Physical Experiments I

Pre-lab Assignment

The Millikan Oil Drop Experiment

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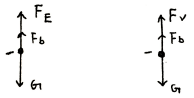
Score

Answers to Questions (20 points)

1. **What forces act on the oil droplet when it is stationary in an electrostatic field? If the field is removed and it reaches its terminal speed, what forces would be acting on it?**
   When it is stationary in an electrostatic field, there are gravity(G), buoyant force (F_b), and electric force (F_E) acting on it.
   When the field is removed, there will be buoyant force (F_b), air resistance (F_v) and gravity(G) acting on it.



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2. **An oil droplet in a Millikan apparatus is determined to have a mass of $3.3\times10^{-15}kg$. It is observed to float between two parallel plates separated by a distance of 0.95cm with 340V of potential difference between them. Determine how many excess(extra) electrons are on the droplet.**

   From the formula get on the book, we can calculate as follows.

$$q\frac{V}{d} = mg$$

$$q\ ?\quad m = 3.3\times10^{-15}\,kg$$
$$g = 9.8\ N/kg$$
$$d = 0.95\times10^{-2}\,m$$
$$V = 340V$$
$$q = mgd/V = 9.8\times3.3\times10^{-15}\times 0.95\times10^{-2}/340$$
$$= 9.036\times10^{-19}\,C$$

   So $q = 5.6476e \approx 6e$
   There are 5.6476 electrons in on the drop lets which is 6 electrons after rounding off.

3. **What is Stokes' law?**
   Stokes' law is the relation between the particle radius and the speed of the small particles' free settlement rate in static water. The resistance of a spherical object, when it is moving in a fluid, is equal to the **radius of the spherical object** product the **velocity** and the **viscosity of the fluid** and **6 π**. This law is called stokes' law. We can use this formula to find the velocity if the object falls in the fluid because of its own weight.

   Stokes' law $F_v = 6\pi r\eta v$

$\mathbf{F_{vd}}$: is the frictional force – known as Stokes' drag – acting on the interface. between the fluid and the particle.
η: is the dynamic viscosity (Some authors use the symbol μ).
r: is the radius of the spherical object.
v: is the flow velocity relative to the object.
In SI units, $\mathbf{F_{vd}}$ is given in Newtons, **η** in Pa·s, **r** in meters, and **v** in m/s.

Some parts I write on this prelab which is reference from Wikipedia and Baidu.