Fall 2011
CHEM 1110.40413
Test 2, Form A

Name: KEY

Part I. Multiple Choice: Clearly circle the best answer. (60 pts)

1. An aluminum ion, Al^{3+}, has:
   A) 27 protons and 24 electrons
   B) 13 protons and 13 electrons
   C) 13 protons and 10 electrons
   D) 10 protons and 13 electrons

C

Al 13 p / 13 e⁻
Al^{3+} 13 p / 10 e⁻

2. The formula for sodium sulfide is
   A) K_2S
   B) Na_2S
   C) NaS
   D) NaS_2

B

$Na^+ S^{2-}$
Na_2S

3. Which ion is *isoelectronic* with Ar?
   A) Fe^{2+}
   B) Ca^{2+}
   C) Br^-
   D) F^-

B

4. The compound, P_4S_{10}, is used in the manufacture of safety matches. What is its name?
   A) tetraphosphorus decasulfide
   B) phosphoric sulfide
   C) phosphorus decasulfide
   D) phosphorus sulfide

A

5. Select the element whose Lewis symbol is correct.
   a. b. c. d.

C

6. Consider the element with the electron configuration [Kr] $5s^2 4d^{10} 5p^5$. This element is
   A) an alkali metal.
   B) a noble gas.
   C) a transition metal.
   D) a halogen.

D

7. The elements in a column of the periodic table are known as
   A) a group.
   B) nonmetals.
   C) a period.
   D) metalloids.

A

8. Tetrasulfur dinitride decomposes explosively when heated. What is its formula?
   A) $4SN_2$
   B) S_2N_4
   C) S_4N
   D) S_4N_2

D

S_4N_2

9. Which of these atoms is the *most* electronegative?

B

A) Ge
B) P
C) As
D) Cs

10. Which is the correct formula for copper (II) phosphate?

D

A) $Cu(PO_3)_2$
B) $Cu(PO_4)_2$
C) Cu_2PO_4
D) $Cu_3(PO_4)_2$

$Cu^{2+}\ PO_4^{3-}$

$Cu_3(PO_4)_2$

11. How many *valence electrons* does a tin (Sn) atom have?

B

A) 50
B) 4
C) 36
D) 2

12. What is the formula for the ionic compound formed by calcium ions and nitrate ions?

B

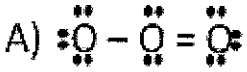
A) Ca_2NO_3
B) $Ca(NO_3)_2$
C) Ca_3N_2
D) $CaNO_3$

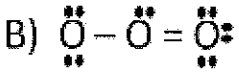
$Ca^{2+}\ NO_3^-$

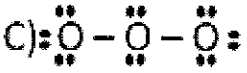
$Ca(NO_3)_2$

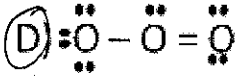
13. Which of these choices is a correct Lewis structure for ozone, O_3?

D

A) 

B) 

C) 

D) 

14. How many electrons are in a triple bond?

B

A) 1
B) 6
C) 4
D) 2

15. Which of the following is the empirical formula for hexane, C_6H_{14}?

C

A) C_6H_{14}
B) $C_{12}H_{28}$
C) C_3H_7
D) $CH_{2.3}$

C_3H_7

16. What is the name of $Mn(CO_3)_2$? $Mn^{4+}\ CO_3^{2-}$

B
A) manganese (II) carbonate
B) manganese (IV) carbonate
C) manganese carbide
D) magnesium (II) carbonate

17. Which two electron configurations represent elements that would have similar chemical properties?

(1) $1s^2 2s^2 2p^4$ (2) $1s^2 2s^2 2p^5$ (3) $[Ar]4s^2 3d^{10} 4p^3$ (4) $[Ar]4s^2 3d^{10} 4p^4$

A
A) (1) and (4)
B) (1) and (2)
C) (2) and (4)
D) (1) and (3)

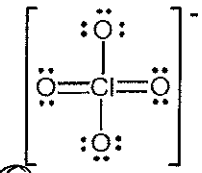
18. Which of these compounds is most likely to be ionic?

B
A) ICl
B) KF
C) CS_2
D) CO_2

19. Which of these atoms has the smallest radius?

C
A) As
B) Te
C) P
D) Al

20. The formal charge on Cl in the structure shown for the perchlorate ion is



$7 - 6 = +1$

A
A) +1
B) –2
C) +2
D) –1

21. Iron (III) chloride hexahydrate is used as a coagulant for sewage and industrial wastes. What is its formula?

B
A) $Fe_3Cl(H_2O)_6$
B) $FeCl_3 \cdot 6H_2O$
C) $Fe_3Cl \cdot 6H_2O$
D) $Fe(Cl \cdot 6H_2O)_3$

22. Which of these elements exhibits chemical behavior similar to that of oxygen?

A
A) sulfur
B) magnesium
C) chlorine
D) sodium

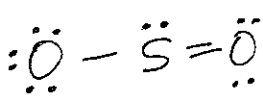
23. Diiodine pentaoxide is used as an oxidizing agent that converts carbon monoxide to carbon dioxide. What is its chemical formula?

D
A) I_5O_2
B) $(IO_5)_2$
C) IO_5
D) I_2O_5

I_2O_5

24. The formal charge on the sulfur atom in the resonance structure of sulfur dioxide which has one single bond and one double bond is

D
A) –1
B) 0
C) +2
D) +1



$6 - 5 = +1$

25. Which of these pairs of elements would be most likely to form an ionic compound?

C
A) Cl and I
B) C and S
C) Cl and Mg
D) Al and K

26. Arrange aluminum, nitrogen, phosphorus and indium in order of increasing electronegativity.

A
A) In < Al < P < N
B) In < P < Al < N
C) Al < In < P < N
D) Al < In < N < P

27. Which of these choices is the electron configuration of the iron(III) ion?

D
A) [Ar] $4s^1 3d^5$
B) [Ar] $4s^2 3d^3$
C) [Ar] $4s^2 3d^9$
D) [Ar] $3d^5$

Fe [Ar] $4s^2 3d^6$

Fe^{3+} [Ar] $3d^5$

28. Which element would be expected to have properties similar to arsenic?

A
A) Sb
B) Pb
C) Sn
D) Se

29. The Lewis dot symbol consists of the symbol for the element surrounded by dot(s). What does the dot or dots represent?

C
A) Electron configuration
B) Atomic number
C) Valence electrons
D) Core electrons

30. Which of these elements has the smallest first ionization energy?

A
A) K
B) Cl
C) Na
D) Be

Part II. Calculations: Clearly show all work for full credit. (25 pts)

1. (15 pts) Nicotine ($C_{10}H_{14}N_2$) is a stimulant that is highly addictive.
   a. What is the molar mass of nicotine?

10 C $10(12.01\ g/mol) = 120.1\ g/mol$

14 H $14(1.008\ g/mol) = 14.11\ g/mol$

2 N $2(14.01\ g/mol) = 28.02\ g/mol$

$162.1\ g/mol$

   b. What is the percent nitrogen in nicotine?

$$\%N = \frac{28.02}{162.1} \times 100 = 17.27\%$$

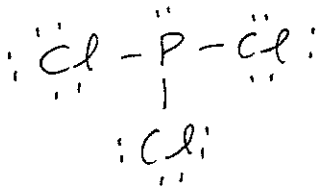
2. (10 pt) Sulfur trioxide can react with atmospheric water vapor to form sulfuric acid that fall as acid rain. Calculate the number molecules in 53.6 g of sulfur trioxide. (MM of SO_3 = 80.06 g/mol)

$$53.6\ g\ SO_3 \times \frac{1\ mol\ SO_3}{80.06\ g\ SO_3} \times \frac{6.022 \times 10^{23}\ molecules\ SO_3}{1\ mol\ SO_3}$$

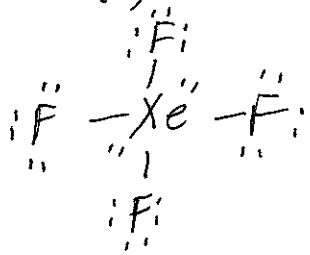
$$= 4.03 \times 10^{23}\ molecules\ of\ SO_3$$

Part III. Lewis Structures: Draw the following molecules. Make sure you include any possible resonance structures. (15 pts)

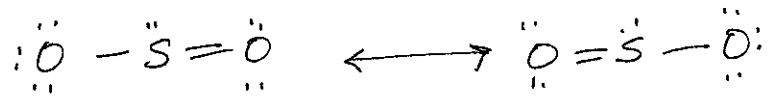
a. PCl_3 $5+3(7)=26$



b. XeF_4 $8+4(7)=36$



c. SO_2 $6+2(6)=18$



	IA								VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 **H** 1.008	IIA																	2 **He** 4.00
2	3 **Li** 6.94	4 **Be** 9.01												5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
3	11 **Na** 22.99	12 **Mg** 24.31	IIIB	IVB	VB	VIB	VIIB	VIIIB				IB	IIB	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
4	19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.71	29 **Cu** 63.55	30 **Zn** 65.37		31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
5	37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** [98]	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.40		49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.30
6	55 **Cs** 132.9	56 **Ba** 137.3	71 **Lu** 175	72 **Hf** 178.5	73 **Ta** 181	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197	80 **Hg** 200.59		81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209	84 **Po** [209]	85 **At** [210]	86 **Rn** [222]
7	87 **Fr** [223]	88 **Ra** [226]	103 **Lr** [262]	104 **Rf** [267]	105 **Db** [268]	106 **Sg** [271]	107 **Bh** [272]	108 **Hs** [270]	109 **Mt** [276]	110 **Ds** [281]	111 **Rg** [280]	112 **Uub** [285]		113 **Uut** [284]	114 **Uuq** [289]	115 **Uup** [288]	116 **Uuh** [293]		118 **Uuo** [294]

57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** [145]	62 **Sm** 150.4	63 **Eu** 152	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.93	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173
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** [252]	100 **Fm** [257]	101 **Md** [258]	102 **No** [259]