KEY

Work Sheet Ch# 7, 8

Solve 20 Questions

Q1:
What is the wavelength of the radiation to be absorbed by the hydrogen atom in its ground state so as to excite the electron to n=6?

$\Delta E = -2.179 \times 10^{-18} \left[\frac{1}{n_f^2} - \frac{1}{n_i^2}\right]$

$= 2.178 \times 10^{-18}$ J ($n_f = 6$, $n_i = 1$)

$\Delta E = h\nu = \frac{hc}{\lambda}$

$\Rightarrow \lambda = \frac{hc}{\Delta E} = 9.38 \times 10^{-8}$ m

Q2:
"No two electrons in an atom can have the same four quantum numbers"
This statement is known as:

A. Bohr's theory
B. Hund's rule
C. De broglie model
(D) the Pauli exclusion principle
E. Heisenberg uncertainty principle

Q3:
What is the maximum number of electrons in an atom having the quantum numbers:
$n = 4, l = 3, m_l = -2, m_s = +1/2$?

only one $\bar{e}$, According to Pauli exclusion principle

Q4:
What is the energy of a photon with $m = 5.201 \times 10^{-44}$ g?

$5.201 \times 10^{-44}\ g \times \frac{1\ kg}{10^3\ g} = 5.201 \times 10^{-47}$ kg

$E = mc^2$

$= (5.201 \times 10^{-47}\ kg)(3 \times 10^8\ m/s)^2 = 4.68 \times 10^{-3}\ kg\ m^2/s^2$ (J)

Q5:
What is the correct order of decreasing ionic radius?
I^-, Te^{2-}, Cs^+, Ba^{2+}, Ca^{2+}

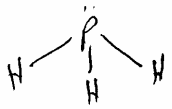
$Te^{2-} > I^- > Cs^+ > Ba^{2+} > Ca^{2+}$

Isoelectronic

$Z \uparrow \Rightarrow r \downarrow$

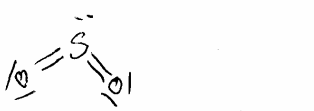
Q6:
Which of the following are polar molecules: (PH$_3$) (SO$_2$) CO$_2$, SO$_3$

PH_3 V.$\bar{e}$ = 5 + 3 = 8 $\bar{e}$



$\mu \neq 0 \Rightarrow$ Polar

SO_2 V.$\bar{e}$ = 6 + 2(6) = 18 $\bar{e}$



$\mu \neq 0 \Rightarrow$ Polar

Q7:

Given	bond energy (kJ/mol)
C=C	612
C – C	347
C – H	414
H – H	436

ΔH_{rxn} = Bond Breaking − Bond formed

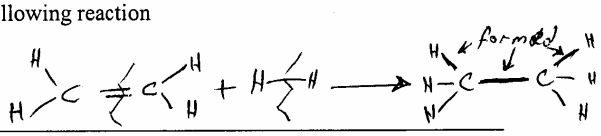
= B.E (react.) − B.E (prod.)

= 612 + 436 − 2(414) − 347

= −127 KJ/mol

Estimate ΔH_{rxn}, in kJ/mol, for the following reaction

$CH_2 = CH_2 + H \rightarrow CH_3 - CH_3$



Q8:

Among the following molecules find the two having the same shape

NI_3, I_3^-, NO_3^-, SO_3^{2-}

they have trigonal pyramidal shape.

Q9:

Blue light has a frequency of 6.6×10^{14} Hz.

Calculate the energy of a mole of blue light photons in J/mol.

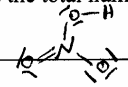
$E = nh\nu$

$= (6.02 \times 10^{23})\, h\, (6.6 \times 10^{14}\ s^{-1})$

$= 2.6 \times 10^{5}$ J/mol

Q10:

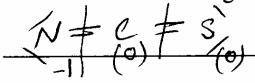
What is the total number of lone pairs in the Lewis structure of nitric acid $HONO_2$?



7 lone pairs

Q11:

What is the formal charge of nitrogen in the preferred Lewis structure of the anion NCS^-?



$\Rightarrow$ F.C(N) = −1

Q12:

Which of the following species has the highest ionic character?

A. HCl B. HBr C. HI D. H_2 (E) HF

since $\Delta E.N$ is highest

Q13:

Which of the following ions is largest in size?

A. Na^+ B. K^+ C. Cl^- (D) Se^{2-} E. F^-

$Se^{2-} > Cl^- > K^+ > F^- > Na^+$

Se^{2-}: largest size

Cl^-, K^+: Isoelectronic

F^-, Na^+: Isoelectronic

Q14:
Calculate the wavelength in nm for a transition from n = 6 to n = 4, in a hydrogen atom.

$\Delta E = -2.179 \times 10^{-18} \left[\frac{1}{n_f^2} - \frac{1}{n_i^2}\right]$

$= -7.566 \times 10^{-20}$ J

$\Delta E = h\nu = \frac{hc}{\lambda}$

$\Rightarrow \lambda = \frac{hc}{|\Delta E|} = 2.627 \times 10^{-6}$ m

$= 2627$ nm

Q15:
Arrange the following sets of quantum numbers in order of increasing energy.

a) (2, 1, 0, +1/2)
b) (1, 0, 0, -1/2)
c) (3, 2, -2, +1/2)
d) (3, 1, -1, -1/2)

$b < a < d < c$

Q16:
The electron configuration of Mo is $[Kr]\ 5s^1 4d^5$ (exception)

Q17:
Which of the following statements **are** true?

(a) Within a group the higher the atomic number the larger the atomic radius.
b) Within a period the higher the atomic number the lower the first ionization energy.
(c) The electron affinity is the energy change when an electron is added to a gaseous atom.
d) For a given element, the anion is smaller in size than the cation.

Q18:
The uncertainty in the speed of an electron is 0.0500 m/s. calculate the minimum uncertainty in its position. (mass of the electron = 9.11×10^{-28} g, assume zero uncertainty on the mass of the electron).

$\Delta x \cdot \Delta(m \cdot v) = \frac{h}{4\pi}$ (mass in kg)

$\Delta x = 1.16 \times 10^{-3}$ m

Q19:
Which one of the following sets of quantum numbers is not acceptable?

A. n = 3, l = 2, m_l = -2, m_s = -1/2
B. n = 4, l = 1, m_l = 1, m_s = +1/2
(C) n = 5, l = 2, m_l = -3, m_s = +1/2
D. n = 2, l = 0, m_l = 0, m_s = -1/2
E. n = 1, l = 0, m_l = 0, m_s = +1/2

$m_l = -l, \ldots 0, \ldots +l$

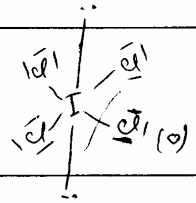
$= -2, \ldots 0, \ldots +2$ cannot -3

Q20:
Which of the following statements is **NOT** true?

(A) the more we are certain about the position of the electron in an atom, the more accurately we know its momentum.
B. In the hydrogen atom, different orbitals having the same "n" have the same energy.
C. The higher the frequency of a radiation the shorter is its wavelength.
D. 1s orbital of the hydrogen atom is described by the sphere that encloses 90% of the total electron probability.
E. Light has the dual properties of both particle and wave.

Q21:
What is the formal charge of chlorine in ICl_4^-?

F.C(Cl) = 0

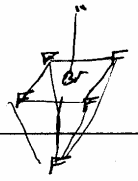


Q22:
The number of bonding pairs in the Lewis structure of N_2Cl_2 (Cl N N Cl) is:

Cl — N = N — Cl ⇒ 4 Bonding pairs

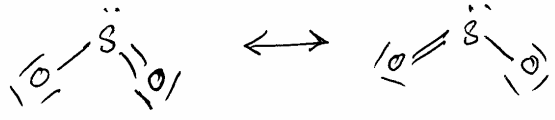
Q23:
What is the molecular shape of BrF_5?

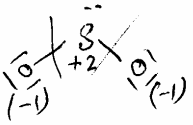
Square pyramidal



Q24:
In which of the following species resonance occurs:

A. NF_3 (B) SO_2 C. H_2O D. NH_4^+ E. BeH_2





Not stable

- due to high formula charge
- Not octet