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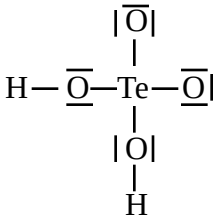
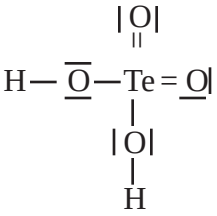
1: Which of the following is the best Lewis structure for H_2TeO_4? **(8A-4,5,7,9,10)**

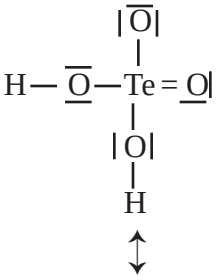
A:



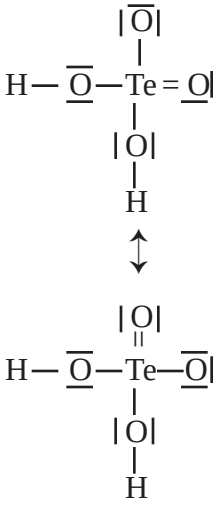
B:



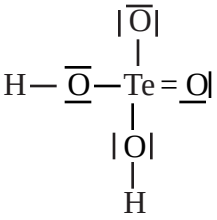
C:



D:



E:



2: If 11 moles of X and 15 moles of Y are mixed and allowed to react according to the equation: 2 X + 3 Y → 1 Z, what is the maximum number of moles of Z which could be formed? **(4-3)**

A: 5.5 B: 11 C: 15 D: 5 E: 10

Chem 1010 **2nd Sample for Final Exam** **Updated by JWC, 12/02**

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3: Given the following standard bond dissociation enthalpies in kJ/mole,

Bonds with Carbon				Bonds w/H		Bonds w/N		Other Bonds	
C-Br	219	C-I	240	H-Br	324	N-Br	250	Br-Br	193
C-C	350	C=N	615	H-Cl	431	N-Cl	190	Cl-Cl	242
C=C	614	C≡N	891	H-F	567	N-F	280	F-F	155
C≡C	839	C-O	358	H-H	435	N-I	150	I-I	151
C-Cl	330	C=O	799	H-I	299	N-N	160	O-O	146
C-F	485	C=S	477	H-N	390	N≡N	946	O=O	495
C-H	413			H-O	463				
				H-S	370				

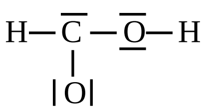
what is the enthalpy change for the reaction, 1 Cl_2 + 2 CH_4 → H_2 + 2 CH_3Cl? (Note: In CH_3Cl, C is the central atom) **(9-1)**

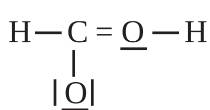
A: 27 kJ B: -27 kJ C: -110 kJ D: -88 kJ E: 88 kJ

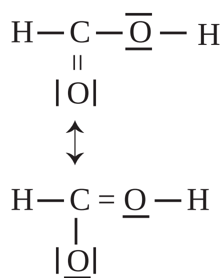
4: When Cl_2 + HNO_3 → $HClO_3$ + NO_2 (acidic solution) is balanced, the sum of all coefficients is: **(9-10)**

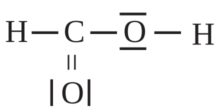
A: 27 B: 26 C: 31 D: 18 E: 23

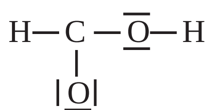
5: Which of the following is the best Lewis structure of HCOOH? **(8A-4,5,7,9,10)**

A:


B:


C:


D:


E:


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6: Calculate the enthalpy change in kJ for the reaction

$2\ Cr(s) + 3\ O_2(g) \rightarrow 2\ CrO_3(s)$,

Given: $4\ Cr(s) + 3\ O_2(g) \rightarrow 2\ Cr_2O_3(s)$, H = -2,256.8 kJ

$2\ Cr_2O_3(s) + 3\ O_2(g) \rightarrow 4\ CrO_3(s)$, H = -101.2 kJ **(6-8)**

A: 1179.0 kJ B: -4412.4 kJ C: -2358.0 kJ D: -1179.0 kJ E: -2054.4 kJ

7: How many mL of 0.640 M hydroiodic acid are needed to completely neutralize 300.0 mL of 0.240 M strontium hydroxide? **(4-10)**

A: 2.25×10^2 mL B: 1.60×10^3 mL C: 1.13×10^2 mL D: 5.63×10^1 mL E: 3.00×10^2 mL

8: How many grams of ammonium dihydrogen phosphate are needed to prepare 675 mL of 0.422 M solution? **(4-6,7,8)**

A: 77.6 B: 38.5 C: 48.5 D: 71.6 E: 32.8

9: Calculate the enthalpy change for the following reaction. **(6-10)**

$2\ SO_2\ (g) + O_2\ (g) \rightarrow 2\ SO_3\ (g)$

A: –251 kJ B: 198 kJ C: –99.1 kJ D: –198 kJ E: 251 kJ

10: If 6 moles of A and 11 moles of B are mixed and allowed to react according to the equation: $2\ A + 1\ B \rightarrow 2\ C$, how many moles of B would remain when there are 2 moles of A in the container? **(3-7)**

A: 9 B: 6 C: 0 D: 5 E: 2

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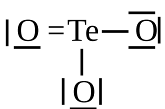
11: What is the weight percent of lithium in lithium phosphate? **(3-8)**

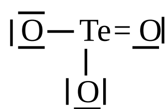
A: 26.8% B: 55.27% C: 18.0% D: 6.81% E: 14.9%

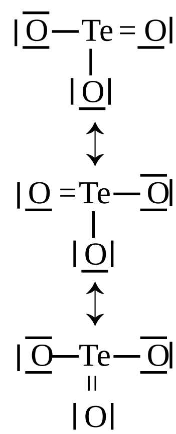
12: What is the molecular weight of a gas if 2.45 g of the substance occupies 500 mL at 10 ˚C and 560 torr? **(5-4)**

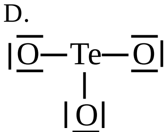
A: 155 B: 159 C: 72 D: 54.6 E: 83.9

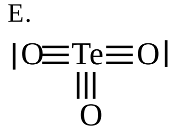
13: The best Lewis structure of TeO_3 is: **(8A-4,5,7,9,10)**

A:


B:


C:


D.


E.


14: Calculate the density of dinitrogen trioxide gas at 235˚C and 367 torr. Express your answer in grams/liter. **(5-4)**

A: 1.9 g/L B: 6.7 g/L C: 0.072 g/L D: 0.88 g/L E: 1.1 g/L

Chem 1010 **2nd Sample for Final Exam** **Updated by JWC, 12/02**

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15: A sample of gas with a temperature of $2.00*10^2$ K is manipulated so that its pressure is increased to four times its original value while its volume is halved. What is the temperature of the gas at the end of the manipulation? **(5-2,5)**

A: $2.50*10^1$ K B: $1.60*10^3$ K C: $1.00*10^2$ K D: $8.00*10^2$ K E: $4.00*10^2$ K

16: A 5.21 g sample of methanol (C_2H_5OH) is reacted with 22.3 g of oxygen. What is the maximum amount (theoretical yield) of water which could be formed? **(4-4)**

A: 6.11 g B: 12.6 g C: 3.06 g D: 12.2 g E: 9.94 g

17: A gas initially at 126 °C and 761 torr is cooled to 18.0 °C and the pressure is reduced to 647 torr. If the final volume is 194 mL, what was the initial volume? **(5-5)**

A: 1.15×10^3 mL B: 3.13×10^2 mL C: 2.26×10^2 mL D: 1.20×10^2 mL E: 1.66×10^2 mL

18: If 0.56 moles of radon and 0.73 moles of hydrogen are placed in a 3.7 liter container at 235˚C, what pressure does the mixture exert? **(5-6)**

A: 15 atm B: 6.7 atm C: 8.2 atm D: 6.3 atm E: 2.0 atm

19: When hydrogen burns according to the equation, $2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(l)$, the change in enthalpy is -579 kJ. What is the enthalpy change if 1.00 grams of hydrogen reacts in this manner? **(6-7)**

A: -2.83×10^2 kJ B: -8.43×10^2 kJ C: -1.14×10^3 kJ D: -1.43×10^2 kJ E: -5.65×10^2 kJ

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20: Calculate the heat change when 13.6 grams of ice at -15^{o}C is heated to 63^{o}C. **(10-10)**

A: 4.5 kJ B: 8.6 kJ C: 4.4 kJ D: 0.43 kJ E: 1.3 kJ

21: An unknown compound is found to 56.4% phosphorous and to contain no other element except oxygen. What is the empirical formula of the compound? **(3-10)**

A: PO B: P_2O_3 C: P_3O_2 D: P_2O E: PO_2

22: Calcium reacts with water, how many grams of water must react with calcium in order to produce 1.0 grams of hydrogen gas? **(3-6)**

A: 4.5 g B: 8.9 g C: 22 g D: 2.0 g E: 18 g

23: 75 milliters of 4.5 M acetic acid is diluted with water to a volume of $6.0*10^2$ milliters. What is the concentration of the resulting solution? **(4-6,7,8)**

A: 1.8 M B: 0.56 M C: 1.0 M D: 0.20 M E: 3.6 M

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51: **K-TYPE answer format**: *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.***(7B-8)**

A: The first ionization energy of P is less than the first ionization energy of Cl. **(7B-8)**
B: The first ionization energy of Cl is less than the first ionization energy of I. **(7B-8)**
C: It is easier to remove the first electron from a Tc atom than to remove the second electron. **(7B-8)**
D: The equation $Cu + 1\ e^- \rightarrow Cu^- + I.E.$ correctly represents ionization energy. **(7B-8)**

52: **K-TYPE** answer format: *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: The nucleus contains all of the protons and neutrons in the atom. **(3-3)**
B: ^{108}Ag is an isotope of ^{108}Pd. **(3-3)**
C: The mass of the proton is about 1 amu. **(3-3)**
D: The charge on the neutron is +1. **(3-3)**

53: **K-TYPE answer format:** *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: Iron and cobalt are in the same group in the periodic table. **(2-5)**
B: Sulfur is a halogen. **(2-5)**
C: Fluorine, nitrogen, and phosphorous are gases under normal conditions. **(1-4)**
D: Chlorine, hydrogen, and oxygen occur as diatomic species under normal conditions. **(1-4)**

54: What is the mass of a substance which occupies 272 ml if it has a density of 0.33 g/mL? **(1-9)**

A: $3.0*10^{0}$ g B: $8.2*10^{2}$ g C: $4.2*10^{1}$ g D: $1.0*10^{-2}$ g E: $9.0*10^{1}$ g

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55: What is the correct electronic configuration of Tc^{2+}? **(7A-10, 7B-1,2)**

A: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2 3d^{10}\ 4p^6\ 4d^5$

B: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2 3d^{10}\ 4p^6\ 5s^1 4d^5$

C: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2 3d^{10}\ 4p^6\ 5s^2 4d^8$

D: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2 3d^{10}\ 4p^6\ 5s^2 4d^4$

E: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2 3d^{10}\ 4p^6\ 5s^2 4d^6$

56: If strontium reacts with nitrogen the formula of the compound formed is likely to be **(2-7)**

A: Sr_3N B: SrN_2 C: SrN D: Sr_3N_2 E: Sr_2N_3

57: Choose the correct statements from the following concerning CF^{3-} and CF^+ using **K-TYPE answer format**:
*Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: The distance between the atoms is greater in CF^{3-} than in CF^+ . **(8A-6)**

B: CF^{3-} would be easier to break (would require less energy to break) than CF^+ . **(8A-6)**

C: CF^+ is held together by a single bond. **(8A-6)**

D: CF^{3-} is held together by a double bond. **(8A-6)**

58: **K-TYPE answer format**: *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.* **(7B-6,7)**

A: Mo^{2-} ion is larger than a Mo atom. **(7B-6,7)**

B: C atom is larger than a Ge atom. **(7B-6,7)**

C: Si atom is smaller than a Na atom. **(7B-6,7)**

D: Sr^{2+} ion is larger than a Sr atom. **(7B-6,7)**

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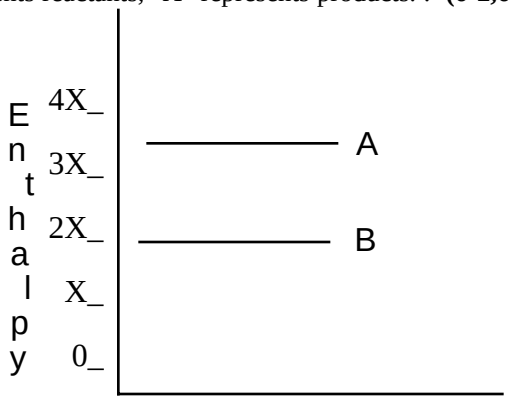
59: On the diagram below: X = 100 J, "B" represents reactants, "A" represents products. . **(6-2,6)**

Choose the correct statements regarding the diagram to the right using K-TYPE format:

Mark a if A, B, & C are correct.
b if A & C are correct.
c if B & D are correct.
d if D only is correct.
e otherwise.



A: On the diagram to the right, the enthalpy of the products is approximately 350 J . **(6-6)**
B: The change in enthalpy for the reaction diagrammed to the right is approximately 150 J . **(6-6)**
C: The reaction diagrammed to the right is endothermic. **(6-6)**
D: Kinetic energy is energy due to position or state. **(6-1)**

60: **K-TYPE answer format**: *Mark **a** if A, B, C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: An ionic solid is a solid in which oppositely charged ions are packed in an alternating way so as to minimize their total energy. **(10-7)**
B: Hydrogen bonding is generally stronger than other dipole-dipole interactions. **(10-2)**
C: Melting point increases as intermolecular forces increase. **(10-3)**
D: Amorphous solids have definite melting points. **(10-5)**

61: Choose the correct statements from the following using K-TYPE answer format. **I.E.Mark "A" if a, b, and c are correct; "B" if a and c are correct; "C" if b and d are correct; "D" if d only is correct; and "E" if any other pattern is correct.**

A: Energy is absorbed when electrons move from the $n = 2$ to the $n = 4$ level. **(7A-6)**
B: An electron in a 2*s* orbital would have less energy than one in a 2*p* orbital. **(7A-6)**
C: An electron in a 3*p* orbital would be closer to the nucleus than one in a 4*s* orbital. **(7A-6)**
D: The magnetic quantum number *m* is related to the orbital's energy. **(7A-8)**

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62: Which of the following correctly lists the compounds in order of decreasing boiling point? **(10-4)**

A: Ar, CaF_2, HF
B: HF, CaF_2, Ar
C: Ar, HF, CaF_2,
D: CaF_2, HF, Ar
E: HF, Ar, CaF_2

63: **K-TYPE answer format**: *Mark **a** if A, B, C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: SO_2 is nonpolar. **(8B-7,8)**
B: NH_3 is polar. **(8B-7,8)**
C: A Si-Cl bond is less polar than a P-Cl bond. **(8B-2)**
D: A nonpolar molecule may contain polar bonds. **(8B-3)**

64: **K-TYPE answer format**: *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: The average velocity of gas molecules at 35˚C is less than that in a sample at 70˚C. **(5-8)**
B: A sample of helium gas at 60^{o}C and 3 atm would be less likely to act as an ideal gas than would a sample of the same gas at 95^{o}C and 3 atm pressure. **(5-9)**
C: The average speed of nitrogen dioxide gas is less than that of sulfur trioxide gas at the same temperature. **(5-8)**
D: If volume and amount of gas are held constant, the pressure of a gas increases when the temperature increases. **(5-2)**

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65: **K-TYPE answer format:** *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: If the empirical formula of a compound is C_2H_3 and its molecular weight is 54, the molecular formula of the compound would be C_4H_6. **(3-9)**

B: Ionic bonding is the attraction between oppositely charged ions. **(2-6)**

C: If nitrogen reacts with fluorine to form a compound, the bonding in the compound would probably be covalent. **(2-6)**

D: If calcium forms an ion, it would have a +1 charge. **(2-7)**

66: **K-TYPE** answer format: *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.* **(2-9)**

A: Oxygen usually has an oxidation number of +2 in compounds. **(2-9)**

B: The oxidation number of Br in BrO_2^- is +3. **(2-9)**

C: The oxidation number of O in $O_2(g)$ is -2. **(2-9)**

D: The oxidation number of N in N_2O_5 is +5. **(2-9)**

67: What type of force(s) must be broken in order to melt CH_4? (10-4)

A: covalent bonds

B: induced dipole-induced dipole interaction (London dispersion forces) AND covalent bonds

C: induced dipole-induced dipole interaction (London dispersion forces)

D: covalent bonds, induced dipole-induced dipole interaction (London dispersion forces), AND H-bonding

E: induced dipole-induced dipole interaction (London dispersion forces) AND H-bonding

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68: Identify the equations which correctly match reactants and products without regard to whether the equations are balanced using **K-TYPE answer format**. *(Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.)* (Note: States, if given, are correct.) **(3-3)**

A: $CH_3CH_2OH + O_2 \rightarrow CO_2 + H_2O$

B: $H_2SO_4 + NaOH \rightarrow NaSO_4 + H_2O$

C: $Na + H_2O \rightarrow NaOH$ and H_2

D: $Na_2CO_3(aq) + ZnBr_2(aq) \rightarrow ZnCO_3(s) + Na_2Br(aq)$

69: **K-TYPE answer format**: *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: Se and Te are not isoelectronic. **(7B-7)**

B: A silicon atom in its ground state would be diamagnetic. **(7B-3)**

C: The two elements with atomic numbers 17 and 35 would have similar chemical properties. **(7B-4)**

D: Atoms with all electrons paired are paramagnetic. **(7B-3)**

70: What is the electronic configuration of Tc? **(7A-10, 7B-1,2)**

A: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^5$

B: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 4d^7$

C: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 4d^3 5s^2 6s^2$

D: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 5p^5$

E: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^6 5s^2 4d^{10} 5p$

Questions 51-82 are worth 3 points each. Twenty-four of these types of questions will appear on the final exam. Place your answer on the BACK side of the Scantron sheet in the space corresponding to the question number.

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71: **K-TYPE** answer format: *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.* **(8A-8)**

A: The electronegativity of Sb is greater than that of N. **(8A-8)**
B: The electronegativity of S is greater than that of Al. **(8A-8)**
C: The formal charge of C in HCO_2^- is -1. **(8A-5)**
D: Electronegativity is defined as the tendency of an atom to attract electrons when bonded to another atom. **(8A-8)**

72: **K-TYPE answer format**: *Mark **a** if A, B, C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: The compounds most likely to display hydrogen bonding are those in which a hydrogen atom is bonded to an F, N, or O atom. **(10-2)**
B: The boiling point of water is higher than that of similar compounds. **(10-2)**
C: Surface tension is defined to be a measure of the tendency of molecules on the surface of a liquid to be pulled back into the liquid. **(10-3)**
D: HCl has a higher viscosity than expected compared to similar compounds due to hydrogen bonding. **(10-2)**

73: **K-TYPE answer format**: *Mark **a** if A,B,C are correct; **b** if A, C; **c** if B, D; **d** if D only; **e** otherwise.*

A: A bond formed by the sharing of electrons is called a covalent bond. **(8A-2)**
B: If fluorine and sulfur were to react, the compound which forms would probably be covalent. **(8A-2)**
C: Covalent substances tend to have low melting points. **(8A-2)**
D: The formula of the compound which would probably form if sodium reacted with nitrogen would be NaN_2. **(8A-3)**

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74: Choose the correct statements concerning the species $^{37}Ar^{-}$ using K-TYPE answer format. **I.E.Mark "A" if a, b, and c are correct; "B" if a and c are correct; "C" if b and d are correct; "D" if d only is correct; and "E" if any other pattern is correct. (2-4)**

A: The species contains 18 protons.
B: The species contains 18 electrons.
C: The species contains 19 neutrons.
D: The approximate mass of the species is 40 amu.

75: **K-TYPE** answer format: *Mark* ***a*** *if A,B,C are correct;* ***b*** *if A, C;* ***c*** *if B, D;* ***d*** *if D only;* ***e*** *otherwise.*

A: The general electronic configuration of the carbon group is ns^2np^4. **(7B-4,5)**
B: A 2p subshell may contain a maximum of 6 electrons. **(7A-8,9,10)**
C: An element whose electronic configuration is $1s^22s^22p^63s^23p^64s^23d^{10}4p^5$ is in the nitrogen group. **(7B-4,5)**
D: An oxygen atom needs to gain two electrons to have a filled outer shell. **(8A-1)**

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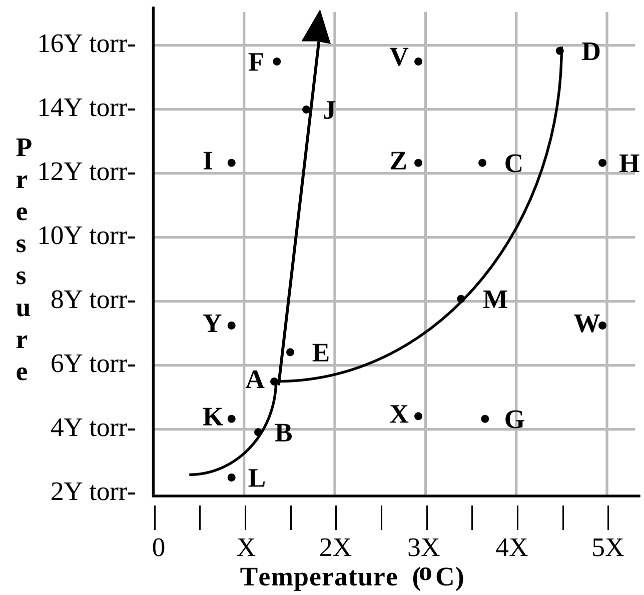
76: Choose the correct statements from the following using **K-TYPE format** where X = 20 and Y = 100 on the diagram below. **(10-9)**

K-TYPE answer format:
- •Choose *a* if A, B, and C are correct.
- •Choose *b* if A and C are correct.
- •Choose *c* if B and D are correct.
- •Choose *d* if D only is correct.
- •Choose *e* if any other pattern is correct.



A: The normal melting point of the substance is approximately 29 ˚C.
B: The boiling point of the substance at 1000 torr is approximately 79 ˚C.
C: The normal boiling point of the substance is approximately 64 ˚C.
D: The substance would be a solid at 1200 torr and 40 ˚C.

77: Choose the correct statements concerning the phase diagram above using
K-TYPE answer format: *Mark* ***a*** *if A, B, C are correct;* ***b*** *if A, C;* ***c*** *if B, D;* ***d*** *if D only;* ***e*** *otherwise.* **(10-9)**

A: The triple point is at point A.
B: At point M, solid is in equilibrium with liquid.
C: The substance changes from a solid to a liquid in going from point I to point C.
D: The substance changes from a liquid to a solid in going from point L to point K.

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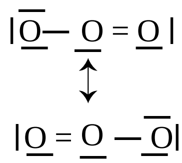
78: The Lewis structure of O_3 is: **(9-6,7)**



On the basis of this a correct description of one of the bonds in O_3 would be "There is a _____ bond between the central O and the end O atoms, formed by overlap of _____ orbital on the central O and a _____ orbital on the end O atom."

A: sigma, p, p
B: sigma, sp^3, sp^3
C: sigma, sp^2, sp^3
D: sigma, sp^2, sp^2
E: pi, sp^2, sp^2

79: The O-O-O bond angle in O_3 is ____. (Refer to question above.) **(8B-5,6,7,8,9,10)**

A: 90˚
B: 109˚
C: 120˚
D: 180˚
E: 90˚ or 120˚ depending on atoms considered

80: The best description of the shape of O_3 is _____. (Refer to question above.) **(8B-5,6,7,8,9,10)**

A: All three atoms lie in a straight line.
B: The three atoms are "bent" or "angular."
C: The three atoms form an equilateral triangle.
D: The three atoms form a tetrahedral.
E: The three atoms form a square.

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81: Choose the correct statements from the following using **K-TYPE answer format**. I.E. *Mark* ***a*** *if A,B,C are correct;* ***b*** *if A, C;* ***c*** *if B, D;* ***d*** *if D only;* ***e*** *otherwise.*

A: If two electrons are placed in the same orbitals they must have opposite spins. **(7A-10)**
B: The electron in an atom cannot exist at just any distance from the nucleus. **(7A-8)**
C: The frequency of ultraviolet radiation is greater than that of infrared radiation. **(7A-4)**
D: After an atom is heated to a very high temperature, it emits a continuous spectrum as it cools and the electrons return to the lowest energy level. **(7A-5)**

82: Choose the correct statements from the following using **K-TYPE answer format**. I.E. *Mark* ***a*** *if A,B,C are correct;* ***b*** *if A, C; c if B, D;* ***d*** *if D only;* ***e*** *otherwise.*

A: If NaCl solutions with concentrations of 0.20 M and 0.40 M are mixed, the resulting mixture might have a concentration of 0.10 M. **(4-8)**
B: A solute is composed of a solvent and a solution. **(4-5)**
C: There are strong forces between molecules of an ideal gas until the molecules collide. **(5-8)**
D: At the same temperature and pressure, 5 moles of ideal gas A would occupy the same volume as would 5 moles of ideal gas B. **(5-8)**