Chemistry 59-110 - A

Professor Ricardo Aroca

Midterm Exam: October 21 At 11:30- **Erie Hall**

48/25-

18/25

Respect yourself and others will respect you. Confucius.
Chinese philosopher & reformer (551 BC - 479 BC) .

Student's name:.[redacted] **#..**[redacted]

Total 25 points **Write with CAPITAL letters TRUE or FALSE**

1. The monoelectronic approximation gives rise to atomic and molecular orbitals	True
2. Molecular solids are characterized by high melting points.	TRUE
3. Eight (8) electrons cannot have the same quantum number n=3, l =2.	FALSE
4. The Madelung constant is different for different crystal types.	FALSE
5. For n=3, the size of the atom decreases along a period of the periodic table.	TRUE
6. Using the periodic table it is possible to predict the trend in ionization potentials.	TRUE
7. A photon is a quantum of energy with spin equal to 1.	TRUE
8. The highest energy transitions in Hydrogen atom start at n= 2 (Balmer).	FALSE
9. The particle in a box problem has a zero interaction potential.	TRUE
10. Matter is particulate and has wave properties.	TRUE
11. Color is due to electronic absorption in the infrared region of the spectrum.	FALSE
12. The degeneracy in atomic orbitals is $2l+1$.	TRUE
13. The ionization energy of Li is larger than that of Na.	FALSE
14. Metals and nonmetals are good conductors of heat and malleable.	FALSE
15. Covalent and ionic bonds are defined by an energy minimum with vibrational states.	FALSE
16. Sharing electrons leads to covalent bonds.	TRUE
17. Hybridization is a linear combination of bonding orbitals.	TRUE
18. Spectral line is a discrete value of a quantity such as frequency or wavelength.	FALSE
19. A triple bond is composed of two σ bonds and one π bond.	FALSE
20. Temperature, pressure and volume are independent quantities for a given amount of substance	FALSE
21. In kinetic theory, the amount of energy per degree of freedom is kT	TRUE
22. The average molecular speed and the speed of sound increases with temperature.	TRUE
23. A liquid with high surface tension forms droplets.	TRUE
24. Bond multiplicity leads to resonant structures.	TRUE
25.. For the same molecule, a broader speed distribution is achieved at higher T.	TRUE

MARKS ....

15
15

$c = \lambda v$
$v = \frac{c}{\lambda}$ $\downarrow\lambda \uparrow v$

CONCEPTS AND PROBLEMS

EACH QUESTION IS WORTH 5

Question 1.

5

Which of the following statements is true regarding electromagnetic radiation?

a Electromagnetic radiation with a wavelength of 400 nm travels faster than that with a wavelength of 600 nm.
b The frequency of electromagnetic radiation determines how fast it travels.
C Electromagnetic radiation with a wavelength of 400 nm has a frequency that is smaller than that with a wavelength of 600 nm.
D Electromagnetic radiation with a wavelength of 600 nm travels faster than that with a wavelength of 400 nm.
E Electromagnetic radiation with a wavelength of 600 nm has a frequency that is smaller than that with a wavelength of 400 nm.

ANSWER HERE……E……

Question 2.

5

A lawyer who received a speeding ticket argues that because of the Heisenberg Uncertainty Principle the radar reading is uncertain. The judge, who happens to have a science degree, rules against the lawyer. Which of the following statements is true?

The judge is incorrect because the uncertainty in position is large.
B The judge is correct because the car is so massive that the uncertainty in speed is very small.
The judge is correct because the uncertainty in momentum is very large.
The judge is incorrect because radar has only wave characteristics.
The judge is incorrect because $(m\Delta v)(\Delta x) \geq ½h$.

ANSWER HERE…B………

Question 3

5

Consider the following ground-state electronic configurations. Which atom has both the highest first ionization energy and the highest electron affinity?

[Ne] $3s^2 3p^5$ Cl
[Ne] $3s^2 3p^3$ P
[Ne] $3s^2 3p^1$
[Ne] $3s^2 3p^4$

ANSWER HERE: [Ne] $3s^2 3p^5$

Question 4

For the ground-state iodide ion, what type of orbital do the electrons with highest energy reside in?

ANSWER HERE……SP……

Question 5

Predict the N-O bond lengths in NO_2^- given the N-O and N=O bond lengths of 140 and 120 pm, respectively.

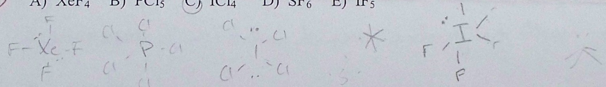
O=N=O

ANSWER HERE……140 pm…… for each

Question 6

Which of the following has a dipole moment?

A) XeF_4 B) PCl_5 C) ICl_4^- D) SF_6 E) IF_5



ANSWER HERE……IF5……

Question 7

Oxygen can be produced in the laboratory by the following reaction:

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

How many moles of potassium chlorate are needed to produce 2.75 L of oxygen, collected over water at 37°C and 94.9 kPa? The vapor pressure of water at 37°C is 6.28 kPa.

P = 6.28 kPa
88.62 kPa
T = 310 K
V = 2.75 L
n = ?

PV = nRT

ANSWER HERE…………2mol to every 3 moles of O2

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Question 8

Which molecules of the following gases will have the greatest average kinetic energy?

A) CO_2 at 1 atm and 298 K.
B) N_2 at 1 atm and 298 K.
C) All the molecules have the same kinetic energy.
D) He at 0.1 atm and 298 K.
E) H_2 at 0.5 atm and 298 K.

ANSWER HERE:....H_2 at 0.5 atm & 298K

Question 9

Which of the following is true?

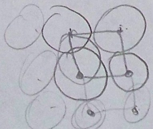
Butane, C_4H_{10}, has a higher boiling point than acetone, CH_3COCH_3.
Pentane, C_5H_{12}, has a lower boiling point than 2,2-dimethylpropane, C_5H_{12}.
CHF_3 has a higher boiling point than CF_4.
CH_4 has a higher boiling point than CCl_4.
HI has a lower boiling point than HBr.

ANSWER HERE: ....CHF_3 has higher boiling pt than CF_4

Question 10

The atomic radius of magnesium is 160 pm. Estimate its density, given that the metal has a cubic close-packed structure. Mg (24.31 g mole^{-1}).

$d = \frac{m}{v}$



diameter x 2

$4\pi r^3$

$V =$

$d = \frac{M}{V}$

$= \frac{656.37}{262144000}$

ANSWER HERE: ....~~2.8034 x 10^{-6}~~

$2{,}503 \times 10^{-6}$ g/mol.