GREEN CHEMISTRY SOLUTIONS (Post Midsem)

1. **Lateral Thinking** and **Vertical Thinking** were coined by **Edward de Bono**.
2. The **Passerini reaction** was discovered in the **1920s** and involves reactants such as **isocyanide**, **carboxylic acid**, and **carbonyl compound**.
3. **Bruce H. Lipshutz** received the **Presidential Green Chemistry Challenge Award** in **2011** for his project "**Towards Ending Our Dependence on Organic Solvents**."
4. At **200°C**, water behaves similarly to **acetonitrile** as a solvent.
5. **Near-critical water (NCW)** generally has a temperature range between **250°C and 374°C**. At **300°C**, the dielectric constant of water is approximately that of **acetone**.
6. The **supercritical temperature** and **pressure** for **carbon dioxide** are **31.1°C** and **73.8 bar**, respectively.
7. The antimalarial drug **quinine** is isolated from the bark of the **cinchona tree**, while the anticancer drug **taxol** is derived from the bark of the **Pacific yew tree (Taxus brevifolia)**.
8. The drug used for the treatment of **Parkinson's disease** is **Levodopa**, and for neuropathic pain, **Gabapentin** is commonly used.

Remaining Questions and Answers:

9. The mnemonic for the **12 principles of green analytical chemistry** is **SAFER**. The **4th letter "F"** stands for "**Facilitate regeneration of chemicals and reagents**."
10. The full form of the ionic liquid **[bmim]BF4** is **1-butyl-3-methylimidazolium tetrafluoroborate**.
11. The full form of **VBrPO** is **Vanadium Bromoperoxidase**. The second-generation solid brominating reagent, **n-tetrabutyl ammonium tribromide (TBATB)**, is prepared by treating **tetrabutyl ammonium bromide** with bromine in a suitable solvent.
12. The major shortcoming of **deductive thinking** is that it relies on premises that are not questioned; if the initial premise is incorrect, the answer will be fundamentally wrong.
13. An **"inverse temperature dependence"** reaction is one in which the reaction rate decreases as temperature increases, which is contrary to typical behavior. The **Passerini reaction** is an example.

14. The **5th Principle of Green Engineering** is: **Output-pulled versus input-pushed**. This principle advocates designing processes that are "output-pulled," using energy and materials optimally to align with product output.
15. **Surfactants** lower the surface tension of a liquid, enabling easier spreading and mixing. A **micelle** is an aggregate of surfactant molecules formed in a colloidal solution, with a hydrophobic core and hydrophilic surface, allowing it to solubilize nonpolar substances in water.
16. Despite the low yields of **Friedel-Crafts alkylation** in superheated water, researchers explore these reactions for environmental benefits, such as reduced need for organic solvents, making the process greener and safer.
17. Chemical industry products are divided into three main categories: **basic chemicals** (e.g., ethylene, chlorine), **specialty chemicals** (e.g., dyes, agrochemicals), and **consumer chemicals** (e.g., soaps, detergents).
18. **Plastics** are synthetic materials made from polymers with added ingredients for versatility. **Engineering plastics** are specialized polymers designed for mechanical strength and stability, commonly used in automotive and electrical applications.
19. Four key advantages of using **supercritical conditions** are:

- Enhanced solubility of reactants
- Increased reaction rates
- Improved mass transfer
- Elimination of organic solvents

20. For calculating reaction metrics like **Reaction Mass Efficiency (RME)**, **Mass Intensity (MI)**, and **Mass Productivity (MP)**, I can assist if needed.
21. A simplified phase diagram of water would show three primary phases: **solid**, **liquid**, and **gas**, with the **critical point** at **374°C** and **22.1 MPa**, and the **triple point** at **0.01°C** and **0.00604 MPa**.
22. Definitions:

- **In-water reaction**: where the reaction takes place with water as the solvent.
- **On-water reaction**: where the reactants are insoluble and react at the interface with water.

- **Water-promoted reaction**: where water accelerates the reaction without acting as a solvent.
- **In the presence of water reaction**: where water is involved in the reaction environment but not necessarily as a solvent.

23. For reversible gaseous reactions, an **increase in pressure** generally shifts the equilibrium towards the side with fewer moles of gas, while a **decrease in pressure** favors the side with more moles.
24. For specific reactions, please provide the reaction scheme to predict the products.
25. The principles of **Green Chemistry** focus on reducing waste and avoiding hazardous substances, while **Green Engineering** emphasizes the efficient design of products and processes to minimize environmental impact throughout their lifecycle.
26. Fill-in-the-blanks (specific to the provided text):

- **i)** Innovation, premises, protection, wrong, prevention.
- **ii)** Creativity, critical thinking.
- **iii)** Problem-solving, critical thinking, creative thinking, decision-making.
- **iv)** High, low, 100%, high, 10.
- **v)** Radical polymerization, secondary, isotactic, syndiotactic, atactic.

Additional Points:

1. The **12 Principles of Green Engineering** were proposed by **Paul T. Anastas** and **Julie B. Zimmerman** in **2003**.
2. The **6th Principle of Green Engineering** is **"Conserve complexity,"** emphasizing the conservation of embedded complexity in materials during recycling or reuse.
3. The **C2C (Cradle to Cradle)** concept, which aims to replace the traditional "Cradle to Grave" model, was introduced by **William McDonough** and **Michael Braungart** in **2002**.
4. The statement "**Water near its critical point possesses properties very different from those of ambient water**" was made by **Philip E. Savage**.

5. Using concentrated **H_2SO_4** above the catalytic amount in **Fischer esterification** to remove water is not considered green. **Alternative green methods** could involve using **molecular sieves** or **Dean-Stark apparatus**.
6. **Innovation** is the implementation of a new idea, process, or product to improve something, while **Invention** is the creation of something new that has never existed before.
7. For a **novel green reaction**, considerations include **minimizing hazardous reagents**, **using sustainable solvents**, **reducing energy consumption**, and **maximizing efficiency**.
8. The **abbreviation of the award-winning surfactant** and details of its structure require further context.
9. For a **Diels-Alder reaction in water**:
    - (a) The **"on-water" effect** often accelerates Diels-Alder reactions, enhancing product formation.
    - (b) **Additives like surfactants or cyclodextrins** can help speed up the reaction.
    - (c) The **greenest additive** would be one that is non-toxic and biodegradable, like certain surfactants.
10. (a) The **triple point of water** is the unique condition where solid, liquid, and vapor phases coexist in equilibrium, occurring at **0.01°C and 0.006 atm**.
11. (a) A **solventless reaction** can also be referred to as a **neat reaction**.
12. **Four important uses of supercritical carbon dioxide (SC-CO_2)**:

- **Extraction**: Used for decaffeination of coffee and extraction of flavors and fragrances.
- **Dry Cleaning**: A safer alternative to traditional solvents for dry cleaning fabrics.
- **Reaction Medium**: Acts as a green solvent in organic and polymer chemistry due to its tunable properties.
- **Polymer Processing and Foaming**: Used in the foaming of polymers and in polymer synthesis, reducing the need for harmful organic solvents.

13. Definitions for various reaction types:

- **In-water reaction**: where the reaction takes place with water as the solvent.
- **On-water reaction**: where reactants are insoluble and react at the water interface.
- **Water-promoted reaction**: where water accelerates the reaction without acting as a solvent.
- **In the presence of water reaction**: where water is involved in the reaction environment but not necessarily as a solvent.