

Part II: Workout

Show all the necessary steps clearly and neatly only on the space provided

1. A ladder 13 meter long is leaning against the side of a building. If the foot of the ladder is pulled away from the building at a constant rate of 8 meters per second, how fast is the area of the triangle formed by the ladder, the building and the ground changing at the instant when the top of the ladder is 12 meter above the ground? (5 points)

2. A window is designed to have the shape of a rectangle with an equilateral triangle attached at the top. Assuming that the perimeter of the window is 12 meter, find the dimensions that allow the maximum amount of light to enter. (5 points)



$$0 = 12 \dots \dots \dots dh = 10m = 0$$

3. Evaluate

$$\int \frac{x+1}{x(x-1)^2} dx$$

(5 points)

$$A = 1, (A+B)x$$

$$\begin{aligned} A+B &= 0 \\ A &= 8 \\ B &= -1 \end{aligned}$$

$$\begin{aligned} 2AX - 11 - 8 &= 0 \\ 2 + 1 &= 0 \\ -1 + 0 &= 0 \end{aligned}$$

$$\begin{aligned} \lim_{x \rightarrow \infty} \frac{1}{x} &= 0 \\ \lim_{x \rightarrow \infty} \frac{1}{x^2} &= 0 \end{aligned}$$

4. For $f(x) = \frac{4x}{x^2+4}$

(10 Points)

- a. Find the intercepts

line

1) ~~x~~ - intercept

we get x-intercept by making y=0

$$\lim_{x \rightarrow \infty} \frac{4x}{x^2+4} = 0 \Rightarrow 4x = 0 \Rightarrow x = 0$$

x-intercept (0,0)

2) y-intercept we set x=0

Part I : Short answer

Write your most simplified answer only on the space provided .(each blank space worth 1.5)

1. $\lim_{x \rightarrow 0} \left(\frac{e^{3x} - 1 - 3x}{e^{x^2} - \cos x} \right) = \underline{3}$

2. Find the number c that satisfies the mean value theorem for $f(x) = \frac{1}{2}x^2 - 3x$ on $[1, 2]$

$c = \underline{3/2}$

3. Define $f : [-2, 3] \rightarrow \mathbb{R}$ by $f(x) = x^3 - 3x^2 + 2$

a. the global minimum value of f is $= \underline{f(-2) = -10}$

b. the global maximum value of f is $= \underline{f(0) = f(3) = 2}$

4. $\int e^x \sin x \, dx = \underline{\hspace{2cm}}$

5. $\int_3^{2+\sqrt{2}} \frac{1}{\sqrt{4x-x^2}} \, dx = \underline{\hspace{2cm}}$

6. The area A of the region between the graphs of the functions $g(x) = x^2 + 4x$ and $k(x) = x - 2$

On the interval $[-3, 0]$.Answer $\underline{\hspace{2cm}}$

7. $\frac{d}{dy} \int_{\sin y}^{2y} \cos t \, dt = \underline{\hspace{2cm}}$

8. For what value(s) of k does $f(x) = x - \frac{k}{x}$ have a relative maximum at $x = -2$.

Answer. $\underline{\hspace{2cm}}$

9. Find an equation of a curve passing through the point $(6, 2)$ and having slope $x^2 - x + 1$

at every point (x, y) .Answer $\underline{\hspace{2cm}}$

$$\int \frac{1}{\sqrt{4x-x^2}} dx$$

$$\left[\cos \theta - \cos(\sin \theta) \cdot \cos \theta \right]$$

$$+ (-4 + 4x - x^2) = 4x - x^2$$

$$-x^2 + 4x -$$

$$-x^2 + 4x -$$

$$-x(x+2) -$$

b. Find the asymptotes(if any)

$$f(x) = \frac{4x}{x^2+4}$$

i) it has ~~vertical~~ vertical asymptote at $x=d$

$$\text{if } \lim_{x \rightarrow d} \frac{4x}{x^2+4} = \infty$$

but this is not d or $\lim_{x \rightarrow d} \frac{4x}{x^2+4} = \infty$

ii) horizontal asymptote

$$\lim_{x \rightarrow \infty} \frac{4x}{x^2+4} = \lim_{x \rightarrow \infty} \frac{4}{x} = 0$$

$$\lim_{x \rightarrow -\infty} \frac{4x}{x^2+4} = \lim_{x \rightarrow -\infty} \frac{4}{x} = 0$$

if it is $\frac{\infty}{\infty}$ or $\frac{0}{0}$ or indeterminate form use L'Hopital's rule

c. Find the critical points

$$f'(x) = \frac{4(x^2+4) - (4x)(2x)}{(x^2+4)^2} = \frac{4x^2+16-8x^2}{(x^2+4)^2} = \frac{-4x^2+16}{(x^2+4)^2}$$

to find the critical numbers more $f'(x) = 0$

$$\frac{-4x^2+16}{(x^2+4)^2} = 0 \Rightarrow -4x^2+16=0 \Rightarrow 4x^2=16$$

$$x^2=4 \Rightarrow x = \pm 2$$

d. Find the interval of increase and decrease

	-2	2
$4(4-x^2)$	+	+
$(x^2+4)^2$	+	+
$f'(x)$	+	+

f is increasing on $(-2, 2)$
 f is decreasing on $(-\infty, -2)$
 f is decreasing on $(2, \infty)$

e. Find the interval of concave up and concave down

$$f'(x) = \frac{-4x^2 + 16}{(x^2 + 4)^2}, \quad f''(x) = \frac{-8x(x^2 + 4)^2 - (-4x^2 + 16)(2)(x^2 + 4)(2x)}{(x^2 + 4)^4}$$

$$f''(x) = \frac{(x^2 + 4)(-8x(x^2 + 4) - (-4x^2 + 16)(2x))}{(x^2 + 4)^4}$$

$$f''(x) = \frac{4x(-2(x^2 + 4) + 4x^2 - 16)}{(x^2 + 4)^3} = \frac{4x(2x^2 - 20)}{(x^2 + 4)^3}$$

$$f''(x) = \frac{4x(2x^2 - 20)}{(x^2 + 4)^3} = 0 \Rightarrow x = 0, \pm 2\sqrt{5}$$

f. Find the inflection point(s)

g. Test for symmetry.

h. Sketch the graph

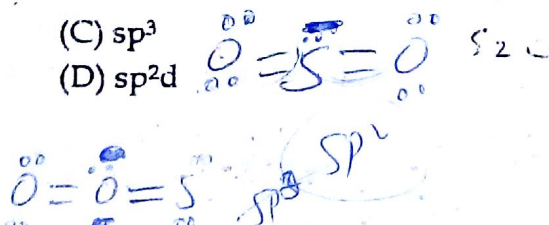


G. Chemistry Mid-exam

2009 E.C.

Part I: Multiple Choices (1 pts each)

- D 1. Which one of the following is true about modern view of atomic structure?
 (A) Atom of the same element has equal number of protons and electrons $\times$
 (B) Every atom has equal number of protons $\times$
 (C) Every atom is made up of molecules
 (D) Proton and electron reside together in the nucleus of an atom
- B 2. One of the following is true about isotopes
 (A) Atom with different atomic and proton number $\times$
 (B) Atom of a given element have the same atomic number
 (C) Atom with different proton number $\times$
 (D) Atom of a given element have the same mass number
- C 3. Which one of the following elements normally occurs as a diatomic molecule?
 (A) Ozone
 (B) Water
 (C) Nitrogen
 (D) Ammonia
- A 4. One of the following compounds is not build from a polyatomic ion?
 (A) Ammonium bromide
 (B) Cobalt (II) nitrate
 (C) Potassium sulfate
 (D) Iron (III) chloride
- D 5. Which one of the following is true about polar covalent bond?
 (A) The bond is formed by equal sharing of pair of electrons
 (B) The bond is formed by electron transfer within an organic compound
 (C) The bond is formed due to unequal sharing of pair of electrons in the formed ionic compound
 (D) The bond is formed due to the difference in electronegativity between individual atoms
- C 6. Which of the following molecule has the strongest bond?
 (A) Oxygen molecule
 (B) Hydrogen molecule
 (C) Nitrogen molecule
 (D) Fluorine molecule
- B 7. What is the possible geometry in sp^3d hybridization?
 (A) Linear
 (B) Trigonal bipyramidal
 (C) Tetrahedral
 (D) Octahedral
- B 8. What kinds of hybrid orbitals are formed between sulfur and oxygen atoms in sulfur dioxide molecules?
 (A) sp
 (B) sp^2
 (C) sp^3
 (D) sp^2d



SOL

66

9. Certain elements (Fe = 372.0 nm, K = 404.7 nm, Mg = 285.2 nm, and Na = 589.6 nm) emit light of a specific wavelength when they are burned. Determine which element emits photons of highest energy?

- (A) Iron (C) Sodium
(B) Magnesium (D) Potassium

10. Which one is the possible chemical formula for ammonium tetra chlorocuprate (II)?

- (A) $(\text{NH}_4)_2\text{CuCl}_4$ (C) $[\text{Cu}(\text{NH}_4)_4]\text{Cl}$
(B) NH_4CuCl_4 (D) $(\text{NH}_4)_2[\text{CuCl}_4]$

Part II: Short Answer

1. Magnesium has three isotopes, with mass number 26, 25, and 24. (3 pts)

(a) Write the complete chemical symbol for each of them, respectively.

Ans: $^{26}_{12}\text{Mg}$, $^{25}_{12}\text{Mg}$, and $^{24}_{12}\text{Mg}$

(b) How many neutrons are in an atom of each isotope, respectively?

Ans: 14, 13, and 12

2. What are the most probable Empirical, Molecular, and Structural formula for hydrogen peroxide molecule, respectively? Ans: HO , H_2O_2 , and $\text{H}-\text{O}-\text{O}-\text{H}$ (3 pts)

3. Write the balanced chemical equation for a reaction when sodium metal reacts with liquid water would yields for the formation of base and evolutions of gas? (1 pts)

Ans: $2\text{Na}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$

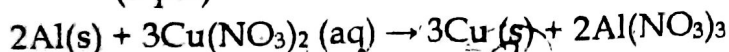
4. A 5.325 g sample of methyl benzoate, a compound used in the manufacture of perfumes, contains 3.758 g of carbon, 0.316 g of hydrogen, and 1.251 g of oxygen and the molecular mass of this compound is, $M_r = 136 \text{ g/mol}$. (4 pts)

(A) What is the empirical formula? Ans: $\text{C}_7\text{H}_6\text{O}_2$

(B) What is the molecular formula? Ans: $\text{C}_{14}\text{H}_{12}\text{O}_4$

5. A strip of aluminum metal with a mass of 2.00 g is placed in an aqueous solution containing 2.50 g of copper nitrate, causing the following reaction to occur:

(3 pts)



(A) Which reactant is limiting? Ans: $\text{Cu}(\text{NO}_3)_2$

(B) How many grams of Cu will form? Ans: 0.251 g

(C) How many grams of $\text{Al}(\text{NO}_3)_3$ will form? Ans: 1.888 g

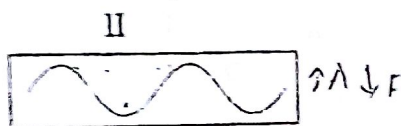
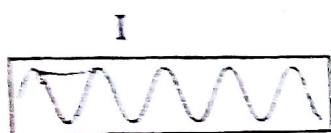
6. From the given molecule NO, NO⁺, and NO⁻.

(A) Which molecule has the highest bond order? NO⁺ (3 pts)

(B) The most stable molecule is NO⁺

(C) Which one is diamagnetic? NO⁺

7. From the two electromagnetic wave representations; (2 pts)



(A) Which wave has the higher frequency? I

(B) If one Wave represent Infrared light and the other represent Ultraviolet light, then,

Which wave is Ultraviolet and infrared, respectively? I and II

8. For the complex [Co(NH₃)₄(H₂O)Cl]Cl₂; (4 pts)

(A) Oxidation number of central metal ion +2

(B) The condensed state electron configuration of central metal ion 1s²2s²2p⁶3s²3p⁶4s²3d⁷

(C) The coordination number of the metal 6

(D) Systematic name of the complex Tetraammineaquachloro (dichloride)

1-PO
 2-PO
 3-SP
 4-T
 5-T
 6-
 7-SD
 8-LO
 9-LO
 10-LO
 11-LO
 12-LO

1-PO
 2-PO
 3-SP
 4-T
 5-T
 6-
 7-SD
 8-LO
 9-LO
 10-LO
 11-LO
 12-LO

Part III: Workout, Show the necessary steps

1. What is the momentum, wavelength, energy, and frequency, of an electron traveling at $1.25 \times 10^5 \text{ m/s}$ if the mass of the electron is $9.11 \times 10^{-31} \text{ kg}$? (4 pts)

Given $m_e = 9.11 \times 10^{-31} \text{ kg}$, $h = 6.63 \times 10^{-34} \text{ J.s}$, $c = 3 \times 10^8 \text{ m/s}$
 $m_e = 9.11 \times 10^{-31} \text{ kg}$, $c = 3 \times 10^8 \text{ m/s}$

$\lambda = \frac{h}{mv}$ $\Rightarrow \lambda = \frac{h}{p}$, since $h\nu = p$

$p = \frac{h}{\lambda}$, $\Delta E = h\nu$, $\lambda = \frac{c}{f}$, $u = \frac{c}{f}$, $d = \frac{h}{mv}$

$d = \frac{h}{mv}$, $u = \frac{h}{mv}$, $E = \frac{h}{mv}$

2. Discuss the splitting of d orbitals in $[\text{Mn}(\text{CN})_6]^{4-}$ & $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ complex compound according to the crystal field theory (CFT). (3 pts)

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

$h\nu = mc^2$

$\Delta E = mc^2$

$E = \frac{mc^2}{\lambda}$

$E =$

$E = mv^2$

$E = h\nu$

$E = \frac{hc}{\lambda}$

$p = mv$

