Name: ..... Centre/Index No: .....

School..... Signature.....

P525/1
CHEMISTRY
Paper 1
July/August
2 ¾ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

- *Attempt all questions in section A and any six questions from section B.*
- *All questions are to be answered in the spaces provided.*
- *A Periodic Table with relevant atomic masses is supplied at the end of the paper.*
- *Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.*
- *Illustrate your answers with equations where applicable.*
- *Molar gas volume at s.t.p = 22.4 dm^3*

For Examiner's Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 MARKS)

Attempt **all** questions in this section.

1. Peroxodisulphate ions oxidise Iodide ions according to the equation:

$S_2O_8^{2-}(aq) + 2I^-(aq) \longrightarrow 2SO_4^{2-}(aq) + I_2(aq)$

The rate equation for the redox reaction is given by:

Rate $= k[S_2O_8^{2-}][I^-]$ at 25°C

(a) State two methods by which the rate of reaction above can be determined. (01 mark)

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(b) State the effect of the following changes on the rate. In each case give a reason for your answer.

(i) Addition of Iron (II) sulphate solution to the reaction mixture. (1½ marks)

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(ii) Doubling the concentration of peroxodisulphate ions while the concentration of Iodide ions is halved. (1½ marks)

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(iii) Using ice-cold solutions of both reactants. (1½ marks)

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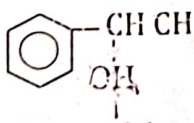
2. Complete the following equations and in each case name the main organic product.

(a) $CH_3C(=O)-NH_2 + NaOBr(aq) \xrightarrow{NaOH(aq)}$

Name of the product.....

(1½ marks)

(b)  $\xrightarrow[\text{Heat}]{\text{Excess NaBr(s)/ Conc. } H_2SO_4}$

Name of the product.....

(1½ marks)

(c) $(CH_3)_2C = CHCH_3 \xrightarrow[\text{Heat}]{\text{Conc. } KMnO_4 / H_2SO_4}$

Name of the product(s).....

(1½ marks)

3. A Manganese is a transition element which forms stable compounds in oxidation states +2, +4 and +7.

(a) Write the formula of the oxide of manganese in oxidation state; (1½ marks)

(i) +2: .....

(ii) +4: .....

(iii) +7: .....

(b) Write an equation for the reaction that takes place between;

(i) oxide in +2 and dilute sulphuric acid. (01 mark)

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(ii) hot concentrated hydrochloric acid and the oxide in +4. (01 mark)

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(iii) oxide in +7 and dilute sodium hydroxide solution. (01 mark)

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4. Methanoic acid in an organic solvent such as benzene dimerises.

(a) State the;

(i) type of bonds between the acid molecules in benzene. (½ mark)

.....

(ii) observed relative formula mass of methanoic acid. (½ mark)

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(b) The vapour pressure of pure benzene at 30°C is 122mmHg. Calculate the vapour pressure of a solution containing 0.092g of methanoic acid in 156g of benzene at 30°C. (2½ marks)

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(c) Compare your answer in (b) above with the vapour pressure of pure benzene at 30°C. State the reason for your answer. (1½ marks)

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5. Ammonium sulphate reacts with water as shown below.

$$NH_4^+(aq) + H_2O(l) \rightleftharpoons NH_3(aq) + H_3O^+(aq)$$

The pH of an aqueous solution of ammonium sulphate was found to be 6.24 at 25°C.

Turn Over

Calculate the;

(a) (i) concentration of hydroxonium ions in the solution. (1½ marks)

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(ii) concentration of gdm^{-3} of ammonium sulphate in the solution.
(Kb for ammonia at 25°C is 1.78×10^{-5} $moldm^{-3}$) (03 marks)

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(b) (i) State what would happen to the pH of the solution in (a) if an equimolar solution of aqueous ammonia is added to it. (½ mark)

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(ii) Give a reason for your answer in b (i). (1 mark)

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6. (a) Define the term bond dissociation energy. **(1 mark)**

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(b) The bond energies of; C = O, N – H, C= N and O – H are 799, 391, 615 and 463 $KJmol^{-1}$ respectively.
Calculate the enthalpy of the reaction.

$$CH_3COCH_3 + H_2NOH \longrightarrow CH_3\overset{\overset{NOH}{\|}}{C} - CH_3 + H_2O$$ **(03 marks)**

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7. Chlorine forms oxo acids of the formulae; HOCl, $HClO_2$, $HClO_3$ and $HClO_4$.

(a) State how acid strength of the oxo acids varies with oxidation state of chlorine. (01 mark)

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(b) Explain your answer in (a). (03 marks)

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(c) A solution containing $HClO_4$ was added to 1M sulphuric acid followed by Iron (II) sulphate solution.

(i) State what was observed. (1½ mark)

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(ii) Write an equation for the redox reaction that takes place. (1½marks)

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8. State what would be observed and write an equation for the reaction that would take place when each of the following substances are mixed.

(a) Diethylamine and ice-cold sodium nitrite in the presence of concentrated hydrochloric acid. (1½ marks)

Observation:.....

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Equation:

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(b) Sodium benzoate solution and dilute hydrochloric acid. (1½ marks)

Observation:.....

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Equation:

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(c) Benzene diazonium chloride and phenol in alkaline medium. (02 marks)

Observation:.....

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Equation:

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9. Tin and carbon belong to group IV of the periodic table.

(a) Write the;

(i) formulae of stable chlorides of Tin and Carbon. (1½marks)

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(ii) equation for the reaction of the chlorides in (a)(i) above with water. (02 marks)

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(b) Excess acidified Tin (II) sulphate solution was added to potassium dichromate solution.

(i) State what was observed. (01 marks)

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(ii) Write an equation for the redox reaction that took place. (01 marks)

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SECTION B (54 MARKS)

Attempt any **six** questions from this section.

10. (a) What is meant by the term **cell constant**? (01 mark)

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(b) The molar conductivity of 0.05M of Magnesium chloride placed between electrodes of cross sectional area $\underline{1.25664 \times 10^{-3} m^2}$ and $\underline{0.12m}$ apart is $\underline{0.0194 \Omega^{-1} m^2 mol^{-1}}$. When 0.05M Barium chloride solution is placed in the same cell, the resistance was 93.92Ω.
Calculate the;

(i) cell constant. (01 mark)

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(ii) molar conductivity of 0.05M Barium chloride solution. (03 marks)

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(c) (i) Compare the molar conductivities of the electrolytes in (b) above. (01 mark)

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(ii) Explain your answer. (03 marks)

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11. Compound Q consists of carbon, 77.78%, hydrogen 7.41%, the rest being oxygen. When steam distilled at 95°C and 760mmHg, the distillate contained 53.18% by mass of Q. the vapour pressure of water is 639mmHg.

(a) Determine the;

(i) empirical formula of Q. (02 marks)

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(ii) molecular formula of Q. (03 marks)

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(b) Q burns with **a sooty flame** and gives **no observable change** with neutral Iron (III) chloride solution. Q reacts with ethanoic acid to form a sweet fruity smelling compound.
Write the;

(i) structural formula and IUPAC name of Q. (01 mark)

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(ii) structural formula of an isomer of Q which does not react with sodium metal. (½ mark)

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(c) Q was added to concentrated hydrochloric acid in the presence of anhydrous Zinc chloride and the mixture warmed.

(i) State what was observed. (½ mark)

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(ii) Suggest a suitable mechanism for the reaction that takes place. (02 marks)

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12. (a) Na, Al and P belong to period 3 of the Periodic Table. Write the formulae of the chlorides of each element and state the type of bond in the table below.(3½ marks)

Element	Na	Al	P
Formula(e) of chloride			
Type of bond			

(b) State the trend in melting points of the chlorides in (a) above.
Explain your answer. (2½ marks)

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(c) Describe the reaction of the chlorides of; Na, Al and P with water. (03 marks)

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13. (a) Use equations to show the following conversions can be effected.

(i) 1, 1 −dichloropropene to $CH_3CH = CHOH$ (03 marks)

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(ii) But-2-yne to $CH_3\,C(OH)(CH_2CH_3)\,COOH$ (03 marks)

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(b) Without using equations describe how 2-bromoethanol can be synthesized from ethanoic acid. (03 marks)

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14. Ethanol and cyclohexane boil at 78.4°C and 80.8°C respectively at 760mmHg while an azeotropic mixture (43% ethanol and 57% cyclohexane) boils at 64.8°C.

(a) (i) Define the term **azeotropic mixture**. (01 mark)

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(ii) State the type of deviation from Raoult's in the ethanol-cyclohexane system. Explain your answer. (2½ marks)

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(b) (i) Sketch a well-labelled boiling point composition diagram for ethanol-cyclohexane system. (2½ marks)

(ii) State the products of **fractional distillation** of a liquid mixture containing 50% ethanol. (02 marks)

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(c) State any two methods by which the azeotropic mixture of ethanol and cyclohexane can be separated. (01 mark)

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15. (a) Name the reagent that can be used to distinguish between each of the following pairs of substances. State what would be observed in each case.

(i) $NiCO_3(s)$ and $BaCO_3(s)$ (02 marks)

Reagent:

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Observations.

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(ii) KI(aq) and NaBr(aq) (02 marks)

Reagent:

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Observations.

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(b) Explain why;

(i) a white precipitates is formed in a brown solution when potassium iodide solution is added to an aqueous solution of Copper (II) chloride. (2½marks)

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(ii) there is no observable change when hydrogen sulphide gas is bubbled into acidified Nickel (II) sulphate solution. (2½ marks)

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Turn Over

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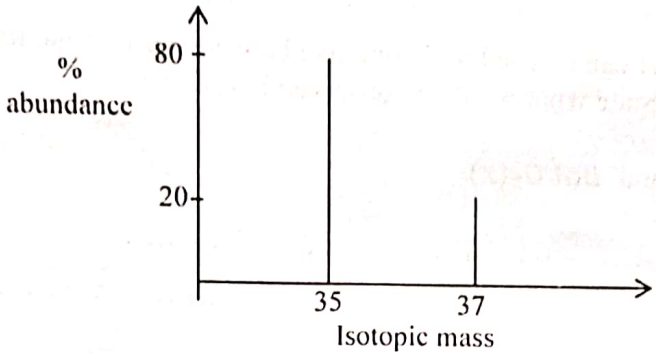
16. (a) The mass spectrum of chlorine atoms is shown in the figure below.



(i) Name the most abundant isotope of chlorine. (01 mark)

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(ii) Calculate the average relative atomic mass of chlorine. (02 marks)

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(b) Explain why the mass spectrum of chlorine gas has three peaks. (04 marks)

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(c) State two advantages of using the mass spectrometer to determine relative atomic mass of elements. (02 marks)

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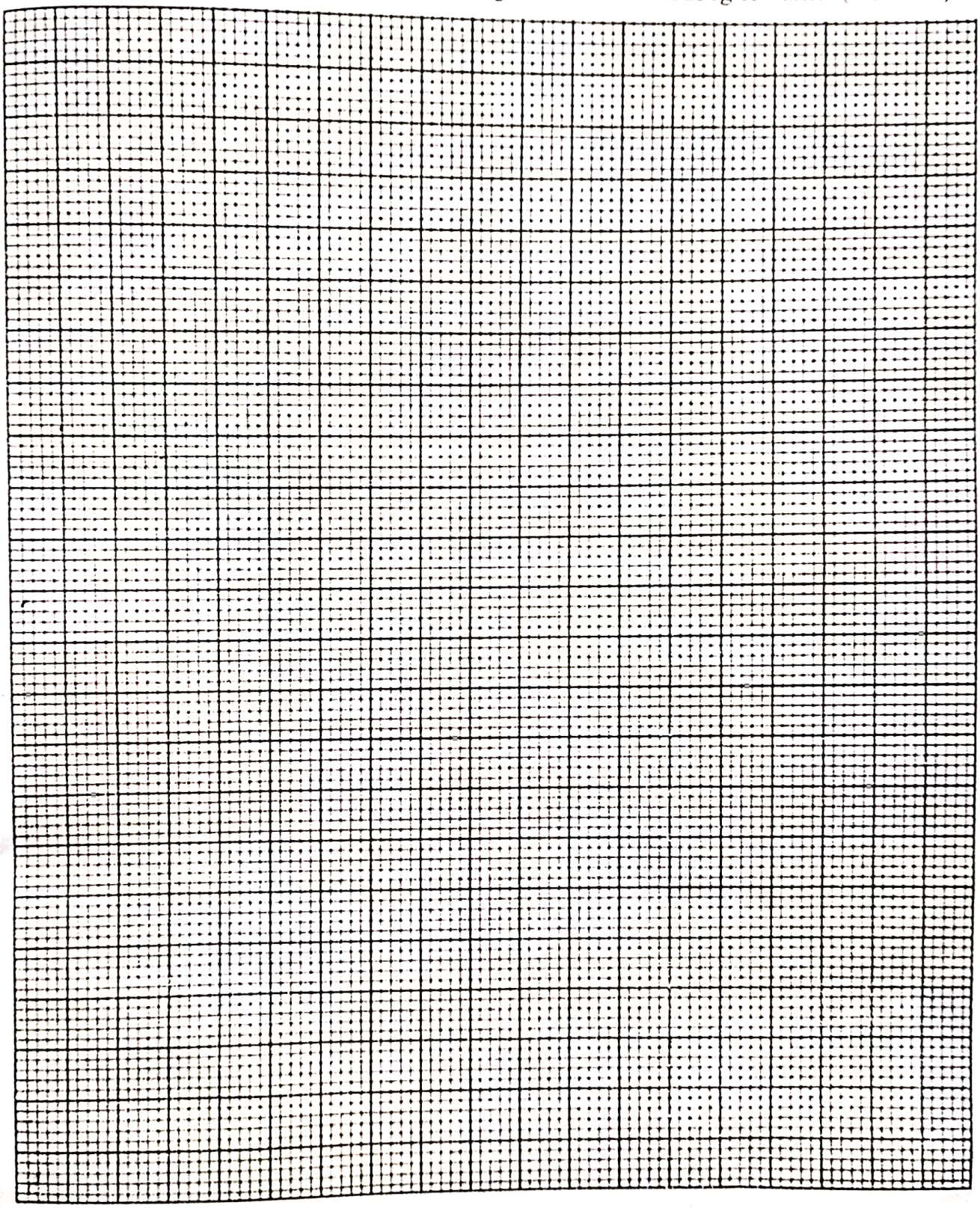
17. Different masses of a non-volatile compound X were separately dissolved in 250g of water at 101.325 *Kpa* and the freezing point of the resultant solution measured.

Mass of X in 250g of water (g)	5.0	10.0	15.0	20.0	25.0	30.0
Freezing point (°C)	-0.11	-0.22	-0.32	-0.43	-0.54	-0.65

(a) (i) Plot a graph of freezing point against mass of X in 250g of water. (2½ marks)



Use your graph to determine the;

(ii) freezing point of pure water. (01 mark)

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(iii) molar mass of compound X. (2½ marks)

(cryoscopic constant of water is 1.86°C Kg^{-1} mol^{-1})

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(b) Explain why cryoscopy is not a suitable method to determine the molar mass of;

(i) ionic compounds with water as a solvent. (1½ marks)

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(ii) short chain carboxylic acids dissolved in hexane. (1½ marks)

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THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1 H 1.0																1 H 1.0	2 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.7	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)															

			58 La 139	59 Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 152	63 Sm 150	64 Eu 152	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
			89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf 251	99 Es (254)	100 Fm (257)	101 Mv (256)	102 No (254)	103 Lw

1. 1 ← Indicates atomic number.
   II

2. II
   1.0 ← Indicates relative atomic mass.

END