

## Dr MST sample questions and answers

1. As a teacher or parent, why would it be better to use experiments in solid materials in place of more standard chemistry experiments?
  - A. Since solids are less volatile, this reduces the potential exposure of students to harmful chemicals and fumes. Students can also identify more easily with solids than with liquids or gasses normally used in chemistry.
2. When I bend a piece of metal like a paper clip or an aluminum rod, I can feel the bend portion getting warm. It also seems to get stronger. Why does this happen?
  - A. Bending a metal causes planes of atoms to slide over one another. This causes hardening as the planes slide and in some cases get tangled up with one another, giving increased strength. This process generates the heat that you feel. Many metals are strengthened by bending, rolling or hammering, all of which cause hardening. The increased strength remains until the metal is annealed by heating to a high temperature.
3. Aluminum comes in a lot of forms. I know about aluminum foil but I read that airplanes are made of aluminum too. What is the difference in these forms of aluminum?
  - A. Pure aluminum is a relatively weak material, so that most aluminum products are alloys, containing other elements (called alloying elements). Aluminum foil is nearly pure aluminum, and is easily rolled into thin sheets, the form we use it in. Aluminum alloys can contain a variety of other elements in amounts from a few percent to 20 or more percent. Each alloy will have a specific set of properties such as strength, toughness, corrosion resistance, etc. Aluminum alloys may also be strengthened by heat treatments where they are heated and cooled in a specific manner. Each aluminum part on an airplane is chosen with specific properties in mind, and then matched to the correct alloy and heat treatment to produce those properties.
4. When glass breaks it usually breaks into lots of sharp pieces. But there are some types of glass that don't do that, but rather break into small chunks. What is the difference?
  - A. The glass that breaks into small chunks is called tempered glass. It is "tempered" by heating to a very high temperature, followed by a rapid cooling to room temperature. This makes the glass 3 to 4 times stronger than regular glass; it also makes it brittle so that when it breaks, it breaks into the small chunks that you have seen. Automobile side and rear windows are usually tempered glass; windshields are not—they are a laminated layered glass, called

"safety glass," in which 2 layers of glass are laminated with a sheet of plastic in between. When safety glass breaks, the pieces stick to the internal plastic sheet rather than separating from the windshield.

5. I have heard of composite materials. What are they and how are they used?
  - A. Composite materials are made of 2 or more materials, put together in layers, dispersed granules. Fiberglass is a good example of a layered composite, where glass fibers are imbedded in an epoxy resin—the glass fibers give strength whereas the resin provides toughness. A good example of a layered composite is standard plywood, a composite made up of layers of wood and glue. Dispersed granules are often used in metal matrix composites, where a set of small hard granules is imbedded in a metal matrix.
  
6. I have used an epoxy casting module, but there are several problems, the worst being that the fumes bother some of the students. What can be done to alleviate this problem?
  - A. The material called Eurocast works better for a casting example and emits fewer fumes. Be sure to have good ventilation when this is done. Also, the best molds are cookie cutters or plaster molds-- plastic tends to stick and paper is hard to remove.