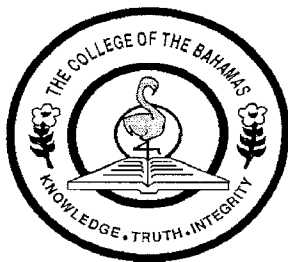# THE COLLEGE OF THE BAHAMAS

EXAMINATION

SEMESTER 01-2002

FACULTY OF PURE AND APPLIED SCIENCES
SCHOOL OF NATURAL SCIENCES AND ENVIRONMENTAL STUDIES

X NASSAU
FREEPORT
EXUMA
ELEUTHERA

DATE AND TIME OF EXAMINATION: Wednesday, April 17, 2002 at 9 a.m.
DURATION: 2 ½ HOURS

COURSE NUMBER: CHEM 115

COURSE TITLE: INTRODUCTORY CHEMISTRY

STUDENT NAME:

STUDENT NUMBER:

LECTURER'S NAME:

INSTRUCTIONS TO CANDIDATES: This paper has 9 pages and 36 questions. Please follow the instructions given.

Answer ALL questions
Section A – MULTIPLE CHOICE QUESTIONS
Select the letter on the answer sheet provided, which corresponds to the most appropriate answer for the following questions. Each question in this section is worth one mark

1. A hydrocarbon which rapidly decolorizes aqueous potassium permanganate solution is likely to be.
    A. an alkene
    B. an alcohol
    C. alkane
    D. ester
    E. a carboxylic acid

2. Which of one of the following statements about the homologous series of alkynes is correct?
    A. Their general formula is C_nH_{2n-2}
    B. They all have the functional $>C=C<$
    C. They are all gases at room temperature and pressure
    D. Each member of the series is an isomer of the next member in the series.
    E. The molecules all contain at least one methyl group, CH_3

3. The type of reaction between bromine water and ethene is best described as:
    A. Substitution
    B. Addition
    C. Decomposition
    D. Combustion
    E. Oxidation

4. The correct systematic name for

$$CH_3 - \overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - CH_2CH_3$$
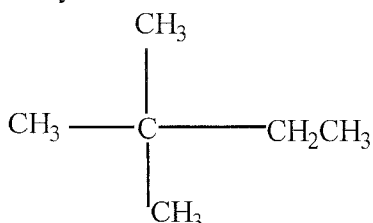
    A. 3,3-dimethyl butane
    B. 2-ethyl-2-methyll propane
    C. 2,2-dimethyl butane
    D. 2-methyl pentene
    E. 4-methyl-1-pentene

5. In the reaction between methane and chlorine.
    A. Light slows down the reaction.
    B. Manganese(IV) oxide is used as catalyst.
    C. The final product is dichloromethane
    D. The reaction is an addition reaction.
    E. Hydrogen chloride is one of the products

6. 4.4 grams of carbon dioxide at S.T.P. occupies. [C = 12, O = 16]
    A. 2.24 dm^3
    B. 1.12 dm^3
    C. $4.4 \text{ dm}3$
    D. 0.22 dm^3
    E. 9.85 dm^3

7. Which one of the following figures is closest to the percentage by mass of magnesium in $MgSO_4.7H_2O$? [Mg = 24, S = 32, O = 1, H =1]
    A. 9.8%   B. 51.2%   C. 13.0%   D. 26.0%   E. 19.5%

8. The correct systematic name for

$$CH_2CH_2CH_3$$
$$|$$
$$CH_3CCH_2CH_2OH$$
$$|$$
$$CH_2CH_3$$
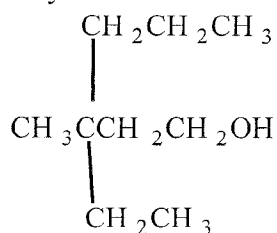
   A.   3-ethyl-3-propyl butanol
   B.   3-methyl-3-propyl pentanol
   C.   3-methyl-3-propyl hexanol
   D.   3-ethyl-3-methyl hexanol
   E.   3-ethyl-3propyl butanol

9. Which one of the following statements regarding the elements hydrogen and
    oxygen under the same conditions of temperature and pressure is true?
      A. One mole of each will occupy a different volume at s.t.p.
      B. One mole of each will have the same mass.
      C. One mole of each will occupy the same volume if they are solidified.
      D. One mole of each will occupy the same volume if they are liquefied.
      E. One mole of each will contain the same number of molecules.

10. A gas which turns lime water milky is
      A. Hydrogen B. oxygen C. ammonia D. carbon dioxide E. chlorine

11. What will be the new concentration when 250 ml of distil water is added to 150ml
    of 0.25M solution of Sodium hydroxide?
      A. 0.20M   B. 1.50M   C. 2.00M   D. 0.15M   E 0.42M

12. In which one of the following series does NO change occur?
      A.   Mg(s) added to $ZnSO_4$(aq)
      B.   Pb (s) added to $ZnSO_4$(aq)
      C.   Pb(s) added to $AgNO_3$(aq)
      D.   Fe(s) added to $CuSO_4$(aq)
      E.   Fe(s) added to $Pb(NO_3)_2$(aq)

13. Which one of the following compounds only oxygen as a gaseous product
    on heating?
      A.   Lead (II) nitrate
      B.   Copper (II) nitrate
      C.   Calcium (II) nitrate
      D.   Potassium nitrate
      E.   Silver nitrate

14. Which one of the following hydroxide does NOT exist?
      A. Calcium hydroxide
      B. Silver hydroxide
      C. Aluminum hydroxide
      D. Lead hydroxide
      E. Magnesium hydroxide

15. Which one of the following properties of element decreases in magnitude as you
    go down group II metals?
      A.   Atomic size
      B.   Number of electrons
      C.   Number of protons
      D.   Reactivity
      E.   Ionization energy

16. Element X is in group VI of the periodic table. The oxides of X are like to be:
      A.   Amphoteric B. Neutral C. Basic D. Non-existent E acidic

17. Which of the following metals is the most powerful reducing agent?
    A. Copper B. Silver C. Sodium D. Lead E. Potassium

Questions 18 through 21 are concerned with the following equilibrium system and the answers provided.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$
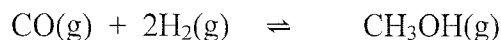
    A.   The backward reaction is favored
    B.   The equilibrium position shifts to the left
    C.   There is no change in the equilibrium position of the system
    D.   The production of CH_3OH is increased
    E.   The forward and backward reactions rates are equally increased

18. Predict the effect of adding more CO to the equilibrium system.

19. What effect would decreasing the pressure on the system have?

20. In a similar experiment, pure CO was mixed with pure H_2. If a catalyst was added to this mixture, what effect would it have?

21. What would be the effect of adding CH_3OH to the equilibrium?

Questions 22 to 24 involve the energy profile diagram for a reversible reaction shown   below.

Progress of Reaction
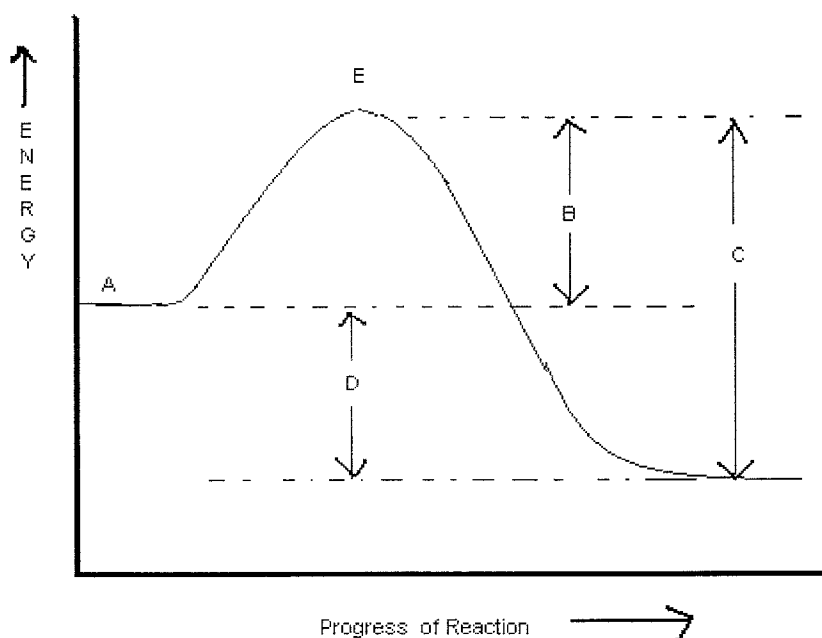
Select, from the diagram, the appropriate energy change **A – E** for each of the following questions.

22. The heat change of the reaction

23. Activation energy of the reaction

24. Transition state or activation complex

25. Which is the best explanation of product formation according to *Collision Theory*?
    A. All the collisions between the molecules result in product formation
    B. All the molecules must have both the necessary activation energy and correct orientation for product formation
    C. All the molecules must have either the correct orientation or activation energy for product formation.
    D. All the molecules must be heated for any reaction to occur.
    E. The reaction must be exothermic for any reaction to occur

26. When dilute sulphuric acid is electrolyzed, the reaction at the cathode (negative electrode) can be expressed as

   A. $2H^-(aq) \rightarrow H_2(g) + 2e^-$

   B. $4OH^-(aq) + 4e^- \rightarrow H_2O(l) + O_2(g)$

   C. $2SO_4^{2-}(aq) \rightarrow 2SO_3^{2-}(aq) + O_2(g)$

   D. $2H^-(aq) + 2e^- \rightarrow H_2(g)$

   E. $2SO_4^{2-}(aq) \rightarrow S_2O_8^{2-}(aq) + 2e^-$

27. What type of reaction that occurs during electrolysis is called

   A. a redox reaction
   B. a dehydration reaction
   C. oxidation reaction
   D. addition reaction
   E. substitution reaction

28. What would you expect to occur if a copper strip was used in a zinc nitrate solution?

   A. No reaction would take place
   B. Sulphate ions would be reduced.
   C. Copper metal would be produced.
   D. The same reaction would occur as before.
   E. Copper would displace zinc.

29. A weak electrolyte

   A. contains no ions
   B. contains covalent molecules only
   C. contains mobile electrons
   D. is totally dissociated
   E. contains few ions and\many molecules

30. In electrolysis the cathode

   A. is the electrode where oxidation occurs.
   B. is the electrode where reduction occurs.
   C. is positive.
   D. dissolves during the electrolytic process.
   E. does not conduct electricity.

SECTION B: SHORT ANSWER QUESTIONS
Answer ALL the questions in the space provided on question paper. Indicate clearly how you arrive at your answers.

1. The rate of the reaction between magnesium and hydrochloric acid was investigated in two experiments. The results of the first experiment are shown in the graph below. These results were obtained using 5.0g of magnesium and 2000cm^3 of 0.5M Hydrochloric acid, at a temperature of 25°C.
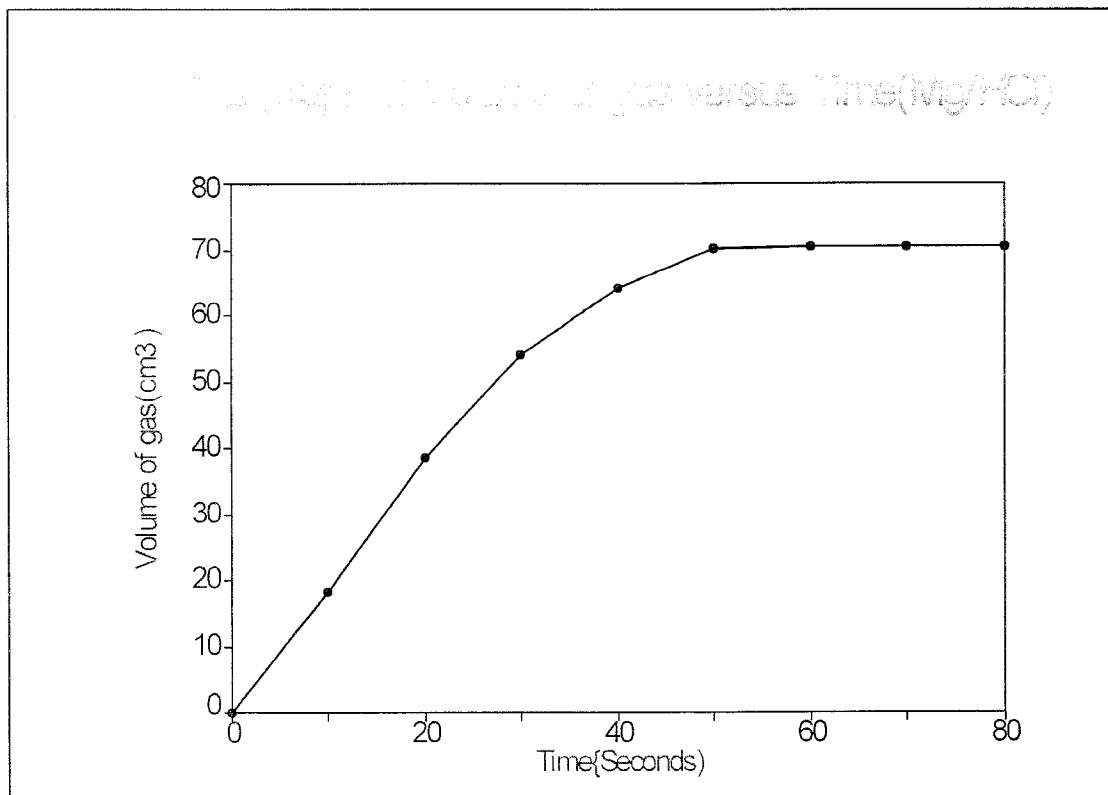
i. Write a balance equation for this reaction **(2)**

ii. Use the graph to determine the volume of gas formed in the first 45 seconds.**(1)**

iii. The curve begins to flatten out after 50 seconds. How do you account for this? **(1)**

iv. Name the gas that is produced. **(1)**

v. State how the gas formed in this experiment could be identified. **(1)**

vi. This experiment was repeated using the same amounts of reactants but at 35°C. Draw, on the graph above, the position and shape of the curve that you

would expect to obtain. Label this curve B. **(1)**

2. 50 cm^3 of 2M hydrochloric acid reacted with excess calcium carbonate($CaCO_3$)
   Ca = 40   C = 12   O = 16   H = 1   Cl = 35.5
   a. Write a balanced equation for this equation.**(1)**

   b. Calculate the number of moles of hydrochloric acid used in the reaction.**(2)**

   c. According to the balanced chemical equation, how many moles of calcium carbonate reacted with the 50 cm^3 of 2M hydrochloric acid? **(2)**

   d. Calculate the weight of Calcium carbonate used in grams. **(2)**

   e. What volume of carbon dioxide is given off in this reaction at s.t.p? **(2)**

3. Consider the following reversible reaction which is exothermic.

   $$4NH_{3(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)}$$
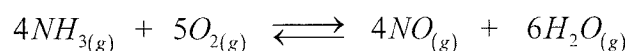
   Predict, using Le Chatelier's Principle, the effect on the position of equilibrium of the following:
   a. Lowering the temperature   **(2)**

   b. Increasing the pressure   **(2)**

   c. Decreasing the concentration of ammonia **(2)**
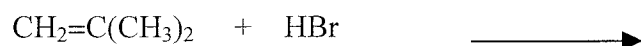
4a. Draw structural formulae for the following compounds: **(2)**
  (i) 2,2-dimethylpentane   (ii)   2-methyl-4-ethyloctane

  b. (i)   Define Markovnikov rule. **(1)**

    (ii) Using the above rule, write the structure for the main product of
        addition reaction that would be obtained. **(1)**

$$CH_2=C(CH_3)_2 \quad + \quad HBr \quad \longrightarrow$$

    (iii) Write an equation to show what happens when ethanol reacted with
        acidified potassium dichromate solution, show the structural formula of
        the organic product. [You may represent the acidified potassium dichromate
        as [O] . Name the organic product. **(2)**

    (iv) Propanol and this organic product react to give one member of a class of
        organic compounds, which are noted for their sweet pleasant smells.
        Write an equation for the reaction.   **(2)**

SECTION C
Answer one question from this section

5. The diagram below shows an apparatus in which a direct current can be passes between electrode A and B through an electrolyte C.
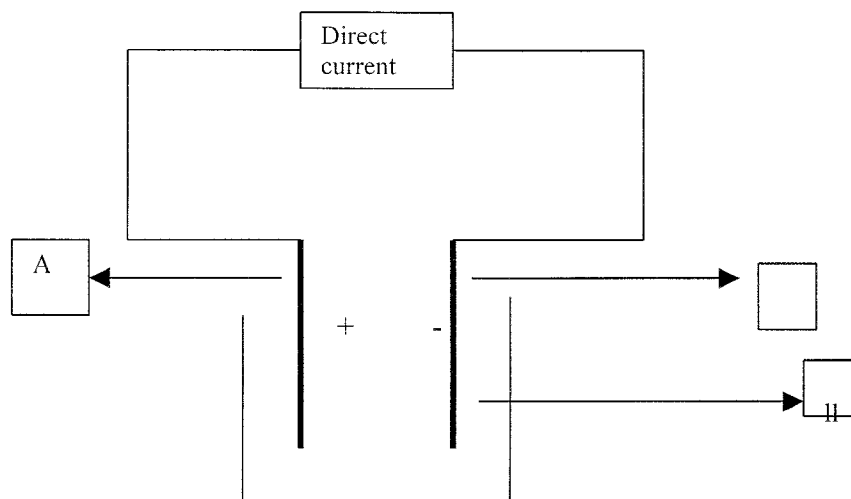
a.   Name the electrodes A and B on the above diagram **(2)**

Electrode A   -

Electrode B   -

b.   If the electrolyte C, in the above diagram was a concentrated aqueous solution of sodium bromide, give the name of the product formed at: **(2)**

i.   the positive electrode -
ii.   the negative electrode –

c.   (i). Write a chemical equations for the reactions taking place at the positive electrode to give the above product. **(1)**

(ii) Write chemical equations for the reactions taking place at the negative electrode to give above product. **(1)**

d.   If the electrolyte was dilute sulphuric acid, give chemical equation(s) leading to the formation of the product at each electrode. **(2)**
(i)   Electrode A

(ii)   Electrode B

e.   If both electrodes were of Copper and electrolyte is aqueous copper sulphate.
i.   Give the chemical reaction(s) at the positive electrode. **(1)**

ii. Give the chemical reaction(s) at the negative electrode. **(1)**

6. Consider the following cell set up: $Ag(s)\big|Ag^+\big\|Cu^{2+}(aq)\big|Cu(s)$

   $E^{\phi}_{Ag} = +0.80 \qquad E^{\phi}_{Cu} = +0.34$

   a. Draw an electrochemical cell: **(3)**

   b. Provide a chemical equation for the half reaction at the cathode. **(1)**

   c. Provide a chemical equation for the half reaction at the anode. **(1)**

   d. Provide the redox equation for the reaction occurring in the cell. **(1)**

   e. Show the direction of electron flow on the diagram in (a) **(1)**
   f. What is meant by the term standard electrode potential, E^{ϕ} ? **(1)**

   g. Explain how you could find the standard electrode potential for either Ag or Cu. **(2)**