

Thought Lab 15.2: Problem-Solving with Organic Compounds Answer Key

Answers to Procedure Questions

Answers will vary, depending on the issue your group selected. Some examples are included below:

From the article “Octane-Enhancing Compounds Reduce Engine Knocking”:

1. Gasoline with a low octane number is less efficient in combustion and can lead to damage to a car engine.
2. The fuel additive tetraethyl lead acts as a catalyst to increase fuel efficiency and decrease knocking.
3. Compounds of lead from gasoline were emitted by cars in the form of lead oxides, and also gaseous lead(II) bromide formed in the reaction with the fuel additive ethylene dibromide. The neurological and developmental problems associated with these lead compounds are regarded as a serious environmental problem.
4. Current automobile fuels use organic fuel additives such as methyl tertiary-butyl ether (MTBE) or other alcohols to prevent knocking. Although tetraethyl lead was added to the list of controlled toxic substances for the 1999 Canadian Environmental Protection Act, this only applies to automobile fuels. Currently, aviation fuel and recreational marine fuels still use tetraethyl lead as an antiknock agent.
5. MTBE is responsible for widespread contamination of groundwater and drinking water supplies as a result of its ability to dissolve in water. It biodegrades slowly, and once into a groundwater supply, produces an offensive “turpentine” like taste and odour, making water virtually unfit to drink. The United States Environmental Protection Agency (EPA) began proceedings in early 2000 to eliminate or limit the use of MTBE as a fuel additive.

For issues relating to the production and use of chlorofluorocarbons (CFCs):

1. To keep fresh food from spoiling, it is helpful to keep the food cold. Early refrigerators used substances such as ammonia or methyl chloride. Accidental releases of these toxic chemicals occasionally proved fatal.
2. Toxic refrigerants were replaced with stable and nontoxic CFCs, which are organic compounds.
3. Decades later, it was discovered that CFCs cause the depletion of the ozone layer, leading to increased risks of skin cancer and damage to crops and forests. CFCs are also greenhouse gases and contribute to global warming.
4. CFCs are no longer produced in Canada, and existing CFCs are being recycled. CFC substitutes such as hydrofluorocarbons are being introduced.
5. Both CFCs and hydrofluorocarbons are greenhouse gases, so they contribute to global warming. Hydrocarbons are flammable, so they pose a health risk.

For issues relating to production of pesticides, particularly DDT:

1. Insects and weeds destroy crops and spread disease.

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ANSWER KEY		

2. The development of pesticides such as DDT dramatically reduced crop damage and the spread of diseases.
3. DDT and other chlorinated pesticides bioaccumulate and have toxic properties.
4. DDT and other chlorinated pesticides are either restricted or prohibited and are being replaced with other less harmful pesticides.
5. Substitute pesticides are often less effective and may also have unidentified environmental health risks.

Answers to Analysis Questions

1. Some of the benefits may include:
 - development and use of pharmaceutical drugs
 - development of polymers and other synthetic materials for clothing, packaging, and building components
 - development of effective synthetic pesticides to control disease and food spoilage
 - development of solvents for cleaning
 - development of adhesives for medical and construction purposes
 - development of synthetic fertilizers to increase agricultural yields
2. Some of the unintended results that have occurred include:
 - pollution of aquifers
 - destruction of stratospheric ozone
 - enhanced greenhouse effect
 - pesticide-resistant organisms
 - antibiotic-resistant bacteria
 - accumulation of plastics in the environment
 - development of chromosomal and developmental aberrations due to exposure to organic solvents
3. Regardless of the position you take, it is important for you to be able to support your arguments with pertinent facts. Compare the costs and benefits associated with your answers.