Science, Technology, Society and the Environment (STSE)
Chemistry Textbook Questions

States of Matter in Reactions (pg 162)

What is a rebreather?

A rebreather allows a SCUBA diver to rebreathe the air that has been exhaled with some oxygen added in.

Describe the 3-step process that allows rebreathers to prevent any gas from escaping (which would create bubbles and scare away wildlife).

$CO_{2\,(g)} + H_2O_{\,(l)} \longrightarrow H_2CO_{3\,(aq)}$

$H_2CO_{3\,(aq)} + 2NaOH_{\,(aq)} \longrightarrow Na_2CO_{3\,(aq)} + 2H_2O_{\,(l)}$

$Ca(OH)_{2\,(aq)} + Na_2CO_{3\,(aq)} \longrightarrow CaCO_{3\,(s)} + 2NaOH_{\,(aq)}$

Conservation of Mass (pg 166 - 167)

What is green chemistry?

Green chemistry focuses on designing reactions that produce less waste and eliminating toxic substances that are used in many chemical reactions.

What benefits has switching to a green reaction for making the drug Emend resulted in?

Emend is a drug used to treat vomiting a nausea caused by chemotherapy. The new reaction uses smaller amounts of reactants, water and energy but results in twice as much product.

How is the conservation of mass important when cleaning toxic spills?

Toxic spills are often cleaned by adding other chemicals to the spill. It is important to calculate the exact amount needed so none will remain in the environment.

Chemical Reactions (pg 182 - 197)

What is the chemical reaction used to produce ammonia? What type of reaction is this? (182)

Ammonia is produced by a synthesis reaction known as the Haber process.

$N_{2\,(g)} + 3H_{2\,(g)} \longrightarrow 2NH_{3\,(g)}$

Give three examples of why ammonia is important? (182)

Ammonia is an important component of fertilizers. It also plays an role in making paper, extracting nickel and zinc from ore, in explosives and cleaning products.

Why is hydrogen a better choice as a fuel than fossil fuels? (182)

Hydrogen is a plentiful element (unlike fossil fuels). The electrical energy produced from the reaction between hydrogen and oxygen only produces the waste products heat and water which are not greenhouse gases.

What reaction results in the production of smog? (183)

The synthesis reaction between nitrogen and hydrogen produces nitrogen dioxide, the brown hazy gas we call smog.

Write the chemical equation for the reaction of TNT (trinitrotoluene). (186)

$2C_7H_5N_3O_{6\ (s)} \longrightarrow 3N_{2\ (g)} + 5H_2O_{\ (g)} + 7CO_{\ (g)} + 7\ C_{\ (s)}$

What type of reaction does TNT undergo when it creates an explosion? (186)

The decomposition of TNT creates the explosion.

What actually creates the explosion from the reaction of TNT? (186)

The rapid expansion of gases pushes material away from the blast site.

Describe the reaction used to make a car airbag inflate. (187)

The decomposition of sodium azide triggered by an electrical impulse (catalyst) causes nitrogen to be produced resulting in the airbag inflating.

$2NaN_{3\ (s)} \longrightarrow 3N_{2\ (g)} + 2Na_{\ (s)}$

What is the main ingredient in concrete? How is it created? (188)

The main ingredient in concrete is calcium oxide. It made by decomposing calcium carbonate.

$CaCO_{3\ (s)} \longrightarrow CaO\ (s) + CO_{2\ (g)}$

How did the Sudbury basin form? (190)

The Sudbury basin is believed to have formed from a meteorite impact.

What is the main element found in the Sudbury basin? What is this element used to manufacture? (190)

Nickel is the main element found in the Sudbury basin. It is the largest deposit of nickel in the world. Nickel is used to manufacture stainless steel.

What type of reaction is used to extract the nickel from nickel (II) sulfide? (190)

A single displacement reaction between nickel (II) sulfide and oxygen is used to extract the nickel from the ore.

Which compound is commonly used to preserve dried fruits? (197)

Sulfur dioxide is used to preserve the colour of dried fruits.

What would happen if the fruit was not treated with this compound? (197)

Without sulfur dioxide the fruit would darken and change flavor.

What potential allergies can this trigger? (197)

Many individuals are allergic to sulfites (sulfur containing compounds) that are used as a preservative.

Reactions and Environmental Issues (pg 199 – 205)

What are the steps used to clean up an oil spill in a body of water? (199)

Cleaning an oil spill often involves initial containment (using oil absorbing material) followed by treatment with chemicals that breakdown the oil. A more environmental approach is to use biological agents (bacteria) degrade the oil. This is called bioremediation.

What are some of the harmful waste products that can be released from a car's exhaust?

Nitrogen oxides such as NO and NO_2 are harmful waste products often released from a car's exhaust.

What is a catalytic converter? How does it work? (201)

A catalytic converter can help reduce the harmful emissions from a vehicle. Metals such as platinum or palladium act as a catalyst to decompose nitrogen oxides into nitrogen and oxygen gas.

Why is using cyanide ions to recovery gold from ore potentially dangerous? (202)

Cyanide compounds are highly toxic and can be lethal at low levels. Cyanide getting into the environment can be extremely hazardous.

What type of chemical is often used for cleaning pools? (203)

Chlorinating agents are often used to clean pools. These will release chlorine when dissolved in water.

Why do you need to be careful if mixing these chemicals? (203)

Mixing some chlorinates with each other can produce an explosive mixture. Others will be corrosive and can cause chemical burns to you skin.

What is the main chemical reaction that occurs if bleach and ammonia are combined? (205)

$$2NH_{3\,(aq)} + 2NaClO_{\,(aq)} \longrightarrow 2NaONH_{3\,(aq)} + Cl_{2\,(g)}$$

Why is this reaction dangerous? (205)

This reaction produces chlorine gas. Chlorine gas has been used as a chemical weapon (WW1 and WW2). If inhaled chlorine is highly reactive in the respiratory system and can cause serious damage and even death.