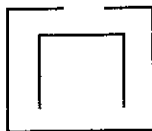


ANSWERS TO UNIT VI : CHEMICAL REACTIONS

- A system that is enclosed by an opaque box. (Light can't get in.)
 - A system that is enclosed by a transparent box. (Material can't get in or out, but light can.)
 - A system that is enclosed by a sound-absorbing box (transparent or opaque).
 - A system that, for example, is surrounded by two boxes, one that is open at the top and one that is open at the bottom, as shown below.



- A system in a container with heat-insulation. (This is not truly "closed"; see exercise 2; below.)
- The only system which might be closed is the universe itself (and astronomers are still arguing about this point). In general approximately closed systems can be made; but even the best heat insulation cannot keep a liquid hot forever. The problem is making a container through which energy cannot pass.
 - What is CONSERVED: the composition (the material is still paper); total mass and properties such as colour, volume and density
 - What is NOT CONSERVED: the number of pieces present, shape
 - What is CONSERVED: composition and properties such as colour and density
What is NOT CONSERVED: total mass; volume, surface area, shape and number of pieces
 - Conservation of atoms (primarily) and conservation of mass will also be violated since Fe atoms have a different mass from Cu atoms.
 - Conservation of mass (15 g of reactants cannot make 16 g of products)
 - Conservation of charge: total charge on left = +1; total charge on right = 0.
 - No conservation laws violated.
 - Conservation of atoms (different numbers of Cr's and O's on either side). Conservation of mass will also be violated as a result.
 - No conservation laws violated
 - Only (b) is **always** conserved. The others occasionally may be conserved in particular reactions.
 - Left hand side contains: 1 C + 4 H + 4 O ; molar mass of reactants = 1 x 16.0 + 2 x 32.0 = 80.0 g
Right hand side contains: 1 C + 4 O + 4 H ; molar mass of products = 1 x 44.0 + 2 x 18.0 = 80.0 g
Since left and right sides have the same number and types of atoms and the same mass, atoms and mass are conserved.
 - Left hand side contains: 1 Na + 1 O + 2 H + 1 Cl ; molar mass of reactants = 40.0 + 36.5 = 76.5 g
Right hand side contains: 1 Na + 1 Cl + 2 H + 1 O ; molar mass of products = 58.5 + 18.0 = 76.5 g
Since left and right sides have the same number and types of atoms and the same mass, atoms and mass are conserved.
 - $2 \text{ Sn} + \text{ O}_2 \longrightarrow 2 \text{ SnO}$
 - $\text{ H}_2 + \text{ Cl}_2 \longrightarrow 2 \text{ HCl}$
 - $\text{ N}_2 + 3 \text{ H}_2 \longrightarrow 2 \text{ NH}_3$
 - $2 \text{ Na} + 2 \text{ H}_2\text{O} \longrightarrow 2 \text{ NaOH} + \text{ H}_2$
 - $4 \text{ NH}_3 + 3 \text{ O}_2 \longrightarrow 2 \text{ N}_2 + 6 \text{ H}_2\text{O}$
 - $2 \text{ C}_6\text{H}_{14} + 19 \text{ O}_2 \longrightarrow 12 \text{ CO}_2 + 14 \text{ H}_2\text{O}$
 - $2 \text{ KNO}_3 \longrightarrow 2 \text{ KNO}_2 + \text{ O}_2$
 - $\text{ CaC}_2 + 2 \text{ O}_2 \longrightarrow \text{ Ca} + 2 \text{ CO}_2$
 - $\text{ C}_5\text{H}_{12} + 8 \text{ O}_2 \longrightarrow 5 \text{ CO}_2 + 6 \text{ H}_2\text{O}$
 - $\text{ K}_2\text{SO}_4 + \text{ BaCl}_2 \longrightarrow 2 \text{ KCl} + \text{ BaSO}_4$
 - $2 \text{ KOH} + \text{ H}_2\text{SO}_4 \longrightarrow \text{ K}_2\text{SO}_4 + 2 \text{ H}_2\text{O}$
 - $\text{ Ca(OH)}_2 + 2 \text{ NH}_4\text{Cl} \longrightarrow 2 \text{ NH}_3 + \text{ CaCl}_2 + 2 \text{ H}_2\text{O}$
 - $5 \text{ C} + 2 \text{ SO}_2 \longrightarrow \text{ CS}_2 + 4 \text{ CO}$