1. (1) In chemistry, it is common to express pressures in units of atmospheric pressure: 
1 atm = 101325 Pa. So, in a column of 1 cm² cross-section of Hg (density 13.6 g/cm³), what is the height needed to counter 1 atm? (5%) 
(2) What if water were used in place of mercury? (5%) 

2. Describe following terms (16%) 
(1) Boyle’s Law (4%) 
(2) Charles’ Law (4%) 
(3) Avogadro’s Law (4%) 
(4) The ideal gas equation of state (4%) 

3. (1) In an industrial process, a gas confined to a volume of 1 L at a pressure of 20 atm is allowed to flow into a 12-L container by opening the valve that connects the two containers. What will be the final pressure of the gas? (5%) 
(2) The air pressure in a car tire is 30 psi (pounds per square inch) at 10°C. What will be pressure be after driving has raised its temperature to 45°C? (Assume that volume remains unchanged.) (5%) 

4. A biscuit made with baking powder has a volume of 20 mL, of which one-fourth consists of empty space created by gas bubbles produced when the baking powder decomposed to CO₂. What weight of NaHCO₃ was present in the baking powder in the biscuit? Assume that the gas reached its final volume during the baking process when the temperature was 400°C. (Hint: Baking powder consists of sodium bicarbonate mixed with some other solid that produces an acidic solution on addition of water, initiating the reaction NaHCO₃(s) + H⁺ → Na⁺ + H₂O + CO₂.) (10%) 

5. Compute number density of air at 1 atm and 0°C. (10%) 

6. (1) Compute total molecular mass of air. (5%) 
(2) Compute air density at 1 atm and 0°C. (5%) 

7. Describe following terms (20%) 
(1) unimolecular reaction (4%) 
(2) bimolecular reaction (4%) 
(3) termolecular reaction (4%) 
(4) reaction rate constant (4%) 
(5) reaction mechanism (4%)
8. Describe following terms (14%)
   (1) greenhouse gases (2%)
   (2) isotopes (2%)
   (3) hygroscopic (2%)
   (4) isomers (2%)
   (5) heterogeneous reaction (2%)
   (6) the atmosphere (4%)

Useful data:
- Universal gas constant \( R_u = 0.0821 \) liter-atm/mol-K