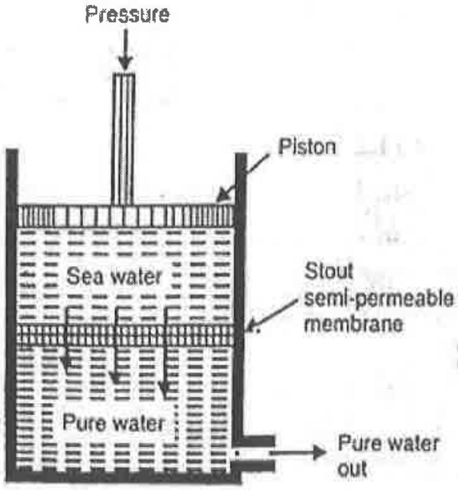
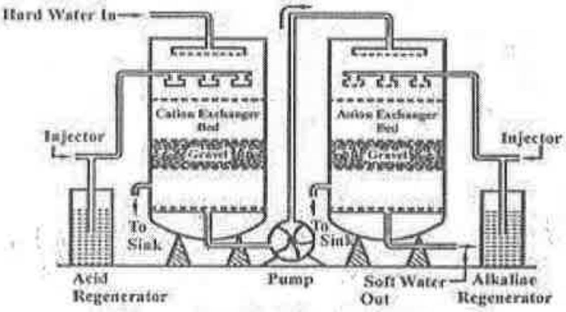
Subject Code: 24BC11RC01 **R-24**

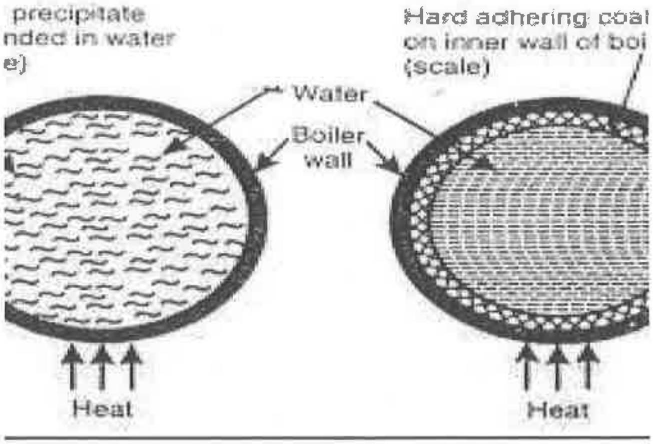
GAYATRI VIDYA PARISHAD COLLEGE OF ENGINEERING FOR WOMEN
(AUTONOMOUS)
(Affiliated to Andhra University, Visakhapatnam)
IB.Tech. - II Semester Regular Examinations, June – 2025

Green-Chemistry
(Common to **CSE-(AI&ML) & ECE**)

Scheme of valuation
Max Marks: 70

S.NO	Description	Awarded Marks
1 a	**EDTA Method Principle**: The determination of hardness is carried out by titrating water sample with Sodium salt of Ethylene Diamine Tetra Acetic Acid (EDTA) using Eriochrome Black-T as an indicator and keeping the pH of the water at 9.0 - 10.0. The end point is the change in colour from wine - red to blue, when the EDTA solution complexes the calcium and magnesium salt completely. (Ca2+ or Mg2+) + EBT Hardness-salts indicator → [Ca – EBT] (or) [Mg – EBT] unstable complex (wine red) [Ca – EBT] (or) [Mg – EBT] + EDTA → [Ca – EDTA] (or) [Mg – EDTA] + EBT Unstable complex (wine red) stable complex (colourless) **Determination of Permanent Hardness**: Take 100 ml of sample water in 250 ml beaker. Boil it to remove temporary hardness to about half of its volume and cool to room temperature, filter through filter paper to remove insoluble salts. Make up the volume to the original 100ml by adding distilled water. Now Pipette out 20 ml of this solution (V4) in a conical flask. Add 4 ml of buffer solution and 2 drops indicator. Titrate with EDTA solution till wine-red colour changes to clear blue. Let volume used by 'Z' ml. M2 V2 = M4 V4 Where, M2 = Molarity of EDTA, V2= Volume of EDTA (Z ml). M4 = Molarity of Permanent hard water, V4 = Volume of Permanent hard water (20 ml) Permanent Hardness = M4 × Molecular weight of CaCO3 (100) × One Litre (1000ml) = M4 × 105 ppm **Calculation related formula** M1 V1 = M2 V2 Where, M_1 = Molarity of Standard Hard water (0.01M), V_1 = Volume of Standard Hard water (20 ml), M_2 = Molarity of EDTA, V_2 = Volume of EDTA (Xml).	2 M 4M 1M
b	Reverse osmosis method **definition** Reverse Osmosis is a process in which pressure greater than the osmotic pressure is applied on the high concentration side of the membrane, the flow of solvent move from concentrated side to dilute side across the membrane Reverse osmosis method neat diagram **with procedure** In this process pure water is separated from salt water. 15-40 kg/cm2 pressure is applied for separating the water from its contaminants. The membranes used are cellulose acetate, polymethyl acrylate and polyamide polymers. The process is also known as super or hyper filtration.	1 M 4 M 2 M

	 Fig. 17. Reverse osmosis cell. Write any two methods **Advantages**: ➢ It is simple and reliable process & Capital and operating expenses are low. ➢ The life of the semi-permeable membrane is about two years and it can be easily replaced within a few minutes, thereby nearly uninterrupted water supply can be provided.	
2 a	**Cation Exchange Resins:** Cation exchange resins are styrene divinyl benzene co-polymers, which on sulphonation (or) carboxylation, which contains –COOH, –SO3H functional groups which responsible for exchanging their hydrogen ions with cations in water. $2RH + Ca(HCO_3)_2 \rightarrow R2Ca + H_2CO_3$ $2RH + Mg(HCO_3)_2 \rightarrow R_2Mg + H_2CO_3$ $2RH + CaCl_2 \rightarrow R_2Ca + 2HCl$ $2RH + MgCl_2 \rightarrow R_2Mg + 2HCl$ $2RH + MgSO_4 \rightarrow R2Mg + H2SO_4$ $2RH + CaSO_4 \rightarrow R_2Ca + H_2SO_4$ (RH = Cation exchange resin) **Anion Exchange Resins:** Anion exchange resins are Phenol formaldehyde (or) amine formaldehyde copolymers, which contains amino or basic functional groups which responsible for exchanging their OH− ions with anions in water. $ROH + HCl \rightarrow RCl + H2O$ **Regeneration:** When cation exchanger losses capacity of producing H+ ions and exchanger losses capacity of producing OH− ions, they are said to be exhausted. The exhausted cation exchanger is regenerated by passing it through dilute sulphuric acid. $R2Ca + 2HCl \rightarrow 2RH + CaCl2$ $R2Mg + 2H2SO4 \rightarrow 2RH + MgSO4$ The exhausted anion exchanger is regenerated by passing a dilute solution of NaOH **Ion -Exchange Resins neat diagram**  *Fig. Demineralization of Water*	3M 2 M 2M
b	Sludge is a soft, loosy and slimy precipitate formed within the boiler. It is formed at comparatively colder portions of the boiler and collects in the area where flow rate is slow. Ex: MgCO3, $MgCl_2$, $CaCl_2$, $MgSO_4$. **Disadvantages of sludges:** 1. Sludges are bad conductors of heat and results in the wastage of heat and fuel. 2. Excessive sludge formation leads to the settling of sludge in slow circulation areas such as pipe connections, plug openings, gauge–glass connections leading to the choking of the pipes.	1M 3M



3 M

Prevention of sludge formation: a. By using soft water which is free from dissolved salts like MgCO3, MgCl2, CaCl2 and MgSO4 can be prevent sludge formation. b. By blow down operation carried out frequently can prevent sludge formation.

Reasons for formation of scales: a. Decomposition of calcium bicarbonate: The calcium bicarbonate at high temperature decomposes to calcium carbonate which is insoluble salt, forms scale in low pressure boilers. $Ca(HCO3)_2 \rightarrow CaCO_3 + H_2O + CO_2$

b. Hydrolysis of Magnesium salts: Magnesium salts gets hydrolyzed at high temperature forming $Mg(OH)_2$ precipitation which forms salt type scale. $MgCl_2 + H_2O \rightarrow Mg(OH)_2 + 2HCl$ c. Decomposition of calcium sulphate: The solubility of $CaSO_4$ in water decreases with the increase in temperature and forms precipitation on the surface of the boiler further which forms hard scale. This type of scales is formed in high-pressure boilers.

Prevention of scales: a. If the scale formation is soft it can be removed by a scrapper, wire brush. b. By giving thermal shocks, by sudden heating and sudden cooling which makes scale brittle and removed by scrubbing with wire brush. c. If scale is very hard that is formed by $CaCO_3$ can be removed by washing with 5-10% HCl and $CaSO_4$ can be removed with EDTA solution.

3 a

Nickel- Cadmium cell;

4M

The electrolyte in NiCd is an alkaline electrolyte (potassium hydroxide). Most NiCd batteries are cylindrical in which several layers of positive and negative materials are wound into a jelly-roll. The flooded version of NiCd is used as the ship-battery in commercial aircrafts and in UPS systems operating in hot and cold climates requiring frequent cycling. NiCd is more expensive than lead acid but lasts longer.

The anode material used in the battery is Cadmium, while the cathode is NiOOH.The following reactions can be observed during discharging

3 M

At anode : Oxidation reaction is taking place and it involves release of electrons from Cd and it can be represented as follows

$$Cd + 2OH^- \rightarrow Cd(OH)_2 + 2e^-$$

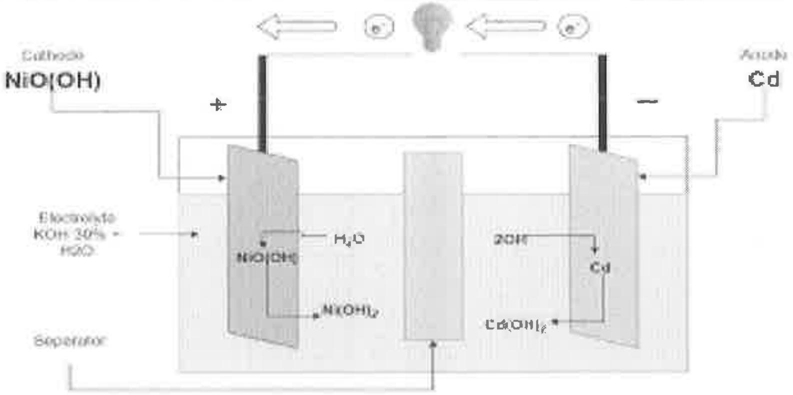
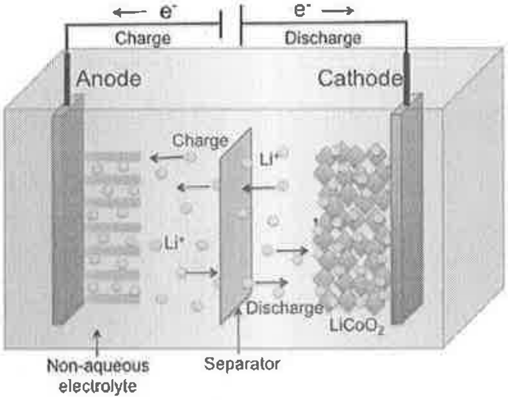
At cathode, Reduction reaction taking place and it involves gaining of electrons from anode through external circuit , and it can be represented as follows

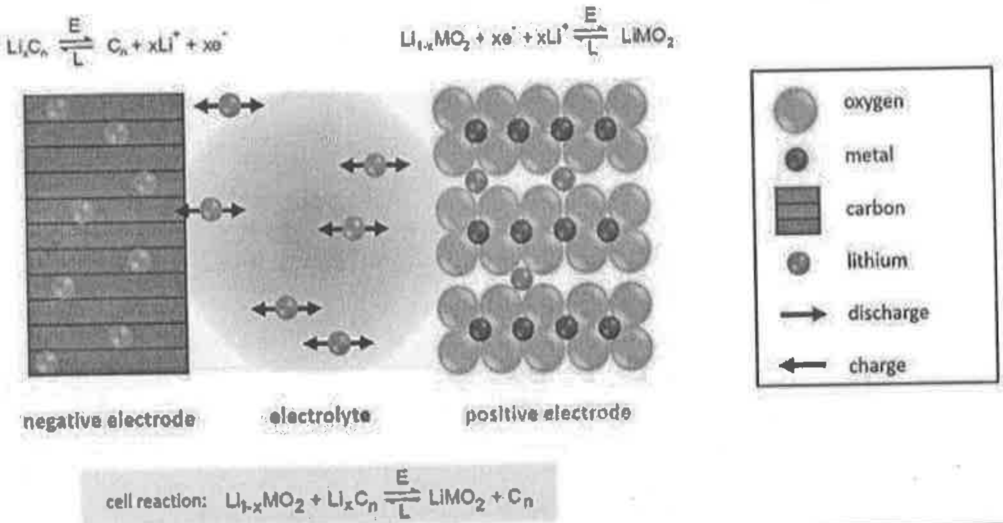
$$2NiO(OH) + 2 H_2 O + 2 e^- \rightarrow 2 Ni (OH)_2 + 2 OH^-$$

Net reaction,

$$2NiO(OH) + Cd + 2 H_2 O \rightarrow 2 Ni (OH)_2 + Cd(OH)_2$$

Nickel- Cadmium battery-diagram with explanation

		
b	**Primary battery**: In which the cel reaction is not reversible. When the reactants have for the most part been converted to products **Ex; Dry cell, Zinc-Air cell** **Secondary battery**: Cell reaction can br reversibe.Passing dc current in opposite directions. The Secondary battery may be used through a arge number of cyces of discharging and charging **EX; Lead-acid, Nicke-Cadmium** **Applications;** It has a high specific energy 2. Light Weight 3. High Cycle life	**2.5 M** **2.5 M** **2 M**
4 a	 **Lithium-MnO_2 battery:** These are primary battery that canot be recharged. In these batteries ithium metal or ithium compounds are used as anode(Fig:3). The cathode is made of specially treated MnO_2 crystasobtained by special heat treatment. Since ithum is highey reactive with water and non- aqueous solvents.These sovents cannot be used as electrolyte. Instead, ithium sat solution in propylene carbonate and dimethoxy sats is used as the electrolyte. Sovents ike thionyl choride containing lithium compounds such as LiCl, LiBr, $LiAlCl_4$, $LISO_3CF_3$ can also be used. *THE CELL CAN BE REPRESENTED* *At anode,* $Li \rightarrow Li^+ + e^-$	**2 M** **3 M** **2 M**

	At anode, $Li \rightarrow Li+ + e-$ At cathode, $Mn(IV)O2 + LI^{+}$ $+e^{-} \rightarrow Mn(III)\ O2\ (Li^{+})$The net cell reaction, $Mn(IV)O2 + Li \rightarrow Mn(III)\ O2\ (Li+)$	
b	**Advanced Batteries for electric vehicles** A lithium-ion battery cell contains four main components: cathode, anode, electrolyte and separator. shows the main components' functions and material compositions. Lithium- ion battery cells are sold in "battery packs," which include battery management systems (see Figure). A detailed description of each component will be shown in the U.S. Value Chain section. Alternatively it is used by sodium beta battery and vanadium battery  	2 M 3 M 2 M
5 a	**Definition of optical fiber;** Optical fibers work on the principle of total internal reflection. Light is guided through a core, typically made of glass or plastic, by repeatedly bouncing off the inner walls of the fiber. This occurs because the core has a higher refractive index than the surrounding cladding material, causing light to reflect back into the core when it strikes the boundary at a sufficiently shallow angle **Working principal of optical fiber with diagram;** **Construction:** • Core: The central part of the fiber, with a higher refractive index. • Cladding: The surrounding layer, with a lower refractive index than the core An optical transmission system has three components: 1. Transmitter: The information in electronic form must be digitized into bits, i.e. 1's and 0's in an Encoder Then it is necessary to convert this electrical signal into an optical (photonic) signal which takes	1 M 4 M 2 M

place in the electrical to optical converter.

This converter is a semiconductor LASER, which emits monochromatic and coherent light.

The wavelength lies between 0.78 μm and 1.6 μm, which is IR region of electromagnetic spectrum.

Within this range of λ, absorption losses are low.

2. Transmission medium:

The output from the LASER converter is in the form of pulses of light; binary of 1 is represented by

a high power pulse; whereas a 0 corresponds to low power pulse or absence of pulse as shown in

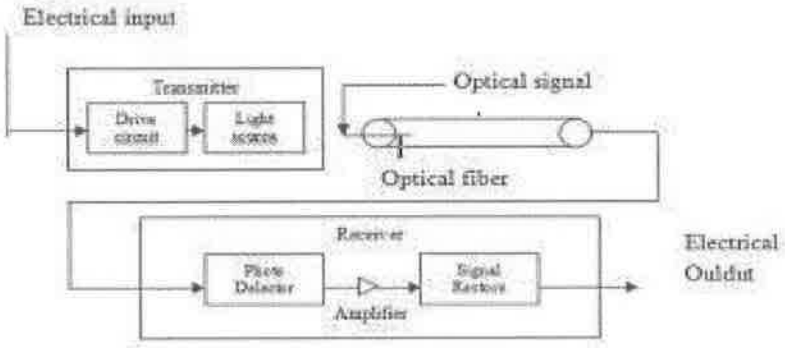
figures (a) & (b) below.

These photonic signals are then fed into and carried through the "fibre optical cable" or "waveguide"

to the receiving end.

For long distance transmissions, "repeaters" maybe required. Repeaters are devices that amplify and

regenerate the signal

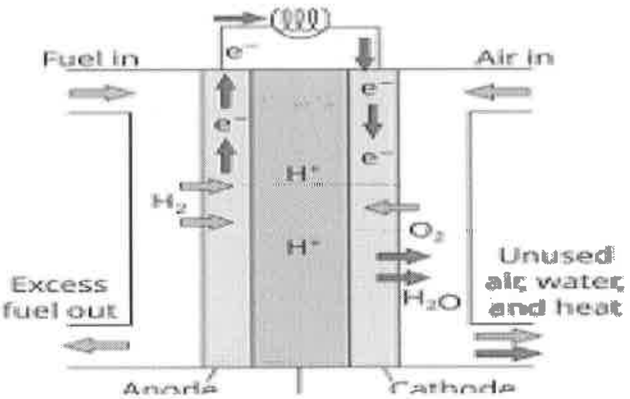


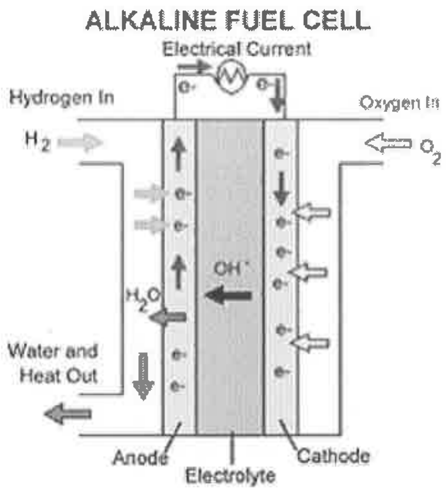
3. Receiver: Finally at the receiving end, the photonic signal is reconverted to an electronic one, and is

decoded or undigitized

Schematic diagram showing the components of an optical fibre communication system

- **Applications of optical fiber;** Economical and cost-effective
- Thin and non-flammable
- Less power consumption
- Less signal degradation
- Flexible and lightweight

b	**Proton Exchange Membrane Fuel Cell (PEMFC)** reaction can be expressed by the following equations: Anode reaction: $H2 \rightarrow 2H+ + 2e-$ Cathode reaction: $½O2 + 2H+ + 2e- \rightarrow H2O$ Overall reaction: $H2 + ½O2 \rightarrow H2O$ The following figure depicts the PEMFC's basic principle. **Main Components of PEMFC** The ion exchange membrane as solid electrolyte b. An electrically conductive, porous gas diffusion layer c. An electro-catalyst (the electrodes) at the interface between the backing layer and the membrane d. Cell interconnects and flow plates that deliver the fuel and oxidant to reactive sites via flow channels and electrically connect the cells. **Write Proton Exchange Membrane Fuel Cell diagram**  **Applications;** Fuel cells have three main applications: a. Transportation b. Portable uses c. Stationary power installations	2 M 3 M 2M
6 a	**Alkaline fuel cells Cell- reactions;** Anode reaction: $H2 + 2OH- \rightarrow 2H2O + 2e-$ Cathode reaction: $½O2 + H2O + 2e- \rightarrow 2OH-$ Overall reaction: $H2 + ½O2 \rightarrow H2O$	3 M 4 M



Applications;

The advantages of alkaline fuel cells include: a. Low-temperature cells have the advantage of being able to start up easily from cold b. Competitive costs due to the simplicity of the materials used in cell structure c. High efficiency up to 65% (which is high for cold fuel cells). d. Need little or no platinum catalyst e. Minimal corrosion f. The relative ease of operation g. Low mass and volume

b

3 M

Methanol-Oxygen Cell-Reactions

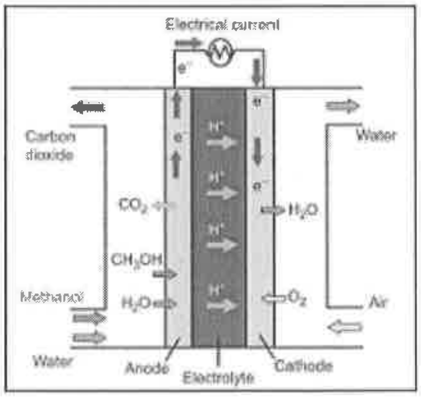
Anode reaction: $MeOH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$

Cathode reaction: $3(\frac{1}{2}O2) + 6H+ + 6e- \rightarrow 3H_2O$

Overall reaction: $MeOH + H_2O + 3(\frac{1}{2}O2) \rightarrow CO_2 + 3H_2O$

Sketch neat diagram;

3 M



1 M

Applications;

High energy density: Easy storage and transportation: Simple system design: Potential for renewable source: Reduced dependency on fossil fuels:

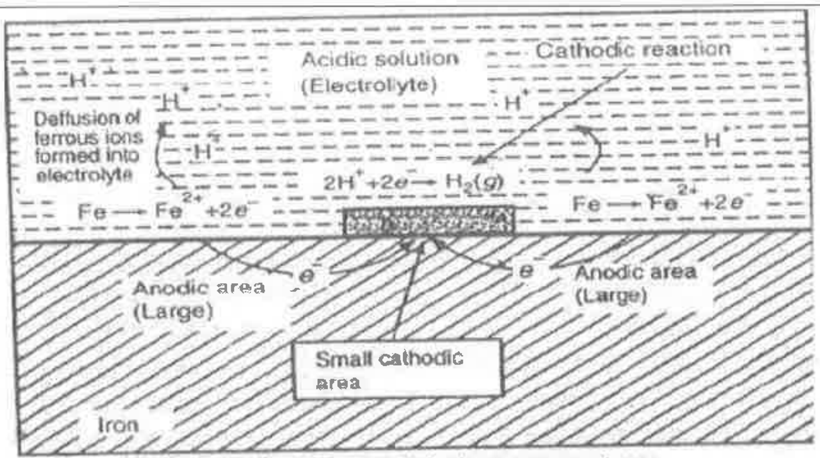
7
a

3 M

Mechanism: Electrochemical corrosion involves flow of electrons between anode and cathode. The anodic reaction involves dissolution of metal liberating free electrons. The cathodic reaction consumes electrons with either evolution of hydrogen or absorption of oxygen which depends on the nature of corrosive environment. Wet corrosion takes place in two ways. 1. 2. Evolution of Hydrogen Absorption of Oxygen

Evolution of Hydrogen: This type of corrosion occurs in acidic medium. Eg: Rusting of

4M

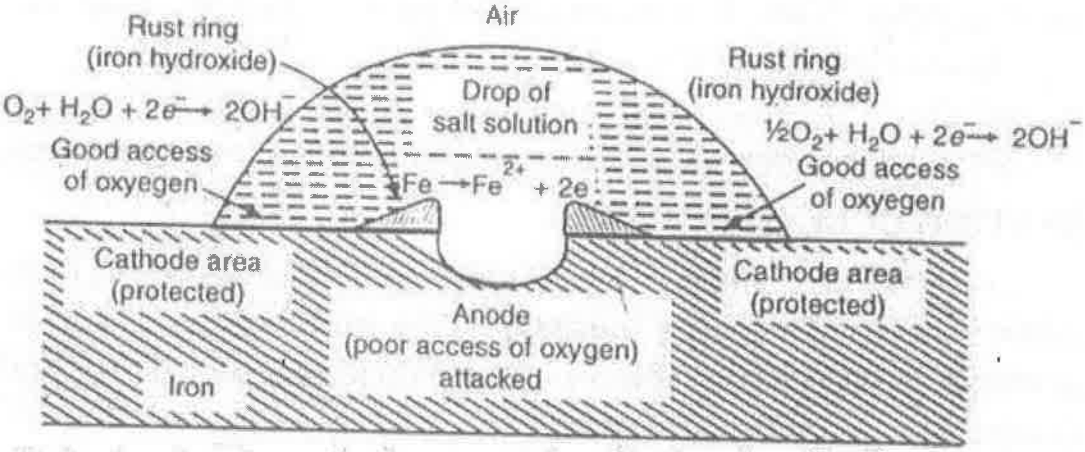


iron

Mechanism of wet corrosion by hydrogen evolution

$$2H^+ + 2e^- \rightarrow H_2$$

Absorption of Oxygen: • This type of corrosion takes place in basic or neutral medium in presence of oxygen. • For example, rusting of iron in neutral or basic aqueous solution of electrolyte in presence of atmospheric oxygen. • Usually the surface of iron is coated with a thin film of iron oxide. • If the film develops cracks, anodic areas are created on the surface and the rest of the metal surface acts as cathodes. • It shows that anodic areas are small and the cathodic areas are large.



Mechanism of wet corrosion by oxygen adsorption (rusting of iron)

b **Factors influencing corrosion; :** The rate of extent of corrosion depend on the following ctors a)nature of metal b) Nature of corroding atmosphere 3 M

)Nature of metal and corroded product

Position in galvanic series: The extent of corrosion is determined by the difference in the sition of metals.The greater is difference ,the faster and higher is corrosion 4M

)Relative areas of anodic and cathodic parts: When two dissimilar metals or alloys are in ntact, the corrosion of the anodic parts is directly proportional to the areas of the cathodic d anodic part.

r example, a small pipe made of steel fitted in a large copper tank ,because the rapid rrosion due to smaller anodic areas is the current density at a smaller anodic area is much eater and the large cathodic area demands more electrons ,which should be met by smaller odic areas only by undergoing corrosion rapidly

i)**Purity of metal**: Heterogenity is produced if impurities are present in a metal ,which form tiny electrochemical cells at the exposed parts.The anodic parts are corroded

)**Nature of surface film**: In aerated atmosphere,practically all metal produce a thin surface lm of metal oxide.If the specific volume ration is more, the rate of corrosion is less,because ıe surface of metal is completely covered by film,offering protection to metal surface

)**Physical state of metal**: The smaller the grain size of the metal or alloy greater will be the ıte of corrosion

i)**Passive character of metal**: Metals like Ti,Al ,Cr, and Co are passive and they exhibit ıuch higher corrosion resistance than expected from their position in the electrochemical ːries

i)**volatility of corrosion product**: If the corrosion produced volatilizes as soon as it is formed ıe metal surface is exposed for further attack(leads to excessive corrosion)

)**Nature of corroding environment:**

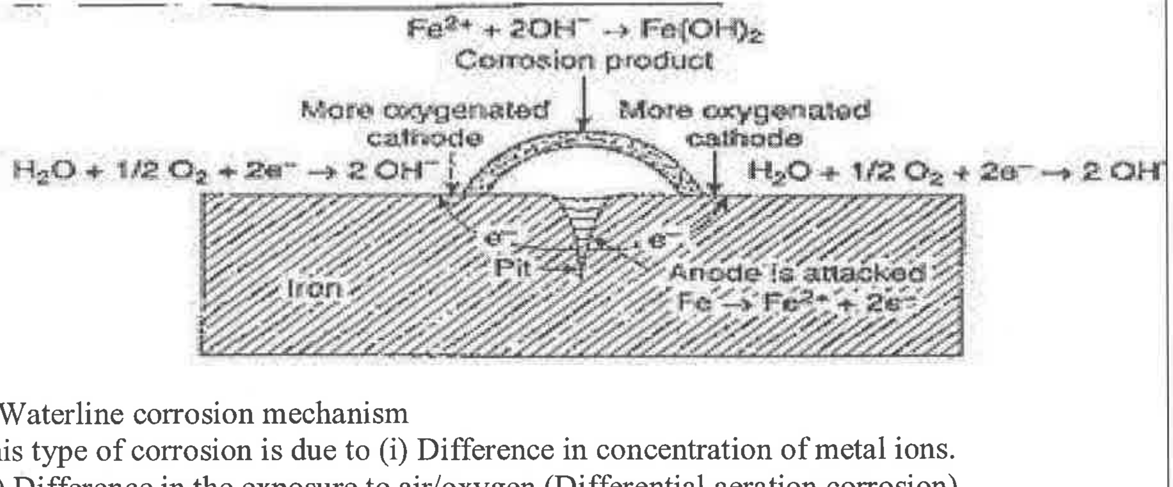
Temperature: The rate of corrosion increases with increase in temperature
) **Humidity of air**: The humidity of air is a deciding factor for rate of corrosion.The relative umidity above which ,the rate of corrosion increases sharply is called critical humidity.
i)**presence of impurities in atmosphere**: With increase in impurities in metal ,the corrosion ːndency is increases
)**P^H value of medium**: With decreasing P^H (increase in acidity) of the medium ,the corrosion ːndency is increases
) **Amount of oxygen in atmosphere**: With increase in the percentage of oxygen in ːmosphere, the rate of corrosion is increases

8 a **4 M**

Definition of pitting corrosion with explanation of mechanism

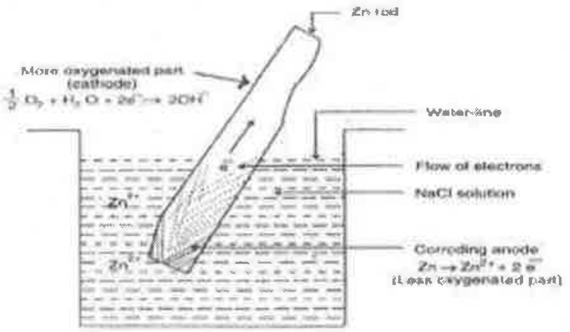
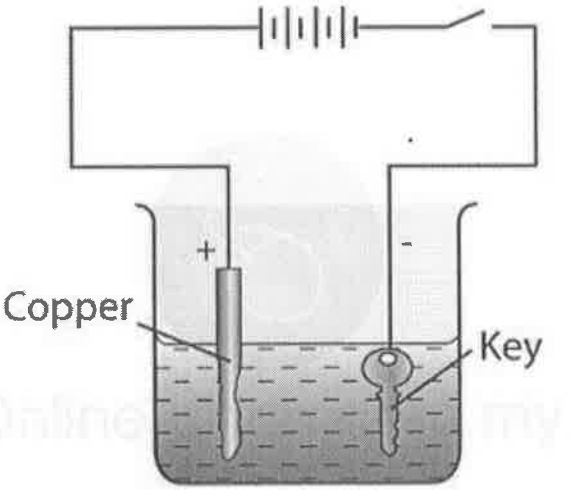
3 M

Pitting corrosion is a cavity, hole or pit that forms in a small area or point. Mostly this kind of corrosion affects the metals with passive layer like stainless steel. Either because of physical action like rubbing or chemical action, the pits or holes are formed on the metal surface. Therefore, it creates and electrochemical cell by forming anode and cathode parts on the metal surface. The area which has less accessibility(pit or hole) to oxygen called anode the remaining part acts as cathode. High electron demand by the large cathode is put on the small anode, the result is intense pitting corrosion. It will be subtle and happen rapidly with very harmful effects. Only a small spot of rust is visible on the surface while damage happens deep in the metal structure below



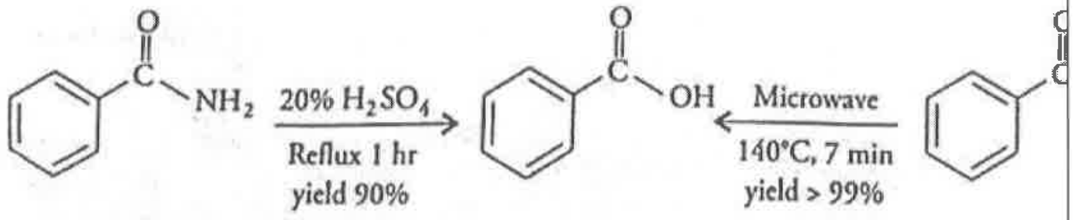
Waterline corrosion mechanism

This type of corrosion is due to (i) Difference in concentration of metal ions.
(ii) Difference in the exposure to air/oxygen (Differential aeration corrosion)
(iii) Difference in temperature. Differential aeration corrosion is the most common type of concentration cell corrosion. When a metal is exposed to different air concentrations, it has

	been found to be poorly oxygenated of the metal becomes anodic and well oxygenated part becomes cathodic.The potential difference is created which causes the flow of electrons from anode (metallic part immersed in NaCl solution) to cathode (exposed to atmosphere).Eg. Zn rod immersed deep in NaCl solution: Anode Zn rod above NaCl solution : Cathode  	
B	**Electroplating:** It is a process in which coating metal is deposited on the base metal by passing direct current through an electrolytic solution containing the soluble salt of the coating metal. • The base metal is first subjected to acid pickling to remove any scales, oxides etc. The base metal is made as cathode of the electrolytic cell and the coating metal is made as anode.  **Electroplating** of **copper procedure;** When direct current is passed, the Cu2+ ions migrate to the cathode and deposit on the base metal article. Anode Cu(s) → Cu2+(aq) + 2e- Cathode: Cu2+(aq) + 2e- → Cu(s) **Electroplating of copper diagram;**	**1M** **4 M** **2 M**
9 a	**Write any three Energy minimized green synthetic reactions** **Green synthsis energy minimized definition**	**1 M** **3x2=6 M**

Microwave assisted organic reactions

1. **Hydrolysis of benzamide** In the hydrolysis of benzamide, the use of co source requires refluxing with 20% H_2SO_4 for one hour and the yield is 9 conversion if carried out in microwave, can be achieved by 7 min microwa 140°C and the yield is 99%.

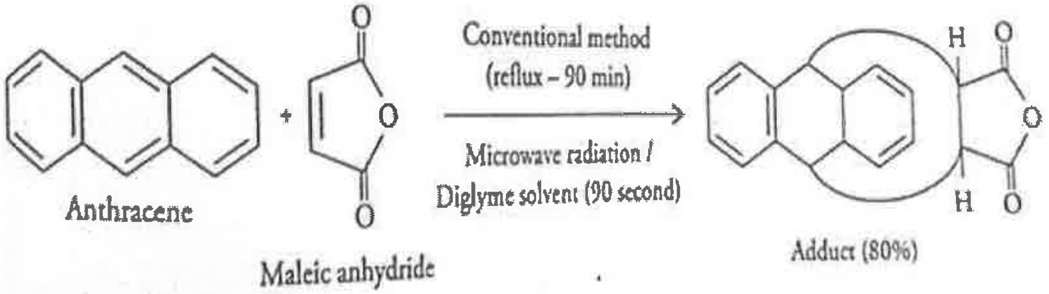


Conventional method

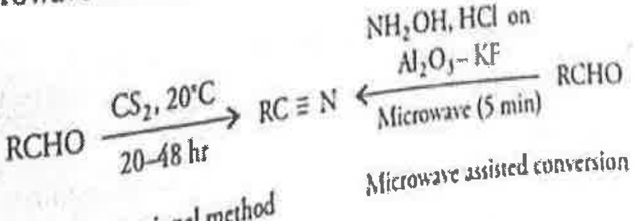
Microwave assisted conversion

crowave assisted

Diels–Alder reaction Anthracene (a diene) and maleic anhydride (a dienophile) form an adduct on refluxing in nearly 90 minutes. The same reaction can be completed in just 90 seconds in the presence of microwave radiations.



Conversion of aldehydes to nitriles Conventional method using CS_2 is completed in 20–48 hrs at about 20°C, whereas the same reaction is completed in just 5 minutes in the presence of microwave radiations.



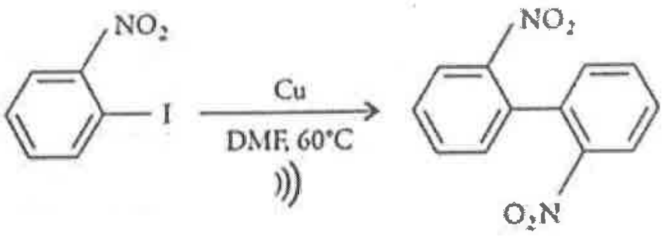
Conventional method

Microwave assisted conversion

Ultra sound-Assisted method for green synthetic methods;

Some common reactions are given below.

1. **Ullman reaction** It is the coupling of two molecules of iodobenzene in the pr copper powder in a sealed tube to form biphenyl. The reaction takes place at high ten and the yield is also low. In the presence of ultrasound radiation, the rate of reactio yield both increase significantly. It is believed that the ultrasound radiations break th catalyst increasing its surface area.



2, 2' – dinitrobiphenyl

Esterification *If the reaction is carried out by conventional methods, it procee with poor yields. However, in the presence of ultrasound radiations, the reaction room temperature with better yield.*

$$RCOOH + R'OH \xrightarrow[H_2SO_4,\ \text{room temp.}]{\text{Esterification}} RCOOR'$$

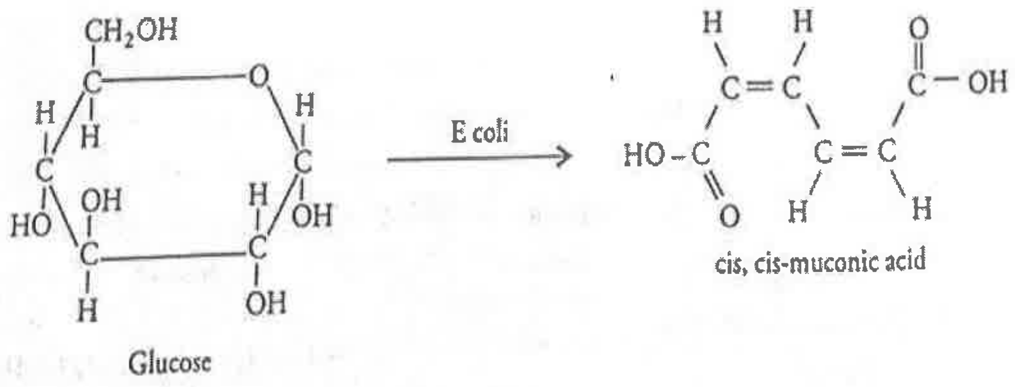
)))

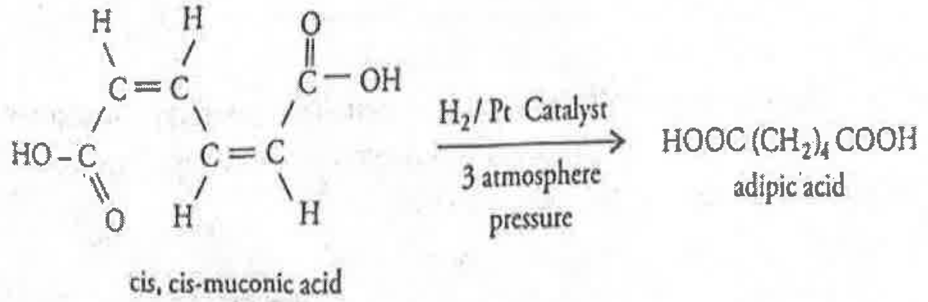
B

Definition of green synthesis **1 M**

Green synthesis of adipic acid

3 M





Green synthesis method for paracetamol

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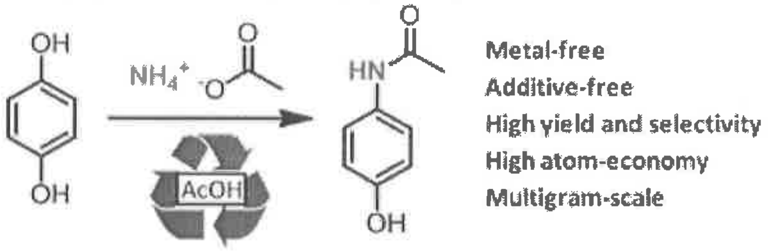
3 M

A direct synthesis of paracetamol (acetaminophen) from hydroquinone has been developed using ammonium acetate as an amidating agent. The reaction proceeds in acetic acid at elevated temperatures without any metallic catalyst. Under these conditions, paracetamol was obtained with high yield and selectivity (>95%).

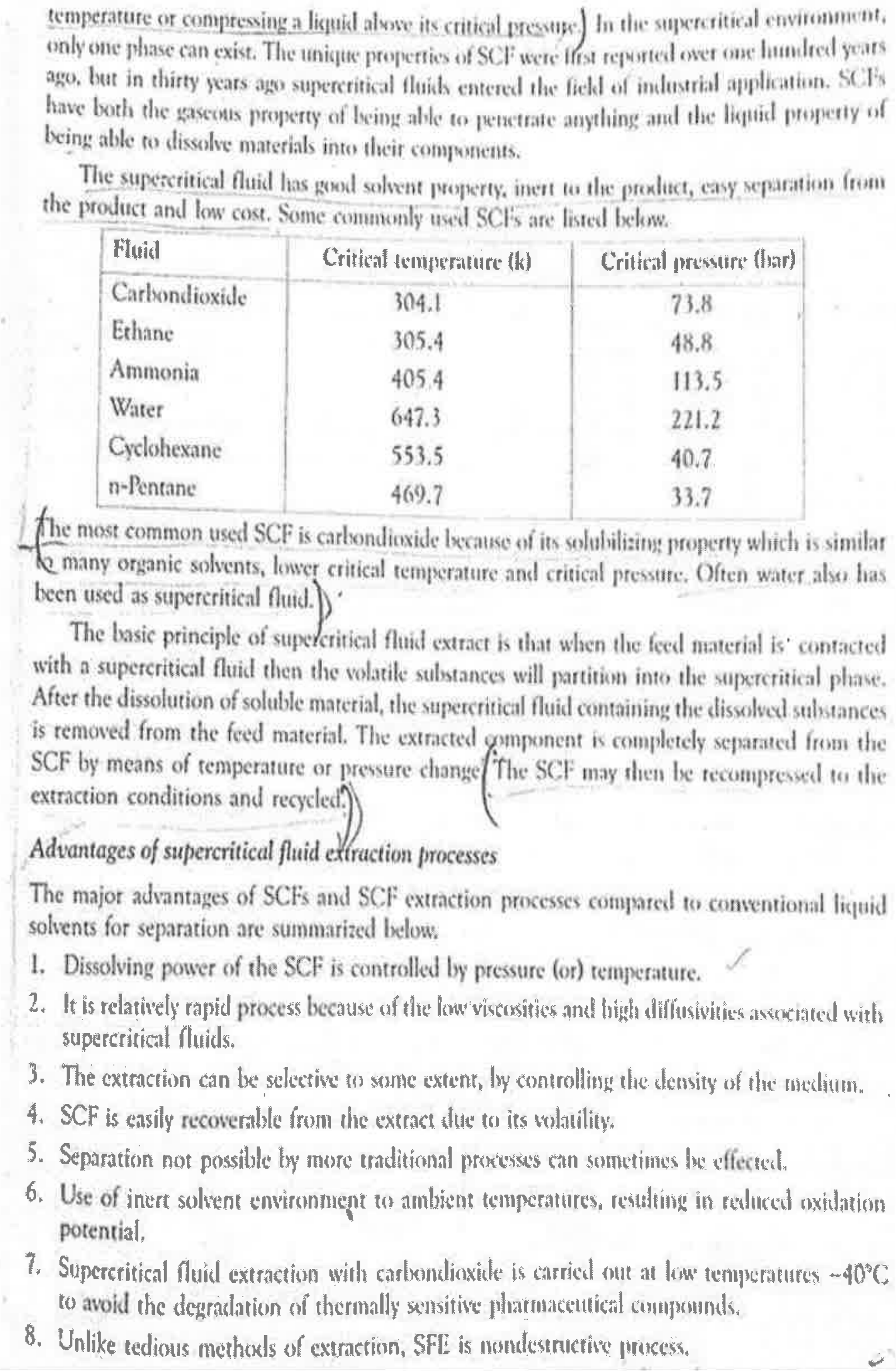


10 a **7 M**

Write 12 green synthesis principals

1. **Prevention**
   It is better to prevent waste than to treat or clean up waste after it has been created.
2. **Atom Economy**
   Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. **Less Hazardous Chemical Syntheses**
   Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. **Designing Safer Chemicals**
   Chemical products should be designed to effect their desired function while minimizing their toxicity.
5. **Safer Solvents and Auxiliaries**
   The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.
6. **Design for Energy Efficiency**
   Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.
7. **Use of Renewable Feedstocks**
   A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
8. **Reduce Derivatives**
   Unnecessary derivatization (use of blocking groups, protection/ deprotection, temporary modification of physical/chemical processes) should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.
9. **Catalysis**
   Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. **Design for Degradation**
    Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.
11. **Real-time analysis for Pollution Prevention**
    Analytical methodologies need to be further developed to allow for real-time, in-

	process monitoring and control prior to the formation of hazardous substances. 12. **Inherently Safer Chemistry for Accident Prevention** Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.	
b	**Definition of supercritical fluid method** **Significance of supercritical fluid method with explanation** **Examples of supercritical fluid method**	**1 M** **4 M** **2 M**



temperature or compressing a liquid above its critical pressure. In the supercritical environment, only one phase can exist. The unique properties of SCF were first reported over one hundred years ago, but in thirty years ago supercritical fluids entered the field of industrial application. SCFs have both the gaseous property of being able to penetrate anything and the liquid property of being able to dissolve materials into their components.

The supercritical fluid has good solvent property, inert to the product, easy separation from the product and low cost. Some commonly used SCFs are listed below.

Fluid	Critical temperature (k)	Critical pressure (bar)
Carbondioxide	304.1	73.8
Ethane	305.4	48.8
Ammonia	405.4	113.5
Water	647.3	221.2
Cyclohexane	553.5	40.7
n-Pentane	469.7	33.7

The most common used SCF is carbondioxide because of its solubilizing property which is similar to many organic solvents, lower critical temperature and critical pressure. Often water also has been used as supercritical fluid.

The basic principle of supercritical fluid extract is that when the feed material is contacted with a supercritical fluid then the volatile substances will partition into the supercritical phase. After the dissolution of soluble material, the supercritical fluid containing the dissolved substances is removed from the feed material. The extracted component is completely separated from the SCF by means of temperature or pressure change. The SCF may then be recompressed to the extraction conditions and recycled.

Advantages of supercritical fluid extraction processes

The major advantages of SCFs and SCF extraction processes compared to conventional liquid solvents for separation are summarized below.

1. Dissolving power of the SCF is controlled by pressure (or) temperature.
2. It is relatively rapid process because of the low viscosities and high diffusivities associated with supercritical fluids.
3. The extraction can be selective to some extent, by controlling the density of the medium.
4. SCF is easily recoverable from the extract due to its volatility.
5. Separation not possible by more traditional processes can sometimes be effected.
6. Use of inert solvent environment to ambient temperatures, resulting in reduced oxidation potential.
7. Supercritical fluid extraction with carbondioxide is carried out at low temperatures ~40°C to avoid the degradation of thermally sensitive pharmaceutical compounds.
8. Unlike tedious methods of extraction, SFE is nondestructive process.