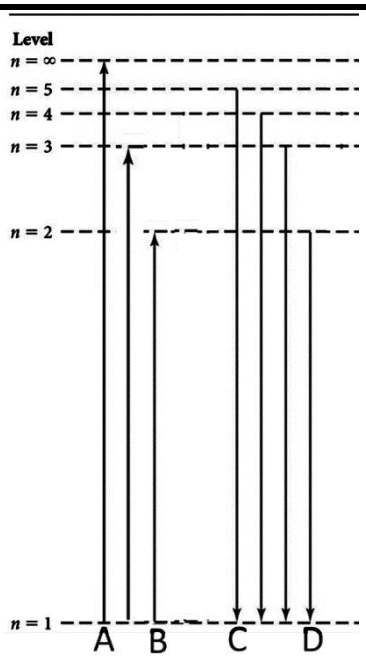
Questions 1 – 13 cover material from Exam 1

1. The recommended diet for the average human being is 2000 Calories per day. How long would 2000 Calories power a 100-Watt light bulb? (1W = 1 J/s, 1 Calorie = 4184 J)

A. 23 hours
B. 18 hours
C. 20. hours
D. 12 hours

2. Consider the following figure. Which electronic transition results from the **absorption** of the highest energy photon?



A. A
B. B
C. C
D. D

3. A sample of an unknown metal with a mass of 57.0 grams absorbs 119.2 J of energy when heated from 25 °C to 29 °C. What is the most probable identity of the metal?

Metal	Specific heat capacity, C_s
zinc	0.387 J/g·°C
tungsten	0.134 J/g·°C
titanium	0.523 J/g·°C
uranium	0.116 J/g·°C

A. zinc
B. tungsten
C. titanium
D. uranium

4. A 31.1 g wafer of pure gold, initially at 69.3 °C, is submerged into 64.2 g of water at 27.8 °C. What is the final temperature of both substances at thermal equilibrium?
(specific heat of gold = 0.128 J/g·°C, specific heat of water = 4.18 J/g·°C)

A. 25.0 °C

B. 28.4 °C

C. 45.3 °C

D. 57.8 °C

5. The enthalpy change of which reaction is a standard enthalpy of formation, $\Delta H°_f$?

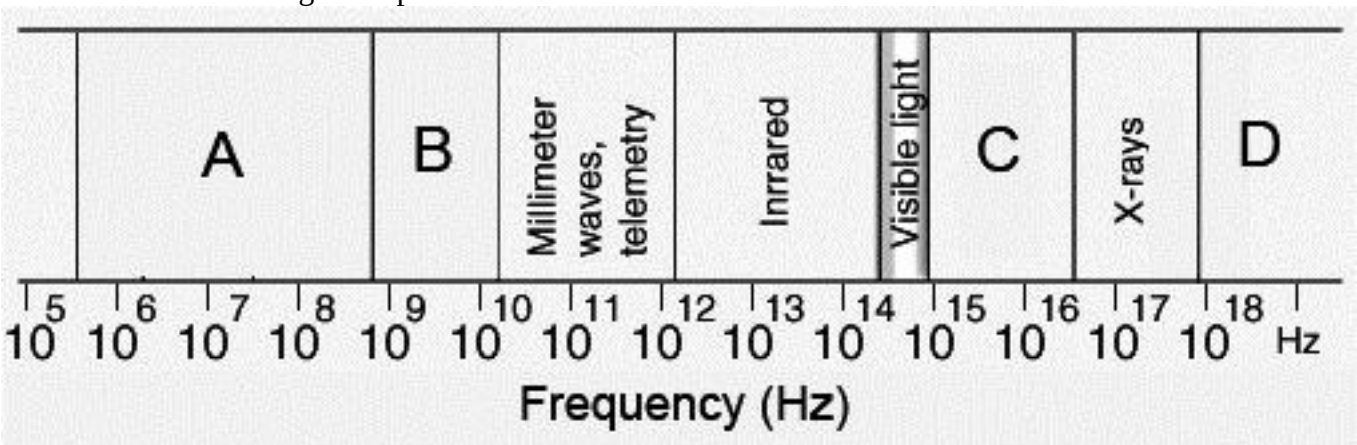
A. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

B. $Mg^{2+}(aq) + CO_3^{2-}(aq) \rightarrow MgCO_3(s)$

C. $Na(s) + 1/2H_2(g) + C(s) + 3/2O_2(g) \rightarrow NaHCO_3(s)$

D. $1/2H_2(g) + 1/3O_3(g) \rightarrow H_2O(l)$

6. Consider the electromagnetic spectrum:



Which response assigns the regions of the electromagnetic spectrum correctly?

A. **A** =gamma, **B** = ultraviolet, **C** = microwave, **D** = radio

B. **A** = ultraviolet, **B** = gamma, **C** = radio, **D** = microwave

C. **A** = microwave, **B** = gamma, **C** = radio, **D** = ultraviolet

D. **A** = radio, **B** = microwave, **C** = ultraviolet, **D** = gamma

7. An electron has the following set of quantum numbers in the ground state:

$$n = 5,\ l = 1,\ m_l = -1,\ m_s = +½$$

The electron is located in an atom of

A. tin.

B. palladium.

C. silver.

D. selenium.

8. Which set of quantum numbers is **allowed**?

A. $n = 1,\ l = 1,\ m_l = -1,\ m_s = +½$

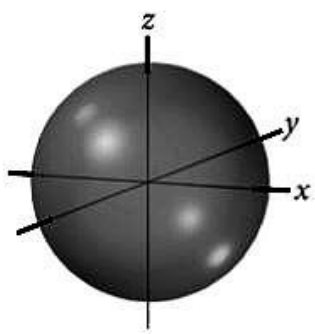
B. $n = 2,\ l = 1,\ m_l = -2,\ m_s = +½$

C. $n = 3,\ l = 1,\ m_l = -1,\ m_s = +½$

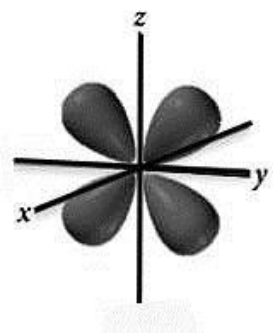
D. $n = 4,\ l = 0,\ m_l = -1,\ m_s = +½$

9. Which one of the following orbitals could have the quantum number $n = 5$, $l = 3$?

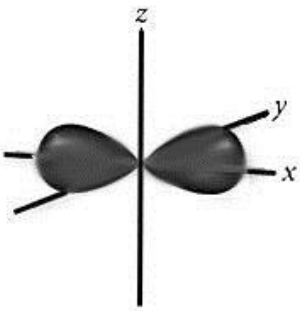
A.



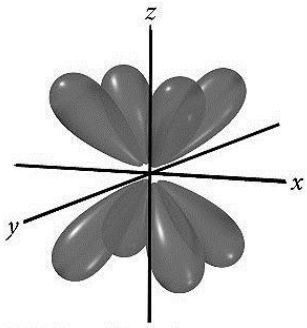
C.



B.

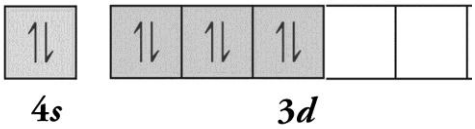


D.

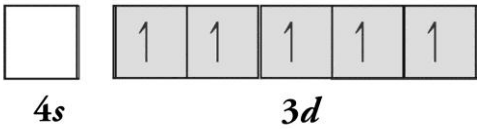


10. Which is the correct orbital diagram for the valence electrons of Fe^{3+} in the ground state?

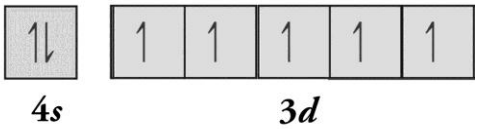
A.



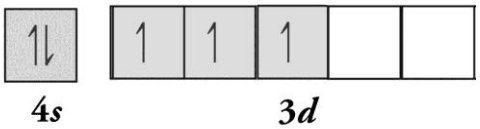
B.



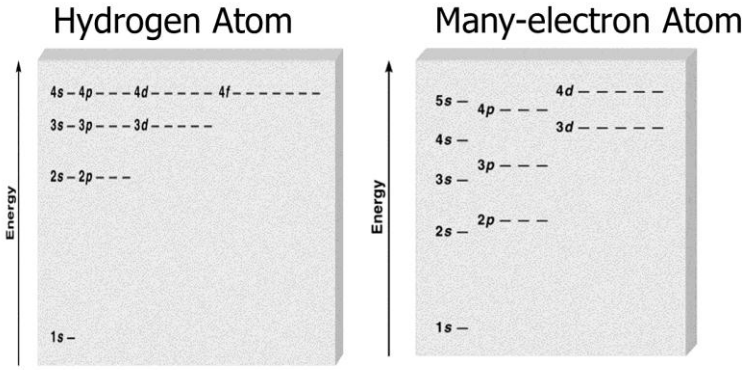
C.



D.



11. Atoms containing multiple electrons have orbitals with varying energies even when the principal quantum number, *n*, is identical. What causes the energy splitting observed in multi-electron atoms?



A. Core electrons shield valence electrons from the full attractive force of the nucleus and high-energy electrons penetrate into the 1s orbital space.

B. Valence electrons shield core electrons from the full charge of the nucleus.

C. Screening electrons penetrate into higher energy orbital space and core electrons are easy to ionize.

D. Repulsive forces occur between the nucleus and electrons.

12. Which element has the highest effective nuclear charge (Z_{eff})?

A. carbon

B. oxygen

C. hydrogen

D. nitrogen

13. Which atom/ion is the **largest**?

A. Ca

B. Br

C. Br^-

D. Cl^-

Questions 14 – 25 cover material from Exam 3

14. Consider the following electronegativity values:

Element	Electronegativity
Be	1.5
H	2.1
O	3.5
Li	1.0

Which of the following chemical bonds is the most **ionic**?

A. Be−H

B. Li−O

C. H−H

D. O−H

15. Which of the following ionic compounds has the **largest** lattice energy?

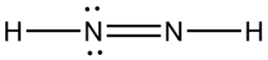
A. Sr_3N_2

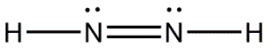
B. RbCl

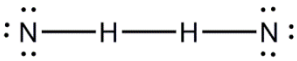
C. NaCl

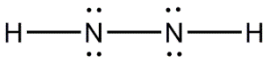
D. Mg_3N_2

16. What is the **best** Lewis structure for N_2H_2? (Formal charges are **not** shown.)

A. 

B. 

C. 

D. 

17. Which bond is the **most** polar?

A. H−F

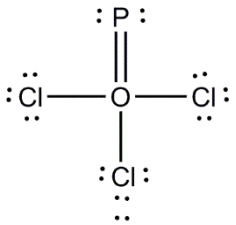
B. H−Cl

C. H−O

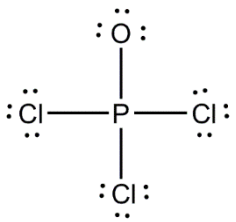
D. H−I

18. Which is the **best** Lewis structure for Cl_3PO? (Formal charges are **not** shown.)

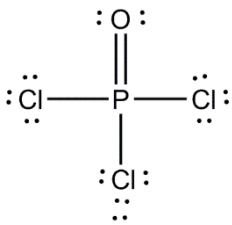
A.



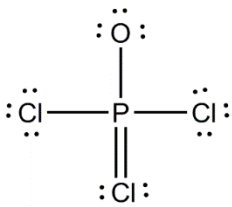
B.



C.



D.



19. Calculate the ΔH_{rxn} for the reaction using average bond energies:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

Bond	**ΔH_{BE}**
C−H	414 kJ/mol
O=O	498 kJ/mol
C=O	799 kJ/mol
O−H	464 kJ/mol

A. −453 kJ

B. −758 kJ

C. +2150 kJ

D. −802 kJ

20. What is the molecular geometry of CH_4?

A. square planar

B. trigonal pyramidal

C. trigonal bipyramidal

D. tetrahedral

21. What is the molecular geometry of SF_4?

A. trigonal bipyramidal

B. tetrahedral

C. octahedral

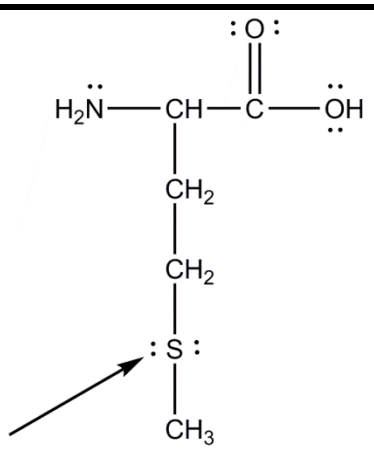
D. seesaw

22. Which of the following gas-phase molecules is **polar**?

A. CO_2 C. CF_4

B. $SeCl_4$ D. XeF_2

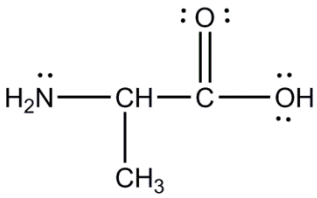
23. What is the hybridization of the sulfur atom in this molecule?



A. *sp* C. sp^2

B. sp^3 D. sp^3d^2

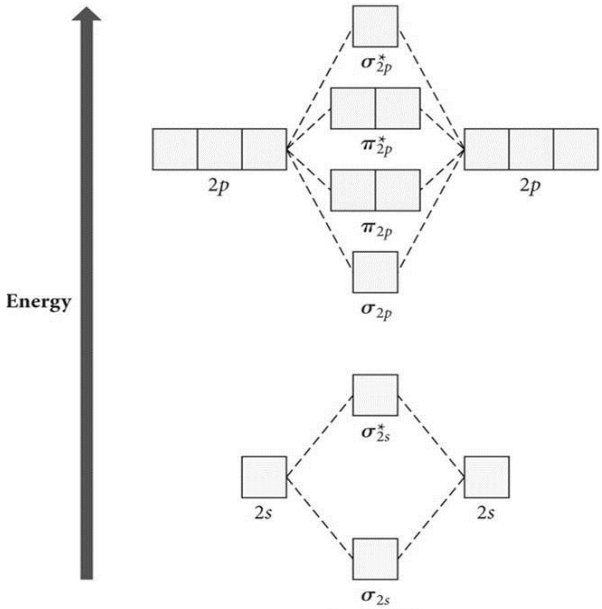
24. How many sigma (σ) bonds are in this molecule?



A. 8 C. 10

B. 12 D. 14

25. Consider this molecular orbital energy diagram. Which of the following molecules/ions has the **highest** bond order?



A. O_2 C. O_2^-

B. O_2^{2-} D. F_2

Answer Key:

1. A
2. A
3. C
4. B
5. C
6. D
7. A
8. C
9. D
10. B
11. A
12. B
13. C
14. B
15. D
16. B
17. A
18. C
19. D
20. D
21. D
22. B
23. B
24. B
25. A