Advanced Inorganic Chemistry part Inorganic Molecules

Exercises 1 and 2 (electronic and molecular structure, building reaction, and chemical and physical properties of inorganic molecules and ions)

Exercise 1

Of the 6 molecules and ions each listed below, give the oxidation numbers of the non-ligand atoms, draw a suitable Lewis structure with the formal charges (if necessary) by using lines for bond and free electron pairs and dots for single electrons, the ψ-type AL_mE_n (m = number of ligands, n = number of free electron pairs or single electrons) the resulting ψ-polyhedron, the gas phase structure/shape and the symmetry of the molecule (in form of a draw or description), and mark those with a star which have no resonance structures (no other electronic structure).
Give the result in form of a table as given below.

Formula	**Ox. no.**	**Lewis struct.**	**ψ-type**	**ψ-polyhedron**	**Mol. struct.**	**Sym.**
NF_3	3+	draw it	AL_3E	tetrahedron	trig. pyr.	C_{3v}

Molecules/ions to be treated in exercise 1.

Abdulhussain	AsX_3	ClF_5	N_2	OX_2	S_2	SeX_2
Ali	AsX_4^+	CO_2	N_2O	$P_2O_6^{4-}$	S_2Cl_2	SeX_4
Bayat	$BeCl_2$	CO_3^{2-}	$N_2O_2^{2-}$	$P_2O_7^{4-}$	S_2F_{10}	SF_4
Benner	BeX_4^{2-}	CX_4	N_2O_3	P_2Se_5	S_2F_2	SF_6
Frettlöh	BrF_3	GaI_3	N_2O_4	$P_4(NR)_6$	$S_2O_3^{2-}$	SiF_6^{2-}
Haas	BrF_4^-	GeX_4	N_2O_5	P_4O_{10}	$S_2O_4^{2-}$	SiX_4
Kaouk	BrF_5	$H_2PO_2^-$	NO	P_4O_6	$S_2O_6^{2-}$	$SnCl_2$
Klotz	BX_3	HgX_2	NO^+	P_4S_6	$SbCl_5$	SO_2
Kohlhaas	BX_4^-	HPO_3^{2-}	NO_2	PCl_3F_2	SbF_5	SO_3
Lavoie-Cardinal	$[(CH_3)_2PN]_3$	I_2Cl_6	NO_2^-	PCl_5	SbX_3	SO_3^{2-}
Özyürek	$[(CH_3)_2SiO]_3$	I_3^-	NO_2^+	PCl_6^-	SCl_2	SO_4^{2-}
Peram	$[Cl_2PN]_3$	ICl_2^-	NO_3^-	PF_5	SCl_4	SX_2
Tehrani	$[Cl_2PN]_4$	ICl_4^-	NX_3	PF_6^-	Se_2F_{10}	$Te(OH)_6$
Thomas	CdX_2	IF_5	NX_4^+	PO_4^{3-}	SeF_4	TeF_4
Zamrik	ClF_3	IF_7	OH_3^+	PX_3	SeF_6	TeF_6

* X = F, Cl, Br, and/or I

Every student has to treat the 6 molecules/ions given in the table.

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Exercise 2

Of the molecules and ions listed below, give the formula, the names, a suitable building reaction, the reactivity, the color, the state of matter under normal conditions (if possible), and the magnetic properties (d for dia- and p for paramagnetic).
As far as possible, give the result in form of a table.

Molecules/ions to be treated in exercise 2.

Abdulhussain	AsX_3	ClF_5	N_2	OX_2	S_2	SeX_2
Ali	AsX_4^+	CO_2	N_2O	$P_2O_6^{4-}$	S_2Cl_2	SeX_4
Bayat	$BeCl_2$	CO_3^{2-}	$N_2O_2^{2-}$	$P_2O_7^{4-}$	S_2F_{10}	SF_4
Benner	BeX_4^{2-}	CX_4	N_2O_3	P_2Se_5	S_2F_2	SF_6
Frettlöh	BrF_3	GaI_3	N_2O_4	$P_4(NR)_6$	$S_2O_3^{2-}$	SiF_6^{2-}
Haas	BrF_4^-	GeX_4	N_2O_5	P_4O_{10}	$S_2O_4^{2-}$	SiX_4
Kaouk	BrF_5	$H_2PO_2^-$	NO	P_4O_6	$S_2O_6^{2-}$	$SnCl_2$
Klotz	BX_3	HgX_2	NO^+	P_4S_6	$SbCl_5$	SO_2
Kohlhaas	BX_4^-	HPO_3^{2-}	NO_2	PCl_3F_2	SbF_5	SO_3
Lavoie-Cardinal	$[(CH_3)_2PN]_3$	I_2Cl_6	NO_2^-	PCl_5	SbX_3	SO_3^{2-}
Özyürek	$[(CH_3)_2SiO]_3$	I_3^-	NO_2^+	PCl_6^-	SCl_2	SO_4^{2-}
Peram	$[Cl_2PN]_3$	ICl_2^-	NO_3^-	PF_5	SCl_4	SX_2
Tehrani	$[Cl_2PN]_4$	ICl_4^-	NX_3	PF_6^-	Se_2F_{10}	$Te(OH)_6$
Thomas	CdX_2	IF_5	NX_4^+	PO_4^{3-}	SeF_4	TeF_4
Zamrik	ClF_3	IF_7	OH_3^+	PX_3	SeF_6	TeF_6

* X = F, Cl, Br, and/or I

Every student has to treat the 6 molecules/ions given in the table.

For help, information, and further exercise, refer to the given textbook(s) of inorganic chemistry and our corresponding website (http://anorganik.chemie.uni-siegen.de).

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Exercise 3
Please explain why P_4O_6, and P_4O_{10} are built instead of P_2O_3 and P_2O_5, respectively.

Exercise 4
$(Cl_2PN)_3$ was found to have symmetry D_{3h}. Please explain why it is not aromatic.

Exercise 5
Name and describe structurally two forms each of the elements C, P, and S.

Exercise 6
Name and describe structurally the allotropic forms of the main group IV and V elements.

Exercise 7
Name and describe structurally the thermodynamically stable forms of the elements C, P, and S.

Exercise 8
Name and describe structurally the allotropic forms of the main group VI elements.

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