solutions. The possible cations are potassium, zinc, aluminum, or silver. The possible anions are nitrate, carbonate, phosphate, or sulfide.

You should provide both *quantitative* and *qualitative* evidence to support your answers.

Lab Problem 2

LDPE (low density polyethylene, #4) is a petroleum-based polymer used to make flexible bottles, films, and plastic containers. Given water, ethanol (density = $0.789 \text{ g}\cdot\text{mL}^{-1}$), and the equipment provided, devise and carry out an experiment to precisely determine the thickness of the LDPE samples provided

Lab Problem #1

This problem involves knowledge of solubility rules and precipitation reactions. In addition, the identification of the unknown cation and anion requires relating the volumes (drops) of the reacting solutions to the quantity of precipitate produced and hence, to the molar ratios of the reacting ions.

Plan

The plan should include both an intention to gather qualitative information about the individual solutions and the mixture and quantitative information related to the quantity of precipitate produced upon combining the two solutions.

Qualitative observations

- Both solutions are clear and colorless.
- There is no odor from the anion solution.
- When mixed, a white precipitate is formed.
- No bubbles/gas is produced.

Quantitative observations

When the two solutions are mixed in test tubes so that the ratio of the cation and anion are varied in a systematic manner the quantity of precipitate should be greatest in the tube with a 3:2 ratio of $MCl_x:Na_ZY$.

Excellent Student Results

- Student included a range of qualitative observations and reasoning based on them such as; Clear MCl_x solution indicates the absence of Ag^+ since $AgCl$ is insoluble.
- Lack of odor in Na_ZY solution indicates the absence of S^{2-} .
- Appearance of precipitate indicates the absence of K^+ and NO_3^- ions since all their compounds are soluble.
- Lack of bubbles in Na_ZY solution and upon mixing indicates absence of CO_3^{2-} .
- Possible cations are Zn^{2+} and Al^{3+} while the anion is most likely PO_4^{3-} .
- Student provided a clear explanation of the variation of the number of drops to determine the stoichiometry ratio of $MCl_x:Na_ZY$.
- Student gave a clear data table with several trials to demonstrate the 3:2 ratio of $MCl_x:Na_ZY$.
- Student identified the cation as Zn^{2+} and the anion as PO_4^{3-} .

Average Student Results

Some qualitative information is given to demonstrate a knowledge of solubility and precipitate formation. Student provided evidence of several combinations of the two solutions and may have inferred something about the relationship between the solution ratio and identity of the salts.

Below Average Student Results

Little or no qualitative information was reported or used to make predictions about the identity of the unknown cation and anion.

Student either did not report any quantitative information or was unable to use the quantitative information acquired to infer any information about the reaction stoichiometry from it.

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Lab Problem #2

Excellent Students Results:

Student proposed a clear, detailed procedure for determining the thickness of the LDPE sheet, recognizing that measuring the volume of such a sheet directly would not be possible because of the small volume. Excellent procedures invariably involved measuring the density of the plastic; good methods included making a series of ethanol-water mixtures and interpolating the mixture of neutral buoyancy, or starting with one liquid and adding the other until neutral buoyancy was achieved. Density of the neutrally buoyant liquid was measured either by using the weighted average of ethanol or water, or by direct measurement of the mass of a known volume of the liquid.

Student performed several buoyancy trials, either using a variety of water-ethanol volume ratios in a series of standards, or by redetermining the point of neutral buoyancy. Results were clearly displayed in a data table. Area and mass of LDPE piece(s) were measured in duplicate.

Calculations are clearly shown using proper unit measurements and significant figures in final answers. Student demonstrated knowledge of the assumptions used in calculation (for example, the assumption of additive volumes if density of the neutrally buoyant mixture was calculated rather than measured directly). Final value for thickness was within 20% of the accepted value.

Average Student Results:

Measurement of density was proposed, but not clearly thought out; or, less precise procedures for determining volume directly (e.g., by displacement of liquid in the graduated cylinder) were proposed. Student made only qualitative (floats in water, sinks in ethanol) or grossly erroneous measurements of density.

Only one trial was performed.

Final value for thickness was within 40% of the accepted value.

Below Average Student Results:

Procedure was vague or unintelligible.

Calculations were unclear or in error.

Final value for thickness was over 40% off from the accepted value.