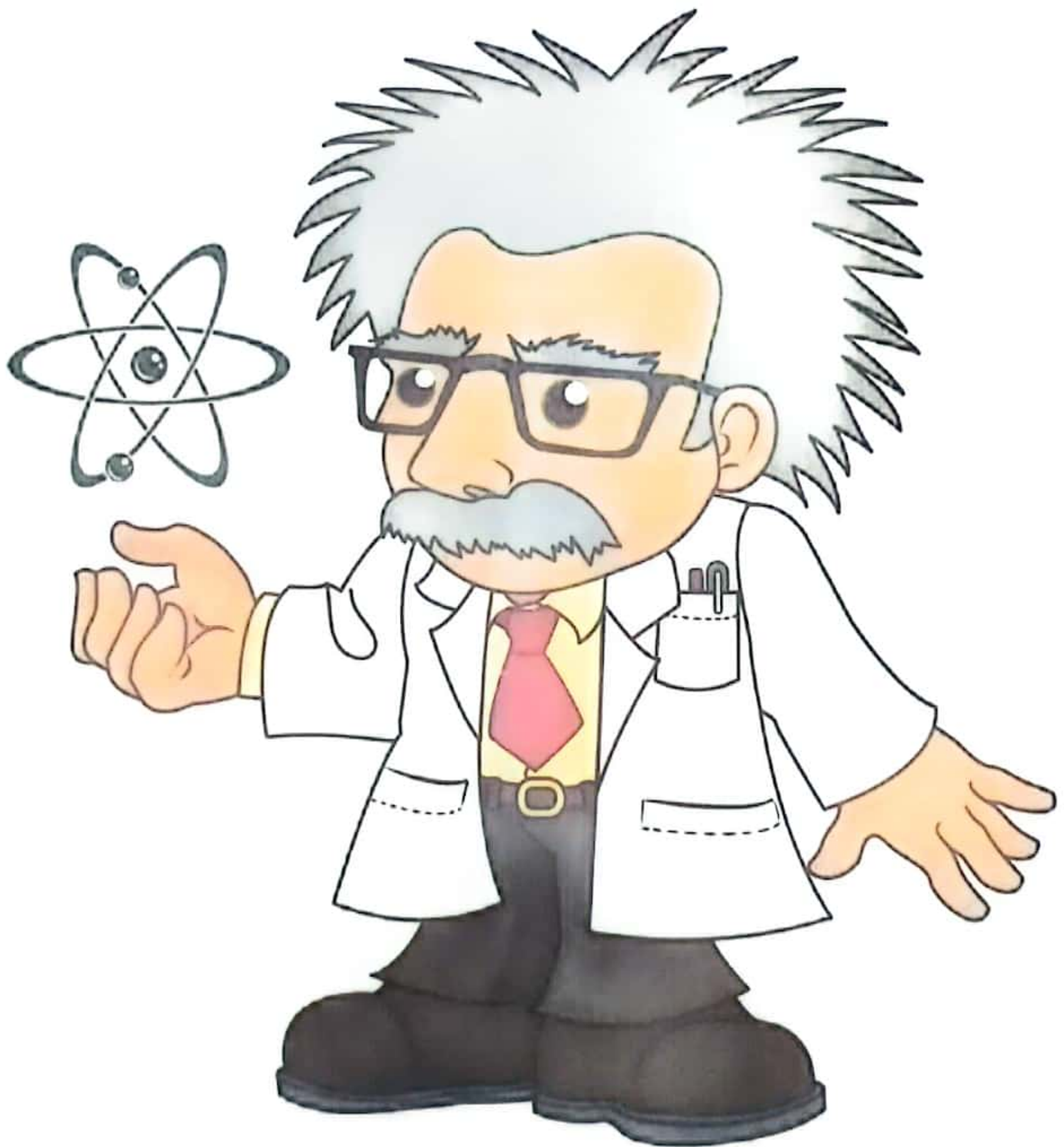


SCHEME PROPERTIES OF MATTER



① Surface tension* Aim

- Determination the surface tension of a Liquid by capillary tube method.

تعيين معامل التوتر السطحي لسائل بطريقة الأنبوبية الشعرية

* Theory

- Surface tension is the Force acting on the Unit Length of the Liquid surface.

معامل التوتر السطحي هو القوة المؤثرة على وحدة الطول من سطح السائل

$$T = \frac{F}{L} \quad \text{dyne/cm} \quad (\text{N/m})$$

- If a Capillary tube is dipped in a Liquid the Liquid will rise inside the tube to a certain height, at which the two forces equal & opposite in direction.

where ;

$T \rightarrow$ Surface tension of the Liquid. (dyne/cm)

عامل التوتر لسطح سائل

$\rho \rightarrow$ density of Liquid. (gm/cm)

كثافة السائل

$r \rightarrow$ Radius of Capillary tube. (cm)

نصف قطر الأنبوبة الشعرية

$g \rightarrow$ Earth's gravity Acceleration. (cm/sec²)

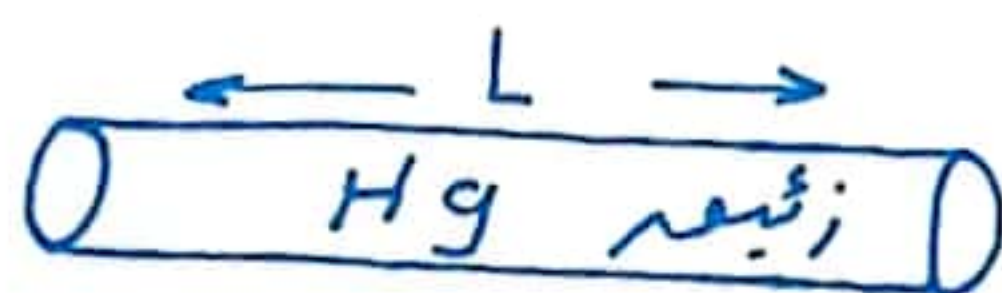
عجلة جاذبية للأرضية

$h \rightarrow$ the height of Liquid in Capillary tube (cm)

ارتفاع سائل في الأنبوبة الشعرية

$\theta \rightarrow$ the contact angle.

زاوية التماس



$$m_{Hg} = \rho_{Hg} \cdot V = \rho_{Hg} \cdot \pi \cdot r^2 \cdot L$$

$$\therefore r^2 = \frac{m_{Hg}}{\pi \rho_{Hg} L}$$

$$\therefore r = \sqrt{m_{Hg} / \pi \rho_{Hg} L}$$

5) Find the weight of the mercury Only .
أوجد وزنه الزئبق فقط

6) Substitute in the equation to find the radius of capillary tube.

عووض في المعادلة للعثور على نصف قطر الأنبوب

$$\therefore \gamma = \sqrt{\frac{m Hg}{\pi \times 13.6 \times 10}} = \dots \text{Cm}$$

By substituting;

بالتعويض

$$\therefore T = \frac{8ghr}{2} \quad \text{dyne/cm}$$

(2) The Simple pendulum

* Aim

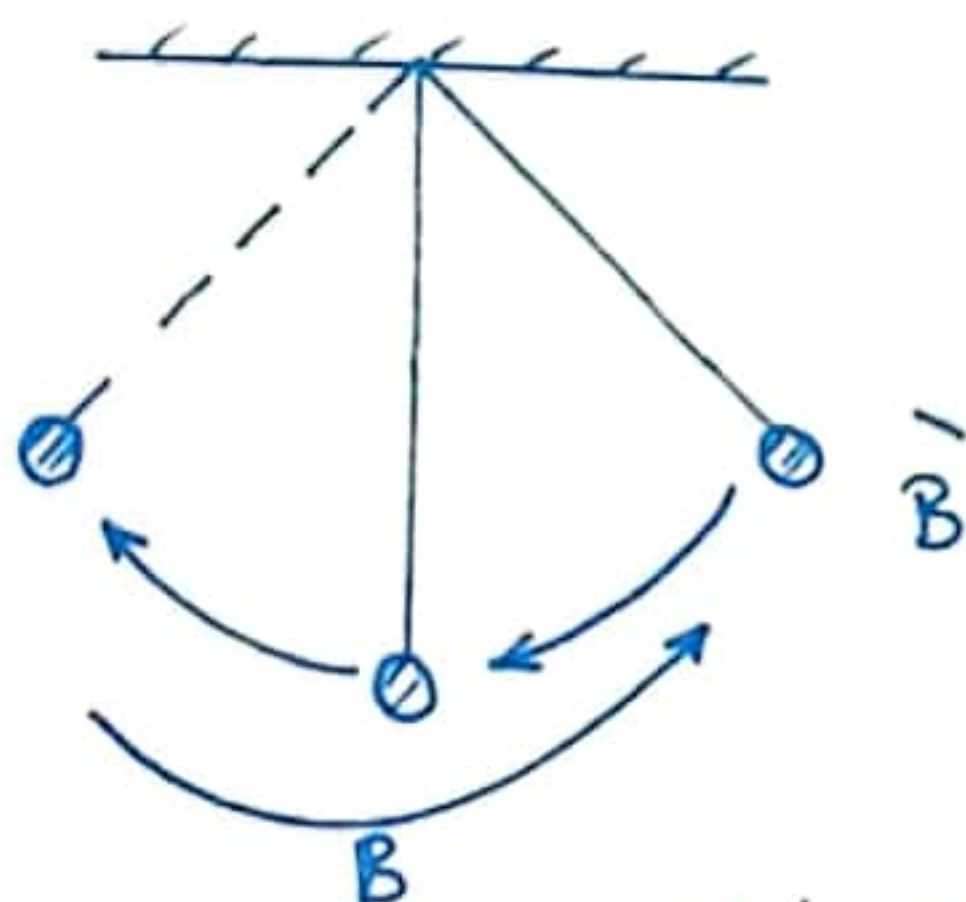
- Determination of the earth's gravity Acceleration.

- تعيين عجلة الجاذبية الأرضية .

* Theory

the simple pendulum consists of metallic ball (B) of mass (m) connected to a string of fixed end at (A) .

- البندول بسيط يتكون من الكرة المعدنية متصلة بخيط مثبت من طرف .



- هذا الحركة هي تذبذبات توافقية بسيطة

(Simple Harmonic motion)

* Simple Harmonic motion :-

Is the motion that repeats it self at equal
Periods .

* الحركة التوافقية البسيطة : هي حركة التي تكرر نفسها على فترات زمنية
متساوية .

* The periodic time (T) :-

Is the time required to make one complete
Oscillation .

الزمن الدوري :- الزمن اللازم لعمل اهتزاز كامل .

$$T = 2 \pi \sqrt{L/g}$$

$$T^2 = 4 \pi^2 \frac{L}{g}$$

$$\therefore g = 4 \pi^2 \cdot \frac{L}{T^2}$$

- this means that the length of the Simple Pendulum is directly proportional to the square of its period.

هذا يعني أنه طول البندول يتناسب طردياً مع مربع الزمن الدوري

* Apparatus

1. Metallic ball كروية معدنية
2. String خيط
3. Stand
4. Stop watch
5. Ruler

* steps

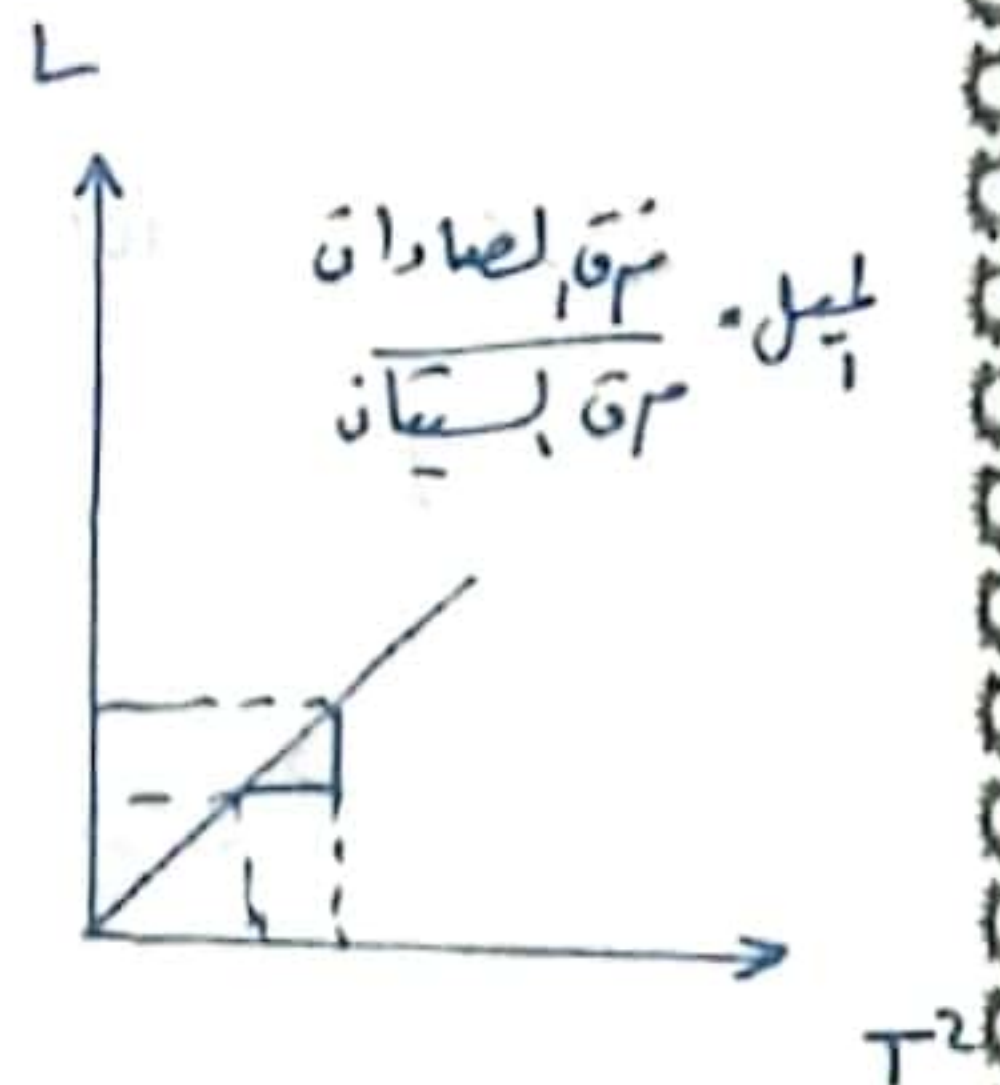
- 1- Measure the Length of the string (L)
- 2- Move the metal by a small angle which less than (15)
- 3- Measure the time of (10) , complete oscillation by using of stop watch then find the time of one complete oscillation.
- 4- Repeat the last steps changing the length of pendulum and measuring the time (10) oscillator.
- 5- Calculate the Results and put in table.

L	T_{10}	$T_{10} - \frac{T_{10}}{10}$	T^2
1 -			
2 -			
3 -			
4 -			
5 -			

$$\text{slope} = \frac{L}{T^2}$$

$$\therefore g = 4\pi^2 \times \text{slope}$$

$$= \dots \text{cm/sec}^2$$



"Hook's Law"

* Aim

- * Verification of Hook's Law.
- * Determination of specific weight of Solid.

- تحقيق قانون هوك
- تعيين الوزن النوعي لجسم صلب.

* Theory

Hook's Law :- within the Limit of elasticity. The increase " ΔL " in an elastic body of length " L " is directly proportional to

+0
قانون هوك :- خلال حدود مرونة، الزيادة في طول الجسم المرنة تتناسب
طردية مع القوة التي تسبب هذه الزيادة.

$$\therefore F \propto \Delta L$$

$$\therefore F = k \Delta L \quad \therefore k = \frac{F}{\Delta L} \text{ dyne/cm}$$

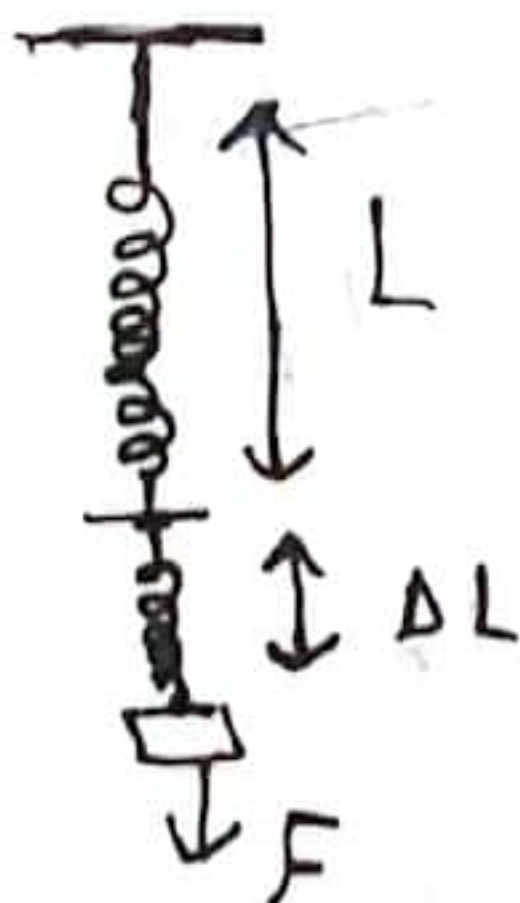
$$\left[\therefore k = \frac{m}{\Delta L} \times g \right]$$

where;

$k \rightarrow$ "the Hook's constant" modulus of elasticity (the Force Producing a unit extension)

$$(\Delta L = 1)$$

هو ثابت هوك "عامل مرونة" بقرة التي تتسبب استطالة مقدارها الوحدة



* Apparatus

- Spring مفاتيح
- weights أوزان
- scale تدرج
- Solid جسم صلب
- Cube of water.

* Steps(A) Verification of Hooke's Law

1. Take the Zero reading of the pointer on the scale.
2. Add a weight of 10 grams & read the readings.
3. Repeat the last step by increasing the weights and record the readings of pointer.
4. Record these results in a table.
5. Draw a graph between m & ΔL

١- خذ حفر البندرج للمؤشر.

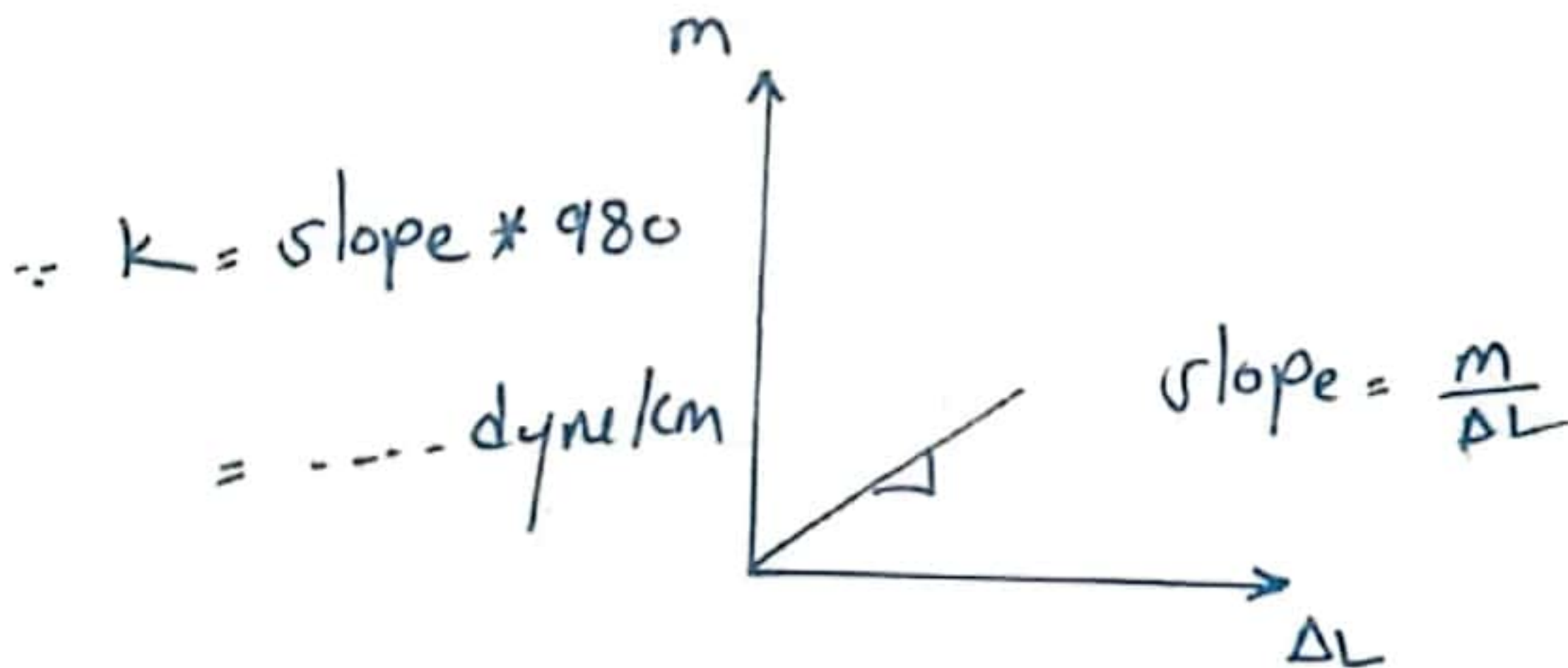
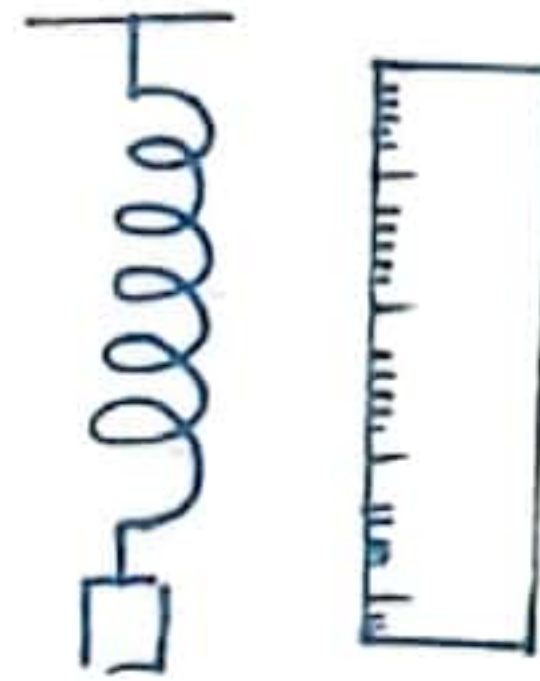
٢- اضع وزنه - اجرام ثم سجل لقراءة -

٣- كرر الخطوات السابقة بزيادة لوزنه وسجل لقراءة اوان .

٤- سجل النتائج في الجدول -

٥- ارسم رسم بياني بين m و ΔL .

m	ΔL
10	
20	
30	
↓	



[B] Determination of the Specific gravity of Solid by using Hook's Law.

1- Put the solid in the end of spring & calculate (ΔL)

- ضع الجسم الصلب من نهاية البندول ثم احس مقدار الاستطالة.

2- immerse the solid completely in the water beaker, without touching the wall or bottom, Find $(\Delta L)_w$

- انغمس الجسم الصلب كلياً في كأس الماء بدون أن يمس الجدار أو القاع ثم احس مقدار الاستطالة.

$$\therefore \text{Specific gravity} = \frac{(\Delta L)_a}{(\Delta L)_a - (\Delta L)_w}$$

اللزوجة "Viscosity"

* Aim :- Determination of viscosity Coefficient of Liquid. (1)

* Theory :-

→ viscosity :- the resistance of Liquid to Flow.

→ viscosity coefficient :- Tangential Force

between two layers of Flowing Liquid have the same area of the unity and the velocity gradient between them is one.

velocity gradient



$$F = \eta \left(\frac{\Delta v}{d} \right) A \Rightarrow \eta = \frac{F}{\frac{\Delta v}{d} A} \quad (\text{poise})$$

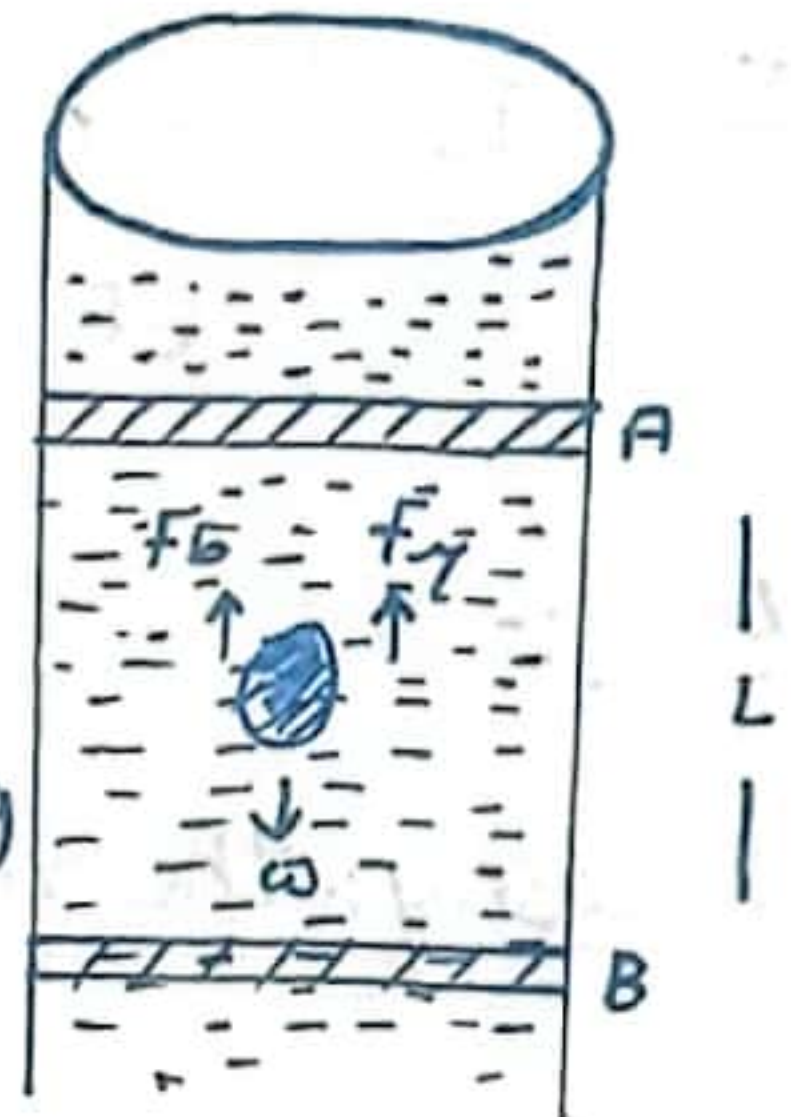
* Falling ball in Liquid.

→ this ball is affected by three forces

1) Downward force قوة للأسفل

- weight

$$W = m_s g = \rho_s V g = \rho_s \left(\frac{4}{3} \pi r^3 \right) g$$



2) Upward force

قوة لأعلى

- Up thrust force

قوة دفع

$$F_b = m_L g = \rho_L V g = \rho_L \left(\frac{4}{3} \pi r^3 \right) g$$

- Frictional force due to viscosity

قوة الاحتكاك
نتيجة اللزوجة

$$F_f = 6 \pi \eta r v$$

velocity of falling ball.

- when the ball fall with a uniform velocity,
there is equilibrium between the down ward
and the up ward forces.

في حالة سقوط الكرة بسرعة منتظمة ثابتة لا تتغير، تكون القوى
المؤثرة على الكرة متزنة تماماً.

* Down ward Force = Upward force

$$\omega = F_b + F_v$$

$$\therefore \omega - F_b = F_v$$

$$\rho_s \left(\frac{4}{3} \pi r^3 \right) g - \rho_L \left(\frac{4}{3} \pi r^3 \right) g = 6 \pi \eta r v$$

$$\frac{4}{3} \pi r^3 g (\rho_s - \rho_L) = 6 \pi \eta r v$$

$$\therefore \eta = \frac{2}{9} g (\rho_s - \rho_L) \frac{r^2}{v} \quad (\text{poise})$$

* Apparatus

- 1- Balls of different radii .
- 2- Liquid .
- 3- Ruler .
- 4- Long tube.
- 5- stop watch.
- 6- Micrometer .

* Steps

- ① Measure the radius of each ball by micrometer .
- ② Drop the first ball in the center of the tube , when the ball reaches mark (A)

Start the stop watch and when it reaches mark (B), stop the stop-watch, calculate the time (T).

③ Measure the distance (L) between two marks A & B.

④ Calculate the velocity of the Falling ball

$$V = \frac{L}{T}$$

⑤ Repeat steps 2, 3, 4 for each ball.

⑥ tabulate your Results.

⑦ Plot a curve between v^2 on y-axis and v on x-axis and calculate the v_{stop} and then calculate (g).

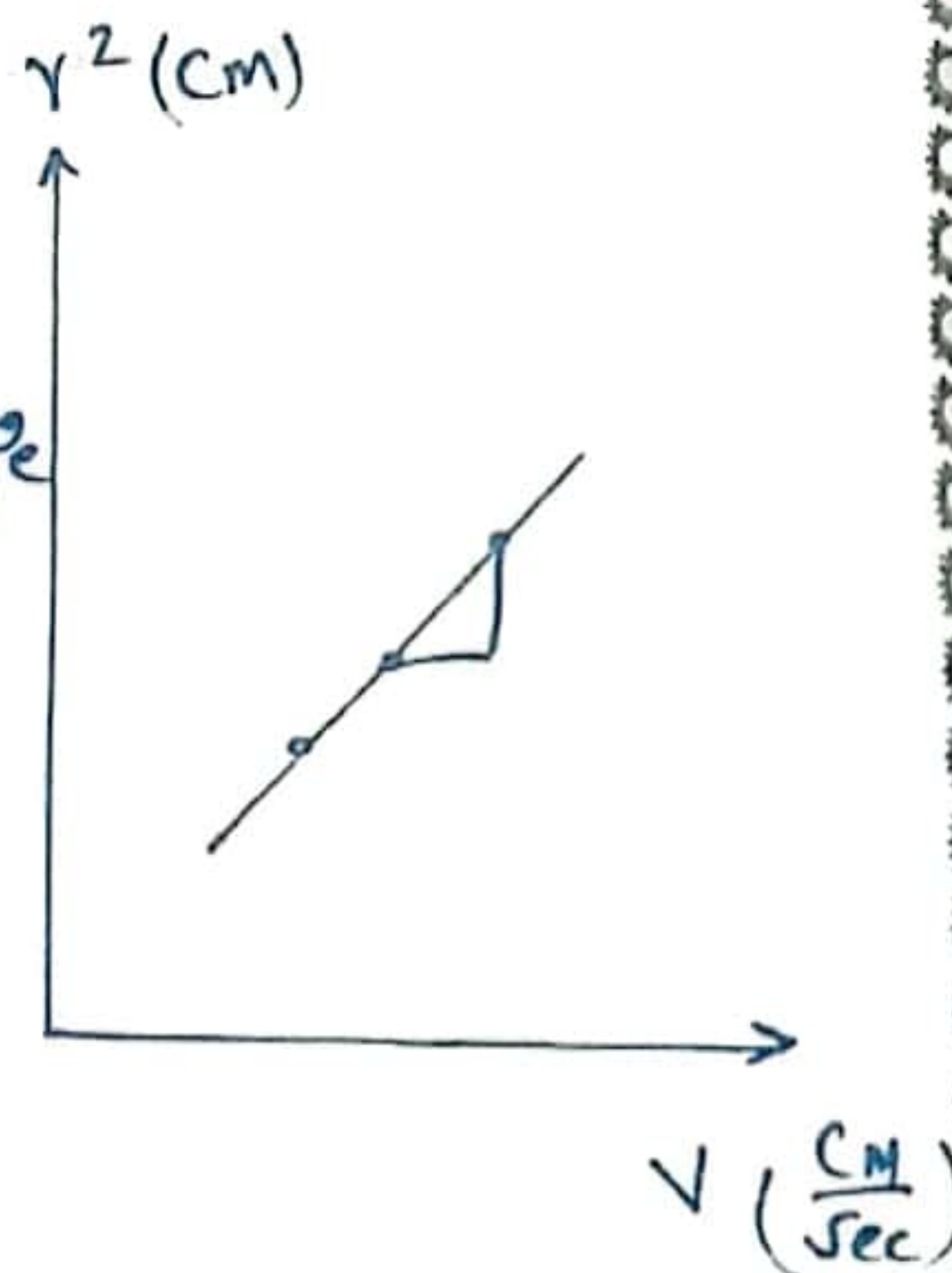
* Results

$L = \dots \text{cm}$

d	$r = \frac{d}{20}$	t	$v = \frac{L}{T}$

$\therefore \eta = \frac{2}{9} g (\rho_s - \rho_L) \times \text{slope}$

$\eta = \dots \text{poise.}$



Archimeds principle

AIME :- Determination of specific weight

of → Solid صلب
 → Liquid سائل
 → Cork فلين

THEORY :-

(1) Specific weight = $\frac{\text{weight of certain volume of matter}}{\text{weight of same volume of water}}$

(2) Archimeds principle :- " if body totally or partially immersed in liquid it will affect by up thrust force equal to the weight of displaced liquid "

إذا غمر جسم كلياً أو جزئياً في سائل فإنه سوف يتأثر بقوة دفع

تساوي وزن السائل المزاح

In case of total immers

(1*) Volume of immersed body = volume of displaced liquid.



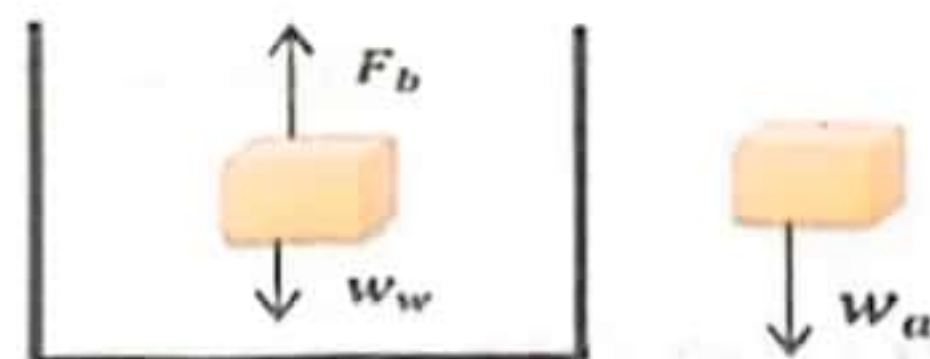
الصورة للتوضيح فقط

(2*) $F_b = \text{weight of displaced liquid}$

(3*) $F_b = \text{weight of displaced liquid}$

$$= w_a - w_w$$

(a) $F_b = M_l \cdot g$



$$\rho_l = \frac{m_l}{v} \longrightarrow m_l = \rho_l \cdot v$$

$$F_b = \rho_l \cdot v \cdot g$$

Up word force

$$w = m_s \cdot g = \rho_l \cdot v \cdot g$$

down word force

If $F_b > w$ $\rho_l > \rho_s$ Body Floats as Wood	If $F_b = w$ $\rho_l \approx \rho_s$ Body will not sink (hanged) يعلق	If $F_b < w$ $\rho_l < \rho_s$ Body will sink
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(3) S.W of solids

$$S.W = \frac{W_a}{W_a - W_w}$$

(4) S.W of liquid

$$S.W = \frac{W_a - W_l}{W_a - W_w}$$

(5) S.W of cork

$$S.W = \frac{(w_c)_a}{w_1 - w_2}$$

فلين

صلب

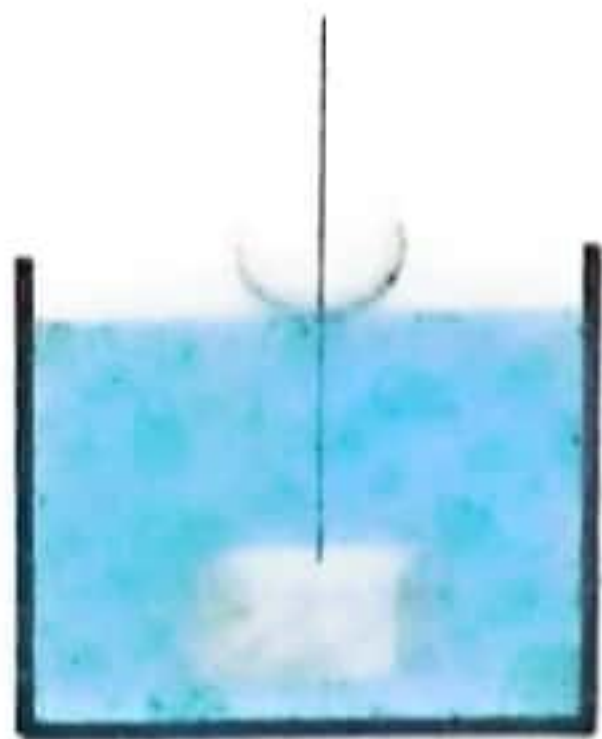
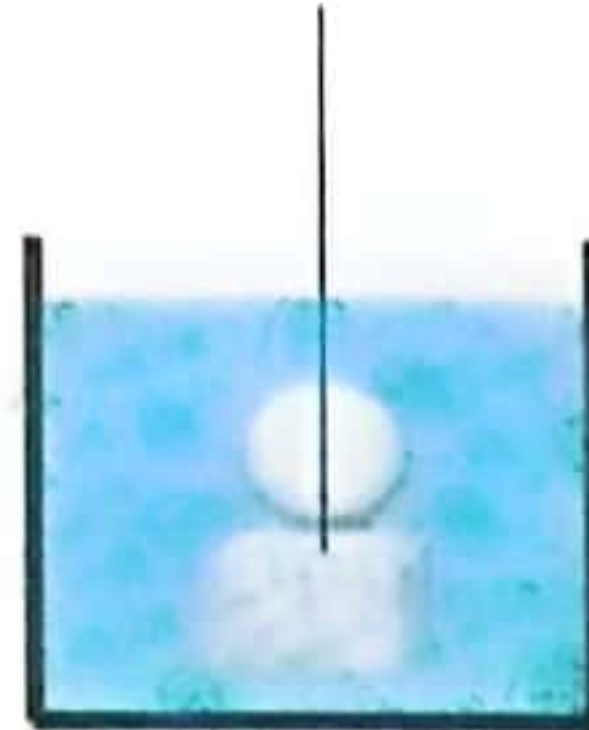


Figure (1)



w_1

w_2

$$(((w_c)_a + (w_s)_w))$$

$$(((w_c)_w + \cancel{(w_s)_w}))$$

APPARATUS :-

Balance – Solid – Liquid – Cork – Bridge – Weights .

STEPS :-

- (1) Find the weight of solid in air W_a .*
- (2) Find the weight of solid in water W_w .*
- (3) Find the weight of solid in liquid w_l*
- (4) Find the weight of cork in air $(w_c)_a$.*
- (5) Find w_1 & w_2 as shown in figure (1) .*
- (6) Substitute in previous laws and find $(S.W)_s$.*

RESULTS :-

$$W_a = \dots \text{ gm}$$

$$W_w = \dots \text{ gm}$$

$$W_l = \dots \text{ gm}$$

$$(w_c)_a = \dots \text{ gm}$$

$$W_1 = \dots \text{ gm}$$

$$W_2 = \dots \text{ gm}$$

$$(S.W)_s = \frac{W_a}{W_a - W_w} = \dots$$

$$(S.W)_l = \frac{W_a - W_l}{W_a - W_w} = \dots$$

$$(S.W)_l = \frac{(w_c)_a}{W_1 - W_2} = \dots$$

