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

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P525/1
CHEMISTRY
Paper 1
July/August 2015
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.*

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

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SECTION A (46 marks)

Answer **all** questions in this section.

1. (a) X, Y and Z are structural isomers of $C_4H_{10}O$. The isomers react with sodium metal liberating hydrogen gas.

(i) Name the functional group in the isomers of $C_4H_{10}O$. ($^1/_2$ mark)

_____

(ii) Write an equation for the general reaction that occur between $C_4H_{10}O$ and sodium metal. (1 mark)

_____

_____

(b) Isomer x reacts with hot concentrated sulphuric acid but it gives no observable change on addition of warm acidified potassium dichromate solution.

(i) identify x. (1mark)

_____

_____

_____

(ii) Suggest a suitable mechanism for the reaction between x and hot concentrated sulpuric acid. (2 marks)

_____

_____

_____

_____

_____

_____

(iii) State the molecularity of the reaction in b(ii) above.
Give a reason for your answer. ($1^1/2$ mark)

_____

_____

_____

2. (a) Copper like other transition elements forms compounds in oxidation states: +1 and +2.

Write the electronic configuration of:

(i) Copper (I) ions. ($^1/_2$ mark)

_____

_____

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(c) State any two practical applications of radioactive isotopes. (1 mark)

4. Name the reagent(s) that can be used to distinguish between each of the following pairs of compounds. State the observation(s) when each compound is separately treated with the reagent(s).

(a) $CH_3COONH_4(aq)$ and $NH_4F(aq)$ ($1\frac{1}{2}$ marks each)

Reagent(s)

Observations.

(b) $CH_3CH(OH)CH_2NH_2$ and $CH_3CH(OH)NHCH_3$

Reagent(s)

Observations.

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(c) NiO and FeO.

Reagent(s)

Observations.

5. Given the following reduction reactions and their corresponding electrode potentials.

A: $Fe^{3+}(aq) + e^- \longrightarrow Fe^{3+}(aq)$: $E_1 = +0.77V$.

B: $I_2(aq) + 2e^- \longrightarrow 2I^-(aq)$: $E_2 = ?$

The two half cell reactions; A and B form a feasible cell reaction with reaction A at the cathode and E^θcell = +0.23V.

(a) (i) Write the equation for the reaction that occurs at the anode. (1 mark)

(ii) Calculate the value of E_2. (1mark)

(b) Draw a well labelled diagram to show how the E^θcell = $^+$0.23V can be measured practically from the half-cell reactions. (3 marks)

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(c) State two conditions under which the cell in (b) above is set-up. (1 mark)

6. Iron and lead form mixed oxides Fe_3O_4 and Pb_3O_4 respectively.

(a) Write the;

(i) IUPAC name of the oxide of lead (PB_3O_4) that represents the ratio in which the oxides mix.

(ii) Equation to show that Fe_3O_4 is a mixed oxide. (1 mark)

(b) PB_3O_4 oxidises hot concentrated hydrochloric acid to a pale green gas and itself reduced to a colourless solution which forms a white precipitate on cooling.

(i) Identify the;

Pale green gas. ($^1/_2$ mark)

White precipitate. ($^1/_2$ mark)

(ii) Write the equation for the reaction between Pb_3O_4 and hot concentrated hydrochloric acid. (1 mark)

(c) State any two other chemical properties to show the similarity between iron and lead. (1 mark)

7. At 100^0C, the dissociation pressures of carbon dioxide in equilibrium with the carbonates of Lithium, sodium and potassium are given in the table below.

Li_2CO_3	Na_2CO_3	K_2CO_3
90mmHg	19mmHg	8mmHg

(a) Which one of these carbonates is thermally most stable at 100^0C?

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Give a reason f

(b) (i) Identify th

(ii) Write an
the carbo

(iii) Explain w
b(i) above

(c) State any two c
in b(ii) above d

8 The figure below sho
and W.

Ste

CH_3COOH

Ste

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(a) Name the compounds:

(i) Q _____ (½ mark)

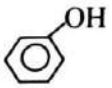
(ii) W _____ (½ mark)

(b) State the condition(s) necessary for the formation of:

(i) Q from CH_3COOH (½ mark)

_____

_____

(ii) W from 

_____

_____

(c) (i) Name the type of reaction that occurs in step III. (½ mark)

_____

_____

(ii) Explain why W reacts with Q to form Z under the conditions in step III. (1½ mark)

_____

_____

_____

_____

(d) (i) State what would be observed when compound Q is reacted with 

(½ mark)

_____

_____

(ii) Write an equation for the reaction in d(i) above. (1 mark)

_____

_____

_____

_____

9. Pure water boils at 100^0C at $1013.25KNm^{-2}$ pressure. However aqueous solutions of nitric acid and ethanol boil at temperatures shown below.

Solution	Composition	Boiling point (°C)
Aqueous nitric acid	68.0% HNO_3	120.5
Aqueous ethanol	95.6% CH_3CH_2OH	78.2

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(a) If pure nitric acid boils at 87^0C at $1013.25KNm^{-2}$ pressure, labelled phase diagram) to show how the boiling point of aq with the mole fraction of water in the solution.

(b) A solution containing 26% ethanol, 74% water was fractiona
(i) Distillate.

(ii) Residual liquid.

(c) Using the table of boiling points and composition above, stat ethanol to water on the;
(i) Intermolecular forces in water.

(ii) Vapour above the mixture relative to ideal solutions.

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SECTION B

Answer only **six** questions from this section.

Any additional questions answer **will not be marked.**

10. In an experiment to determine the formular of an alkylhalide, RCH_2I, the alkylhalide is refluxed with concentrated aqueous sodium hydroxide followed by acidified silver nitrate. The mixture is filtered and the mass of dry residue measured.

(a) (i) Write equation(s) for the reaction(s) that take place in the experiment. (2 marks)

(ii) Why is the silver nitrate solution acidified? (1 mark)

(iii) Name the type of reaction that occurs on reflux. ($^1/_2$ mark)

(b) 3.4g an alkylhalide RCH_2I were refluxed with excess 2M sodium hydroxide solution. To the resultant mixture, excess acidified silver nitrate was added and the product filtered. The mass of the dry residue was found to be 4.70g.

(i) Calculate the formula mass of R. (2 marks)

(ii) Deduce the structural formula of RCH_2I from your answer in b(i) above.

(c) Using equations, show any alkylhalide RCH_2I can be converted to RI. ($2^1/_2$ marks)

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11. Explain each of the following observations. Illustrate your answer with equations of reactions (where applicable).

(a) When potassium methanoate solution is added to copper (II) sulphate solution, a blue precipitate is formed. (3 marks)

(b) When boiled with Fehling's solution, aliphatic alkanals form a reddish brown precipitate. (3 marks)

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(c) Helium can be separated from Argon by diffusion however a mixture of ethane and nitrogen cannot be separated by diffusion. (3 marks)

12. (a) 3.0g of solid calcium iodate(v) were vigorously shaken with water in a stoppered bottle and the mixture allowed to stand at 25^0C for about 30 minutes. The resultant mixture was filtered to obtain exactly $200cm^3$ of the filtrate. Given that calcium iodate (v) is sparingly soluble in water;

(i) Name the filtrate. ($^1/_2$mark)

(ii) Write an equation for the reaction that occurs at 25^0C at the end of the 30 minutes. (1marks)

(b) $20cm^3$ of the filtrate were pipetted into excess acidified potassium iodide solution and the mixture titrated with exactly $6.75cm^3$ of 0.1M sodium thiosulphate solution in the presence of starch indicator.
Calculate the percentage by mass of calcium iodate(V) in $200cm^3$ of the filtrate. ($4^1/_2$ marks)

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(c) The experiment in (a) above was repeated with potassium iodate solution instead of water at 25^0c.

(i) State whether the percentage of calcium iodate(v) in the filtrate would be less, equal to or greater than the calculated value in (b) above. (1 mark)

(ii) Explain your answer in c(i) above. (2 marks)

13. (a) F_2, Cl_2, Br_2 and I_2 are diatomic molecules of group VII elements of the periodic table. Briefly describe how the elements react with;

(i) Potassium bromide solution, (2 marks)

(ii) Hydrogen sulphide. (2 marks)

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(b) The hydride of the elements in (a) above boil at different temperatures shown in the table below.

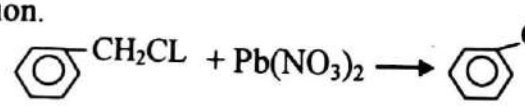
HF	HCL	HBR.	HI
$+20^0C$	-85^0C	-67^0C	-35^0C

State and explain the trend in the boiling points of the hydrides. (3 marks)

(d) (i) State the order in reducing strength of the hydrides.

(ii) Write a general equation for the reaction between aqueous solutions of halogen acids (hydrides) with solid sodium carbonate. (1 mark)

14. (a) In the hydrolysis – oxidation reaction, benzyl chloride is boiled under air-reflux with lead (II) nitrate solution for about 3 hours to form Benzaldehyde according to the equation.



Benzaldehyde is obtained by steam distillation from the reaction mixture and extracted by ether from the distillate. State the reason(s) why:

(i) the basic chloride of lead Pb (OH)Cl is not found in the steam distillate? ($^1/_2$ mark)

(ii) ether is used to extract benzaldehyde from the distillate. (1 mark)

(b) Benzaldehyde is separately treated with cold concentrated potassium hydroxide followed by dilute hydrochloric acid and hydroxylamine in acidic medium.

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(c) Write an equation for the reaction between benzaldehyde and potassium hydroxide followed by dilute hydrochloric acid (1 mark)

(d) Suggest a suitable mechanism for the reaction between benzaldehyde and hydroxylamine in acidic medium (3 marks)

(e) Using equations only, show how benzaldehyde can be prepared from methyl benzene (3½ marks)

(f) Benzamide is benzylisothiazole (2 marks)

15 (a) Define the following terms as applied in ionic equilibria

(i) ionization (1 mark)

(ii) Salt hydrolysis (1 mark)

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(b) Write an equation for the; (1 mark)

(i) Ionisation of ammonia in water.

(1 mark)

(ii) hydrolysis of ammonium sulphate.

(c) You are provided with solid anhydrous ammonium sulphate, water and 250ml volumetric flask. Briefly outline how a solution of ammonium sulphate of pH = 5.20 can be prepared in the laboratory. (Kb for ammonia = $1.78 \times 10^{-5} moldm^{-3}$ and ionic product of water at 25^0C, Kw = 1.0×10^{-14} mol^2dm^{-6}) (5 marks)

16. (a) Powdered chlomite ($FeCr_2O_4$) is roasted with anhydrous sodium carbonate in air and calcium oxide.

$4FeCr_2O_4(s) + 8Na_2CO_3(s) + 7O_{2(g)} \longrightarrow 2Fe_2O_3(s) + 8Na_2CrO_4(s) + 8CO_{2(g)}$

Hot water is added to the products of the reaction and a yellow solid crystallises out.

(i) Name the yellow solid. ($^1/_2$ mark)

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(ii) Draw the structure and name the shape adopted by the anion in the ionic crystal lattice of the yellow solid in a(i) above. (1 mark)

(b) The yellow solid dissolves in excess dilute sulphuric acid to form an orange solution which is a strong oxidizing agent. State what would be observed and write an equation for the REDOX reaction (where applicable) that occurs when the orange solution is reacted with;

(i) Concentrated sodium hydroxide solution, ($1\frac{1}{2}$ marks)

(ii) A saturated solution of potassium Sulphite. (2 marks)

(iii) Excess warm ethanol. (2 marks)

(c) Other than acting as an oxidizing agent in volumetric analysis, the aqueous solution of the yellow solid in a(i) above is used in precipitation titration involving silver nitrate solution.

(i) State the role of the yellow aqueous solution in precipitation titration. ($\frac{1}{2}$ mark)

(ii) Write an equation for the reaction that occurs and state the observation at the end point. (1 mark)

17 (a) (i) Define the term vapour pressure. (1 mark)

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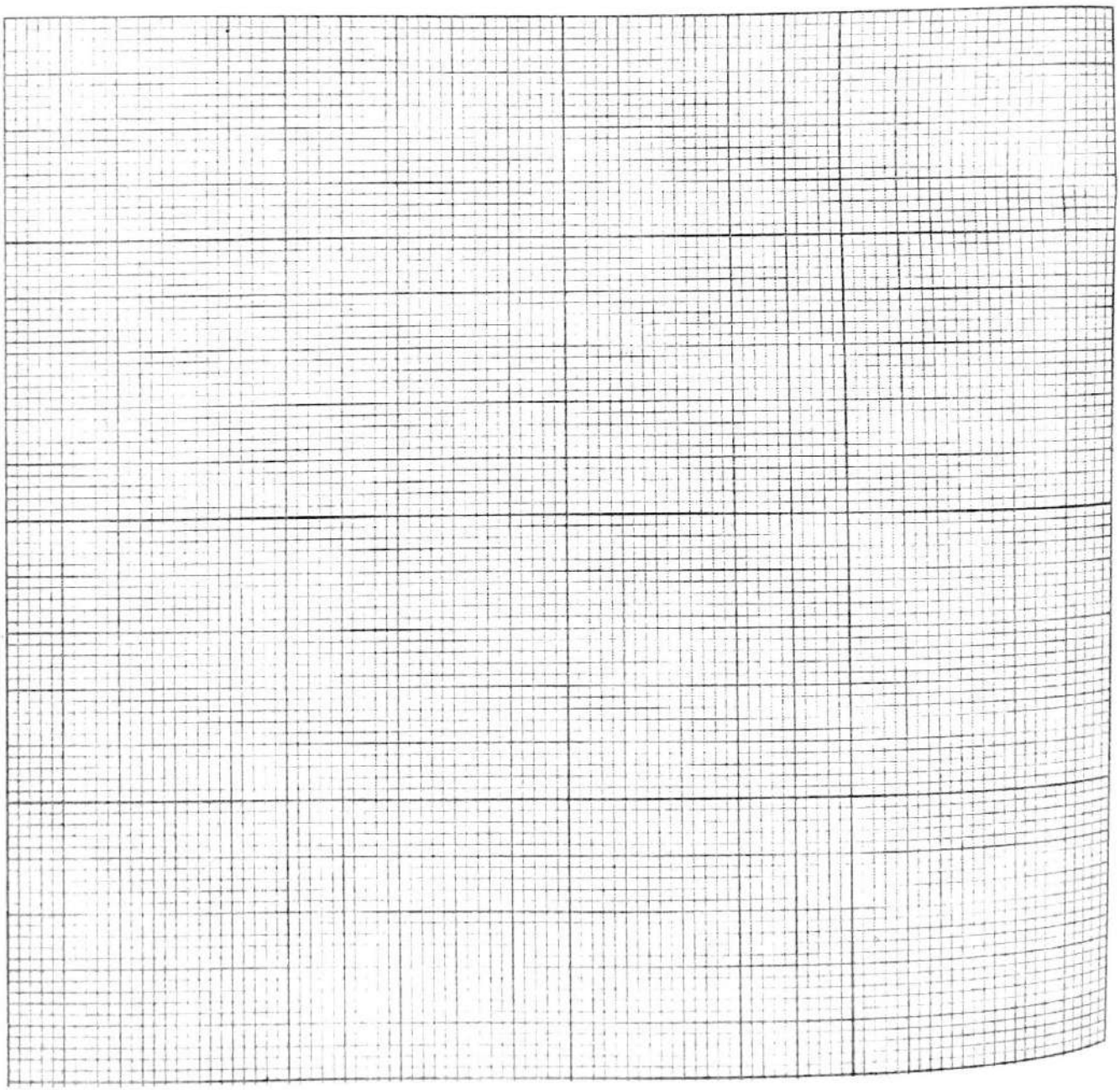
(ii) State Raoult's law of vapour pressure lowering. (1 mark)

(b) The vapour pressure of aqueous solutions of glucose containing 9.0g of water at 27^0C varies with the mass of glucose dissolved as shown in the table below.

Mass of glucose dissolved in 9.0g of water	0.00	0.45	0.90	1.80	3.60	4.50	7.20
Vapour pressure of solution (mmHg)	31.82	31.66	31.50	31.32	30.55	30.23	29.27

(i) Plot a graph of lowering in vapour pressure (ΔP) against mass of glucose dissolved in 9.0g of water. (4 marks)



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(ii) Use your graph in b(i) above to determine the molar mass of glucose. **(2 marks)**

(e) State the effect of water on the molecular state of glucose. Give a reason for your answer using the molar mass calculated in b(ii) above. **(1 mark)**

END

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hydrogen 1 **H** 1.0079																		helium 2 **He** 4.0026
lithium 3 **Li** 6.941	beryllium 4 **Be** 9.0122												boron 5 **B** 10.811	carbon 6 **C** 12.011	nitrogen 7 **N** 14.007	oxygen 8 **O** 15.999	fluorine 9 **F** 18.998	neon 10 **Ne** 20.180
sodium 11 **Na** 22.990	magnesium 12 **Mg** 24.305												aluminium 13 **Al** 26.982	silicon 14 **Si** 28.086	phosphorus 15 **P** 30.974	sulfur 16 **S** 32.065	chlorine 17 **Cl** 35.453	argon 18 **Ar** 39.948
potassium 19 **K** 39.098	calcium 20 **Ca** 40.078		scandium 21 **Sc** 44.956	titanium 22 **Ti** 47.867	vanadium 23 **V** 50.942	chromium 24 **Cr** 51.996	manganese 25 **Mn** 54.938	iron 26 **Fe** 55.845	cobalt 27 **Co** 58.933	nickel 28 **Ni** 58.693	copper 29 **Cu** 63.546	zinc 30 **Zn** 65.39	gallium 31 **Ga** 69.723	germanium 32 **Ge** 72.61	arsenic 33 **As** 74.922	selenium 34 **Se** 78.96	bromine 35 **Br** 79.904	krypton 36 **Kr** 83.80
rubidium 37 **Rb** 85.468	strontium 38 **Sr** 87.62		yttrium 39 **Y** 88.906	zirconium 40 **Zr** 91.224	niobium 41 **Nb** 92.906	molybdenum 42 **Mo** 95.94	technetium 43 **Tc** [98]	ruthenium 44 **Ru** 101.07	rhodium 45 **Rh** 102.91	palladium 46 **Pd** 106.42	silver 47 **Ag** 107.87	cadmium 48 **Cd** 112.41	indium 49 **In** 114.82	tin 50 **Sn** 118.71	antimony 51 **Sb** 121.76	tellurium 52 **Te** 127.60	iodine 53 **I** 126.90	xenon 54 **Xe** 131.29
caesium 55 **Cs** 132.91	barium 56 **Ba** 137.33	57-70 *	lutetium 71 **Lu** 174.97	hafnium 72 **Hf** 178.49	tantalum 73 **Ta** 180.95	tungsten 74 **W** 183.84	rhenium 75 **Re** 186.21	osmium 76 **Os** 190.23	iridium 77 **Ir** 192.22	platinum 78 **Pt** 195.08	gold 79 **Au** 196.97	mercury 80 **Hg** 200.59	thallium 81 **Tl** 204.38	lead 82 **Pb** 207.2	bismuth 83 **Bi** 208.98	polonium 84 **Po** [209]	astatine 85 **At** [210]	radon 86 **Rn** [222]
francium 87 **Fr** [223]	radium 88 **Ra** [226]	89-102 * *	lawrencium 103 **Lr** [262]	rutherfordium 104 **Rf** [261]	dubnium 105 **Db** [262]	seaborgium 106 **Sg** [266]	bohrium 107 **Bh** [264]	hassium 108 **Hs** [269]	meitnerium 109 **Mt** [268]	ununnilium 110 **Uun** [271]	unununium 111 **Uuu** [272]	ununbium 112 **Uub** [277]		ununquadium 114 **Uuq** [289]				

*Lanthanide series	lanthanum 57 **La** 138.91	cerium 58 **Ce** 140.12	praseodymium 59 **Pr** 140.91	neodymium 60 **Nd** 144.24	promethium 61 **Pm** [145]	samarium 62 **Sm** 150.36	europium 63 **Eu** 151.96	gadolinium 64 **Gd** 157.25	terbium 65 **Tb** 158.93	dysprosium 66 **Dy** 162.50	holmium 67 **Ho** 164.93	erbium 68 **Er** 167.26	thulium 69 **Tm** 168.93	ytterbium 70 **Yb** 173.04
* *Actinide series	actinium 89 **Ac** [227]	thorium 90 **Th** 232.04	protactinium 91 **Pa** 231.04	uranium 92 **U** 238.03	neptunium 93 **Np** [237]	plutonium 94 **Pu** [244]	americium 95 **Am** [243]	curium 96 **Cm** [247]	berkelium 97 **Bk** [247]	californium 98 **Cf** [251]	einsteinium 99 **Es** [252]	fermium 100 **Fm** [257]	mendelevium 101 **Md** [258]	nobelium 102 **No** [259]

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