

A decorative graphic consisting of several overlapping, wavy, purple shapes that resemble stylized leaves or petals, set against a dark gray background. The shapes are rendered with a slight gradient and shadow, giving them a three-dimensional appearance.

**CHEMISTRY 101 TEST BANK BY
YASMEEN HAMDAN**

1-Which one of the following atoms/ions is diamagnetic

A. Mn^{2+}

B. Cu^+

C. Cr^{3+}

D. Fe^{3+}

E. Fe^{2+}

ANS:B

2-a mixture of three gases has a total pressure of 1380mmHg at 298 K .The mixture contain 1.27 mol CO₂ , 3.04 mol CO and 1.50 mol Ar .

What is the partial pressure of CO

A.356mmHg

B.722mmHg

C.0.258atm

D.5345mmHg

E.8020mmHg

ANS:B

3-which one of the following ions has greatest lattice energy?

A.KCL=KF=KBr=KI

B.KCl

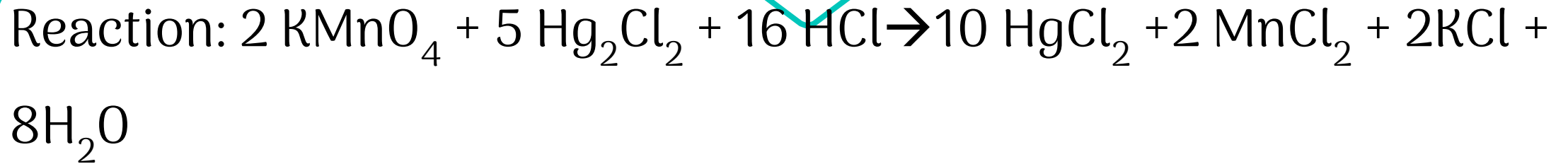
C.KI

D.KBr

E.KF

ANS:E

4-Using the following data:



Molar mass (g/mol): $\text{KMnO}_4 = 158.0$, $\text{Hg}_2\text{Cl}_2 = 472.09$

Mass(g): $\text{KMnO}_4 = 316.1$, $\text{Hg}_2\text{Cl}_2 = 1999$, $\text{HCl} = \text{excess}$

The excess reactant(s) would be :

A. Only KMnO_4

B. KMnO_4 and HCl

C. Only HCl

D. KMnO_4 and Hg_2Cl_2

E. KMnO_4 and HCl

5-what is the shape of PF_4^- molecule ?

- A. Trigonal pyramidal
- B. Distorted tetrahedral(seesaw)
- C. Square planner
- D. Tetrahedral
- E. T-shaped

ANS:B

6- what is the minimum amount of H_2O (18.02g/mol) in grams are necessary to produce (200g) of sulfuric acid (98.07 g/mol) in the following reaction ?



A. 33.6g

B. 36.7g

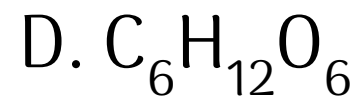
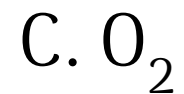
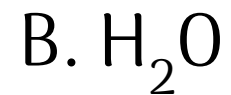
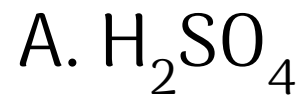
C. 131g

D. 61.3g

E. 202g

ANS: B

7-One of the following is the strongest electrolyte:



ANS:A

8-which of the following atoms has the highest ionization energy?

A.O

B.Na

C.N

D.Li

E.Ca

ANS:C

9-Which of the following has the greatest lattice energy:



E. All have the same lattice energy.

ANS:B

10-What is the shape of IF_4^+

A. square planar

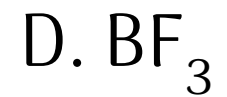
B. seesaw

C. octahedral

D. T shape

ANS:B

11-One of these molecules is polar :



ANS:B

12-which two ions from the following have the electron

Configuration:[Ar]3d⁶

A. Ti⁺² and V⁺³

B. Fe⁺² and Co⁺³

C. Fe⁺³ and Mn⁺²

D. Mn⁺³ and Cr⁺²

E. Cr⁺³ and V⁺²

ANS:B

13-what is the maximum number of electrons that can have this quantum numbers

$$N=3 \quad L=1 \quad m_l=-1$$

A. 2

B. 3

C. 1

D. 4

E. 5

ANS:A

14-which element has the highest for ionization energy?

A. As

B. K

C. Cs

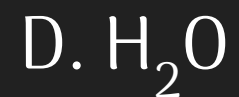
D. Bi

E. Ga

ANS:A

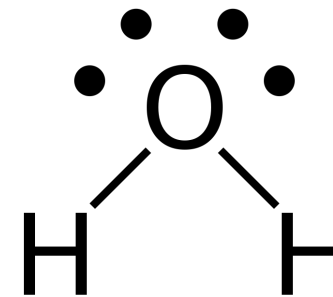
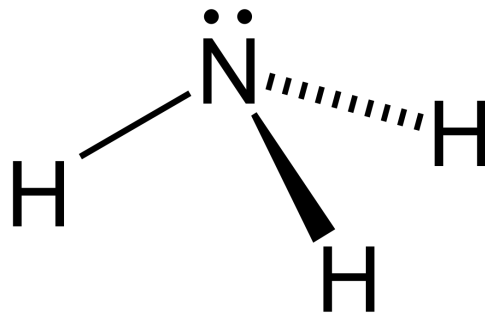
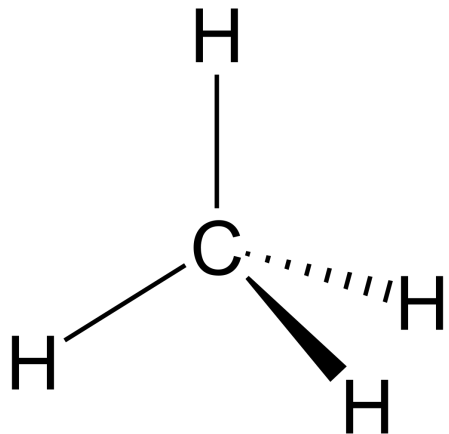


15-which one of the following molecules is nonpolar?



ANS:C

16-



Which statement is correct

- A. The hybridization of C atom in CH₄ is SP²
- B. The hybridization of N atom in NH₃ is SP³
- C. The hybridization of C atom in CH₄ is SP³
- D. The hybridization of O atom in H₂O is SP
- E. C and B are correct

ANS:E

17-arrange the following ions order of increasing ionic radius :

$\text{Na}^+/\text{Mg}^{+2}/\text{N}^{-3}/\text{F}^-$

A. $\text{N}^{-3} > \text{F}^- > \text{Na}^+ > \text{Mg}^{+2}$

B. $\text{F}^- > \text{N}^{-3} > \text{Na}^+ > \text{Mg}^{+2}$

C. $\text{Na}^+ > \text{F}^- > \text{N}^{-3} > \text{Mg}^{+2}$

D. $\text{Mg}^{+2} > \text{N}^{-3} > \text{Na}^+ > \text{F}^-$

E. $\text{F}^- > \text{Mg}^{+2} > \text{N}^{-3} > \text{Na}^+$

ANS:A

18-which of these is paramagnetic

A. Cr^{+3}

B. Zn^{+2}

C. Cu^{+}

D. Zn

E. Ne

ANS:A

19-which one of these ions is not isoelectronic with Ar?

A. S^{-2}

B. Ca^{+2}

C. Fe^{+2}

D. Cl^{-}

E. K^{+}

ANS:C

20-which one of the following orders of increasing electronegativities is correct

A. $\text{Mg} < \text{P} < \text{N} < \text{Si}$

B. $\text{N} < \text{Mg} < \text{P} < \text{Si}$

C. $\text{Mg} < \text{N} < \text{P} < \text{Si}$

D. $\text{Mg} < \text{Si} < \text{P} < \text{N}$

E. $\text{Si} < \text{Mg} < \text{N} < \text{P}$

ANS:D

21-which of the following molecules has central atom with sp^3 hybridization?



ANS:E

22-which one of the following sets of quantum numbers
Is allowed

A. $n=3, l=1, m_L=-1, m_s=+1/2$

B. $n=2, l=1, m_L=+2, m_s=+1/2$

C. $n=3, l=0, m_L=0, m_s=0$

D. $n=2, l=2, m_L=-1, m_s=-1/2$

E. $n=3, l=1, m_L=-2, m_s=-1/2$

ANS:A

23-what volume of CO_2 gas at 1.00 atm and 800 K could be produced by the reaction of 45.0 g of CaCO_3 according to the equation?



(Molar masses (g/mol): $\text{CaCO}_3=100.1$, $\text{CaO}=56.1$, $\text{CO}_2=44.0$,

$R=0.0821 \text{ atm}\cdot\text{L}/\text{mol}\cdot\text{K}$)

A. 34.8 L

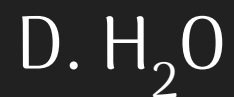
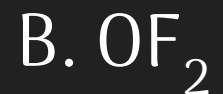
B. 29.5 L

C. 14.8 L

D. 9.84 L

E. 2.46 L

24-which one of the following molecules is nonpolar?



ANS:A

25-which one of these is a strong electrolyte?

A. H_2O

B. KOH

C. CH_3COOH (acetic acid)

D. $\text{C}_2\text{H}_6\text{O}$ (ethanol)

E. N_2

ANS:B

26-what is the mass, in grams, of 5 arsenic (As) atom?

(molar mass of As=74.9216 g/mol , Avogadro's number= 6.022×10^{23})

A. 1.00×10^{-18} g

B. 74.9 g

C. 5.48×10^{-22} g

D. 6.22×10^{-22} g

E. 8.04×10^{21} g

ANS:D

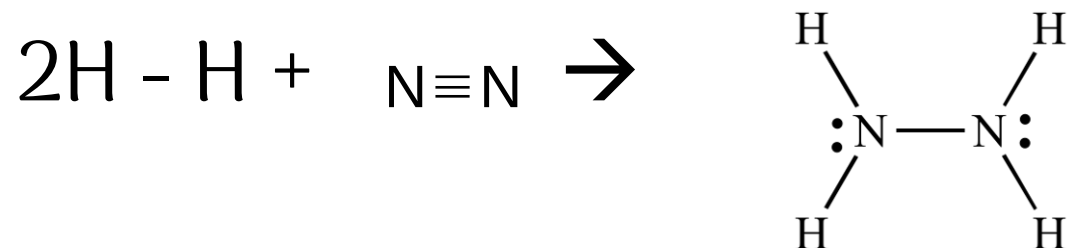
27-what is the best answer to report for:

$$\frac{(4.416\text{g} + 7.656\text{g})}{4.791\text{mL}} + 0.380\text{g/mL}$$

- A. 2.900 g/mL
- B. 2.9000 g/mL
- C. 2.9 g/mL
- D. 2.9 g/mL
- E. 3.0 g/mL

ANS:

28-based on the bond energy, calculate ΔH_r for the reaction (in KJ/mol):



- A. +90
- B. +110
- C. +130
- D. +150
- E. +170

| bond | Bond energies(KJ/mol) |
|------|-----------------------|
| H-H | 466 |
| N≡N | 945 |
| N-N | 163 |
| N-H | 391 |

29-balance the following equation with the smallest whole number coefficients . Choose the answer that is the sum of the Coefficients of the reactants in the balanced equation



- A. 7
- B. 12
- C. 5
- D. 3
- E. 6

ANS:A

30-how many grams of CsNO_3 (molar mass=194.9 g/mol)

Are needed to prepare a 100.0 mL of 0.1700 M CsNO_3

Solution?

A. 2.790 g

B. 2.414 g

C. 6.626 g

D. 3.313 g

E. 4.225g

ANS:D



Chemistry 101

Final Exam 022

Name (in Arabic):

Form 3

Student ID:

1. The density of a liquid is 2.65 g/cm^3 . Calculate the mass of 0.25 m^3 of this liquid (in kg).
- a) 7.1×10^2 b) 9.5×10^2 c) 5.0×10^2 d) 6.6×10^2 e) 8.2×10^2
2. The correct name for P_2O_5 is:
- a) Phosphorous(V) oxide b) Phosphorous pentoxide c) Diphosphorous pentoxide.
d) Phosphorous oxide e) Phosphoric oxide
3. The mass of one molecule of a compound is $2.03 \times 10^{-22} \text{ g}$. Calculate the molar mass of the compound (in g/mol), (Avogadro's Number = 6.02×10^{23}).
- a) 122 b) 158 c) 192 d) 146 e) 134
4. Which of the following pairs of aqueous solutions would not produce a reaction when mixed?
- a) NaNO_3 and CuCl_2 b) Na_2SO_4 and Ba(OH)_2 c) Ba(OH)_2 and HCl
d) CuCl_2 and Na_3PO_4 e) AgNO_3 and HCl
5. The molar mass of an unknown gas was measured by an effusion experiment. It was found that it took 60 s for a given volume of the gas to effuse, whereas the same volume of nitrogen gas required 48 s to effuse under the same conditions (rate of effusion $\propto 1/\sqrt{M}$). The molar mass (in g/mol) of the gas is:
- a) 25 b) 35 c) 18 d) 31 e) 44
6. Consider the reaction: $\text{C}_2\text{H}_5\text{OH}(l) + 3\text{O}_2(g) \rightarrow 3\text{H}_2\text{O}(g) + 2\text{CO}_2(g)$, $\Delta H = -1236 \text{ kJ}$. If the reaction mixture expands under constant pressure and does work on the surroundings equal to 5.0 kJ, then ΔU (internal energy change) for the reaction (in kJ/mol) is:
- a) -1231 b) -1237 c) -1251 d) -1241 e) -1246
7. When 0.0500 mol of $\text{HCl}(aq)$ reacted with 0.0500 mol of $\text{NaOH}(aq)$ in a coffee cup calorimeter, the temperature of the solution increases by 5.99°C . What is the enthalpy change for the following reaction (in kJ)
- $$\text{HCl}(aq) + \text{NaOH}(aq) \rightarrow \text{NaCl}(aq) + \text{H}_2\text{O}(l)$$
- Assume that the heat capacity of the calorimeter and its contents is $465.4 \text{ J/}^\circ\text{C}$.
- a) -55.8 b) -38.6 c) 38.6 d) -0.139 e) 55.8
8. All the following statements about the quantum numbers are true except:
- a) m_l has $2l + 1$ possible values. b) n may take values from 1 to ∞ .
c) m_l may take values of $+l$ to $-l$, including zero. d) l may take integral values from 1 to $n - 1$.
e) m_s may take only the values of $+1/2$ and $-1/2$
9. The ground state electron configuration of manganese atom (${}_{25}\text{Mn}$) has _____ unpaired electrons and is _____
- a) 5, paramagnetic b) 0, diamagnetic c) 2, paramagnetic d) 3, paramagnetic
e) 5, diamagnetic
10. Which of the following elements has the largest second ionization energy?
- a) Si b) Cl c) Na d) S e) Mg

11. The ground state electron configuration of ${}_{29}\text{Cu}$ atom is:

- a) $[\text{Ar}] 4s^1 3d^{10}$ b) $[\text{Ar}] 4s^1 4d^9$ c) $[\text{Kr}] 4s^1 3d^{10}$ d) $[\text{Kr}] 4s^2 3d^9$ e) $[\text{Ar}] 4s^2 3d^9$

12. Which of the following isoelectronic ions has the smallest radius:

- a) Ca^{2+} b) Mg^{2+} c) O^{2-} d) S^{2-} e) F^-

13. Which of the following compounds would be expected to have the highest melting point?

- a) NCl_3 b) OCl_2 c) MgCl_2 d) LiCl e) CCl_4

14. Which of these species have *two* resonance structures?

- a) CH_4 b) CH_2O c) H_2O d) NO_2Cl e) H_2S

15. The formal charge on N in the Lewis structure of NO_2^- is:

- a) +2 b) +1 c) 0 d) -1 e) -2

16. Which of the following compounds does not obey the octet rule?

- a) SiCl_4 b) XeCl_4 c) PH_3 d) H_2S e) NO_3^-

17. What is the molecular geometry (shape) of BrF_4^- ?

- a) T-shaped b) tetrahedral c) square planar
d) trigonal pyramidal e) seesaw or distorted tetrahedral

18. The hybridization of the central atom, P, in PCl_3 is:

- a) sp^3 b) sp^2 c) sp d) sp^3d^2 e) sp^3d

19. Which of the following compounds is polar (has a dipole moment)?

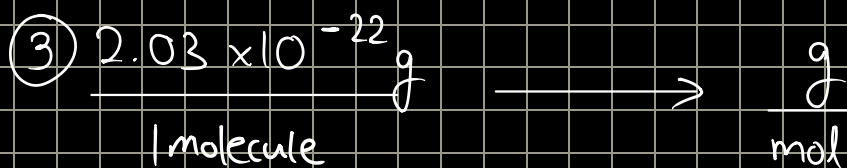
- a) CF_4 b) ClF_3 c) BeF_2 d) XeF_4 e) BF_3

20. According to valence-bond theory, the bonding in ketene, H_2CCO , is best described as

- a) five π bonds. b) three σ bonds and two π bonds.
c) four σ bonds and two π bonds. d) four σ bonds and one π bond.
e) five σ bonds.

$$\textcircled{1} \quad 0.25 \text{ m}^3 \times 100^3 = 250000 \text{ cm}^3$$

$$\frac{2.65 \text{ g}}{1 \text{ cm}^3} \times 250000 \text{ cm}^3 = 662,500 \text{ g} \Rightarrow 6.625 \text{ kg} \approx 6.6 \times 10^2 \text{ kg}$$



$$\frac{2.03 \times 10^{-22} \text{ g}}{1 \text{ molecule}} \times \frac{6.02 \times 10^{23} \text{ molecule}}{1 \text{ mol}} = 122.06 \frac{\text{g}}{\text{mol}}$$



No precipitation

↑
Soluble
Salt

↑
Soluble
Salt

Correction:

Question 4. Is A, because both CuNO_3 and NaCl produced are soluble

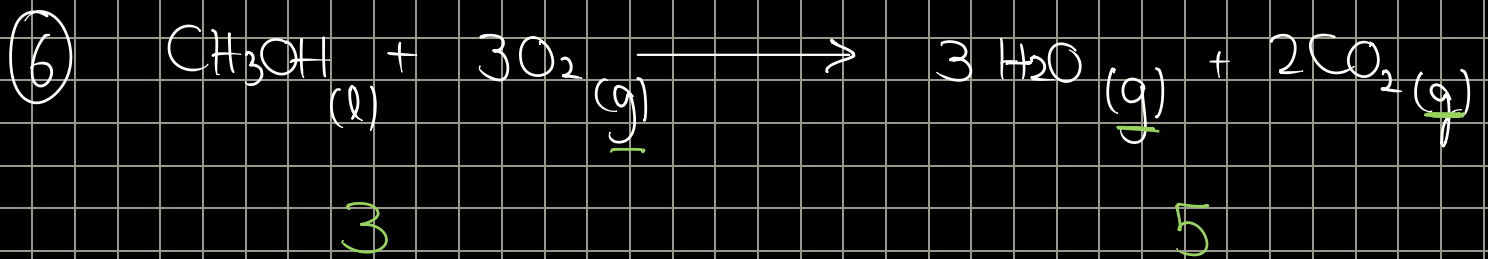
Question 8: is D, not A because ml **can** take values between $2l + 1$,

But the question is wrong anyway because technically ml **may** take values between 1 and $n - 1$

$\textcircled{5} \quad \frac{t_x}{t_{\text{N}_2}} = \sqrt{\frac{M_x}{M_{\text{N}_2}}}$

$$\frac{60}{48} = \sqrt{\frac{M_x}{28}}$$

$$M_x = 43.75 \text{ g/mol}$$



$$\Delta U = q + w$$

$$= -1236 \text{ kJ} - 5 \text{ kJ}$$

$$= \boxed{-1241 \text{ kJ}}$$

work done by System, on Surroundings.

$\textcircled{7}$ No limiting

$$Q_{\text{cal.}} = s \Delta T = 465.4 \frac{\text{J}}{\cancel{\text{g}}} \times 5 \cancel{99}^{\circ\text{C}} = 2878.746 \text{ J}$$

$$= 2.878746 \text{ kJ}$$

$$Q_{\text{rxn.}} = -Q_{\text{cal.}}$$

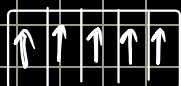
$$Q_{\text{rxn.}} = -2.878746 \text{ kJ}$$

$$\Delta H = \frac{Q_{\text{rxn.}}}{n_{\text{lim.}}} = \frac{-2.878746 \text{ kJ}}{0.05 \text{ mol}} = \boxed{-57.57 \text{ kJ/mol}}$$

$\textcircled{8}$ m has $(2l+1)$ values \rightarrow false as m_l from $-l \leq m_l \leq l$

$\textcircled{9}$ Mn: $25e^-$

[Ar] $4s^2 3d^5$

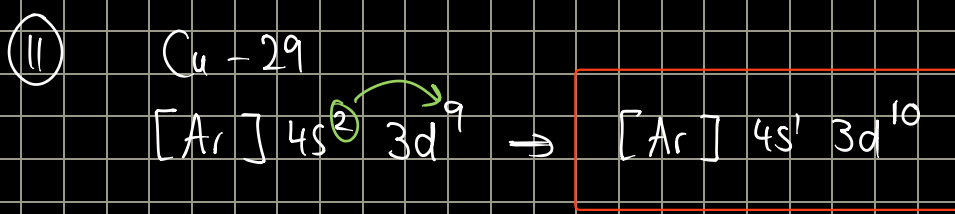


5 unpaired e^- s

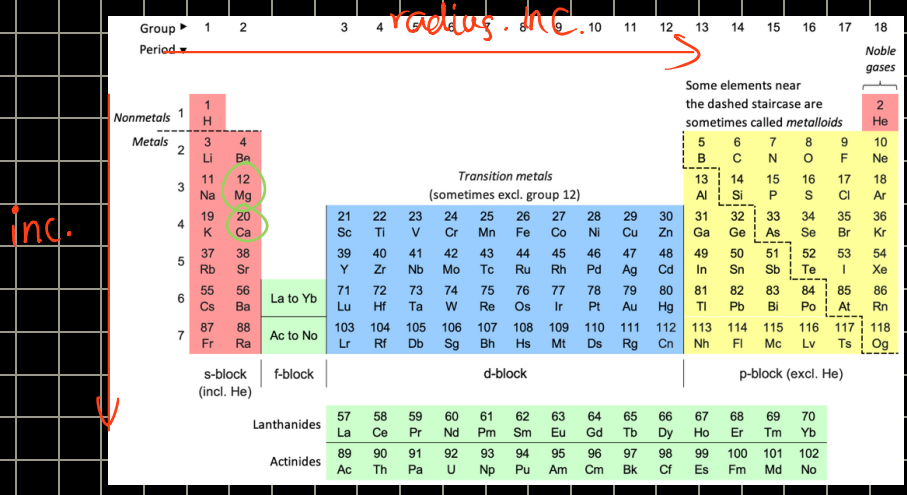
presence of unpaired $e^- \Rightarrow$ para.



Na already achieved Noble Gas Config. when it became Na^+ , it is hard to remove extra e^- s from inner shells



⑫ Smallest Radius \Rightarrow +vely charged, either Ca^{2+} or Mg^{2+}



Mg^{2+} is smaller than Ca^{2+}

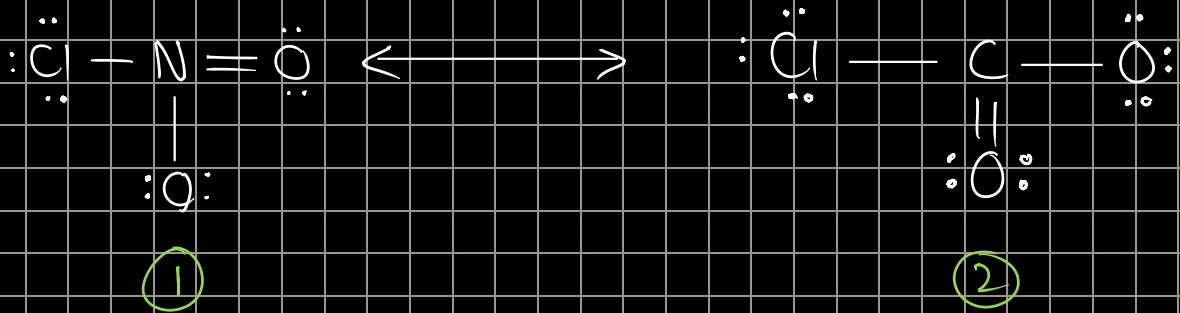
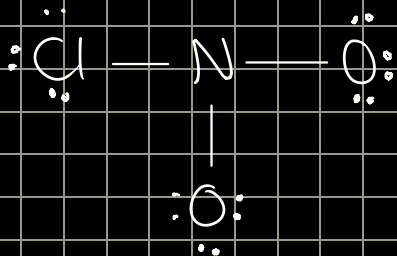
⑬ Highest MP \Rightarrow largest Q_1, Q_2 , smallest r

$\begin{array}{l}
 NCl_3 \\
 OCl_2 \\
 CCl_4
 \end{array}
 \left. \vphantom{\begin{array}{l} NCl_3 \\ OCl_2 \\ CCl_4 \end{array}} \right\} \text{Covalent compounds, low MP}$

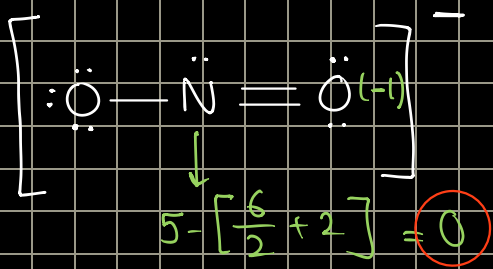
$MgCl_2$ vs. $LiCl$
 highest Q_1, Q_2

∴ highest MP is MgCl_2

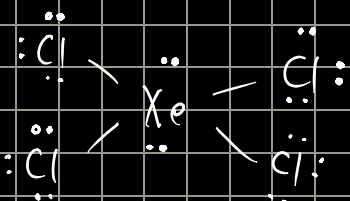
(14) $\text{NO}_2\text{Cl} \Rightarrow 5 + 2(6) + 7 = 24e^-$



(15) $\text{NO}_2^- : 5 + 2(6) + 1 = 18e^-$

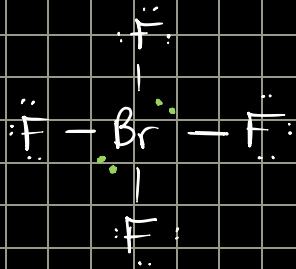


(16) $\text{XeCl}_4 = 8 + 4(7) = 36e^-$

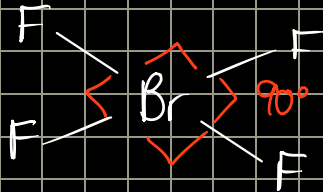


Doesn't obey octet

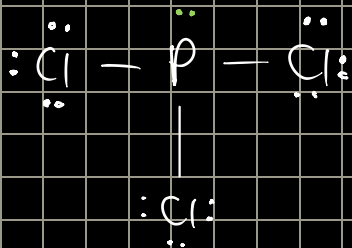
17) $\text{BrF}_4^- = 7 + 4(7) + 1 = 36e^-$



4 BP
2 LP
Square planar



18) $\text{PCl}_3 = 5 + 3(7) = 26e^-$

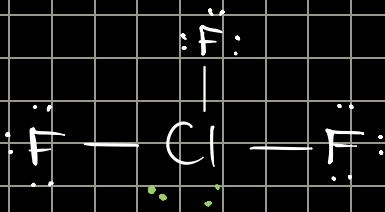


4 electron domains
around P.

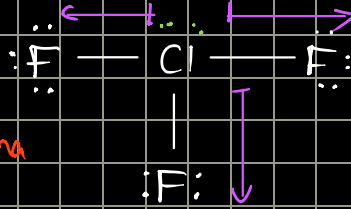
3 BP + 1 LP

sp^3

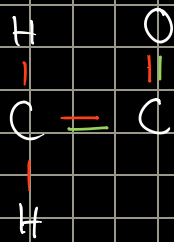
19) $\text{ClF}_3 = 7 + 3(7) = 28e^-$



T-shape, polar



20) H_2CCO



σ -Sigma

π -pi

4 σ
2 π

Instructor's name:

Section:

Name (in Arabic):

Student ID:

- 1) The number with the most significant zeros is _____.
- A) 250000001 B) 0.00002510 C) 2.5100000 D) 0.02500001 E) 2.501×10^{-7}
- 2) The correct name for HNO_2 is _____.
- A) nitrous acid B) pernitric acid C) nitric acid D) hyponitrous acid E) hydrogen nitrate
- 3) Calculate the percentage by mass of hydrogen in $\text{PtCl}_2(\text{NH}_3)_2$.
- A) 1.008 B) 0.034 C) 1.558 D) 0.672 E) 2.016
- 4) What mass in grams of hydrogen is produced by the reaction of 4.73 g of magnesium with 1.83 g of water?
- $$\text{Mg (s)} + 2\text{H}_2\text{O (l)} \rightarrow \text{Mg(OH)}_2 \text{ (s)} + \text{H}_2 \text{ (g)}$$
- A) 0.102 B) 0.204 C) 0.0485 D) 0.219 E) 0.0162
- 5) How many moles of Na^+ are present in 343 mL of a 1.27 M solution of Na_2SO_4 ?
- A) 1.31 B) 0.436 C) 0.871 D) 11.1 E) 3.70
- 6) Which of the following is not part of the kinetic-molecular theory?
- A) Atoms are neither created nor destroyed by ordinary chemical reactions.
 B) The volume occupied by all of the gas molecules in a container is negligible compared to the volume of the container.
 C) Gases consist of molecules in continuous, random motion.
 D) Collisions between gas molecules do not result in the loss of energy.
 E) Attractive and repulsive forces between gas molecules are negligible.
- 7) The value of ΔH° for the reaction below is -72 kJ. _____ kJ of heat are released when 80.9 grams of HBr is formed in this reaction.
- $$\text{H}_2 \text{ (g)} + \text{Br}_2 \text{ (g)} \rightarrow 2\text{HBr (g)}$$
- A) -72 B) 0.44 C) 72 D) 36 E) 144
- 8) Which one of the following is not a valid value for the magnetic quantum number of an electron in a 5d subshell?
- A) 1 B) 2 C) 3 D) -1 E) 0
- 9) Of the following, which gives the correct order for atomic radius for Mg, Na, P, Si and Ar?
- A) $\text{Si} > \text{P} > \text{Ar} > \text{Na} > \text{Mg}$
 B) $\text{Na} > \text{Mg} > \text{Si} > \text{P} > \text{Ar}$
 C) $\text{Ar} > \text{P} > \text{Si} > \text{Mg} > \text{Na}$
 D) $\text{Ar} > \text{Si} > \text{P} > \text{Na} > \text{Mg}$
 E) $\text{Mg} > \text{Na} > \text{P} > \text{Si} > \text{Ar}$
- 10) Of the choices below, which gives the order for first ionization energies?
- A) $\text{Ga} > \text{Ge} > \text{Se} > \text{Br} > \text{Kr}$
 B) $\text{Kr} > \text{Se} > \text{Br} > \text{Ga} > \text{Ge}$
 C) $\text{Ga} > \text{Br} > \text{Ge} > \text{Kr} > \text{Se}$
 D) $\text{Kr} > \text{Br} > \text{Se} > \text{Ge} > \text{Ga}$
 E) $\text{Br} > \text{Se} > \text{Ga} > \text{Kr} > \text{Ge}$

11) Which of the following is an isoelectronic series?

A) O^{2-} , F $^-$, Ne, Na $^+$

B) S, Cl, Ar, K

C) B^{5+} , Si^{4+} , As^{3+} , Te^{2+}

D) F $^-$, Cl $^-$, Br $^-$, I $^-$

E) Si^{2+} , P^{2+} , S^{2+} , Cl^{2+}

12) The Lewis structure of N_2H_2 shows _____.

A) each nitrogen has two nonbonding electron pairs

B) each hydrogen has one nonbonding electron pair

C) a nitrogen-nitrogen single bond

D) a nitrogen-nitrogen triple bond

E) each nitrogen has one nonbonding electron pair

13) Of the bonds C-C, C=C, and C \equiv C, the C-C bond is _____.

A) weakest/shortest

B) strongest/shortest

C) strongest/longest

D) intermediate in both strength and length

E) weakest/longest

14) How many equivalent resonance structures can be drawn for the molecule of SO_3 without having to violate the octet rule on the sulfur atom?

A) 3

B) 2

C) 1

D) 5

E) 4

15) Given the electronegativities below, which covalent single bond is most polar?

Element:

H C N O

Electronegativity:

2.1 2.5 3.0 3.5

A) O—C

B) O—H

C) O—N

D) C—H

E) N—H

16) The ground-state electron configuration of the element _____ is $[Kr]5s^14d^5$.

A) Nb

B) Tc

C) Cr

D) Mn

E) Mo

17) The F-B-F bond angle in the BF_2^- ion is approximately _____.

A) 90°

B) 109.5°

C) 120°

D) 180°

E) 60°

18) There are _____ σ and _____ π bond(s) in the $H_2C=CH_2$ molecule.

A) 3 and 4

B) 5 and 1

C) 3 and 2

D) 2 and 3

E) 4 and 3

19) The molecular geometry of the PF_4^+ ion is _____.

A) trigonal pyramidal

B) octahedral

C) trigonal bipyramidal

D) tetrahedral

E) trigonal planar

20) The hybrid orbitals used for bonding by Xe in the unstable XeF_2 molecule are _____ orbitals.

A) sp^3d^2

B) sp

C) sp^2

D) sp^3

E) sp^3d

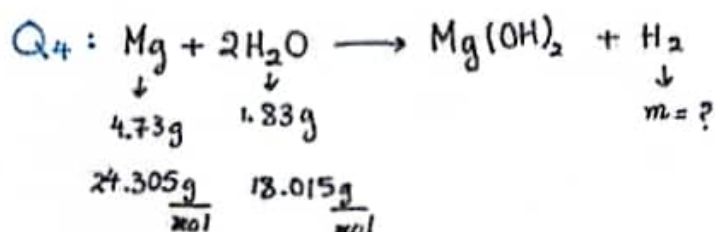
Good Luck

$$Q_1: \underline{a} \quad 250000001.$$

$$Q_2: \text{HNO}_2 \rightarrow \text{nitrous acid} \Rightarrow \underline{a}$$

$$Q_3: \text{molar mass of } \text{PtCl}_2(\text{NH}_3)_2 = 300.04504 \text{ g/mol.}$$

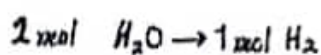
$$\% \text{H} = \frac{1.008 \text{ g/mol H}}{300.0450 \text{ g/mol } \text{PtCl}_2(\text{NH}_3)_2} \times \frac{6 \text{ mol H}}{1 \text{ mol } \text{PtCl}_2(\text{NH}_3)_2} \times 100\% = 2.016\% \rightarrow \underline{E}$$



$$n_{\text{Mg}} = \frac{4.73}{24.305} = 0.195 \text{ mol}$$

$$1 \text{ mol Mg} \rightarrow 1 \text{ mol H}_2 \rightarrow n_{\text{Mg}} = n_{\text{H}_2} = 0.195 \text{ mol}$$

$$n_{\text{H}_2\text{O}} = \frac{1.83}{18.015} = 0.102 \text{ mol}$$



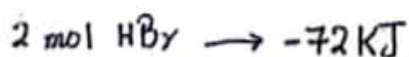
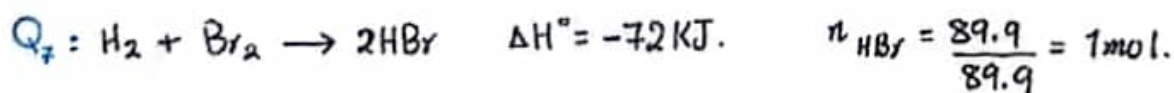
$$0.102 \rightarrow n_{\text{H}_2} \Rightarrow n_{\text{H}_2} = \frac{0.102}{2} = 0.051 \text{ mol} \rightarrow \text{limit}$$

$$\rightarrow m_{\text{H}_2} = 0.051 \text{ mol} \times \frac{2.016 \text{ g}}{\text{mol}} = 0.102 \text{ g} \rightarrow \underline{a}$$

$$Q_5: n_{\text{Na}_2\text{SO}_4} = 0.3432 \times 1.27 \frac{\text{mol}}{\text{L}} = 0.43561 \text{ mol.}$$

$$0.43561 \text{ mol Na}_2\text{SO}_4 \times \frac{2 \text{ mol Na}^+}{1 \text{ mol Na}_2\text{SO}_4} = 0.871 \text{ mol.}$$

$$Q_6: \underline{A}$$



$$1 \text{ mol HBr} \rightarrow q \rightarrow q = \frac{-72}{2} = \ominus 36 \text{ KJ} \rightarrow \underline{D}$$

↳ released

Q₈: $5d \rightarrow l=2 \rightarrow m_l = -2, -1, 0, 1, 2 \rightarrow 3$ is not valid $\rightarrow \underline{C}$

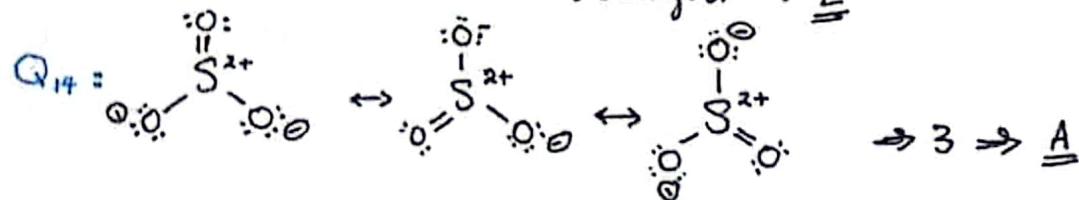
Q₉: $Na > Mg > Si > P > Ar \Rightarrow \underline{B}$

Q₁₀: $Kr > Br > Se > Ge > Ga \rightarrow \underline{D}$

Q₁₁: $O^{2-}, F^-, Ne, Na^+ \rightarrow \underline{A}$

Q₁₂: $N_2 H_2 \rightarrow \begin{array}{c} \ddot{N} \\ | \\ H \end{array} = \begin{array}{c} \ddot{N} \\ | \\ H \end{array}$ each N has one nonbonding electron pair $\rightarrow \underline{E}$

Q₁₃: C-C bond is weakest, longest $\rightarrow \underline{E}$



Q₁₅: most polar \Rightarrow highest E.N. difference.

$$O-C \rightarrow \Delta EN = 3.5 - 2.5 = 1$$

$$C-H \rightarrow \Delta EN = 2.5 - 2.1 = 0.4$$

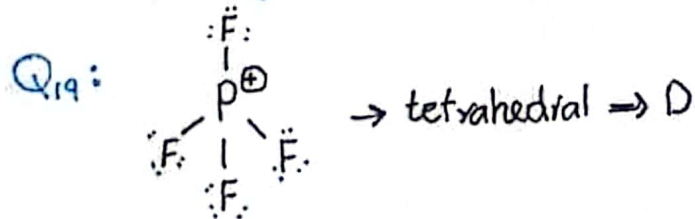
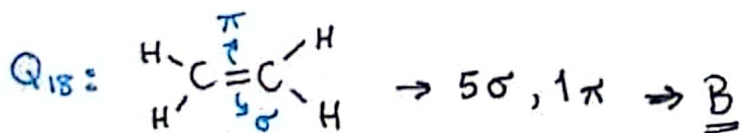
$$O-H \rightarrow \Delta EN = 3.5 - 2.1 = 1.4 \rightarrow \underline{B}$$

$$N-H \rightarrow \Delta EN = 3 - 2.1 = 0.9$$

$$O-N \rightarrow \Delta EN = 3.5 - 3 = 0.5$$

Q₁₆: $^{42}\text{Mo} ([Kr] 5s^1 4d^5) \rightarrow 36 + 1 + 5 = 42 \rightarrow \underline{E}$

Q₁₇: $\text{BrF}_2^- \rightarrow [\text{F} \text{---} \text{Br} \text{---} \text{F}]^- \rightarrow AX_2E_3 \rightarrow \text{linear} \rightarrow 180^\circ \rightarrow \underline{D}$



Q₂₀: $\text{XeF}_2 \rightarrow \text{:F:} \text{---} \text{Xe} \text{---} \text{F:} \rightarrow sp^3d \rightarrow \underline{E}$

8 + 14

① 2.5100000
All significant

5 sig.

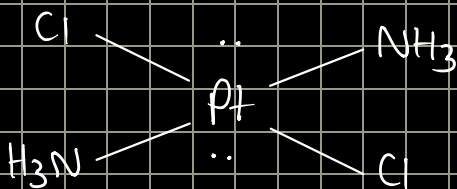
0.02500001
insign. significant

4 sig.

② HNO_2 (Nitrous)

Note: HNO_3 is Nitric Acid

③ $PtCl_2(NH_3)_2$



The Periodic Table of the Elements

| Key | |
|-----------------------------------|-------------------------------------|
| relative atomic mass | atomic symbol |
| atomic (proton) number | |
| 1 H hydrogen 1 | 4 He helium 2 |
| 7 Li lithium 3 | 9 Be beryllium 4 |
| 23 Na sodium 11 | 24 Mg magnesium 12 |
| 39 K potassium 19 | 40 Ca calcium 20 |
| 85 Rb rubidium 37 | 86 Sr strontium 38 |
| 133 Cs cesium 55 | 137 Ba barium 56 |
| [223] Fr francium 87 | [226] Ra radium 88 |
| [227] Ac actinium 89 | [261] Rf rutherfordium 104 |
| [262] Db dubnium 105 | [266] Sg seaborgium 106 |
| [264] Bh bohrium 107 | [277] Hs hassium 108 |
| [268] Mt meitnerium 109 | [271] Ds darmstadtium 110 |
| [272] Rg roentgenium 111 | |

6(1)

x 100 %

$$195 + 2(17) + 2(35.5)$$

$$= 2.0\%$$



limiting:

$$\frac{4.73g}{12} \times 1 = 0.394 \text{ mol}$$

Mg

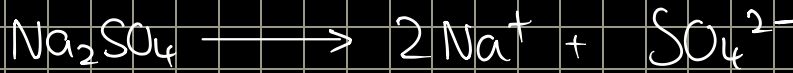
$$\frac{1.83g}{18} \times 1 = 0.11 \text{ mol}$$

H₂O

$$0.11 < 0.394 \therefore H_2O \text{ limiting}$$

$$1.83 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2}{2 \text{ mol H}_2\text{O}} \times \frac{2 \text{ g H}_2}{1 \text{ mol H}_2} = 0.1016 \text{ g H}_2 \approx 0.11 \text{ g H}_2$$

$$\textcircled{5} \quad \frac{1.27 \text{ mol Na}_2\text{SO}_4}{1} \times \frac{0.343 \text{ L}}{1} = 0.43561 \text{ mol Na}_2\text{SO}_4$$



$$0.43561 \text{ mol} \xrightarrow{\times 2} 0.87122 \text{ mol Na}^+$$

$\textcircled{6}$ Atoms are neither created nor destroyed

$$\textcircled{7} \quad \Delta H = -72 \text{ kJ} = -36 \text{ kJ/mol HBr}$$

$$\Delta H = \frac{-72 \text{ kJ}}{2 \text{ mol HBr}} = \frac{-36 \text{ kJ}}{1 \text{ mol HBr}}$$

$$80.9 \text{ g HBr} \times \frac{1 \text{ mol HBr}}{81 \text{ g HBr}} = 0.998 \text{ mol HBr}$$

The Periodic Table of the Elements

| 1 | | 2 | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------|-----------------------------|--------------------------------|-------------------------------------|-------------------------------|----------------------------------|-------------------------------|-------------------------------|----------------------------------|------------------------------------|-----------------------------------|---|---------------------------|----------------------------|-----------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------------------|-----------------------------|--------------------------------|-----------------------------|------------------------------|----------------------------|----------------------------|------------------------------|---------------------------|------------------------------|---------------------------|--------------------------|---------------------------|-----------------------------|----------------------------|---------------------------|----------------------------|---------------------------|---------------------------|--------------------------|---------------------------|----------------------------|------------------------|---------------------------|----------------------------|------------------------|---------------------------|----------------------------|----------------------------|-------------------------|
| 1 H hydrogen 1 | | | | | | | | | | | 3 Li lithium 3 | 4 Be beryllium 4 | 5 B boron 5 | 6 C carbon 6 | 7 N nitrogen 7 | 8 O oxygen 8 | 9 F fluorine 9 | 10 Ne neon 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 Na sodium 11 | 12 Mg magnesium 12 | 13 Al aluminum 13 | 14 Si silicon 14 | 15 P phosphorus 15 | 16 S sulfur 16 | 17 Cl chlorine 17 | 18 Ar argon 18 | 19 K potassium 19 | 20 Ca calcium 20 | 21 Sc scandium 21 | 22 Ti titanium 22 | 23 V vanadium 23 | 24 Cr chromium 24 | 25 Mn manganese 25 | 26 Fe iron 26 | 27 Co cobalt 27 | 28 Ni nickel 28 | 29 Cu copper 29 | 30 Zn zinc 30 | 31 Ga gallium 31 | 32 Ge germanium 32 | 33 As arsenic 33 | 34 Se selenium 34 | 35 Br bromine 35 | 36 Kr krypton 36 | | | | | | | | | | | | | | | | | | | | | | | | |
| 37 Rb rubidium 37 | 38 Sr strontium 38 | 39 Y yttrium 39 | 40 Zr zirconium 40 | 41 Nb niobium 41 | 42 Mo molybdenum 42 | 43 Tc technetium 43 | 44 Ru ruthenium 44 | 45 Rh rhodium 45 | 46 Pd palladium 46 | 47 Ag silver 47 | 48 Cd cadmium 48 | 49 In indium 49 | 50 Sn tin 50 | 51 Sb antimony 51 | 52 Te tellurium 52 | 53 I iodine 53 | 54 Xe xenon 54 | 55 Cs cesium 55 | 56 Ba barium 56 | 57 La* lanthanum 57 | 58 Ce cerium 58 | 59 Pr praseodymium 59 | 60 Nd neodymium 60 | 61 Pm promethium 61 | 62 Sm samarium 62 | 63 Eu europium 63 | 64 Gd gadolinium 64 | 65 Tb terbium 65 | 66 Dy dysprosium 66 | 67 Ho holmium 67 | 68 Er erbium 68 | 69 Tm thulium 69 | 70 Yb ytterbium 70 | 71 Lu lutetium 71 | 72 Hf hafnium 72 | 73 Ta tantalum 73 | 74 W tungsten 74 | 75 Re rhenium 75 | 76 Os osmium 76 | 77 Ir iridium 77 | 78 Pt platinum 78 | 79 Au gold 79 | 80 Hg mercury 80 | 81 Tl thallium 81 | 82 Pb lead 82 | 83 Bi bismuth 83 | 84 Po polonium 84 | 85 At astatine 85 | 86 Rn radon 86 |
| [223] Fr francium 87 | [226] Ra radium 88 | [227] Ac* actinium 89 | [261] Rf rutherfordium 104 | [262] Db dubnium 105 | [266] Sg seaborgium 106 | [264] Bh bohrium 107 | [277] Hs hassium 108 | [268] Mt meitnerium 109 | [271] Ds darmstadtium 110 | [272] Rg roentgenium 111 | Elements with atomic numbers 112-116 have been reported but not fully authenticated | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

$$\frac{-36 \text{ kJ}}{1 \text{ mol HBr}} \times 0.998 \text{ mol HBr} = -35.95 \text{ kJ} \Rightarrow -36 \text{ kJ}$$

$\Rightarrow 36 \text{ kJ released}$

$\textcircled{8}$ $5d \rightarrow l = 2$

$n = 5$

$-l < m_l < l$

$-2 < m_l < 2$

$\therefore +3 \text{ is impossible}$

| | | | | | |
|---|---|---|---|---|---|
| n | 1 | 2 | 3 | 4 | 5 |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 1 | 0 | 0 |
| 3 | 0 | 0 | 0 | 1 | 0 |
| 4 | 0 | 0 | 0 | 0 | 1 |

9

radius inc.

The Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | | | |
|-------------------------------|-----------------------------|---|-------------------------------------|-------------------------------|----------------------------------|--------------------------------|-------------------------------|----------------------------------|------------------------------------|-----------------------------------|---|-----------------------------|-----------------------------|-----------------------------|-------------------------------|-------------------------------|----------------------------|--|--|
| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 | | |
| | | Key | | | | | | | | | | | | | | | | | |
| | | relative atomic mass atomic symbol atomic (proton) number | | | | | | | | | | | | | | | | | |
| 7 Li lithium 3 | 9 Be beryllium 4 | | | | | | | | | | | 11 B boron 5 | 12 C carbon 6 | 14 N nitrogen 7 | 16 O oxygen 8 | 19 F fluorine 9 | 20 Ne neon 10 | | |
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| 85 Rb rubidium 37 | 88 Sr strontium 38 | 89 Y yttrium 39 | 91 Zr zirconium 40 | 93 Nb niobium 41 | 96 Mo molybdenum 42 | [98] Tc technetium 43 | 101 Ru ruthenium 44 | 103 Rh rhodium 45 | 106 Pd palladium 46 | 108 Ag silver 47 | 112 Cd cadmium 48 | 115 In indium 49 | 119 Sn tin 50 | 122 Sb antimony 51 | 128 Te tellurium 52 | 127 I iodine 53 | 131 Xe xenon 54 | | |
| 133 Cs caesium 55 | 137 Ba barium 56 | 139 La* lanthanum 57 | 178 Hf hafnium 72 | 181 Ta tantalum 73 | 184 W tungsten 74 | 186 Re rhenium 75 | 190 Os osmium 76 | 192 Ir iridium 77 | 195 Pt platinum 78 | 197 Au gold 79 | 201 Hg mercury 80 | 204 Tl thallium 81 | 207 Pb lead 82 | 209 Bi bismuth 83 | [209] Po polonium 84 | [210] At astatine 85 | [222] Rn radon 86 | | |
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radius inc.

9

Na > Mg > Si > P > Ar

10

inc.

The Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | | | |
|-------------------------------|-----------------------------|---|-------------------------------------|-------------------------------|----------------------------------|--------------------------------|-------------------------------|----------------------------------|------------------------------------|-----------------------------------|---|-----------------------------|-----------------------------|-----------------------------|-------------------------------|-------------------------------|----------------------------|--|--|
| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 | | |
| | | Key | | | | | | | | | | | | | | | | | |
| | | relative atomic mass atomic symbol atomic (proton) number | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | 11 B boron 5 | 12 C carbon 6 | 14 N nitrogen 7 | 16 O oxygen 8 | 19 F fluorine 9 | 20 Ne neon 10 | | |
| | | | | | | | | | | | | 27 Al aluminium 13 | 28 Si silicon 14 | 31 P phosphorus 15 | 32 S sulphur 16 | 35.5 Cl chlorine 17 | 40 Ar argon 18 | | |
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| 133 Cs caesium 55 | 137 Ba barium 56 | 139 La* lanthanum 57 | 178 Hf hafnium 72 | 181 Ta tantalum 73 | 184 W tungsten 74 | 186 Re rhenium 75 | 190 Os osmium 76 | 192 Ir iridium 77 | 195 Pt platinum 78 | 197 Au gold 79 | 201 Hg mercury 80 | 204 Tl thallium 81 | 207 Pb lead 82 | 209 Bi bismuth 83 | [209] Po polonium 84 | [210] At astatine 85 | [222] Rn radon 86 | | |
| [223] Fr francium 87 | [226] Ra radium 88 | [227] Ac* actinium 89 | [261] Rf rutherfordium 104 | [262] Db dubnium 105 | [266] Sg seaborgium 106 | [264] Bh bohrium 107 | [277] Hs hassium 108 | [277] Mt meitnerium 109 | [271] Ds darmstadtium 110 | [272] Rg roentgenium 111 | Elements with atomic numbers 112-116 have been reported but not fully authenticated | | | | | | | | |

inc.

Kr > Br > Se > Ge > Ga

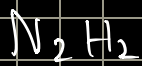
11

O^{2-} , F^- , Ne, Na^+

(8+2) (9+1) (10) (11-1)

10e⁻

12



$$\begin{array}{r}
 2N \quad 2 \times 5 \\
 2H \quad 2 \times 1 \\
 \hline
 12e^-
 \end{array}$$



$$2(2) + 2(3) = 10e^-$$

$12e^- - 10e^- = 2e^- \Rightarrow$ add double bond b/w N.



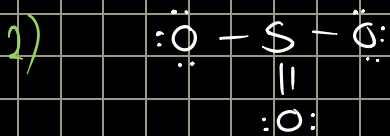
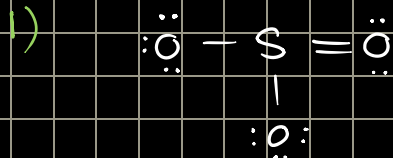
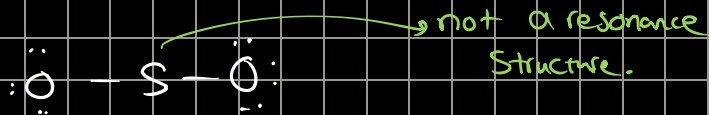
$$5 - \left[\frac{6}{2} + 2 \right] = 0$$

FC = 0 ✓
Sum of FC = 0 ✓

13



$$6 + 3(6) = 24e^-$$





Chemistry 101

Final Exam021

Final 021

1. A 1.728 in³ substance has a mass of 36 grams. What is the density of the substance in g/cm³?
(1 inch = 2.54 cm)

A) 21
B) 5.6
C) 30
D) 14
E) 1.3

Answer: E

2. What is the atomic weight of an element consisting of two isotopes, one with mass = 64.23 amu, relative abundance = 0.260, and one with mass = 65.32 amu?

A) 65.3 amu
B) 64.4 amu
C) 64.9 amu
D) 65.0 amu
E) 64.8 amu

Answer: D

3. If 2.89 g of an osmium oxide contains 2.16 g of osmium (molar mass = 190.23 g/mol), what is the empirical formula of the oxide?

A) O₅O₃
B) O₅O₄
C) O₅O₅
D) O₅O
E) O₅O₂

Answer: B

4. When 250. mL of a 0.15 M solution of (NH₄)₂S is added into 120. mL of a 0.053 M solution of CdSO₄, how many grams of CdS are formed? (Molar mass of CdS = 144.5 g/mol)



A) 5.4g
B) 0.92g
C) 2.6g
D) 1.9g
E) 530g

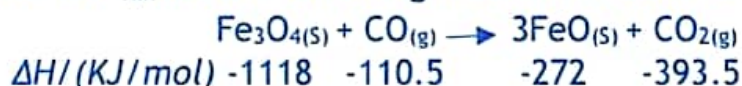
Answer: B

5. Three 1.0-liter flasks are filled with H_2 , O_2 and Ne, respectively, at STP, which of the following statements is true?

- A) Each flask has the same number of gas molecules.
- B) The velocity of the gas molecules is the same in each flask.
- C) The density of all gases is the same.
- D) There are twice as many Ne atoms than O_2 and H_2 .
- E) None of the above is true.

Answer: E

6. Calculate ΔH°_{rxn} for the following reaction at 25.0 °C :



- A) -263 KJ
- B) 54 KJ
- C) 109 KJ
- D) -50 KJ
- E) 19 KJ

Answer: E

7. A 0.156 mol of methanol, CH_3OH , was combusted in the presence of excess oxygen in a bomb calorimeter. If the temperature of the calorimeter increased from 24.00 °C to 29.77 °C and the heat capacity of the calorimeter and its contents was 19400. J/°C, calculate ΔU for the reaction in KJ/mol.

- A) -314 KJ/mol
- B) -789 KJ/mol
- C) -718 KJ/mol
- D) -121 KJ/mol
- E) -69.5 KJ/mol

Answer: C

8. Which statement about the four quantum numbers which describe electrons in atoms is wrong?

- A) n = principle quantum number, $n = 1, 2, 3, \dots$
- B) l = Angular momentum quantum number, $l = 1, 2, 3, \dots$
- C) m_l = magnetic quantum number, $m_l = (-l), \dots, 0, \dots, (+l)$
- D) m_s = spin quantum number, $m_s = +1/2$ or $-1/2$.
- E) The magnetic quantum number is related to the orientation of atomic orbitals in space.

Answer: B

9. Which of the following electron configurations is correct for nickel ($_{28}\text{Ni}$)?

- A) $[\text{Ar}] 4s^1 3d^9$
- B) $[\text{Kr}] 4s^1 4d^8$
- C) $[\text{Kr}] 4s^1 3d^8$
- D) $[\text{Kr}] 4s^2 3d^8$
- E) $[\text{Ar}] 4s^2 3d^8$

Answer: E

10. The valance shell electronic configuration ns^2np^4 corresponds which one of the following elements in its ground state?

- A) As
- B) Ca
- C) Cr
- D) Br
- F) S

Answer: E

11. In the ground state of cobalt ($_{27}\text{Co}$) atom there are _____ unpaired electrons and the atom is _____.

- A) 3, paramagnetic
- B) 5, paramagnetic
- C) 2, diamagnetic
- D) 0, diamagnetic
- E) 2, paramagnetic

Answer: A

12. Which one of the compounds below is most likely to be ionic?

- A) GaAs
- B) ScCl_3
- C) NO_2
- D) CCl_4
- E) ClO_2

Answer: A

13. The Lewis structure for hydrogen cyanide (HCN) shows:

- A) 2 double bonds and two lone pairs of electrons on the N atom.
- B) 1 C-H, 1 C=N bond, 1 lone pair of electrons on the C atom and 1 lone pair of electrons on the N atom.
- C) 1 C-H, 1 C-N bond, 2 lone pair of electrons on the C atom and 3 lone pair of electrons on the N atom.
- D) 1 triple bond between C and N , 1 N-H bond and 2 lone pairs of electrons on the C atom.
- E) 1 triple bond between C and N , 1 C-H bond and 1 lone pairs of electrons on the N atom.

Answer: E

14. In the Lewis structure of XeBr_4 molecule, the number of lone pairs of electrons around the central Xe atom is:

- A) 0
- B) 1
- C) 2
- D) 3
- E) 4

Answer: C

15. Which one of the following does not obey the octet rule?

- A) PCl_3
- B) CBr_4
- C) NF_3
- D) OF_2
- E) AsF_3

Answer: E

16. Which of the following ions has the largest ionic radius?

- A) Cl^-
- B) Ca^{2+}
- C) P^{3-}
- D) K^+
- E) S^{2-}

Answer: C

17. The geometry around each carbon atom in C_2H_4 is:

- A) trigonal planar
- B) linear
- C) tetrahedral
- D) octahedral
- E) trigonal pyramidal

Answer: A

18. Which of the following four molecules is (are) polar: PH_3 , OF_2 , HF , BCl_3 ?

- A) all except BCl_3
- B) only HF
- C) only HF and OF_2
- D) none of them
- E) all of them

Answer: A

19. What kind of hybrid orbitals are utilized by the carbon atom in CF_4 molecules?

- A) sp
- B) sp^2
- C) sp^3
- D) $sp^3 d$
- E) $sp^3 d^2$

Answer: C

20. Which of the following represents the number of π bonds and σ bonds in the best Lewis structure of H_2SO_4 ?

- A) 6 σ and 2 π
- B) 4 σ and 2 π
- C) 4 σ and 4 π
- D) 6 σ and one π
- E) 5 σ and 2 π

Answer: A

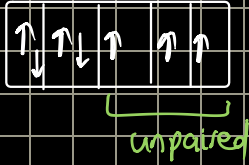
$$\Delta U = \Delta H - \Delta nRT$$

8) B , as l can take a value of 0

9) $[Ar] 4s^2 3d^8$

10) $ns^2 np^4 \Rightarrow 2+4=6$ group 6. $\Rightarrow S$

11) $[Ar] 4s^2 3d^7$



paramagnetic.

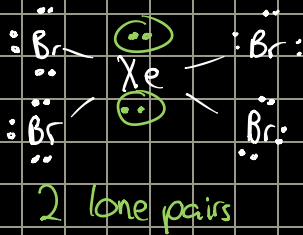
12) $B?$

13) $HCN \quad 1+4+5=10$



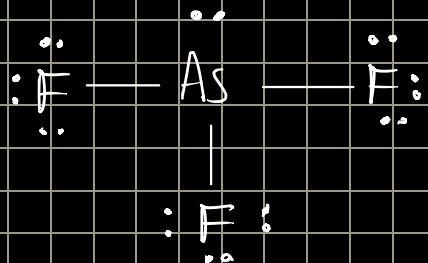
14) $XeBr_4$

$$8 + 4(7) = 36e^-$$



15) ? All obey octet rule

$$AsF_3 \quad 5 + 3(7) = 26$$



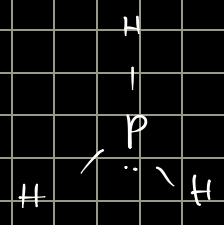
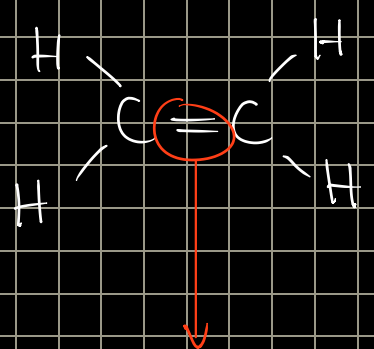
16) largest -ve charge \Rightarrow largest radius (P^{3-})

The Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 1 H hydrogen 1 | 2 He helium 4 | 3 Li lithium 7 | 4 Be beryllium 9 | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 | 11 Na sodium 23 | 12 Mg magnesium 24 | 13 Al aluminum 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 39.9 | 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 63.5 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 | 37 Rb rubidium 85.5 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium [98] | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 51 Sb antimony 122 | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 | 55 Cs cesium 133 | 56 Ba barium 137 | 57 La* lanthanum 139 | 58 Ce cerium 140 | 59 Pr praseodymium 141 | 60 Nd neodymium 145 | 61 Pm promethium [147] | 62 Sm samarium 150 | 63 Eu europium 152 | 64 Gd gadolinium 157 | 65 Tb terbium 159 | 66 Dy dysprosium 163 | 67 Ho holmium 165 | 68 Er erbium 167 | 69 Tm thulium 169 | 70 Yb ytterbium 173 | 71 Lu lutetium 175 | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium [209] | 85 At astatine [210] | 86 Rn radon [222] | 87 Fr francium [223] | 88 Ra radium [226] | 89 Ac* actinium [227] | 90 Th thorium [232] | 91 Pa protactinium [231] | 92 U uranium [238] | 93 Np neptunium [237] | 94 Pu plutonium [244] | 95 Am americium [243] | 96 Cm curium [247] | 97 Bk berkelium [247] | 98 Hf hassium [265] | 99 Mt meitnerium [268] | 100 Ds darmstadtium [271] | 101 Rg roentgenium [272] |
|-------------------------|------------------------|-------------------------|---------------------------|-----------------------|------------------------|--------------------------|------------------------|--------------------------|------------------------|--------------------------|-----------------------------|----------------------------|---------------------------|-----------------------------|-------------------------|------------------------------|---------------------------|----------------------------|---------------------------|----------------------------|----------------------------|---------------------------|----------------------------|-----------------------------|------------------------|--------------------------|--------------------------|----------------------------|------------------------|---------------------------|-----------------------------|---------------------------|----------------------------|---------------------------|---------------------------|------------------------------|-----------------------------|--------------------------|-----------------------------|---------------------------|------------------------------|--------------------------------|------------------------------|----------------------------|------------------------------|---------------------------|----------------------------|---------------------------|------------------------|-----------------------------|------------------------------|--------------------------|--------------------------|---------------------------|---------------------------|-------------------------------|---------------------------|---------------------------------|------------------------------|---------------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|----------------------------|---------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|----------------------------|---------------------------|----------------------------|-----------------------------|-------------------------|----------------------------|-----------------------------|-------------------------|----------------------------|-------------------------------|-------------------------------|----------------------------|-------------------------------|-----------------------------|--------------------------------|------------------------------|-----------------------------------|-----------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------------------|--------------------------------|------------------------------|---------------------------------|------------------------------------|-----------------------------------|

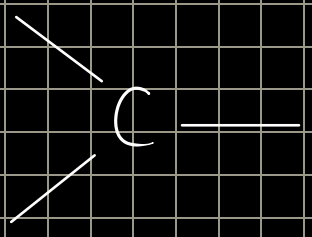
Elements with atomic numbers 112-116 have been authorized

17 C_2H_4 ethene



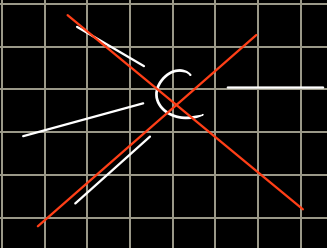
don't count double bonds as two; instead, you count each double bond as one bonding pair of electrons

So it is like this

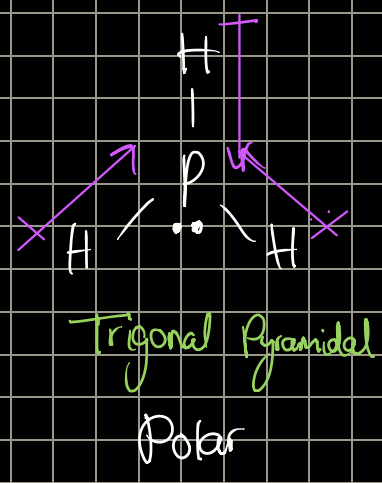


AX_3 configuration
Trigonal Planar

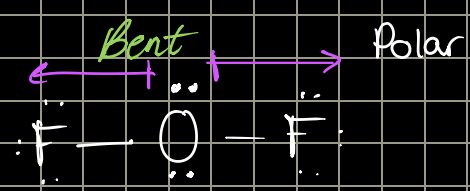
Not this



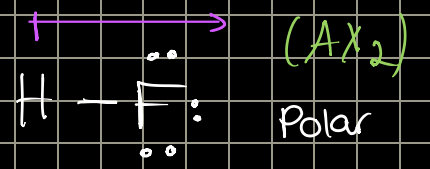
18 PH_3



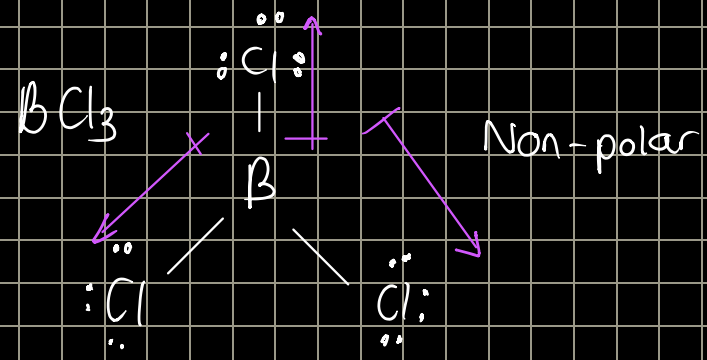
OF_2



HF

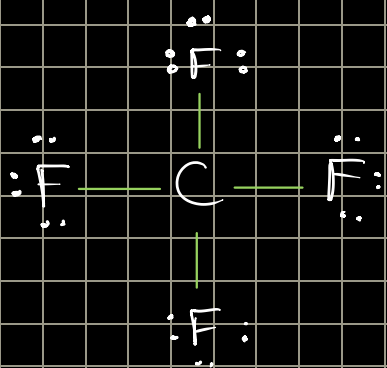


BCl_3





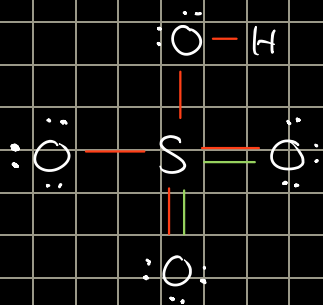
$$4 + 4(7) = 32e^-$$



4 bonds
around C
 $\Rightarrow sp^3$



$$2 + 6 + 4(6) = 32e^-$$



5 σ
2 π



Chemistry 101

Final Exam 020

Done by:

Shahed Atiyat

1. Which is a reasonable mass corresponding to 1026 molecules of a substance?

- a. 100 gram
- b. 100 microgram
- c. 100 nanogram
- d. 100 milligram
- e. 100 kilogram

2. Consider the following reaction: $2A + B \rightarrow 3C + D$; 3.0 mol A and 2.0 mol B react to form 4.0 mol C. Which is the percent yield of this reaction?

- a. 75%
- b. 67%
- c. 50%
- d. 89%
- e. 100%

3. What is the net ionic equation for the reaction of NH_3 with HNO_3 ?

- a. $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- b. $\text{H}^-(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{H}_2(\text{g})$
- c. $\text{NH}_3(\text{aq}) + \text{HNO}_3(\text{aq}) \rightarrow \text{NH}_4\text{NO}_3(\text{aq})$
- d. $\text{NH}_3(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{NH}_4^+(\text{aq})$
- e. $\text{NH}_3(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{NH}_2^-(\text{aq}) + \text{HNO}_3(\text{aq})$

4. Which of the following atoms is the most electronegative?

- a. B
- b. N
- c. Na
- d. Cs
- e. Al

5. What is the molecular geometry around an atom in a molecule or ion which is surrounded by five single bonds and no lone pairs of electrons?

- a. trigonal planar
- b. tetrahedral
- c. linear
- d. octahedral
- e. trigonal bipyramidal

6. What volume of ammonia gas measures at 547.9 mmHg and 27.6 °C, is required to produce 8.98 g of ammonium sulfate according to the following balanced chemical equation?

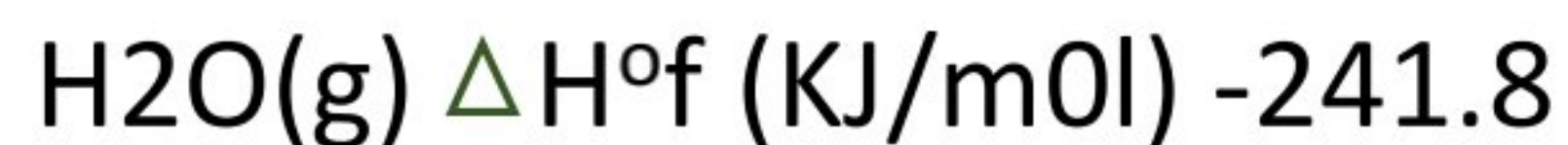
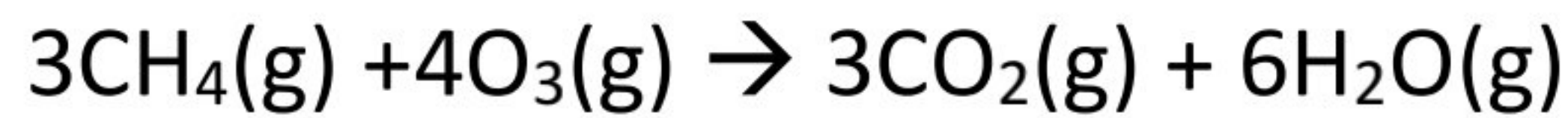


- a. L 18
- b. 1.16
- c. L 0.00397

d. L 4.65

e. L 0.000992

7. *What is the standard enthalpy change for the following reaction?*



a. +2285.1 KJ

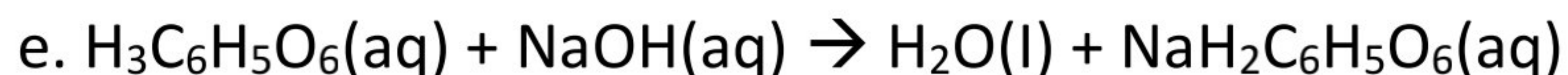
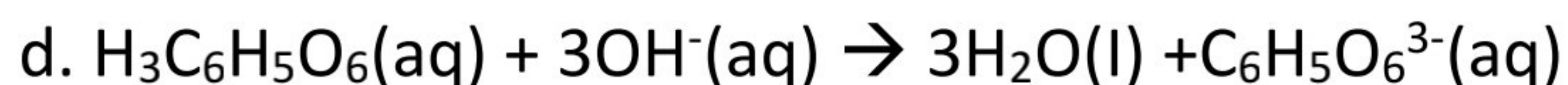
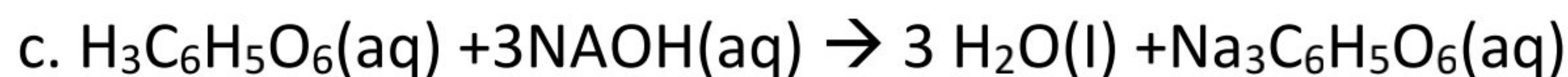
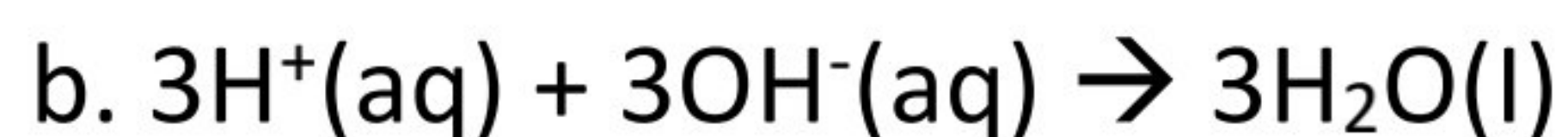
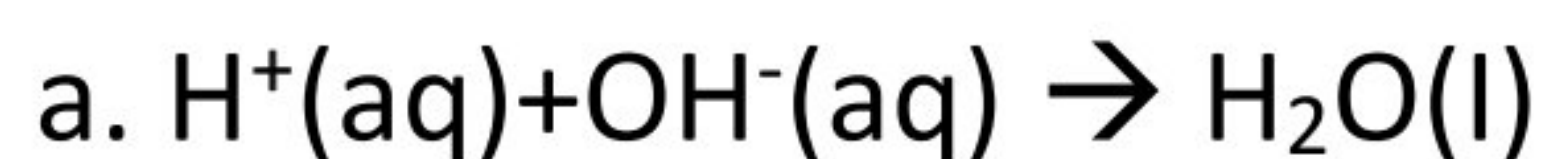
b. +2977.5 KJ

c. -3426.5 KJ

d. -2977.5 KJ

e. -2285.1 KJ

8. *What is the net ionic equation for the complete neutralization of the triprotic acid citric acid, $\text{H}_3\text{C}_6\text{H}_5\text{O}_6$, by a strong base?*



9. Which of the following electron configuration represents an excited state of the indicated atom?

- a. He: $1s^2$
- b. P: $1s^2 2s^2 2p^6 3s^2 3p^2 4s^1$
- c. Na: $1s^2 2s^2 2p^6 3s^1$
- d. Ne: $1s^2 2s^2 2p^6$
- c. N: $1s^2 2s^2 2p^3$

10. A thin sheet of iridium metal that is 3.12 cm by 5.21 cm has a mass of 87.2 g and a thickness of 2.360 mm. What is the density of iridium?

- a. 0.441 g/cm^3
- b. 0.044 g/cm^3
- c. 2.260 g/cm^3
- d. 22.600 g/cm^3
- e. $3.36 \times 10^3 \text{ g/cm}^3$

11. A 1.74 g sample for an element contains 7.887×10^{21} atoms. What is the element symbol?

- a. I
- b. Cs
- c. Cd
- d. Sb
- e. In

12. Which of the following subshells does not exist?

- a. 4d
- b. 2s
- c. 6g
- d. 3f
- e. 3p

13. which of the following compounds would be expected to have the highest melting point?

- a. OCl_2
- b. CCl_4
- c. LiCl
- d. MgCl_2
- e. NCl_3

14. The complete combustion of phenylhydrazine, $\text{C}_6\text{H}_5\text{NHNH}_2$, with the oxidizer dinitrogen tetroxide is shown in the following equation:

$__ \text{C}_6\text{H}_5\text{NHNH}_2 + __ \text{N}_2\text{O}_4 \rightarrow __ \text{CO}_2 + __ \text{H}_2\text{O} + __ \text{N}_2$; When this equation is balanced, the sum of all the coefficients (using smallest whole numbers) is:

- a. 10
- b. 30
- c. 20

d. 25

e. 15

15. Which molecule or ion has the same molecular geometry as SeO_3^{2-} ?

a. CO_3^{2-}

b. NO_3^-

c. SO_3^{2-}

d. SeO_3

e. SO_3

16. Which pair of species is isoelectronic?

a. Ne and Ar

b. Li^+ and Ne

c. K^+ and Cl^-

d. Na^+ and Be^{2+}

e. K^+ and Na^+

17. Which of the following is true?

a. The krypton 1s orbital and the helium 1s orbital are the same size because both s orbitals can have only two electrons.

b. The krypton 1s orbital is smaller than the helium 1s orbital because krypton's p and d orbitals crowd the s orbitals.

- c. The krypton 1s orbital is larger than the helium 1s orbital because krypton's ionization energy is lower so it's easier to remove electrons.
- d. The krypton 1s orbital is smaller than the helium 1s orbital because krypton's nuclear charge draws the electrons closer.
- e. The krypton 1s orbital is larger than the helium 1s orbital because krypton contains more electrons.

18. The reaction of iron with hydrochloric acid is represented by the following thermochemical equation:

$Fe(s) + 2HCl(aq) \rightarrow FeCl_2(aq) + H_2(g); \Delta H^\circ: -87.9 \text{ KJ}$; If, in a particular experiment, 1.56KJ of heat was released at constant pressure what volume of $H_2(g)$, measured at STP, was produced?

($R = 0.0821 \text{ L.atm/(k.mol)}$)

- a. 0.397 L
- b. 22.4 L
- c. $1.26 \times 10^3 \text{ L}$
- d. $1.38 \times 10^3 \text{ L}$
- e. 0.434 L

19. Which of the following is the best explanation for a covalent bond?

- a. positive ion attracting negative ions.
- b. an interaction between outer electrons.
- c. electrons simultaneously attracted by more than one nucleus.

d. the overlapping of two electron-filled orbitals having different energies.

e. the overlapping of unoccupied orbitals of two or more atoms.

20. A 70.4-L sample of a gaseous hydrocarbon measured at 1.00 atm pressure and 25.0 °C is burned in excess oxygen, liberating 4.06×10^3 KJ of heat at constant pressure. What is the identity of the hydrocarbon?

($R=0.0821$ L.atm/(K.mol));

| Substance | ΔH°_f (KJ/mol) |
|-----------|-------------------------------|
|-----------|-------------------------------|

| | |
|-----------|--------|
| $CO_2(g)$ | -393.5 |
|-----------|--------|

| | |
|-----------|--------|
| $H_2O(l)$ | -285.8 |
|-----------|--------|

a. ethane ($C_2H_6, \Delta H^{\circ}_f = -84.68$ KJ/mol)

b. acetylene ($C_2H_2, \Delta H^{\circ}_f = 226.73$ KJ/mol)

c. propane ($C_3H_8, \Delta H^{\circ}_f = -104.7$ KJ/mol)

d. ethylene ($C_2H_4, \Delta H^{\circ}_f = 52.47$ KJ/mol)

e. propylene ($C_3H_6, \Delta H^{\circ}_f = 20.41$ KJ/mol)

21. ammonia can be made by reaction of water with magnesium nitride: $_ _ Mg_3N_2(s) + _ _ H_2O(l) \rightarrow _ _ Mg(OH)_2(s) + _ _ NH_3(g)$; When the equation is properly balanced, the sum of the coefficients is:

a. 6

b. 9

c. 8

d. 12

e. 14

22. Which of the following solutes dissolved in 1000g of water, would provide the greatest number of particles?

a. 0.030 mol of acetic acid, CH_3COOH

b. 0.030 mol of calcium sulfate, $\text{Ca}(\text{NH}_2)_2$

c. 0.030 mol of urea, $\text{CO}(\text{NH}_2)_2$

d. 0.030 mol of barium chloride, BaCl_2

e. 0.030 mol of ammonium nitrate, NH_4NO_3

23. How much heat is liberated at constant pressure when 97.7 g of calcium oxide reacts with 29.0 L of carbon dioxide gas, measured at 1.00 atm pressure and 25.0 °C? ($R = 0.0821 \text{ L}\cdot\text{atm}/(\text{K}\cdot\text{mol})$)



a. $-1.74 \times 10^4 \text{ KJ}$

b. $-2.11 \times 10^2 \text{ KJ}$

c. $-5.22 \times 10^2 \text{ KJ}$

d. $-5.17 \times 10^3 \text{ KJ}$

e. $-3.11 \times 10^2 \text{ KJ}$

24. What is the molecular geometry of the bromate ion, BrO_3^- ?

a. square planar

b. square pyramidal

- c. trigonal planar
- d. tetrahedral
- e. trigonal pyramidal

25. A barn is an atomic unit of area equal to 10^{-28} m^2 . What is the surface area of the Earth expressed in unit of barn? Assume Earth is a sphere with a radius of km. (The surface area of a sphere is $4\pi r^2$).

- a. 5.12×10^{42} barn
- b. 5.12×10^{-14} barn
- c. 5.12×10^{30} barn
- d. 5.12×10^{36} barn
- e. 5.12×10^{-20} barn

26. Which of the following statements concerning lattice energy is false?

- a. MgO has a larger lattice energy than NaF
- b. MgO has a larger lattice energy than LiF
- c. Lattice energy is often defined as the change in energy that occurs when an ionic solid is separated into isolate ions in the gas phase.
- d. The lattice energy for a solid with 2+ and 2- ions should be two times that for a solid with 1+ and 1- ions
- e. all of these are true

27. Which of the following statements is true about the ionization energy of Mg^{2+} ?

- a. it will be equal to the ionization energy of Li
- b. it will be equal to and opposite in sign to the electron affinity of Mg^{2+}
- c. it will be equal to and opposite in sign to the electron affinity of Mg^+
- d. none of the above
- e. it will be equal to and opposite in sign to the electron affinity of Mg

28. What is the total number of valence electrons in the sulfite ion?

- a. 32
- b. 8
- c. 30
- d. 26
- e. 24

29. In 0.266 mol of trimellitic acid, $C_6H_3(COOH)$, there are:

- a. 2.67×10^{23} hydrogen atoms
- b. 1.60×10^{22} molecules
- c. 4.80×10^{23} oxygen atoms
- d. 6.41×10^{24} molecules
- e. 1.44×10^{24} carbon atoms

30. The total number of oxygen atoms in 1.93 g of CaCO_3 is:

- a. 2.24×10^{23}
- b. 1.92×10^{23}
- c. 5.81×10^{22}
- d. 3.49×10^{22}
- e. 4.65×10^{22}

31. What is the total number of valence electrons in N_2O ?

- a. 17
- b. 11
- c. 22
- d. 34
- e. 16

32. In which of the following reaction will the pressure increase upon completion of the reaction at constant temperature?

- a. $\text{C}_2\text{H}_6\text{O}(\text{l}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l})$
- b. $\text{Cl}_2(\text{g}) + 3\text{F}_2(\text{g}) \rightarrow 2\text{ClF}_3(\text{g})$
- c. $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
- d. $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
- e. $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$

33. What is the volume occupied by a mixture of 0.774 mol of N_2 and 0.774 mol of O_2 gases at 1.04 atm and $25.6^\circ C$?

- a. 3.12 L
- b. 36.5 L
- c. 1.56 L
- d. 18.2 L
- e. 1.1×10^3 L

34. When 50.0 mL of 1.27 M of $HCl(aq)$ is combined with 50.0 mL of 1.32 M of $NaOH(aq)$ in a coffee cup calorimeter, the temperature of the solution increase by $8^\circ C$. What is the change in enthalpy for this balanced reaction?

$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$; Assume that the solution density is 1.00 g/mL and the specific heat capacity of the solution is $4.18 J/g \cdot ^\circ C$

- a. 55.8 KJ
- b. -51.5 KJ
- c. -26.8 KJ
- d. 51.5 KJ
- e. -55.8 KJ

35. What is the standard enthalpy change for the combustion of gaseous propylene, C_3H_6 ?



- a. -658.9 KJ
- b. +2017.5 KJ
- c. -2058.3 KJ
- d. +2058.3 KJ
- e. -2017.5 KJ

36. What is the total number of valence electrons in the monohydrogen phosphate ion, HPO_4^{2-} ?

- a. 30
- b. 34
- c. 28
- d. 32
- e. 36

37. What is the O-N-O bond angle in the nitrite ion?

- a. 109°
- b. 180° and 90°

c. 90°

d. 180°

e. 120°

38. Which ground-state electron configuration is incorrect?

a. K: $[\text{Ar}]4s^1$

b. Na: $1s^22s^22p^63s^1$

c. Zn: $[\text{Ar}]3d^{10}4s^2$

d. Fe: $[\text{Ar}]3d^5$

e. Br: $[\text{Ar}]3d^{10}4s^24p^5$

39. Which molecule or ion has a trigonal pyramidal molecular geometry?

a. H_2CCO

b. H_2CO

c. C_2H_4

d. CH_3^+

e. CH_3^-

40. Which of the following subshells does not exist?

a. 2s

b. 6g

- c. 4d
- d. 3p
- e. 3f

41. Which of the following compounds has the most ionic bonding has the highest percentage of ionic character?

- a. CaF_2
- b. CsF
- c. OF_2
- d. LiF
- e. LiI

42. The approximate CCO angle in acetone, is:

- a. 180°
- b. 60°
- c. 109°
- d. 90°
- e. 120°

43. What is the standard enthalpy of formation of liquid methylamine (CH_3NH_2)?





- a. +3899.2 KJ/mol
- b. -3899.2 KJ/mol
- c. -47.3 KJ/mol
- d. +3178.4 KJ/mol
- e. +47.3 KJ/mol

44. A barleycorn is an English unit of length equal to $\frac{1}{3}$ of an inch. What is the height of the Empire state Building (449 m) expressed in barleycorn?

- a. 4×10^4 barleycorn
- b. 5×10^4 barleycorn
- c. 3×10^5 barleycorn
- d. 6×10^{-1} barleycorn
- e. 6×10^3 barleycorn

45. The amount of calcium in a 15.0 g sample was determined by converting the calcium to calcium oxalate, CaC_2O_4 . The CaC_2O_4 weighed 10.3 g. What is the percent of calcium in the original sample?

- a. 12.1%
- b. 68.7%

- c. 21.5%
- d. 8.8%
- e. 27.5%

46. Which molecule or ion has the same molecular geometry for its central atom(s) as BF_3 ?

- a. C_2F_4
- b. BF_4^-
- c. CF_4
- d. C_2F_6
- e. CH_3^-

47. What is the total volume of gases produced at 1092 K and 1.00 atm pressure when 320 g of ammonium nitrite undergoes the following decomposition reaction?



- a. $5 \times 22.4 \text{ L}$
- b. 22.4 L
- c. $20 \times 22.4 \text{ L}$
- d. $60 \times 22.4 \text{ L}$
- e. $4 \times 22.4 \text{ L}$

48. In which of the series of elements listed below would the elements have most nearly the same atomic radius?

- a. B, Si, As, Te
- b. Na, Mg, Al, Si
- c. F, Cl, Br, I
- d. Na, K, Rb, Cs
- c. Sc, Ti, V, Cr

49. Which pair of elements would form a covalent bond that is the least polar?

- a. S and Li
- b. O and F
- c. SS and Cs
- d. Al and N
- e. O and H

50. What is the final concentration of HCl in a solution prepared by addition of 922.0 mL of 4.73 M HCl to 549.0 mL of 2.03 M HCl? Assume volume are additive.

- a. 3.03 M
- b. 3.72 M
- c. 3.38 M
- d. 0.00459 M

e. 6.76 M

51. The following equation represents the partial combustion of, CH₄.
 $2\text{CH}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}(\text{g}) + 4\text{H}_2\text{O}(\text{g})$; At constant temperature and pressure, what is the maximum volume of carbon monoxide that can be obtained from 6.62×10^2 L of methane and 3.31×10^2 L of oxygen?

a. 2.21×10^2 L

b. 2.32×10^3 L

c. 1.32×10^3 L

d. 9.93×10^2 L

e. 6.62×10^2 L

52. Two metals of equal mass with different heat capacities are subjected to the same amount of heat. Which undergoes the smaller change in temperature?

a. The metal with the higher capacity undergoes the smaller change in temperature

b. Both undergoes the same change in temperature

c. You need to know which metals you have

d. The metal with the lower heat capacity undergoes the smaller change in temperature

e. You need to know the initial temperature of the metals

53. Which of the following true?

- a. The triple bond in N₂ has a smaller bond order and a smaller bond length than the single bond in F₂
- b. The triple bond in N₂ has a larger bond order and a larger bond length than the single bond in a F₂
- c. The triple bond in N₂ has larger bond order and a smaller bond length than the single bond in F₂
- d. The triple bond in N₂ and the single bond in F₂ have the same bond order and same bond length
- e. The triple bond in N₂ has a smaller bond order and a larger length than single bond in F₂.

54. Which of the following has the shortest bond distance?

- a. H₂
- b. Br₂
- c. I₂
- d. F₂
- e. Cl₂

55. Which of the following processes will result in the lowest final temperature of the metal-water mixture at equal specific heat of cobalt is $0.421 \text{ J}/(\text{g}\cdot^\circ\text{C})$?

- a. the addition of 100 g of cobalt at 95°C to 20 mL of water at 25°C in an insulated container
- b. the addition of 100 g of cobalt at 95°C to 60 mL of water at 25°C in an insulated container
- c. the addition of 100 g of cobalt at 95°C to 80 mL of water at 25°C in an insulated container
- d. the addition of 100 g of cobalt at 95°C to 40 mL of water at 25°C in an insulated container
- e. the addition of 100 g of cobalt at 95°C to 100 mL of water at 25°C in an insulated container

ANSWERS

| | | | | | | | | | |
|---|---|----|---|----|---|----|---|----|---|
| 1 | C | 9 | B | 17 | D | 25 | E | 33 | B |
| 2 | D | 10 | D | 18 | A | 26 | D | 34 | B |
| 3 | D | 11 | B | 19 | C | 27 | B | 35 | C |
| 4 | B | 12 | D | 20 | | 28 | D | 36 | D |
| 5 | E | 13 | D | 21 | D | 29 | E | 37 | E |
| 6 | D | 14 | C | 22 | D | 30 | D | 38 | D |
| 7 | D | 15 | C | 23 | B | 31 | E | 39 | E |
| 8 | D | 16 | D | 24 | E | 32 | E | 40 | E |

| | | | |
|----|---|----|---|
| 41 | B | 49 | B |
| 42 | E | 50 | B |
| 43 | C | 51 | A |
| 44 | B | 52 | A |
| 45 | C | 53 | C |
| 46 | A | 54 | A |
| 47 | D | 55 | E |
| 48 | E | | |

GOOD LUCK 