

Recitation
Week 5
Ionic Compounds

KEY

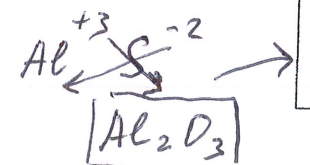
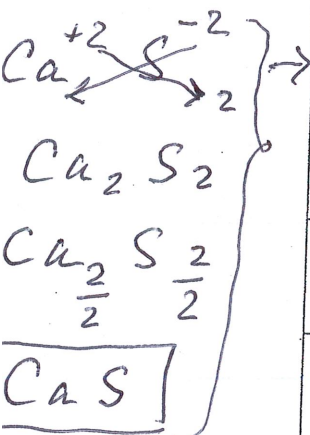
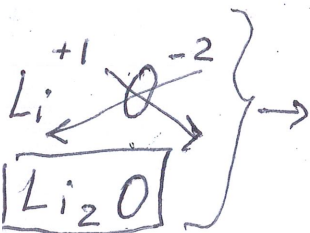
Problem 1: Write full electron configuration (spdf- notation, box-notation, noble gas notation), for the following:

- a) Mg and Mg^{+2}
- b) P and P^{3-}
- c) Fe and Fe^{+3}

See the answer on the last page.

Problem 2: Use the principle of neutrality to determine the formulas for Type I binary ionic compounds.

Combination of Ions	# Cations needed	# Anions Needed	Empirical Formula	Name of Ionic Compound
Na^+ with Cl^-	1	1	NaCl	Sodium Chloride
Li^+ with O^{2-}	2	1	Li_2O	Lithium Oxide
K^+ with P^{3-}	3	1	K_3P	Potassium Phosphide
Mg^{2+} with F^-	1	2	MgF_2	Magnesium Fluoride
Ca^{2+} with S^{2-}	1	1	CaS	Calcium Sulfide
Be^{2+} with N^{3-}	3	2	Be_3N_2	Beryllium Nitride
Al^{3+} with Cl^-	1	3	AlCl_3	Aluminum Chloride
Ga^{3+} with O^{2-}	2	3	Ga_2O_3	Gallium Oxide
Al^{3+} with S^{2-}	2	3	Al_2S_3	Aluminum Sulfide



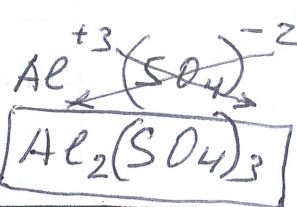
Problem 3:

Formulas and Names for ionic compounds containing ions of **variable-charge** metals

Combination of Ions	# Cations needed	# Anions Needed	Empirical Formula	Name of Ionic Compound
Cu^+ with Cl^-	1	1	CuCl	Copper (I) chloride
Cu^{2+} with Cl^-	1	2	CuCl_2	Copper (II) chloride
Fe^{2+} with S^{2-}	1	1	FeS	Iron (II) sulfide
Fe^{3+} with S^{2-}	2	3	Fe_2S_3	Iron (III) sulfide
Mn^{2+} with F^-	1	2	MnF_2	manganese (II) fluoride
Mn^{3+} with F^-	1	3	MnF_3	manganese (III) fluoride

Problem 4:

Formulas and Names for ionic compounds containing **polyatomic** ions



Combination of Ions	# Cations needed	# Anions Needed	Empirical Formula	Name of Ionic Compound
K^+ with PO_4^{3-}	3	1	K_3PO_4	Potassium phosphate
Mg^{2+} with NO_3^-	1	2	$\text{Mg}(\text{NO}_3)_2$	Magnesium Nitrate
Al^{3+} with SO_4^{2-}	2	3	$\text{Al}_2(\text{SO}_4)_3$	Aluminium sulfate
Na^+ with CO_3^{2-}	2	1	Na_2CO_3	Sodium Carbonate
Na^+ with HCO_3^-	1	1	NaHCO_3	Sodium Bicarbonate
NH_4^+ with Cl^-	1	1	NH_4Cl	Ammonium chloride

Problem 5:

Putting it all together

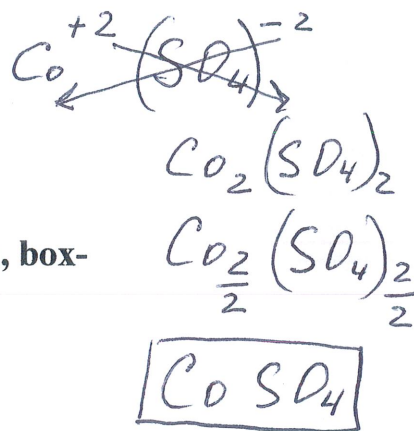
Combination	Formula	Name
Sodium with fluorine	NaF	Sodium fluoride
Magnesium with Nitrogen	Mg_3N_2	magnesium nitride
Ba with Cl	BaCl_2	Barium chloride
Potassium with oxygen	K_2O	Potassium oxide
Al with Br	AlBr_3	Aluminum bromide
Potassium with phosphate	K_3PO_4	Potassium phosphate
Na^+ and SO_4^{2-}	Na_2SO_4	Sodium sulfate
Iron (3+) with chlorine	FeCl_3	Iron(III) chloride
Copper (2+) with chlorine	CuCl_2	Copper (II) chloride
Ammonium with sulfur	$(\text{NH}_4)_2\text{S}$	Ammonium sulfide
Vanadium (3+) with oxygen	V_2O_3	Vanadium (III) oxide
Iron (3+) with oxygen	Fe_2O_3	Iron(III) oxide
K^+ with hydroxide	KOH	Potassium hydroxide
Copper (1+) with sulfate	Cu_2SO_4	Copper(I) sulfate

Problem 6:

- Copper (II) chloride - CuCl_2
- Calcium fluoride - CaF_2
- Iron (II) phosphate - $\text{Fe}_3(\text{PO}_4)_2$
- Potassium hydroxide - KOH
- Ammonium sulfate - $(\text{NH}_4)_2\text{SO}_4$

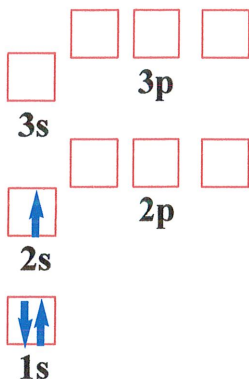
Problem 7: Name each of the following ionic compounds:

- KF - Potassium fluoride
- Na_2O - Sodium oxide
- MgCl_2 - Magnesium chloride
- FeCl_3 - Iron(III) chloride
- CoSO_4 - Cobalt(II) sulfate
- $\text{Ba}(\text{NO}_3)_2$ - Barium nitrate
- $(\text{NH}_4)_2\text{CO}_3$ - Ammonium carbonate



Problem 1: Write full electron configuration (spdf- notation, box-notation, noble gas notation), for the following:

- Li and Li^+
- Cl and Cl^-
- Fe and Fe^{+3}
- Mg and Mg^{+2}
- P and P^{-3}

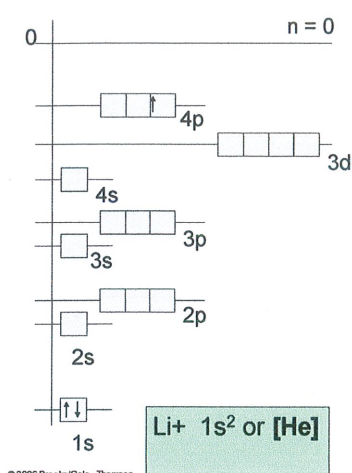




$1s^2 \rightarrow$ 2 total electrons

or

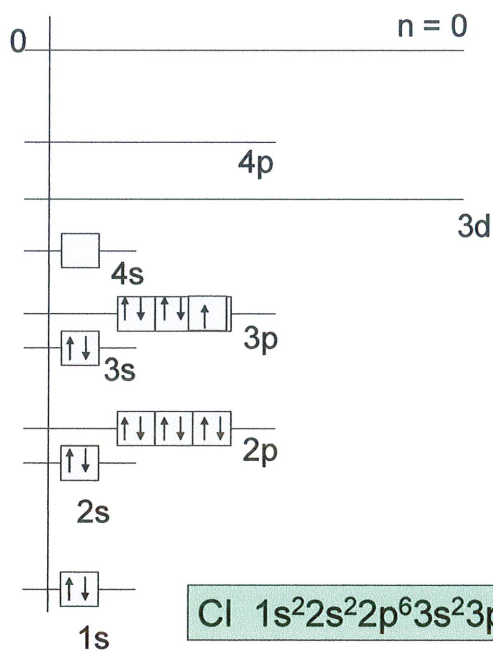
[He]



b)



$1s^2 2s^2 2p^6 3s^2 3p^5$ - 17 total electrons; 7 valence



Cl

Cl⁻

$1s^2 2s^2 2p^6 3s^2 3p^6$ - 18 total electrons;
or [Ar]

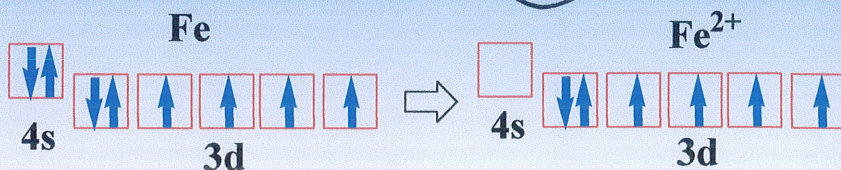
c)

Ion Configurations

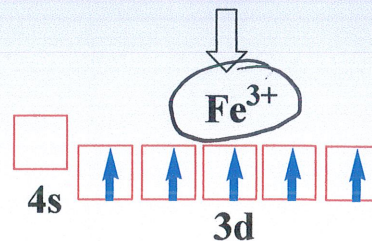
For transition metals, remove ns electrons and then (n - 1) electrons.



loses 2 electrons ----> Fe²⁺ [Ar] 4s⁰ 3d⁶



To form cations, always
remove electrons of
highest n value first!



d)

Phosphorus (P)

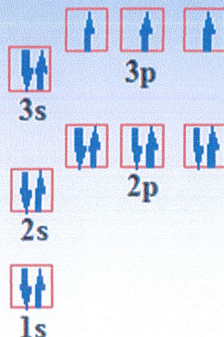
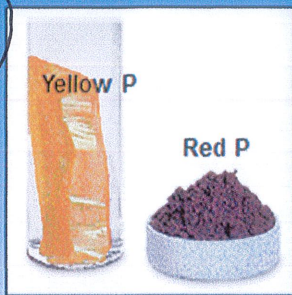
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Group 5A

Atomic number = 15

$1s^2 2s^2 2p^6 3s^2 3p^3$

$[Ne] 3s^2 3p^3$



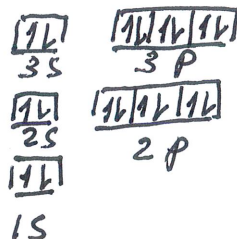
All Group 5A elements have [core] $ns^2 np^3$ configurations where n is the period number.

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P gains 3 electrons to form anion =
= argon electron configuration



$1s^2 2s^2 2p^6 3s^2 3p^6$
[Ar]



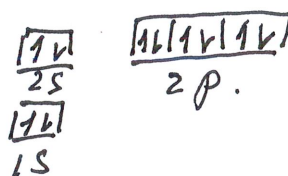
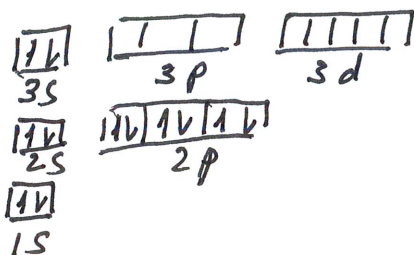
e)



Loses 2 electrons → Mg^{2+}
= Neon electron configuration

$1s^2 2s^2 2p^6 3s^2$
[Ne] $3s^2$

$1s^2 2s^2 2p^6$
[Ne]



Alkali metals (except H)		Alkaline earth metals		Atomic number		Atomic mass		Group designation		Halogens		Noble gases																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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1 H 1.00794	10 Ne 20.1797	2 He 4.002602	13 Al 26.98154	14 Si 28.0855	15 P 30.97376	16 S 32.065	17 Cl 35.453	18 Ar 39.948	19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.93320	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.409	31 Ga 69.723	32 Ge 72.64	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.798																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
3 Li 6.941	4 Be 9.012182	11 Na 22.98977	12 Mg 24.3050	37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc 98.9062	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.293	55 Cs 132.90545	56 Ba 137.327	57 *La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96654	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98037	84 Po 209	85 At 209	86 Rn 222																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
6 Cs 132.90545	6 Ba 137.327	6 *La 138.9055	6 Hf 178.49	6 Ta 180.9479	6 W 183.84	6 Re 186.207	6 Os 190.23	6 Ir 192.217	6 Pt 195.078	6 Au 196.96654	6 Hg 200.59	6 Tl 204.3833	6 Pb 207.2	6 Bi 208.98037	6 Po 209	6 At 209	6 Rn 222	6 Fr 223	6 Ra 226	6 Ac 227	6 Rf 261	6 Db 262	6 Sg 263	6 Bh 264	6 Hs 265	6 Mt 266	6 Ds 267	6 Uu 268	6 Uub 269	6 Uuc 270	6 Uud 271	6 Uue 272	6 Uuf 273	6 Uug 274	6 Uuh 275	6 Uui 276	6 Uuj 277	6 Uuk 278	6 Uul 279	6 Uum 280	6 Uun 281	6 Uuo 282	6 Uuq 283	6 Uur 284	6 Uus 285	6 Uut 286	6 Uuv 287	6 Uuw 288	6 Uux 289	6 Uuy 290	6 Uuz 291	6 Uua 292	6 Uub 293	6 Uuc 294	6 Uud 295	6 Uue 296	6 Uuf 297	6 Uug 298	6 Uuh 299	6 Uui 300	6 Uuj 301	6 Uuk 302	6 Uul 303	6 Uum 304	6 Uun 305	6 Uuo 306	6 Uuq 307	6 Uur 308	6 Uus 309	6 Uut 310	6 Uuv 311	6 Uuw 312	6 Uux 313	6 Uuy 314	6 Uuz 315	6 Uua 316	6 Uub 317	6 Uuc 318	6 Uud 319	6 Uue 320	6 Uuf 321	6 Uug 322	6 Uuh 323	6 Uui 324	6 Uuj 325	6 Uuk 326	6 Uul 327	6 Uum 328	6 Uun 329	6 Uuo 330	6 Uuq 331	6 Uur 332	6 Uus 333	6 Uut 334	6 Uuv 335	6 Uuw 336	6 Uux 337	6 Uuy 338	6 Uuz 339	6 Uua 340	6 Uub 341	6 Uuc 342	6 Uud 343	6 Uue 344	6 Uuf 345	6 Uug 346	6 Uuh 347	6 Uui 348	6 Uuj 349	6 Uuk 350	6 Uul 351	6 Uum 352	6 Uun 353	6 Uuo 354	6 Uuq 355	6 Uur 356	6 Uus 357	6 Uut 358	6 Uuv 359	6 Uuw 360	6 Uux 361	6 Uuy 362	6 Uuz 363	6 Uua 364	6 Uub 365	6 Uuc 366	6 Uud 367	6 Uue 368	6 Uuf 369	6 Uug 370	6 Uuh 371	6 Uui 372	6 Uuj 373	6 Uuk 374	6 Uul 375	6 Uum 376	6 Uun 377	6 Uuo 378	6 Uuq 379	6 Uur 380	6 Uus 381	6 Uut 382	6 Uuv 383	6 Uuw 384	6 Uux 385	6 Uuy 386	6 Uuz 387	6 Uua 388	6 Uub 389	6 Uuc 390	6 Uud 391	6 Uue 392	6 Uuf 393	6 Uug 394	6 Uuh 395	6 Uui 396	6 Uuj 397	6 Uuk 398	6 Uul 399	6 Uum 400	6 Uun 401	6 Uuo 402	6 Uuq 403	6 Uur 404	6 Uus 405	6 Uut 406	6 Uuv 407	6 Uuw 408	6 Uux 409	6 Uuy 410	6 Uuz 411	6 Uua 412	6 Uub 413	6 Uuc 414	6 Uud 415	6 Uue 416	6 Uuf 417	6 Uug 418	6 Uuh 419	6 Uui 420	6 Uuj 421	6 Uuk 422	6 Uul 423	6 Uum 424	6 Uun 425	6 Uuo 426	6 Uuq 427	6 Uur 428	6 Uus 429	6 Uut 430	6 Uuv 431	6 Uuw 432	6 Uux 433	6 Uuy 434	6 Uuz 435	6 Uua 436	6 Uub 437	6 Uuc 438	6 Uud 439	6 Uue 440	6 Uuf 441	6 Uug 442	6 Uuh 443	6 Uui 444	6 Uuj 445	6 Uuk 446	6 Uul 447	6 Uum 448	6 Uun 449	6 Uuo 450	6 Uuq 451	6 Uur 452	6 Uus 453	6 Uut 454	6 Uuv 455	6 Uuw 456	6 Uux 457	6 Uuy 458	6 Uuz 459	6 Uua 460	6 Uub 461	6 Uuc 462	6 Uud 463	6 Uue 464	6 Uuf 465	6 Uug 466	6 Uuh 467	6 Uui 468	6 Uuj 469	6 Uuk 470	6 Uul 471	6 Uum 472	6 Uun 473	6 Uuo 474	6 Uuq 475	6 Uur 476	6 Uus 477	6 Uut 478	6 Uuv 479	6 Uuw 480	6 Uux 481	6 Uuy 482	6 Uuz 483	6 Uua 484	6 Uub 485	6 Uuc 486	6 Uud 487	6 Uue 488	6 Uuf 489	6 Uug 490	6 Uuh 491	6 Uui 492	6 Uuj 493	6 Uuk 494	6 Uul 495	6 Uum 496	6 Uun 497	6 Uuo 498	6 Uuq 499	6 Uur 500	6 Uus 501	6 Uut 502	6 Uuv 503	6 Uuw 504	6 Uux 505	6 Uuy 506	6 Uuz 507	6 Uua 508	6 Uub 509	6 Uuc 510	6 Uud 511	6 Uue 512	6 Uuf 513	6 Uug 514	6 Uuh 515	6 Uui 516	6 Uuj 517	6 Uuk 518	6 Uul 519	6 Uum 520	6 Uun 521	6 Uuo 522	6 Uuq 523	6 Uur 524	6 Uus 525	6 Uut 526	6 Uuv 527	6 Uuw 528	6 Uux 529	6 Uuy 530	6 Uuz 531	6 Uua 532	6 Uub 533	6 Uuc 534	6 Uud 535	6 Uue 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636	6 Uuj 637	6 Uuk 638	6 Uul 639	6 Uum 640	6 Uun 641	6 Uuo 642	6 Uuq 643	6 Uur 644	6 Uus 645	6 Uut 646	6 Uuv 647	6 Uuw 648	6 Uux 649	6 Uuy 650	6 Uuz 651	6 Uua 652	6 Uub 653	6 Uuc 654	6 Uud 655	6 Uue 656	6 Uuf 657	6 Uug 658	6 Uuh 659	6 Uui 660	6 Uuj 661	6 Uuk 662	6 Uul 663	6 Uum 664	6 Uun 665	6 Uuo 666	6 Uuq 667	6 Uur 668	6 Uus 669	6 Uut 670	6 Uuv 671	6 Uuw 672	6 Uux 673	6 Uuy 674	6 Uuz 675	6 Uua 676	6 Uub 677	6 Uuc 678	6 Uud 679	6 Uue 680	6 Uuf 681	6 Uug 682	6 Uuh 683	6 Uui 684	6 Uuj 685	6 Uuk 686	6 Uul 687	6 Uum 688	6 Uun 689	6 Uuo 690	6 Uuq 691	6 Uur 692	6 Uus 693	6 Uut 694	6 Uuv 695	6 Uuw 696	6 Uux 697	6 Uuy 698	6 Uuz 699	6 Uua 700	6 Uub 701	6 Uuc 702	6 Uud 703	6 Uue 704	6 Uuf 705	6 Uug 706	6 Uuh 707	6 Uui 708	6 Uuj 709	6 Uuk 710	6 Uul 711	6 Uum 712	6 Uun 713	6 Uuo 714	6 Uuq 715	6 Uur 716	6 Uus 717	6 Uut 718	6 Uuv 719	6 Uuw 720	6 Uux 721	6 Uuy 722	6 Uuz 723	6 Uua 724	6 Uub 725	6 Uuc 726	6 Uud 727	6 Uue 728	6 Uuf 729	6 Uug 730	6 Uuh 731	6 Uui 732	6 Uuj 733	6 Uuk 734	6 Uul 735	6 Uum 736	6 Uun 737	6 Uuo 738	6 Uuq 739	6 Uur 740	6 Uus 741	6 Uut 742	6 Uuv 743	6 Uuw 744	6 Uux 745	6 Uuy 746	6 Uuz 747	6 Uua 748	6 Uub 749	6 Uuc 750	6 Uud 751	6 Uue 752	6 Uuf 753	6 Uug 754	6 Uuh 755	6 Uui 756	6 Uuj 757	6 Uuk 758	6 Uul 759	6 Uum 760	6 Uun 761	6 Uuo 762	6 Uuq 763	6 Uur 764	6 Uus 765	6 Uut 766	6 Uuv 767	6 Uuw 768	6 Uux 769	6 Uuy 770	6 Uuz 771	6 Uua 772	6 Uub 773	6 Uuc 774	6 Uud 775	6 Uue 776	6 Uuf 777	6 Uug 778	6 Uuh 779	6 Uui 780	6 Uuj 781	6 Uuk 782	6 Uul 783	6 Uum 784	6 Uun 785	6 Uuo 786	6 Uuq 787	6 Uur 788	6 Uus 789	6 Uut 790	6 Uuv 791	6 Uuw 792	6 Uux 793	6 Uuy 794	6 Uuz 795	6 Uua 796	6 Uub 797	6 Uuc 798	6 Uud 799	6 Uue 800	6 Uuf 801	6 Uug 802	6 Uuh 803	6 Uui 804	6 Uuj 805	6 Uuk 806	6 Uul 807	6 Uum 808	6 Uun 809	6 Uuo 810	6 Uuq 811	6 Uur 812	6 Uus 813	6 Uut 814	6 Uuv 815	6 Uuw 816	6 Uux 817	6 Uuy 818	6 Uuz 819	6 Uua 820	6 Uub 821	6 Uuc 822	6 Uud 823	6 Uue 824	6 Uuf 825	6 Uug 826	6 Uuh 827	6 Uui 828	6 Uuj 829	6 Uuk 830	6 Uul 831	6 Uum 832	6 Uun 833	6 Uuo 834	6 Uuq 835	6 Uur 836	6 Uus 837	6 Uut 838	6 Uuv 839	6 Uuw 840	6 Uux 841	6 Uuy 842	6 Uuz 843	6 Uua 844	6 Uub 845	6 Uuc 846	6 Uud 847	6 Uue 848	6 Uuf 849	6 Uug 850	6 Uuh 851	6 Uui 852	6 Uuj 853	6 Uuk 854	6 Uul 855	6 Uum 856	6 Uun 857	6 Uuo 858	6 Uuq 859	6 Uur 860	6 Uus 861	6 Uut 862	6 Uuv 863	6 Uuw 864	6 Uux 865	6 Uuy 866	6 Uuz 867	6 Uua 868	6 Uub 869	6 Uuc 870	6 Uud 871	6 Uue 872	6 Uuf 873	6 Uug 874	6 Uuh 875	6 Uui 876	6 Uuj 877	6 Uuk 878	6 Uul 879	6 Uum 880	6 Uun 881	6 Uuo 882	6 Uuq 883	6 Uur 884	6 Uus 885	6 Uut 886	6 Uuv 887	6 Uuw 888	6 Uux 889	6 Uuy 890	6 Uuz 891	6 Uua 892	6 Uub 893	6 Uuc 894	6 Uud 895	6 Uue 896	6 Uuf 897	6 Uug 898	6 Uuh 899	6 Uui 900	6 Uuj 901	6 Uuk 902	6 Uul 903	6 Uum 904	6 Uun 905	6 Uuo 906	6 Uuq 907	6 Uur 908	6 Uus 909	6 Uut 910	6 Uuv 911	6 Uuw 912	6 Uux 913	6 Uuy 914	6 Uuz 915	6 Uua 916	6 Uub 917	6 Uuc 918	6 Uud 919	6 Uue 920	6 Uuf 921	6 Uug 922	6 Uuh 923	6 Uui 924	6 Uuj 925	6 Uuk 926	6 Uul 927	6 Uum 928	6 Uun 929	6 Uuo 930	6 Uuq 931	6 Uur 932	6 Uus 933	6 Uut 934	6 Uuv 935	6 Uuw 936	6 Uux 937	6 Uuy 938	6 Uuz 939	6 Uua 940	6 Uub 941	6 Uuc 942	6 Uud 943	6 Uue 944	6 Uuf 945	6 Uug 946	6 Uuh 947	6 Uui 948	6 Uuj 949	6 Uuk 950	6