Date: 22/10/2021

Q1. What is the effect of temperature on chemisorption?

Q2. In reference of Freundlich adsorption isotherm write the expression for adsorption of gases on solids in the form of an equation.

Q3. Define the following term: Adsorption.

Q4. Physisorption is reversible while chemisorption is irreversible. Why?

Q5. Differetiate between adsorption and absorption.

Q6. Write two applications of adsorption.

Q7. Adsorption of a gas on surface of solid is generally accompained by a decrease in entropy, stil it is a spontaneous process. Explain.

Q8. Out of NH_3 and CO_2, which gas will be adsorbed more readily on the surface of activated charcoal and why?

Q9. Of physisorption or chemisorption, which has a higher enthalpy of adsorption?

Q10. Define the following term: Sorption.

Q11. What type of forces are responsible for the occurrence of physisorption?

Q12. Write the expression for the Freundlich adsorption isotherm for the adsorption of gases on solids, in the form of an equation.

Q13. Why is adsorption always exothermic?

Q14. In chemisorption why x/m initially increases and then decreases with rise in temperature?

Q15. Why does physisorption decrease with the increase of temperature?

Q16. Name the two types of adsorption phenomenon.

Q17. What are physisorption and chemisorption?

Q18. What is the basic difference between adsorption and absorption?

Q19. Why is a finely divided substance more effective as an adsorbent?

Q20. Physisorption is multi-layered, while chemisorption is mono-layered.

Q21. Out of $BaCl_2$ and KCl, which one is more effective in causing coagulation of a negatively charged colloidal sol? Give reason.

Q22. Write the main reason for the stability of colloidal sols.

Q23. Give an example of 'shape-selective catalyst'.

Q24. What are biocatalysis? Give an example.

Q25. Define the following term: Shape selective catalysis.

Q26. Give reasons for the following observation: It is necessary to remove CO when ammonia is prepared by Haber's process.

Q27. Define the following term: Electrophoresis.

Q28. In reference to surface chemistry, define dialysis.

Q29. Write the dispersed phase and dispersion medium of butter.

Q30. What is the difference between lyophobic sol and lyophilic sol?

Q31. Based on the type of dispersed phase, what type of colloid is micelles.

Q32. Name of the temperature above which the formation of micelles takes place.

Q33. What are the dispersed phase and dispersion medium in milk?

Q34. Give one example each of lyophobic sol and lyophilic sol.

Q35. Give one example each of sol and gel.

Q36. Which aerosol depletes ozone layer?

Q37. What are lyophobic colloids? Give an example for them.

Q38. How is a sol different from an emulsion?

Q39. How can a colloidal solution and true solution of the same colour be distinguished from each other.

Q40. Define peptization.

Q41. Which complexion is formed when undecomposed AgBr is washed with hyposolution in photography?

Q42. To which colloidal system does milk belong?

Q43. Define the term "Tyndall effect".

Q44. What causes brownian movement in a colloidal solution?

Q45. Describe 'electrophoresis' briefly.

Q46. What happens when gelatin is added to gold solution?

Q47. Explain the following terms giving a suitable example: Emulsification.

Q48. What are emulsions? Give an example.

Q49. Give one example each of 'oil in water' and 'water in oil' emulsion.

Q50. What is an emulsion?

Q51. What are emulsions? Name an emulsion in which water is a dispersed phase.

Q52. Explain the following: Artificial rain is caused by sparying salt over clouds.

Q53. Give reasons for the following observations: A delta is formed at the meeting point of sea water and river water.

Q54. Give reasons for the following observations:

(a) NH_3 gas absorbs more readily than N_2 gas on the surface of charcoal.

(b) Powdered substances are more effective adsorbents.

Q55. Write the differences between physisorption and chemisorption with respect to the following:

(a) Specificity (b) Temperature dependence

(c) Reversibility (d) Enthalpy change

Q56. Name the two groups into which phenomenon of catalysis can be divided. Give an example of each group with the chemical equation involved.

Q57. Explain how the phenomenon of adsorption find application in the followig processes:

(a) Production of vaccum. (b) Heterogeneous catalysis.

Q58. Distinguish between homogeneous and heterogeneous catalysis. What role does adsorption play in heterogeneous catalysis?

Q59. Write the dispersed phase and dispersion medium of the following colloidal systems: (a) Smoke, (b) Milk.

Q60. Define the following terms: (a) Tyandall effect (b) Electrophoresis.

Q61. Define the following terms: (a) Peptization, (b) Sol.

Q62. (a) Based on type of particles of dispersed phase, give one example each of associated colloid and multimolecular colloid.

(b) Write an important characteristic of lyophilic sols.

Q63. Give reasons for the following observations:

(a) Leather gets hardened after tanning.

(b) Lyophilic sol is more stable than lyophobic sol.

Q64. (a) Out of $MgCl_2$ and $AlCl_3$, which one is more effective in causing coagulation of negatively charged sol and why?

(b) Out of sulphur sol and proteins, which one forms multimolecular colloids?

Q65. Explain the following term giving a suitable example. "Homogeneous catalysis.

Q66. Distinguish between micelles and colloidal particles. Give one example of each.

Q67. Explain the following terms: (a) Tyndall effect (b) Coagulation

Q68. Explain the following terms: (a) Electrophoresis (b) Dialysis.

Q69. Define the following: (a) Peptization (b) Reversible sols.

Q70. What is meant by coagulation of a colloidal solution. Name any method by which coagulation of lyophobic sols can be carried out.

Q71. Define the following terms: (a) acrosol (b) Coagulation of colloids.

Q72. Define the following terms giving an example of each: (a) Emulsion (b) Hydrosol.

Q73. (a) Same substances can act both as colloids and crystalloids. Explain.

(b) What will be the charge on AgI colloidal particles when it is prepared by adding small amount of $AgNO_3$ solution to KI solution in water? What is responsible for the development of this charge?

Q74. Explain the cleaning action of soap. Why do soaps not work in hard water?

Q75. Explain the following terms giving one example for each. (a) Micelles, (b) Aerosol.

Q76. What are the following colloidal solutions prepapred?

(a) Sulphur in water (b) Gold in water.

Q77. What is the difference between multimolecular and macromolecular colloids? Give one example of each.

Q78. What are emulsions? State one application of emulsification.

Q79. What is the difference between oil/water (O/W) type and water/oil (W/O) type emulsions? Give an example of each type.

Q80. Define the following terms:

(a) Lyophilic colloid (b) Zeta potential (c) Associated colloids

Q81. Define adsorption.Write any two features which distinguish physisorption from chemisorption

Q82. What is an adsorption isotherm? Describe Freundlich adsorption isotherm.

Q83. Giving appropriate examples, explain how the two types of processes of adsorption (physisorption and chemisorption) are influenced by the prevailing temperature, the surface area of adsorbent and the activation energy of the proces?

Q84. How do the size of particles of adsorbent, pressure of gas and temperature influence the extent of adsorption.

Q85. What is an 'adsorption isotherm'?

Q86. What are the characteristics of the following colloids? Give one example of each.

(a) Multimolecular colloids (b) Lyophobic sols (c) Emulsions.

Q87. Describe the following processes:

(a) Dialysis (b) Electrophoresis (c) Tyandall effect.

Q88. Define the following terms:

(a) Brownian movements (b) Peptization (c) Multimolecular colloids.

Q89. Explain what is observed when:

(a) A beam of light is passed through a colloidal solution.

(b) NaCl solution is added to hydrated ferric oxide sol.

(c) Electric current is passed through a colloidal solution.

Q90. Explain the following terms:

(a) Electrophoresis (b) Coagulation (c) Tyandall effect.

Q91. Distinguish between multimolecular, macromolecualr and associated colloides. Give one example of each.

Q92. Classify colloids where the dispersion medium is water. State their characteristics and write an example of each of these classes.

Q93. What is meant by coagulation of a colloidal solution? Describe briefly any three methods by which coagulation of lyophobic sols can be carried out.

Q94. (a) What is the difference between a colloidal solution and an emulsion? Give one example of each.

(b) What are emulsifiers?

Q95. What are emulsions? What are their different types? Give one example of each type.

Q96. Explain what is observed when

(a) KCl, and electrolyte, is added to hydrated ferric oxide sol.

(b) an electric current is passed through a colloidal solution.

(c) a beam of light is passed through a colloidal solution.

Q97. What are lyophilic and lyophobic sols? Give one example of each type. Which one of these two types of sols is easily coagulated and why?

Q98. How are the following colloids different from each other in respect of dispersion medium and dispersed phase? Give one example of each type.

(a) An aerosol (b) A hydrosol (c) An emulsion.

Q99. What is the difference between multimolecular and macromolecular colloids? Give one example of each type. How are associated colloids different from these two types of colloids?

Date: 22/10/2021

S1. **Effect of temperature:** Chemisorption is an exothermic process. Hence, according to Le Chatelier principle, rate of adsorption decreases with rise in temperature. Rate of adsorption is low at lower temperature because of high energy of activation hence, with increasing temperature rate of adsorption increases initially.

S2.

$$\frac{x}{m} = kp^{1/n} \; (n > 1)$$

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

where $\frac{x}{m}$ is the mass of gas adsorbed per gram of the adsorbent and p is the pressure of gas.

S3. Adsorption is the phenomenon of attracting and retaining the molecules of a substance on the surface of a liquid or a solid resulting in higher concentration of the molecules on the surface.

S4. Physisorption takes place (any one) with the help of non-covalent bonding between an adsorbate and an adsorbent; it makes the process reversible. Chemisorption, on the other hand, takes place with the help of covalent bonding; it makes the process irreversible.

S5. Adsorption is a surface phenomenon. In this process the adsorbate is concentrated on the surface of the adsorbent and does not penetrate into the bulk whereas, adsorption of a substance takes place throughout the bulk of the material. In adsorption, concentration of adsorbate is high on the surface of adsorbent, while during adsorption concentration is uniform throughout. *e.g.*, water vapour is adsorbed by silica gel whereas absorbed by anhydros calcium carbide.

S6. Applications of adsorption:

(a) Deionisation of water. (b) In chromatographic analysis.

S7. For the process to be spontaneous ΔG must be negative.

As ΔS is negative, ΔG can be negative only if ΔH is negative and greater than $T\Delta S$.

S8. NH_3 gas will be adsorbed more readily on the surface because it has higher critical temperature than CO_2 gas.

Due to the greater attraction of the gas molecules on the surface of the adsorbent, greater will be the adsorption.

S9. Chemisorption has higher enthalpy of adsorption.

S10. The term sorption is used to describe both the processes adsorption and absorption.

S11. The forces operating in these cases are weak van der Waals' forces.

S12.
$$\frac{x}{m} = kp^{1/n} \ (n > 1)$$
$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

where $\frac{x}{m}$ is the mass of gas adsorbed per gram of the adsorbent and p is the pressure of gas.

S13. In adsorption, there is always a decrease in residual unbalanced forces on the surface. This results in decrease in surface energy which appears as heat. Hence, adsorption is unconditionally an exothermic process.

S14. **Effect of temperature:** Chemisorption is an exothermic process. Hence, according to Le Chatelier principle, rate of adsorption decreases with rise in temperature. Rate of adsorption is low at lower temperature because of high energy of activation hence, with increasing temperature rate of adsorption increases initially.

S15. Since, adsorption is exothermic and according to Le-Chatelier's principle, low temperature is favourable for physical adsorption hence, physisorption decreases with increase in temperatue.

$$\text{Solid} + \text{Gas} \rightleftharpoons \text{Gas adsorbed on solid} + \text{Heat}$$

S16. The two types of adsorption phenomenon are chemisorption or chemical adsorption and physisorption or physical adsorption.

S17. **Physisorption:** The phenomenon in which adsorbate and adsorbent are held by van der Waals' forces.

It is reversible in nature. *e.g.*, setting a layer of dust particles on the furniture.

Chemisorption: The phenomenon in which adsorbate and adsorbent are held by chemical bonds.

It is irreversible in nature. *e.g.*, painting on a furniture.

S18. Adsorption is a surface phenomenon. In this process the adsorbate is concentrated on the surface of the adsorbent and does not penetrate into the bulk whereas, adsorption of a substance takes place throughout the bulk of the material. In adsorption, concentration of adsorbate is high on the surface of adsorbent, while during adsorption concentration is uniform throughout. *e.g.*, water vapour is adsorbed by silica gel whereas absorbed by anhydros calcium carbide.

S19. A finely divided substance is more effective as adsorbent because

(a) It has more surface area so more adsorption occurs.

(b) The number of active sites (active centres) becomes more and the extent of adsorption increases.

S20. Physical adsorption occurs due to intermolecular attractive forces between the adsorbate and adsorbent. If the size of the adsorbent pores is close to the size of adsorbate molecules, multilayer adsorption takes place, *i.e.*, adsorption takes place until all the pores are filled with adsorbate molecules, whereas in chemisorption chemical bonds are formed between adsorbate and adsorbent molecules. Therefore, it is monolayered.

S21. $BaCl_2$ is more effective in causing coagulation of negatively charged colloidal sol.

Because greater the valency of the coagulating ion, greater is its power to bring about coagulation.

S22. The main reason for the stability of colloids is the electrostatic stabilisation *i.e.*, equal and same type of charge on the collodial particles which causes repulsion between them and prevents the coagulation of the sol.

S23. Zeolites (ZSM – 5) are good shape selective catalysts which convert alcohols directly into gasoline (petrol) by dehydrating them to give a mixture of hydrocarbons.

S24. Enzymes are termed as biocatalysts as they help in catalysis of biological reactions.

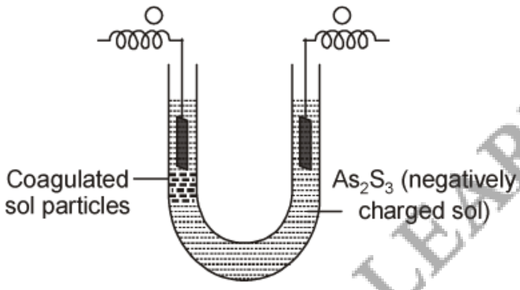
For example, inversion of cane sugar with the help of invertase enzyme.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}(aq)} + H_2O(l) \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6(aq)} + \underset{\text{Fructose}}{C_6H_{12}O_6(aq)}$$

S25. The catalytic reaction that depends upon the pore structure of the catalyst and the size of the reactant and product molecules is called shape selective catalysis.

S26. CO is a catalytic poison. It reacts with iron to form iron carbonyl thus inhibiting the activity of catalyst.

S27. The movement of collodial particles under an applied electric potential is called electrophoresis. Positively charged colloidal particles move towards the cathode, while negatively charged particles move towards the anode.



Electrophoresis

S28. Dialysis: It is the process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane.

A bag of suitable membrane containing the colloidal solution is suspended in a vessel through which fresh water is continuously flowing.

The molecules and ions diffuse through membrane into the water and pure colloidal solution is left behind.

S29. Dispersed phase: Liquid.

Dispersion medium: Solid.

S30. Lyophobic sol: The collodial solution in which particles of the dispersed phase have no or very little affinity for dispersion medium.

These are irreversible in nature *i.e.*, once precipitated, they have little tendency to get back into the colloidal form on simply adding dispersion medium *e.g.*, As_2S_5 solution. Lyophobic sols need stabilising agents for their preservation.

Lyophilic sol: The colloidal solution in which particles of the dispersed phase have a strong affinity for the dispersion medium.

These colloidal sols, even if precipitated, change back to the colloid from simply by adding dispersion medium. So, lyophilic sols are reversible in nature. *e.g.*, glue, starch, rubber, etc.

S31. Associated colloids.

S32. The formation of micelles takes place only above a particular temperature called *Kraft temperature* (T_k).

S33. Liquid fat is the dispersed phase and water is the dispersion medium.

S34. A colloidal sol in which dispersed phase and dispersion medium attract each other is called lyophilic colloid. *e.g.*, gum. A colloidal sol in which dispersed phase and dispersion medium repel each other is called lyophobic colloid. *e.g.*, gold solution.

S35.

Type of colloid	Dispersed phase	Dispersion medium	Examples
Soild	Solid	Liquid	Paints or cell fluids
Gel	Liquid	Solid	Cheese or butter or Jellies

S36. CFC (Chlorofluorocarbon).

S37. **Lyophobic sol:** The collodial solution in which particles of the dispersed phase have no or very little affinity for dispersion medium.

These are irreversible in nature *i.e.*, once precipitated, they have little tendency to get back into the colloidal form on simply adding dispersion medium *e.g.*, As_2S_5 solution. Lyophobic sols need stabilising agents for their preservation.

Lyophilic sol: The colloidal solution in which particles of the dispersed phase have a strong affinity for the dispersion medium.

These colloidal sols, even if precipitated, change back to the colloid from simply by adding dispersion medium. So, lyophilic sols are reversible in nature. *e.g.*, glue, starch, rubber, etc.

S38. Sol is a type of colloid in which the dispersed phase in solid and the dispersion medium is a liquid. Examples include mud, milk of magnesia.

Emulsion is a type of colloid in which the dispersed phase is liquid and dispersion medium is also a liquid. Examples include milk, face cream etc.

S39. When a powerful beam of light is passed through true and colloidal solutions each kept in a glass vessel then, colloidal solution exhibits tyandall effect whereas true solution does not.

S40. Peptization is the process of conversion of a precipitate into colloidal state in the presence of some electrolyte.

S41. The developed film is immersed in sodium thiosulphate (hypo) solution which removes unchanged silver bromide as a complex ion.

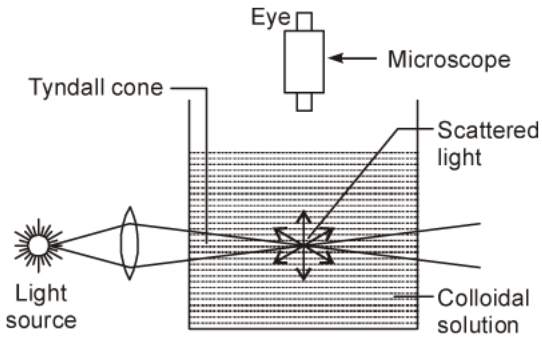
This is known as fixing.

$$AgBr + 2Na_2S_2O_3 \longrightarrow Na_3[Ag(S_2O_3)_2] + NaBr$$

After fixing, the film is not sensitive to light.

S42. Emulsion.

S43. When a beam of light is passed through a colloidal solution and viewed perpendicular to the path of incident light, the path of beam is illuminated by a bluish light. This phenomenon is called Tyandall effect. This is due to the fact that colloidal particles scatter light in all the direction in space.

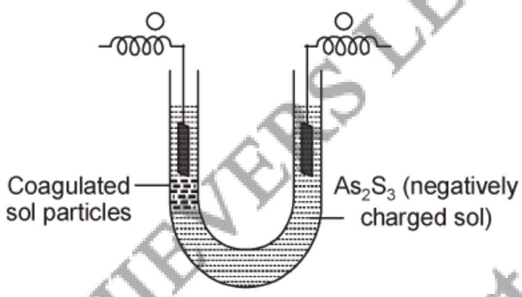


S44. The continuous rapid zig-zag motion of the colloidal particles in the dispersion medium is called Brownian movement.

Unbalanced bombardment of the particles of dispersed phase by molecules of dispersion medium causes Brownian motion.

This stabilises the sol.

S45. The movement of colloidal particles under an applied electric potential is called electrophoresis. Positively charged colloidal particles move towards the cathode, while negatively charged particles move towards the anode.



Electrophoresis

S46. Gold solution which is lyophobic solution starts behaving like a lyophilic colloid when gelatin is added to it.

S47. **Emulsification:** The process of making emulsion is known as emulsification. To stabilise an emulsion, an emulsifying agent or emulsifier is added. Soaps and detergents are most frequently used emulsifiers.

S48. **Emulsion:** It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. *e.g.*, milk.

S49. Oil in water emulsion: Milk.

Water in oil emulsion: Butter.

S50. **Emulsion:** It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. *e.g.*, milk.

S51. (a) **Emulsion:** It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. *e.g.*, milk.

(b) Butter is an emulsion in water acts a dispersed phase and oil acts as the dispersion medium.

S52. Clouds are colloidal dispersion of water particles in air. These water particles carry some charge over them. On spraying oppositely charged colloidal dust or sand particles over a cloud from an aeroplane, the colloidal water particles present in the cloud will get neutralized and as a result they will come closer and will grow in size to form bigger water drops and ultimately will coagualate of precipitate causing artificial rain.

S53. Sea water contains a lot of electrolytes. River contains colloids of sand and clay. When they meet the electrolytes neutralise the charge on colloidal particles which results in the precipitation of sand, clay etc. thus, resulting in a delta formation.

S54. (a) Higher the critical temperature of gas, more readily it can get adsorbed on the surface of an adsorbent due to stronger van der Waals' forces.

NH_3 (132°C) has a higher critical temperature than dinitrogen (– 147°C). Thus, NH_3 gas adsorbs more readily than N_2 gas on the surface of charcoal.

(b) A finely divided substance is more effective as adsorbent because

(i) It has more surface area so more adsorption occurs.

(ii) The number of active sites (active centres) becomes more and the extent of adsorption increases.

S55.

Sl. No.	Criteria	Physisorption	Chemisorption
(a)	Specificity	It is not specific in nature.	It is highly specific in nature.
(b)	Temperature dependence	It decreases with increase in temperature. Thus, low temperature is favourable for physisorption.	It increases with increase in temperature. Thus, high temperature is favourable for chemisorption.
(c)	Reversibility	Resersible in nature.	Irreversible in nature.
(d)	Enthalpy change	Low enthalpy of adsorption.	High enthalpy of adsorption.

S56. Catalysis is divided into following two groups.

Homogeneous catalysis: When reactants and the catalysts are in the same phase.

i.e., liquid or gas, the catalysis is known as homogeneous catalysis.

e.g., $$2H_2O_2(aq) \xrightarrow{I^-(aq)} 2H_2O(l) + O_2(g)$$

or $$\frac{3}{2}O_2(g) \xrightarrow{NO(g)} O_3(g)$$

Heterogeneous catalysis: When reactants and the catalysts are in different phases, the catalysis is known as heterogeneous catalysis. In most cases, the catalyst is solid, while reactants are either liquid or gases. Here, the catalyst is usually a metal or an oxide in finely divided from *e.g.*,

$$\text{Vegetable oils }(l) + H_2(g) \xrightarrow{Ni(s)} \text{Vegetable ghee}(s)$$

$$4NH_2(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O(g)$$

S57. (a) **Production of Vacuum:** Adsorption can be applied to create condition of high vacuum. Vessel which has already been exhausted by vacuum pump is connected to a bulb containing charcoal. The remaining traces of air inspite of low pressure are adsorbed by the charcoal almost completely.

(b) **Role of adsorption in heterogeneous catalysis:** The reactant molecules in gaseous state or in solutions are adsorbed on the surface of the solid catalyst by physisorption or chemisorption. As result, the concentration of the reactant molecules on the surface increases and hence, the rate of reaction increases.

S58. Catalysis is divided into following two groups.

Homogeneous catalysis: When reactants and the catalysts are in the same phase.

i.e., liquid or gas, the catalysis is known as homogeneous catalysis.

e.g., $$2H_2O_2(aq) \xrightarrow{I^-(aq)} 2H_2O(l) + O_2(g)$$

or $$\frac{3}{2}O_2(g) \xrightarrow{NO(g)} O_3(g)$$

Heterogeneous catalysis: When reactants and the catalysts are in different phases, the catalysis is known as heterogeneous catalysis. In most cases, the catalyst is solid, while reactants are either liquid or gases. Here, the catalyst is usually a metal or an oxide in finely divided from *e.g.*,

$$\text{Vegetable oils }(l) + H_2(g) \xrightarrow{Ni(s)} \text{Vegetable ghee}(s)$$

$$4NH_2(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O(g)$$

Role of adsorption in heterogeneous catalysis: The reactant molecules in gaseous state or in solutions are adsorbed on the surface of the solid catalyst by physisorption or chemisorption. As result, the concentration of the reactant molecules on the surface increases and hence, the rate of reaction increases.

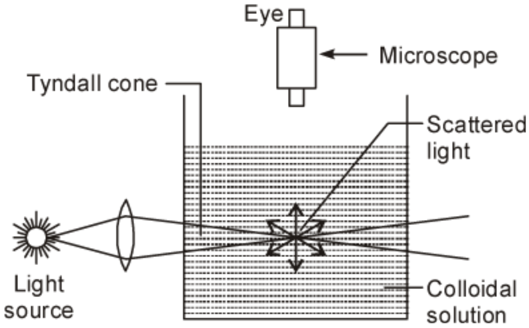
S59. (a) Dispersed phase of smoke = Solid.

Dispersion medium of smoke = Gas.

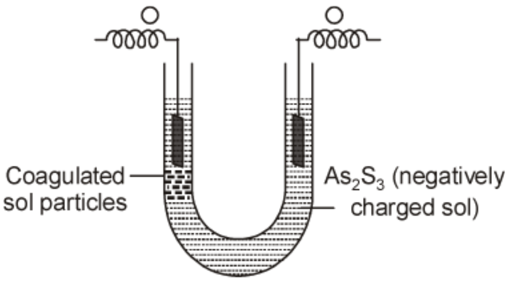
(b) Dispersed phase of milk = Liquid.

Dispersion medium of milk = Water (liquid).

S60. (a) When a beam of light is passed through a colloidal solution and viewed perpendicular to the path of incident light, the path of beam is illuminated by a bluish light. This phenomenon is called Tyandall effect. This is due to the fact that colloidal particles scatter light in all the direction in space.



(b) The movement of collodial particles under an applied electric potential is called electrophoresis. Positively charged colloidal particles move towards the cathode, while negatively charged particles move towards the anode.



Electrophoresis

S61. (a) Peptization is the process of conversion of a precipitate into colloidal state in the presence of some electrolyte.

(b) Sol is a type of colloid in which dispersed phase is solid and dispersion medium is liquid *e.g.*, paints.

S62. (a) Associated colloid: Soap.

Multimolecular colloid: Sulphur sol.

(b) Lyophilic sols are reversible sols. These are quite stable and cannot be easily precipitated.

S63. (a) Animal hides are colloidal in nature. When a hide, which has positively charged particles is soaked in tanin, containing negatively charged colloidal particles, mutual coagulation takes place. This results in the hardening of leather.

(b) Lyophilic sol is more stable than lyophobic sol because it is highly hydrated in the solution.

S64. (a) According to Hardy-Schulze rule, for negatively charged sol greater the valency of positive ion added to it, greater is its coagulation power.

In $AlCl_3$, Al has +3 charge which is more than Mg with +2 charge in $MgCl_2$.Thus, $AlCl_3$ is more effective in causing coagulation of negatively charged sol.

(b) Proteins are macromolecules which cannot form multimolecular colloids while sulphur sol have smaller S_8 molecules which can form multimolecular colloids.

S65. Homogeneous catalysis: When reactants and the catalysts are in the same phase.

i.e., liquid or gas, the catalysis is known as homogeneous catalysis.

e.g., $$2H_2O_2(aq) \xrightarrow{I^-(aq)} 2H_2O(l) + O_2(g)$$

or $$\frac{3}{2}O_2(g) \xrightarrow{NO(g)} O_3(g)$$

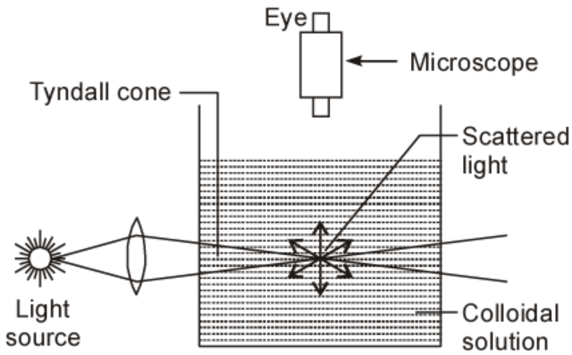
S66. **Micelles:** When small particles (ions) of an electrolyte molecule form the aggregate particles which behave like colloidal particles, these aggregated particles are known as micelles.

Examples: Soap and detergents.

Colloidal particles: Colloidal particles have an enormous surface area per unit mass as a result of their small size. Its size ranges between 1 nm to 100 nm.

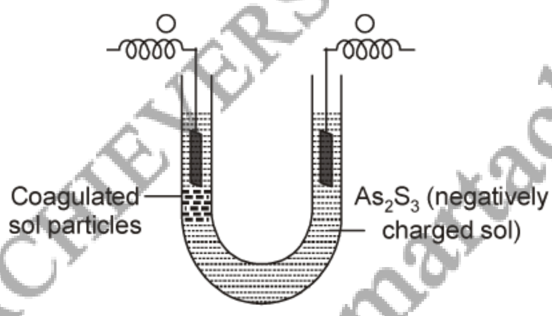
Examples: Sulphur sol.

S67. (a) **Tyndall effect:** When a beam of light is passed through a colloidal solution and viewed perpendicular to the path of incident light, the path of beam is illuminated by a bluish light. This phenomenon is called *Tyandall effect*. This is due to the fact that colloidal particles scatter light in all the direction in space.



(b) **Coagulation:** The process of aggregating together the colloidal particles into large sized particle which ultimately settle down under the force of gravity as a precipitate is called *coagulation*.

S68. (a) The movement of colloidal particles under an applied electric potential is called electrophoresis. Positively charged colloidal particles move towards the cathode, while negatively charged particles move towards the anode.



Electrophoresis

(b) **Dialysis:** It is the process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane.

A bag of suitable membrane containing the colloidal solution is suspended in a vessel through which fresh water is continuously flowing.

The molecules and ions diffuse through membrane into the water and pure colloidal solution is left behind.

S69. (a) **Peptization** is the process of conversion of a precipitate into colloidal state in the presence of some electrolyte.

(b) **Reversible sols:** Lyophilic colloids are also known as reversible sols. These sols are directly formed by mixing substances like gum, gelatin, strach etc. with a suitable liquid. These sols are stable and cannot be easily coagulated.

S70. Coagulation: The process of aggregating together the colloidal particles into large sized particle which ultimately settle down under the force of gravity as a precipitate is called coagulation.

Coagulation of lyophobic sol can be carried out by adding electrolyte.

S71. (a) Colloid of a liquid in a gas is called aerosol *e.g.*, fog, sprays etc.

(b) **Coagulation:** The process of aggregating together the colloidal particles into large sized particle which ultimately settle down under the force of gravity as a precipitate is called coagulation.

S72. (a) **An emulsion:** It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. *e.g.*, milk.

(b) **A Hydrosol:** It is a colloidal solution of a solid in water as the dispersion medium. *e.g.*, starch solution.

S73. (a) Ths same substance can act as both colloid and crystalloid. It depends on the size of the particles.

When the size of the particles lies between 1 to 1000 nm, it behaves as a colloid. If particle size is less than 1 nm, it exists as a true solution and behave like a crystalloid.

(b) When $AgNO_3$ solution is added to aqueous KI solution, a negatively charged sol of AgI is formed.

This is due to selective adsorption of I^- ions from the dispersion medium.

$$\underset{\text{Dispersion medium}}{AgI + I^-} \longrightarrow \underset{\text{Negative sol}}{[AgI]\, I^-}$$

S74. The cleansing action of soap is due to the fact that soap molecules form micelle around the oil droplet in such a way that hydrophobic part is in the oil droplet and hydrophilic part interact with water, the oil droplet surrounded by stearate ions is now pulled to water and removed from the dirty surface.

Thus, soap helps in emulsification and washing away of oils and fats. The negatively charged sheath around the globules prevents them from coming together and forming aggregates.

(a) (b) (c)

Hard water contains calcium and magnesium ions.

These ions form insoluble calcium and magnesium salts when sodium or potassium soaps are dissolved in hard water. These insoluble soaps separate as scum in water and are useless as cleansing agent.

S75. (a) Aggregated particles of associated colloids at high concentration are called micelles. *e.g.*, soaps.

(b) Colloid of a liquid in a gas is called aerosol *e.g.*, fog, sprays etc.

S76. (a) Sulphur sol is prepared by the oxidation of H_2S with SO_2.

$$SO_2 + 2H_2S \xrightarrow{\text{Oxidation}} \underset{\text{(Sol)}}{3S} + 2H_2O$$

(b) Gold sol is prepared by Breding's arc process or by the reduction of $AuCl_3$ with HCHO.

$$2AuCl_3 + 3HCHO + 3H_2O \xrightarrow{\text{Oxidation}} \underset{\text{(Sol)}}{2Au} + 3HCOOH + 6HCl$$

S77.

Sl. No.	Multimolecular colloids	Macromolecular colloids
1.	When a large number of small molecules or atoms (diameter < 1 nm) of a substance combine together in a dispersion medium to form aggregates, having size in the colloidal range, the colloidal solutions thus, formed are known as multimolecular colloids.	When substances which possess very high molecular masses are dispersed in suitable dispersion medium, the colloidal solutions thus, formed are called macromolecular colloids.
2.	*e.g.*, gold sol, sulphur sol, etc.	*e.g.*, cellulose, starch, etc.

S78. (a) **Emulsion:** It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. *e.g.*, milk.

(b) **Application of emulsification:** Cleansing action of soaps is due to the emulsification of oils and fats. Actually, soaps help in emulsification of oils and fats.

S79. The two types of emulsions are:

(a) Oil in water type in which small droplets of an oil are dispersed in water.

Example: Milk, cod liver oil.

(b) Water in oil type in which water droplets are dispersed in an oil medium.

Example: Butter.

S80. (a) **Lyophobic sol:** The collodial solution in which particles of the dispersed phase have no or very little affinity for dispersion medium.

These are irreversible in nature *i.e.*, once precipitated, they have little tendency to get back into the colloidal form on simply adding dispersion medium *e.g.*, As_2S_5 solution. Lyophobic sols need stabilising agents for their preservation.

(b) The difference of potential between fixed layer and diffused layer of a colloidal sol is known as electrokinetic or zeta potential. It is given by

$$Z = \frac{4\pi\eta u}{K}$$

Z – Zeta potential

η – Co-efficient of viscosity of sol

u – Velocity of sol particles

K – Dielectric constant.

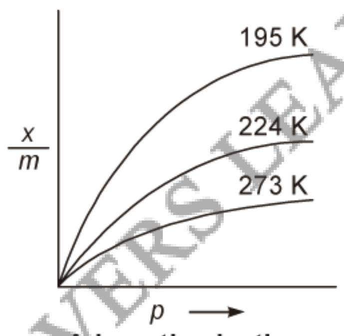
(c) **Associated colloids:** The substances which at low concentration, behave as normal strong electrolytes but at higher concentration exhibit colloidal behaviour due to the formation of aggregated particles, are known as *associated colloids*.

These are also known as *micelles*. The formation of micelles takes place only above a particular temperature, called the Kraft temperature and above a particular concentration, called the Critical Micelle Concentration (CMC), *e.g.*, surface active agents such as soaps and synthetic detergents.

S81. Adsorption is the phenomenon of attracting and retaining the molecules of a substance on the surface of a liquid or a solid resulting in higher concentration of the molecules on the surface.

Sl. No.	Criteria	Physisorption	Chemisorption
(a)	Specificity	It is not specific in nature.	It is highly specific in nature.
(b)	Temperature dependence	It decreases with increase in temperature. Thus, low temperature is favourable for physisorption.	It increases with increase in temperature. Thus, high temperature is favourable for chemisorption.
(c)	Reversibility	Resersible in nature.	Irreversible in nature.
(d)	Enthalpy change	Low enthalpy of adsorption.	High enthalpy of adsorption.

S82. Adsorption isotherm: It is the variation in the amount of gas adsorbed by the adsorbent with pressure at constant temperature.



Adsorption isotherm

Freundlich adsorption isotherm: It is an empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.

$$\frac{x}{m} = kp^{1/n} \ (n > 1) \qquad \text{... (i)}$$

when, $n = 1$,

$$\Rightarrow \quad \frac{x}{m} = kp \quad \text{or} \quad \frac{x}{m} \propto p$$

where x is the mass of gas adsorbed on mass m of the adsorbent at pressure p. k and n are constants which depend on the nature of the adsorbent and the gas at the particular temperature.

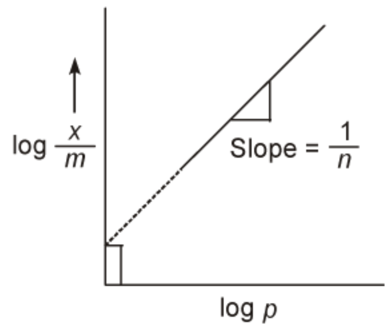
These curves indicate that on increasing temperature, physical adsorption decreases at a fixed pressure.

Taking log in Eq. (i), gives

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

The validity of Freundlich isotherm can be verified by plotting $\frac{x}{m}$ on *y*-axis and log *p* on *x*-axis.

If it comes to be a straight line, the Freundlich isotherm is valid.



Freundlich isotherm

S83. Effect of temperature: Physisorption decreases with increase of temperature and chemisorption first increases then decreases with increase of temperature.

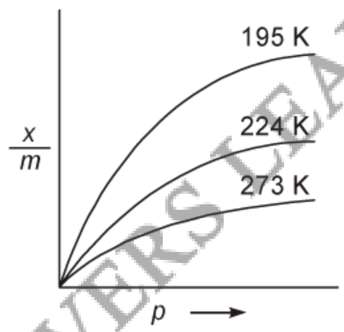
Surface area: Greater the surface area, greater is the physisorption and chemisorption.

S84. Size of adsorbent particles: Smaller the size of adsorbent particles, larger is the surface area and hence, higher is the adsorption.

Pressure: Increase in pressure forces gas molecules to come closer to the surface of adsorbent leading to increase in the amount of adsorption.

Temperature: Adsorption is an exothermic reaction hence is favoured at lower temperature, at higher temperature the K.E. of adsorbate is high and hence extent of adsorption is low.

S85. Adsorption isotherm: It is the variation in the amount of gas adsorbed by the adsorbent with pressure at constant temperature.



Adsorption isotherm

S86. (a) **Multimolecular colloids:** A colloid in which large number of small molecules combine to form a particle of colloidal size is called *multimolecular colloids*, *e.g.*, sulphur sol.

(b) **Lyophobic sol:** The colloidal solution in which particles of the dispersed phase have no or very little affinity for dispersion medium.

These are irreversible in nature *i.e.*, once precipitated, they have little tendency to get back into the colloidal form on simply adding dispersion medium *e.g.*, As_2S_5 solution. Lyophobic sols need stabilising agents for their preservation.

Lyophilic sol: The colloidal solution in which particles of the dispersed phase have a strong affinity for the dispersion medium.

These colloidal sols, even if precipitated, change back to the colloid from simply by adding dispersion medium. So, lyophilic sols are reversible in nature. *e.g.*, glue, starch, rubber, etc.

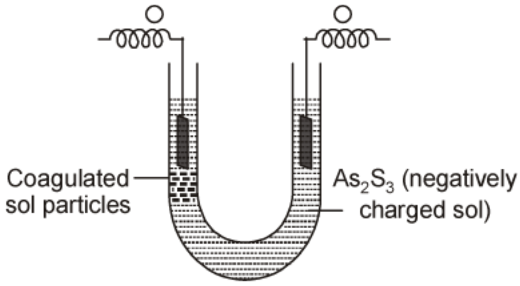
(c) **An emulsion:** It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. *e.g.*, milk.

S87. (a) **Dialysis:** It is the process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane.

A bag of suitable membrane containing the colloidal solution is suspended in a vessel through which fresh water is continuously flowing.

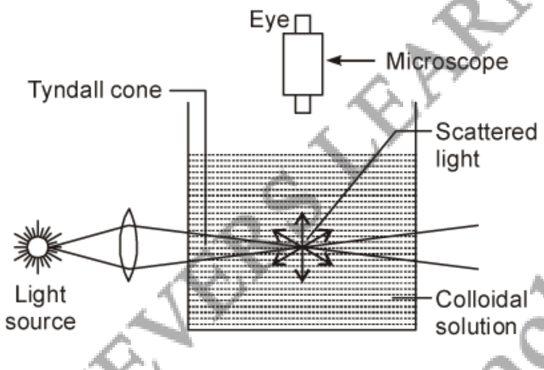
The molecules and ions diffuse through membrane into the water and pure colloidal solution is left behind.

(b) The movement of colloidal particles under an applied electric potential is called electrophoresis. Positively charged colloidal particles move towards the cathode, while negatively charged particles move towards the anode.



Electrophoresis

(c) When a beam of light is passed through a colloidal solution and viewed perpendicular to the path of incident light, the path of beam is illuminated by a bluish light. This phenomenon is called Tyandall effect. This is due to the fact that colloidal particles scatter light in all the direction in space.



S88. (a) **Brownian movements:** When the colloidal particles are observed under the ultramicroscope, the particles are seen to be in constant motion is zig-zag path.

This zig-zag motion of dispersed phase particles is called Brownian movements.

(b) **Peptization:** Peptization is the process of conversion of a precipitate into colloidal state in the presence of some electrolyte.

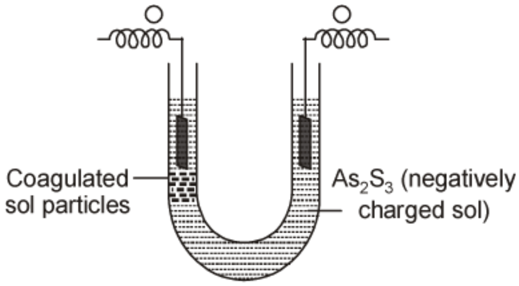
(c) **Multimolecular colloids:** A colloid in which large number of small molecules combine to form a particle of colloidal size is called *multimolecular colloids*, *e.g.*, sulphur sol.

S89. (a) Scattering of light by the colloidal particles takes place and the path of light becomes visible (Tyndall effect).

(b) The positivity charged colloidal particles of ferric hydroxide sol get coagulated by the oppositely charged Cl^- ions provided by NaCl.

(c) On passing electric current through a sol, colloidal electrodes where they lose their charge and get coagulated (electrophoresis)

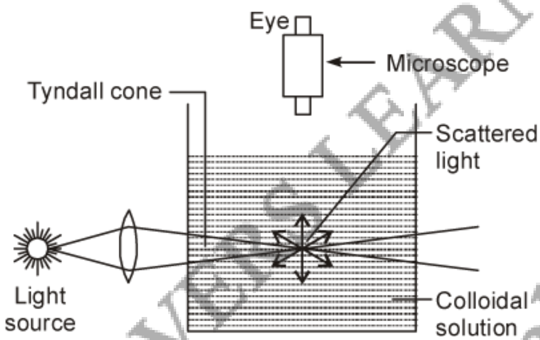
S90. (a) **Electrophoresis:** The movement of collodial particles under an applied electric potential is called electrophoresis. Positively charged colloidal particles move towards the cathode, while negatively charged particles move towards the anode.



Electrophoresis

(b) **Coagulation:** The process of aggregating together the colloidal particles into large sized particle which ultimately settle down under the force of gravity as a precipitate is called coagulation.

(c) **Tyandall effect:** When a beam of light is passed through a colloidal solution and viewed perpendicular to the path of incident light, the path of beam is illuminated by a bluish light. This phenomenon is called Tyandall effect. This is due to the fact that colloidal particles scatter light in all the direction in space.



S91.

Sl. No.	Multimolecular colloids	Macromolecular colloids
1.	When a large number of small molecules or atoms (diameter < 1 nm) of a substance combine together in a dispersion medium to form aggregates, having size in the colloidal range, the colloidal solutions thus, formed are known as multimolecular colloids.	When substances which possess very high molecular masses are dispersed in suitable dispersion medium, the colloidal solutions thus, formed are called macromolecular colloids.
2.	*e.g.*, gold sol, sulphur sol, etc.	*e.g.*, cellulose, starch, etc.

Associated colloids: The substances which at low concentration, behave as normal strong electrolytes but at higher concentration exhibit colloidal behabiour due to the formation of aggregated particles, are known as *associated colloids*.

These are also known as *micelles*. The formation of micelles takes place only above a particular temperature, called the Kraft temperature and above a particular concentration, called the Critical Micelle Concentration (CMC), *e.g.*, surface active agents such as soaps and synthetic detergents.

S92. (a) **Sol:** When solids is dispresed in water, it is called sol, e.g., gold sol starch sol.

(b) **Emulsion:** When liquid is dispresed in water, it is called emulsion, *e.g.*, milk.

(c) **Foam:** When gas is dispersed in water, it is called foam or forth, *e.g.*, soap lather, whipped cream.

S93. The process of setting of colloidal particles is called coagulation of the sol. It is also known as precipitation. Following are the three methods by which coagulation of lyophobic sols can be carried out:

(a) **Electrophoresis:** In this process, the colloidal particles move towards oppositely charged electrodes and get discharged resulting in coagulation.

(b) **Mixing of two oppositely charged sols:** When equal proportions of oppositely charge sols are mixed, they neutralise each other resulting in coagulation.

(c) **Dialysis:** By this method, electrolytes present in sol are removed completely and colloid becomes unstable resulting in coagulation.

S94. (a) **Colloidal solution:** These are the solutions in which the diameter of dispersed phase particles may range from 1 to 1000 nm. These are intermediate of true solutions and suspensions. The colloidal particles do not settle down under the force of gravity even on long standing. A colloidal is a heterogeneous system, *e.g.*, gold sol, sulphur sol, soap etc. Emulsions are one of the types of colloidal system, in which both the dispersed phase and dispersion medium are liquids, *e.g.*, milk.

(b) **Emulsifiers:** The substances which are added to stabilise the emulsion are called emulsifiers. *e.g.*, various kinds of soaps, lyophilic colloids (proteins, gum etc.).

S95. (a) **Emulsion:** It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. *e.g.*, milk.

(b) Types of emulsions:

Oil dispersed in water *e.g.*, milk.

Water dispersed in oil *e.g.*, butter.

S96. (a) Scattering of light by the colloidal particles takes place and the path of light becomes visible (Tyndall effect).

(b) The positivity charged colloidal particles of ferric hydroxide sol get coagulated by the oppositely charged Cl^- ions provided by NaCl.

(c) On passing electric current through a sol, colloidal electrodes where they lose their charge and get coagulated (electrophoresis).

S97. Lyophobic sol: The collodial solution in which particles of the dispersed phase have no or very little affinity for dispersion medium.

These are irreversible in nature *i.e.*, once precipitated, they have little tendency to get back into the colloidal form on simply adding dispersion medium *e.g.*, As_2S_5 solution. Lyophobic sols need stabilising agents for their preservation.

Lyophilic sol: The colloidal solution in which particles of the dispersed phase have a strong affinity for the dispersion medium.

These colloidal sols, even if precipitated, change back to the colloid from simply by adding dispersion medium. So, lyophilic sols are reversible in nature. *e.g.*, glue, starch, rubber, etc.

Hydrophobic solutions get easily coagulated on the addition of small amount of electrolyte or by heating or even shaking as they are not stable.

S98. (a) Colloid of a liquid in a gas is called aerosol *e.g.*, fog, sprays etc.

(b) **A Hydrosol:** It is a colloidal solution of a solid in water as the dispersion medium. *e.g.*, starch solution.

(c) **An emulsion:** It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. *e.g.*, milk.

S99.

Sl. No.	Multimolecular colloids	Macromolecular colloids
1.	When a large number of small molecules or atoms (diameter < 1 nm) of a substance combine together in a dispersion medium to form aggregates, having size in the colloidal range, the colloidal solutions thus, formed are known as multimolecular colloids.	When substances which possess very high molecular masses are dispersed in suitable dispersion medium, the colloidal solutions thus, formed are called macromolecular colloids.
2.	*e.g.*, gold sol, sulphur sol, etc.	*e.g.*, cellulose, starch, etc.

Associated colloids: The substances which at low concentration, behave as normal strong electrolytes but at higher concentration exhibit colloidal behabiour due to the formation of aggregated particles, are known as *associated colloids*.

These are also known as *micelles*. The formation of micelles takes place only above a particular temperature, called the Kraft temperature and above a particular concentration, called the Critical Micelle Concentration (CMC), *e.g.*, surface active agents such as soaps and synthetic detergents.