Chapter-5: Vocational Chemistry

Ques. ▶ 1 X(NaOH); Y (NH_4OH); Z(NaCl).

[D.B, Dj. B, S. B, J. B- 18]

a. What is 4-digit balance? 1
b. Explain Pauli exclusion principle. 2
c. Explain the role of 'Z' for food examining. 3
d. Which compound of the stem is suitable to prepare glass cleaner? Analyse. 4

Answer to the question no. 1

a 4-digit balance is a balance with which a substance can be weight up to four decimal of gram i.e up to 0.0001g correctly.

b The Pauli is exclusion principle says that no. electron in an atom are permitted to have an identical set of quantum number. It means that among the electrons in an atom value of at one quantum number must be different. For example, there are 2 electrons in helium atom. The two electrons have the following values for four quantum numbers.

For 1st electron, e_1 : $n = 1, l = 0, m = 0, s = +\frac{1}{2}$

for 2nd electron, e_2 : $n = 1, l = 0, m = 0, s = -\frac{1}{2}$

Among the values of four quantum numbers of these two electrons, three values are identical but the fourth value (i.e. spin quantum number) is different. Hence pauli exclusion principle is supported by helium atom.

c In the stem, the compound Z is NaCl. There are a great role of NaCl for the food canning. For food preservation, curing is widely used. For the preservation of food, with a definite concentration of NaCl is called canning or curing. NaCl absorbs water from food materials, so microbe present in the food does not get any environment to grow.

NaCl is a natural preservative. NaCl absorbs water from the food i.e. it acts as dehydration. So the growth of microbe in the foods is stopped. Salt decreases the solubility of oxygen, so bacteria cannot grow. The mixture salt and acid (mainly lactic acid) obstructs the germs purefaction.

d The Y compound of the stem is NH_4OH. So then the Y compound will be appropriate for glass cleaner. Because, basically the main ingredients of glass cleaner is NH_3, from which NH_4OH is obtained.

Ammonia, NH_3 as a weak base forms ammonium hydroxide, NH_4OH by reacting with H_2O. This ammonium hydroxide is also a weak alkaline solution which is good enough to dissolute the dirts on the glass surface and is not harmful to the glass. It only dissolves the greases.

$$NH_3 + H_2O \longrightarrow \overset{+}{N}H_4 + \bar{O}H = NH_4OH$$

$$\begin{array}{l} CH_2\text{–}OCOR \\ | \\ CH\text{–}OCOR \\ | \\ CH_2\text{–}OCOR \end{array} + NH_4OH \longrightarrow \underbrace{3RCOONH_4}_{\text{removed from glass surface}} + \begin{array}{l} CH_2\text{–}OCOR \\ | \\ CHOH \\ | \\ CH_2OH \end{array}$$

oil/grease/fats

Glass (Ca) Na silicate + NH_4OH → No reaction

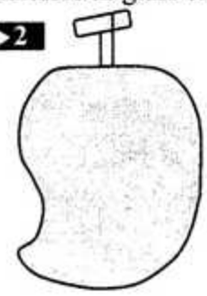
Figure : Cleaning mechanism of glass cleaner

So NH_3 is used safely with ethanol or others in glass cleaner. But NaOH is strong base, it reacts with glass and destroys the glass surface.

$2NaOH + SiO_2 \rightarrow Na_2SiO_3 + H_2O$

From the above discussion it is said that NaOH is more corrosive and NH_4OH is weak base comparatively. So, Na_4OH is more suitable as glass cleaner.

Ques. ▶ 2



Mango
Figure 1

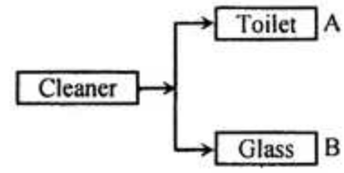


Figure 2

[R.B, C.B, Ctg. B, B.B-18]

a. What is measuring cylinder? 1
b. Why is the configuration of electron of Cu exception of general rule? 2
c. Explain preservation method of the fruit of figure-1. 3
d. Compare the cleaning mechanism of A and B of the figure-2. 4

Answer to the question no. 2

a Measuring cylinder is a type of glass cylinder that has lines printed on the side of it showing how much it contains, used by scientist.

b The electronic configuration of Cu– $1s^2\ 2s^2 2p^6\ 3s^2\ 3p^6\ 3d^9\ 4s^2$.
From the electronic configuration mentioned above. Cu (29) 3d orbital has 9 electrons and 4s has 2. But, to get a stable configuration, 1 electron from 4s will get transferred into 3d giving it an exceptional electronic configuration of (Ar) $3d^{10}4s^1$.

c The fruit following the stem is mango. mango is generally preserved by canning. The method of canning explained below-

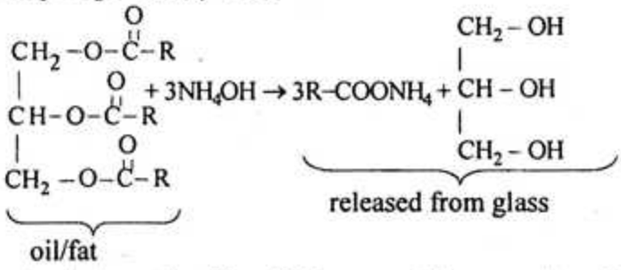
1. Ripe and matured mangoes are selected for canning selected mangoes are washed thoroughly and skin and other undesired parts are removed.
2. The peeled mangoes are sliced to proper sizes and the seed is removed.
3. The sliced pieces are introduced into the jar; 40% sugar solution and 0.25% citric acid are added. Sugar and acid work as preservatives.
4. Cans are now exhausted and sealed. Afterwards, they are processed through putting into boiling water for 20-30 minutes.
5. The cans are then cooled to room temperature and labelled. The label should contain production and expiry date.

d In the figure (ii) following the stam, A and B are toilet cleaner and glass cleaner. In case of glass cleaner, ethanol and detergent are used with ammonia. Again, the glass cleaner can be made by ammonia solution only.

NH_3 reacts with water to form NH_4OH. The OH^- ion of NH_4OH releases the glass contaminant, grease, oil and fat like substances. NH_4OH removes the attached glass contaminants and do not undergo any kind of reaction with glass.

Glass (Calcium and sodium silicate) $NH_4OH \rightarrow$ No chemical changes.
Therefore, for cleaning glass, objects, NH_3-solution alone or in combination with ethanol and detergents can safely be used.
On the other hand, use of NaOH solution for cleaning glass objects can corrode the glass. Because, glass component silica reacts with NaOH to form sodium silicate.

$$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$$



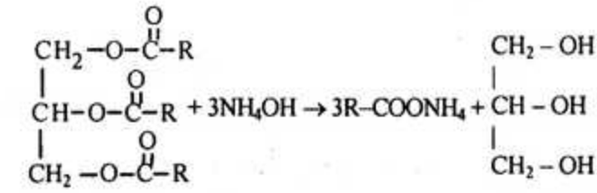
adsorbed on glass[R = C_nH_{2n+1}; n = 15or more than 15]

Figure-1 : Cleaning mechanism of glass cleaner

Use of NaOH in toilet cleaner is very effective in removing the solid dirts. NaOH does not have any damaging effect on the toilet materials– like ceramic, mosaic etc.
NaOH reacts with protein-like contaminants to form NH_3 and forms immiscible emulsion with oils, grease or fat-like dirts.

$$NaOH + SiO_2 \longrightarrow Na_2SiO$$

$$R - CO - NH_2 + NaOH \longrightarrow R - COONa + NH_3$$



[R = C_nH_{2n+1}; n = 15 or more than 15]

Figure-2: Cleaning mechanism of toilet cleaner

NaOH is alkaline and corrosive. It easily reacts with dirts (dust, fat, protein) to form salt which is water soluble and can easily be removed with washing.

Ques. ▶3

Reagent	Product
Caustic soda	Cleaner A
NH_3 solution	Cleaner B

[D. B-17]

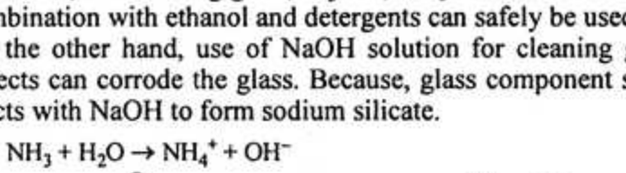
a. What is a suspension? 1
b. Explain the role of chemistry in food security. 2
c. Explain the cleaning mechanism of cleaner 'A'. 3
d. Can the cleaner 'B' be used as a toilet cleaner? Analyse with justification. 4

Answer to the question no. 3

a Suspension is a heterogeneous mixture that contains solid particles sufficiently large for sedimentation. In the suspension, the partials may be visible to the nacked eye. usually must be greater than 1 μm.

b Chemistry has a great role for food safety. Food safety is a scientific rules which keep food from Poisoning pollution during various steps of food processing and preservation, serving etc.
This includes a number of routines that should be followed to avoid potentially severe health hazards. Safety between food industry and the market and the consumer include food labeling, foods hygiene, food additives and pesticide residues as well as policies on technology foods management by import and export inspection, safe delivery and preparation of the foods for the consumer.

c In the stem, A is caustic soda (NaOH) which is used widely as toilet cleaner. Reacting with oil and fat component of dirt. NaOH produces soap and glycerin.



In produced soap molecule to polar carboxylate ion remains hydrophilic end and to non polar alcohol radical remains lipophilic end.

This hydrophilic end are soluble in water and lipophilic end soluble in oil or fat.

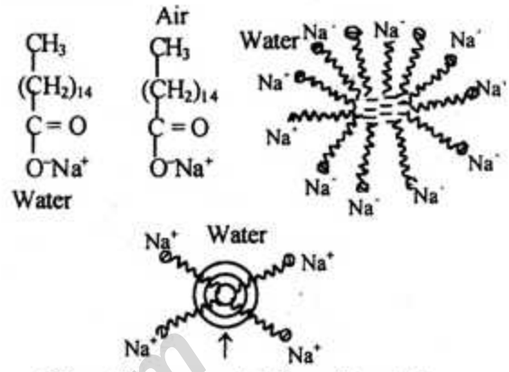
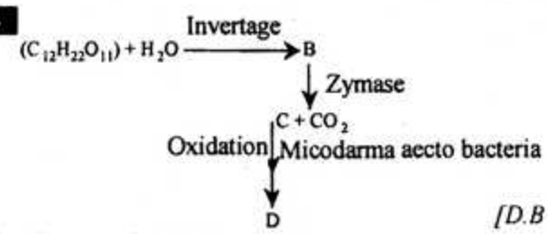


Fig: The cleaner mechanism of soap

As a result, lipophilic end surrounds oil or fat and hydrophilic end remains outside. Thus with NaOH, oil end fat reacts end produces soap which keeps role to clean toilet.
Again, NaOH is more appropriate as toilet cleaner due to the having intense corrosive character.
Cleaner-A and Cleaner-B both are used to clean. But since cleaner A is NaOH and it is strong alkali.

d NaOH is very effective as toilet cleaner in removing the solid dirts. NaOH does not have any damaging effect on the toilet materials like ceramic, mosaic etc. NaOH reacts with protein– like contaminants to form NH_3 and forms immiscible emulsion with oils, grease or fat like dirts. It easily reacts with dirts (dust, fat, protein) to form salt which is water soluble and easily be removed with washing.
One the other hand, cleaner B means ammonia (NH_3) is a milded cleaner. It is widely used in glass cleaner. It is not able to remove dirt, grease, oil and fat like substances from the toilet ceramic properly.
From the above discussion we can say, cleaner-A is strong, so, it is better to use as toilet cleaner.

Ques. ▶4



[D.B - 16]

a. What is coagulation? 1
b. Why caustic soda is not used on glass cleaner? 2
c. Write down the reaction of the stem. 3
d. Analyse whether the preservation mechanism of "A" and "D" of the stem are same or not-Explain with proper reason. 4

Answer to the question no. 4

a Coagulation is a process which involves coming together of colloidal practices so as to change into large sized particles which ultimately settle as a precipitate or float on the surface.

b In caustic soda (NaOH) is not used in glass cleaner, because the main component of glass is SiO_2 which reacts with NaOH produces the compound sodium silicate (Na_2SiO_3). In this case glass will be decayed.

$NaOH + SiO_2 \longrightarrow Na_2SiO_3 + H_2O$

c The reaction of the stem are as follows:

$$A\ (C_{12}H_{22}O_{11}) + H_2O \xrightarrow{\text{Invertage}} \underset{\text{Glucose}}{C_6H_{12}O_6}\ (B) + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{Glucose}}{C_6H_{12}O_6}\ (B) \xrightarrow{\text{Zynmase}} \underset{\text{Ethanol}}{CH_3CH_2OH}\ (C) + CO_2$$

$$2CH_3CH_2OH(C) + 2O_2 \xrightarrow{\text{Micodama acetobacteria}} \underset{\text{Acetic acid}}{2CH_3COOH} + H_2O$$

d Compound 'A' is sugar and compound 'D' is vinegar.
The preservation mechanisms of 'A' and 'D' of the stem are not same. Preservation of foods by sugar depends on the concentration of sugar solution. When foods like carbohydrates are immersed in 65-70% sugar solution, the foods are in good condition for a long time. This chemical (sugar solution) preservation resists the growth of the bacteria, yeasts and moulds. This chemical substance disrupts the cell membrane of the micro organism and can resists the enzymic actions.
Again, 6-10% aqueous solution of acetic acid (ethanol acid) is the vinegar. If the pH values of this solution be kept low (3.14-4.74), then it is favorable to preserve foods. In this sate bacteria or fungus do not able to grow i.e in presence of less H^+, the harmful bacteria cannot alive. Eg-vinegar which is mainly acetic acids, it reacts as follows:

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

Alive harmful bacteria + $H^+ \rightarrow$ dead or inactive bacteria.
Therefore, preservation mechanisms of sugar and vinegar are different.

Ques. ▶5

A	B	C
Fruits, vegetables	Food preserved by natural preservatives	Food preserved by synthetic preservatives

[R.B- 17]

a. What are colloids? 1
b. The value of R_f is less than 1; why? 2
c. Describe the canning process for "A". 3
d. Which of the processes between B and C is more safe for health? Explain. 4

Answer to the question no. 5

a Colloid is a mixture in which one substances of microscopically dispersed insoluble particles is suspended throughout another substance.

b The distance travelled by the separated components (solutes) is expressed by the value of R_f (retardation factor value), where $R_f = \frac{\text{Distance travelled by the solutes}}{\text{Distance travelled by the solvents}}$

So, the R_f value will be less than 1, because, any solute cannot travell more distance compared to the solvent. Even R_f value would be zero in minimum. The value of R_f is in the range one to zero ($1 \geq R_f \geq 0$).

c In the stem, A is fruits and vegetables.
Fruits and vegetable canning procedure consists of the following steps.

i. **Collection of raw materials** : The fruits, vegetables, fish and meat which have uniform shape, colour, smell and uniformly fresh and defectless are selected and collected.
ii. **Elimination of unwanted parts of raw materials** : The unwanted parts of: vegetables, are rejected and seeds of fruits are eliminated, fats bones and noneatable parts of fish and meat are eliminated.
iii. **Washing** : Food items which are to be canned are washed well in pure water to remove dirty particles. For this purpose the food items are immersed in water for sometime and then washed by spraying water or by revolving method. External dirt and microbes are removed on an average.
iv. **Sizing** : The washed food items are cut into $\frac{1}{4} - \frac{1}{2}$ inch pieces.
v. **Blanching** : Heating of the food items in boiling water or in steam for 5-10 minutes is called blanching. The volumes reduce unwanted smell is removed. colours become improved, microbes are destroyed in blanching. It is not needed for ripe fruits.
vi. **Sterilization of cans** : The cans or pots where food items are to preserved are sterilized by heating them in boiling water for half an hour $\left(\frac{1}{2}\text{ hrs}\right)$.
vii. **Filling up of the sterilized cans :** The food item after blanching are averaged in uniform way in the sterilized cans so that salt or sugar solution can reach every parts of the food item and heat may be reached uniformly.
viii. **Addition of sugar or salt solution in the cans** : For vegetables, meat and fish normally 7-15% NaCl aqueous solution is added to the cans. For fruits 30-40% purified sucrose solution is added. Sugar and salt here act as preservatives. If necessary other preservatives like ethanol, vinegar, sodium benzoate, sodium nitrite, SO_2 etc. are added now.
ix. **Exhausting** : Before sealing the cans the food items are again heated by special process- this is known as exhausting. In this process, the air in the can is removed so that can does not rust in absence of air, and aireal microbes cannot grow. Moreover cooking of the food is fulfilled to some extent.
x. **Sealing of the cans :** After exhausting, immediately sealing of the can with lids is performed with care so that the cans become fully air- tied. This is highly technical process. The success of the whole process depends upon the process of sealing.
xi. **Retorting** : After sealing of the cans, the cans with food item are again heated it is called retorting. The food items which are not acidic (pH $\cong$ >7) are heated at 121°C for 1.5 hrs -2 hrs and the food items which are acidic (pH< 7) are heated at 90-100°C for 30 minutes. At this all microbes in the cans are destroyed.
xii. **Cooling of the cans** : After retorting the hot cans are cooled down to room temperature.
xiii. **Labeling** : Finally the cans are labeled with name of the food item, expiry date/manufacturing date etc.
xiv. **Stocking** : Finally the canned foods are stocked in a suitable place (godowns) which is dry, cold (temp. 2-15°C) and dark before marketing.

d Given, 'B' is food preserved by the natural preservatives and 'C' is food preserved by the artificial preservatives. Between the two food preserved 'B' is safer for health.

1. **Natural food preservatives:** The main source of these preservatives are nature which are usually used in food preservation and food processing. They include salt, sugar, alcohol, vinegar etc. They are used in preparation of jam, jelly, pickles, sauce, juices. Salt and sugars are considered

as old food preservatives. They effectively arrest the growth of bacteria. Salt is used in curing of fish and meat, castor oil, citric acid, citrous juice and rosemary extract are also used as natural food preservatives.

2. **Chemical or artificial food preservatives:** These preservatives are chemical substances, synthetically manufactured, which may be either
(i) Antimicrobial,
(ii) Antioxidant preservatives,
(iii) Anti-enzymatic preservatives.
(i) **Antimicrobial preservatives:** They inhibit the growth of bacteria or fungi, including mold. They include mostly Na or Ca-salts of sorbic acid, Ca- propionate, benzoic acid, Na nitrate/ nitrite, potassium bisulfite etc.
(ii) **Antioxidant preservatives:** These preservatives resist oxidation of food constituents especially oxidation of fats and lipids.
(iii) **Anti-enzymatic preservatives:** Anti enzymes preservatives block the enzymatic process such as ripening occurring in foodstuffs even after harvest.

From the above discussion we can conclude that natural food preservatives is safer for health.

Ques. ▶6

Sucrose → A (Organic acid)
Sucrose → B (Sucrose)

[Dj. B-17]

a. What is orbital – hybridisation? 1
b. Why is the first ionisation potential of nitrogen higher than that of oxygen? 2
c. Describe with equations the preparation of A compound from compound B. 3
d. Which of the compounds between A and B is more suitable for fish preservation? Analyse. 4

Answer to the question no. 6

a Hybridisation is the idea that atomic orbitals fuse to form newly hybridized orbitals which in turn, influence molecular geometry and bonding properties.

b In the periodic table, position of oxygen is in right of Nitrogen. So, ionization potential of oxygen will be more than Nitrogen; but in reality ionization potential of nitrogen is more than oxygen; because in electronic configuration, in p-orbital of last shell of nitrogen present three (3) electrons which is half filled and it is more stable frame. So, to release electron from here more energy is required. On the other hand, in p-orbital of last shell of oxygen has four (4) electrons from where less energy than nitrogen is required to left. So, the first ionization potential of nitrogen is greater than that of oxygen.

c In the stem B is sucrose and A is organic Acid. The preparation of organic acid (vinegar) from sucrose given below–

Preparation of B (organic acid) from A:

The date juice or cane sugar juice contains sucrose sugar ($C_{12}H_{22}O_{11}$). In dilute sucrose solution, malt and yeast are mixed; which secrete enzyme and promotes fermentation of sucrose. At this, first ethanol forms and then enthanol is oxidized to dilute ethanoic acid. The 6-10% aqueous solution of ethanoic acid is the vinegar.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[37°C]{\text{invertase}} C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose [glucose + fructose = invert sugar]

$$2\,C_6H_{12}O_6 \xrightarrow[20°–24°C]{\text{Zymase}} 4CH_3CH_2OH + 4CO_2$$

invert sugar ethanol

$$CH_3CH_2OH\,(10\%) + O_2 \xrightarrow[\text{bactor}]{\text{aceto}} CH_3COOH + H_2O$$

ethanol acetic acid (6%)

d Among the compounds A is a organic acid (vinegar) and B is sucrose. Vinegar is more suitable for the preservation of fish. 6-10% water solution of acetic acid is called vinegar. Vinegar can be used to preserve many foods. Various people of the world have been using vinegar as a preservative for a long time.

If we leave our foods normally at room temperature, then gradually rots. The main reason is bacteria. Bacteria attacks the food and breads there. As a result, the food gradually decays. In this case vinegar plays an effective role. Vinegar destroys harmful bacteria or delays their function. As a result food can be kept fresh for some days. But vinegar is also effective in destroying various germs and moulds. Protein has a special type of structure, (three dimensional structure) which stops their function. This function can be changed by different factors. For example pH temperature and so on. Vinegar is a weak acid. Its pH is very low. That is why vinegar can change the structure of many proteins and disable them. This is how vinegar breaks down protein structure and destroys bacteria. In vinegar, white vinegar is most effective in destroying bacteria. It is inexpensive and environment friendly. But vinegar cannot preserve food for too long. Because some bacteria can survive the effect of vinegar and keep on breeding and helps to decay food gradually. If food is sterilized it becomes free of bacteria and can be kept fresh for a long time.

From the above discussion, it is clear that for preservation of fishes, organic acid (A) is more suitable.

Ques. ▶7 Vinegar (A) | NH_3 Solution (B) | NaOH Solution (C)

[Dj. B- 16]

a. What is suspension? 1
b. Write down the Hess's law and explain. 2
c. Describe the mechanism of A for food preservation. 3
d. Between the solution B and C of the stem which one is better for glass cleaning- Explain. 4

Answer to the question no. 7

a When a heterogeneous mixture contains dispersed insoluble particles of sizes greater than 500 nm, then it forms an unstable colloid for a small period. This type of mixture is called suspension. For example blood is an example of suspension.

b **Hess's Law:** If a reaction can take place by single step or several steps, the overall change in enthalpy is the same whichever route is followed with same initial reactants and final products.

In other words, the net enthalpy change in a reaction does not depend on the path by which the reaction takes place.

Explanation: Let us suppose that a reactant 'A' may be converted to a product 'C' through two different paths or routes. These reactions with enthalpy changes have been shown in fig.

i. (A) $\xrightarrow{\Delta H_1}$ [C] : (by single step)

ii. (A) $\xrightarrow{\Delta H_2}$ (B) $\xrightarrow{\Delta H_3}$ [C] : (by two steps)

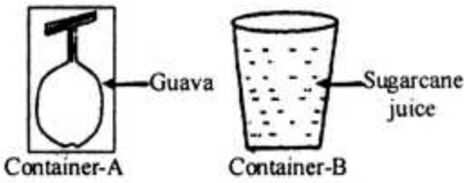
c The food preservation technique of vinegar given below–

Vinegar is an acidic solution, it decreases the pH of the preserved food. (5 to below 4.0). As a result microbes specially bacteria which responsible for food adulteration do not have

the favourable environment for growth and development. 5% ethanoic acid containing vinegar has a pH of 2.4, which is sufficient to kill bacteria. If salt is added with vinegar, the preservation becomes more effective. Addition of salt extracts the excess water from food products. This does not reduce the concentration of vinegar. Since it dissolves very well in water, it mixes well with food water easily and maintains a homogenous concentration and thus resists the growth micro-organisms. Because of its higher boiling point than (118° C) water, it does not get evaporated during the application of heat at the time of food processing. It is easily available and does not show any side effect. For pH reduction during the food processing and preservation, acid concentration in vinegar can be increased. In case of low acidic food, acid concentration of vinegar has to be increased.

d Similar to the question no-1 (d).

Ques. ▶8



[C. B-17]

a. What is equilibrium? 1
b. Why is conc. HCl used in flame test? 2
c. Describe a long time preservation method for the fruit mentioned in container-A. 3
d. Is it possible to prepare vinegar from the component of container-B? 4

Answer to the question no. 8

a Equilibrium is a state in which the rate of the forward reaction equals the rate of the backward reaction.

b Salts of metals are less volatile. So, in flame test when conc. HCl is used, the metal salts reacting with produced metal chlorides which are comparatively more volatile. When this salt is heated in oxidizing flame, it is easily converted to vapour.
At vapourized state, metal cation taking electrons from nearer anion forms isolated metal atom. Later, this metal atom absorbed light of fixed wavelength and becomes excited. This excited atom radiating energy produces special colour in the flame and comes back to its earlier position.
For this reason HCl acid used in flame test.

c In the stem, container represents the guava fruits. The long time preservation method of the fruit given below:

i. First of all ripe guavas are collected, washed with water and cut into pieces.
ii. Then cans are filled up with guava pieces.
iii. 10% solution of sugar and a mixture of 0.06% citric acid and 0.125% ascorbic acid solution are added to the can and care is taken so that the pieces are immersed in the solution.
iv. After exhausting the cans are sealed airtight.
v. Sealed cans are heated in boiling water for 20-30 minutes.
vi. Finally, the cans are labelled with name of the product, packaging and expiry date and stocked in a dry, cool, dark, godown for marketing.

d Container-B contains sugar cane juice. Again, vinegar is a 6-10% water solution of acetic acid. From sugarcane juice vinegar can be prepared. The procedure is described in the following:
The remaining part is similar to the question no- 6 (c).

Ques. ▶9 Sugar (A) $\xrightarrow{H_2O}$ $C_6H_{12}O_6$ $\xrightarrow{Zymase}$ B(I) $\xrightarrow{Oxidation}$ C

[C. B- 16]

a. What is reagent? 1
b. Explain the comparision to the melting point orthonitrophenol and paranitrohenol. 2
c. Explain the types of foods preserved by A at the stem. 3
d. Analyze the techniques preserving the foods by C of the stem. 4

Answer to the question no. 9

a A reagent is a chemical substance that is used to create a reaction in combination with some other substance.

b In both the compound of orthonitrophenol and paranitrophenol form hydrogen bond. But when the hydrogen bond forms among orthophenol, its melting point does not change so much. Molecules of paranitrophenol joined to each other with the intermolecular hydrogen bond.
So, extra heat is required to break the extra hydrogen bond to midst of molecules of it. Therefore, melting point of paranitrophenol is more than that of orthonitrophenol.

c A or sugar of the stem is the main source of preservative in nature which is widely used in food preservation and processing. They are used as preservation of jam, jelly, pickles, sauce, juice. Salt and sugars are considered as old food preservatives. They effectively arrest the growth of bacteria. Sugar sbosrbs free sugar and water to make solution and maintain homogenous density by mixing with food. Sugar creates osmotic pressure to bacterial cell wall and ultimately destroy the cell wall. As a result, it becomes very difficult for the growth and survival of microorganisms. Moreover, sugar combinedly increase the taste and quality of food. These create comfortable environment for beneficial microbes. In wine, sugar is converted to ehtanol by yeast and organic acids are formed due to lactic acid fermentation.

d In the stem, C is vinegarr. The meachamism if food preservation by vinegar given below–
The remaining part is similar to the question no- 7(c).

Ques. ▶10 Vinegar is an important compound. It has multipurpose uses. *[Ctg. B. 17]*

a. What is coagulation? 1
b. NaCl is a strong electrolyte — explain. 2
c. How would you prepare the compound of the stem by fermentation? 3
d. Explain the food preservation mechanism of the compound mentioned in the stem. 4

Answer to the question no. 10

a When the insoluble particles of colloid or suspension are associated to a large sizes by mechanical or chemical process by destroying their inter particles forces such as ion-dipole force, the process is called coagulation.

b Compound which in solution or in the molten state, conducts an electric current and is simultaneously decomposed is called electrolyte. NaCl is a strong electrolyte, because in solution or in molten state it is completely decomposed.
$NaCl(s) \longrightarrow Na^+(l) + Cl^-(l)$
At anode oxidation: $2Cl^-(l) \longrightarrow Cl_2(g) + 2e^-$
At cathode-reduction: $2Na^+(l) + 2e^- \longrightarrow 2Na(s)$

c In the stem, the mentioned compound is vinegar. The process described in the following:
The date juice contains sucrose sugar ($C_{12}H_{22}O_{11}$). In dilute sucrose solution, malt and yeast are mixed, which secrete enzyme and promotes fermentation of sucrose. At this first ethanol forms and then ethanol is oxidized to dilute ehtanoic acid is the vinegar.

Alcoholic fermentation:
Date juice at first boiled and a few amount of ammonium sulphate and phosphate is added so that yeast can grow. Then about 5g yeast powder disperse on the mixture. Then the mixture is kept at 25-30°C. The lid of the container loosely fitted so that CO_2 gas produced from fermentation, can go out. Fermentation goes to end and ethanol is produced.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[37°C]{\text{invertage}} C_6H_{12}O_6 + C_6H_{12}O_6$$

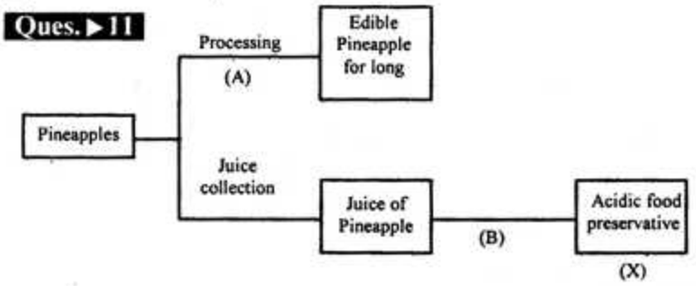
sucrose [glucose + fructose = invert sugar]

$$2C_6H_{12}O_6 \xrightarrow[20°\text{-}24°C]{\text{zymase}} 4CH_3CH_2OH + 4CO_2$$

invert sugar ethanol

d Similar to the question no- 7(c).

Ques. ▶ 11



[Ctg. B- 16]

a. What is rate of a reaction? 1
b. Why the first ionization potential of Nitrogen is greater than of Oxygen? 2
c. Describe the principle of the processing (A). 3
d. Explain the mechanism of food preservation with (X). 4

Answer to the question no. 11

a The rate of a reaction is the change in concentration over the change in time.

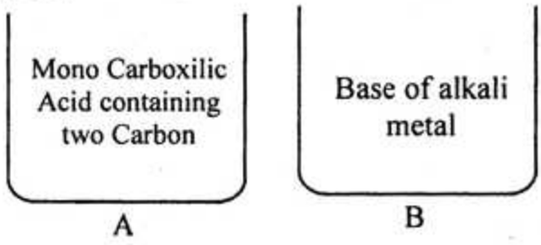
b The electronic configurations of N and O are–
$N(7) = 1s^2\ 2s^2\ 2p^3$
$O(8) = 1s^2\ 2s^2\ 2p^4$
Nitrogen (N) and oxygen (0) are of same period, but at the centre of oxygen, positive charge is more, so its size is small and ionization potential is more. From the electronic configuration it is seen that 2p orbital of N is half-filled. We know that, half-filled and full-filled orbitals are stable. So, from the outermost layer to eliminate electron this stable condition should be broken. On the other side, in case of oxygen (O), to eliminate electron from the outermost layer, it is not "needed to break the stable condition. So, the first ionization potential of nitrogen is greater than that of oxygen.

c In the stem, A represents the canning process. Canning is a method of preserving food in which the food contents are processed and sealed in an air tight.

Principle of food preservation by canning:
The heat tolerance capacity of a germ is expressed by its thermal death time or TDT. At a constant temperature, the minimum time required for the destruction of germs and spores is called TDT. It depends on the nature of food and the number of germs and their spores. In some food containers, a temperature of 121°C that persists for 30 minutes destroy the germs present in the container. As a result, food is preserved unless there is a hole in the can. The can has to be air-tight. In this way, food in a can remains in good condition for 2- 3 years.

d In the stem 'X' is mainly vinegar which is produced from juice of pineapple. Mechanism of this type of food preservation with 'X' is as follows:
The remaining part is similar to the question no- 7(c).

Ques. ▶ 12



[S.B 17]

a. What is rate of reaction? 1
b. Why the electron affinity of Chlorine is greater than of Fluorine? 2
c. Solution of vessel B is not used for glass cleaner but it may be used as toilet cleaner– Explain. 3
d. Discuss the mechanism of food preservation by solution (6-10%) of vessel A. 4

Answer to the question no. 12

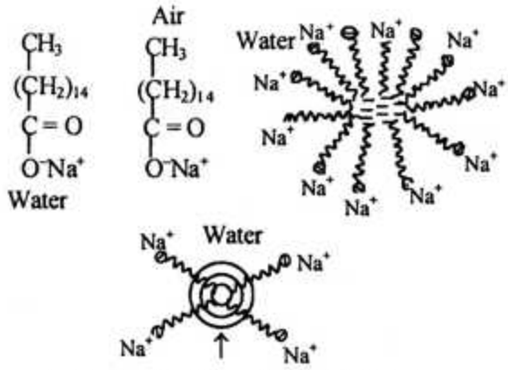
a The rate of reaction refers to the amount of reaction which occurs in unit time.

b The size of the fluorine atom is very small as compared to the chlorine atom and due to its small size there are strong inner repulsion among valenee electrons and so the outer electron does not fell the attraction from the nucleus. So, electron affinity of chlorine is greater that of fluorine.

c In the stem, Solution of vessel-B is strong base (NaOH). So, it not used for glass cleaner but it may be used as toilet cleaner. NaOH is used to clean toilets. NaOH reacting with oil and fat of dirt of toilet's produces soap and glycerine.

$$\begin{array}{l} CH_2\text{–}COOR \\ | \\ CH\text{–}COOR \\ | \\ CH_2\text{–}COOR \end{array} + 3NaOH \longrightarrow \begin{array}{l} CH_2\text{–}OH \\ | \\ CH\text{–}OH \\ | \\ CH_2\text{–}OH \end{array} + \underset{\text{Soap}}{3R\text{–}COONa}$$

In produced soap molecule to polar carboxylate ion remains hydrophilic end and to non polar alcohol radical remains lipophilic end.
This hydrophilic end are soluble in water and lipophilic end soluble in oil or fat.



Oil particles separated from dirty cloth
Fig: The cleaning mechanism of soap

As a result, lipophilic end surrounds oil or fat and hydrophilic end remains outside. Thus with NaOH, oil end fat reacts end produces soap which keeps role to clean toilet.

Again, if the NaOH is to be used as glass cleaner, it corrodes the glass. Because, the main glass component silica reacts with NaOH to form sodium silicate.

$$NaOH + SiO_2 \rightarrow Na_2SiO_3$$

So, from the above discussion it is coneluded that NaOH is not used for glass cleaner but it may be used as toilet cleaner.

d The mechanism of food preservation by solution (6-10%) of versel-A is described in the following:
Vessel-A contains monocarboxilic acid containing two carbons i.e. acetic acid. We know, (6-10%) water solution of acetic acid or ethanoic acid solution is called vinegar.
The remaining part is similar to the question no-7 (c).

Ques. ▶ 13 Hydroxide of element A ($3s^1$), B (HCHO) and C (C_6H_6) are widely used recently. *[S.B- 16]*

a. What is α-particle? 1
b. Semi-micro analysis is environment friendly-Explain. 2
c. Describe the preservation method of compound 'A'. 3
d. Which one of the organic compounds mentioned in the stem is more harmful in respective of our country? Analyze with argument. 4

Answer to the question no. 13

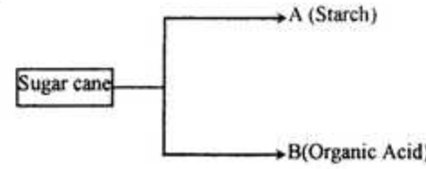
a α- particle is helium nucleus. It is expressed as $_2^4He^{2+}$.

b In semi micro analysis, a small amount of reagent is used. Reagents are costly. So by using semi micro method, the educational institutions can save much money; and more practical classes can do with less chemicals.
Besides this, the students can do experimental works in a short time in semi micro method.
In semi micro method, the poisonous H_2S is not used from Kipp's apparatus, but H_2S is slowly prepared from thioacetamide (CH_3CSNH_2) in the test tube containing reacting solution. In this case, the mixture is warmed to produced H_2S. This H_2S reacts with reactant completely and cannot bubble out in air. So air is not polluted by H_2S.
So, we can conclude that semi-micro analysis is environment friendly.

c Electronic configuration of last orbit of the element 'A' is $3s^1$. So, its atomic number is 11; therefore the element 'A' is sodium (Na). Na is very reactive element. It is a dangerous material. It reacts at room temperature highly with oxygen and water. So it is immersed in kerosene or paraffin in a glass container. The density of kerosene or paraffin is less than Na; so, it will be under kerosene or paraffin. Na reacts with water producing NaOH and H_z gas which can explode. So, Na is preserved under kerosene or paraffin.

d In the stem stated compound are methanal (HCHO) or formalin and benzene (C_6H_6).
Both compounds have harmful effect on human body and environment. But among the two, in respective of our country, methanol or formalin is more harmful compared to benzene. In our country some dishonest businessmen use formalin as food preserative. (eg. fish, meat, fruit, vegetables etc.) This formalin enters into the human body mixing with the food and thus it creates harmful effect on human body.
Short term damages for formalin are watery eyes, coughing, wheezing. nausea and skin irritation. Formalin increases risk of leukemia, blood cancer and other lymphomas. US FAD both classify as a human carcinogen. It causes irritation to mucous membrane like throat, respiratory tract causing sore throats, bronchitis and pneumonia. Formalin causes kidney and liver problems."
On the other hand benzene has carcinogenic character. But in respective in our country it is not used as food preservative. So, it has less threat compared to formalin.

Ques. ▶ 14



[S. B-16]

a. What is orbital? 1
b. Why muddy water of river is cleaned when combined with sea water? 2
c. Prepare the compound B from A showing chemical reaction. 3
d. Which one of the two compound between A and B is more suitable for the preservation of fish? Analyze. 4

Answer to the question no. 14

a Each of the actual or potential patterns of electron density which may be formed in an atom or molecule by one or more electrons and can be represented as a wave function is called orbital.

b In muddy water of river mud, soil etc colloid particles are as negativity charged state. When the river water combined with sea water, then Na^+, K^+ present in the sea water neutralized the negative charge particles of muddy water of river and the muddy water is cleaned.

c See the question no- 6(c).

d See the question no- 6(d).

Ques. ▶ 15 The mixture of ammonia solution, isopropyl alcohol and detergent is a cleaner. *[J. B-17]*

a. What is heat of combustion? 1
b. Why rider is needed? Explain. 2
c. Explain the cleaning technique of the mixture mention in the stem. 3
d. The application field becomes different when a strong base is used instead of ammonia in the mixture– Explain. 4

Answer to the question no. 15

a The change of heat when 1 mole fundamental or compound substance is burnt completely in oxygen at a definite temperature and 1 atm pressure, is called heat of combustion.

b There is a weight box for a chemical balance. It contains 1.0 g to 100g weights and 1mg to 500mg weight. So, any substance can be measured upto two decimal of a gram. In rider, there is 100 marked and that is equal to 5mg × 2 = 10mg (where 5mg is the rider).
So, with the help of rider we can measure upto 10g ÷ 100 = 0.1 mg = 0.0001g. If 10mg is the rider, then we can measure upto 10 × 20mg ÷ 100 = 0.2mg = 0.0002g. So, with the help of rider, we can measure a substance more and more accurately.

c In the following stem, the mixture is glass cleaner. Dust, grease and carbon powder deposit on glass indoors and glasses of different apparatus and useable wares. So as a cleansing agent glass cleaner is used.
Glass contains different silicates as its compositions. So when strong alkalies like coustic soda (NaOH) and caustic potash (KOH) comes in contact with glass material, then the strong alkali reacts with the silicates of the glass components to form water soluble sodium silicate or potassium silicate.

This creates stains like scratching. Hence as a glass cleaner components, strong alkali like NaOH solution or KOH solution cannot be used at all. For this reason, in the glass cleaner, as a solvent of grease ammonia solution is used.

The adhering substances on glass materials include dust and grease. Ammonia is used in glass cleaner to dissolve adhering grease. Besides this, sodium lauryl sulphate detergent is an anionic detergent. It reduces the surface tension of water as wetting agent. Thus the primary cleansing agent NH_4OH can wash out adhering substances on the glass materials. The anionic end of the detergent is hydrophilic and can wet the surface of glass. Again the other part of the detergent is hydrophobic (insoluble in water); but being liphophilic (soluble in oil or fat), it can remove oily .substance, from the glass surface. On the other hand, water is the third liquid medium which can wash out all the dust and oily particles finally. The fourth ingredient isopropyl alcohol absorbs the water from the glass surface. Again ethylene glycol monobutyl ether is used to reduce the volatility of the alcohol used and as antibacterial agent. The structural formula of sodium lauryl sulphate (detergent) is :

$CH_3(CH_2)_{10}\,CH_2O - SO_3Na^+$

Water insoluble Water soluble

Non polar part (tail) polar part (head)

In a simple way, the tail and head of the detergent is shown as:

WWW = Na

tail

d In the stem, the given mixture is used as glass cleaner. If instead of ammonia a strong base like NaOH is used, the application of the mixture becomes different.

From the composition of different classes of glass, it is clear that the acidic silicon dioxide (SiO_2) is the common ingredient of glass. With contact of strong alkali NaOH, the acidic SiO_2 reacts with NaOH slowly to form water soluble sodium silicate. As a result, the smoothness of the glass surface is lost, stains or itching appears. Besides this, calibrating markings on burette, pipette and other laboratory apparatus are destroyed and those apparatus become out of uses. The chemical reaction with caustic soda and silica is:

$2NaOH(aq) + SiO_2(s) \longrightarrow Na_2SiO_3(aq) + H_2O(l)$

On the other hand, use of NaOH solution in toilet cleaner is very effective in removing the solid dirts. NaOH does not have any damaging effect on the toilet materials– like ceramic, mosaic etc. NaOH reacts with protein– like contaminants to form NH_3 and forms immiscible emulsion with oils, grease or fat-like dirts. NaOH is alkaline and corrosive. It easily reacts with dirts (dust, fat, protein) to form salt which is water soluable and can easily be removed with washing.

$R- CO - NH_2 + NaOH \longrightarrow R- COONa + NH_3$

(From protein)

$$\begin{array}{l} CH_2 - \overset{O}{\overset{\|}{C}} - O - R \\ | \\ CH - \overset{O}{\overset{\|}{C}} - O - R \\ | \\ CH - \overset{O}{\overset{\|}{C}} - O - R \end{array} + 3NaOH \longrightarrow 3R-COONa + \underset{\text{Soap}}{} \quad \begin{array}{l} CH_2-OH \\ | \\ CH-OH \\ | \\ CH_2-OH \end{array}$$

(From oil/fast/grease

[$R = -C_nH_{2n+1}$; n = 15 or more than 15]

So, from the above discussion, it is concluded that the application field becomes different when NaOH is used instead of ammonia in the mixture.

Ques. ▶ 16 (A) NaOH (B) NH_4OH *[J.B-16]*

a. What is quantum number? 1

b. How can you indentify Fe^{3+} ion in solution? 2

c. What is the role of 'A' for cleaning toilet? 3

d. Which compound of the stem is suitable for the preparation of glass cleaner? Explain with reaction. 4

Answer to the question no. 16

a Quantum numbers are a set of values that describes the state of an electron including its distance from the nucleus, the orientation and type of orbital where it is likely to be found, and its spin.

b **Detection/Indentification of Fe^{3+} ion in solution:**

About 2–1 mL stock solution is taken in a test tube and a few drops of potassium ferricyanide solution is added.

Deep blue ppt. of potassium ferrous ferri cyanide forms.

Fe^{3+} ion is present and confirmed in sample salt.

$Fe^{3+}(aq) + K_4[Fe(CN)_6]\,(aq) \rightarrow K\,Fe\,[Fe(CN)_6]\,(aq) + 3K^+(aq)\,F$

c Caustic soda or NaOH is used in toilet cleaner. In human waste ester is present as oils and fast which reacts with ammonia but reacts with urine and becomes amide. This amide does not react with ammonia, caustic soda and become a soluble compound, as a result, toilet pans can be cleaned easily. That is why caustic soda is used in toilet cleaners.

$RCOOR + NH_3 \longrightarrow RCONH_2 + ROH$

Ester (oil or fat) (Amide) (Alcohol)

$RCONH_2 + NaOH \rightarrow NH_3 + RCOONa$

Sodium Carboxylate (Soluble in water)

$RCOOR + NaOH \rightarrow ROH + RCOONa$

d Dust, grease and carbon powder deposit on glass indoors and glasses of different apparatus and useable wars. So as a cleansing agent glass cleaner is used.

Glass contains different silicates as its compositions. So when strong alkalies like caustic soda (NaOH) and caustic potash (KOH) comes in contact with glass material, then the strong alkali reacts with the silicates of the glass components to from water soluble sodium silicate or potassium silicate.

$2NaOH + SiO_2 \rightarrow Na_2SiO_3 + H_2O$

This creates stains like scratching. Hence as a glass cleaner components, strong alkali like NaOH solution or KOH solution cannot be used at all. On the other hand, the OH^- ion of NH_4OH (B) releases the glass contaminants, grease, oil and fat like substances. NH_4OH removes the attached glass contaminants and do not undergo any kind of reaction with glass.

Glass (calcium and sodium silicate) + $NH_4OH \rightarrow$ No chemical change.)

For this reason, in the glass cleaner, i.e the solution of B of the stem is better for glass cleaner.

Ques. ▶ 17

A = Milk → B = Butter | Colloid *[B.B-17]*

1st Part 2nd Part

a. What is Rider constant? 1

b. CO_2 is gas, but SiO_2 is solid-why? 2

c. According to the stem, describe the preparation process of B from A. 3

d. The particles of 2nd part of the stem do not coagulate normally, but can be coagulate by adding electrolytes- Explain. 4

Answer to the question no. 17

a The 100 parts of the beam of the balance is the mobile-field of 10mg rider. So, on each division out of 100 divisions of the balance-began, the weight of the differs by a constant weight which is called rider constant 0.0001f.

b In carbon dioxide (CO_2) molecule two oxygen atomic are joined with carbon atom by double bond and weak Vander Waal's force is acting among the molecules. So, at normal temperature CO_2 is gas.

O=C=O

Fig: Structure of CO_2

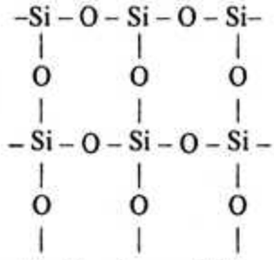


Fig: Structure of SiO_2

On the other hand, in SiO_2 in each Si atom four oxygen atom is attached and form a large solid cluster of SiO_2. So, to break covalent of them a large amount of energy is required. For this reason, CO_2 is gas and SiO_2 is solid.

c In the following stem, A and B represent milk and butter respectively.

Preparation of butter from milk:

At first cream should be separated from milk. Then it is cooled. The quality of butter depends on the acidity or the fat presence in cream of milk. Then the cream was agitated extremely to break membranes around the fat consisting lipoprotein. Then the butter grain is formed by fats. The butter grain is taken to a filter and washing it by water again and again. After removing the water from butter it has to be cooled. To increase the taste of the butter a little amount of salt is added to it. Then it is cut in different sized in a suitable pot. Butter is preserved in refrigerator under 10°C.

d Particles ranges from 10^{-9} m to 10^{-7} m are colloid particles. They cannot be seen by ordinary microscope, their existence can only be observed by ultra microscope.

Colloidal particles in a solution carry the same charge. Being similarly charged, they repel each other. The repulsive forces between the similarly charged particles do not allow them to come closer. Hence, they remain scatted or suspended throughout the dispersion medium. However, if the charge is removed by some means, the colloidal particles come together to form bigger aggregates and settle down under the influence of gravity. This process by which the colloidal particles come closer and result in the precipitation of the colloidal particles is called coagulation.

When an electrolyte is added to a solution the charged colloidal particles adsorb the oppositely charged ions produced by the dissociation of electrolyte. In this way, the charge on the colloidal particles is neutralized and the resulting natural particles come together to form bigger aggregates and thus get precipitated. For example, when sodium chloride is added to the negativity charged sol^n of As_2S_3, arsenous sulphide settles down in the form of yellow precipitate. On adding NaCl, the Na^+ ions neutralize the negative charge on the colloidal particles. After losing the change, the particles come together to form aggregates which finally settle down as yellow precipitate (as solid).

Ques. ▶ 18 A young entrepreneur uses natural food preservative sugar solution instead of using chemical food preservative sodium sulphite to preserve fruits like mango, apple, pineapple, guava etc by canning process. *[B.B-16]*

a. What is activation energy? 1

b. Why is the melting point of $FeCl_3$ less than that of $FeCl_2$? 2

c. Keeping temperature constant at different steps is mandatory for the process following by the Young entrepreneur.– Explain it. 3

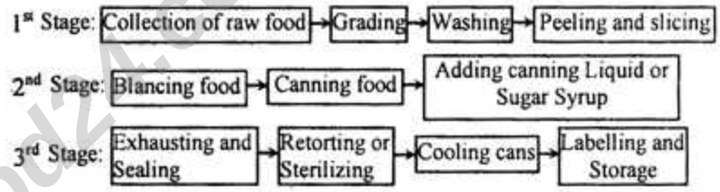
d. Do you agree with decision of using 2nd preservative instead of 1st preservative mentioned in the stem? Give logic on behalf of your answer. 4

Answer to the question no. 18

a The amount of energy necessary for molecules of any reactant to take part in the chemical reaction is called the activation energy for the related reaction.

b Ionic radius of Fe^{3+} is 0.60Å and ionic radius of Fe^{2+} is 0.75 Å. The size of action, participating in a electrovalency, if small the capacity of polarizing of its ion is high. If the radius of cation is less, the concentration of change density increases and the attraction to electron cloud from nucleus increases. So, characteristics of electrocovalent bond increases. Characteristic of covalent valency of $FeCl_3$ is greater that of $FeCl_2$. For this reason melting point of $FeCl_3$ is less than that of $FeCl_2$.

For food canning the following three main stages are followed:



Each stage consists of a number of step. Here we are discussing some stages.

c In the stem, the process followed by the young entrepreneur is canning process.

ii. Exhausting : Before sealing, food materials are heated by a special method. This removes the trapped air from the container. The xhausting eliminates the possibility of rusting inside the Ca; aerobic mcrobes cannot grow and reproduce in absence of oxygen. In this step, the can filled with food materials has to be heated at 95–110°C temperature for about 5–7 minutes.

iii. Retorting : After the can being sealed it undergoes the process of retorting. Retorting sterilize food after it is sealed in container by steam or other heating methods. Accidic foods are heated at temperature 90°–100C° for 30 minutes so that all microorganisms are killed. Less acidic foods are heated at 121°C for 1.5 hr– 2hr. Bacteria-spores can exist in less acidic food. Only at 121°C this spoore structure of bacteria gets destroyed. At 121°C, all micro organisms in the cane are destroyed.

i. Blanching: The sliced and raw food materials are heated for 5-10 minutes in boiling water or steam flow. This process of heating the food materials is called blanching. Blanching is not needed for soft vegetables and ripe fruits.

d In the stem, the 1st preservative is artificial chemical preservatives. This type of preservatives protect the food from oxidation and black spots. They can also kill micro organisms. So, sodium sulphite is used for the preservation of unripe fruits, dry fruits, confectioneries etc. But it has some adverse effects such as fatigue, headache, allergy, cancer may be created. So, as preservative, if is not appropriate for the food preservation.

On the other hand, the 2nd preservative mentioned in the stem is sugar. It creates osmotic pressure to bacterial cell and ultimately destroy the cell wall. As a result, it becomes very difficult for the growth and survival of microorganisms. Over and above, being natural preservative, it has no side effects.
So, from the above discussion, it is concluded that, the 2nd preservative following the stem is more appropriate for the food preservation than the 1st preservative.

Ques. ▶ 19 Read the given stem :

Natural Food preservatives	Antioxidizing agent	Antimicrobial
(A)	(B)	(C)

[Notre Dame College, Dhaka]

a. What is solubility? 1
b. Why distilled water is used in preparation of solutions? 2
c. Give the equations of preparation of 'A' of given stem from sucrose and describe the steps. 3
d. Analyze the comparison of food preservation processes of given preservatives? 4

Answer to the question no. 19

a At a given temperature the amount of solute required to make a saturated of 100g of solvent is called solubility of the solute at that temperature.

b We use distilled water instead of tap water because it is purely clean while tap water contains minerals, salts, bacteria, fungi and other chemicals to make it clean which can not give accurate and perfect result. If we use distilled wipes the experimental results will be fair and our results wont be effected by any other chemicals.

c According to the stem A is the natural food preservatives. Vinegar, ethanol, table salt and sugar are the typical example of natural food preservatives. Among the above preservatives vinegar is widly used natural food preservatives which is prepared from sugar by following ways. On addition of yeast, sugar is converted to glucose and fructose. Glucose and fructose are converted to ethanol by the action of enzyme. Finally by the action of acetobacter, ethanol is oxidises by oxygen of air to ethanoic acid.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[30°C]{\text{Invertase}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

$$C_6H_{12}O_6 + C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 4CH_3CH_2OH + 4CO_2$$

$$CH_3CH_2OH + O_2 \xrightarrow{\text{Acetobacter}} \underset{\text{vinegar}}{CH_3 - COOH} + H_2O$$

d The comparison of food preservation process of given preservatives in stem discuss below:
Naural food preservatives : Sugar and table salt are two common natural preservatives. Sugar and salt absorb free sugar and water to make solutions and maintain homogenous density by mixing with food. Sugar and salt create osmotic pressure to bacterial cell wall and ultimately destroy the cell wall. As a result, it becomes very difficult for the growth and survival of microorganisms.
Antioxidizing agent: Antioxidants delayed the rate of food oxidation by several mechanisms; playing a role of free radical scavenger (favor entrapment of radicals $\dot{R}$; $R\dot{O}$, $R\dot{O}O$; $H\dot{O}$ e.t.c.) formation of chelate complexes with proxidant metals, singlet oxygen and photo-sensitizers quenching, suppression of radical $N\dot{O}$. accumulation, peroxydinitrite and lipoxy-genases deactivation.

Antimicrobial : The chemical food preservatives which provide adverse environment for the growth of bacteria, mould and yeast, destroy their enzyme activity and also disrupt their cell membranes are called antimicrobials.

Ques. ▶ 20

Fish
Fig-1

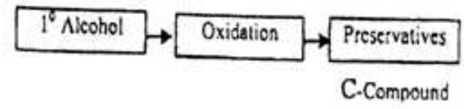


Fig-2

[BAF Shaheen College, Dhaka]

a. What is rider constant? 1
b. Explain Hund's principle? 2
c. Discuss the preservation process of fish of figure-1 in the above stem. 3
d. Discuss the reaction mechanism of C compound in the figure-2. 4

Answer to the question no. 20

a When the rider is placed on the beam the weight obtained for each division of the rider is called rider constant.

b According to Hund's rule, 'electrons are distributed among the orbitals of a subshell in such a way as to give the maximum number of unpaired electrons and have the same direction of spin.'
When the vacant, degenerate orbitals are filled with single electrons the incoming new electrons occupy the singly filled electron with opposite spin.
s subshell has one orbital only. So, in filling s orbital Hund's rule is not applicable. It is applicable to p, d and f orbitals.
p subshell has three orbitals. According to Hund's rule,
p subshell will be filled in by 2, 3 or 4 electrons with the following electron configuration.

p_x	p_y	p_z
1	1	

p_x	p_y	p_z
1	1	1

p_x	p_y	p_z
1↓	1	1

Similarly, d subshell is filled with 4, 5 or 6 electrons. According to Hund's rule, the electron configuration will be–

1	1	1	1	

1	1	1	1	1

c In figure–1 of the stem there is fish. The preservation process of fish describe below.
The canning and curing of fish are two available preservation methods for fish. The curing is incient and canning is modern and widely used fish preservation method. The canning process is discussed following.

i. Fresh and fatless fishes are selected for canning. In general, Hisha, tuna and shrimp fish are suitable for canning.
ii. Fish is cleaned properly and undesirable parts are removed and graded according to size. In case of big fish. back bone is removed and sliced to smaller pieces.
iii. The fish pieces are soaked in NaCl solution for a short period. This removes the blood clot and other impurities.
iv. The fish is then boiled in an evaporator to remove the undesirable liquid, fat or odour. This heating kills the germs and fish pieces become strong. The fish is then put into a sulfur preventive can. There should be a coating of ZnO inside the can. This reacts with sulfide of the fish to form ZnS, which brings color to the fish.
v. Salt, sugar, spice, tasting salt are added into the can.

vi. The can is heated to remove the air form the can. When can is heated, the volume inside increases the air is expelled form the can. The can is then sealed with a lid.

vii. Fish is a kind of low acid food. Harmful bacteria and spore can grow in fish very easily. For this reason, can-filled fish is heated to 121°C for 50-60 minutes.

viii. After heating, the cans are cooled through cold running water. The cans are then labelled and stored.

c From the stem we have

i – Alcohol → Oxidation→ Preservatives (C)

Typical example of above scheme is

$$CH_2CH_2OH + O_2 \xrightarrow{\text{Acetobactor}} CH_3COOH\ (c)$$

The 5–10% aqueous solution of C(CH_3COOH) is known as vinegar which is one of the widely used natural food preservatives. The food preservation mechanism of vinegar explained as follows:

1. It is a weak acid and hence it does not have the possibility of increasing the acidity. It maintains the pH balance of the body.
2. Since it is an acidic solution, it decreases the pH of the preserved food. (5 to below 4.0). As a result, microbes specially bacteria do not have the favourable environment for growth and development. 5% ethanoic acid containing vinegar has a pH of 2.4, which is sufficient to kill bacteria. If salt is added with vinegar, the preservation becomes more effective, Addition of salt extracts the excess water from food products. This does not reduce the concentration of vinegar.
3. Since it dissolves very well in water, it mixes well with food water easily and maintains a homogenous concentration and thus resists the growth of micro-organisms.
4. Because of its higher boiling point than (118°C) water, it does not get evaporated during the application of heat at the time of food processing.
5. It is easily available and does not show any side effect,
6. For pH reduction during the food processing and preservation, acid concentration in vinegar can be increased. In case of low acidic food, acid concentration of vinegar has to be increased.

Fruits, vegetables, fish and meat can be processed and preserved by using-vinegar. Hence, vinegar plays very important role in food preservation.

Ques. ▶ 21 Observe the following reaction.

$$\text{Ethanol (10\%)} + O_2 \xrightarrow{\text{Micoderma acety, 35°C}} A + H_2O$$

[Birshrestha Noor Mohammad Public College, Dhaka]

a. What is polarity? 1

b. What are the differences between glass cleaner & toilet cleaner? 2

c. How can you prepare "A" from natural source?-Explain. 3

d. Analyze the mechanism of food preservation technique of "A". 4

Answer to the question no. 21

a The formation of dipole (positive and negative poles) in a covalent bonded compound is called polarity and the compound is known as polar compound.

b Difference between glass cleaner and toilet cleaner

Glass cleaner	Toilet cleaner
1. Glass cleaner cleans the sand, dirt & oil or fat adsorbed on to the glass surface.	1. Toilet cleaner removes microorganisms, dirt and odour.
2. The main components of glass cleaner are rubbing alcohol and liquor ammonia.	2. The component of toilet cleaner is NaOH and borax.
3. Glass cleaner should be kept away from fire because of the presence of alcohol.	3. It is not necessary to keep the toilet cleaner away from fire because of absence of any alcohol.

c From the stem, the reaction is given below:

$$CH_3CH_2OH + O_2 \xrightarrow[\text{acetobactor, 35°C}]{\text{Micro-organism}} CH_3COOH + H_2O$$

(10%) (A)

Thus, the stem compound A is ethanoic acid and 6-10% solution of it is known as vinegar. Vinegar is prepared from natural sauce like can juice and date juice.

Sugarcane juice or date juice contains a substantial amount of sugar. On the addition of yeast, sugar is converted to glucose and fructose. Glucose and fructose are convered to ethanol by the action of enzyme. Finally by the action of acetobacter. ethanol is oxidised by the oxygen of air to ethanoic acid.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[30°C]{\text{Invertase}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

$$C_6H_{12}O_6 + C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 4CH_3CH_2OH + 4CO_2$$

$$CH_3CH_2OH + O_2 \xrightarrow{\text{Acetobacter}} \underset{\text{(vinegar)}}{CH_3 - COOH} + H_2O$$

d The food preservation technique of A (CH_3COOH) is explained as follows:

Similar to the question no-7(c)

Ques. ▶ 22 Answer the following questions based on the given scenarios–

Scenario–1: $(C_6H_{10}O_5)_n + H_2O \xrightarrow[\text{2.Maltase}]{\text{1. Diastase}} A \xrightarrow[\text{4. Acitobacter}]{\text{3. Zymase 30°C}} B(7\%\ \text{aqu.sol}^n)$

Scenario–2 :

D	E
Aqueous Solution of NH_3	Aqueous Solution of NaOH

[Adamjee Cantonment College, Dhaka]

a. What is rider constant? 1

b. Explain the disposal process of wastage Na. 2

c. Between D and E which one is more suitable in toilet cleaner-explain with necessary reactions. 3

d. Whether B is suitable for food preservation-explain with necessary reactions by completing the reactions in scenario-1 of above stem. 4

Answer to the question no. 22

a When the rider is placed on the beam the weight obtained for the each division of the rider is called rider constant.

b The disposal process of wastage Na are—

i. Na metal is neutralized by methanol or butanol. The usual way to neutralize sodium is to put small pieces of in an organic solvent like n-hexane and slowly add either isopropyl alcohol or ethanol to it. Isopropyl alcohol reacts slower, and is therefore a bit safer. When all the sodim, is dissolved, we can add water to make sure there is no elementary sodium left. In this case acid base neutralitation reaction occurs.

ii. Na neutralized by sand (SiO_2). In this case acid base neutralitation reaction occurs.

c In the stem D and E are the aqueous solutions of NH_3 and NaOH respectively.

Toilet cleaner is used to keep the toilet cleaned. The toilet cleaner removes the undesirable Bacteria fungus from the toilet. In general, the heavy dirts (fat, protein, micro-organism, various organic components) are adsorbed in the toilet. To remove this heavy dirts, strong corrosive agents are needed. We know, NaOH is a corrosive substance. But NH_3 is not corrosive. The OH^- ion can easily remove the dirt and kill the microbes. So, only a concentrated solution of NaOH is sufficient enough to clean the toilet. Upto 50% NaOH can be used to prepare the cleaner. However, some other ingredients like detergent, antibacterial agent, aroma agent and dyes are added to make a toilet cleaner. If toilet cleaner is made by sing NaOH, it is OH^- ion which plays the important role in removing the contaminants.

$R–CONH_2 + NaOH \rightarrow R–COONa + NH_3$ (From protein)

The contaminated oils/grease/fats which contain ester react with NaOH to release them from the toilet materials.

$R–COOR' + NaOH \rightarrow R - COONA + R'OH$

NaOH possesses emulsifying power to break the oils and fats to smaller particles. Proteins have dispersion power. The toilet cleaner hydrates the proteins of the dirt which get dissolved. The toilet cleaner because of its washing ability removes the dirt through chemical processes. Therefore, between E and D the E (NaOH) is more suitable in toilet cleaner.

d From scenario–1 in stem we have

1. $(C_6H_{10}O_5)_n + H_2O \xrightarrow{\text{Diastage}} C_{12}H_{22}O_{11}$
   starch → Sugar
2. $C_{12}H_{22}O_{11} + \uparrow \xrightarrow{\text{Maltase}} C_6H_{12}O_6 + C_6H_{12}O_6$
   Sugar → Glucose (A) Fructose (A)
3. $C_6H_{12}O_6 + C_6H_{12}O_6 \xrightarrow{\text{Zymage}} 4CH_3CH_2OH + 4CO_2$
   Glucose, Fructose → Ethanol
4. $CH_3CH_2OH + O_2 \xrightarrow{\text{Acetobactor}} CH_3COOH + H_2O$
   Ethanol → Vinegar (B)

The 7% aqueous solution of B (CH_3COOH) is called vinegar which is a natural food preservatives.

For food preservation, it is widely used. The reasons are—

1. It is a weak acid and hence it does not have the possibility of increasing the acidity. It maintains the pH balance of the body.
2. Since it is an acidic solution, it decreases the pH of the preserved food. (5 to below 4.0). As a result, microbes specially bacteria do not have the favourable environment for growth and development. 5% ethanoic acid containing vinegar has a pH of 2.4, which is sufficient to kill bacteria. If salt is added with vinegar, the preservation becomes more effective. Addition of salt extracts the excess water from food products. This does not reduce the concentration of vinegar.
3. Since it dissolves very well in water, it mixes well with food water easily and maintains a homogeneons concentration and thus resists the growth of micro–organisms.

Ques. ▶ 23

Reagent	Product substance
Caustic soda	Cleaner A
Ammonia solution	Cleaner B

[Willes Little Flower School & College, Dhaka]

a. What is suspension? 1
b. Why is cold cream used in winter season? 2
c. Explain the cleaning mechanism of A. 3
d. Can be used 'B' as a toilet cleaner— Analyze with logic. 4

Answer to the question no. 23

a When a heterogeneous mixture contains dispersed insoluble articles of sizes greater than 500 nm, then it forms an unstable colloid for a small period. This type of mixture is called suspension.

b Cold cream is a mixture of water and oil or fat which is an emulsion of water in oil. In winter, the atmosphere contains less humidity and the skin gets cracked. Cold cream is used to prevent this cracking of skin. When applied to skin, water from emulsion vapourises slowly. This prevents the cracking of skin. Cold cream is usually used to keep the skin soft and smooth. This cream gives good results to prevent any kind of injury to face skin. That is why cold cream is used in winter.

c Here, cleaner-A is a caustic soda (NaOH) which is used to clean toilets. NaOH reacting with oil and fat of dirt of toilets produces soap and glycerine.

$$\begin{array}{l} CH_2–COOR \\ | \\ CH–COOR + 3\,NaOH \rightarrow \\ | \\ CH_2 – COOR \end{array} \quad \begin{array}{l} CH_2–OH \\ | \\ CH–OH + 3R – COONa \\ | \\ CH_2 – OH \end{array} \quad \text{Soap}$$

In produced soap molecule, polar carboxylate ion remains in hydrophilic end and non polar alcohol radical remains in Lipohilic end.

This hydrophilic end is soluble in water end is Lipohilic and soluble in oil or fat.

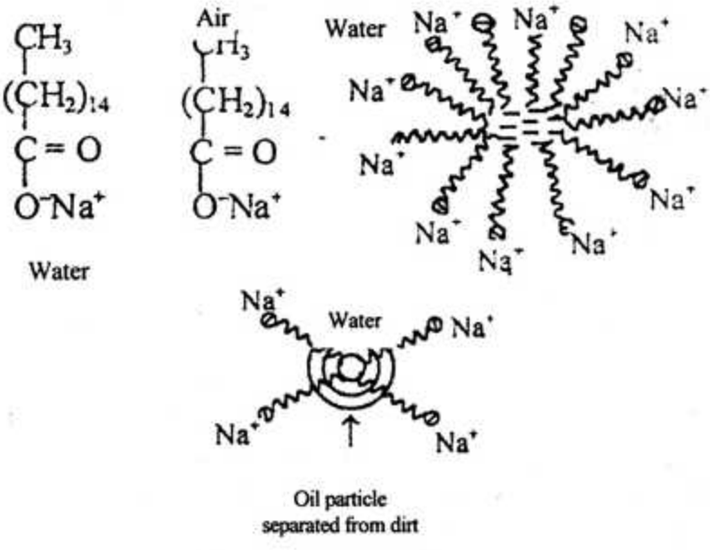
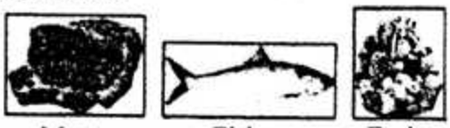


Figure: The cleaning mechanism of NaOH

As a result, Lipohilic end surrounds oil or fat and hydrophilic end remains outside. Thus with NaOH, oil and fat reacts and produces soap which keeps role to clean toilet.

d See the question no 3(d)

Ques. ▶ 24 Some diet



Meat Fish Fruit

A ⟶ Vinegar
B ⟶ Salt (NaCl)
C ⟶ Sugar
D ⟶ Turmeric powder
E ⟶ Garlic paste

[Bangladesh International School and College, Dhaka]

a. What is food safety? 1
b. Why is electron affinity of chlorine more than that of fluorine? 2
c. Describe the process of production of C and A. 3
d. Discuss the role of the given food preservatives in preservation. 4

Answer to the question no. 24

a The Scientific rules when keep food safe from poisoning or pollution during various steps of food processing and preservation, serving etc are called food safety.

b Similar to the question of no.12 (b).

c Following the stem, C and A are sugar and vinegar respectively.

The production process of sugar given below:

Sugar is manufactured from the raw materials of sugarcane. At first sugarcane is collected and then the sugarcane must be crushed to extract the juice.

The crushing process must break up the hard nodes of the cane and flatten the stems. The juice is collected, filtered and sometimes treated and then boiled to drive the excess water. The dried cane residue (bagasse) is often used as fuel for this process.

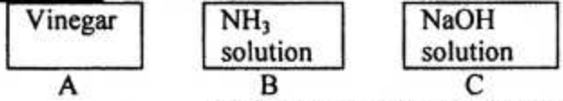
The production process of vinegar:

Similar to the question no 8(d)

d In the stem, A, B, C, D, E are the preservatives. They have great role in the food Preservation.

Generally, The substances which are added to food in a very small amount to prevent from the attack of various micro-organisms (bacteria, yeast, mould) are called preservatives. The commercially available foods that we usually collect are all preserved by some kinds of preservatives. Almost all commercial foods– solid, liquid or semi liquid are marketed by proper food processing with preservatives; the shelf-life of food does not last long. The food gets spoiled within a very short period. However, the concentration of preservatives should not exceed the recommended limit. Otherwise, the quality of food would be reduced which could be hazardous to health. Human food digestion and energy production involve the participation of about 500 microbes. Excessive amount of preservatives lead to inactivity or death of beneficial microbes. This can inhibit the digestion process and energy-production which can induce various diseases. Therefore, definite type and recommended amount of preservatives should be used for food processing and preservation.

Ques. ▶ 25



[BIAM Laboratory School & College, Bogura]

a. What is suspension? 1
b. Write down the Hess's law and explain. 2
c. Describe the mechanism of A for food preservation. 3
d. Between the solution B and C of the stem which one is better for glass cleaning – Explain. 4

Answer to the question no. 25

a If fine particles of insoluble substance are added to water and is stirred, the relatively heavy particles will settle down due to the higher gravitational force and produce a turbid solution, thus mixture of the fine particles of water is called suspension.

b See the question no- 7(b)

c See the question no- 7(c)

d Similar to the question no- 1(d)

Ques. ▶ 26

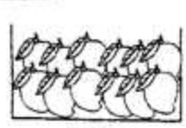


Figure-I

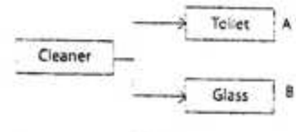


Figure-II

[The Millennium Stars School and College, Rangpur]

a. What is auto-catalyst? 1
b. How are colloids stable? 2
c. How will you preserve the fruits of figure-1. 3
d. Analyze the differences in cleaning mechanism of A and B. 4

Answer to the question no. 26

a Catalysis in which one of the products of the reaction acts as catalyst for the reaction is called the auto-cata lyst.

b The stability of the colloid is due to the presence of similar and equal charges. For the similar and equal charges of the particles of the colloid solution repel one another and cannot combine together to form larger particles which keeps them dispersed in the medium and the colloid remains stable.

c In the figure–1, the fruits are mangoes. For the preservation of these fruit, the canning process is preferable to me. The process is given below:

i. Ripe and matured mangoes are selected for canning. Selected mangoes are washed throughly and skin and other undesired parts are removed.
ii. The peeled mangoes are sliced to proper sizes and the seed is removed.
iii. The sliced pieces are introduced into the jar; 40% sugar solution and 0.25% citric acid are added. Sugar and acid work as preservatives.
iv. Cans are now exhausted and sealed. Afterwards, they are processed through putting-into boiling water for 20–30 minutes.
v. The cans are then cooled to room temperature and labelled. The label should contain production and expiry date.

d Following the figure –II. A is the toilet cleaner and B is the glass cleaner. The differences between the toilet cleaner and glass cleaner are given below–

Cleaning mechanism of glass cleaner : The adhering substances on glass materials are dust and grasel. Ammonia is used as glass cleaner to dissolve adhering grease. Besides this, sodium lauryl sulphate is an anionic detergent. It reduces the surface tension of water as wetting agent. Thus the primary cleaning agent NH_3OH can wash out the adhering substances on the glass materials. Again, the can remove oily substances from the glass surface. On the other hand, water is third liquid medium which can wash out all the dust and oily particles finally. The fourth ingredient, isopropyl alcohol absorbs the water from the glass surface. Again, ethylene glycol monobutyl ether is used to reduce the volatility of the alcohol and acts as anti-bacterial agent.

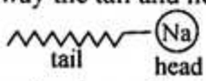
The structural formula of sodium lauryl sulphate (detergent) is:

$CH_3(CH_2)_{10}CH_2O$ – SO_3Na^+

water insoluble — water soluble

non polar part (tail) — polar part (head)

In a simple way the tail and head of the detergent is shown as:



Cleaning mechanism of toilet cleaner: The caustic soda and detergent (sodium lauryl sulphate) ate the two main components of the toilet cleaner and act as the washing agents of toilet cleaner. The other ingredient is calcuum hypochloride which acts as bleaching agent and can remove bad odour and stains on toilet cleaner, yet NaOH can not be used in glass cleaner. The causes of this depends on the composition of different types of glasses and their cleaning mechanism. For example—

The indoor glass contains: $Na_2O.\ CaO,\ 5SiO_2$

The hard potash glass contains: $K_2O.\ CaO.\ 5SiO_2$

The boroglass of pyren and gena companies contains : $Na_2O.\ ZnO.\ BaO.\ B_2O_3.\ XSiO_2$.

The chemical reaction with caustic soda and sillica is :

$2NaOH(aq) + SiO_2(s) \rightarrow NasSiO_3(aq) + H_2O(l)$

But the alkaline NH_4OH is used in glass cleaner which does not react with slilica of the glass materials.

So, ammonia does not do any harm to glass materials.

Ques. ▶ 27 i) NaOH ii) NH_4OH iii) $C_2O_2H_4$

[Navy Anchorage School & College, Khulna]

a. What is colloid? 1

b. Why opaque water in river becomes clean into sea?– Describe. 2

c. Explain food preservation mechanism of (iii). 3

d. Between (i) and (ii) which one is more suitable to use in toilet cleaner and glass cleaner? Analyze. 4

Answer to the question no. 27

a A homogeneous non-crystalline substance consisting of ultramicroscopic particles of one substance dispersed through a second substance.

b **1. Formation of delta at river estuary :** In the turbid water of river, colloidal particles of soil, mud a re in negatively charged form.

When the turbid water reaches the estuary, the negatively charged colloidal particles are neutralised by the salts, Na^+, K^+ Ca^{2+}, Al^{3+} etc of sea water. The neutralised particles then undergo, coagulation. The repeated coagulation processes form the delta of silt at the estuary.

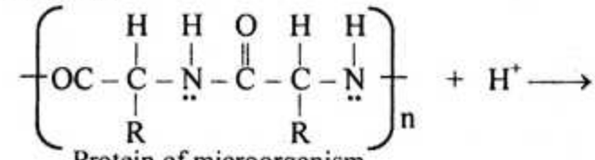
Thus, opaque water in river becomes clean into

c The (iii) number compound of stem is acetic acid (CH_3COOH). The 5–10% aqueous solution of acetic acid is called vinegar.

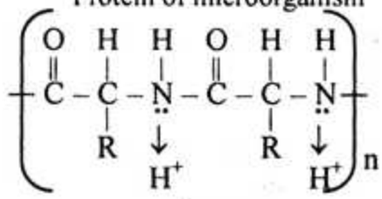
Food products are deteriorated and poisoned by the action of bacteria, mould and yeast. Bacterium is very sensitive to acidic environment. Foods having pH less than 4.5 are not degraded by bacteria. However, yeast and mould can reproduce at low pH. Most micro-organisms require optimum pH value between 6.6–7.5 for their growth and development.

Vinegar is a natural food preservative. For food preservation, it is widely used. The reasons are–

1. It is a weak acid and hence it does not have the possibility of increasing the acidity. It maintains the pH balance of the body.
2. Since it is an acidic solution, it decreases the pH of the preserved food. (5 to below 4.0). As a result, microbes specially bacteria do not have the favourable environment for growth and development. 5% ethanoic acid containing vinegar has a pH of 2.4, which is sufficient to kill bacteria. If salt is added with vinegar, the preservation becomes more effective. Addition of salt extracts the excess water from food products. This does not reduce the concentration of vinegar.
3. Excreted enzymes from microorganisms are responsible for the food adulteration by fermentation. The lone pair electrons in nitrogen of enzyme protein chain provide active site for the catelytic reaction. But, the proton provided by the ethanoic acid of vinegar neutralises the active site.



Protein of microorganism



vinegar

Because of neutralisation, the enzymes cannot catalyse. There occurs no fermentation of food. Hence, food adulteration cannot take place, i.e food remains preserved.

Because of neutralisation, the enzymes cannot catalyse. There occurs no fermentation of food. Hence, food adulteration cannot take place, i.e. food remains preserved.

d The main ingredients of glass are the disilicate compounds of Ca and Na. Oil, grease dust are genrally the dirts on the glass surface. These have to be cleaned everyday. Various types of glass cleaner are used in cleaning glass. Most glass cleaner contains ammonia as the main ingredient. Gaseous ammonia is obtained from the combination of hydrogen and nitrogen.

Ammonia reacts easily with water to form ammonium hydroxide. Ammonia takes proton from water and form NH_4+ ion and OH– ion.

$NH_3 + H–OH \rightarrow NH_4OH$

In water, ammonia solution acts as a cleaner. Ammonia is base and reacts with oils or fats to form soap.

Ammonia of glass cleaner attracts oil or fat and forms a layer of soap on the surface of glass.

$R–COOR + NH_4OH \rightarrow R–COO–\ NH_4^+ + R–OH$

The water of ammonia solution dissolves the soap which can easily be wiped out. The remaining ammonium hydroxide solution is evaporated.

NaoH cannot be used, because main component of glass is SiO_2. SiO_2 reacts with NaOH to form (Na_2SiO_3) compound. $2NaOH + SiO_2 \longrightarrow Na_2SiO_2 + H_2O$ As a result, glass is corroded. For this reason, caustic soda cannot be used in glass cleaner.

Toilet cleaner is used to keep the toilet cleaned. The toilet cleaner removes the undesirable smell, bacteria, fungus from the toilet. In general, the heavy dirts (fat, protein, micro-organisms, various organic components) are adsorbed in the toilet, To remove this heavy dirts, strong corrosive agents are needed. We know, NaOH is a corrosive substance. The OH– ion can easily remove the dirt and kill the microbes. So, only a concentrated solution of NaOh is sufficient enough to clean the toilet. Upto 50% NaOH can be used to prepare the cleaner. However, some other ingredients like detergent, antibacterial

agent, aroma agent and dyes are added to make a toilet cleaner. If toilet cleaner is made by using NaOH, it is OH^- ion which plays the important role.

It is evident from above discussion that stem's compound (i) used as toilet clear and (ii) used as as glass cleaner.

Ques. ▶ 28 Sugarcane ⟶ Vinegar

[Mirzapur Cadet college, Tangail]

a. What is green chemistry? 1
b. What is meant by solubility product? Explain. 2
c. Explain the causes of using above acid solution as a preservative? 3
d. Analyze the preparation of above preservative from sugarcane. 4

Answer to the question no. 28

a Green Chemistry is the design of chemical product and process that reduces or eliminate the use and generation of hazardous substances.

b At a fixed temperature, the maximum product of the concentration of the ions of a low soluble salt in a solution is called the solubility product of that salt. For example, the electrolytic process if a low soluble salt AgCl,

$$AgCl \longrightarrow Ag^+ + Cl^-$$

∴ The solubility product of AgCl,

$$Ksp = [Ag^+] \times [Cl^-]$$

At a fixed temperature, the value of Ksp is constant. Ksp means the product of the concentration of the ions Ag^+ and Cl^{-1} in a saturated solution of AgCl. This value is constant. It doesn't depend separately on the concentration of Ag^+ ion and Cl^- ion.

c Similar to the question no- 8(d)

d Similar to the question no- 8(c)

Ques. ▶ 29

A = Milk ⟶ B = Butter (1st Part) Colloid (2nd Part)

[Mymensingh Girls' Cadet College, Mymensingh]

a. What is food security? 1
b. Why H_2SO_4 and ether salt are not first class preservatives? Explain. 2
c. According to the stem, describe the preparation process of B from A. 3
d. The particles of 2nd part of the stem do not coagulate normally, but can be coagulate by adding electrolytes- explain. 4

Answer to the question no. 29

a Food security is a set of principles relating food processing food production and storage of food which assure the sufficient quantity of affordable, nutritious food.

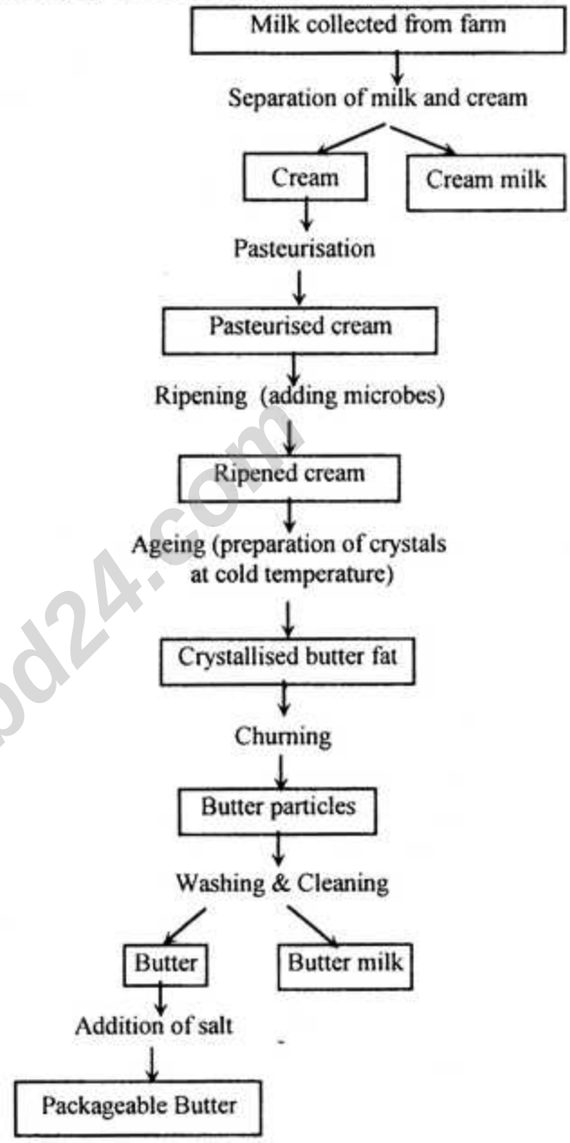
b H_2SO_4 acid is not used directly in food for its law pH value,, For this reason it is a corrosive and strong oxidizing agent. Thus, use H_2SO_4 as food preservatives causes a havoc damage of food. On the other hand salt of ethers are basic in nature. No base is used for food preservation due to its high (≥ 7.0) pH value. On this atmo sphere destruction of micro-organism is possible rather it is favorable condition for growth of such micro-organisms.

Therefore H_2SO_4 and salts of ether are not first class preservatives.

c Preparation process B (Butter) form A (Milk) indicated in stem describe below.

Non-homogenous boiled milk or cream contains two parts : butter fat and the other is globules or protein are surrounded by thin membrane like phospholipids and for this reason, fat or butter fats cannot combine together. When this type of mixture (milk or cream) is agitated, the thin membrane gets disrupted and butter fat molecules can combine themselves.

Churning process creates small particles of butter in aqueous solution. This butter milk is removed to prepare butter and fine particles of butter are separated. Butter particles are brought closer by compression process. This process is carried out mostly by a wooden handle, which is called "scotch hands".



d 2nd part stated in the stem is colloid which is a homogeneous non-crystalline substance consisting of ultramicroscopic particles one substance dispersed through a second substance.

Colloidal particles possess charge. These show Brownian movement. Because of the repulsion between two similarly charged particles, colloids do not coagulate at normal conditions. The particles remain apart because of repulsion. By addition of oppositely charged electrolytes, the charge of colloid particles become neutralised. As a result, the colloidal particles have no barrier to come closer to each other and they aggregate.

When the colloidal particles are separated through coagulation process from polluted water, the other substances are also get separated. In water most colloid particles remain as negatively charged ions. Hence, positively charged coagulants are used to separate the colloidal particles from mixture. In such cases. iron and aluminium salts are used as coagulants. If the colloids are positive, then negative coagulants are used.

Ques. ▶ 30 Sugarcan ⟶ Preservative

[Joypurhat Girls' Cadet College]

a. What is Chromatography? 1
b. How Fe^{2+} and Fe^{3+} ion can be differentiated? 2
c. What are the steps related to separation ethanoic acid from sugarcan? 3
d. Describe the food preservation technique of vinegar. 4

Answer to the question no. 30

a Chromatography is a technique for the separation of a mixture by passing it in solution or suspension through a medium in which the components move at different rates.

b **Detection of Fe^{2+} ion:** Addition of potassium ferrocyanide $K_4[Fe(CN)_6]$ to the stock solution results in light blue precipitation which confirms the presence of Fe^{2+} (ferrous) ion.
$FeCl_2 + K_4[Fe(CN)_6] \rightarrow 2KCl + K_2Fe[Fe(CN)_6] \downarrow$ (light blue precipitate)
Detection of Fe^{3+} ion: When few drops of potassium ferrocyanide solution ($K_3[Fe(CN)_6$) is added to the stock solution, the solution becomes brown which indicate the presence of ferric salt:

$$FeCl_3 + K_3[Fe(CN)_6] \rightarrow Fe[Fe(CN)_6] + 3KCl$$
(brown)

c Similar to the question no– 6(c)

d Similar to the question no– 7(c)

Ques. ▶ 31

NH_3 Solution	Caustic soda solution
Compound A	Compound B

[Pabna Cadet College, Pabna]

a. What do you mean by coagulation? 1
b. Define the difference between colloid & suspension? 2
c. Describe the application & mechanism of compound A as a cleaning agent. 3
d. Between A & B which is used as toilet & glass cleaner & why? Is there any problem if NaOH is used as glass cleaner. 4

Answer to the question no. 31

a Coagulation is a process, by which the colloidal particles in a solution are converted to relatively larger particles and separated from the solution by addition of a suitable chemical substance.

b The differences between colloids and suspension are given below :

Colloids	Suspension
i. The size of the article is between 2 to 1000 nm	ii The size of particle is larger than 1000 nm
ii Particles cannot be seen with low power microscope	ii Particles can be seen by low power microscope
iii It is homogenus	iii It is heterogenous

c Similar to the question no. 15(c).

d Similar to the question no. 2(d).

Ques. ▶ 32 One day morning, Azad was cleaning toilet in bathroom and saw the wall-mirror was dirty. Then he used toilet cleaner on that mirror and left for school. At the afternoon, he entered into bathroom and washed out that mirror with water. Then he surprised that mirror became opaque; but toilet materials were shining. *[Rangpur Cadet College, Rangpur]*

a. What is talc? 1
b. Prove that, "blood is a suspension". 2
c. Explain the mechanism of proper mirror cleaner. 3
d. Describe the proper causes of different activities of material cleaner of stem on glass and toilet. 4

Answer to the question no. 32

a Talc is a white, grey or pale green soft mineral with a greasy fell consisting of hydrated magnesium silicate.

b When in a liquid solvent, the diameter of a solid solute particle ranges larger than 10^{-5} cm, being separated as small particles produce a turbid, non-homogenous and unstable mixture, the solute particles can not penetrate through normal filter paper or parchment paper. Then the resulting turbid, non-homogenous and unstable mixture is called suspension. Blood is a great example of suspension. When blood is kept in the funnel, the blood particles such as WBC (White Blood Cell). RBC (Red Blood Cell) are deposited through the serum. These particles are seen through microscope. Blood's sedimentation Rate (SR)is tested by the blood suspension characteristic. Thus, it can be said that blood is a suspension.

c Similar the question no- 15(c)

d Similar to the question no- 2(d)

Ques. ▶ 33 P = Milk | Q = Butter | R = Colloid

[Cumilla Cadet College, Cumilla]

a. What is co-ordinate covelent bond? 1
b. Explain Hess's law. 2
c. How can you prepare Q from the P of the stem? Explain. 3
d. Patterns of R of the stem is not coagulated at normal state but if electrolyte is added then it is coagulated— Analyze. 4

Answer to the question no. 33

a A covalent chemical bond between two atoms that is produced when one atom shares a pair of electrons with another atom lacking such a pair called co-ordinate covalent bond.

b Hess's law states that, if the initial and final steps are fixed. then the total enthalpy change during the complete course of chemical reaction is the same whether the reaction is carried out in one step or in several steps.
Let the reactant "A" is converted to "C" in two different pathways.

i. ΔH amount of heat evolved when 'A' is directly converted to 'C' directly. i.e. $A \xrightarrow{\Delta H} C$.
ii. A is converted to C in two steps : In each step, ΔH_1 and ΔH_2 amount of heat is evolved respectively. i.e. $A \xrightarrow{\Delta H_1} B$; $B \xrightarrow{\Delta H_2} C$;

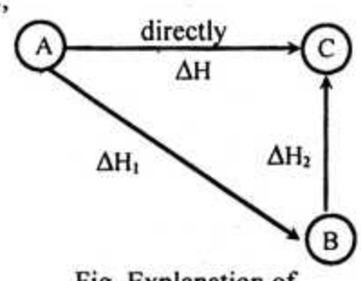


Fig. Explanation of Hess's law

So, according to Hess's law, $\Delta H = \Delta H_1 + \Delta H_2$
For example, considering the combustion reaction between Carbon and Oxygen.

c See the question no- 17(c)

d See the question no- 17(d)

Ques. ▶ 34 X = Milk | Y = Butter | Z = Colloid

[Feni girls' cadet college, Feni]

a. What is rate reaction? 1
b. How can you distinguish between Fe^{+2} & Fe^{+3} ion solution? 2
c. How can you can prepare Y from X? 3
d. Particles of Z, are not normally aggregated, but with addition of an electrolyte, it is coagulated— explain. 4

Answer to the question no. 34

a For chemical reaction, reaction rate as the change or decrease of concentration of reactant per unit time.

b **Detection of Fe^{2+} ion:** Addition of potassium ferrocyanide ($K_4[Fe(CN)_6]$) to the stock solution results in light blue precipitation which confirms the presence of Fe^{2+} (ferrous) ion.

$FeCl_2 + K_4[Fe(CN)_6] \longrightarrow 2KCl + K_2Fe[Fe(CN)_6] \downarrow$ (light blue precipitate).

Detection of Fe^{3+} ion: When few drops of potassium ferrocynide solution ($K_3[Fe(CN)_6]$) is added to the stock solution, the solution becomes brown which indicate the presence of ferric salt:

$$FrCl_3 + K_3[Fe(CN)_6] \longrightarrow \underset{\text{(brown)}}{Fe[Fe(CN)_6]} + 3KCl$$

c See the question no- 17(c)

d See the question no- 17(d)

Ques. ▶ 35 $X\ (Sugar) + water \xrightarrow{invertase} Y$ — (i)

$$Y \xrightarrow[O_2\ micoderma]{Zymaze} CO_2 + Z \text{ — (ii)}$$

$$Z \xrightarrow[acetobactor]{} W \text{ — (iii)}$$

[Feni Girls' Cadet College, Feni]

a. What is food security? 1
b. Why dewatering is essential for butter? 2
c. Write down the reactions as per given stem. 3
d. Explain whether the mechanism of food preservation of X and W are same or not? 4

Answer to the question no. 35

a Food security is defined as the access of all people at all times to enough food for an active, healthy life.

b After the preparation of butter there exists 16% water. Milk, protein and lactose dissolved with in this water makes butter roten and thus the stability decreased. For thus dewatering is essential for butter.

c See the question no– 4(c)

d Similar to the question no– 4(d)

Ques. ▶ 36 Answer the questions related to given stem;

1. $C_{12}H_{22}O_{11} + H_2O \xrightarrow{invertase} (A + B)$
2. "A" $\xrightarrow{zymase}$ "C" $\xrightarrow{mucoderma.acetobactor}$ "D"

[Faujdarhat Cadet College, Chattogram]

a. Write full name of MSDS. 1
b. The wave length of a violet light is 410nm. What are its frequency and wave number? 2
c. Complete all the equations of related reactions of given stem and identify compound "D". 3
d. Explain the importance of "D" compound as food presevattive. 4

Answer to the question no. 36

a The full name of MSDS is Material safety Data sheet.

b Given,

Wave length, $\lambda = 410\ nm$
$= 410 \times 10^{-9}\ m$

Wave number, $\bar{\nu} = \frac{1}{\text{wave length}} = \frac{1}{\lambda}$
$= \frac{1}{410 \times 10^{-9}}\ m^{-1}$
$= 2.439 \times 10^{6} m^{-1}$

Again, $c = f\lambda$
$f = \frac{c}{\lambda}$
$= \frac{3 \times 10^{8}}{410 \times 10^{-9}}$
$= 7.317 \times 10^{14}\ HZ$

$c = 3 \times 10^{8}\ ms{-}1$
$\lambda = 410 \times 1010^{-9} m$
$f = ?$

So, The wave number of the ray is $2.439 \times 10^{6} m^{-1}$ and frequency 7.317×10^{14} Hz

c See the question no– 4(c)

d According to the stem, the D compound is vinegar. It has great importance for the food perseveration, Explained below–

i. It is a weak acid and hence it does not have the possibility of increasing the acidity. It maintains the pH balance of the body.
ii. Since it is an acidic solution, it decreases the pH of the preserved food. (5 to below 4.0). As a result, microbes specially bacteria do not have the favourable environment for growth and development. 5% ethanoic acid containing vinegar has a p^H of 2.4, which is sufficient to kill bacteria. If salt is added with vinegar, the preservation becomes more effective. Addition of salt extracts the excess water form food products. This does not reduce the concentration of vinegar.
iii. Since it dissolves very well in water, it mixes well with food water easily and maintains at homogenous concentration and thus resists the growth of micro-organisms.
iv. Because of its higher boiling point than (118°C) water, it does not get evaporated during the application of heat at the time of food processing.
v. It is easily available and does not show any side effect.
vi. For pH reduction during the food processing and preservation, acid concentration in vinegar can be increased. In case of low acidic food, acid concentration of vinegar has to be increased.

Fruits, vegetables, fish and meat can be processed and preserved by using-vinegar. Hence, vinegar plays very important role in food preservation.

Ques. ▶ 37 $Ethanol(10\%) + O_2 \xrightarrow[Acetobactor]{} X + H_2O$

[Sylhet Cadet College, Sylhet]

a. What is pasturaization? 1
b. Explain the term "coagulation". 2
c. How can you prepare compound X from ethyne? 3
d. Write the significance of X as a preservative. 4

Answer to the question no. 37

a Pasteurization is a process in which certain packaged and non-packaged foods are treated with mild heat, usefully less than 100°C, to eliminate pathogens and extend shelf life.

b Coagulation is a process, by which the colloidal particles in a solution are converted to relatively larger particles (coagulum) and separated from the solution by addition of a suitable chemical substance, called coagulant.

Coagulation process is applied to separate the various chemical substances in industrial production. Before making coagulum the smaller particles are called sols. Nowadays coagulation process is successfully applied to remove the pollutants from polluted water (waste water).

c According to the stem, the reaction given below—

$$CH_3CH_2OH(10\%) + O_2 \xrightarrow{\text{Acetobactor}} \underset{X}{CH_3COOH} + H_2O$$

So, X is the ethanoic acid. The preparation of ethanoic from ethyne explained below—

At present huge amount of ethanoic acid being produced from ethyne.

In this process ethanol is available from ethyne received from petroleum passing through the mixture of 20% H_2SO_4 and 1% $HgSO_4$ at 60°C temperature. The ethanol (CH_3CHO) received from ethyne oxidized in the presence of Mn^{2+} catalyst. and then turned into ethanoic acid.

$$\underset{\text{Ethyne}}{HC\equiv CH} + H_2O \xrightarrow[1\%\ HgSO_4]{20\%\ H_2SO_4} \underset{\text{Ethyne}}{CH_3CH}$$

$$CH_3 - \underset{\text{Ethanol}}{CHO} + O_2 \xrightarrow{Mn^{2+}\ 60°C} 2CH_3COOH$$

Produced above ethanoic acid is not pure. So it has to be purified. If NaOH is added with obtained ethanoic acid, then $CH_3COONa\ 3H_2O$ crystal formed. This crystal has to be dried by filtration. Distillation is done adding H_2SO_4 with dry Na–ethanoate. Then 99.5% purified ethanoic acid is available as distilled liquid.

$$CH_3COOH + NaOH \longrightarrow \underset{\text{Crystal}}{CH_3COONa.H_2O} + H_2O$$

$$CH_3COONa.3H_2O \xrightarrow{\Delta} CH_3COONa + 3H_2O$$

$$CH_3COONa + H_2SO_4(conc) \longrightarrow Na_2SO_4 + \underset{\text{99.5\% purified ethanoic acid.}}{CH_3COOH}$$

d Following stem, X is vinegar.

Vinegar is widely used to preserve various food products of fish, meat, fruits, vegetables. Food preservation by vinegar improves the quality, taste and nutritional status of various food items.

Vinegar in preserving vegetables

All types of vegetables are not available everywhere in the country. The vegetables are easily bio-degradable. Vinegar preservation maintains the colour, nutritional status & vitamins of vegetables. The vegetables can be used for a longer period.

Fig : Vinegar

Vinegar in preserving fruits

Various fruits or fruit products can be preserved by vinegar. Vinegar plays important role in making pickles from various fruits. Fruits are essential for balanced diet, but seasonal fruits are not available throughout the year. Hence, it is necessary to preserve fruits so that these can be available throughout the year.

Vinegar in preserving meat and fish

Fish gets rotten very rapidly. Fish and meat are the major sources of protein. Because of the presence of basic components in meat and fish, these two food materials undergo adulteration rapidly. However, if they are preserved using vinegar, the adulteration is stopped. They can be used for a longer period.

Vinegar in destroying bacteria and toxins in food

Food materials are generally contaminated with bacteria, yeast and mould. Vinegar plays important role in developing resistance against bacteria.

Vinegar in developing resistance against diseases

Vinegar, if taken in optimum quantity can play important role in human health. This brings appetite, increases blood flow, enhances digestive capability, assists in removing body's liquid waste, removes undesirable fats in blood.

Ques. ▶ 38 This question is about three aqueous solutions of A, B and X. The molecular mass of these three compounds are 60, 17 and 40 respectively. *[Jhenaidah Cadet College. Jhenaidah]*

a. What is green chemistry? 1

b. Write the percentage composition of different compounds of vanishing cream. 2

c. How A preserve food? 3

d. Among A, B and X which one is more suitable as glass cleaner?— Analyze. 4

Answer to the question no. 38

a Green chemistry is the design of chemical product and processes that reduce or eliminate the use and generation of hazardous substance.

b The percentage composition of different compound, of vanishing cream is given below—

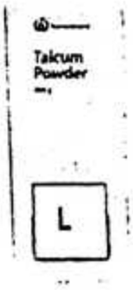
Component	Percentage (%)
Stearic acid	17%
Sodium carbonate	0.5%
Potassium hydroxide	0.5%
Glycerin	6%
Water	71%
Alcohol	4.5%
Flavour	0.5%

c Having molecular mass 60, the A compound is vinegar. The mechanism of food preservation is given below—

Similar to the question no– 7(c)

d Similar to the question no– 16(d)

Ques. ▶39 Read the stem carefully and answer the following questions.



[Barishal Cadet College,Barishal]

a. What is chelating agent? 1

b. Explain the differences between colloid and suspension. 2

c. Analyze the function of the components in bottle L. 3

d. Create a model formula of ingredients and uses of NH_4OH in countainer M. 4

Answer to the question no. 39

a Chelating agent is a chemical compound which destroys the microbes creating complex structure with food.

b The differences between colloid and suspension are given below :

Colliod	Suspension
(i) Colliod particles are comparatively small (1–200 nm)	(i) Suspension particles are comparatively large.
(ii) Particles pass through the filter paper.	(ii) Particles cannot pass through the filter paper.
(iii) Particles do not undergo sedimentration.	(iii) Particles undergo sedimentration.

c In the stem there is talcum powder in L bottle. Talcum powder is usually used to prevent from humidity, sweat and skin irrition, skin folds etc.

The functions of the components in talcum powder is given below–

Name of component	Amount (%)	Functional characteristics of components
Talc	60	Covering agent, increases softness to skin
Zinc oxide	10	Protects skin from sun's harmful radiation
Calcium carbonate	10	Brings homogeneity to powder
Magnesium carbonate	18	Absorbs sweat & removes humidity
Starch	2	–
Colour & perfume	As required	Brings pleasant feeling in mind

d The container M indicates the glass cleaner. Glass cleaner is used to clean heavy dirt or grease. The main component of glass cleaner is ammonia. Moreover, iso propyl alcohol, vinegar, colouring agent and aroma agent are used in glass cleaner.

The Formulation of glass cleaner is given below :

Formulation

Production	Weight (%)
Distilled water	90.79
Isopropyl alcohol	5.00
Propylene glycol methyl ether	4.00
Magnesium lauryl ether sulfate	0.02
Monoethanolamine	0.15
Ammonia (24%)	0.15
Surfactant	0.01
Aroma, colour, preservatives	As required

The usage of NH_4OH :

NH_3 used to glass cleaner reacts with water to produce NH_4OH. The OH^- ion of NH_4OH removes the grease, oil and fatty substance. Although NH_4OH removes dirt, it don't participate any chemical reaction with glass.

$$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$$

$$\underbrace{\begin{matrix} CH_2-O-\overset{O}{\overset{\|}{C}}-R \\ | \\ CH-O-\overset{O}{\overset{\|}{C}}-R \\ | \\ CH_2-O-\overset{O}{\overset{\|}{C}}-R \end{matrix}}_{\text{oil/fat}} + 3NH_4OH \rightarrow \underbrace{3R-COONH_4}_{\text{adsorbed on glass}} + \underbrace{\begin{matrix} CH_2-OH \\ | \\ CH-OH \\ | \\ CH_2-OH \end{matrix}}_{\text{released from glass}}$$

[R = $-C_nH_{2n+1}$; n = 15 or more than 15]

Glass (calcium and sodium silicate) + NH_4OH ⟶ no chemical changes occured.