Kinetic Theory

Vibrating Ball Type

MF1990-001 0 – 12V.DC. Simulates Behaviour Of A Gas

Description:

The IEC 'Kinetic Theory' apparatus simulates the behaviour of a gas. A quantity of small metal spheres are introduced into slim vertical chamber and they rest on the rubber faced plate that forms the bottom surface of the chamber. A very light cylindrical float of styrene foam with a stiff paper underside is introduced into the tube above the spheres. A robust electric motor drives the plate up and down rapidly to violently agitate the spheres up into the chamber to simulate molecules of a gas.

Length: 160mm	Width: 160mm	Height: 430mm	Weight: 0.97kg

Operation:

The spheres bounce up and down in a random manner colliding with the underside of the float, with one another and with the walls of the chamber in a way that is similar to gas molecules moving when captive inside a vessel. Increasing the agitation simulates the heating of the 'gas'. This float 'rides' on the agitated spheres and its weight simulates the gas pressure. A second float is supplied for adding to the first. This allows the simulated pressure to be doubled. The height that the underside of the lower float 'rides' in the tube is measured on a scale from the plate and simulates the gas volume.

For good results, the number of spheres used is important. Although 100 metal spheres are provided, the ideal quantity to load is between 50 and 70. If too many are used, the energy lost in colliding with one another is too great and the energy remaining to lift the float reduces. The speed of the motor is easily adjustable by applying voltages up to 12V.DC. from a standard power supply.

Assembly of the Instrument:

The clear acrylic tube can be removed from the base for storing. To fit the tube to the base, engage the lower end of the tube into the socket and press down firmly through the two rubber rings. The metric scale on the tube will have its zero mark in line with the rubber covered plate. Turn the tube so that the metric scale is facing to the front. Place about 60 spheres into the chamber so that they rest on the rubber covered plate. Take a float and, **with paper side towards the spheres**, allow it to softly slide down the bore. Finally, fit the lid by squashing the foam disc slightly into the mouth of the tube.

Connect the terminals to a DC voltage source which is adjustable up to 12V.DC. As the motor speed increases, the spheres bounce and their scatter and density can be observed relative to the height reached by the float.

General Observations:

If the weight of the float (or float) is doubled by using two floats, (simulated increase of pressure) the volume reduces. If the agitation is increased (simulated heating of gas) the volume increases. The density of molecular activity can be observed at various heights up the vessel simulating the 'thinning' of atmospheric air with height from sea level.

Brownian Motion:

Introduce a light foam sphere of about 10mm diameter with the metal spheres and observe its behaviour within the motion of the heavy spheres.

Boyle's Law:

Begin with a small number of spheres (say 30) and use the foam float. Set the agitation level and note the average height reached by the float during agitation. Double the number of spheres and repeat using the same agitation motor voltage. Observe the new level reached by the float. Using small weights, load up the float to return it to the height previously attained. This demonstrates the increased 'pressure' achieved with more 'molecules' in a given volume.

Charles' Law:

The agitation may be increased to represent heating of a gas and the float may again be loaded to represent an increase in pressure.

Maintenance:

From time to time, wipe out the acrylic tube with a soft cloth. Wash the tube briefly in warm soapy water but do not apply solvents. The spheres should be poured from the tube into their container before removing the tube from the socket however the tube may be removed with the spheres inside. The spheres will fall down below the plate, but a special protection cone will stop the spheres from falling down to the motor section of the base. This cone has a slit hole for the connecting rod to stretch through during assembly.

CAUTION: If the spheres do make contact with the motor body, they will be attracted to the magnets in the motor and will be difficult to recover.

Removal Of The Plate, Connecting Rod And Cam From The Motor Shaft:

A metal cam is fitted to the motor shaft and, as it rotates, the plate is moved up and down. This cam is lubricated for normal life however, after prolonged use, the cam might require additional Vaseline lubricant. Remove the large nylon screw in the centre of the plate. Remove the steel base plate and remove the three screws that hold the motor housing to the base: With the socket removed, the motor mounting plate will slide from the slots in the socket while pulling the head through the slit hole in the cone. This will expose the cam and the big end of the connecting rod. Using a small 'Allen Key' down the long hole through the connecting rod, the grub screw holding the cam to the motor shaft can be loosened. When reassembling, tighten this grub screw firmly.

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Spare Parts:

- Pack of 100 metal spheres. PA1990-002
- Electric motor, 0-12V.DC. high power. PA2210-002
- Crank for motor shaft and connecting rod PA1990-003
- Rubber coated disc and mounting screw PA1990-004
- Foam Float with paper underside: PA1990-005

Designed and manufactured in Australia