5. Gaseous State BSc-H Semester-1
Lecture-5
                                Slide-5

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Johannes van der Waals (1837-1923)

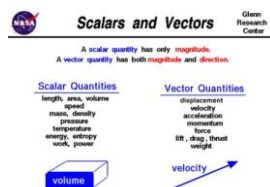**Explained the deviation of real gases from the ideal gas behaviour through VWF**

van der Waals forces vary considerably in magnitude

Magnitude simply means "how much". In physics, we use many kinds of numbers, two of which are scalars and vectors. A scalar is a number
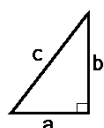
It include
1. Dispersion forces or London forces
2. Dipole-dipole forces
3. Dipole-induced dipole forces.
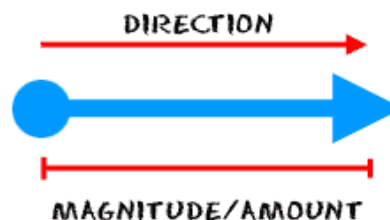**4. Hydrogen bonding. [treated as a separate category]**

Attractive forces between an ion and a dipole are known as ion-dipole forces and these are not van der Waals forces.

Scalars and Vectors

A scalar quantity has only magnitude.
A vector quantity has both magnitude and direction.

Scalar Quantities
length, area, volume
speed
mass, density
pressure
temperature
energy, entropy
work, power

Vector Quantities
displacement
velocity
acceleration
momentum
force
lift, drag, thrust
weight

volume

velocity

Pythagorean Theorem

$$a^2 + b^2 = c^2$$

DIRECTION

MAGNITUDE/AMOUNT

To see how the method works, consider the following problem:

Eric leaves the base camp and hikes 11 km, north and then hikes 11 km east. Determine Eric's resulting displacement.

This problem asks to determine the result of adding two displacement vectors that are at right angles to each other. The result (or resultant) of walking 11 km north and 11 km east is a vector directed northeast as shown in the diagram to the right. Since the northward displacement and the eastward displacement are at right angles to each other, the Pythagorean theorem can be used to determine the resultant (i.e., the hypotenuse of the right triangle).

11 km, N   +   11 km, E   =   11 km, N   11 km, E   R
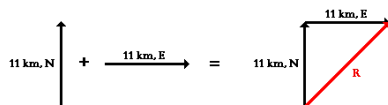
$$11^2 + 11^2 = R^2$$
$$242 = R^2$$
$$15.6 = R$$

The result of adding 11 km, north plus 11 km, east is a vector with a magnitude of 15.6 km. Later, the method of determining the direction of the vector will be discussed.