II. Automotive Emissions

- ________________ sources contribute approximately 60% of total air pollution (78% of CO, 47% of NOX, 44% of total hydrocarbons, 5% of particulates, and 2% of SOX).

1. 20 to 40% of the automobile's total hydrocarbon emissions are from the crankcase. This emission is called ____________________.
   - function of s______________
   - after 1963 all vehicles are required to have a positive c____________________ ventilation (PCV) valve
   - the PCV valve opens up more at h_______________ speeds to allow more crankcase fumes to be sucked into the intake manifold

2. Fuel tank e____________________________. As the fuel tank warms, the vapors in the headspace are exhausted through the vent line.
   - activated carbon canister
   - vent the fuel tank to the crankcase

3. Carburetor Losses. After the engine is shut off, the gas in the float valve evaporates to the atmosphere. This is called h__________ s______________.
   - activated carbon canister
   - vent to the crankcase

4. Engine Exhaust.
   1. E______________ modifications
   2. F_____________ system modifications
   3. E______________ system modifications:
      catalytic converter for NOX and HC control
      platinum-rhodium or platinum-palladium catalyst - requires temp of 350°C (660°F)
      \[ \text{NO} + \text{CO} + \text{HC} \rightarrow \text{N}_2 + \text{CO}_2 + \text{H}_2\text{O} \]

5. Reformulated Gasoline:
   a. 1990 Clean Air Act Amendments had two performance targets for reformulated gasoline:
      - 15% r______________ in VOCs
      - 15% reduction in a_____ t_________ (e.g., benzene)
   b. one third of U.S. uses r______________ gasoline
   c. Congress mandated that reformulated fuel contains 2% o______________
   d. common oxygenates include:
      - m__________________
      - e______________ – fermented from c________
      - MTBE (methyl tertiary butyl ether) derived from natural gas and c________
      - ETBE (ethyl tertiary butyl ether) derived from e__________