Topic: Fluid Mechanics

The fluid as a continuum

Paraphrasing and summarising

A. Paraphrase the following text keeping in mind that:
   a. The length of your text should be approximately the same length as the original.
   b. The meaning of your text should be the same as that of the original.

"Most engineering work is concerned with the macroscopic or bulk behavior of a fluid rather than with the microscopic or molecular behavior. In most cases it is convenient to think of a fluid as a continuous distribution of matter or a continuum".
Welty, J. R.; Wicks, C. E.; Wilson, R. E.; Rorrer, G. L. *Fundamentals of Momentum, Heat, and Mass Transfer*, (5th ed.); Wiley: New York, 2008, p. 1.

B. Write a simple definition of Continuum by using appropriate information from the following excerpt.

Excerpt 1
"As far as we know, fluids are aggregations of molecules, widely spaced for a gas, closely spaced for a liquid. The distance between molecules is very large compared with the molecular diameter. The molecules are not fixed in a lattice but move about freely relative to each other. Thus fluid density, or mass per unit volume, has no precise meaning because the number of molecules occupying a given volume continually changes. This effect becomes unimportant if the unit volume is large compared with, say, the cube of the molecular spacing, when the number of molecules within the volume will remain nearly constant in spite of the enormous interchange of particles across the boundaries. If, however, the chosen unit volume is too large, there could be a noticeable variation in the bulk aggregation of the particles…There is a limiting volume $\delta^{\circ}V^{*}$below which molecular variations may be important and above which aggregate variations may be important.

The limiting volume $\delta^{\circ}V^{*}$ is about 10^{-9} mm^3 for all liquids and for gases at standard conditions (ambient pressure and temperature). For example, 10^{-9} mm^3 of air at standard conditions contains approximately 3×10^7 molecules...Most engineering problems are concerned with physical dimensions much larger than this limiting volume, so that density is essentially a point function and fluid properties can be thought of as varying continually in space...Such a fluid is called a *continuum,* which simply means that its variation in properties is so smooth that differential calculus can be used to analyze the substance…Again there are borderline cases for gases at such low pressures that molecular spacing and mean free path are comparable to, or larger than, the physical size of the system. This requires that the continuum approximation be dropped in favor of a molecular theory of rarefied gas flow. In principle, all fluid mechanics problems can be attacked from the molecular viewpoint...Note that the use of continuum calculus does not preclude the possibility of discontinuous jumps in fluid properties across a free surface or fluid interface or across a shock wave in a compressible fluid. Our calculus in analyzing fluid flow must be flexible enough to handle discontinuities across boundaries".
White, F. M. *Fluid Mechanics*, (7th ed.); McGraw-Hill: New York, 2008, pp. 8-9.