

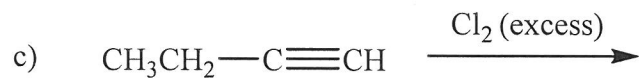
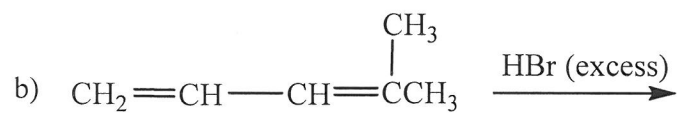
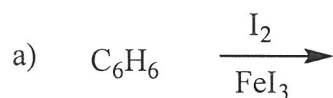
Free Response Questions

GRADING:	MC _____	(75)
	26. _____	(9)
	27. _____	(10)
	28. _____	(11)
	29. _____	(12)
	30. _____	(9)
	31. _____	(12)
	32. _____	(11)
	Total _____	149

For best results please don't leave blanks on the objective or written-out problems.
Please show all steps or logic on the written problems so partial credit can be awarded.

Written out problems – Show all work for partial credit.

26. Write the structural formula for the **major** organic product in each of the following chemical reactions. For the organic product, **name** the compound.
(9)



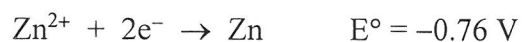
27. When H_2O is reacted with 1-propene in the presence of H^+ , two products are obtained. Propose a detailed mechanism for the major product formed from this reaction. Explain why the major product is preferred over the minor product.
- (10)

28. a) Two of the structural isomers of $C_5H_{11}Cl$ have a chiral carbon, i.e., is optically active.
Name the structural isomers that are optically active.
(11)

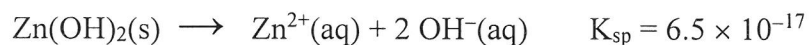
- b) Two of the structural isomers with the formula C_5H_{10} exhibit geometric (cis/trans) isomerism. Name the two structural isomers.

- c) Name the structural isomers of trichlorobenzene.

29. Consider a galvanic cell at 25°C based on the following half-reactions:
(12)



- a) Draw the cell under **standard** conditions labeling the anode, the cathode, the direction of electron flow, the concentration of ions, the electrodes, and the direction of flow of cations and anions through the salt bridge.
- b) To the standard cell above, OH^{-} is added to the zinc compartment causing $\text{Zn}(\text{OH})_2$ to precipitate. After equilibrium is reached, the measured cell potential is 1.05 V. Given the following K_{sp} value for $\text{Zn}(\text{OH})_2$:



calculate the equilibrium $[\text{OH}^{-}]$ in the zinc compartment.

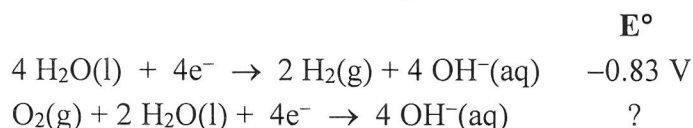
30. Hydrogen-oxygen fuel cells are utilized in some cities to produce electricity. The fuel cell reaction and equilibrium constant at 25°C are:

(9)

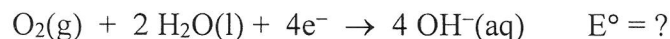


- a) Fuel cells produce power by producing a voltage. Calculate E° , the standard cell potential, for this fuel cell reaction at 25°C.

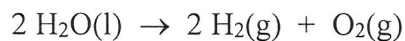
- b) This fuel cell utilizes the following half-reactions:



Using your result from part a, and given the information above, determine the standard reduction potential for:



- c) The reverse reaction of this fuel cell:



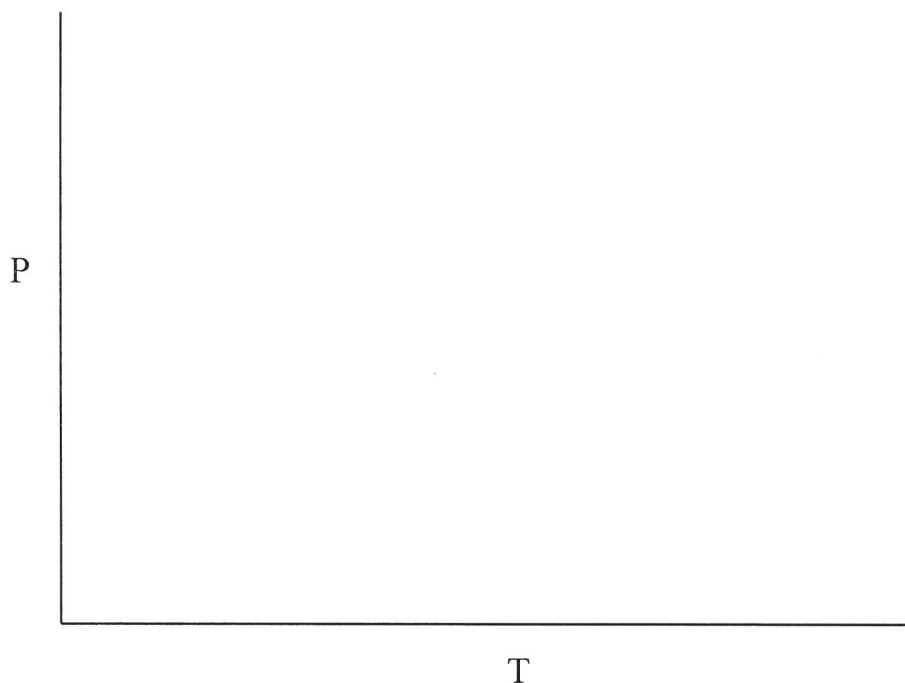
can be used to produce hydrogen and oxygen gases in an electrolytic cell. How many moles of $\text{O}_2(\text{g})$ can be produced if water is electrolyzed by a current of 10.0 amps for 220 minutes?

31. Like most substances, xenon exists in one of three typical phases: solid, liquid and gas. Some important data points in the phase diagram for xenon are:

(12)

1. normal melting point = -112°C
2. normal boiling point = -107°C
3. triple point = -121°C and 0.37 atm
4. critical point = 17°C and 58 atm

- a) Sketch the phase diagram (P vs. T) for Xe, showing the four data points given above (label them 1-4) as well as indicating the area in which each phase is stable (label the various areas solid, liquid or gas). Your phase diagram does **not** have to be to scale. However, on your axes indicate the pressures and temperatures for the four data points given above.



- b) For the following four questions, circle the correct response.

- i) Which is the denser phase, **Xe(s)** or **Xe(l)**?
- ii) As pressure increases, does the melting point of xenon **increase** or **decrease**?
- iii) As pressure increases, does the boiling point of xenon **increase** or **decrease**?
- iv) If solid xenon is heated at a constant pressure of 0.15 atm, will Xe(s) **sublime** or **melt**?

32. a) Draw the molecular orbital diagrams for O_2 and N_2 . Only draw the diagrams for the molecular orbitals formed from the 2p atomic orbitals.
(11)

b) Is O_2 **paramagnetic** or **diamagnetic**? Circle your answer.

Is N_2 **paramagnetic** or **diamagnetic**? Circle your answer.

c) Explain why the removal of one electron from O_2 strengthens the bond, while the removal of one electron from N_2 weakens the bond.

d) Does the O_2 molecule have a **larger** or **smaller** ionization energy than O atoms?
Circle your answer.

Does the N_2 molecule have a **larger** or **smaller** ionization energy than N atoms?
Circle your answer.