Physics Lab 1

JuMan 2014

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* Lap Physics 1 :)

I] eXperimental errors :)

* suppose we have measured the string position as $[\overset{x_1}{x_1 = 9.3} \pm \overset{\Delta x_1}{0.2}\, m]$ and the finishing position as $[\overset{x_2}{x_2 = 14.4} \pm \overset{\Delta x_2}{0.3}\, m]$: The displasement $(x_2 - x_1)$ is?

The displacement $X = X_2 - X_1 \Rightarrow 14.4 - 9.3 \Rightarrow \boxed{5.1\, m}$

But The error in the displacement (ΔX) is:

$$\Delta X = \sqrt{(0.2)^2 + (0.3)^2} \Rightarrow \boxed{\Delta X = .36\, m}$$

* we have measured a displasement of $[\overset{x}{X = 5.1} \pm \overset{\Delta x}{0.4}]$ during a time of $[\overset{t}{t = 0.4} \pm \overset{\Delta t}{0.1}]s$. what is the Average velocity $\left(V_{average} = \frac{X}{t}\right)$ and the error in the Average velocity $(\Delta V_{average})$?

* $V_{averge} = \frac{X}{t} \Rightarrow \frac{5.1}{0.4} \Rightarrow \boxed{V_{averge} = 12.75\, m/s}$

* $\Delta V_{averge} = |V| \cdot \sqrt{\left(\frac{\Delta X}{X}\right)^2 + \left(\frac{\Delta t}{t}\right)^2}$

$$\Delta V_{averge} = 12.75 \cdot \sqrt{\left(\frac{0.4}{5.1}\right)^2 + \left(\frac{0.1}{0.4}\right)^2} \Rightarrow \boxed{\Delta V_{avrge} = 3.34\, m/s}$$

* which of the following numbers are in Correct:

a- $9.82 \pm 0.02\cancel{385}$ → 9.82 ± 0.02

b- 10.4 ± 2 → 10.4 ± 2.0

c- 4 ± 0.5 → 4.0 ± 0.5

* The width(w) of the paper is measured at a number of points on the sheet, and the value of the observation wedth in (cm) are: 31.33, 31.15, 31.26, 31.02, 31.20. Calculate the accepted value in $\underline{w} \pm \underset{\text{error}}{\underline{\Delta w}}$:

$$w_{accepted} = \frac{\Sigma w}{N} = \frac{31.33 + 31.15 + 31.02 + 31.20}{5} = \boxed{31.19\ Cm}$$

$$\Delta w_{accepted} = \sigma_m = \sqrt{\frac{(w - \Delta w_{accepted})^2}{N(N-1)}} = \sqrt{\frac{(x_1-\bar{x})^2+(x_2-\bar{x})^2+\cdots}{5(5-1)}}$$

$$\boxed{\Delta w_{accepted} = 0.15\ Cm}$$

$$w \pm \Delta w \Rightarrow 31.19 \pm 0.15$$

شكوتُ إلى وكيعٍ سوءَ حفظي
فأرشدني إلى تركِ المعاصي
وقال إنّ العلمَ نورٌ
ونورُ الله لا يُؤتى لعاصي

2] measurements and Uncertainties :)

* find measurements of the volume of a disk (dimeter d, thikness t)

Let the fractional error in (d) be ($A = \frac{\Delta d}{d}$) and the fractional error in (t) be ($B = \frac{\Delta t}{t}$). Then the fractional error in the volume ($\frac{\Delta V}{V}$) is:

$$V = \pi R^2 h \Rightarrow \boxed{V_{disk} = \pi \left(\frac{d}{2}\right)^2 t}$$

$$\left(\frac{\Delta V}{V}\right)_{disk} = \sqrt{\left(\frac{2\Delta d}{d}\right)^2 + \left(\frac{\Delta t}{t}\right)} \Rightarrow \sqrt{(2A)^2 + B^2}$$

$$\Rightarrow (4A^2 + B^2)^{\frac{1}{2}} \quad \#$$

* if $R = \frac{x^2}{y}$, and $x \pm \Delta x = \overset{x}{10} \pm \overset{\Delta x}{1}$ (error), $y \pm \Delta y = \overset{y}{5.0} \pm \overset{\Delta y}{0.5}$ (error), then $R \pm \Delta R$ is

$$\# \boxed{R = \frac{x^2}{y}} \Rightarrow \frac{(10)^2}{5} = \frac{100}{5} \Rightarrow \boxed{R = 20}$$

$$\Delta R = \sqrt{\left(\frac{2\Delta x}{x}\right)^2 + \left(\frac{\Delta y}{y}\right)^2} \Rightarrow \sqrt{\left(\frac{2 * 1}{10}\right)^2 + \left(\frac{0.5}{5}\right)^2}$$

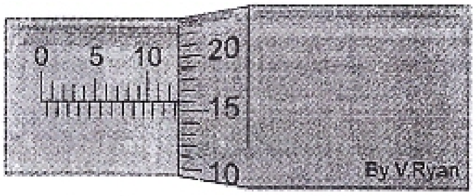
$$\boxed{\Delta R = 4.5}$$

$$\boxed{R \pm \Delta R \Rightarrow 20 \pm 4.5} \quad \#$$

$$\boxed{\rho = \frac{m}{V}} \qquad \Rightarrow \text{sphere} \qquad \boxed{\frac{\Delta V}{V} = 3\,\frac{\Delta d}{d}}$$

$$\boxed{V_{disk} = \pi R^2 h \;\Big|\; Area_{disk} = \frac{\pi}{4} R^2}$$

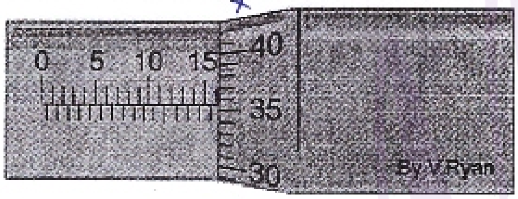
How to Read the Micrometer



SLEEVE READS FULL mm = 12.00
SLEEVE READS ½ mm = 0.50
THIMBLE READS = 0.16
TOTAL MEASUREMENT = 12.66mm

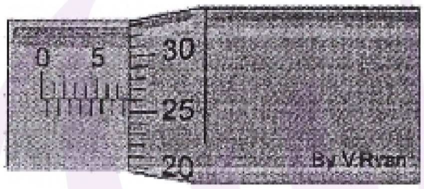
15.5 x

35.5 mm

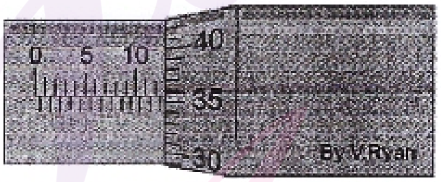


16

SLEEVE READS FULL mm = 16.00
SLEEVE READS ½ mm = 0
THIMBLE READS = 0.355
TOTAL MEASUREMENT = 16.355mm



SLEEVE READS FULL mm = 7.00
SLEEVE READS ½ mm = 0.50
THIMBLE READS = 0.26
TOTAL MEASUREMENT = 7.76mm



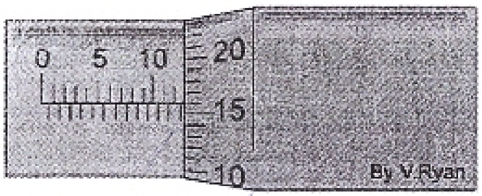
SLEEVE READS FULL mm = 12.00

SLEEVE READS ½ mm = 0.5

THIMBLE READS = 0.36

TOTAL MEASUREMENTS = 12.86 mm

How to Read the Micrometer

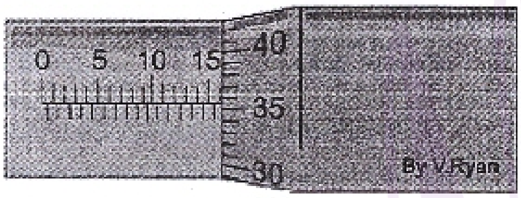


SLEEVE READS FULL mm = 12.00
SLEEVE READS ½ mm = 0.50
THIMBLE READS = 0.16
TOTAL MEASUREMENT = 12.66mm

12 + 0.5 + 0.16

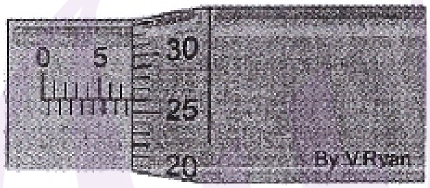
12.5 + .16

12.66mm



16mm

SLEEVE READS FULL mm = 16.00
SLEEVE READS ½ mm = 0
THIMBLE READS = 0.355
TOTAL MEASUREMENT = 16.355mm



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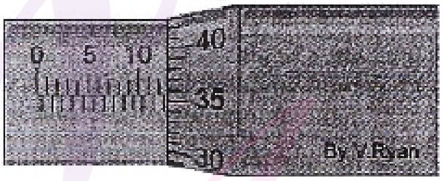
THIMBLE READS = 0.26
TOTAL MEASUREMENT = 7.76mm



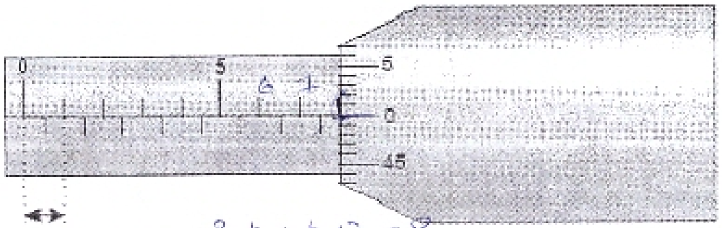
SLEEVE READS FULL mm = 12.00

SLEEVE READS ½ mm = 0.5

THIMBLE READS = 0.36

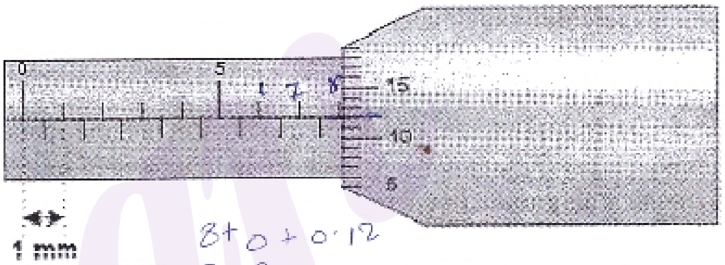
TOTAL MEASUREMENTS = 12.86 mm

The measuring rod is 8.00 mm



8 + 0 + 0 = 8

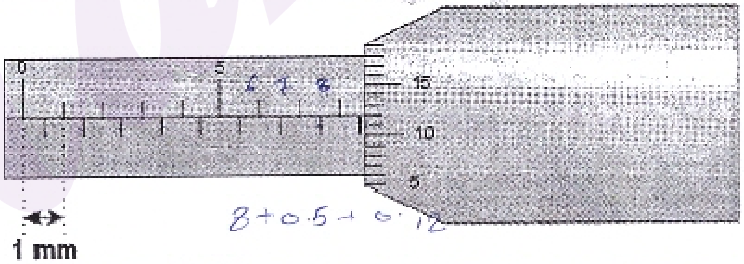
The measuring rods is **8.120** mm.



8 + 0 + 0.12

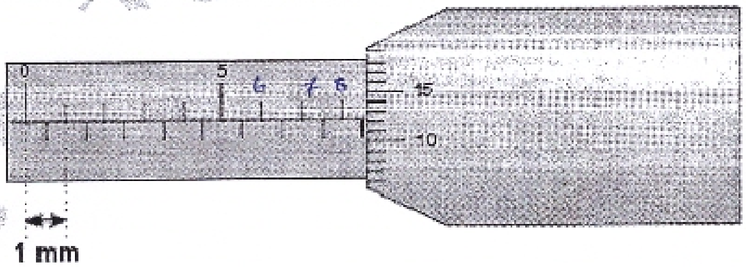
= 8.12

The distance is 0.120 mm greater than *8.500* mm, so the distance is **8.620** mm.



8 + 0.5 + 0.12

Now the distance is greater than 8.620 mm, but clearly less than 8.630 mm. We might estimate this reading to be **8.625** mm.



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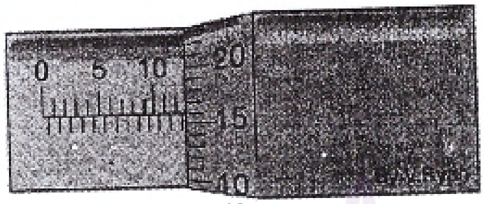
8 + 0.5 + 0.125

0.125
0.5
8
8.625

→ 8
→ 0.5
→ 0.12

8.62

How you can read the micrometer



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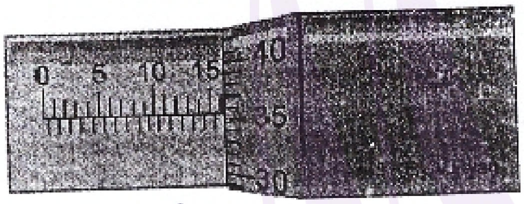
TOTAL MEASUREMENT = 12.66mm

12 + 0.5 + .16



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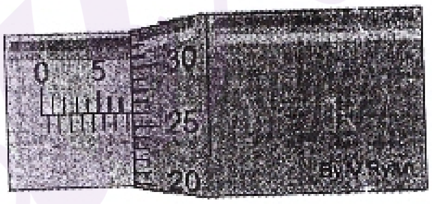
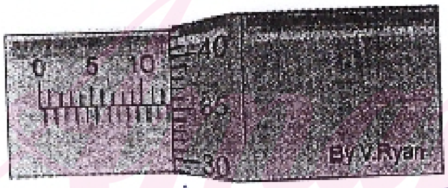
SLEEVE READS ½ mm = 0
THIMBLE READS = 0.355
TOTAL MEASUREMENT = 16.355mm

16 + .355



SLEEVE READS FULL mm = 7.00
SLEEVE READS ½ mm = 0.50
THIMBLE READS = 0.26
TOTAL MEASUREMENT = 7.76mm

7 + 0.5 + .26



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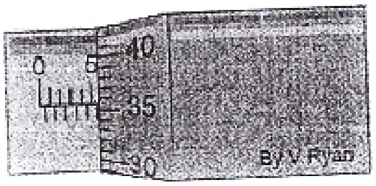
THIMBLE READS = 0.36
TOTAL MEASUREMENTS = 12.86 mm

12.5 + .36 12.5+.36 = 12.86

1?? #



SLEEVE READS FULL mm = 5.00
SLEEVE READS ½ mm = 0.0
THIMBLE READS = 0.355
TOTAL MEASUREMENTS = 05.355 mm

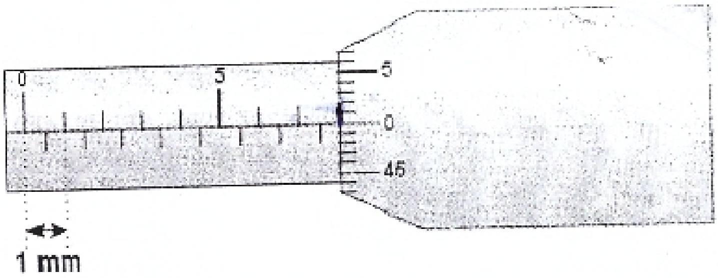
5.5 + .355

2-1 / 0.9-0 step 10 x

step ⓐ 0.85 10

y = x

The measuring rod is 8.00 mm



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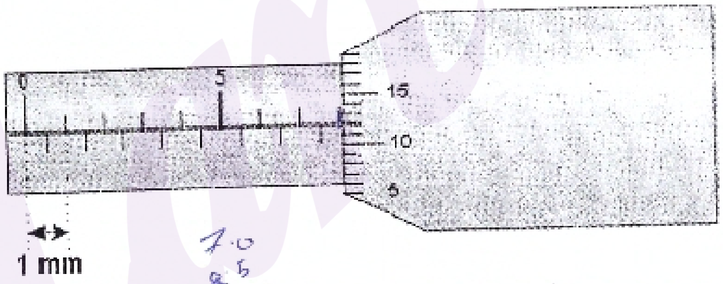
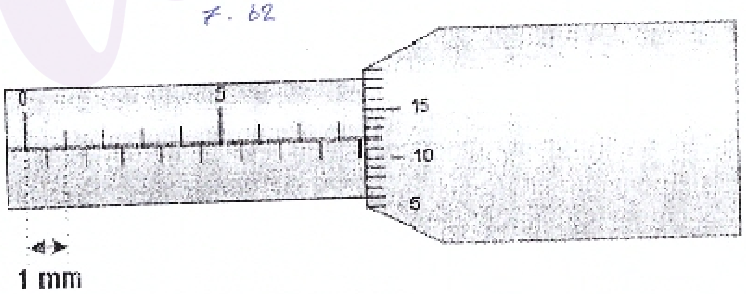


7.0
8.5
0.12
7.62

The distance is 0.120 mm greater than *8.500* mm, so the distance is **8.620** mm.



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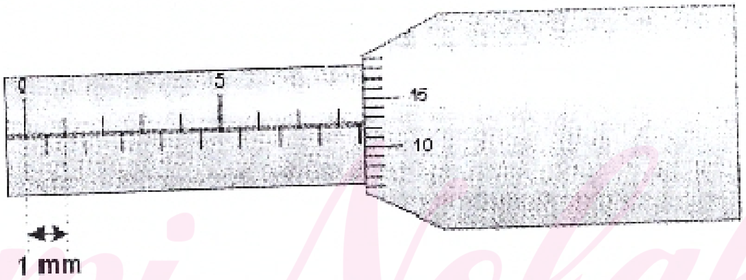
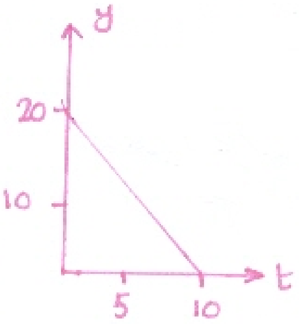


3] Collection and Analysis of Data :)

1] For the figure shown, y as a function of t is given by:

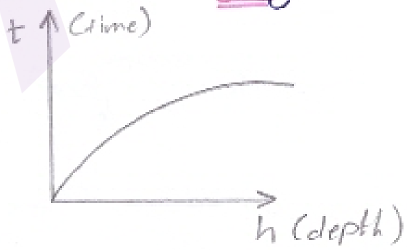


$y = \text{Slope}(t) + y\text{-intercept}$

$\text{Slope} = \frac{20-0}{0-10} \Rightarrow \boxed{m = -2}$

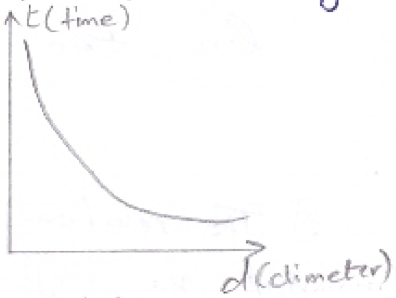
$\boxed{y = -2t + 20}$

2] A cylindrical container with a hole is filled with water to a depth (h). The correct relation between the time (t) needed to empty the container and the depth of water in it can be:



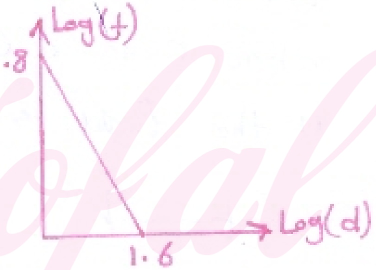
* كلما زاد الارتفاع زاد زمن التفريغ
* طرديا وليس خطي (تربيعي).

3] A cylindrical container with a hole of diameter (d) is filled with water to a depth (h). The correct relation between the time needed to empty the container (t) & (d) can be represented by:



* كلما زاد القطر قل وقت التفريغ.
* عكسي وليس خطي (تربيعي).

4] The relation between t & d can be written as:



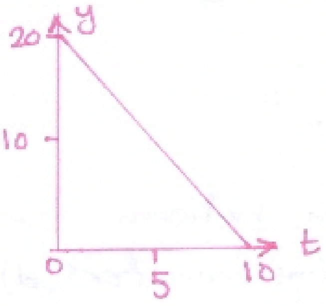
$y = \text{Slope}(d) + y\text{-intersept}$

$\text{Log}(t) = \left(\frac{.8-0}{0-1.6}\right)d + .8$

$e^{\left(\text{Log}(t) = -\frac{1}{2}\log d + .8\right)} \Rightarrow t = d^{-\frac{1}{2}} * e^{.8}$

$\boxed{t = 6.3\, d^{-\frac{1}{2}}}$

5] t as a function of y given by:

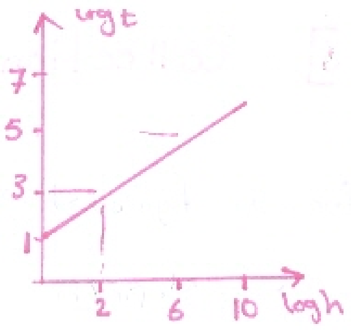


$y = -2t + 20$

$\frac{y - 20}{-2} = \frac{-2t}{-2}$

$\boxed{t = 10 - \frac{1}{2}y}$

6] The expermental relation between t & h is:

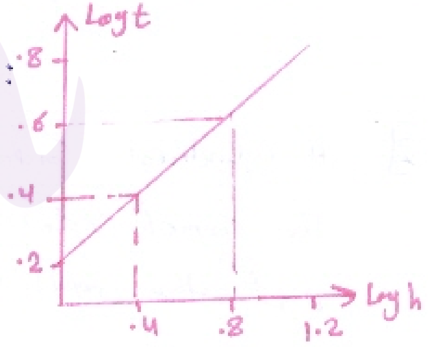


Log t & log h $\longrightarrow$ $\left[\, t = 10^{(\text{y-intercept})} * h^{(\text{slop})} \,\right]$

Slope = $\frac{1}{2}$ $\Rightarrow$ $t = 10^{1} * h^{\frac{1}{2}}$

$\boxed{t = 10\sqrt{h}}$

7] a) The relationship between t & h is given by:



Slope = $\frac{.8 - 0}{0 - 1.2}$ $\Rightarrow$ $\boxed{\text{slope} = -\frac{1}{2}}$

$t = 10^{\text{y-intercept}} * h^{(\text{slop})} \Rightarrow t = 10^{.2} * h^{(-\frac{1}{2})}$

$t = \frac{1.5}{\sqrt{h}} \Rightarrow t^2 = \frac{2.5}{h} \Rightarrow h = \frac{2.5}{t^2} \Rightarrow h = 2.5 * t^{-\frac{1}{2}}$

b) for the same graph, if you plot Log h versus Log t to get a striaght line, then the Pair of (slope, y-intercept) will be: (0.2, 0.5)

8] The relation between the time needed to empty the Container (b) and the height (h) of the water in it is given by $[t = ch^{.6}]$, where c is a Constant, for a certain height, the time needed is (10 s) if the hight is double $_{2h_1}$, then the time (in sec) needed is:

$t = ch^{.6}$ at $h_1 \to t_1 = c(h_1)^{.6}$
$h_2 \to t_2 = c(h_2)^{.6}$ But $h_2 = 2h_1$

$\Rightarrow \begin{array}{l} t_1 = \cancel{c}(h_1)^{.6} \\ t_2 = \cancel{c}(2h_1)^{.6} \end{array} \Rightarrow \frac{t_1}{t_2} = (2)^{.6}$ But $t_1 = 10$

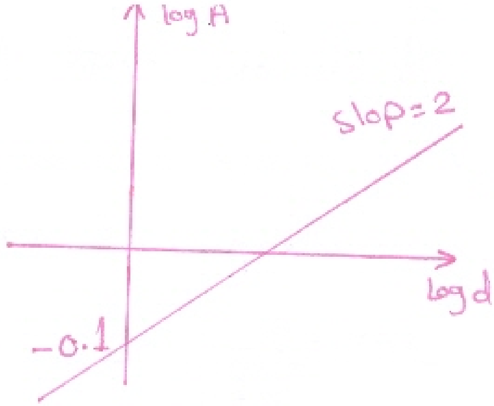
$\frac{t_2}{t_1} = (2)^{.6} \Rightarrow 1.5 * 10 = t_2 \Rightarrow \boxed{t_2 = 15\,\text{Sec}}$

9] The relation between the Area (A) of several disks & their Corresponding diameters (d) are given in the shown graph. The Calculat value of π is:

$y = \text{Slope}(\log d) + y\text{intercept}$

$\downarrow \qquad \downarrow \qquad \downarrow$

$\log A = 2 \log d + \underbrace{-0.1}_{\log \frac{\pi}{4}}$



$A_{disk} = \pi R^2 \Rightarrow \pi \left(\frac{d}{2}\right)^2$

$\boxed{A_{disk} = \frac{\pi}{4} d^2}$

$y\text{intercept} = -0.1 \Rightarrow \left(\log_e \frac{\pi}{4} = -0.1\right) \Rightarrow \frac{\pi}{4} = .79$

$\Rightarrow \pi = 4 * .79 \quad \boxed{\pi = 3.17}$

[10]

* $y = \log t$ * $x^3 = \log h$

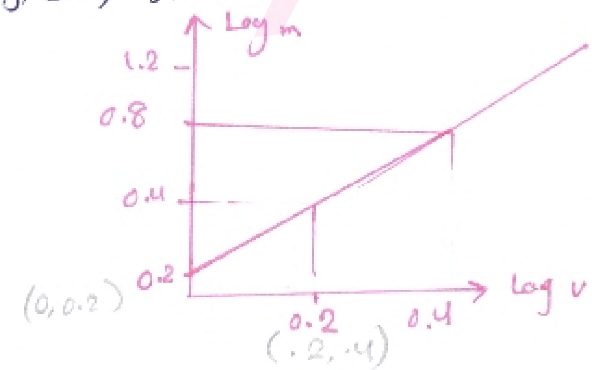
$\Rightarrow$ The relation between y and x^3 is linear

$\Rightarrow$ " " Can by $\log y = 3 \log x + \log b$

$\Rightarrow y = mx^3 + b$

$y = \overset{(y\text{-intercept})}{10} * h^{(\text{slope})}$

[11] The mass (m) and the Volume (V) ..., The figure shows a graph of (log m) versus (log v). The value of density (in g/cm³) of the matirials is:



$y = \text{slope}(\log v) + y\text{-intercept}$

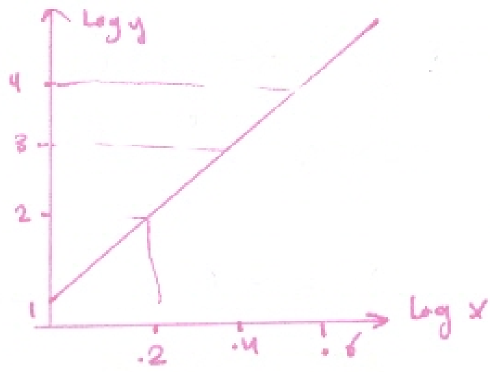
$\text{slope} = \frac{0.4 - 0.2}{0 - 0.2} \Rightarrow \frac{.2}{.2} = \boxed{1}$

$\left(\log_e m = 1 * \log v + .2\right)$

$m = e^{.2} * v \qquad m = 1.58 v$

$\frac{m}{v} = 1.58 \Rightarrow \boxed{\rho = 1.58 \ g/cm^3}$

12] For the graph shown:



$$\log y = \text{slope}(\log x) + y\text{-intercept}$$

$$(\text{Log } y = 5 \log x + 1)$$

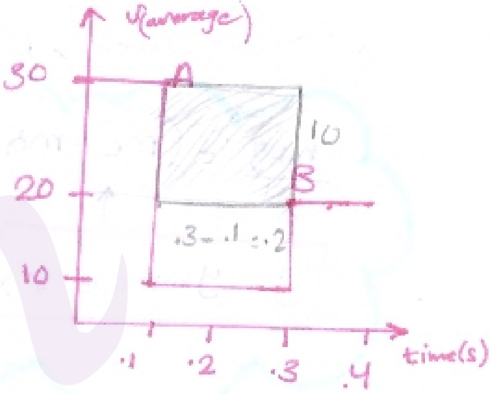
$$\text{Slope} = \frac{2-1}{0.2-0} \Rightarrow 5$$

$$y = x^5 * 10^1 \qquad \boxed{y = 10x^5}$$

4] Kinematics of Rectilinear motion :

1] The displacement (in Cm) between point A and B :)

X



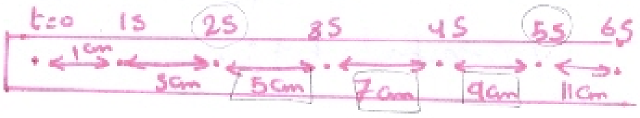
$X_{A \to B}$ = Area under Curve

$= 10 * .2 \Rightarrow \boxed{2\ Cm}$

displacement ← [Δx] الإزاحة، المنحنى، تحت، المساحة *

2] For one dimentional motion, the area under the velocity versus time graph represents: displacement

3] For the turker tape shown below:

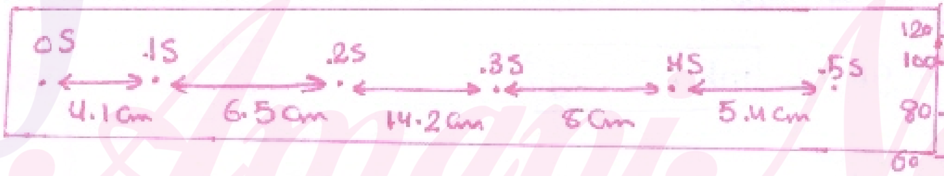


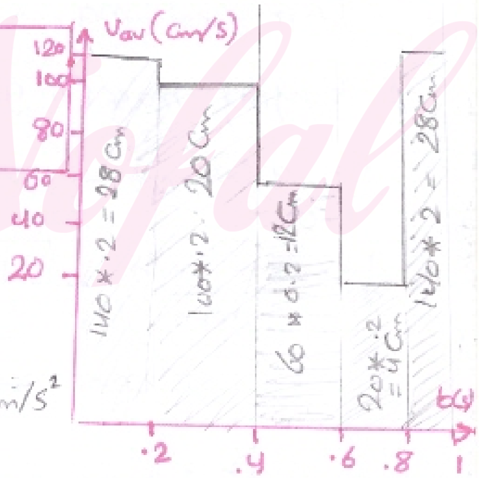
The Averge velocity (in cm/s) for the Period t=2s to t=5s is :

Averge velocity $= \frac{S}{\text{الزمن}} \Rightarrow \frac{5+7+9}{3} = \frac{21}{3} = 7\ cm/s$

$\bar{v} = \frac{\Delta X}{\Delta t} \Rightarrow \frac{X_5 - X_2}{t(5) - t(2)} \Rightarrow \frac{25-4}{5-2} = \frac{21}{3} = 7\ cm/s$ //

4]





a- The average acceleration for the whole period.

$X_{0 \to 5} = 4.1 + 6.5 + 14.2 + 8 + 5.4 \Rightarrow 38.2$

$\bar{v} = \frac{38.2}{0.5} = 76.4$ $\qquad \bar{a} = \frac{76.4}{0.5} = 152.8\ cm/s^2$

b. The average velocity for the whole period: $v_a = 76.4\ cm/s$

c- The averge speed for the motion:

$v = \frac{X_{total}}{t} = \frac{92}{1} = \boxed{92}$

X_{total} = Area under the Curve

$= 28 + 20 + 12 + 4 + 28$ $\qquad \boxed{X_{total} = 92\ Cm}$

5] Force and motion :)

* Driving force $= m_h a$

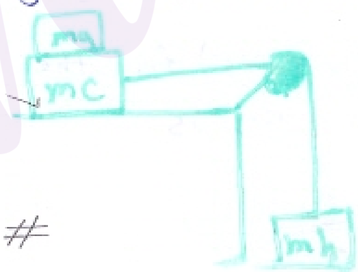
$$\frac{m_h g}{a} = (m_c + m_h) + m_a$$

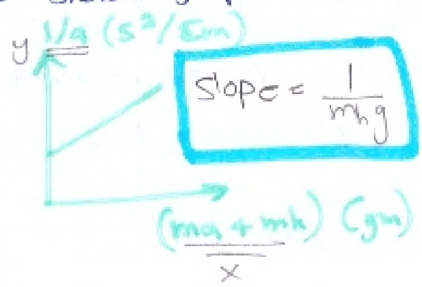
$$\boxed{y = y\text{intercept} + x}$$

- $y = y\text{-intersept} + \text{slope}(x)$
- Driving force $= m_h g$
- y-axis $\rightarrow \frac{1}{a} \rightarrow$ slope $= \frac{1}{m_h g}$
- x-axis $\underline{m_a} \rightarrow$ y-intersept

بدون نقطة، y-intercept $\rightarrow \frac{(m_h + M_c)}{m_h g}$

1] the graph $(1/a)$ versus $(m_a + m_h)$, where a is the acceleration of the system, The slope and the y-intercept of the shown graph are represented by:





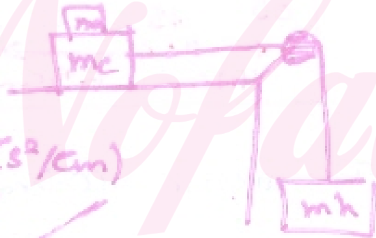
$$\boxed{\text{Slope} = \frac{1}{m_h g}}$$

$y = y\text{-intercept} + (X)\,\text{slope}$

$$\frac{1}{a} = \frac{m_c}{m_h g} + \frac{1}{m_h g}\underbrace{(m_a + m_h)}_{X} \quad \#$$

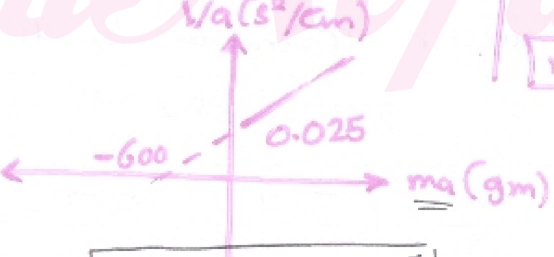
2] The graph shows $(1/a)$ versus m_a, where a is the acceleration of the system and m_a is the added mass to the Cart. Consider $g = 9.8\ m/s^2$

A- hanging mass (in gram), $\boxed{m_h = 24.5g}$



$y = y\text{-intercept} + \text{Slop}(x)$

$$\frac{1}{a} = \frac{m_c + m_h}{m_h g} + \underbrace{\boxed{\frac{1}{m_h g}}}_{\text{Slope}}\underbrace{(m_a)}_{X}$$



$$\therefore \text{slope} = \frac{1}{m_h g} \Rightarrow \frac{0 - 0.025}{-600 - 0} \Rightarrow \boxed{\text{Slope} = 4.1 * 10^{-5}}$$

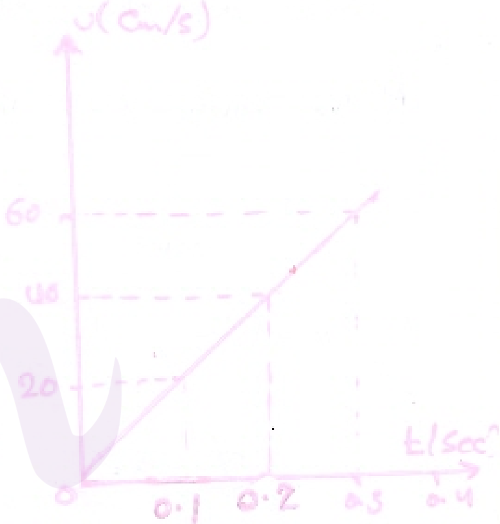
$$4.1 * 10^{-5} = \frac{1}{m_h * 9.8} \Rightarrow m_h = \frac{1}{4.08 * 10^{-4}} \Rightarrow \boxed{m_h = 24.5\ g}$$

B- The mass of the Cart (in gram), M_c:

$$y\text{-intercept} = \frac{M_c + M_h}{m_h g} \Rightarrow 0.025 = \frac{24.5 + M_c}{4.1 * 10^{-5}} \Rightarrow \boxed{M_c = 575.75g}$$

3] The velocity for (0.6 kg) cart pulled by a hanging mass mh.

The value of hanging mass (in kg) is:



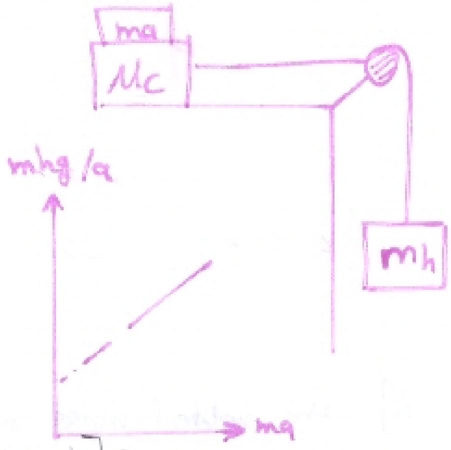
$$m_h g = (M_c + m_h)\, a$$

$$a = \frac{\Delta v}{\Delta t} = \frac{60-0}{0.3-0} = 200\ \text{Cm/s}^2 = \boxed{2\ \text{m/s}^2}$$

$$m_h * 9.8 = (.6 + m_h) * 2$$

$$9.8\, m_h = 1.2 + 2m_h$$
$$-2m_h \qquad\quad -2m_h$$

$$\frac{7.8\, m_h}{7.8} = \frac{1.2}{7.8} \Rightarrow \boxed{m_h = 0.15\ \text{Kg}}$$



4] A) The y-intercept represents:

$$m_h g - T = [M_c + m_a]\, a$$

ma = الكتلة المضافة

$$m_h g = [M_c + m_a + m_h]\, a \Rightarrow \frac{m_h g}{a} = [M_c + m_a + m_h]\frac{a}{a}$$

$$\underbrace{\frac{m_h g}{a}}_{y} = \underbrace{[M_c + m_h]}_{\text{y-intercept}} + \underbrace{1}_{\text{Slope}}\, \underbrace{m_a}_{x}$$

B) The slope of line is: $\boxed{1}$

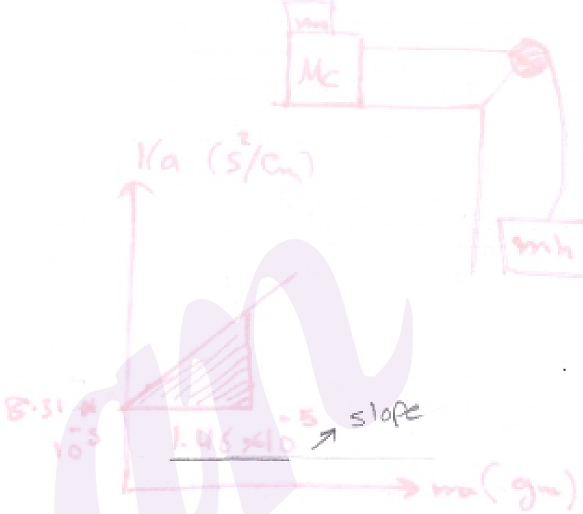
c) The acceleration will: increase

d) The deriving force: increase

deriving force $= m_h g$

5] The relation between $(1/a)$ where a is the acceleration of the Cart, and the added mass (m_a) is shown in the graph.

A) The hanging mass m_h:



$$\text{Slope} = \frac{1}{m_h g}$$

$m \to cm$

$$1.46 \times 10^{-5} = \frac{1}{m_h \times 9.8 \times 10^{2}}$$

$$\frac{0.014\, m_h}{0.014} = \frac{1}{0.014} \qquad \boxed{m_h = 71 g}$$

B) The mass of Cart M_c =

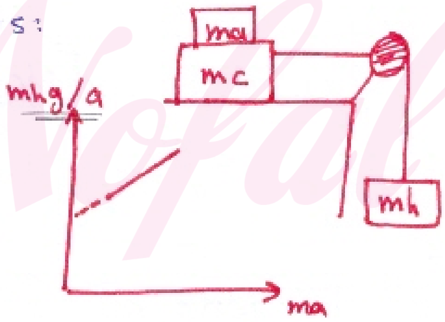
[illegible]

$$y\text{-intercept} = 8.31 \times 10^{-3} \Rightarrow \frac{(M_c + m_h)}{m_h g} = y\text{-intercept}$$

$$8.31 \times 10^{-3} = \frac{M_c + 71}{71 \times 980} \Rightarrow \begin{matrix} 578 = M_c + \cancel{71} \\ 71- \quad\ -\cancel{71} \end{matrix} \qquad \boxed{M_c = 507 g}$$

6] the added mass is m_a (in gram), the mass of the Cart is (400g), the total hanging mass m_h is (50g) and the acceleration is (a)

A- The value of y-intercept for the graph is:



1

$$y = y\text{-intercept} + \text{slope}(x)$$

$$\frac{m_h g}{a} = (M_c + m_h) + m_a$$

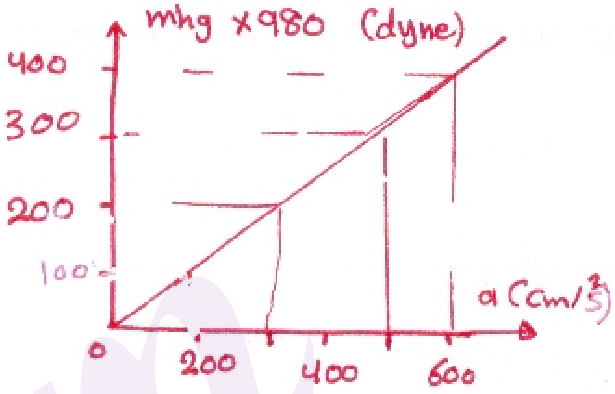
$$y\text{-intercept} = 400 + 50$$

$$= 450 g \ \#$$

B- The force accelerated the Cart is: Less than the weight of the hanging mass

$$a_c < a_h$$

7] when $(m_a + m_h)$ was kept Constant and equal to 480 g, we got the graph below →



A) mass of the Cart is:

$$\boxed{\underset{y}{m_h g} = \underbrace{(M_c + \overset{480}{(m_a+m_h)})}_{\text{slope}}\,\underset{x}{a}}$$

$$\text{Slope} = \frac{400 * 980 - 0}{600 - 0} = 653\ g$$

$\therefore$ slope $= M_c + m_a + m_h$

$$\underset{-480}{653} = M_c + \underset{-480}{480} \qquad \boxed{M_c = 173\ g}$$

B) when the driving force of the system equal to $1.96 * 10^5$ dyne, then the acceleration of the system equals:

driving force $= m_h g \Rightarrow \dfrac{1.96 * 10^5}{980} = m_h g * \dfrac{\cancel{980}}{\cancel{980}}$

$\boxed{m_h g = 200}$ → from graph ⇒ $\boxed{a = 300\ cm/s^2}$

C) when the acceleration of the system equal $4.5\ m/s^2$, then the driving force which Product this acceleration equal to:

$a = 4.5\ m/s^2 \Rightarrow a = 450\ cm/s^2$ $\qquad \boxed{\therefore \text{driving force} = m_h g}$

from graph ⇒ Driving force $= 300 * 980$

$= 294 * 10^3$ dyne #

8] He kept $(m_a + m_h)$ constant and equal to 100 gm,

A) Mass of the cart, M_c =

$$(m_a + m_h) = 100$$

$$m_h g = (M_c + m_a + m_h) a$$

$$\underset{60}{m_h} g = (M_c + 100) \underset{\text{slope}}{a}$$

$$\frac{60 * 980}{117.6} = (M_c + 100) * \frac{\cancel{117.6}}{\cancel{117.6}}$$

$$500 = M_c + \cancel{100}$$
$$-100 \qquad -\cancel{100}$$

$$\boxed{M_c = 400 g}$$

B) The unknown hanging mass:

$$m_h g = (M_c + m_a + m_h) a$$

$$m_h g = (400 + 100) a$$

$$m_h g = 500 \underset{\text{slope} = 88.2}{a} \Rightarrow m_h = \frac{500 * 88.2}{980}$$

$$\boxed{m_h = 45 g}$$ #

9] Consider the setup shown below $M_1 = M_2 = M_3$ then the acceleration of the graph is:

$$m_h g = (M_c + m_a + m_h) a$$

But : $M_1 = M_2 = M_3$

$$mg = (m + m + m) a$$

$$\cancel{m} g = 3 \cancel{m} a \qquad \boxed{a = \frac{g}{3}}$$

6] Ballistic Pendulum

عند الإفلات → Potential E_i = Kinetic E_f ← بعد الإفلات

$$\cancel{\tfrac{1}{2}} K X^2 = \cancel{\tfrac{1}{2}} m v^2$$

$$\boxed{v = \sqrt{\frac{K}{m}}\, X}$$

- m: mass of the ball
- M_{tot}: total mass of the Pendulum

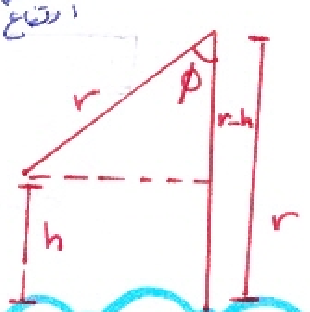
* $\Delta h = r(1-\cos\phi)$
* $v = \sqrt{\dfrac{K X^2}{m}} \rightarrow v = \sqrt{\dfrac{K}{m}}\, X$
* $v = \sqrt{2gr(1-\cos\phi)}$

$y = \text{slope}(x) + y\text{intersept}$ #

* the Conserved of momentum & energy

after: لحظة قبل التصادم $P_i = P_f$ ← بعد التصادم

$K.E_I = P.E_{II}$ ← عند أقصى ارتفاع ; لحظة بعد التصادم



$$K.E_I = P.E_{II}$$

$$\frac{1}{2}(m+M)v^2 = (M+M_{tot})\, g\, \Delta h$$

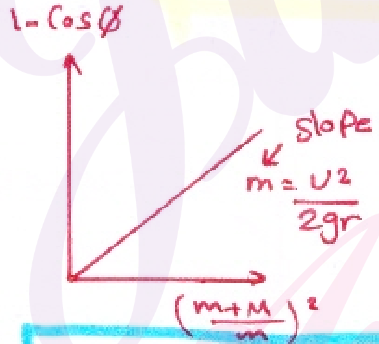
$$v = \sqrt{2gr(1-\cos\phi)}$$

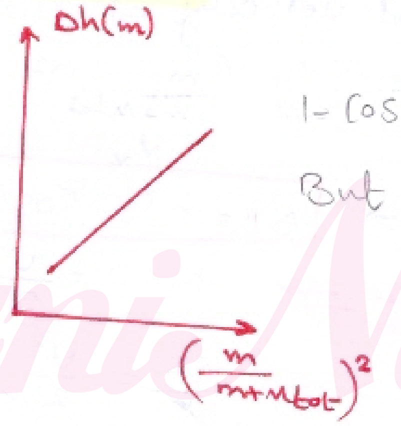
$$v = \frac{m+M}{m}\left(\sqrt{2gr(1-\cos\phi)}\right)$$

$$\cos\phi = \frac{r-h}{r}$$

$$\cos\phi = 1 - \frac{h}{r}$$

$$h = r(1-\cos\phi)$$





$$1-\cos\phi = \frac{U^2}{2gr}\left(\frac{m}{m+M_{tot}}\right)^2$$

But $\Delta h = r(1-\cos\phi)$

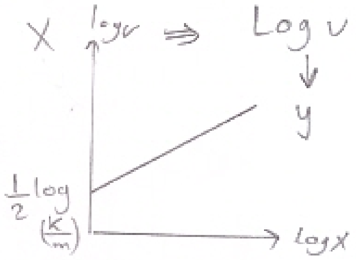
$$\frac{\Delta h}{\cancel{r}} = \frac{U^2}{2g\cancel{r}}\left(\frac{m}{m+M_{tot}}\right)^2$$

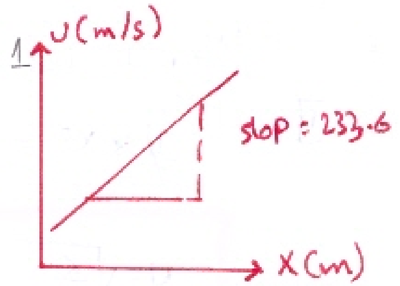
$$\underbrace{\Delta h}_{y} = \underbrace{\frac{U^2}{2g}}_{\text{slope}}\underbrace{\left(\frac{m}{m+M_{tot}}\right)^2}_{x}$$

$$\boxed{\underbrace{1-\cos\phi}_{y} = \underbrace{\frac{U^2}{2gr}}_{\text{slope}}\underbrace{\left(\frac{m}{m+M_{tot}}\right)^2}_{x}}$$

1] which of the following graph (s) represent the relation between the initial velocity (v) and the stell ball of mass (m) and displacement (x) of the spring from its un-streched (x=0) position, where the Constant force of the spring is K:

$U = \sqrt{\frac{K}{m}}\ X \Rightarrow \underbrace{\text{Log}\, v}_{y} = \underbrace{\frac{1}{2}\log\frac{k}{m}}_{\text{y-intercept}} + \underbrace{1}_{\text{slope}}\underbrace{\text{Log}\, X}_{x}$





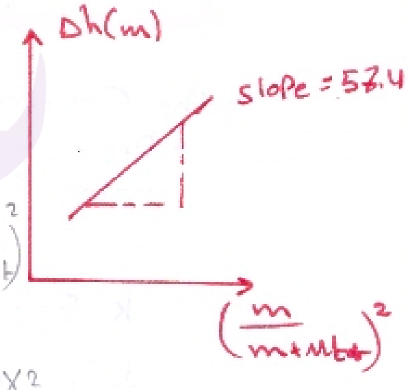
2] find the maximum dispacement of the spring.

Consider $g = 9.8\ m/s^2$

$\underbrace{V}_{y} = \underbrace{\sqrt{\frac{K}{m}}}_{slope_1}\ \underbrace{X}_{x}$, $\Delta h = \underbrace{\frac{U^2}{2g}}_{slope_2}\left(\frac{m}{m+M_{tot}}\right)^2$

$\boxed{U = slop_1\ X}$

$\Delta h = \frac{(slop_1)^2 X^2}{2g}\left(\frac{m}{m+m_{tot}}\right)^2$



$slope_2 = \frac{(slop_1)^2\ X^2}{2g} \Rightarrow 57.4 = \frac{(233.6)^2 \cdot X^2}{2 * 9.8}$

$\frac{1125.04}{54568.96} = \frac{\cancel{54568.96}\ X^2}{\cancel{54568.96}}$

$X^2 = 0.02$

$X = 14 * 10^{-2}\ m$

$\boxed{X = 14\ Cm}$

3] find the intitel velocity of the ball, Consider $g = 9.8\ m/s^2$

$\underbrace{\Delta h}_{y} = \underline{slope}\ \underbrace{\left(\frac{m}{m+m_{tot}}\right)^2}_{x}$

But $\Rightarrow \boxed{\Delta h = r\,(1 - \cos\phi)}$

~~slope~~ $\# \ 1 - \cos\phi = \frac{U^2}{2gr}\left(\frac{m}{m+m_{tot}}\right)^2$

$\frac{\Delta h}{\cancel{r}} = \frac{U^2}{2g\cancel{r}}\left(\frac{m}{m+m_{tot}}\right)^2$

$\underbrace{\Delta h}_{y} = \underbrace{\frac{U^2}{2g}}_{slope}\ \underbrace{\left(\frac{m}{m+m_{tot}}\right)^2}_{x}$

$\Rightarrow slope = \frac{U^2}{2g} \Rightarrow 30.6 = \frac{U^2}{2 * 9.8} \Rightarrow U^2 = 599.76$

$\boxed{U = 24.4\ m/s}$

7] specific heat capacity of met

→ Spacific heat capacity [C]

* $[C]$ = Cal/(g·C°)
↳ material

→ heat capality = mC → material
= [Cal/C°] ↳ mass + volume

→ heat = $Q = m\underline{C}\Delta T$ ← constant

$[Q]$ = Cal

كمية الطاقة اللازمة لرفع درجة حرارة m غرام من مادة سعتها الحرارية C بمقدار ΔT ←

$$Q_{\text{gained by water of calorimeter}} = Q_{\text{lost by brass}}$$

$$m_w C_w \underbrace{\Delta T_w}_{\text{نفسه}} + m_c C_c \underbrace{\Delta T_c}_{\Delta T_c = \Delta T_w} = m_b C_b \Delta T_b$$

$\Delta T_w = |T_F - T_i|$ — T_F: equilibriem temp., T_i: intitel Temp. of water + calori.

$\Delta T_b = |T_2 - T_F|$ — T_2: intitel Temp. of brass

error in C_b = ΔC_b ⇒ $\Delta C_b = C_b\sqrt{\left(\frac{\Delta y}{y}\right)^2 + \left(\frac{\Delta x}{x}\right)^2 + \left(\frac{\Delta z}{z}\right)^2 + \left(\frac{\Delta m}{m}\right)^2}$

y: $(m_w C_w + m_c C_c)$, x: $\Delta T_w = \Delta T_c$, z: ΔT_b

1] The heat capality of an object depends on:
a- The mass of the body
b- The volume of the body
c- The material of the body

$V = \frac{m}{\rho}$ (volume) ⇒ heat capacity $(Q) = m\underline{\underline{C}}$ (mass, material)

2] The unit of spalific heat capality is: Cal·(g·C)$^{-1}$

3] The heat capacity of certain object of mass "M" is "C", its spalific heat is "S", then:

heat capacity = mass * spacific heat

$C = M * S$

$$\boxed{C = MS}$$

4] The specific heat capality of an object depends on: The material of body

5] The heat Lost to the surroundings in the experiment:
Causes the measured value of specific heat to be smaller than the true value.
[C]

6] Increasing the mass (ثابتة) of the metal block: Has NO effect on the measured value of specific heat
[C] ← ثابتة بالكتلة
صفة نوعية للمادة

#
7] The major error contributing to this experiment is: heat Loss

* أهم مصدر للخطأ (accuracy) هي الحرارة الضائعة (المفقودة) التي تخرج من النظام للوسط المحيط (الحرارة المفقودة من النحاس أثناء نقله).

* أهم الاقتراحات للتقليل من الحرارة الضائعة: وضع سلك نحاس داخل الوعاء (النظام) للتقليل من الحرارة المفقودة من النحاس أثناء نقله.

8] True or false: [C] → material of an body

- The $\boxed{\text{specific heat capacity}}$ of an object is depend on its mass (F)
- The specific heat capacity can be expressed in units of $J/(g\cdot°C)$ (T)
- increasing the mass (m) of the metal block causes the value of its heat capacity to increase. (T)

heat capacity = mc

$h \propto m$

9] A ($100g$) (M_1) calorimeter contains ($50g$) (M_w) water at ($20°C$) (T_1), if we added ($25g$) (M_2) of metal of specific heat (0.08 $Cal/g.°C$) (C_2) at ($100°C$) (T) given that:
- Specific heat of calorimeter is (0.22) $Cal/g.°C$ (C_1)
- 〃 〃 water is: (1) $Cal/g.°C$ (C_w)

*The final temperature of the system when it reaches equilibrium state is:

$$(M_wC_w + M_1C_1)(T_f - T_1) = (M_2C_2)(T_2 - T_f)$$
$$(50 * 1 + 100 * .22)(T_f - 20) = (25 * 0.08)(100 - T_f)$$
$$72T_f - 1440 = 200 - 2T_f$$
$$+2T_f \quad +1440 \qquad +1440 \quad +2T_f$$
$$\frac{74T_f}{74} = \frac{1640}{74}$$
$$\boxed{T_f = 22.16°C}$$

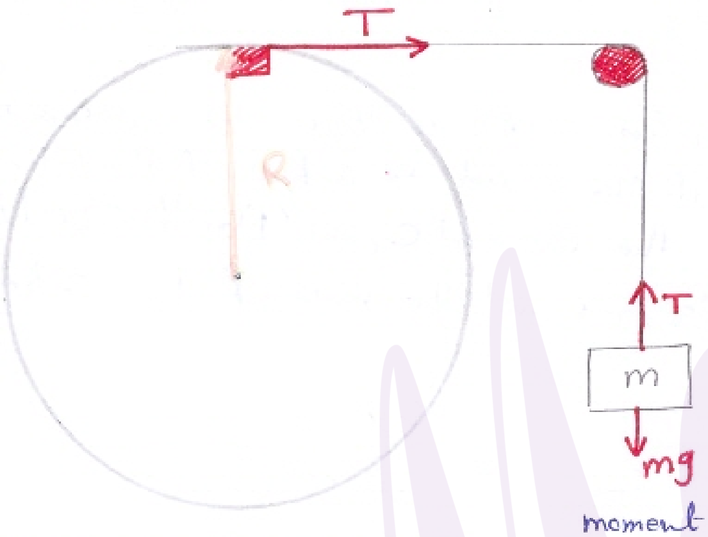
* The unit of heat capacity is: $Cal/°C$

$\boxed{10}$ if the specific heat of ametal is [2 Cal/g.°c] and its mass is (200g), what is the heat needed of raise is tempreture from 20°C To 75°C

$$\text{heat} = MC\,\Delta T$$
$$= 200 * 2 * (75 - 20) = 2.2 * 10^4 \text{ Cal}$$

$\boxed{11}$ The intitel tempreture of acirten metal is $\underline{150°C}_{T_1}$, its mass is $(\underline{50g})_{M_1}$, what is specific heat is C_m, if the intitel tempreture of the Calorimeter, and the water is $\underline{20°C}$, and if the C_w and C_1 are (1) and (0.22 Cal/g°.c) and the mass of the water is $(\underline{75})_{mw}$g and the mass of the Calorimeter Cup is $(\underline{100g})_{M_1}$

8] Rotational motion:



1] $F = ma$

$mg - T = ma$

$T = m(g-a)$ --- ①

* dyne.m
* N.m

$\vec{F} = \vec{T}$ tension

2] $\tau = \vec{r} \times (\vec{F}) = I * \alpha$

بعد القوة عن المحور

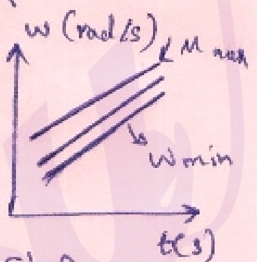
angular acceleration $\alpha = \frac{\vec{a}}{R}$ (rad/s²) acceleration

$$\boxed{I = m\left(\frac{gR}{\alpha} - R^2\right)}$$

moment of inertia

constant, variable, constant, disk radius

* $TR = I\alpha$
* $\omega = \frac{U}{R}$
* $\tau = I\alpha$; $\tau \to y$, $I \to$ slope, $\alpha \to x$



Slope $= \alpha = \frac{\Delta w}{\Delta t}$

$w \propto t$, $\alpha = \frac{a}{R}$

liner, direct realation

* $\boxed{\alpha = \frac{\Delta w}{\Delta t}}$

$\Rightarrow$ when M increas, α decreas

$$\boxed{M \propto \frac{1}{\alpha} \propto I}$$

$[I] = g.cm^2$

1] The slope of the torque versus angular accelartion represents:

The moment of inertia of the turn table $\Rightarrow \tau = I\alpha$; torque (y), slope, angular accelration (x)

2] if we increas the mass of the turn table, then the moment of inertia of the turntable will: $M \propto I \Rightarrow$ increase

3] In the rotational motion of the disk shown, the hanging mass $m_h = 0.5$ kg falls with acceleration of $0.2\ m/s^2$. The torque on the disk is:

$\tau = m\left(\frac{gR}{\alpha} - R^2\right) \Rightarrow 0.5\left(\frac{9.8 \times \cancel{0.2}}{\cancel{0.2}} - (0.2)^2\right) = 4.88$ N.m

$\frac{kg.m}{s^2}$ N

4] increasing the mass of the rotating disk while keeping the hanging mass constant: *Decreas the angular acceleration

$M \propto \frac{1}{\alpha} \propto I$ *لا تتوقف الكتلة في العزم (Torque) ← ثابت
Constant

5] In the rotational motion of the disk of radius 10 cm (R) shown, The block of mass 200 g (m) is allowed to fall with an acceleration of $2\ m/s^2$ (α), The moment of inertia of the disk ($g \cdot cm^2$):

$$I = m\left(\frac{gR}{\alpha} - R^2\right) \Rightarrow 200\left(\frac{980 * 10}{2} - (10)^2\right)$$

$$\boxed{I = 78 * 10^3\ g \cdot cm^2}$$

6] if the following data were obtained for a rotating disk of radius 15 cm:

$I\ (kg \cdot m^2)$	$5.6 * 10^{-3}$	$6.8 * 10^{-3}$
$\alpha\ (rad/s^2)$	11	9

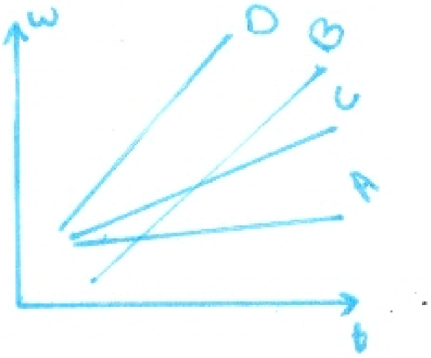
* The Tension in the string (in Newton) is:

$$I = TR = I\alpha \Rightarrow T_1 = \frac{I\alpha}{R} \Rightarrow \frac{5.6 * 10^{-3} * 11}{15 * 10^{-2}} = 0.41\ N$$

$$T_2 = \frac{I\alpha}{R} \Rightarrow \frac{6.8 * 10^{-3} * 9}{15 * 10^{-2}} = 0.4\ N$$

$$T = \frac{0.41 + .40}{2} = .409\ N$$

7] In the rotational motion experiment, the line shown in the figure were obtained using four different turntables made of the same material and different radius



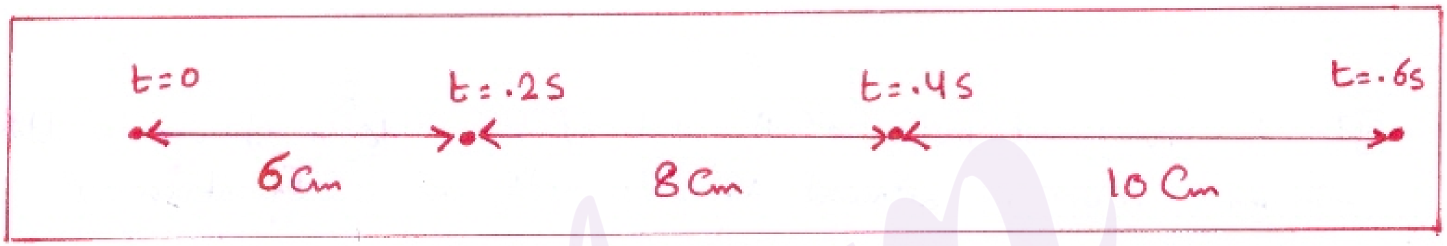
$$\omega \propto t \Rightarrow \frac{\omega}{t} = \text{slope} = \alpha$$

$$\alpha = \frac{a}{R} \Rightarrow \text{slope} = a \Rightarrow \boxed{\frac{1}{\alpha} = I}$$

$$a_D > a_C > a_b > a_a \qquad I_a > I_b > I_c > I_D$$

8] The ticker tap shown below, was taken during an experiment using a turntable (disc) of radius 20Cm.

The angular acceleration of the turntable in rad/s² is:



$\alpha = \frac{w}{t} = \frac{a}{R} \rightarrow \frac{\Delta V}{\Delta t}$

$\vec{V}_1 = \frac{6}{.2} = 30 Cm/s$

$\vec{V}_2 = \frac{8}{.2} = 40 Cm/s$

$\vec{V}_3 = \frac{10}{.2} = 50 Cm/s$

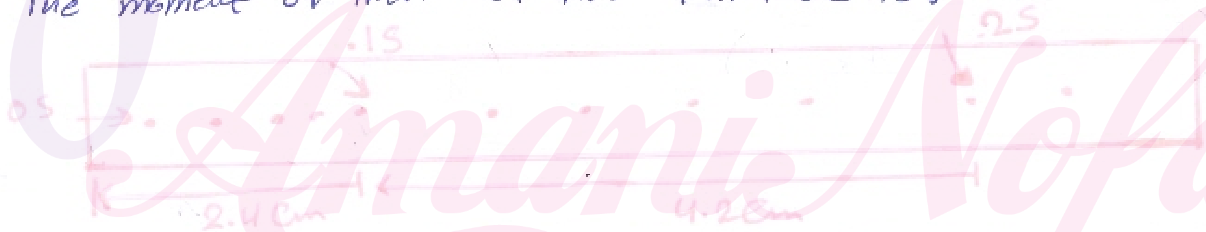
$\bar{a}_{12} = \frac{\Delta V}{\Delta t} = \frac{40-30}{.4-.2} = 50$

$\vec{a}_{23} = \frac{\Delta V}{\Delta t} = \frac{50-40}{.6-.4} = 50$

$\langle a \rangle = 50 Cm/s^2 \Rightarrow \alpha = \frac{\langle \bar{a} \rangle}{R} = \frac{50 * 10^{-2}}{20 * 10^{-2}} \Rightarrow \boxed{2.5 rad/s^2}$

9] The Ticker Tape shown was taken during an experiment using a turntable of mass (200g) and radius (15 Cm) accelerated by a hunging mass equal (40g). the time between any two consecutive ticks is (0.02)s.

The moment of inertia of this turntable is:



$V_1 = \frac{\Delta X}{\Delta t} = \frac{2.4}{.1} = 24 Cm/s \Rightarrow w_1 =$

$V_2 = \frac{\Delta X}{\Delta t} = \frac{4.2}{.1} = 42 Cm/s$

10 Simple Pendulum:

1] a simple Pendulum has a length of 45 Cm in a location where $g = 9.8\ m/s^2$, The Period of 5 oscillations (in sec) is:

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

$$T = 2 * 3.14 * \sqrt{\frac{45*10^{-2}}{9.8}}$$

$T = 1.3$ Sec $\Rightarrow$ for 5 oscillation $\Rightarrow 5*T \Rightarrow 5*1.3$

$\boxed{T = 6.7}$ Sec

L : طول البندول

$T \rightarrow$ [يعتمد فقط على الطول # ليس له علاقة بـ mass]

[الزمن الدوري اللازم لانهاء دورة واحدة]

$* F = \frac{mv^2}{r}$ القوة المركزية

$* \underset{\text{Period of oscillation}}{T} = 2\pi\sqrt{\frac{L}{g}}$

$T^2 = \underbrace{\frac{4\pi^2}{g}}_{\text{ثابت}} L$

$T^2 \propto L$ (direct, liner relation)

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

2] if a simple Pendulum of length L_1 has a period of T_1(sec), the Period T_2(sec) of a pendulum of length L_2 at the same place is equle to:

$T_1 = 2\pi\sqrt{\frac{L_1}{g}}$ $\qquad T_2 = 2\pi\sqrt{\frac{L_2}{g}}$

$T_1 = \frac{2\pi}{\sqrt{g}} * (L_1)^{\frac{1}{2}}$ $\qquad T_2 = \frac{2\pi}{\sqrt{g}} * (L_2)^{\frac{1}{2}}$

$$\frac{T_1}{T_2} = \frac{\cancel{\frac{2\pi}{\sqrt{g}}} * (L_1)^{\frac{1}{2}}}{\cancel{\frac{2\pi}{\sqrt{g}}} * (L_2)^{\frac{1}{2}}} \Rightarrow \frac{T_1}{T_2} = \left(\frac{L_1}{L_2}\right)^{\frac{1}{2}}$$

$$T_1 = T_2\left(\frac{L_1}{L_2}\right)^{\frac{1}{2}}$$

$$\boxed{T_2 = T_1\sqrt{\frac{L_2}{L_1}}}$$

3] increasing the number of oscillations of the Pendulum, for which the time interval massured: Causes the accuracy of measurment to $\boxed{\text{increase}}$

ازدياد عدد الاهتزازات يعطي دقة أكبر

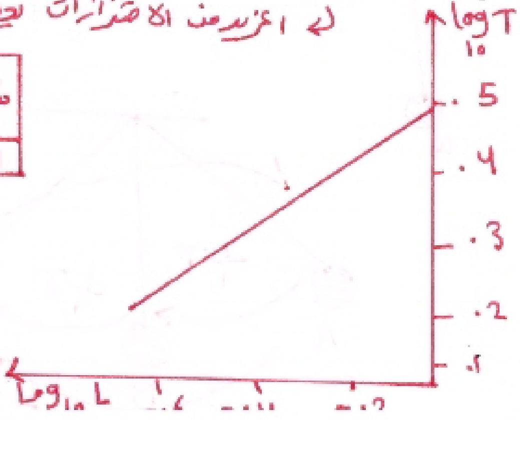
4] $T = \frac{2\pi}{\sqrt{g}} * \sqrt{L}$

Plant	Earth	Mars	Earth's moon	Pluto
g(m/s²)	9.8	3.8	1.6	.29

$\underbrace{\text{Log}\,T}_{y} = \underbrace{\text{Log}\,\frac{2\pi}{\sqrt{g}}}_{\text{y-intercept}} + \underbrace{\frac{1}{2}}_{\text{slope}} \underbrace{\log L}_{x}$

$\Rightarrow$ y-intercept $= .5$ $\Rightarrow$ $.5 = \text{Log}\,\frac{2\pi}{\sqrt{g}}$

$10^{.5} = \frac{2\pi}{\sqrt{g}}$



$g = \left(\frac{2\pi}{10.5}\right)^2 \Rightarrow g = 3.94\ m/s^2$

Plont Mars

5] The graph shown represents aplot of Log T versus Log L, then:

a- The slope: $\frac{1}{2}$

b- The y-intercept: 0.3

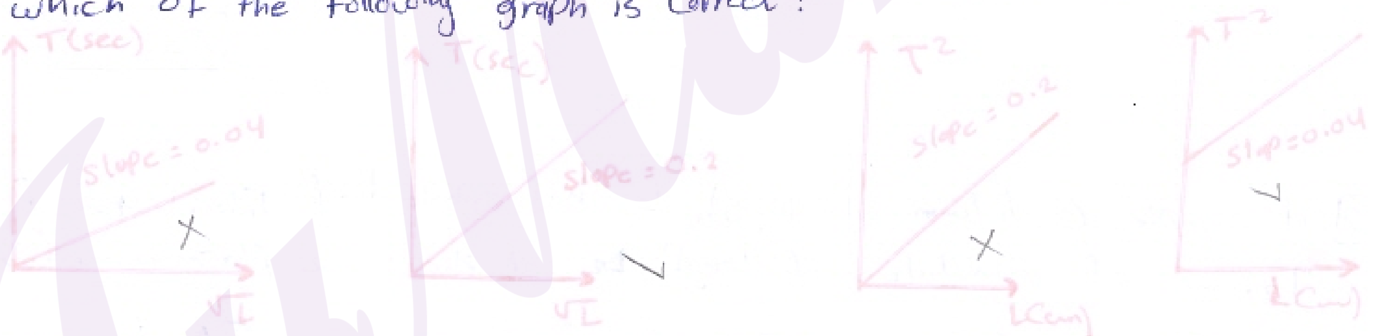
$T = \frac{2\pi}{\sqrt{g}} \cdot (L)^{\frac{1}{2}}$

$\underbrace{\log T}_{y} = \underbrace{\log \frac{2\pi}{\sqrt{g}}}_{\text{y-intercept}} + \underbrace{\frac{1}{2}}_{\text{slope}} \underbrace{\log L}_{x}$

$\text{y-intercept} = \frac{2\pi}{\sqrt{g}}$

$= \frac{2 * 3.14}{\sqrt{9.8}} = \boxed{0.3}$

6] which of the following graph is Correct?



$\underbrace{T}_{y} = \underbrace{\frac{2\pi}{\sqrt{g}}}_{\text{slope}} \underbrace{\sqrt{L}}_{x}$

$\frac{2\pi}{\sqrt{g}} = 2$

$\left(T = \frac{2\pi}{\sqrt{g}} \cdot \sqrt{L}\right)^2$

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

$\text{slope} = \frac{4 * (3.14)^2}{9.8} = 0.04\ \text{Cm}$

7] in the figur shown, the bob takes (0.7 sec) to move from Point A → C, given that the length of the string is 46.7. The acceler. due to gravity in (m/s^2) is

$t = \frac{1}{2} T_{\text{Period}} \Rightarrow$

$T_{(\text{period})} = 2 * .7$

$= 1.4\ \text{sec}$

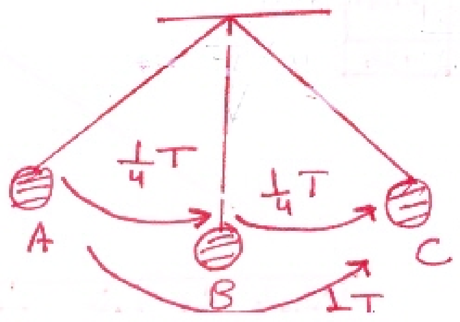
$T = \frac{2\pi}{\sqrt{g}} \cdot (L)^{\frac{1}{2}} \Rightarrow T^2 = \frac{4\pi^2}{g} \cdot L$

$(1.4)^2 = \frac{4 * (3.14)^2}{g} * .467$

$\frac{1.96\, g}{1.96} = \frac{18.41}{1.96}$

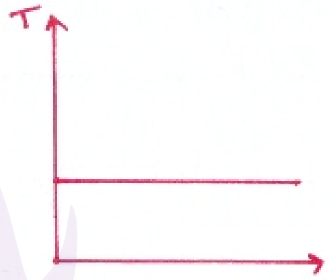
$g = 9.39$

$\boxed{g \simeq 9.4\ m/s^2}$



8] There are three variables which can be changed in the exp. These are: L (the Length of the string), m (The mass of the bob) and θ (The maximum angle of swing), for the graph shown, The variable along the x-axis is:

mass = m



9] The following data was taken for a simple Pendulum of mass 10 gms on a planet of unk.

L (Cm)	10	30	50
Time for 20 cycles (s)	16	28	36

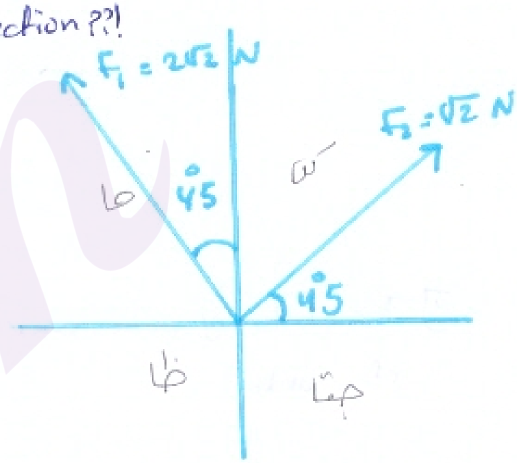
The value of g in (Cm/s²) is:

1] at L = 10 Cm $\rightarrow$ T = 16 $\Rightarrow \left(T = \frac{2\pi}{\sqrt{g}} \cdot \sqrt{L}\right)^2 \Rightarrow T^2 = \frac{4\pi^2}{g} \cdot L$

$(16)^2 = \frac{4 * (3.14)^2}{g} * 10 \Rightarrow 256 g = 394.3$

11 Force Table (vectors) :)

1] The two force shown in the figure act on a body located at the origin. A third force (F_{eq}) is applied to get static equlibrium. Find the magnitude of (F_{eq}) and It's direction ??!



equilibrium force $\rightarrow \Sigma F_x = 0$, $\Sigma F_y = 0$

$$\Sigma F_x = F_2 \cos 45° + F_1 \cos 135°$$

$$\Sigma F_x = \cancel{\sqrt{2}} * \frac{1}{\cancel{\sqrt{2}}} + 2\cancel{\sqrt{2}} * -\frac{1}{\cancel{\sqrt{2}}}$$

$$\boxed{\Sigma F_x = -1 N}$$

$$\Sigma F_y = F_2 \sin 45° + F_1 \sin 135°$$

$$= \cancel{\sqrt{2}} * \frac{1}{\cancel{\sqrt{2}}} + 2\cancel{\sqrt{2}} * \frac{1}{\cancel{\sqrt{2}}}$$

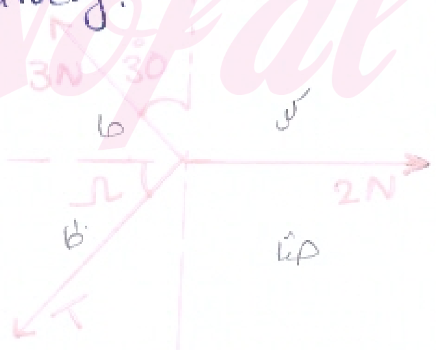
$$\boxed{\Sigma F_y = 3N}$$

$$\Rightarrow * F_{eq} = \sqrt{(\Sigma F_x)^2 + (\Sigma F_y)^2} = \sqrt{9+1} = \boxed{\sqrt{10}} N$$

$$\tan\theta = \frac{\Sigma F_y}{\Sigma F_x} \Rightarrow \theta = \tan^{-1}\frac{3}{-1} \Rightarrow \theta = -71.5$$

OR $\theta = 288.5$

2] Consider a body located at the origin, the body is in equlibrium if T (in N), and Ω (in degree) are respectively:



equlibrium $\rightarrow \Sigma F_x = 0$, $\Sigma F_y = 0$

$$\Sigma F_y = 2\sin 0 + 3\sin 120$$

$$\Sigma F_x = 2\cos 0 + 3\cos 120$$

$$= 2 + 3 * -\frac{1}{2}$$

$$\Sigma F_y = 3 * \frac{\sqrt{3}}{2}$$

$$\boxed{\Sigma F_y = 2.6 N}$$

$$\boxed{\Sigma F_x = \frac{1}{2} N}$$

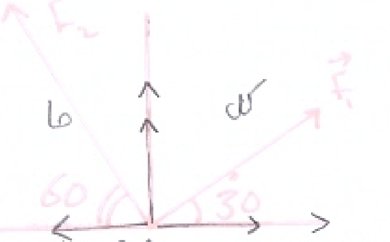
$$F_{eq} = \sqrt{(.5)^2 + (2.6)^2}$$

$$\boxed{F_{eq} = 2.75 N}$$

$$\theta = \tan^{-1}\frac{2.6}{.5}$$

$$\boxed{\theta = 79.1°}$$

3] for the two forces ($\vec{F}_1 = 50N$, $\vec{F}_2 = 50N$) , the magnitude of the resultant force of these forces ($\vec{F}_1$ & $\vec{F}_2$) is:



$$\Sigma F_x = F_1 \cos 30^\circ + F_2 \cos 120$$
$$= \cancel{50}^{25} * \frac{\sqrt{3}}{\cancel{2}} + \cancel{50}^{25} * -\frac{1}{\cancel{2}}$$
$$= 43.3 + -25$$
$$\boxed{\Sigma F_x = 18.3}$$

$$\Sigma F_y = F_1 \sin 30^\circ + F_2 \sin 120$$
$$= \cancel{50}^{25} * \frac{1}{\cancel{2}} + \frac{\cancel{50}}{25} * \frac{\sqrt{3}}{\cancel{2}}$$
$$= 25 + 43.3$$
$$\boxed{\Sigma F_y = 68.3N}$$

GOOD luck

GOOD luck

GOOD luck

GOOD luck