

**Ministry of Higher Education  
& Scientific Research**  
**Al-Isra'a University College**  
**Civil Engineering**  
**Fluid Mechanics Lab.**



**Second Class**

**Experiment No. (1)**

**Fluid Properties**

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**Exp.1:**

**Fluid Properties**

**Objective:**

Knowledge of fluid properties such as density ( $\rho$ ) and viscosity ( $v$ ).

**Theory:**

- Density of fluid: The mass of the volume unit symbolized by the symbol ( $\rho$ ).
- Viscosity of fluid: A property that causes resistance or friction between layers of liquid symbolized by the symbol ( $v$ ).

Where density and viscosity are calculated from the following laws:

Density:

$$\rho = \frac{m}{V}$$

Where:

$\rho$  = fluid density (kg/m<sup>3</sup>)

m = fluid mass (kg)

V = fluid volume (m<sup>3</sup>)

Kinematic viscosity:

$$u = \left( \frac{g d^2}{18 v} \right) \left( \frac{\rho_{ball}}{\rho - 1} \right)$$

Where:

u = speed (m/s)

g = gravity (m<sup>2</sup>/s)

$d$  = diameter (m)

$\nu$  = kinematic viscosity ( $\text{m}^2/\text{s}$ )

$m_{\text{ball}} = 12 \text{ g}$

$d_{\text{ball}} = 7 \text{ cm}$

Dynamic viscosity:

$$\nu = \frac{\mu}{\rho}$$

$$\mu = \nu \rho$$

$\mu$  = dynamic viscosity ( $\text{N}\cdot\text{s}/\text{m}^2$ )

### **Apparatus:**

1. Beaker.
2. Balance for measurement of mass.
3. Liquids to measure its density and viscosity including (water, glycerin oil, engine oil, light oil).
4. Ball.
5. Cylinders included in the oil with known heights.
6. Timer for measuring time.



(Balance)



(Beaker)



(Ball)



(Timer)

## Procedures:

- Measurement of fluid density

1. We measure the mass of the vessel in which we will place the fluid through the mass measurement balance.
2. We place the fluid in a container of a known size. We measure the mass of the vessel with the fluid. Then we repeat this step with another volume. We extract the fluid mass only for each reading and then repeat this step with each type of fluid used in the experiment. Then find density according to the law mentioned earlier.

- Measurement of fluid viscosity

1. Find the starting speed of the body in the fluid where we take the ball known of the diameter and mass throw it from the beginning of the fluid surface in cylinders included in the known heights and run timer thus we can extract the speed from the law below.

$$\text{Speed (u)} = \text{distance} / \text{time} \quad (\text{m/s})$$

2. After that we compensate for the values extracted from the general law of the viscosity mentioned above and extract the values of the fluid.



**Density Calculation Table**

Type of fluid	Mass of beaker (kg)	Mass of beaker and fluid (kg)	Mass fluid (kg)	Volume fluid (m <sup>3</sup> )	Density (kg/m <sup>3</sup> )
Water					
Glycerin oil					
Engine oil					
Light oil					

**Viscosity Calculation Table**

Type of fluid	Time (sec)	Height of fluid (m)	Velocity of fluid (m)	Density (kg/m <sup>3</sup> )	Viscosity (m <sup>2</sup> /s)
Glycerin oil					
Engine oil					
Light oil					

**Discussion:**

1. List the reasons for different readings of the same fluid?
2. Suggest ways to improve the experiment?
3. What are the factors affecting the density of the fluid?
4. What is the difference between dynamic viscosity and kinematic viscosity with the law?
5. What is the effect of heat, flow velocity and pressure on fluid viscosity?
6. If we use the ball allowance for another body, will something change in the scientific laws of the experiment? With a detailed explanation of the conclusion.