ElCoM
ELECTRICAL COMPUTER MECHATRONICS

تقدم لجنة ElCoM الاكاديمية

تلخيص لمادة:

مختبر فيزياء عامة عملية

جزيل الشكر للطالب:

امين ناصر

✳ Experimental Error And Data analysis :-

A. Types of Errors :- ⇒ ليه

B. Accuracy and precision

A. Types of Errors :-
- personal errors
- systematic errors
- Random errors

* personal errors :- also called illegtimate errors

reasons :-
- Carelessness in reading an instrument
- Carelessness in recording observations
- Carelessness in mathematical calculat

Examples of personal errors
- Observer become biased in favor the first observation
- Error In reading scale (زي مثال)
- Not observing significant figure

* Systematic errors :- associated with instruments and techiques of measurement.

Examples of systematic errors

- Unzeroed instrument (Balance or ammeter)
- Thermometer reads 101° when immersed in boiling water
- observer takes low reading of scale devision.
- meter stick has shrunk

* Random errors ~~are~~ result from unknown and ~~unp~~ Unpredictable variations in experimental situation. (also called accidental errors)

include

- Unpredictable Fluctuation in temperature or line Voltage
- Mechanical Vibrations
- Unbiased estimate of measurement readings by observer

B. Accuracy and precision:

Accuracy: الدقة

[How close the experimental result comes to true value]

Ex: $\pi = 3.12$ is more accurate than $\pi = 3.05$.

precision: الضبط

[How much results are close to each other]

ويتم التعبير عنها بحساب نسبة الخطأ

⇐ {uncertainty} , {error}

Calculations of uncertainty (error)

Physical quantities {الكميات}

1. Derived {محسوبة} مشتقة
   - Ex: [Velocity, density ...]
2. measured مقاسة
   - Ex: [mass, temprature ...]

(1) measured quantities

- **Single measurement**
  - مقاسة مرة واحدة
  - ⇐ نركز على نوع الأداة
  - **Degital instrument** (أداة رقمية)
    - Ex: [Degital balance]
    - ⇓ error = smallest devision
  - **analytical instrument** (أداة مدرجة)
    - Ex: [ruler, caliper, micrometer]
    - ⇓ error = $\frac{1}{2}$ smallest devision
- **many measurments**
  - مقاسة لعدة مرات
  - ⇓ error = standared daviation (انحراف معياري) (S.D)

* Determining Error for measured quantities:-

S.D: الإنحراف المعياري

1. Calculate Average Value = $\frac{\text{مجموع القيم}}{\text{عددها}}$

2. Make table:

Trial no. (رقم التجربة)	X	$X-\bar{X}$	$(X-\bar{X})^2$
1			
2			
3			
⋮			$\Sigma(X-\bar{X})^2$

* N_{Tot} =

→ X: نتيجة التجربة

$\bar{X}$: القيمة المتوسطة (Avg value)

N: عدد المحاولات (عدد التجارب)

3. $S.D = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N(N-1)}}$

→ analytical and degital instruments:- الأدوات

Instrument	Analytical/Degital	smallest devision
ruler مسطرة	Analytical	1mm
Caliper ورنية micrometer	Analytical	0.05 mm 0.01 mm
Degital balance	Degital	0.01 g

* Determining Error for derived quantites:-

1) $R = X \pm y \rightarrow \Delta R = \sqrt{(\Delta x)^2 + (\Delta y)^2}$

2) $R = X * y$ or $X/y \rightarrow \Delta R = R\sqrt{\left(\frac{\Delta X}{X}\right)^2 + \left(\frac{\Delta y}{y}\right)^2}$

3) $R = X^n \rightarrow \Delta R = R\, n\left(\frac{\Delta X}{X}\right)$ → كثير الحدود اضرب بالأس

Ex:- $R = a/b^2$

$\Delta R = R\sqrt{\left(\frac{\Delta a}{a}\right)^2 + \left(\frac{2\Delta b}{b}\right)^2}$ → كثير الحدود اضرب بالأس

* Percent error

$= \left|\frac{E-A}{A}\right| * 100\%$

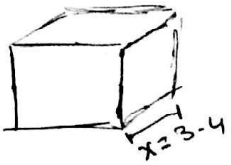
E → Experimental value → Ex:- g=10

A → Accepted value → Ex:- g=9.8

Examples:-

① A student measures the length of a cube side to be 3.4 ± 0.1 then the volume of cube $V \pm \Delta V$ (in cm^3) will be :-

→ Solution:-



$V = X^3$ ⟹ قانون حجم المكعب

$\rightarrow V = (3.4)^3 = 39.3$

$\Delta V = 3V\left(\frac{\Delta X}{X}\right)$ ⟹ كثير حدود

$= 3(39.3)\left(\frac{0.1}{3.4}\right) = 3.468$

$\rightarrow V \pm \Delta V = 39.3 \pm 3.47$

② A series of measurements made to determine $\bar{\pi}$.

The results were: 3.11, 3.12, 3.13, 3.14 and 3.15.

The value of $\bar{\pi} \pm \Delta\bar{\pi}$ will be

← في هذا السؤال نوع الكمية هو كمية متغيرة عدة مرات

⟹ solution:

$\bar{\pi} \pm \Delta\bar{\pi}$

Calculate Arg. Value — standerved daviation

$\text{Avg Value} = \frac{15.65}{5} = 3.13$ → مجموع القيم / عددها

$\Delta\bar{\pi}$:

① $\pi_{avg} = \bar{\pi} = 3.13$

② Table

Trial no.	π	$\pi - \bar{\pi}$	$(\pi - \bar{\pi})^2$
1	3.11	0.02	$4*10^{-4}$
2	3.12	0.01	$1*10^{-4}$
3	3.13	0	0
4	3.14	0.01	$1*10^{-4}$
5	3.15	0.02	$4*10^{-4}$

$\rightarrow \Sigma(\pi - \bar{\pi})^2 = 10*10^{-4}$

$\Delta\bar{\pi} = \sqrt{\frac{10*10^{-4}}{5(4)}} = 0.007$

$\bar{\pi} \pm \Delta\bar{\pi} = 3.13 \pm 0.007$

③ **Two independent experiments give two sets of data for earth acceleration "g" with the expressed results and uncertainties of 9.8±0.5 and 9.7±0.1 m/s². Respectively.(the accepted value of g=9.8ms⁻²)**

(2 marks)

a) **The accuracy and the precision of the second experiment is better than the first.**
b) **The accuracy and the precision of the first experiment is better than the second.**
c) **The second experiment is more precise than the first.** ✓
d) **The first experiment is more precise than the second.**
e) **The second experiment is more accurate than the first.**

7-Measurement & Uncertainties:

معناها أقطار

A- Five measurements of the volume of a disk (diameter, d and thickness, t) were made. Let the fractional errors in d and t be A (i.e. A= Δd/d) and B (i.e. B = Δt/ t) respectively. Then the fractional error in the volume is:

a- $(4A+B)^{1/2}$ **b- $4A^2+B^2$**

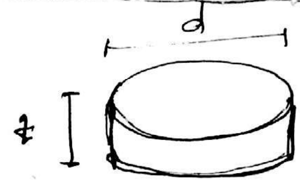
c- $(4A^2+B^2)^{1/2}$ **d- (A^2+B^2)**

B-

- **The error in the Micrometer reading for a single measurement is:-----** 0.005
- **The error in the Vernier caliper is:------** 0.025

Solution :-

A :-



$V = \pi \left(\frac{d}{2}\right)^2 t$ → حجم أسطوانة (ط نق²) × ع

$\frac{\Delta V}{V} = \sqrt{\left(\frac{2\Delta d}{d}\right)^2 + \left(\frac{\Delta t}{t}\right)^2}$ → notic that $\frac{\Delta d}{d} = A$ and $\frac{\Delta t}{t} = B$

→ $\frac{\Delta V}{V} = \sqrt{4\left(\frac{\Delta d}{d}\right)^2 + \left(\frac{\Delta t}{t}\right)^2}$

$\frac{\Delta V}{V} = (4A^2 + B^2)^{\frac{1}{2}}$

✳ Analysis and collection of data

① عند تمثيل العلاقة (A Vs B) ← يكون المتغير الذي يسبب (VS) على محور الصادات ويسمى {dependent variable}
والمتغير الذي عينه VS على محور السينات ويسمى {independent variable}

② $\text{slope} = \frac{\Delta y}{\Delta x}$ → ميل المستقيم

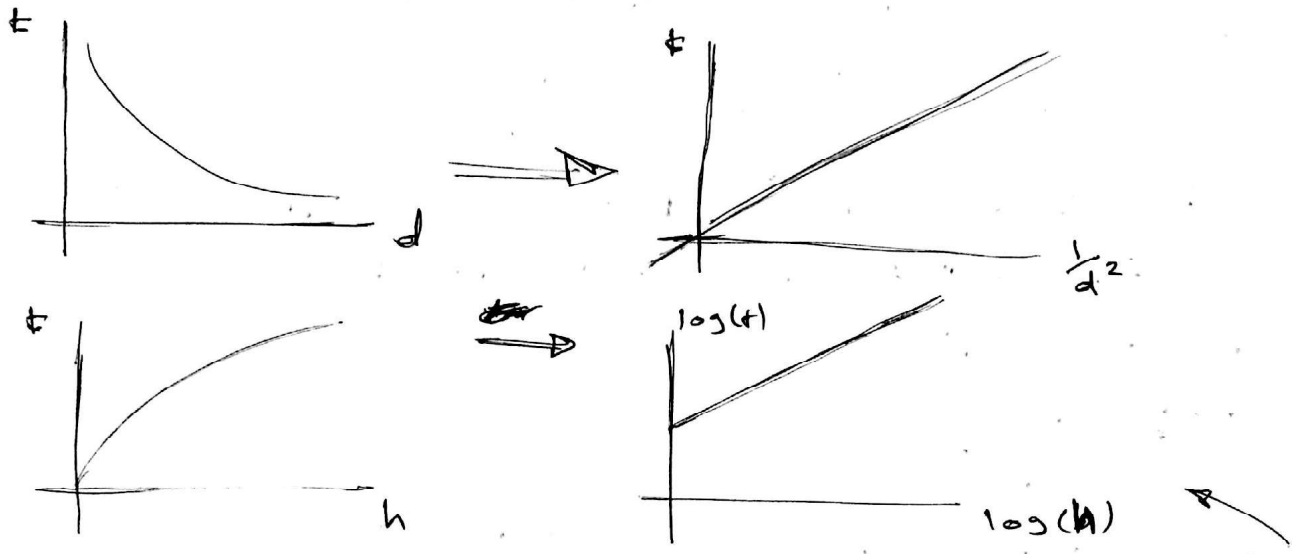
③ linear relationship

$y = mx + b$

$m \Rightarrow$ slope

$b \Rightarrow$ y-intercept

How to make Unlinear relation become linear



* مش مهم كتير نسب للعلم .

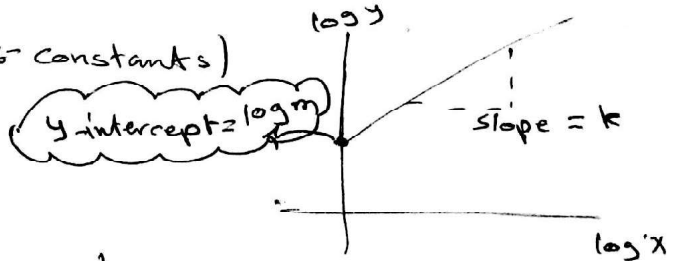
Ex:- $y = mx^k$ → not linear relation

* Use (log) to make it linear

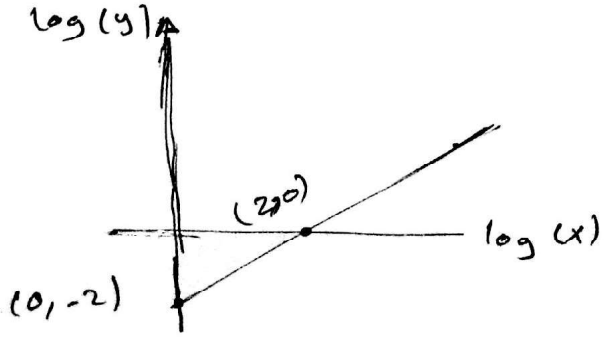
$\log y = \log mx^k$ → (m, k :- constants)

$= \log m + \log x^k$

$\log y = \log m + k \log x$



Ex:- Find empirical relation for the graph



Soln:- $y = mx + b$

$\log(y) = \log x - 2$

$10^{\log(y)} = 10^{(\log x - 2)}$

$y = 10^{\log x} \div 10^2$ → عند قسمة نطرح الأسس

→ $y = x \div 100$ ⑥

$m = \frac{0-(-2)}{1^2} = 1$

$b = -2$

Ex:-

The relation between the time needed to empty container and the depth of the water is given by $t = c\sqrt{h}$ where c is constant. For a certain depth the time needed is 8 sec, if the depth is halved then the time in (sec) needed to empty the container is: **(2 marks)**

a) 3.4 b) 1.73 c) 4.2 d) 5.6 e) 2.6

Solution:-

relation $\Rightarrow t = c\sqrt{h}$

depth	time
h	8
$h/2$	??

$8 = c\sqrt{h}$ ⟶ المحاولة (التجربة) الأولى

$t = c\sqrt{h/2}$ ⟶ المحاولة (التجربة) الثانية

نقسم التجربة الثانية على التجربة الأولى للتخلص من (c, h)

$$\frac{t}{8} = \frac{c\sqrt{h/2}}{c\sqrt{h}} \Rightarrow \frac{t}{8} = \frac{\sqrt{h}}{\sqrt{2}\sqrt{h}} \Rightarrow t = \frac{8}{\sqrt{2}} = 5.65$$

Ex:- Given that $Z = kX^n$ (k, n : constants) if you plot (log z) vs (log x) to get straight line, then:

1- Find y-intercept

2- Find slope

soln:- $\log Z = \log(kX^n)$

$\log Z = \log k + \log X^n \Rightarrow \log Z = \log k + n \log X$

$y = b + mx$

$\log k \rightarrow$ y-intercept

$n \rightarrow$ slope

✳ Measurements and uncertainties

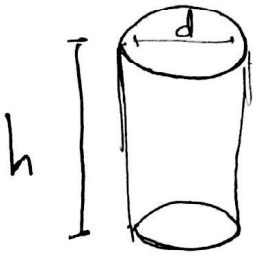
A. Measurement of π

B. Determination of Density (ρ)

A. Measurement of π :-

1- measure the diameter using Vernier caliper

2 - measure the circumference by wrapping a paper tape around it and then measure the length of tape using a meter stick



3- $C = \pi d$ C: المحيط

$\rightarrow \pi = \frac{C}{d}$ d: القطر

$$\Delta\pi = \pi \sqrt{\left(\frac{\Delta C}{C}\right)^2 + \left(\frac{\Delta d}{d}\right)^2}$$

B. Determination of Density (ρ)

1- measure the mass of the cylinder using degital balance

2- measure the length (h) using vernier caliper

3- measure (d) using micrometer

4- $\rho = \frac{m}{V} \rightarrow$ الكتلة / الحجم = الكثافة

5- $V = \pi \left(\frac{d}{2}\right)^2 h \rightarrow$ d → القطر، h → الارتفاع

$$\rightarrow \rho = \frac{4m}{\pi d^2 h}$$

$$\Delta\rho = \rho \sqrt{\left(\frac{\Delta m}{m}\right)^2 + \left(\frac{\Delta\pi}{\pi}\right)^2 + \left(\frac{\Delta h}{h}\right)^2 + \left(\frac{2\pi d}{d}\right)^2}$$

* ملاحظة : غالباً في السؤال يعطى (m, h, d) ويطلب π

نفترض أن $\frac{\Delta\pi}{\pi} = 0$ ونلغي من القانون .

* اتبع الرابط لشرح قراءة الميكرومتر ← hctmetrology.tripod.com/chap4.htm

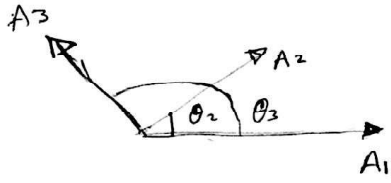
* اتبع الرابط لشرح قراءة الورنية ← hctmetrology.tripod.com/chap3.htm

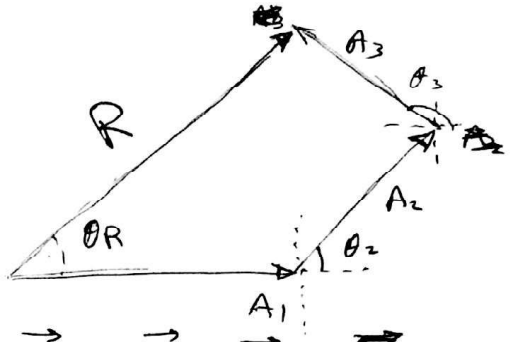
✱ Vectors :- Force table

Vector addition

A. Graphical method | B :- components method | C :- Force table

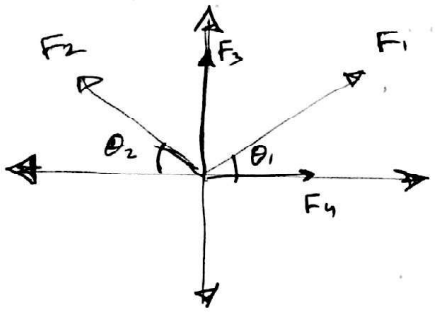
A. Graphical method :-





$$\vec{R} = \vec{A_1} + \vec{A_2} + \vec{A_3}$$

B. Components' method



$F_{1x} = F_1 \cos\theta_1$

$F_{2x} = -F_2 \cos\theta_2$ ← بإشارة السالب

$F_{3x} = 0$

$F_{4x} = F_4$

$F_{1y} = F_1 \sin\theta_1$

$F_{2y} = F_2 \sin\theta_2$

$F_{3y} = F_3$

$F_{4y} = 0$

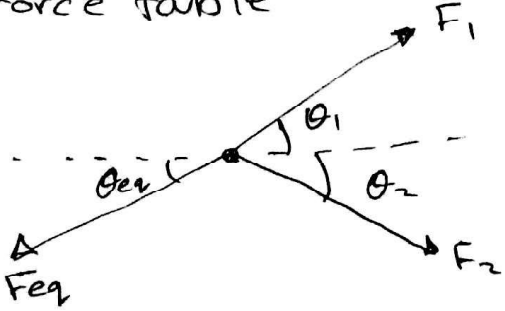
$$R_x = \sum F_x = F_{1x} + F_{2x} + F_{3x} + F_{4x}$$
$$= F_1\cos\theta_1 - F_2\cos\theta_2 + 0 + F_4$$

$$R_y = \sum F_y = F_{1y} + F_{2y} + F_{3y} + F_{4y}$$
$$= F_1\sin\theta_1 + F_2\sin\theta_2 + F_3 + 0$$

$$\tan\theta_R = \frac{\sum F_y}{\sum F_x}$$

$$R = \sqrt{(R_x)^2 + (R_y)^2}$$

C. Force table



$\vec{F}_{Resultant} = -\vec{F}_{equilibrium}$

$\theta_{Resultant} = \theta_{equilibrium} \pm 180$

$F_{Resultant}$:- القوة المحصلة

$F_{equilibrium}$:- القوة الموازنة

Notes:-

Inaccuracy in force table:-

1- systematic error → major source

2- Friction from string on table

3- string may make a difference if its weight over comes Friction.

Ex:- 2) In force table experiment. The magnitude and direction of equilibrant force (القوة المتزنة) for a system consist of two forces; $|F_1| = 10$ N, $\theta_1 = 60°$ and $|F_2| = 13$ N; $\theta_2 = 240°$ will be:

a) 5N, [illegible] b) 3N, 60 c) 2N, 60 d) 2N, 240

Soln:- $F_1 = 10$, $\theta_1 = 60°$

$F_2 = 13$, $\theta_2 = 240$

$F_{1x} = 10\cos 60$

$F_{2x} = 13\cos 240$ → $\Sigma F_x = -1.5$

$F_{1y} = 10\sin 60$

$F_{2y} = 13\sin 240$ → $\Sigma F_y = -2.6$

$F_R = \sqrt{(2.6)^2 + (1.5)^2} = 3$

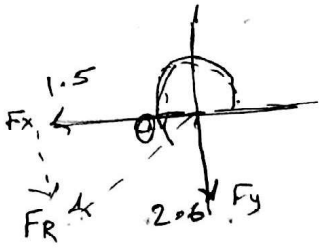
$\tan\theta = \frac{2.6}{1.5} \rightarrow \theta_R = 240°$

$\theta_{eq} = 240 - 180 = 60$

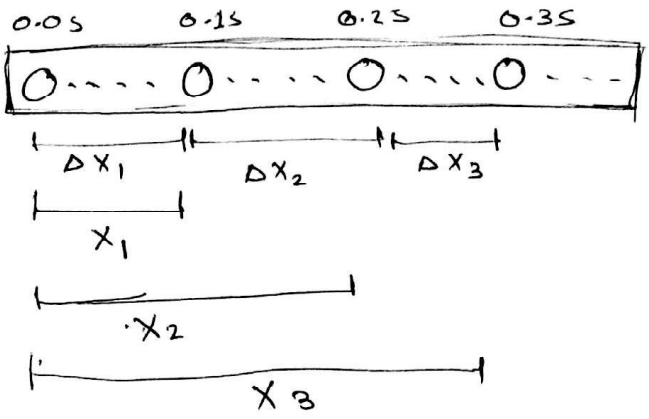
Notice that

$|F_R| = |F_{eq}|$

* حل السؤال هو القوة المحصلة F_R وضدها هو القوة المتزنة F_{eq}



✱ Kinematics of Rectlinear Motion :-

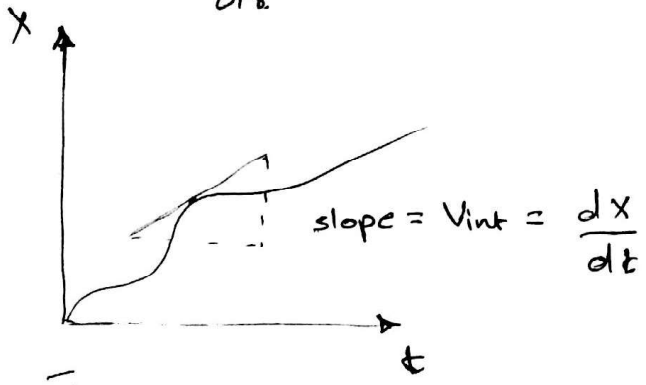


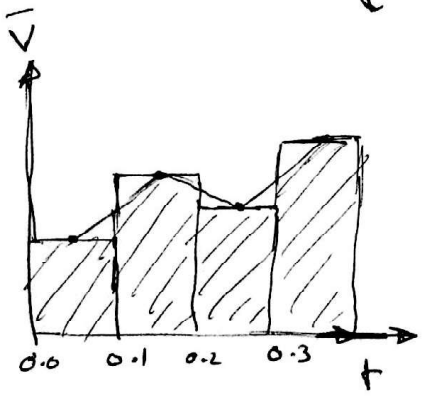
$\bar{V} = \frac{\Delta X}{\Delta t}$ ← السرعة المتوسطة

$V_{int} = \frac{dX}{dt}$ ← السرعة اللحظية

$\bar{a} = \frac{\Delta V}{\Delta t}$ ← التسارع المتوسط

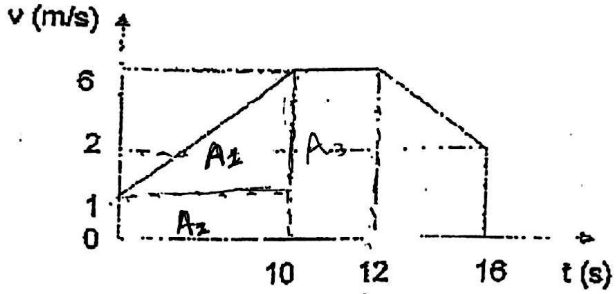
$a_{int} = \frac{dV}{dt}$ ← التسارع اللحظي





* Area = distance
* Accelaration in [0.05 - 0.15] has positive value.
* Accelaration in [0.15 - 0.25] has negative Value.

the experiment on the Kinematics of Rectilinear Motion, the following elocity versus time graph was obtained as below. Use this figure to answer the following questions:



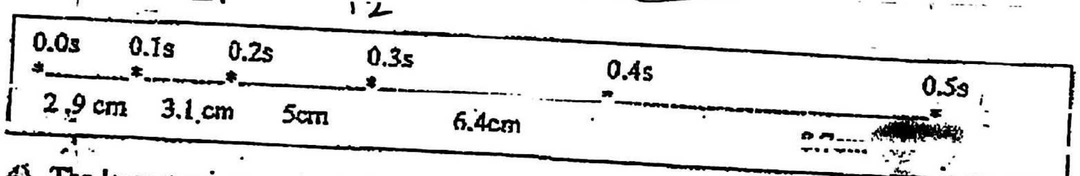
a) The total distance traveled in the first 12 seconds is: **(2 marks)**
   a) 35m b) 25m (c) 47m d) $35m^2$ e) $47m^2$

b) The average acceleration in the time interval t = 0 to t = 12 second is **(2 marks)**
   a) $1.5ms^{-2}$ b) $0.75\ ms^{-2}$ c) $0.51\ ms^{-2}$ d) $0.06\ ms^{-2}$
   (e) $0.42\ ms^{-2}$

Sol :- ⓐ distance = area under curve

$A_1 = \frac{1}{2}(10)(5) = 25$
$A_2 = 1(10) = 10$
$A_3 = 2(6) = 12$
$\Rightarrow A_{total} = 25 + 10 + 12 = \boxed{47\ m}$

ⓑ $\bar{a} = \frac{\Delta V}{\Delta t} = \frac{6-1}{12} = 0.42\ (m/s^2) \to ms^{-2}$



4) The largest average velocity in (cm/sec) is:
   a) 20 b) 31 c) 64 (d) 87

5) The velocity (in cm/ sec) at 0.35 second is:
   a) 29 (b) 64 c) 32 d) 30

6) The smallest value of accelaration (in cm/s^2) is:
   a) 23 b) 14 (c) 20 d) 19

Sol :-

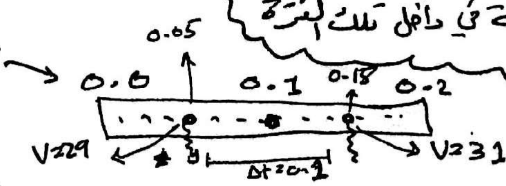
④ الزمن متساوي لذلك الإزاحة الأكبر تعطي سرعة أكبر
interval [0.4 – 0.5] ⟶ $V = \frac{\Delta X}{\Delta t} = \frac{8.7}{0.1} = 87$

⑤ t = 0.35 belongs to interval [0.3 – 0.4] so

$V|_{t=0.35} = V_{0.3-0.4} = \frac{\Delta X}{\Delta t} = \frac{6.4}{0.1} = 64$

(السرعة المتوسطة للفترة كاملة مساوية للسرعة اللحظية لأي نقطة في داخل تلك الفترة)

⑥ ΔX أقل إزاحة في ΔX
ابحث عن فترتين متتاليتين بينهما أقل فرق في الإزاحة
اعمل فترة جديدة من منتصف الفترة الأولى إلى منتصف الفترة



$a = \frac{\Delta V}{\Delta t} = \frac{31-29}{0.1} = 20$

(12)

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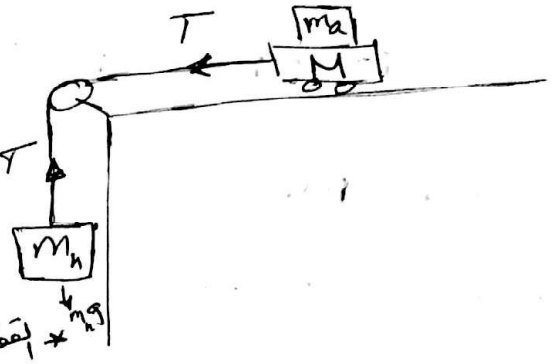
✱ Force and motion :-

① constant driving Force :-

$m_a \rightarrow$ added mass → كتلة متغيرة في التجربة

$m_h \rightarrow$ hanging mass → كتلة ثابتة في التجربة

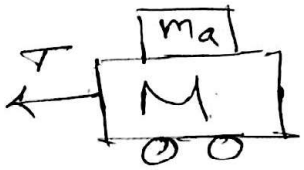
$M \rightarrow$ mass of cart → كتلة العربة



* القوة التي تسبب الحركة في النظام تسمى "driving Force" وهي ثابتة في هذه الحالة (قوة الوزن لـ m_h)

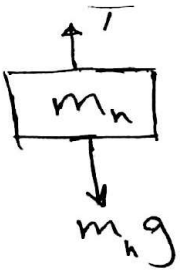
$\Sigma F = m a$ ← قانون نيوتن الثاني

$$T = (M + m_a)\, a \rightarrow (1)$$



$\Sigma F = ma$

$$T - m_h g = m_h a \rightarrow (2)$$

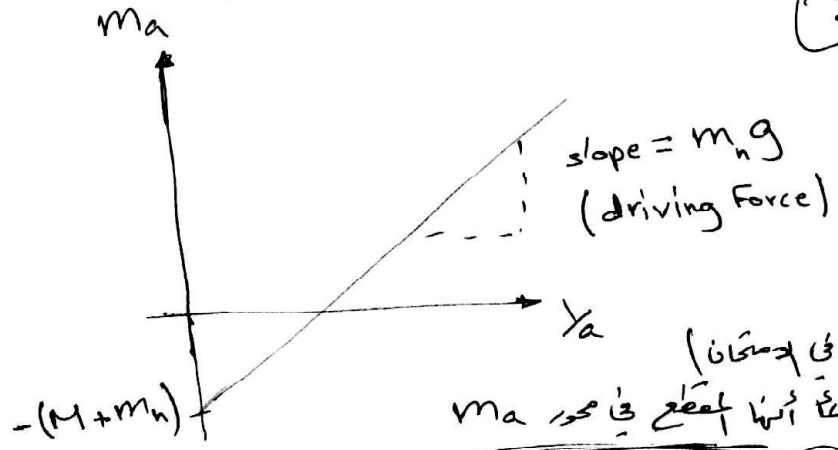


Solving (1) and (2)

$$\rightarrow m_a = m_h g \cdot \frac{1}{a} - (M + m_h)$$

$y = \text{slope} \times + b$

* ملاحظة : يتغير متغير في التجربة



* ملاحظات مهمة عالرسمة :

① انتبه عالمحاور (ممكن أن تطلب في الامتحان)

② ركز عالـ $(M + m_h)$ وتذكر دائماً أنها تقطع في محور m_a

③ لتسهيل الحفظ اعتبر أن $m_a a = m_h g$ وحد بيل عالهذا الأساس

④ driving Force $= m_h g$

(2) Constant total mass

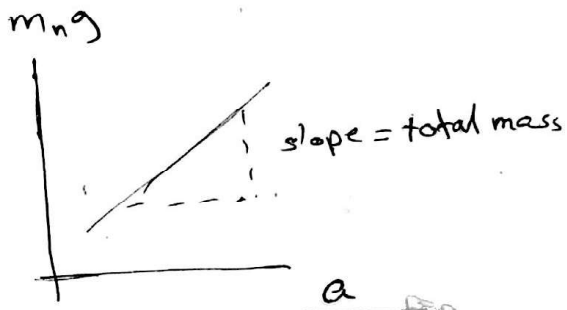
* $m = (M + m_a + m_n)$ → constant

* $a \propto m_n g$ → $a, m_n g$ → متغيرات في هذه الحالة

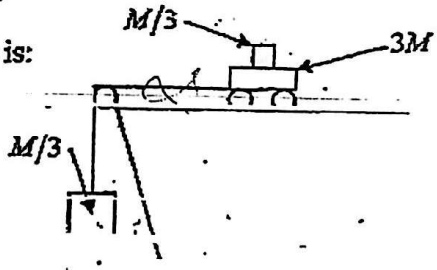
$m_n g = (M + m_a + m_n) a$

$y = \text{slope} * X$

Note: $a = \frac{m_n g}{\Sigma M}$ ← مجموع الكتل



If you have the following setup for force and motion ... answer questions 12 and 13. (NOTE: the friction force is neglected.) 4 Mark



12) The force acting on the system (driving force) is:

(a) Mg/3
(b) 11 Mg/3
(c) Mg/4
(d) 9Mg/2

13) The acceleration of the group is:

(a) g/18
(b) g/4
(c) g/11
(d) 3g/4

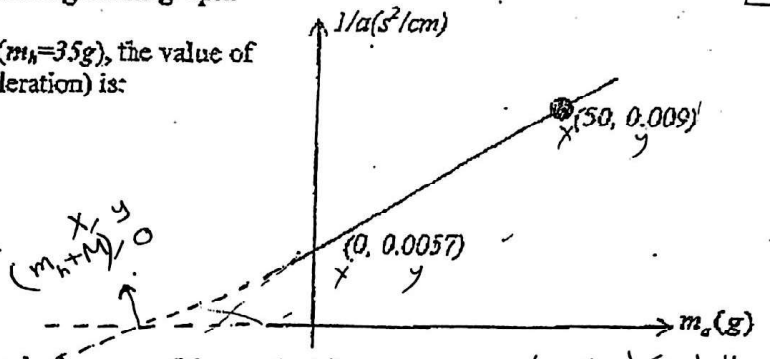
Sol: 1- driving force = $m_n g$

$= M/3 * g = Mg/3$

2- $a = \frac{m_n g}{\Sigma M} = g/11$

ΣM ← $\frac{M}{3} + \frac{M}{3} + 3M$ ...

In the force and motion experiment; a student obtained the following graph, *answer questions 10 and 11 depending on the graph.* 2 Mark



10) If the hanging mass (m_h=35g), the value of g (gravitational acceleration) is:

(a) 980.0cm/s²
(b) 432.9cm/s²
(c) 606.1cm/s²
(d) 1000cm/s²

11) From the previous graph, the mass of the car (m_c) is:

(a) 51.4kg
(b) 61.4kg
(c) 51.4g
(d) 61.4g

sol: (10) $m_h g = m_a a$ → (تبعت تسهيل الحفظ)

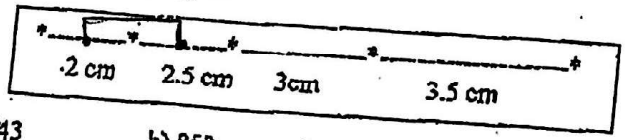
⇒ $m_a a = \frac{\Delta X}{\Delta y} = \frac{50-0}{0.009-0.0057} = 15151.5151$ = 1/slope

$m_h g = 15151.51\ldots$ ⇒ $m_h = 432.9$

(11) Remember that the m_a − intercept = $M + m_h$

From slope → $\frac{0.009-0.0057}{50} = \frac{0.0057-0}{0-(m_h+M)}$ ⇒ M = 51.4 g

10) The ticker tape shown below is for a 800 g cart pulled by a hanging mass m_h. The time interval between any two consecutive points is 0.1s and g=980 cm/s².



a) 43 b) 853 c) 53 d) 753.

$a = \frac{\Delta v}{\Delta t} = \frac{2.5-2.0}{0.1} = 5.0$

sol ⇒ $M_h g = (M + m_a + m_h)a$ (800)

$\frac{M_h g}{a} - M_h = 800$

$\frac{M_h(980)}{5} - M_h = 800$ ⇒ $M_h = 43$

(15)

✳ Collision in two Dimensions

➡ Momentum :-

$$\vec{P} = m\vec{v} \Rightarrow [P] = \frac{kg \cdot m}{s} * \left(\frac{s}{s}\right) = N \cdot s$$

✳ Elastic collision's properties :-

1- Conservation of momentum :-

$$\sum \vec{P}_{\text{before collision}} = \sum \vec{P}_{\text{after collision}}$$

Momentum on X-axis

$$\sum \vec{P}_{x\ \text{before}} = \sum \vec{P}_{x\ \text{after}}$$

Momentum on Y axis

$$\sum \vec{P}_{y\ \text{before}} = \sum \vec{P}_{x\ \text{after}}$$

● Remember that :- Momentum is vector quantity

2- Conservation of ~~kinetic~~ kinetic energy

$$KE = \frac{mv^2}{2}$$

kinetic energy

$$\Rightarrow KE_{\text{before}} = KE_{\text{after}} \Rightarrow \frac{1}{2} m_1 v_{1i}^2 + \frac{1}{2} m_2 v_{2i}^2 = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2$$

● Note :- $KE = \frac{1}{2} mv^2$

$P = mv$ $\Rightarrow$ $KE = \frac{P^2}{2m}$

Ex:- The horizontal component of the velocities of the both of the balls :-

a) change with time b) reduces to zero

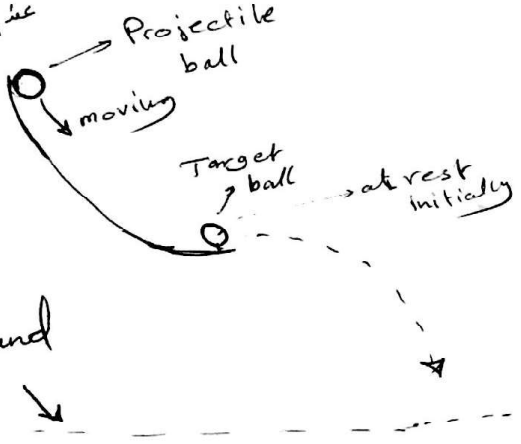
c) remains unchanged d) has zero initial value

Ans:- (c) because he asked about velocities of both balls

$\Rightarrow \sum_{\text{before}} M V_x = \sum_{\text{after}} M V_x$ and mass remains const

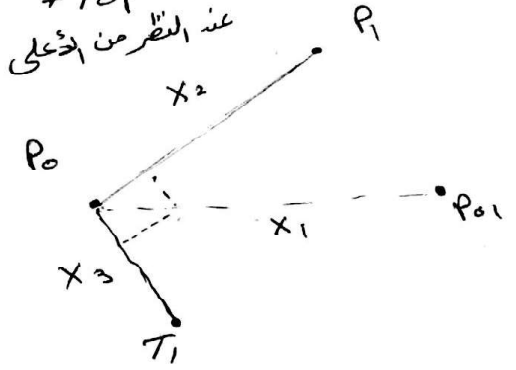
∴ Velocities have to remain const.

* side view عند النظر من الجانب



* وصف و ملاحظات حول التجربة :

* Top view عند النظر من الأعلى



* عند اسقاط Projectile إسقاطاً حراً من الحفر فإنها تسقط في النقطة P_{01}

* عند اجراء التصادم فإن Projectile تسقط في النقطة P_1

* Target تسقط في النقطة T_1

* عند تطبيق مبدأ حفظ الطاقة ومبدأ حفظ الزخم نستنتج أن

$\vec{X}_1 = \vec{X}_2 + \vec{X}_3$ ← مبدأ حفظ الزخم ؛ $X_1 = \sqrt{X_2^2 + X_3^2}$ ← مبدأ حفظ الطاقة الحركية

* دائماً الزاوية بين X_2 و X_3 هي زاوية قائمة .

* لحساب الوقت اللازم لوصول الكرتين إلى الأرض إستخدم معادلة الحركة ($g = 9.8 \approx 10$)

$$\Delta y = V_{iy} * t + \frac{1}{2} g t^2$$

$V_{iy} = 0$

لأنه عند الخروج من الحفر السرعة y تكون صفر

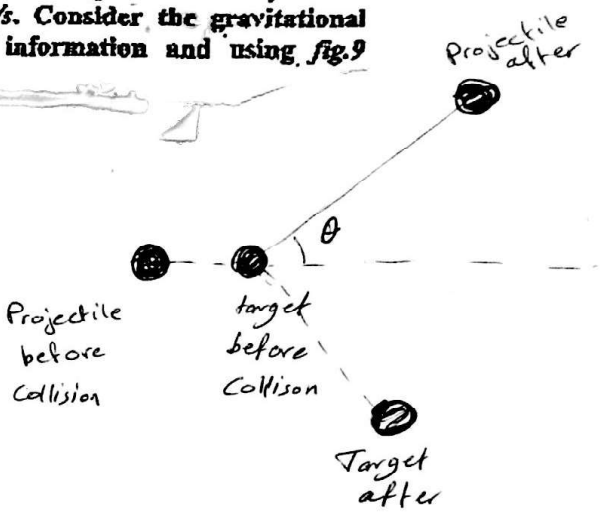
$$\Rightarrow \Delta y = \frac{1}{2} g t^2$$

$$\Rightarrow t = \sqrt{\frac{2 \Delta y}{g}}$$

Δy :- ارتفاع الطاولة (h)

Ex:-

The experimental results for two collided balls of equal masses ($m = 25g$) from height 80cm were obtained. The initial and final velocity of the projectile ball is 50m/s and 40m/s, respectively. The target is stationary before collision and the final velocity of it is 30m/s. Consider the gravitational acceleration $g = 10m/s^2$. Depending on these information and using *fig.9* answer questions (1) : (3).



(1) The time needed of the balls to hit ground :-

$$T = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 * 80 * 10^{-2}}{10}}$$

$$= 0.4 \text{ seconds}$$

(2) The momentum before collision for the target :-

$P = M\vec{V}$ (V_i for target = zero)

$\Rightarrow P = M(0) = 0$

(3) Find angle θ

$\Rightarrow$ You have 2 methods :-

First method :-

$$\sum P_x \text{ before} = \sum P_x \text{ after} \Rightarrow \boxed{(m_1V_1 + m_2V_2)_{\text{before}} = (m_1V_1 + m_2V_2)_{\text{after}}}$$

← الطرف الأيمن فقط

$\Rightarrow \sum P_y \text{ before} = \sum P_y \text{ after} \Rightarrow$ نفس الكلام

Numirically $\Rightarrow$ X-axis :-

$\Rightarrow 2/5 * 50 = 2/5 * 40\cos\theta + 2/5 * 40\sin\theta$

$50 = 40\cos\theta + 30\sin\theta \rightarrow (1)$

y-axis :- $\Rightarrow 0 = 40\sin\theta - 30\cos\theta$

$\Rightarrow 40\sin\theta = 30\cos\theta \rightarrow (2)$

حل المعادلتين (1) و (2) استخدم قوانين أو تعويض

أو بامكانك قسمة أطراف المعادلة (2) على cos وأخذ $\tan^{-1}$

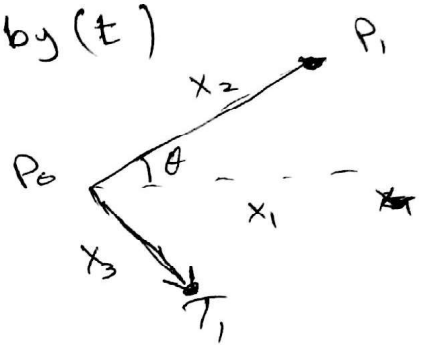
$\theta = 36.86°$

second Method :-

Since

$\vec{X_1} = \vec{X_2} + X_3 \Rightarrow$ and dividing by (t)

we have $\vec{V_1} = \vec{V_2} + \vec{V_3}$



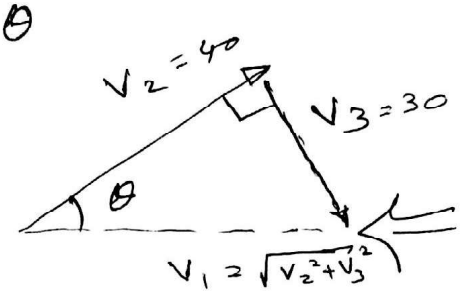
then you can obtain θ

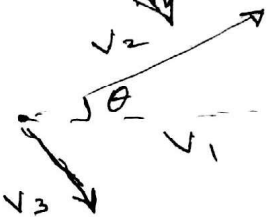
by :-

(1) $\tan^{-1}\theta = \frac{30}{40}$

(2) $\cos^{-1}\theta = \frac{40}{50}$

(3) $\sin^{-1}\theta = \frac{30}{50}$

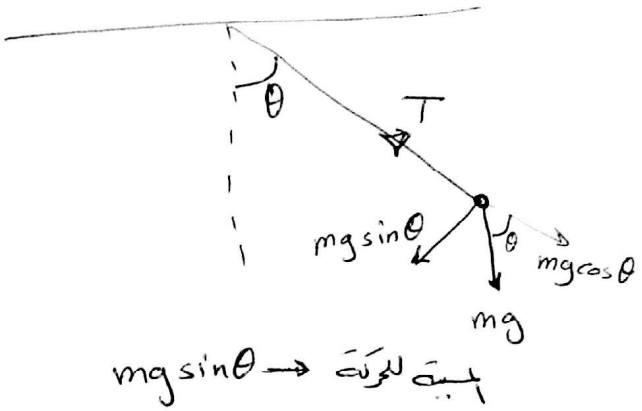




ملاحظة : لا تخاف من شرح السؤال كتير بسيط وبتكرر .

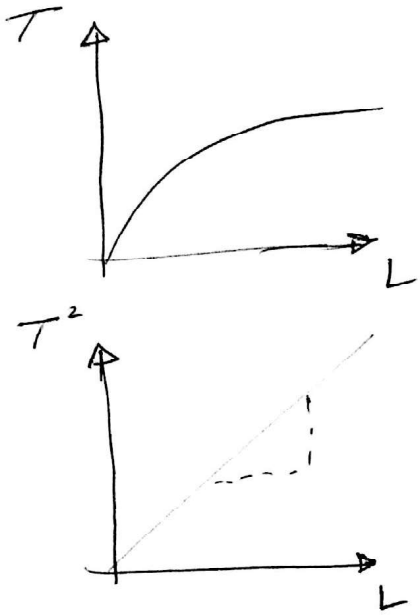
✱ Simple harmonic motion :- simple pendulum

$T \propto L$
$T \propto g$
$\rightarrow$ T :- الزمن الدوري
L :- طول خيط البندول
g :- تسارع الجاذبية الأرضية



$mg\sin\theta \rightarrow$ إسبب للحركة

$\rightarrow T = 2\pi\sqrt{\frac{L}{g}}$



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

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

$$\rightarrow g = \frac{4\pi^2}{\text{slope}}$$

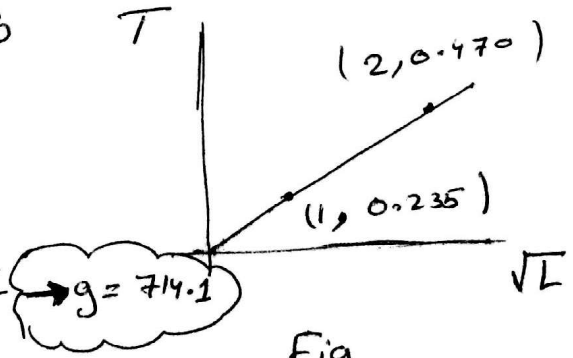
Example :- Figer shownbelow is obtained by a student from The simple pendulum experiment, from this graph calculate gravitional acceleration in (cm/s^2) :-

Solution :- $\text{slope} = \frac{T}{\sqrt{L}} \rightarrow (1)$

and $T = 2\pi\frac{\sqrt{L}}{\sqrt{g}} \rightarrow (2)$

sub (1) and (2) $\rightarrow$ $\left(\frac{T}{\sqrt{L}}\right)_{\text{slope}} = \frac{2\pi}{\sqrt{g}}$

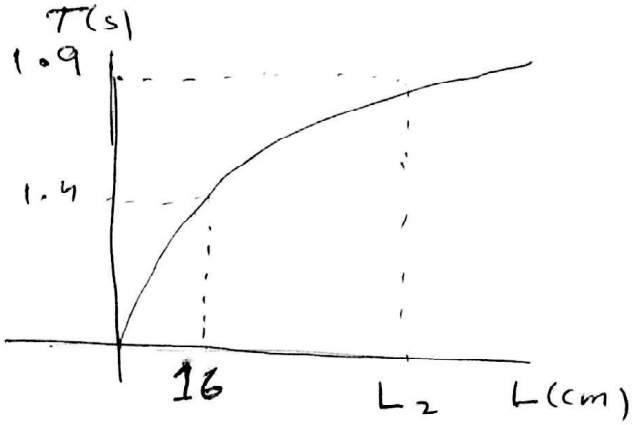
$0.235 = \frac{2\pi}{\sqrt{g}} \rightarrow g = 714.1$



Fig

Example :- figure Shown shows relation between T and L.

→ Find Value of L_2



soln :-

T_1	L_1	$T = 2\pi\sqrt{\frac{L}{9}}$
1.4	16	$1.4 = 2\pi\frac{\sqrt{16}}{\sqrt{9}}$
T_2	L_2	$T = 2\pi\sqrt{\frac{L}{9}}$
1.9	L_2	$1.9 = 2\pi\sqrt{\frac{L_2}{9}}$

⇒ $(T_1, L_1) \Rightarrow 1.4 = 2\pi\frac{\sqrt{16}}{\sqrt{9}}$

⇒ $(T_2, L_2) \rightarrow 1.9 = 2\pi\frac{\sqrt{L_2}}{\sqrt{9}}$

Devide $\frac{(T_2, L_2)}{(T_1, L_1)} \Longrightarrow$ للتخلص من الثوابت

→ $\frac{1.9}{1.4} = \frac{\sqrt{L_2}}{4}$ → $L_2 = 29.5$

Grasses laws "Boyle's law"

→ Studies the relation between P and V where T is constant

P :- Pressure
V :- Volume
T :- Temperature

① $P \propto \frac{1}{V}$ at const T

$\Rightarrow PV = C_1 \quad ; \quad C_1 = nRT$

$\therefore PV = nRT$

n :- Number of molecules
R :- Gas constant
T :- Temperature

② $V = AL$ A :- مساحة المقطع
L :- الارتفاع

$\Rightarrow PAL = C_1$

$PL = \frac{C_1}{A} \quad ; \quad \frac{C_1}{A} = C_2$

$\Rightarrow PL = C_2$

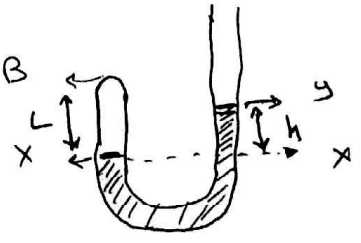
$\therefore P = \frac{C_2}{L}$

الخلاصة

$PV = C_1 \quad ; \quad C_1 = nRT$

$P = \frac{C_2}{L} \quad ; \quad C_2 = \frac{C_1}{A}$

③ Measuring pressure

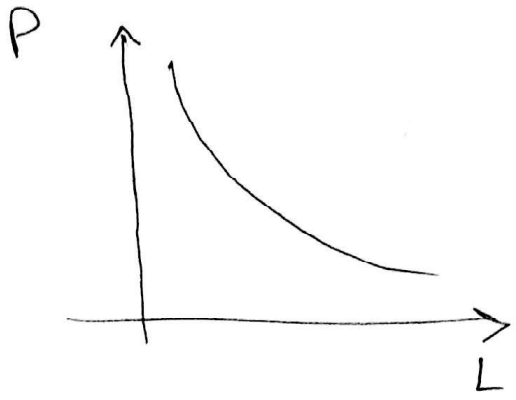


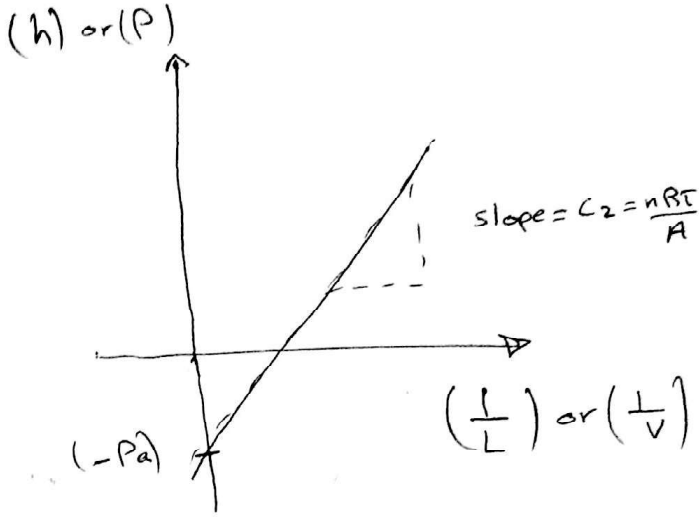
$h = y - x = P$

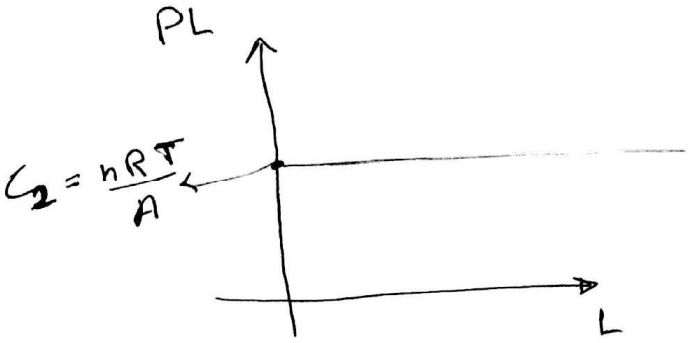
$L = B - x \quad ; \quad L * A = V$

④ $P = P_o + h$ (P_o :- الضغط الجوي)

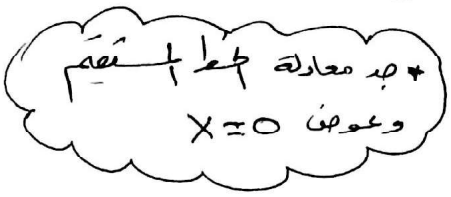
$\frac{C_2}{L} = P_o + h \Rightarrow h = \frac{C_2}{L} - P_a$

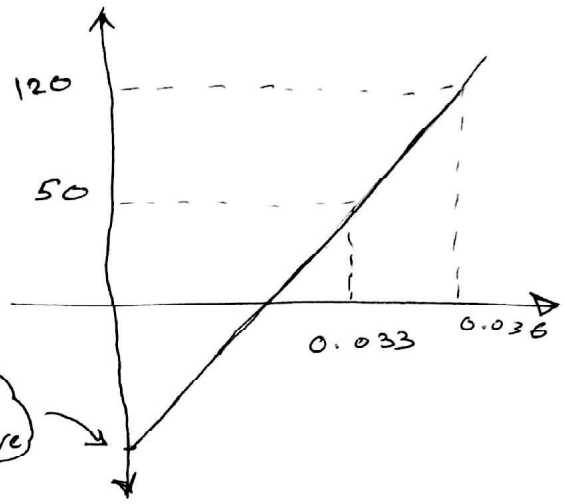






Ex:- For the following graph Find atmospheric pressure





$$m = \frac{\Delta y}{\Delta x} = \frac{120-50}{0.036-0.033}$$

$$= 23333$$

$$y - y_0 = m(x - x_0)$$

$$y - 50 = 23333(x - 0.033)$$

$$\Rightarrow y = (0) - 719.989 \Rightarrow P_a = -719.989 \text{ MMHg}$$

Ex:-

	(1)	(2)
h(cmHg)	40	12.8
L(cm)	15	20.0

Find P_{atm} ??

$$\Rightarrow \frac{C_2}{L} = P_o + h$$

(1) $\frac{C_2}{15} = P_o + 40$

(2) $\frac{C_2}{20} = P_o + 12.8$

$\Rightarrow$ (2) ÷ (1)

$$\frac{\frac{1}{15}}{\frac{1}{20}} = \frac{P_o + 40}{P_o + 12.8}$$

Solve to Find P_o

Ex:- **17.** If the tube in *fig.7* was filled by mercury and the atmospheric pressure is *760 mmHg*, find the pressure of the confined gas.

(a) *810*
(b) *785*
(c) *750*
(d) *725*

$h = y - x$
$h = 80 - 30$
$h = 50$

$P = P_o + h$
$= 760 + 50 = \boxed{810}$

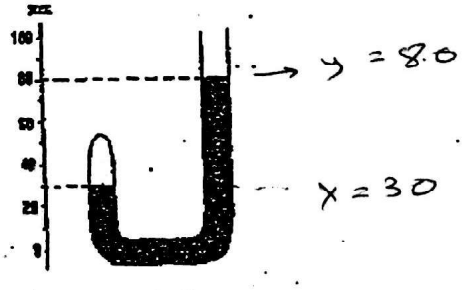


fig.7

Specific heat capacity (C)

١- لابد من التفرقة بين مصطلحين :-

heat capacity ← الطاقة اللازمة لرفع حرارة الجسم درجة واحدة

specific " " ← الطاقة اللازمة لرفع حرارة ١ غرام من الجسم درجة واحدة .

* $Q = M c t$ → Q → الطاقة التي يكتسبها الجسم

c → specific heat capacity

M → mass :- الكتلة

t → temprature :- درجة الحرارة سيليزيوس

* $\Delta Q = M_f C_f t_f - M_i C_i t_i$

M_f, C_f, t_f → نهائية

M_i, C_i, t_i → ابتدائية

But M, C are constants

$\Rightarrow \Delta Q = M C \Delta t$

Note :- $[M] = g$, $[t] = ^\circ C$, $[C] = cal/g.C$

$F^\circ = 1.8 C^\circ + 32$ → تحويل من درجات سيليزيوس إلى فهرنهايت

1 calorie = 4.18 Joul

(5) 100g of copper piece is heated to 50°C and dropped in 60g of water at 80 F, the specific heat capacity of copper and water is 0.14; 1 cal/g. °C, respectively. The final equilibrium temperature T_f is (in °C):

(a) 25.9 (b) 13.8 (c) 31.1 ✓ (d) 38.3

(6) Depending on the previous question, the heat capacity of copper piece (in cal/ °C) is:

(a) 12 (b) 60 (c) 0.12 (d) 14

١- حدد المواد التي سوف تسخن والمواد التي سوف تبرد

٢- المواد التي سوف تسخن ← تكسب طاقة

" " " تبرد ← تخسر طاقة

٣- ΔT → ($T_{كبيرة}$ - $T_{صغيرة}$)

٤- (5) الكسب = المفقودة

الكسب ← الماء (يسخن)

المفقودة ← copper (يبرد)

$(MC\Delta t)_{w} = (MC\Delta t)_{copper} \Rightarrow 60(1)(T_f - T_i) = 100(0.14)(T_i - T_f)$

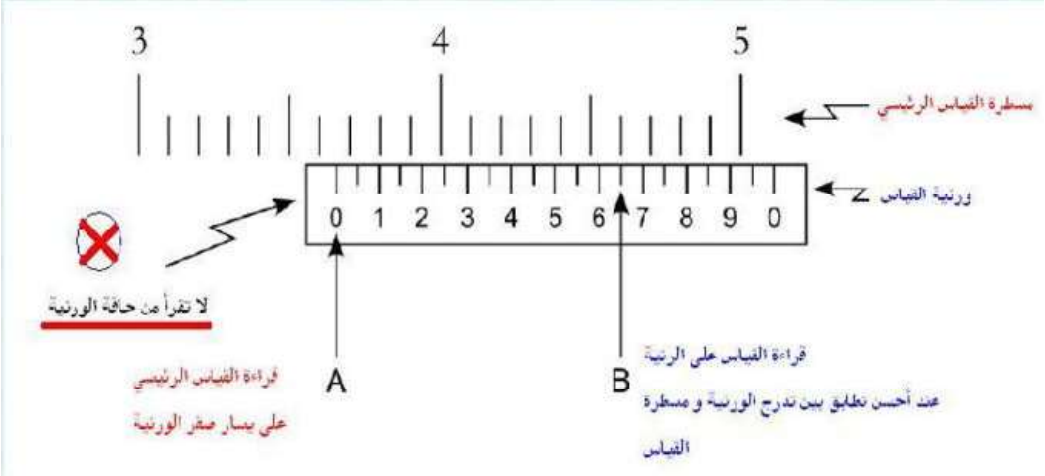
$\Rightarrow T_f = 31.08\ ^\circ C$

(6) Heat capacity = specific heat capacity * mass] → من التعريف

for copper piece ⇒ Heat capacity = (0.14)(100) = 14

أدوات القياس في مادة فيزياء عامة عملية ١

إعداد: أمين ناصر



على المسطرة الرئيسية تكون التداريج على النحو التالي
التدريج الرئيسي ←مضاعفات العشرة mm
التدريج الفرعي← مضاعفات الواحد mm

على المسطرة الفرعية تكون التداريج على النحو
التدريج الرئيسي من مضاعفات ١٠/١ من الmm
التدريج الثانوي من مضاعفات ١٠/٠.٥ من الmm

لقراءة الورنية
نبدأ من النقطة A (الصفر في المسطرة الفرعية) و تجد ما يقابلها في المسطرة الرئيسية
30mm+6mm=36mm←
ثم ننتقل إلى المسطرة الفرعية ونبحث عن افضل تطابق بين التدريج على المسطرة الفرعية والمسطرة الرئيسية لاحظ انه عند النقطة B
0.6mm+0.05mm=0.65mm←
أخيرا نقوم بجمع القراءتين للحصول على قراءة الورنية
36mm+0.65mm=36.65←
وتكون نسبة الخطأ =0.5Xsmallest devision
0.5X0.5/10=0.025mm←

5. The reading of the Vernier Caliper as shown in *fig.2* is:

(a) *(4.020±0.0025)cm*
(b) *(3.902±0.0025)cm*
(c) *(4.045±0.0025)cm*
(d) *(3.945±0.0025)cm*

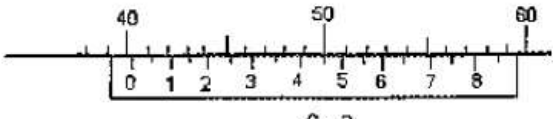
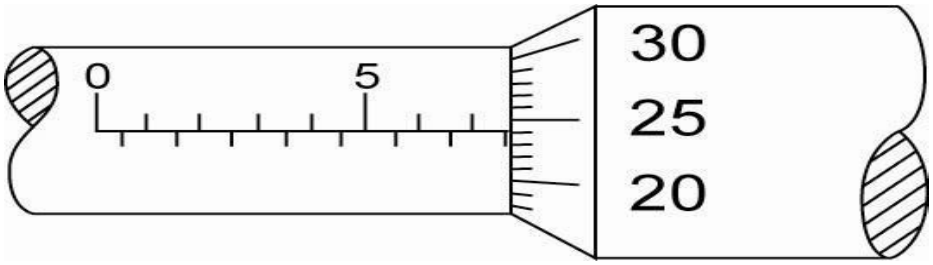


fig.2



يتكون قراءة المايكروميتر من جزيئين
قراءة الsleeve وهي الجزء الأيسر في الشكل الموضح
و قراءة الthimble وهي الجزء الأيمن في الشكل الموضح

التدريج في sleeve
الرئيسي : مضاعفات 1mm (التدريج العلوي)
الفرعي: مضاعفات 0.5mm (التدريج السفلي)

التدريج في Thimble
الرئيسي :مضاعفات 0.05mm
الفرعي :مضاعفات 0.01mm

لقراءة المايكروميتر

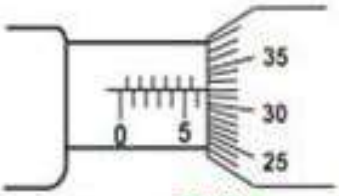
قراءة الsleeve: على التدريج العلوي 7 إضافة إلى 0.5 من التدريج السفلي
7+0.5=7.5mm←

قراءة الthimble:
إفتح فاصلة وضع على يسارها القراءة
0.24mm←

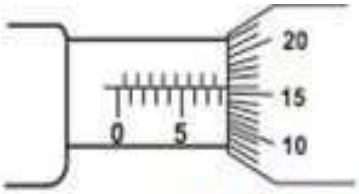
أخيرا إجمع القراءتين 7.5mm+0.24mm=7.76mm←

ملاحظة إذا لم يظهر تدريج فرعي قبل في نهاية sleeve فإننا نكتفي بالقراءة الرئيسية من ال sleeve دون إضافة 0.5 إليها

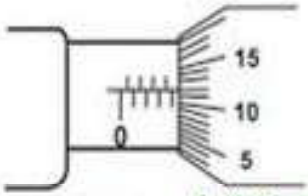
وتكون نسبة الخطأ 0.5X0.01=0.005



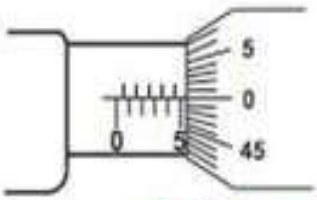
Reading a. 5.82 mm



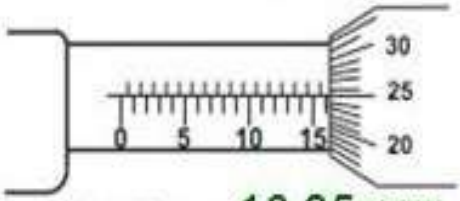
Reading f. 8.16 mm



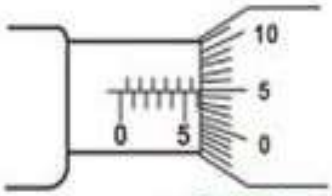
Reading b. 4.12 mm



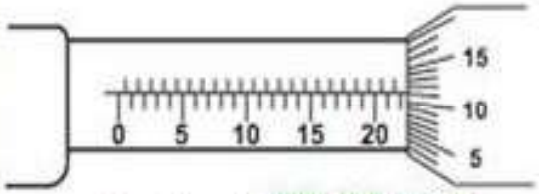
Reading g. 5.50 mm



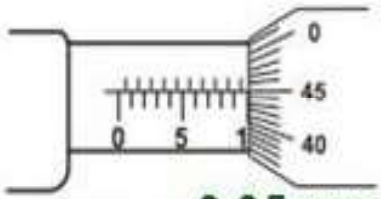
Reading c. 16.25 mm



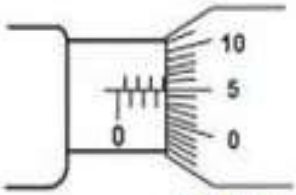
Reading h. 6.05 mm



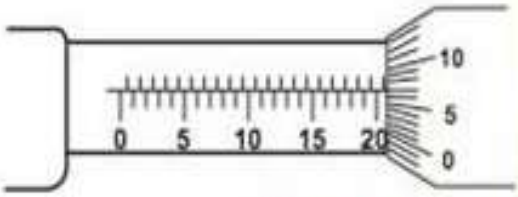
Reading d. 22.11 mm



Reading i. 9.95 mm



Reading e. 3.55 mm



Reading j. 20.57 mm