

the
NAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

DEPARTMENT OF CHEMISTRY

B.Sc. Chemistry, Second Semester Examination, 2003

First Year

CHEM 170: PRACTICAL CHEMISTRY

JUNE, 2003.

TWO HOURS

INSTRUCTIONS.

Write your index number on the question paper.

Do not take the question paper away.

Answer ALL questions.

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SECTION A

Circle the correct answer on the question paper in INK

1. Using the table below, calculate the K_a for an indicator

| pH | $\frac{\log A - \Delta H_{In}}{\Delta In - \Delta}$ |
|------|---|
| 6.68 | 1.752 |
| 6.93 | -0.7592 |
| 7.56 | -0.1913 |
| 7.99 | -0.1691 |
| 8.32 | 1.1130 |

A. 1.9333×10^{-8} B. 1.8333×10^{-8} C. 1.7333×10^{-8} D. 1.6333×10^{-8}

2. At the isobatic point is the relationship between E_{In} and E_{HIn}

A. $E_{In} = \frac{1}{2} E_{HIn}$ B. $E_{In} = E_{HIn}$ C. $E_{In} = \frac{3}{4} E_{HIn}$
D. $E_{In} = 4 E_{HIn}$

3. How many forms can an indicator exist in solution

A. 1 B. 2 C. 3 D. 4

4. In the determination of acid dissociation of phenol red using a spectrophotometric method, the following were obtained; $A_{HIn} = 0.08$, $\Delta_{In} = 2.920$ and $A = 1.054$. Calculate K_a for Phenol red if the pH of the solution containing the indicator was 7.68.

A. 1.0904×10^{-3} B. 1.0904×10^{-8} C. 1.0904×10^{-8}
D. 1.0904×10^{-8}

- B. Thymolphthalein
 C. Phenolphthalein
 D. Methyl orange

Use the following information to answer questions 6 to 8
 A 50.0ml of 0.100M HCl was titrated against 0.100M NaOH

6. Calculate the pH when 0ml of the base had been added
 A. 1.00 B. 2.00 C. 3.00 D. 4.00
7. Calculate the pH of the solution when 49ml of the base had been added
 A. 4.00 B. 3.00 C. 2.00 D. 5.00
8. Calculate the pH of the solution when 50ml of the base had been added
 A. 7.00 B. 8.00 C. 10.00 D. 12.00
9. The reaction represented by the equation

$$\text{NaOH(aq)} + \text{HCl(aq)} \longrightarrow \text{NaCl(aq)} + \text{HO(l)}$$

 A. is a double decomposition B. is a neutralization C. is reversible
 D. is usually catalysed E. attains equilibrium after a few seconds

Use the information below to answer questions 10 – 13.
 Calcium chloride (A) Aqueous solution of Zinc chloride (B), Iron (III) tetraoxosulphate (VI) (C) and lead (II) trioxonitrate (V) (D) are contained in four separate bottles whose labels have been lost. Only aqueous ammonia solution was used to identify the samples; draw inference for the following observations; Write the appropriate letters in the column for the inferences:

| Que. No. | Observation | Inference |
|----------|--|-----------|
| 10. | White gelatinous precipitate soluble in excess aqueous NH_3 | A, D |
| 11. | No visible reaction | C |
| 12. | White precipitate insoluble in excess aqueous ammonia | |
| 13. | Reddish brown precipitate insoluble in excess ammonia | B |

4. If a species was completely transparent to a certain wavelength of light (that is $I = I_0$) what will be the value of percent transmittance
A. 100 B. 0 C. 1 D. 10
15. What is the stereochemistry of the following vanadium complex $[V(H_2O)_6]^{3+}$
A. tetrahedral B. trigonal bipyramidal C. octahedral D. square planar
16. What values of Absorbance corresponds to 65% transmittance?
A. 1.8 B. 0.19 C. 0.81 D. 4.5
17. Arrange the following ligands H_2O , en, gly, NH_3 in order of their capacity to cause orbital splitting
A. $NH_3 < H_2O < en < gly$
B. en < gly < $NH_3 < H_2O$
C. $H_2O < NH_3 < gly < en$
D. gly < en < $NH_3 < H_2O$
18. Which of the following ions is not expected to become coloured when hydrated
A. Cu^{2+}
B. Cr^{3+}
C. Fe^{3+}
D. Ti^{4+}
19. Give the oxidation state of the metal in the following compound $[Fe(SCN)(H_2O)_5]^{2+}$
A. 4 B. 3 C. 2 D. 1
20. A solution containing copper ions is blue because it absorbs the complementary A from white light and transmits the remaining blue light. A is ;
A. Violet B. Yellow C. Green D. Red
21. The energy difference between two sets of d-orbital Δ is called
A. Spectrochemical energy
B. Energy of electronic spectra
C. Crystal field splitting energy
D. Transition energy

22. Which of the following properties can best describe V_2O_5
A. acidic
B. basic
C. neutral
D. amphoteric
23. The anhydrous salts of CuF and $CuSO_4$ are ----- in colour because the ligands are weak and do not cause a big ligand field splitting of energy levels;
A. blue B. white C. green D. violet
24. Which of the following organic compound is most likely to have the highest melting point?
A. Benzophenone
B. Sulphanilamide
C. Salicylic acid
D. Oxalic acid
25. Which of the following organic compound is most likely to react with HCl at room temperature
A. Benzaldehyde
B. Acetophenone
C. Acrolein
D. Toluidine
26. Which of the following compounds could be formed when phenol is made to react with chloromethane in the presence of aluminium chloride?
A. p-chlorophenol B. m-cresol C. p-cresol D. m-chlorophenol.
27. Consider the equation below;
 $RMgBr + HCHO \xrightarrow{H_3O^+} \text{2,2-dimethylpropan-1-ol}$.
What is the name of the alkyl group represented by the letter R ?
A. ethyl B. propyl C. isopropyl D. t-butyl
28. An organic compound X dissolves in both strong and weak alkalis with the release of carbon(IV) oxide X is likely to contain as a functional group
A. C-O-C B. -C-OH C. -C-C-C D. -C-N:

29. The presence of which elements is indicated by the smell of phosphine and the immediate production of a jet black colour when a piece of filter paper moistened with AgNO_3 solution is placed over the mouth of the ignition tube in the sodium fusion test ?
A. fluorine B. chlorine C. bromine D. Phosphorus
30. A student of KNUST in the Chemistry department was given a mixture of Barium Sulphate, Benzoic acid and acetanilides; which of the following solvents would he/she use to quickly extract the benzoic acid from the mixture?
A. Di-ethyl ether
B. Concentrated sulphuric acid
C. Potassium hydroxide solution
D. Water
31. What physical observation accompanies a reaction between RCOOH (aq) and Na_2CO_3 (aq)?
A. Carbon (IV) oxide is evolved
B. RCOOH dissolves
C. There is effervesence
D. RCOOH behaves as an acid
32. Which of the following combination of compounds forms an azeotropic mixture
A. Acetone/carbon disulphide. B. Acetone/chloroform C. water/nitric acid.
D. Benzene/toluene
33. Which of the following reaction is feasible in the sodium fusion test to identify the halogens? ;
A. $\text{Cl}_2(g) + 2\text{F}^-(aq) \rightarrow 2\text{Cl}^-(aq) + \text{F}_2(g)$
B. $\text{I}_2(g) + 2\text{Br}^-(aq) \rightarrow 2\text{I}^-(aq) + \text{Br}_2(g)$
C. $\text{Cl}_2(g) + 2\text{Br}^-(aq) \rightarrow 2\text{Cl}^-(aq) + \text{Br}_2(g)$
D. $\text{Br}_2(g) + 2\text{Cl}^-(aq) \rightarrow 2\text{Br}^-(aq) + \text{Cl}_2(g)$

34. Which of these two types of chemical substances are considered drying agents in organic chemistry?

- A. Deliquescent/efflorescent
- B. Efflorescent/hygroscopic
- C. Hygroscopic/Deliquescent
- D. Amphoteric/Hygroscopic

35. Concentrated tetraoxosulphate (VI) acid is used to dry which type of gases?

- A. All gases
- B. Acidic and neutral gases
- C. Basic gases
- D. Basic and neutral gases

36. What is the meaning of MSDS? *Material Safety Data sheet*
LCSS - Laboratory chemical safety summary

37. Give a brief description of how pipetting is done in the lab.

38. Describe how 2.000g of NaCO₃ can be obtained using an analytical balance

39. State any 4 safety rules one must observe in the lab
- Hand & eye care

40. Which of the following will produce nitrogen(IV) oxide and oxygen when heated strongly;

- A. NaNO₃
- B. KNO₃
- C. Mg(NO₃)₂
- D. Pb(NO₃)₂

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KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI
FACULTY OF SCIENCE

B Sc. Chemistry I/Biochemistry I/Chemical Engineering II
First Semester Examination, 2003/2004

CHEM 169 PRACTICAL CHEMISTRY

81-2003

DECEMBER, 2003 TWO HOURS

SECTION A

(38 MARKS)

Attempt All Questions

1. The following are some of the common apparatus used in the organic lab except
(a) Soxhlet apparatus (b) Buchner funnel (c) Heating bath (d) burette
2. A method of purifying solid organic compounds by dissolving the substance in minimum amount of solvent, the substance is more soluble when the solvent is hot than when cold, the impurities are removed by filtering the hot solution. The filtrate is allowed to cool for the pure substance is.
(a) Filtration (b) Extraction (c) Recrystallisation (d) Distillation.
3. A mixture of granulated sugar and naphthalene is best separated by
(a) Magnetisation (b) Filtration (c) Distillation (d) Extraction
4. All the following parts describes the soxhlet extraction set-up except
(a) Condenser (b) Thimble (c) Separatory funnel (d) Heating mantle.
5. The following are some of the common organic solvents used except (D)
(a) Chloroform (b) Sulphuric acid (c) Petroleum ether (d) Ethanol.
6. RF value is defined as
A. Distance solvent moves/Distance compound moves
B. Compound/Solvent
C. Relative rate of movement of a given compound
D. Distance compound moves x Distance solvent moves
7. The main differences between paper chromatography and Thin layer chromatography is
(a) Solvent phase used (b) Sample used
(c) Stationary phase used (d) Mode of spotting the sample.
8. When a solution is at its boiling point equilibrium exists between evaporating liquid and condensing vapour.
(a) True (b) False

9. The purity of a given substance can best be determined by determining it's
(a) Components (b) Vapour pressure (c) Density (d) Melting point.
10. Which of the following anions forms a brick-red precipitate with AgNO_3 solution?
A. Br^- B. I^- C. CrO_4^{2-} D. CO_3^{2-}
11. An anion forms a white ppt. With AgNO_3 . This ppt. dissolves in hydrochloric acid to give an effervescence of a colourless gas which turns lime water solution milky. The anion is
A. SO_3^{2-} B. CO_2 C. CO_3^{2-} D. Cl^-
12. Which of the following anions forms a white ppt. with aq BaCl_2 solution which is insoluble in dilute HNO_3 ?
A. SO_3^{2-} B. SO_4^{2-} C. PO_4^{3-} D. Br^-
13. When H_2SO_4 acid reacts with Cl^- and I^- ions respectively
- A. Cl^- is converted into HCl whilst I^- is converted into I_2
B. Cl^- is converted into Cl_2 and I^- into I_2
C. Cl^- is converted into HCl and I^- into HI
D. Cl^- is converted into Cl and I^- into HI .
14. One characteristic test for the SO_4^{2-} ion is that it reacts with dilute HCl to produce a colourless gas which
A. turns KMnO_4 solution colourless
B. turns lime water milky
C. decolourises acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution from yellow to colourless
D. decolourises acidified KMnO_4 solution
15. Which of the following acids is always used to acidify KMnO_4 in redox reactions?
A. dilute H_2SO_4 B. Conc H_2SO_4 C. dilute H_2SO_4
D. dilute HNO_3
16. A cation that forms a ppt. on addition of a few drops to an acidified H_2S solution is said to form
A. a very insoluble sulphide
B. a slightly insoluble sulphide
C. a very soluble sulphide
D. an insoluble sulphide.
17. Which of the following pairs of cations form insoluble hydroxides?
A. Ca^{2+} and Pb^{2+} B. Cr^{3+} and Sr^{2+}
C. Cr^{3+} and Fe^{2+} D. Ca^{2+} and Ba^{2+}
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A. SO_3^{2-} B. CO_2 C. CO_3^{2-} D. Cl^-

24. A chemical reaction is carried out in 0.500kg of water in a calorimeter. As a result of the reaction, the temperature of the water rises from 15.5°C to 17.7°C . Calculate the amount of heat released by the reaction, assuming that all the heat is absorbed by the water and only a negligible amount is absorbed by the calorimeter walls. The specific heat capacity of water is $4.184\text{J g}^{-1}\text{C}^{-1}$.

- a. 4.2kJ b. 42kJ c. 4.5kJ d. 4.6kJ

25. The theoretical value of ΔH_f of Fe_2O_3 is -822.2kJ/mol. In an experiment to determine the ΔH_f of $\text{Fe}_2\text{O}_3(s)$, a student had 815.5kJ/mol as its value. Calculate the percentage error.

- a. 8.15% b. 8.2% c. 0.815% d. 0.0815%

26. What is the rate of decomposition of N_2O_5 at 45°C at an instant when the concentration of N_2O_5 is $1.5 \times 10^{-3} \text{ mol L}^{-1}$? The rate constant for this first order reaction at 45°C is $5.7 \times 10^{-4} \text{ s}^{-1}$.

- a. $8.6 \times 10^{-7} \text{ mol L}^{-1}\text{s}^{-1}$ b. $8.6 \times 10^{-7} \text{ mol}^2 \text{ L}^{-2}\text{s}^{-2}$ c. $8.6 \times 10^{-6} \text{ mol L}^{-1}\text{s}^{-1}$
d. $8.65 \times 10^{-8} \text{ mol}^3 \text{ L}^{-3}\text{s}^{-3}$

27. The concentration of H_2SO_4 is 0.4N. What is the molar equivalent?

- a. 0.4M b. 0.05M c. 1M d. 2M

28. Calculate the density of a 25ml 0.014mole solution of MgCO_3 .

$$\text{Mg} = 24 \quad \text{C} = 12 \quad \text{O} = 16.00$$

- a. 4.7g/ml b. 0.47g/ml c. 0.047g/ml d. 0.5g/ml

29. The half life of strontium-90 is 28.8years. Calculate its dissociation constant.

- a. 0.241 yr^{-1} b. 0.0241 yr^{-1} c. 2.41 yr^{-1} d. 24.1 yr^{-1}

30. The rate of a reaction is affected by the following except

- A. Surface area of the reactants
B. Catalyst
C. Concentration
D. pH

Use the following information to answer questions 31 to 33.

A 10.00ml empty volumetric flask and stopper weighs 48.675g. When it is filled exactly to the 10.00ml mark with pure methanol, the filled flask and stopper weighed 56.450g. A solution containing 15.00ml of methanol and 5.00ml of DI water is prepared in a beaker. The solution is poured into a volumetric flask and stopper now weigh 57.180g. The density of DI water is 1g/cm³.

31. What is the value of M_{tot} ?

- a. 16.6625 b. 14.7549 c. 13.2225 d. 17.4693

32. What is the value of V_{act} ?

- a. 18.4912 b. 19.5814 c. 19.4958 d. 19.5914

33. What is the value of D (g/ml)?

- a. 0.7775 b. 0.8885 c. 0.6549 d. 0.3426

4. The density of a solution of sucrose in water is 1.0816g/cm³. The total volume of the solution is 100ml. The mass of sucrose is 108.16g. The density of sucrose is 1.6g/cm³. The density of water is 1g/cm³. The mass of water is 81.84g. The mass of sucrose is 108.16g. The density of sucrose is 1.6g/cm³. The density of water is 1g/cm³. The mass of water is 81.84g.

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18. Why is dilute NH₃ added before adding (NH₄)₂CO₃ to precipitate carbonates?

- A. To provide an acid medium
- B. To neutralise acid that may be present which might decompose the CO₃²⁻ ions in the reagent.
- C. To provide species to react with CO₃²⁻ to produce the precipitate
- D. To reduce common-ion effect.

19. Cd²⁺ and Zn²⁺ both form insoluble sulphides. How do the solubility vary?

- A. ✓ CdS is slightly insoluble whilst ZnS is very insoluble
- B. CdS is slightly soluble whilst ZnS is soluble.
- C. CdS is soluble whilst ZnS is insoluble
- D. CdS is very insoluble whilst ZnS is lightly insoluble.

Use the following information to answer questions 21 and 22

A 10.00ml empty volumetric flask and stopper weigh 46.665g. When it is filled exactly to the 10.00ml mark with pure isopropanol, the filled flask and stopper weigh 54.440g. A solution containing 15.00ml of isopropanol and 5ml of DI water is prepared in a beaker, the solution is poured into a volumetric flask and stopper now weigh 55.170g. The density of the pure solvent is 0.7775g/ml

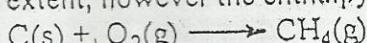
20. Calculate the mole fraction of the 15 + 5 solution mixture

- a. 0.84
- b. 0.25
- c. 0.41
- d. 0.14

21. Calculate the percentage change in volume for the 15 + 5 ml solution mixture

- a. -2.3
- b. 2.3
- c. -2.0
- d. 2.5

22. Under ordinary conditions, carbon does not react with hydrogen to any appreciable extent, however the enthalpy change for the reaction



Can be determined by carrying out the following series of related reactions and measuring their enthalpy changes

- i. C(s) + O₂(g) \longrightarrow CO₂(g) $\Delta H = -393.51 \text{ kJ}$
- ii. H₂(g) + O₂(g) \longrightarrow H₂O(l) $\Delta H = -285.83 \text{ kJ}$
- iii. CH₄(g) + O₂(g) \longrightarrow CO₂ + H₂O(l) $\Delta H = -890.37 \text{ kJ}$

From these data calculate the enthalpy for the reaction of solid carbon with hydrogen gas to form methane gas, CH₄ at 25°C

- a. -84.80kJ
- b. -118.5kJ
- c. -748.0kJ
- d. -74.80kJ

23. Calculate the volume of 12M HCl needed to make 300ml of 0.5M HCl solution

- a. 20.83ml
- b. 21.1ml
- c. 12.5ml
- d. 125ml

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF SCIENCE
FACULTY OF PHYSICAL SCIENCES.

B.Sc. (Chemistry) First Semester Examination, 2005
First Year

CHEM 169 PRACTICAL CHEMISTRY I
For (B.Sc. Chemical Engineering / Petroleum Engineering)

1½ HOURS

NOVEMBER, 2005

INSTRUCTIONS

Answer all Questions. Circle the correct answer on the question paper. Answers to questions 60 to 80 are to be presented in the table provided

1. TLV is an abbreviation that is used to indicate the risk factor of any particular chemical. It is
 - (A) Threshold Limitation Value
 - (B) Threshold Layer Value
 - ~~(C) Threshold Limit Value~~
 - (D) Thin Layer Value
 - (E) Time Lapse Value
2. Environmental Protection Agency (EPA) classifies corrosive wastes as
 - (A) Flammable solvents and solids
 - ~~(B) Common acids and bases~~
 - (C) Non flammable solvents
 - ~~(D) Reactive metals and metal reagents~~
 - (E) Alkyl and aryl halides
3. Error resulting from the instrument used in an experiment is termed
 - (A) Random error
 - ~~(B) Systematic error~~
 - (C) Gross error
 - (D) Indeterminate error
 - (E) Net error
4. Which of the following glassware is used to measure accurately the volume of a solution?
 - (A) Conical flask
 - ~~(B) Measuring cylinder~~
 - (C) Beaker
 - (D) Volumetric flask
 - (E) Pipette
5. What volume is needed to prepare 500ml of 0.1 M HCl from 11.98 M HCl?
 - (A) 41.74ml
 - (B) 1.67ml
 - (C) 4.7ml
 - (D) 2.39ml
 - ~~(E) 0.24ml~~
6. In an acid - base titration, the equivalence point is the point at which the volume of
 - (A) base present is able to react with the acid.
 - (B) base present is the same as that of acid present.
 - (C) acid present is higher than that of the base added.
 - (D) base added is higher than that of the acid present
 - ~~(E) base present is able to neutralize the acid present.~~

Paulo 05/244-075

7. Which of the following anions reacts with concentrated sulphuric acid to give a colourless, odourless gas that turns lime water milky?
(A) NO_3^- (B) Br^- (C) SO_4^{2-} (D) Cl^- (E) CO_3^{2-}
8. Hard water can be distinguished from soft water by the presence of the following cations:
(A) Ca^{2+} (B) Mg^{2+} (C) Na^+ (D) Fe^{3+} (E) Ca^{2+} and Mg^{2+}
9. An effective method for the removal of permanent hardness of water is
(A) Heating (B) Filtration (C) Ion-exchange (D) Centrifuging (E) Distillation
10. A lump of gold weighs 96.6g and has a volume of 5.0 ml, what is its density?
(A) 9.66g/mL (B) 19.32 g/dm³ (C) 19.32g/mL (D) 9.66/dm³ (E) 0.26 g/cm³
11. The analytical balance you used in the analytical laboratory has....decimal places?
(A) 4 (B) 2 (C) 3 (D) 1 (E) 5
12. Which of the following anions give a brick-red colouration upon reaction with silver nitrate?
(A) CrO_4^{2-} (B) PO_4^{3-} (C) CO_3^{2-} (D) NO_2^- (E) Cl^-
13. Which of the following anions reacts with concentrated sulphuric acid to give a colourless gas that can be detected with ammonia?
(A) NO_3^- (B) Br^- (C) I^- (D) Cl^- (E) CO_3^{2-}
14. A pure substance of mass 47.5 g is completely immersed in water in a measuring cylinder. The volume of water was initially 5.0 mL and increased to 31.8 mL. What is the density of the substance?
(A) 3.8 g/mL (B) 2.46 g/mL (C) 2.46 g/mL (D) 3.8 kg/mL (E) 1.49 g/mL
15. A solution containing an anion reacts with conc. H_2SO_4 . Upon heating a reddish-brown gas evolves that turns starch-KI paper bluish-black. The gas is
(A) CO_2 (B) NO_2 (C) SO_2 (D) Cl_2 (E) H_2
16. Which of the following silver salts is soluble in water?
(1) AgF (2) AgCl (3) AgI (4) AgCrO_4
(A) Only 1
(B) Only 2 and 3
(C) Only 3
(D) Only 3 and 4
(E) Only 4
17. The following reagents are employed in the brown ring test.
(1) Cold dilute ferrous sulphate solution
(2) Cold concentrated ferrous sulphate solution
(3) Dilute sulphuric acid
(4) Concentrated sulphuric acid
(A) Only 1 (B) Only 2 (C) Only 1 and 3
(D) Only 2 and 4 (E) Only 4

18. The brown ring test is used for the confirmation of
 (A) Nitrate (B) Iodide (C) Sulphate (D) Fluoride (E) Nitrite
19. Which of the following interferes in the brown ring test?
(1) Fluoride (2) Chloride (3) Iodide (4) Carbonate
(A) Only 1
(B) Only 2
(C) Only 1 and 2
 (D) Only 2 and 3
(E) Only 4
20. Iodides are generally soluble except
 (A) AgI (B) KI (C) HI (D) CaI_2 (E) NaI
21. Upon reaction of a certain solution with conc. H_2SO_4 a colourless gas that smells like rotten egg evolves. The gas turns a filter paper moistened with lead acetate solution black. What anion is involved in the reaction?
 (A) Sulphide (B) Sulphite (C) Sulphate (D) Chromate (E) Phosphate
22. Reproducibility of a measurement is termed
(A) Accuracy (B) Precision (C) Deviation (D) Uncertainty (E) Error
23. Which of the following ions does not react with potassium permanganate?
 (A) Sulphate (B) Sulphite (C) Nitrite (D) Iodide (E) Bromide
24. How many grams of solid NaOH are needed to prepare 500mL of 0.1M NaOH solution? ($\text{Na} = 23; \text{O} = 16; \text{H} = 1$)
(A) 20g (B) 40g (C) 0.4g (D) 0.2g (E) 17g
25. An analytical chemist weighed 106g of Na_2CO_3 into 1L volumetric flask and topped it up to volume after dissolving in distilled water. What is the concentration of sodium in the solution?
($\text{Na} = 23; \text{O} = 16; \text{C} = 12$)
(A) 0.1M Na (B) 1.0M Na (C) 2.0M Na (D) 2.5M Na (E) 0.2M Na
26. The most frequently used reagent to standardize NaOH is:
 (A) HCl (B) NaHCO_3 (C) $\text{H}_2\text{C}_2\text{O}_4$ (D) H_2O (E) HNO_3
27. A standard solution is defined as
(A) A solution of known volume
(B) A saturated solution
(C) A concentrated solution
 (D) A solution of accurately known concentration
(E) HCl concentrated solution
28. A complexing agent used in softening water is
 (A) EDTA (B) Na_2CO_3 (C) NaHCO_3 (D) CaCO_3 (E) Na_2SO_4

29. The solubility of NaCl in water is 0.056g/mL. What minimum amount of NaCl is needed to prepare 150mL aqueous saturated solution?
 (A) 8.33g (B) 0.12g (C) 0.83g (D) 1.20g (E) 15mL

30. What volume of 12M HCl stock solution is required to prepare 500mL 0.1M HCl solution?

- (A) 4.2mL (B) 41.7mL (C) 2.4×10^{-3} mL (D) 6×10^4 mL (E) 2.4×10^2 mL

31. Preparation of NaOH standard solutions must be avoided because

- (A) NaOH is hygroscopic
(B) The weight of NaOH is difficult to determine
 (C) NaOH may contain impurities
(D) NaOH is insoluble
(E) NaOH is in the form of pellets

32. What indicator is used in the titration of NaOH against oxalic acid?

- (A) Methyl orange
(B) Methyl red
(C) Alizarin
 (D) Phenolphthalein
(E) Metol

33. Which of the following elements and in their oxidation states are present in Nessler's reagent?

- (1) Pb²⁺ (2) Pb (3) Hg²⁺ (4) H
(A) Only 1 (B) Only 2 (C) Only 3 (D) Only 4 None

34. Individual components in paper chromatographic separation can be identified using

- (A) UV light (B) X-Ray (C) γ -Radiation (D) IR-radiation (E) Sunlight

35. What volume of double distilled water is in a 200mL of 30% v/v HCl solution?

- (A) 80mL (B) 66.7mL (C) 120mL (D) 76.7mL (E) 133.3mL

36. In chromatography the sorbing medium is known as

- (A) liquid phase
(B) mobile phase
(C) solid phase
 (D) stationary phase
(E) gas phase

37. A mixture of organic compounds is in liquid phase. Sodium hydroxide is added to it and a precipitate settles out. The precipitate can be separated by means of

- (A) Distillation
(B) Recrystallization
 (C) Filtration
(D) Evaporation
(E) Vaporization

38. In paper chromatography of amino acids components can be identified chemically using
(A) Spirit (B) Alcohol (C) Ninhydrin solution (D) Methanol (E) Vinegar

39. A mixture of alcohol and acetone can be separated by
(A) Distillation
(B) Condensation
(C) Filtration
(D) Sublimation
(E) Evaporation

40. The following factors are to be considered in paper chromatography except
(A) Stationary phase
(B) Mobile phase
(C) Temperature
(D) Pressure

41. A fluid is made up of two phases, organic phase and an aqueous phase.
The two phases can be separated using
(A) Distillation flask
(B) Distillation funnel
(C) Separating funnel
(D) Separating flask
(E) Round bottom flask

42. How can a solvent used in a soxhlet extraction be retrieved?
It can be retrieved by
(A) Evaporation
(B) Distillation
(C) Sublimation
(D) Fractional distillation
(E) Condensation

43. The following affects the boiling point of a pure compound.
(A) Temperature
(B) Pressure
(C) Density
(D) Stationary state
(E) Physical state

Use the following information to answer Questions 44 to 47

5.0 g benzoic acid was heated in 20mL of water. The resultant solution was filtered in the hot. The filtrate was cooled on ice. The crystals formed were washed, filtered and dried. The weight of the crystals formed was 2.8g.

44. What is the term used to describe the above purification process?
(A) Rectification (B) Recrystallization (C) Crystallization
(D) Filtration (E) Dissolution

45. Why was heat applied in the process above?
(A) To get the solute dissolved
(B) To get a saturated solution
(C) To get a clear solution
(D) To get the warm
(E) To evaporate part of the water
46. What was the percentage purity of the benzoic acid described above?
(A) 1.79% (B) 56.00% (C) 78.00% (D) 56.12% (E) 44.00%
47. What criteria can be used to ascertain the purity of the benzoic acid described above?
(A) Boiling point
(B) Melting point
(C) Freezing point
(D) Mixed boiling point
(E) Evaporating point
48. Which of the following laboratory apparatus is used for filtration under reduced pressure?
(A) Glass funnel
(B) Plastic funnel
(C) Buchner funnel
(D) Separating funnel
(E) Extraction funnel
49. The rate of a chemical reaction can be dependant on the following except
(A) Concentration
(B) Temperature
(C) Catalyst
(D) Melting point
50. Mole fraction of a solvent in a homogeneous mixture with water is expressed as:
(A) Moles of solvent / Molar mass of solvent
(B) Moles of solvent / Molar mass of (solvent + water)
(C) Moles of solvent / Moles of (solvent + water)
(D) Moles of solvent / moles of water
(E) Grams of solvent / grams of (solvent + water)
- What is the enthalpy of formation of a compound?
(A) The enthalpy change when one mole of the compound is formed.
(A) The enthalpy change when a substance is formed from its constituent elements under standard conditions.
(B) The enthalpy change when one mole of the compound is formed from its constituent elements under standard conditions.
(D) The enthalpy change when a compound is formed from its constituent elements under standard conditions.

52. What is the morality of solution prepared from 18ml of 12M HCl in a 500ml volumetric flask?
(A) 0.432M (B) 0.423M (C) 0.400M (D) 0.422M (E) 0.750M

53. What is the mass of KCl required to prepare 250ml of 0.1M solution?
(A) 1.86g (B) 1.85g (C) 1.88g (D) 1.84g (E) 1.90g

54. In the laboratory preparation of 500ml 0.4M HCl from 12M HCl,
(A) 16.7ml of the conc. acid is pipetted into a 500ml volumetric flask and diluted with water to the mark.
(B) 16.7ml of the conc. acid is pipetted into a 500ml volumetric flask and diluted with distilled water to the mark.
(C) 16.7ml of the conc. acid is measured into a 500ml volumetric flask and diluted with distilled water to the mark.
(D) 16.6ml of the conc. acid is measured into a 500ml volumetric flask and diluted with distilled water to the mark.

55. Heat of reaction is expressed as:
(A) $q_{rxn} = [mC_p\Delta T]_{soln} + [mC_p\Delta T]_{cal}$
(B) $q_{rxn} = [MC_p\Delta T]_{soln} + [MC_p\Delta T]_{cal}$
(C) $q_{rxn} = [mC\Delta T]_{soln} + [mC\Delta T]_{cal}$
(D) $q_{rxn} = [MC_p\Delta T]_{solid} + [MC_p\Delta T]_{liquid}$
(E) $q_{rxn} = [MC_p\Delta T]_{soln} + [MC_p\Delta T]_{solvent}$

56. In the laboratory, it is a good practice to measure and mix acids and explosives in
(A) An explosive box.
(B) In a filter hood.
(C) In an explosive hood.
(D) In a fume hood.

57. A first order reaction is of the type: $A \longrightarrow B + C + \dots$
(A) The rate of disappearance of one of the products is inversely proportional to the concentration of that product in the reaction mixture.
(B) The rate of disappearance of one of the products is directly proportional to the concentration of that product in the reaction mixture.
(C) The rate of disappearance of the reactant is directly proportional to its concentration in the reaction mixture.
(D) The rate of disappearance of the reactant is inversely proportional to its concentration in the reaction mixture.

58. All are true for the Q - test except
 (A) $Q = (x_n - x_0) / w$
 (B) It is used to measure the validity of an individual measurement.
 (C) At a particular confidence level, a measured value can be rejected, if Q is greater than the value in the Q - test Chart.
 (D) Q is always less than the value in the Q - test Chart at a particular confidence level.

59. The following are indicative of the presence of ions in the qualitative anion and cation determination

(1) Evolution of Gas (2) Solubility of solids in water (3) Boiling and Melting Points (4) Colour of solution produced

- (A) Only 1 and 2 (B) Only 2, 3 and 4 (C) Only 1, 2 and 4
 (D) Only 1, 2, and 4 (E) None of the above

Using the information presented in the table below, provide solutions to Questions 60 to 80. The following are to be determined: the change in mass Δm , the density D(g/ml), the total mass $m_{\text{tot}}(\text{g})$, the actual volume $V_{\text{act}}(\text{ml})$, the experimentally determined volume $V_{\text{exp}}(\text{ml})$ and the percentage change in volume $\% \Delta V$ for pure ethanol and ethanol:water mixtures represented with χ_{solv} .

Weight of empty density bottle and stopper = 45.55g

Capacity of density bottle = 10ml

Mass of solution + density bottles + stopper = M_χ

| Solution | M_χ | Δm | D(g/ml) | $m_{\text{tot}}(\text{g})$ | $V_{\text{exp}}(\text{ml})$ | $V_{\text{act}}(\text{ml})$ | $\% \Delta V$ | $\% \Delta V/V$ |
|----------|----------|------------|---------|----------------------------|-----------------------------|-----------------------------|---------------|-----------------|
| Ethanol | 53.31 | Ques.60 | Ques.63 | Ques.66 | Ques.69 | Ques.72 | Ques.75 | Ques.78 |
| 1:5 | 56.55 | Ques.61 | Ques.64 | Ques.67 | Ques.70 | Ques.73 | Ques.76 | Ques.79 |
| 18:5 | 58.87 | Ques.62 | Ques.65 | Ques.68 | Ques.71 | Ques.74 | Ques.77 | Ques.80 |

Answers to Questions 60 to 80 are to be provided in the table below.

| | Δm | D | m_{tot} | V_{exp} | V_{act} | $\% \Delta V$ | $\% \Delta V/V$ | | | | | | |
|----|------------|-----|------------------|------------------|------------------|---------------|-----------------|----|--------|----|--------|----|-------|
| 60 | 7.760 | 63 | 0.776 | 66 | 7.760 | 69 | 10.000 | 72 | 10.000 | 75 | 0.000 | 78 | 0.000 |
| 61 | 11.620 | 64 | 1.160 | 67 | 11.640 | 70 | 28.000 | 73 | 15.127 | 76 | -32.20 | 79 | - |
| 62 | 13.320 | 65 | 1.332 | 68 | 17.967 | 71 | 23.000 | 74 | 14.240 | 77 | 71.86 | 80 | - |