Chapter 1
sections 1.5 & 1.6 & 1.8

Sec 1.5
Units, Standards, and the SI system

When we measure the hight of a table we may write :-

2m → the unit which is the meter

the result of measurement

There are three main units that we use and they are :-

Mass
Length
Time
→ they are the basic units

they are used in the " mks " & " cgs " systems

in SI system

it's called System International in French, but we say it in English International System

We usually use the " mks " system which is referred to :-

m / meters → Length
k / kilograms → Mass
s / seconds → Time

there is also other basic units like :-
electric current : A " ampere "
temperature : K " Kelvin "
amount of substance : mole
luminous intensity : cd " candela "

the " cgs " system is referred to :-
c / centimeters
g / grams
s / seconds

Sec 1.6
Converting Units

it is easy to change from mks to cgs and the opposite for example :-

1m = 100cm , 1kg = 1000 grams

there is also something called (conversion factor) example :-

$9m = ?cm \;/\; 9m \times 1 = 9\cancel{m} \times \frac{100cm}{\cancel{m}}$

$9m = 900cm$

another example :-

1km = 1000cm :- $3km = ?cm \;/\; 3\cancel{km} = \frac{1000cm}{\cancel{km}} \times 3 \longrightarrow 3 = 3000\,cm$

consider the following :-

velocity سرعة m/s $\rightarrow$ L/T

acceleration تسارع m/s^2 $\rightarrow$ L/T^2

density كثافة kg/m^3 $\rightarrow$ M/L^3

(we express these in the term of :- L,M,T)

also, momentum (p = mv) , force (F = ma) are expressed in terms of L,M,T

example:- show that force which has units of (newton) can be expressed in terms of the base quantities L,M,T

$F = m\,a$ (m → mass, a → acceleration)

the unit of force is the newton (N)

$1N = 1kg \,.\, 1m/s^2 = M \,.\, L/T^2$

therefore the newton is a derived quantity , since we can express it in terms of combination of the base unites

Sec 1.8

Dimension and Dimensional Analysis

Dimension of velocity (v):-

base quantities are used to express velocity

$$[\underset{\text{Length}}{L}/\underset{\text{Time}}{T}] \rightarrow \text{base quantities}$$

it means that velocity is measured in units of :-

m/s or cm/s or km/h ... etc

Length/time

Dimensional Analysis :-

$$xy + z = 2$$

each of (xy, z, 2) are terms they may have different values but each of them are a term

*this question is important (Is this equation dimensionally correct?)

it should be "not the same but all of them should equal each other" :

$$[L/T] = [L/T] + [L/T]$$

to be dimensionally correct *it might not be physically correct*

but, if it's otherwise then it is both dimensionally and physically incorrect

Question: what are the dimensions of force?

Answer: *remember* $F = ma$

dimensions of force are $\left[M \frac{L}{T^2}\right]$

mass, length, time

Example: is the relation $V_f = V_i + at^2$ incorrect?

Answer: by using the dimensional analysis the dimensions of V is [L/T] and dimensions of time is [T]

$$\left[\frac{L}{T}\right] \stackrel{?}{=} \left[\frac{L}{T}\right] + \left[\frac{L}{\cancel{T^2}}\right]\left[\cancel{T^2}\right]$$

$$\left[\frac{L}{T}\right] = \left[\frac{L}{T}\right] + [L]$$

same dimensions

different dimension

so this relation is dimensionally and physically incorrect

Consider:- $V_f = V_i + \frac{1}{2}at$

give the dimensional analysis:-

$$\left[\frac{L}{T}\right] \stackrel{?}{=} \left[\frac{L}{T}\right] + \left[\frac{L}{\cancel{T^2}} \times \cancel{T}\right] =$$

$$\left[\frac{L}{T}\right] = \left[\frac{L}{T}\right] + \left[\frac{L}{T}\right]$$

All terms have the same dimensions

it is dimensionally correct but, physically incorrect

Remember:-

it can be:-

- dimensionally & physically correct
- only dimensionally correct
- dimensionally & physically incorrect

$V_f = V_i + at$

0- physically correct

0- dimensionally correct

Solving problems and add notes:-

17. (II) Determine the conversion factor between (a) km/h and mi/h, (b) m/s and ft/s, and (c) km/h and m/s.

we will change km/h to mi/h
Note: 1km = 1000m , 0.621mi = 1km , 1h = 3600s

conversion factor from km/h to mi/h :

$$\frac{1km}{h} = 1\frac{\cancel{km}}{h} \times \left(\frac{0.621mi}{\cancel{km}}\right) = 0.621\ mi/h$$

$$\therefore\ 1\frac{km}{h} = 0.621\ mi/h \rightarrow 1 = \frac{0.621\ mi/h}{km/h}$$

for example:- what is 40 km/h in mi/h?

$$40\ km/h = 40\ \cancel{km/h} \times \frac{0.621\ mi/h}{\cancel{km/h}} = 40 \times 0.621\ mi/h = 24.84\ mi/h$$

km/h and m/s :-

$$1km/h = 1\cancel{k}m/\cancel{h} \times (1000m/\cancel{k}m) \times (\cancel{h}/3600s)$$

$$1km/h = 5/18 - m/s \Rightarrow 1 = 5/18\ (m/s)\ /\ (km/h)$$

14. (I) One hectare is defined as 1.000 * 104 m2. One acre is 4.356 * 104 ft2. How many acres are in one hectare?

hectare = $1 \times 10^4 m^2$ 1ft = 0.3048m

acer = $4.356 \times 10^4 ft^2$ 1ft/0.3048m = 1

$$1\ hectare = (1 \times 10^4)\left(\frac{\cancel{ft}}{0.3048m}\right)^2 \times \left(\frac{acre}{4.356 \times 10^4 \cancel{ft^2}}\right) = 1 \times 10^4 \times \frac{1}{0.3048^2} \times \frac{1}{4.356 \times 10^4}$$

$$= 2.471\ acre$$

21. (II) (a) How many seconds are there in 1.00 year? (b) How many nanoseconds are there in 1.00 year? (c) How many years are there in 1.00 second?

a) 1 year = 1x365x24x60x60 = 3.16×10^{7} s.

$1y = 3.16\times10^{7}s \Longrightarrow 3.16\times10^{7}$ s/y $\rightarrow$ conversion factor

nano$=10^{-9}$

b) 1 ns = 10^{-9} s   1 = (10^{-9} s/ns)

$1y = 1\cancel{y}\,(3.16\times10^{7}\,\cancel{s}/\cancel{y}) \times (ns / 10^{-9}\,\cancel{s}) = 3.16\times10^{16}$ ns

c) $1s = 1\cancel{s} \times (1y / 3.16\times10^{7}\,\cancel{s}) = 31.65\times10^{-9}$ y

$$\cancel{1s} = \frac{1\cancel{min}}{60\cancel{s}} \times \frac{1\cancel{h}}{60\cancel{min}} \times \frac{1\cancel{day}}{24\cancel{h}} \times \frac{1y}{356\cancel{day}} = \frac{1y}{31536000} = 3.17\times10^{-8}$$

$= 31.7\times10^{-9}y$

*33. (I) What are the dimensions of density, which is mass per volume?

density (ρ) = mass / volume

dimensions are : [M / L^{3}]

*34. (II) The speed v of an object is given by the equation $v = At^3 - Bt$, where t refers to time. (a) What are the dimensions of A and B? (b) What are the SI units for the constants A and B?

a & b)

$V = At^3 - Bt$ where (t) is time

the equation must be dimensionally correct

V has dimensions of L/T

$$\left[\frac{L}{T}\right] = [A\,T^3] - [B\,T]$$

must have the dimensions of L/T

must have the dimensions of L/T

$[AT^3] = \left[\frac{L}{T}\right] \rightarrow$ dimensions of A must be L/T^3

$[BT] = \left[\frac{L}{T}\right] \rightarrow$ dimensions of B must be L/T^2

48. An angstrom (symbol Å) is a unit of length, defined as 10^{-10} m, which is on the order of the diameter of an atom. (a) How many nanometers are in 1.0 angstrom? (b) How many femtometers or fermis (the common unit of length in nuclear physics) are in 1.0 angstrom? (c) How many angstroms are in 1.0 m? (d) How many angstroms are in 1.0 light-year (see Problem 18)?

Angstrom = 10^{-10} m

$1Å = 10^{-10}$ m $\Rightarrow$ $1 = 10^{-10}$ m / Å $\rightarrow$ conversin factor

$$1Å = 1\cancel{Å} \times \left(\frac{10^{-10}\,\cancel{m}}{\cancel{Å}}\right) \times \left(\frac{10^{9}\,nm}{\cancel{m}}\right) = 10^{-1}\,nm$$

$$10^{-10}\,nm \Rightarrow 1 = \frac{10^{-1}\,nm}{Å} = \frac{0.1\,nm}{Å}$$

Chapter 2

Sec 2.1 & 2.2 & 2.3 & 2.4

Kinematic in one dimension

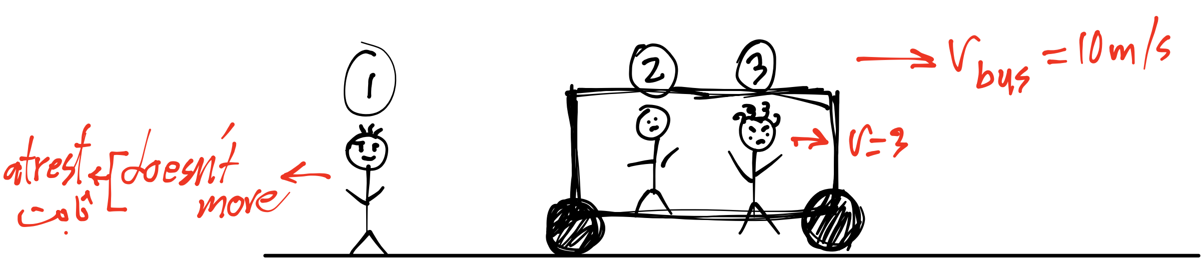
It means: moving along in one line

Sec 2.1 :- Fram of reference إطار الإسناد

* Velocity is a vector
السرعة عبارة عن متجه

* Pressure, temperature, mass, speed: they are scalar that has magnitude
قياسي
مقدار

Describing farm of reference: from each person point view



1 for Person 1 he sees person 2 moves to the right with $v = 10 m/s$ and person 3 moves to the right with $V = 13 m/s$ because $V_{bus} + V_3 = 13 m/s$

---

2 for person 2 he sees person 1 moves to the left with $V = 10 m/s$ and sees Person 3 moving to the right with $v = 3 m/s$

---

3 for person 3 he sees person 2 moves to the left with $v = 3 m/s$ and sees person 1 moves to the left with $v = 13 m/s$.

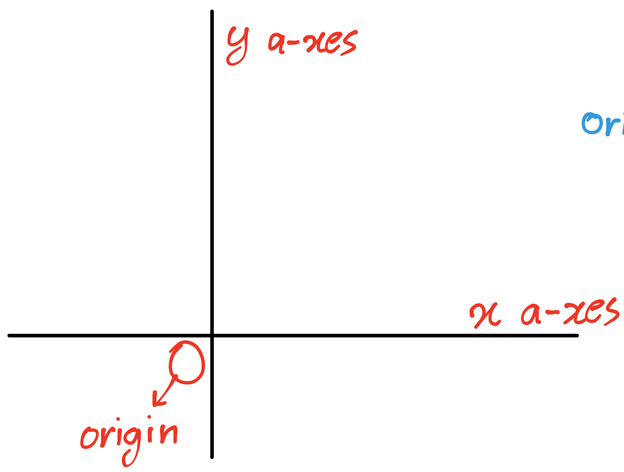
* Velocity, force, distansed have magnitued and directions
مقدار اتجاه

Note: every point of view is correct & it depends on the observe of each person.

we use fram of reference to specify velocity in specific view

What dose fram of referenc consist of?

It dose consists two dimensions the x and the y a-xes



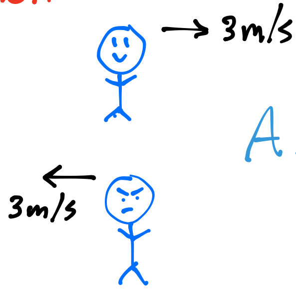
note:- in case 1 the person was representing a fram of reference as an origin poin and give positions with aspect to the origin and measures velocity with aspect of a-xes (x and y).

Sec 2.2:- Average Velocity

more explanation:-

person 1

person 2



$$A.\text{velocity} = \frac{\text{displasment}}{\text{time}} = m/s$$

Both person 1 & 2 have the same speed & speed gives how fast an object or someone moving

So if we say you have moved a distance of 9m in 3s we define an average speed $\bar{s}$ as :-

$$\bar{s} = \frac{\text{distance}}{\text{time}} = \frac{9}{3} = 3\ m/s$$

Q :- what is the difference between speed & velocity?

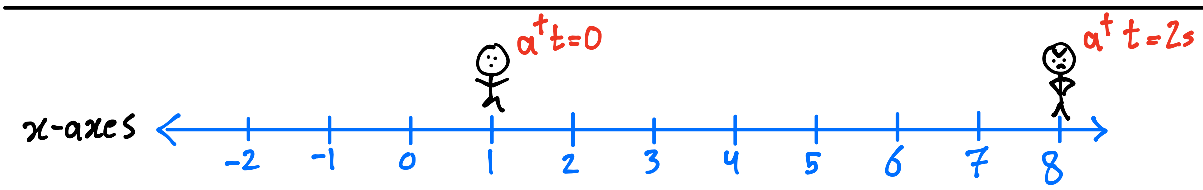
we can say that person 1 moves at $\underbrace{3m/s}_{\text{magnitude}}$ in the positive $\underbrace{x\text{-direction}}_{\text{direction}}$

---

* note :- the directions will be the same as the displasment in velocity & the reason that it's vector, because it contains direction (اتجاه) as well as magnitude (مقدار) of a moving object.

So person 1 / $V_1 = +3\ m/s$
↳ direction to the right (along positive x direction)

and person 2 / $V_2 = -3\ m/s$
↳ direction to the left (along negative x direction)



* the person was (at x=1m at t=0s)
and he moved to (x=8m at t=2s)

So we define average velocity as :-

$$\bar{V} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

the line means average

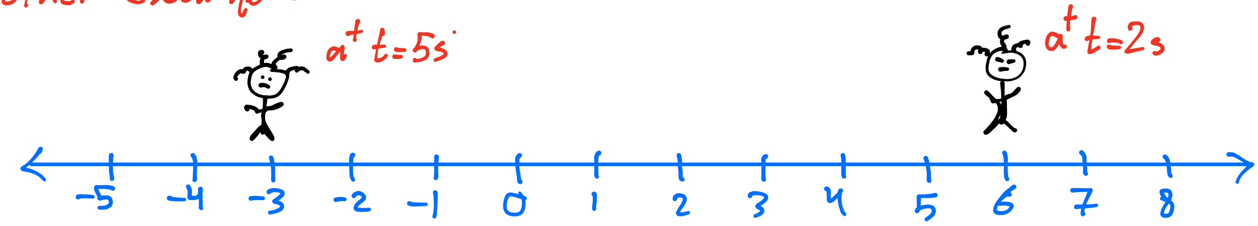
i = inital أولي/ابتدائي
f = final نهائي

$$\bar{V} = \frac{\Delta \text{displacement}}{\Delta \text{time}}$$

So we can write :- $\bar{V}_{0-2} = \frac{8-1}{2-0} = \frac{7}{2} = 3.5\ m/s$

* Arreage velocity depends on the change in displacement

another example:-



Q: Find the average velocity of the person over the time interval $t=2s \rightarrow t=5s$

$$\bar{v}_{2-5} = \frac{-3-6}{5-2} = \frac{\cancel{-9}}{\cancel{3}} = -3\,m/s$$ (because $-3 \times 3 = -9$)

So $\bar{v}_{2-5} = -3\,m/s$

↑ that means that $\bar{v}$ is along the negative x-direction

---

Sec 2.3 :- Instantaneous Velocity

سرعة لحظية

If we said that we were driving and we looked at the odometer (عداد السرعة) we may read 50 Km/h. And this's the velocity at a given instant.

↳ لحظة

معينة لحظة

✱ And we call this instantaneous velocity. which's given at a particular instant of time.

for example:-

$v = 60$ km/h → direction in positive x-axes

$v = -40$ Km/h → direction in negative x-axes

Sec 2.4 Acceleration

When the velocity of an object changes with time then this object accelerates

* Acceleration is the change in velocity with time

التسارع يعتمد على التغيير في السرعة و ليس السرعة عينها.

Avreage Acceleration $\bar{a}$

$$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i} = m/s^2$$

[Examples:-

Q\ if the velocity of an object is zero, dose the acceleration have to be zero?

NO, it dose not

$t_i = 1$ $\quad v_i = 3\,m/s$

$t_f = 5$ $\quad v_f = 10\,m/s$

$$\bar{a} = \frac{\Delta v}{\Delta t} = m/s^2$$

$$\bar{a} = \frac{10-3}{5-1} = \frac{7}{4} = 1.75\ m/s^2$$

Find the average acceleration of the car

$t_i = 2s$, $\quad v_i = 4\,m/s$

$t_f = 2+3 = 5s$, $\quad v_f = 12\,m/s$

$$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{12-4}{5-2} = \frac{8}{3} \simeq 2.7\,m/s^2$$

Problems Chapter 2 & Notes

Note:-

v	a	$\bar{a}$
+	+	+
−	−	−
+	−	decleleration
−	+	decleleration

→ تباطؤ

5. (I) A bird can fly 25 km/h. How long does it take to fly 3.5 km? we use the velocity here

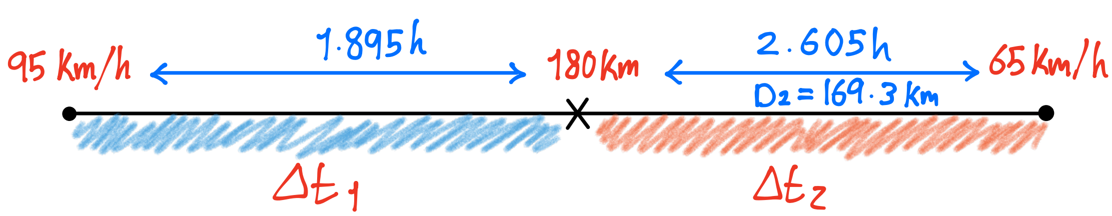
$$\bar{v} = \frac{\Delta x}{\Delta t} \Rightarrow \Delta t\,?$$

$$\Delta t = \frac{\Delta x}{\bar{v}}\ , \quad \Delta t = \frac{3.5\ \cancel{km}}{25\ \cancel{km}/h} = 0.14\,h$$

7. (II) You are driving home from school steadily at 95 km/h for 180 km. It then begins to rain and you slow to 65 km/h. You arrive home after driving 4.5 h.

(a) How far is your hometown from school?

(b) What was your average speed?



$\boxed{1}$ $\bar{v} = \frac{\Delta x}{\Delta t} = \frac{180}{\Delta t} = 95 \Rightarrow \Delta t = \frac{180}{95} = 1.895\,h$

$\boxed{2}$ $4.5 - 1.895 = 2.605\,h$

$\boxed{3}$ $2.605\,\cancel{h} \times 65\ Km/\cancel{h} = 169.3\ Km$

$\boxed{4}$ Aaverage Speed:-

$$\bar{s} = \frac{\text{total distance}}{\text{total time}} = \frac{180 + 169.3}{4.5}$$

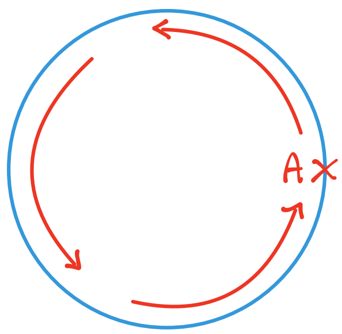
$$\bar{s} = 77.6\ Km/h$$

9. (II) A person jogs eight complete laps around a 400m track in a total time of 14.5 min. Calculate

(a) the average speed.

(b) the average velocity, in ms.

a)



one complete (circle) is 400m. in 14.5 min

So 8 compelet lap =

$8 \times 400 = 3200\,m$

note:- if the objects reterns to the starting point the $\Delta x = $ Zero

So the avreage speed is $\bar{s} = \frac{distance}{time} = \frac{3200\,m}{14.5\,min} = 220.7\,m/min$

b) the runner has began from point A and returened to point A

So the average velocity is Zero

to be sure $\Delta x = x_f - x_i = 0$

11. (II) A car traveling 95 km/h is 210 m behind a truck traveling 75 km/h. How long will it take the car to reach the truck?

we will use the velocity:-

* the car have travelled 210m, So dose the truck, So we can say that the Car & the truch have equal distance pluse 210m $\rightarrow d_{Car} = d_{Truck} + 210$

$\boxed{1}$ $V_c = \frac{\Delta x_c}{\Delta t}$, $V_t = \frac{\Delta x_t}{\Delta t} \Rightarrow \Delta t = \frac{d_c}{V_c}$, $\frac{d_t}{V_t}$

$\boxed{2}$ $\frac{d_t + 210}{95} = \frac{d_t}{75}$

بما معناه :- السيارة تمشي بسرعة ٩٥كم/س و بينها و
بين الشاحنة مسافة ٢١٠م و الشاحنة تمشي بسرعة ٧٥
كم/س. المطلوب هو الزمن اللازم الذي سوف تقطعة
السيارة بمسافة ٢١٠م زائد المسافة التي قطعتها
الشاحنة وهي تتحرك بسرعة ٧٥كم/س فتصبح عندي
مسافتين (d-car & d-truck) و المسافه المعطاه ٢١٠م

$\boxed{3}$ $\therefore 75(dt+210) = 95\,dt$

$$75\times210 \boxed{\begin{matrix}+75\,d_t \\ -95\,dt\end{matrix}} = \cancel{95\,d_t} \quad \cancel{-95\,dt} \quad = \frac{75\times210}{20} = \frac{\cancel{20}\,dt}{\cancel{20}} = \boxed{787.5\,m\ d_t}$$

$\boxed{4}$ now we use $\frac{dt}{v_t} = \Delta t = \frac{787.5\,\cancel{m}}{75\,\cancel{km}/h \times \frac{1000\,\cancel{m}}{\cancel{km}}} = 10.5\times10^{-3}\,\cancel{h} \times \frac{3600\,s}{\cancel{h}}$

$$\Delta t = 37.8\,s$$

20. (II) At highway speeds, a particular automobile is capable of an acceleration of about 1.8 m/s² → a

At this rate, how long does it take to accelerate from 65 km/h (V_i) to 120 km/h (V_f)?

$\boxed{1}$ using the conversion factor :-

$$65\,\cancel{km}/\cancel{h} \times \frac{\overset{5m}{\cancel{1000m}}}{\cancel{km}} \times \frac{\cancel{h}}{\underset{18s}{\cancel{3600s}}} = 65 \times \frac{5m}{18s} = 18.1\,m/s$$

$$120\,\cancel{km}/\cancel{h} \times \frac{\overset{5}{\cancel{1000}m}}{\cancel{km}} \times \frac{\cancel{h}}{\underset{18}{\cancel{3600}s}} = 120 \times \frac{\overset{0.27}{5m}}{18s} = 33.3\,m/s$$

$\boxed{2}$ now we use $\bar{a}$:-

$$\bar{a} = \frac{\Delta V}{\Delta t} = \frac{V_f - V_i}{t_f - t_i} = \frac{33.3\,\cancel{m/s} - 18.1\,\cancel{m/s}}{1.8\,\cancel{m/s^2}} = 8.4\,s$$

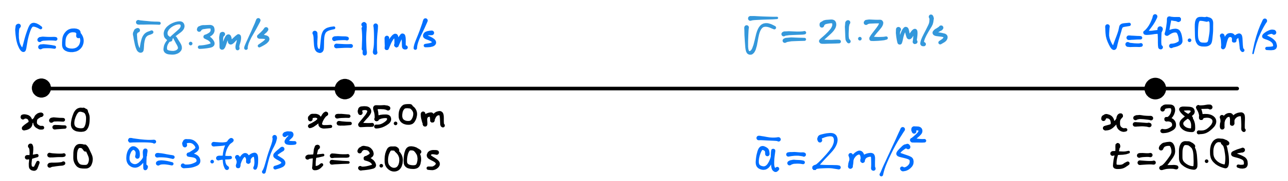
(13)

note: the reason that we used conversion factor is that the velocity & acceleration need to be in the same units
m/s & m/s² or Km/h & Km/h²

what if I want to use the Km/h , Km/h² ?

in the questions that's given speed is Velocity until it proven that it's speed

21. (II)A car moving in a straight line starts at x = 0 at t = 0. It passes the point x = 25.0 m with a speed of 11.0 m/s at t = 3.00s. It passes the point x = 385m with a speed of 45.0 m/s at t = 20.0 s. Find (a) the average velocity, and (b) the average acceleration, between t = 3.00 s and t = 20.0 s.



$\boxed{1}$ Average velocity:-

① $\bar{v} = \frac{\Delta x}{\Delta t} = \frac{25-0}{3-0} = \frac{25}{3} = 8.3\ m/s$ ② $\frac{385-25}{20-3} = \frac{360}{17} = 21.2\ m/s$

$\boxed{2}$ Avrage acceleration:- (3s→20s)

$\bar{a} = \frac{\Delta V}{\Delta t} = \frac{45-11}{20-3} = \frac{34}{17} = 2\ m/s^2$

Newton's Laws

*Kinematic: studying motion of objects regardless of the force causing the motion [need Force]

*Dynamics:- Studying motion of objects taking into accout the force causing the ~~motin~~ moition

Force :- vector

Inertial fram → dosen't accelerate
when newton's Laws are
valid. → ✓ إعطاء أجوبة

*there's no acceleration without force

*to have acc or decc you need a force

*forces cause the moition

*if I'm standing I can't move untill a force affect on me

Speed = magnitude

*there's no force to move the object forward and this's why the object go back

because we need acceleration

no acceleration ⟹ no force

when there's acceleration = there's force

Newton's 1st law:-
an object at last reman, so, an object moving at constint velocity (mag + dir) also remaning so, unless accelerated upon by $\boxed{\text{net Force}}$

important

magnitude + direction

*the law of inertal → قانون القصور الذاتي
يعني الجسم قاصر عن تغيير حالة الحركيه ألا بوجود قوة

[resestant of logice moition]

Mass:- measure in the resistance of an object to change in moition
مقاومتها / ممانعتها للتغيير
distant to an object to moition

Scalar

*object's can't change there moition
لا يتسارع أو يتباطئ ألا أذا أثرت عليه قوة خارجية

Newton's 2nd law:-

$\vec{F} = m\vec{a}$

net force — mass — acceleration

ex of "x" (multiplication عملية الضرب) vector by scalar

we can also write $\vec{a} = \frac{1}{m}\vec{F}$

Force
gravitational Force

*Q: what's the direction of the acceleration? resultant force

mass الكتلة	wieght وزن ($W = mg$)
Scalar	vector
*constant regardless on position	*depends on position "Variable متغير" (on earth > on moon) يعتمد على تسارع الجاذبية

$\underline{g}$

$F_x = m\vec{a}_x$
$F_y = m\vec{a}_y$
$F_z = m\vec{a}_z$

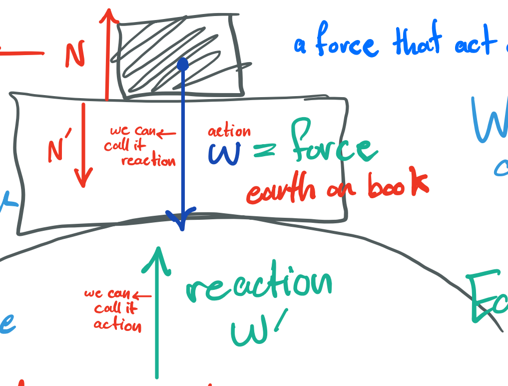
→ Vector quantity

Newton = N
$1\,Kg \cdot m/s^2$ → it's compound

$\frac{M \cdot L}{T^2}$ → dimension of newton

Newton's 3rd law

action - reaction = forces are equal and opposite



عامودية على سطح التلامس

a force that act on the book "wieght"

$W' =$ force of book on earth . call it reaction

$W =$ force earth on book

N = force of table on book (action) يمكن تسميتها reaction

N' = force of book on table (creaction)

reaction W'

action & reaction between the Earth Same two objects

action - reaction NEVER act on the same object

they have same mag & diff direction

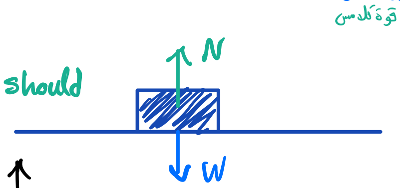
متساويان في المقدار ومتعاكسات في الإتجاه

W & W'
N & N' } they are equal and opposite

Normal reaction / Force :-
normal to the serface of contact
عامودية على سطح التلامس

Contact Force
الكتاب يؤثر على الطاولة بقوة إلى الأسفل و الطاولة تؤثر على الكتاب بقوة إلى الأعلى قوة تلامس

ex:- the force should be positie
القوة لازم تكون موجبة



$\uparrow +$

zero → because acceleration is negative

$N - W = ma = 0$

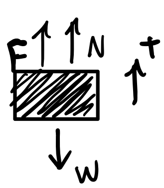
$N - W = 0 \Rightarrow N = W$

غير صحيح أن الـ N و W عبارة عن action-reaction
becaus it has an effect on the same object

رسمة تظهر كل القوة على الجسم

* Free - body digraph

Show all existing force acting on object

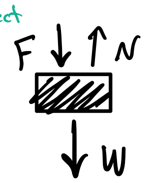


$\uparrow +$

$N + F - W = 0$

$N = W - F$

$N < W$



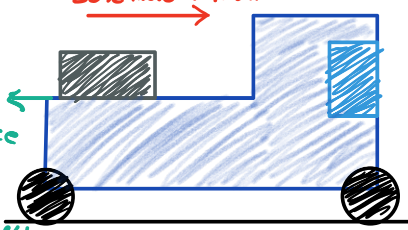
$\uparrow +$ $N - W - F = 0$

$N = W + F \Rightarrow N > W$

the one that's using the Inertial fram dosen't move / accelerate
الشخص الذي يحس لا يتحرك

This was in the beginning of the lecture :-

box move with car



the surface is frictionless → سطح أملس

سطح لا يحتوي على قوة إحتكاك

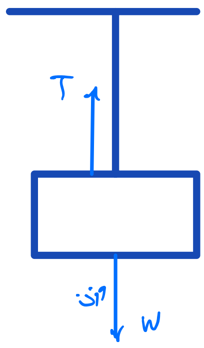
Car moves

الإحتكاك أثر على السيارة فأوقفها.

if the car stops the box will go forward because there's nothing to stop it accelerate

* to have an acceleration of decceleration you need *FORCE*

Examples



sigma

E equilibrium

$\Sigma F = 0$

$F_{net} = 0$

Static equilibrium

Find the tension in the string

$\uparrow +$ ΣF

$F_{net} = ma$

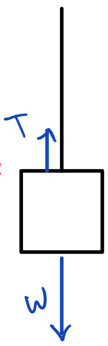
$W = mg$

$T - W = ma \rightarrow (0)$

$\boxed{T = W} \Rightarrow T = mg$

Find T

if system is moving $\Rightarrow$ the direction of the motion to be positive



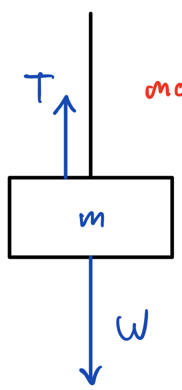
moving up at a constant velocity

Dynamic equilibrium $\rightarrow$ اتزان

$\overset{+}{\uparrow}$ $T - W = 0$

$T = W$

$g = 9.8$



moving up and accelerate $\overset{ex}{\longleftrightarrow}$ if it was deccelerating

at $2\ m/s^2$ Find T

$\overset{+}{\uparrow}$ $T - mg = ma$

$T = mg + ma$

$40 + 4 \times 2 = 48\,N$

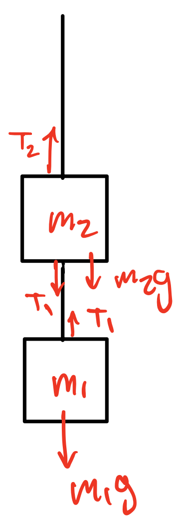
$T - mg = ma$

$T = mg + ma = 40 + 4(-2)$

$= 32$

$m_1 = 6\,kg$

$m_2 = 4\,kg$



static

$\overset{+}{\uparrow}$ for m_1 ①

$T_1 - m_1 g = 0$

$T_1 = 6 \times 9.8 = 60\,N$

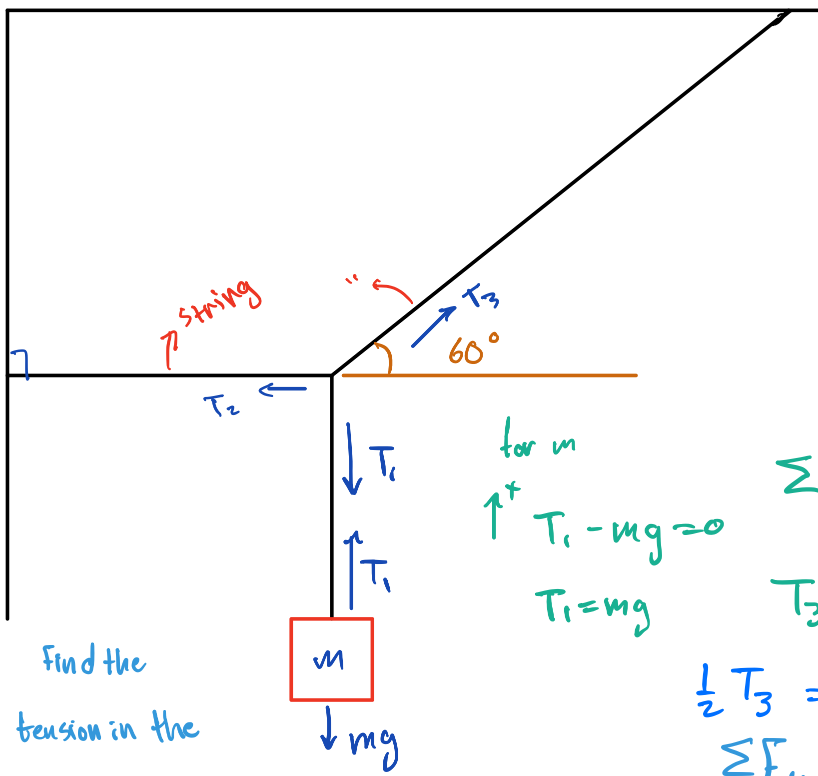
$\overset{+}{\uparrow}$ for m_2 ②

$T_2 - T_1 - m_2 g = 0$

$T_2 = 60 + 40 = 100\,N$

① + ② $\Rightarrow T_2 - m_1 g - m_2 g = 0$

$T_2 = (m_1 + m_2) g$



Find the tension in the strings

for m

$\uparrow^{+}$ $T_1 - mg = 0$

$T_1 = mg$

$\Sigma F_x = ma_x = 0$

$T_3 \cos(60) - T_2 = 0$

$\frac{1}{2} T_3 = T_2 \Rightarrow T_3 = 2 T_2$

$\Sigma F_y = ma_y$

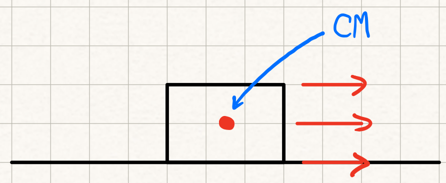
$\uparrow^{+}$ $T_3 \sin 60 - T_1 = 0$

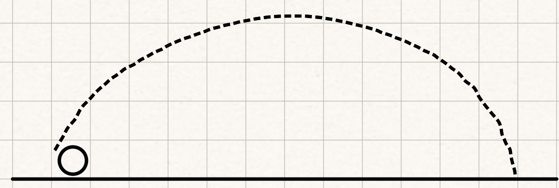
$T_3 \times \frac{\sqrt{3}}{2} = T_1 = mg$

$T_3 = \frac{2}{\sqrt{3}} mg$

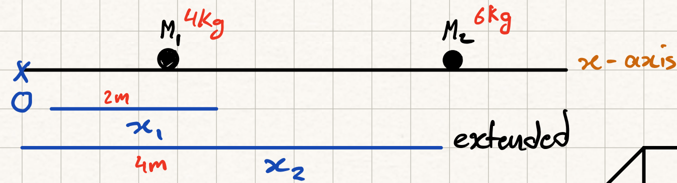
$T_2 = \frac{1}{2} T_3 = \frac{1}{\sqrt{3}} mg$

Center of Mass

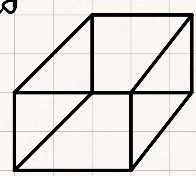




point mass

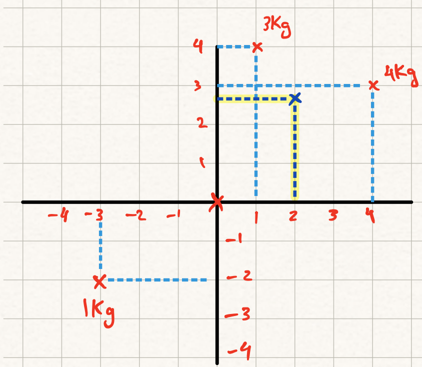


extended



$$x_{cm} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$$

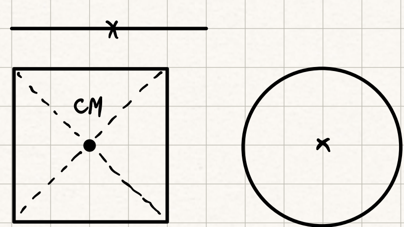
$$x_{CM} = \frac{4(2)+6(4)}{10} = \frac{32}{10} = 3.2m$$



Regular Object

Uniform

turk → عزم الدوران



$$x_{CM} = \frac{3(1)+4(4)+1(-3)}{8} = 2m$$

$$y_{CM} = \frac{3(4)+4(3)+1(-2)}{8} = 2.75m$$

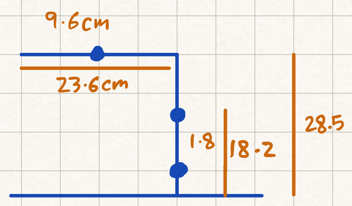
3 Center of mass of legs

a) streached

$$x_{cm} = \frac{M_{UL}\,x_{UL} + M_{LL}\,x_{LL} + M_F\,x_F}{M_{UL} + M_{LL} + M_F} = \frac{21.5(9.6) + 9.6(33.9) + 3.4(50.3)}{21.5 + 9.6 + 3.4} = 20.4\text{ cm}$$

$\hookrightarrow \times \frac{20.4}{100} \times 170$

b) bend



$x_{cm} = 14.9$ units

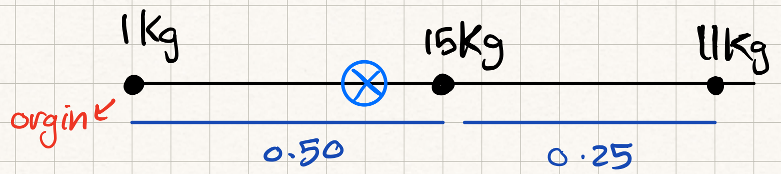
$x_{cm}\ \frac{14.9}{100} \times 1.7\text{m} = 0.25\text{m}$

$y_{cm} = 23$ units

$y_{cm}\ \frac{23}{100} \times 1.7\text{m} = 0.39\text{ m}$

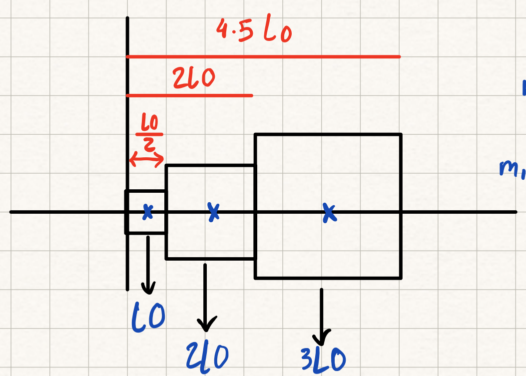
Problems

46]



$$x_{CM} = \frac{1(0)+1.5(0.50)+1.1(0.75)}{1+1.5+1.1} = 0.438\,m$$

48]



density

$$m = \rho V$$

$$m_1 = \rho l^3$$

$$m_2 = \rho (2l_o)^3 = 8\rho l_o^3 = 8m_1$$

$$m_3 = \rho (3l_o)^3 = 27\rho l_o^3 = 27m_1$$

$$x_{CM} = \frac{m_1(\frac{l_o}{2}) + \overset{m_2}{8m_1}(2l_o) + 27m_1(4.5l_o)}{m_1+8m_1+27m_1}$$

$$x_{CM} \simeq 3.8\,l_o$$

51]

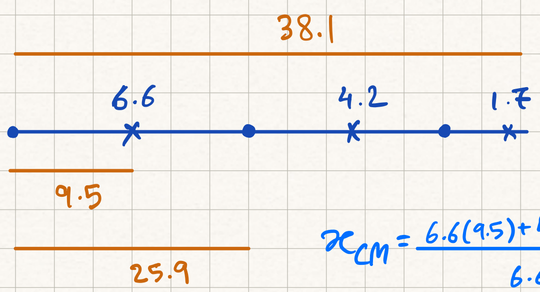
100g

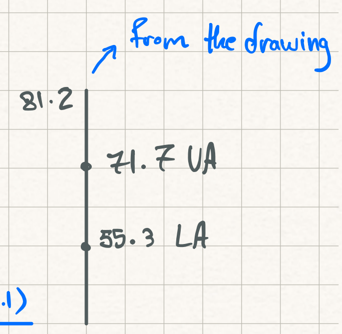
$$M = m_{UL} + m_{LL} + m_F$$

$$= 21.5 + 9.6 + 3.4 = 34.5\,Kg \rightarrow 2 \text{ legs}$$

$$M_{one\ leg} = \frac{34.5}{2} = 17.25\,Kg$$

52]





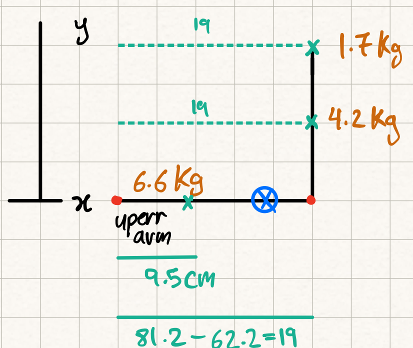
$$x_{cm} = \frac{6.6(9.5) + 4.2(25.9) + 1.7(38.1)}{6.6 + 4.2 + 1.7}$$

$$= 19\,cm$$

for 160 cm tall preson :-

$$x_{CM} = \frac{19\,cm}{100} \times 160 = 30.4\,cm$$

53]



$$62.2 - 55.8 = 6.9\,m$$

$$\rightarrow 62.2 - 43.1 = 19.1\,cm$$

for 155cm tall person

$$x_{CM} = \frac{14}{100} \times 155 = 21.7\,cm$$

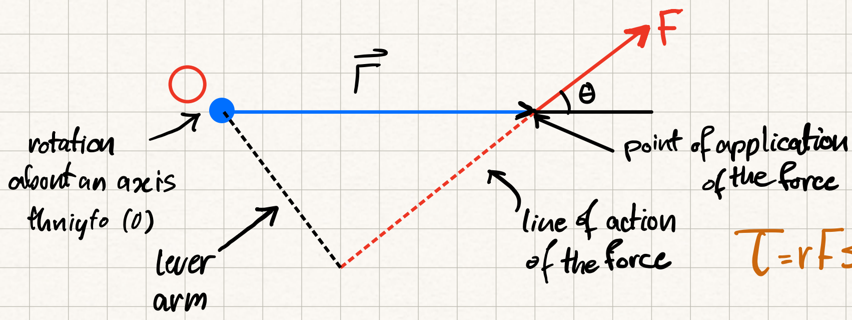
$$y_{CM} = \frac{4.9}{100} \times 155 = 7.6\,cm$$

$$x_{CM} = \frac{6.6(9.5) + 4.2(19) + 1.7(19)}{6.6 + 4.2 + 1.7} = 14.0\,m$$

$$y_{CM} = \frac{6.6(0) + 4.2(6.9) + 1.7(19.1)}{6.6 + 4.2 + 1.7} = 4.9\,cm$$

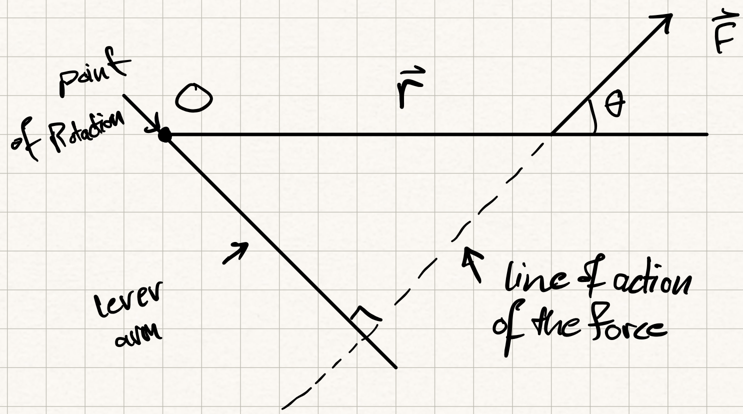
Ch8 torque

عزم الدوران



$$\tau = rF\sin\theta$$

Ch7-2



$r \uparrow \quad \tau \uparrow$

$\tau \propto r, \; \tau \propto F$

$\tau \propto \sin\theta$

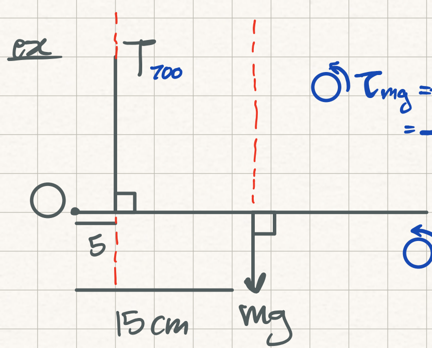
$\sin\theta = 0$

$\theta = 0 \Rightarrow \tau = 0$

$\theta = 180^\circ \rightarrow \sin 180^\circ = 0$

$\tau = 0$

ex



$\circlearrowleft \; \tau_{mg} = -mg \times (0.15) \sin 90$

$= -0.15\, mg$

-2.25 N.m

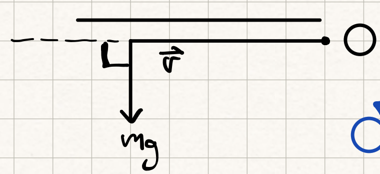
$\tau \rightarrow$ vector

$\circlearrowleft \; \tau_T = (700)(0.05) \sin 90$

$= 35$ N.m

$\tau_{net} = 35 - 2.25 = 32.75$ N.m

24]

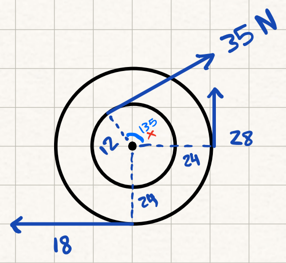


$\tau_{max} = \theta = 90$

$\circlearrowleft \; \tau_{max} = mg(0.17) \sin 90$

$= 86.6$ N.m

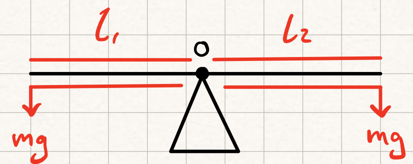
25]

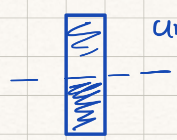


$\circlearrowright \tau = (28)(0.24)\sin 90 - (35)(0.12)\sin 90 - (18)(0.24)\sin 90 = -1.8\ N.m$

$\tau_{net} = \tau + \tau_f = -1.8 + 0.6 = 1.2\ N.m$

27]





$\overset{+}{\circlearrowright}\ \tau_{net} = -mgl_2 + mgl_1$

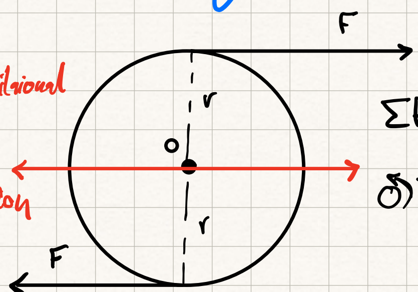
$mg(l_1 - l_2)$

Static Equilibrium

Static equilibrume

$\Sigma \vec{F} = 0$ x transilaional

$\Sigma \tau = \tau_{net} = 0$ x rotaiction



$\Sigma F = 0$ no translianl moition

$\circlearrowright \tau = -rF\sin 90 - rF$

$-2rF$

clockwise rotation

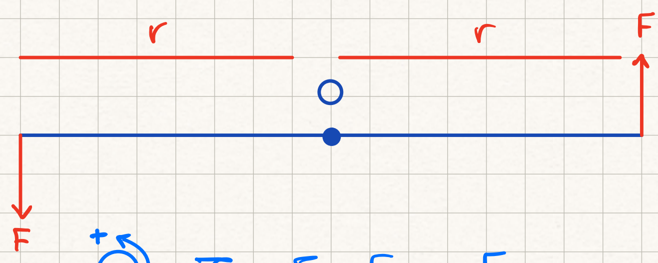
my have rotaition moition

$\Rightarrow$

No static equilibrume

Ch9

رسمك الدائرة



$$+\circlearrowleft = \tau = rF + rF = 2rF$$

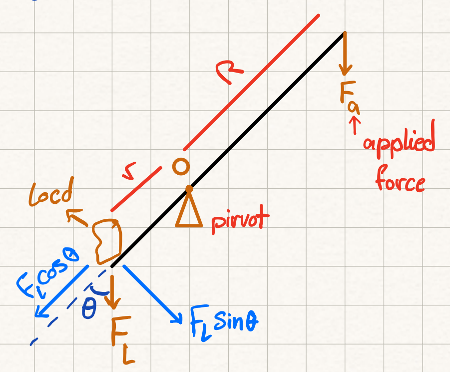
$$\tau = DF$$

perpendicular distance between the two forces

this's called Couple

$\Sigma F = 0$
$\Sigma \tau \neq 0$

Lever



assume static equilibrium

$\Sigma \tau = 0$

$F r \sin\theta$

$r(F \sin\theta)$

$\circlearrowleft^{+}\ \tau = F_L r \sin\theta - F_a R \sin\theta = 0$

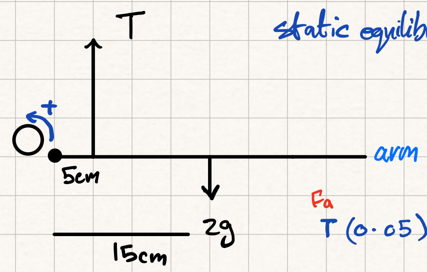
$rF_L = RF_a$

$\frac{F_L}{F_a} = \frac{R}{r} \Rightarrow$ MA mechanical advantage

MA>1 ✓

ex

static equilibrium

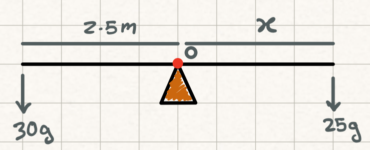


$$\overset{F_a}{T(0.05)} - \overset{F_L}{2g(0.15)} = 0$$

$$T = \frac{0.15}{0.05} = 3(2g)$$

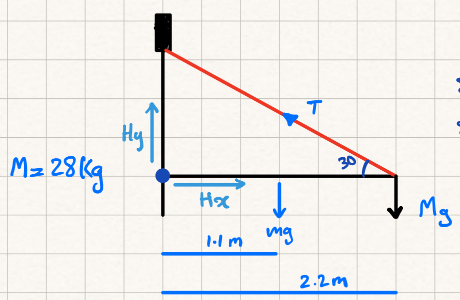
$$MA = \frac{F_L}{F_a} = \frac{2g}{3(2g)} = \frac{1}{3} < 1$$

ex



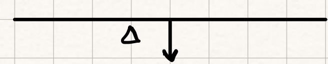
$$\circlearrowleft^{+} \quad 30g(2.5) - 25g\,x = 0 \qquad \frac{30(2.5)}{25} = \frac{\cancel{25}x}{\cancel{25}} = 3m$$

ex



$$\Sigma F = 0$$
$$\Sigma \tau = 0$$

Hinge force / joint force



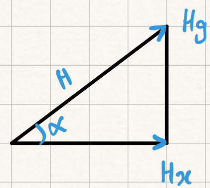
$$\circlearrowleft^{+} \quad (T\sin 30)(2.2) - \overset{28}{M}g(2.2) - mg(1.1) = 0$$

$$T = 794\ N$$

$$\Sigma F_x = 0$$

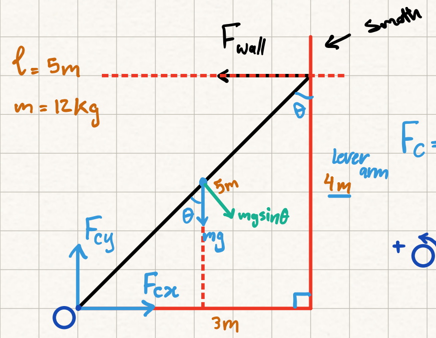
$$\xrightarrow{+} \quad H_x - T\cos 30 = 0$$
$$H_x (794)\frac{\sqrt{3}}{2} \sim 687.6\ N$$

$$+\uparrow$$
$$\Sigma F_y = 0$$
$$H_y + T\sin 30 - mg - Mg = 0$$
$$H_y = 122.4\ N$$



$$H = \sqrt{H_x^2 + H_y^2}$$

$$\tan\alpha = \left|\frac{H_y}{H_x}\right| \quad \alpha \sim 10.1$$



$\Sigma F = 0$

$\Sigma \tau = 0$

$F_C = \sqrt{F_{cx}^2 + F_{cy}^2}$

$+\circlearrowleft \quad (F_w)(4) - (mg\sin\theta)\left(\frac{5}{2}\right) = 0$

$F_w = 44.1\ N$

$\Sigma F_x = 0$

$\xrightarrow{+} \quad F_{cx} - F_w = 0$

$F_{cx} = F_w = 44.1$

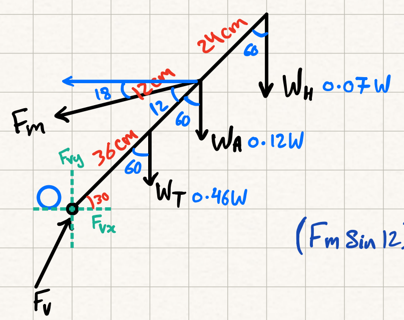
$\Sigma F_y = 0$

$F_{cy} - mg = 0$

$F_{cy} = mg = 12g$

$F_c = 125.6N$

$\tan\alpha = \left|\frac{F_{cy}}{F_{cx}}\right| = 69.4$



Static equilibrium

$\Sigma \tau = 0$

$\Sigma \vec{F} = 0$

$(F_m \sin 12)(0.48) - (W_T \sin 60)(0.36) - (W_A \sin 60)(0.48) - (W_H \sin 60)(0.72) = 0$

$F_m = 2.37\ w$

$\Sigma F_x = 0$

$\xrightarrow{+} \quad F_{vx} - F_m \cos 18 = 0$

$F_{vx} = 2.25\ w$

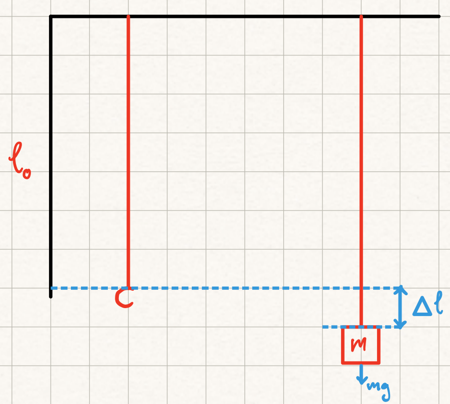
$F_v = \sqrt{F_{vx}^2 + F_{vy}^2} \sim 2.7\ w$

$+\uparrow \quad F_{vy} - W_T - W_A - W_H - F_m \sin 18 = 0$

$F_{vy} = 1.38\ w$

Elasticity

Stress, strain



Hook's Law

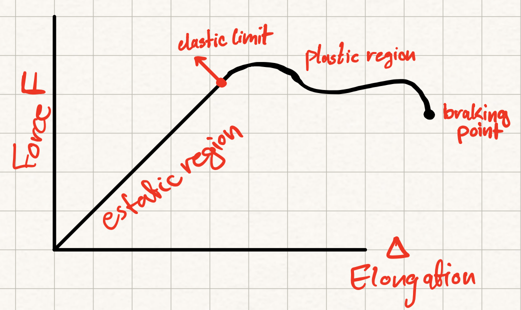
$F = k\Delta l$

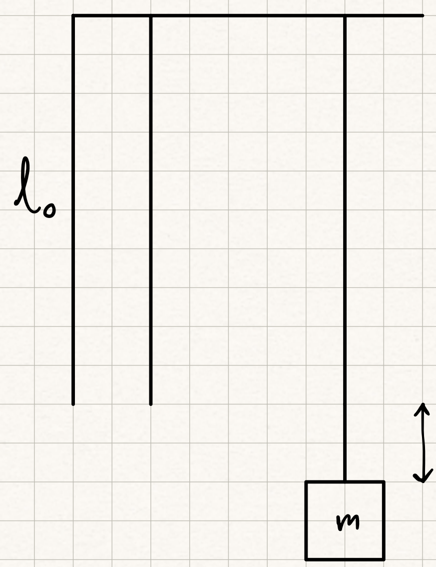
magnitued

Hook's Law

$F = -kx$

$\Delta l \ll l_0$





$$\Delta l \propto \frac{l_o}{A} F$$

$$\Delta l = \frac{1}{E}\, l_o \boxed{\frac{F}{A}} \qquad \frac{N}{m^2}$$

young's modulus

stress

$$\frac{\Delta l}{l_o} = \text{strain}$$

$$E = \frac{F}{A} \cdot \frac{l_o}{\Delta l} = \frac{F/A}{\left(\frac{\Delta l}{l_o}\right)} = \frac{\text{stress}}{\text{strain}}$$

Modulus	$E\,(N/m^2)$
– Steel	200×10^9
– bone (limb)	15×10^9

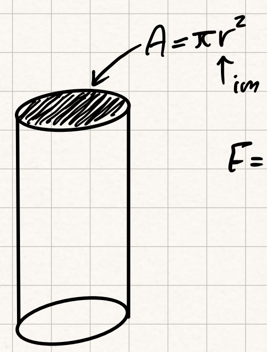
كلما كان أكبر
كانت المادة
أقوى

example :-

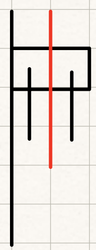
$l_o = 1.6\,m$

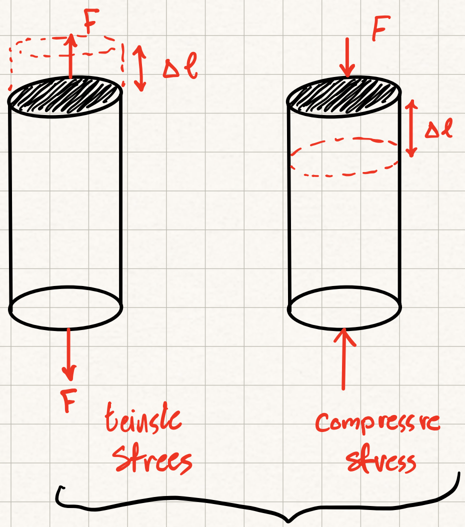
$D = 0.2\,cm \Rightarrow r = 0.1\,cm$

$\Delta l = 0.25\,cm$



$F = 980\,N$

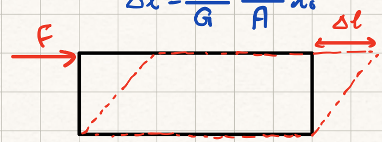




young's modulus

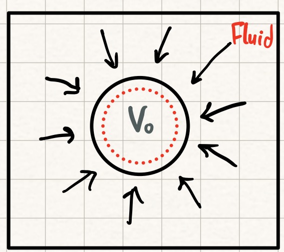
Shear modulus

$$\Delta l = \frac{1}{G}\frac{F}{A} l_0$$



Shear Stress

Bulk



$P = \frac{F}{A}$ Same as stress pressuar

Original Volume V_0

Change in Volume ΔV

$$\frac{\Delta V}{V_0} = -\frac{1}{B}\Delta P$$

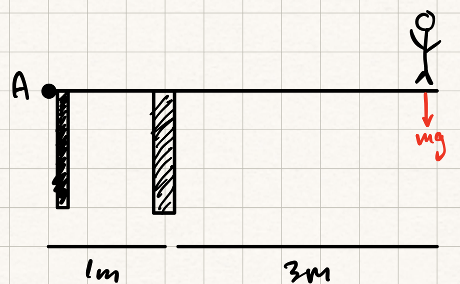
bulk modulus

Fracture

	tensile stress (N/m^2)	Compressive Stress	Shear stress
Steel	$500-250 \times 10^6$	500×10^6	250×10^6
Bone	130×10^6	170×10^6	

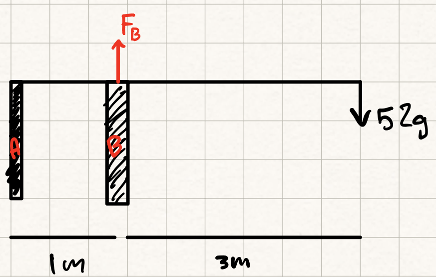
---

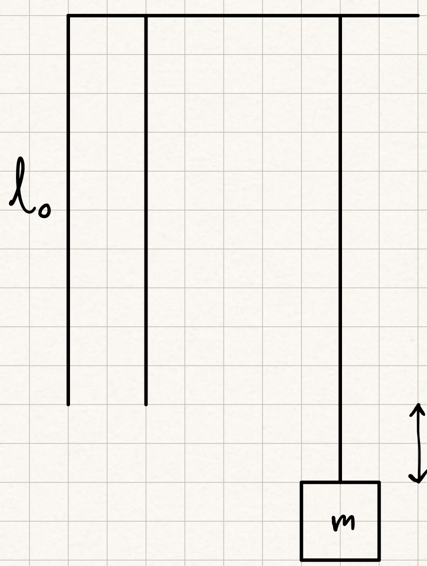
4)



$+\circlearrowleft A)\quad -1800 = -(mg)(4)$

$m = \frac{1800}{4} \sim 45.9\,kg$





$$\Delta l \propto \frac{l_0}{A} F$$

$$\Delta l = \frac{1}{E}\, l_0 \frac{F}{A} \qquad \frac{N}{m^2}$$

young's modulus

stress

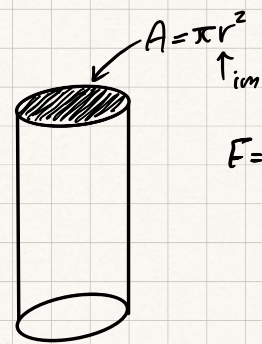
$$\frac{\Delta l}{l_0} = \text{strain}$$

$$E = \frac{F}{A} \cdot \frac{l_0}{\Delta l} = \frac{F/A}{\left(\frac{\Delta l}{l_0}\right)} = \frac{\text{stress}}{\text{strain}}$$

Modulus	$E\,(N/m^2)$
– Steel	260×10^9
– bone (limb)	15×10^9

كلما كان أكبر كانت المادة أقوى

example :-

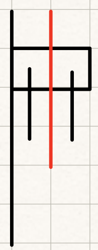


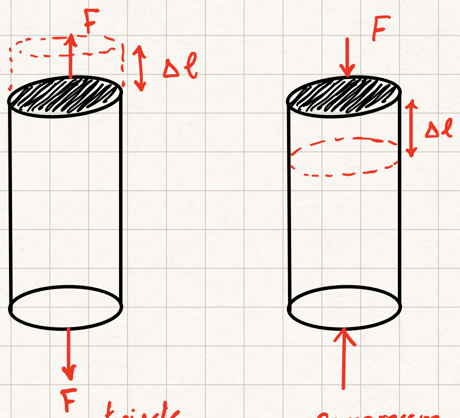
$F = 980\ N$

$l_0 = 1.6\, m$

$D = 0.2\, cm \Rightarrow r = 0.1\, cm$

$\Delta l = 0.25\, cm$





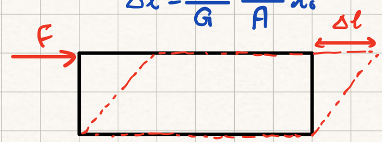
teinsle stress

compressive stress

young's modulus

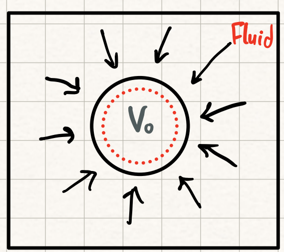
Shear modulus

$\Delta l = \frac{1}{G} \frac{F}{A} l_0$



Shear Stress

Bulk



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Fracture

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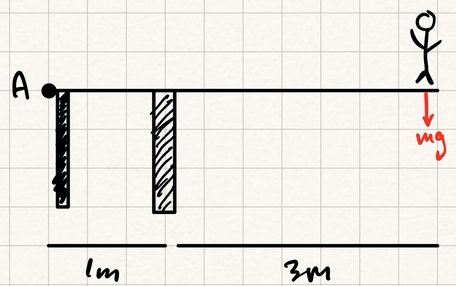
---

4)



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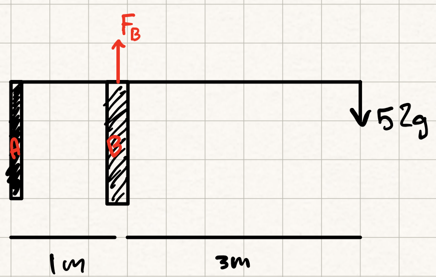


46]

$stress = \frac{F}{A}$ $F_{max} = A \times stress$ → maximum stress

$F_{max} = A \times 170 \times 10^6$

50]

$3300 \frac{N}{m^2}$ $stress \frac{F}{A}$

$\frac{3300}{7} =$

Fluids موائع

states of matter

- Gas, no fixed Volum nor Shape
- liquid, fixed Volum, no Fixed Shape
- solid, fixed Volum & Shape
- plasma

dinsity $\frac{\text{mass}}{\text{Volum}}$

$\rho = \frac{m}{V}$ Kg/m²

Spesific gravity

$$SG = \frac{\text{density of matterial}}{\text{〃 〃 water at } 4c^\circ}$$

ex:-

Iron

$$SG \ \frac{7800}{1000} = 7.8$$

Pressure

$$\frac{\text{Force}}{\text{area}} \ \frac{N}{m^2} = \text{Pascal}$$

ex:-

$m = 60$ kg

$A = 500\ cm^2$

a) both feet

$$\frac{F}{A} = \frac{mg}{A} = \frac{60 \times 9.8}{500 \times 10^{-4}}$$

$= 12000\ N/m^2 \sim Pa$

b) one foot

$$P_1 = \frac{mg}{\frac{A}{2}} = 2\frac{mg}{A}$$

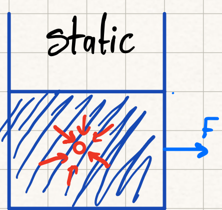
$= 24000$ Pa

two features

Static fluids

$\Sigma F = 0$

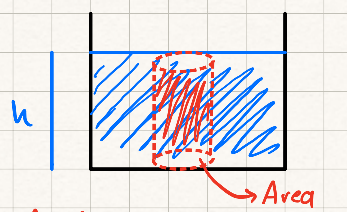
$P = 0$



① at any one point at static the prusure in all deriction

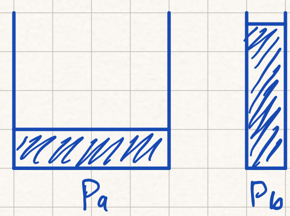
② the force of any liquid is عمودية على سطح التلامس

pressure due (a static) fluids



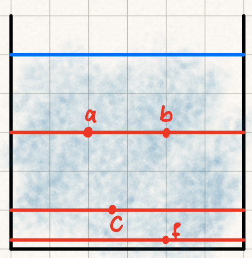
find the pressure on the base due to the fluid

$$P = \frac{F}{A} = \frac{mg}{A} = \frac{\rho_F V g}{A} = \frac{\rho_F (Ah) g}{A} = \rho_F g h$$

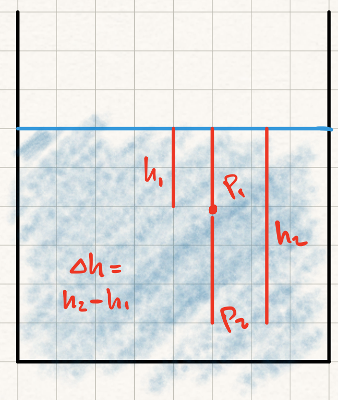


كثافة الهواء 1.29
كثافة الدم 159
كثافة الماء 1

$P_b > P_a$ as pressure



$P_a = P_b < P_c < P_f$



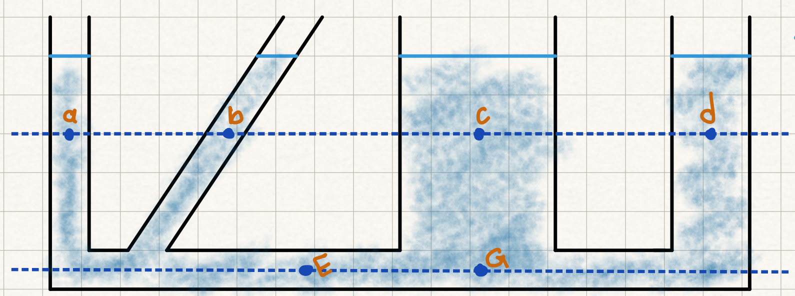
$$P_1 = \rho_F g h_1$$

$$P_2 = \rho_F g h_1$$

$$P_2 - P_1 = \rho_F g (h_2 - h_1)$$

$$P_2 - P_1 = \rho_F g \Delta h$$

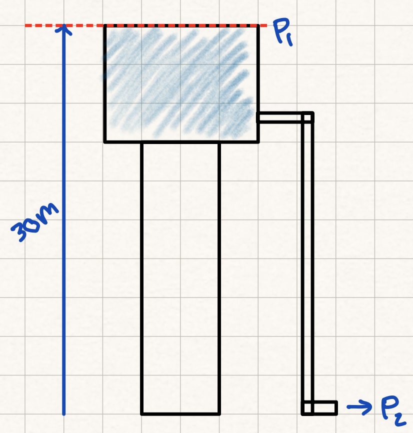
$$\boxed{P_2 = P_1 + \rho_F g \Delta h}$$



Same pressure

pressure due Fluid

$$P_E = P_G$$



$$P_2 - P_1 = \rho_F g \Delta h$$

$$= (1000)(9.8)(30)$$

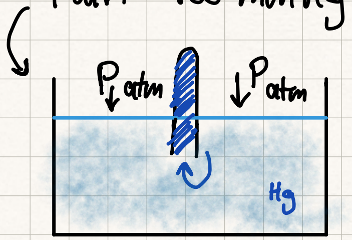
$$= 2.9 \times 10^5 \text{ Pa}$$

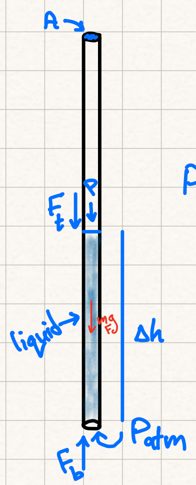
Atmospherce Pressure

$1\,atm = 1.013\times10^5\,pa = 1.013\,bar$

$1\,bar = 1\times10^5\,pa$

$1\,atm = 760\,mmHg$





depends on pressure in side

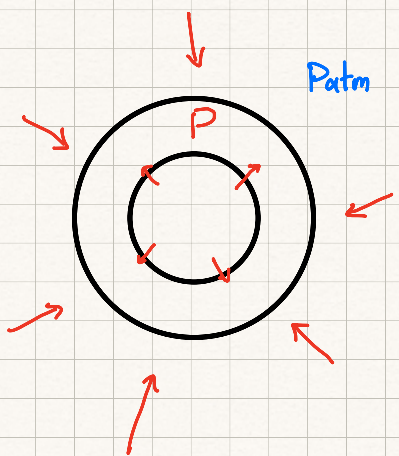
$P_{atm} = P + \rho g \Delta h$

$P_{atm}A = PA + \rho g \Delta h A$

$F_b = F_t + \rho_{Fl} g V$

$\boxed{F_b = F_t + m_F g}$

Gauge Pressure

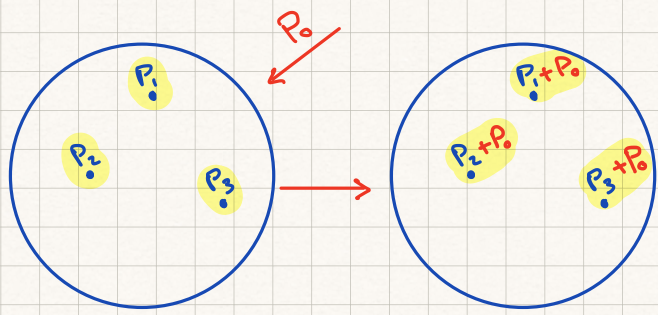


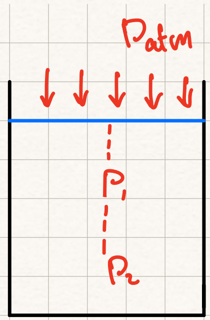
absolute pressure

$P_{gauge} = P - P_{atm}$

Pascals' principle

traped fluid





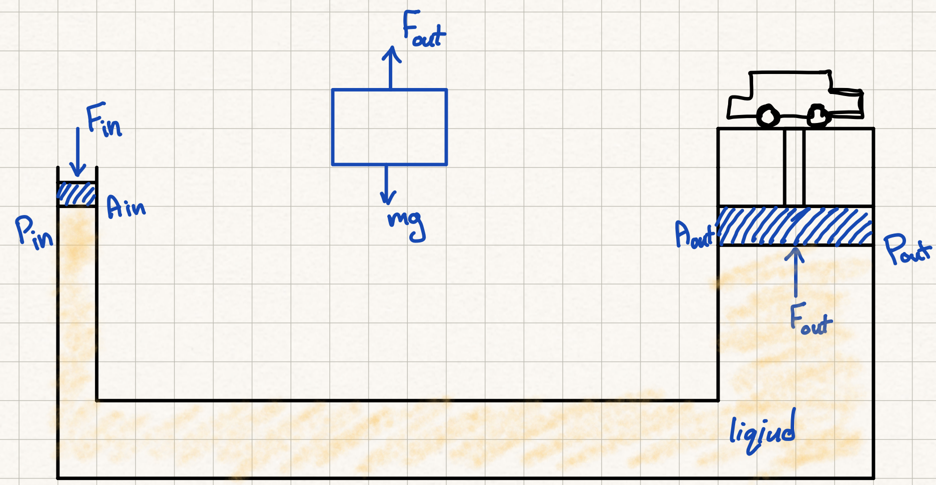
$$\left.\begin{aligned} P_1 &= \rho_F g h_1 \\ P_2 &= \rho_F g h_2 \end{aligned}\right] \rightarrow \text{due to fluide}$$

$$P_{1\,tot} = P_1 + P_{atm}$$

$$P_{2\,tot} = P_2 + P_{atm}$$

$$P_{2tot} - P_{1tot} = (P_2 + P_{atm}) - (P_1 + P_{atm})$$

$$P_{2tot} - P_{1tot} = P_2 - P_1 = \rho_F g \Delta h$$



$$P_{in} = P_{out}$$

$$\frac{F_{in}}{A_{in}} = \frac{F_{out}}{A_{out}}$$

$$F_{out} = \frac{A_{out}}{A_{in}} F_{in}$$

$$A_{out} > A_{in} \Rightarrow F_{out} > F_{in}$$

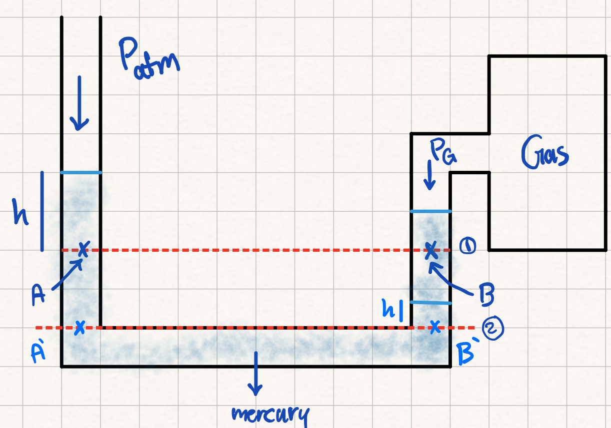
F_{out} lift the car upwards

$W = 10,000\ N$
$A_{out} = 20\ A_{in}$

$$F_{in} = \frac{A_{in}}{A_{out}} F_{out}$$
$$= \frac{1}{2\cancel{0}} (10,00\cancel{0})$$
$$= 500\ N$$

$$MA = \frac{F_L}{F_a} = \frac{100\cancel{00}}{5\cancel{00}} = 20$$

Open-tube manometer



$$P_A = P_B$$

$$P_{atm} + \rho_F g h = P_G$$

$$P_{atm} + \rho g \Delta h = P_G$$

$$P_{A`} = P_{B`}$$

$$P_{atm} = P_G + \rho g \Delta h$$

$$P_{atm} > P_G$$

Barometer

Pic
Barometer

$P_A = P_B$

$\rho_F g h = P_{atm}$

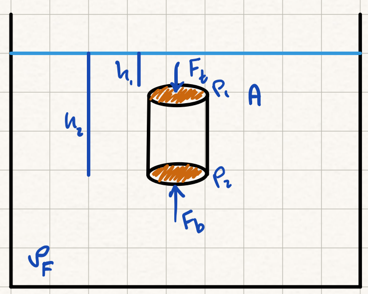
fo mercury $h = 760$ mmHg
$1\,atm = 760\,mmHg = 1.013 \times 10^5\,Pa = 1.013\,bar$

for water Find h

$\rho_w g h_w = 1.013 \times 10^5$
1000 9.8 ?

$h \sim 10.3\,m$

Buoyancy and Archimede's principle



$P_t = \rho_F g h_1$

$F_t = P_t A = \rho_F g h_1 A$

$P_b = \rho_F g h_2$

$F_b = \rho_F g h_2 A$

$P_b > P_t \Rightarrow F_b > F_t$

there's always resultant force upwards

resultant force due liquid

$F_B = F_b - F_t = \rho_F g A (h_2 - h_1)$

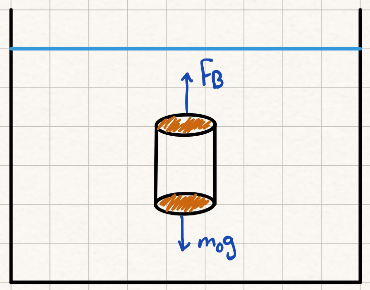
buoyant force

$F_B = \rho_F g A h$

mass of displased fluid

$F_B = \rho_F g V = \rho_F V g = m_F g$

F_B = weigh of displased fluid



$+\uparrow \quad F_R = F_B - m_o g = \rho_F V g - \rho_o V g$

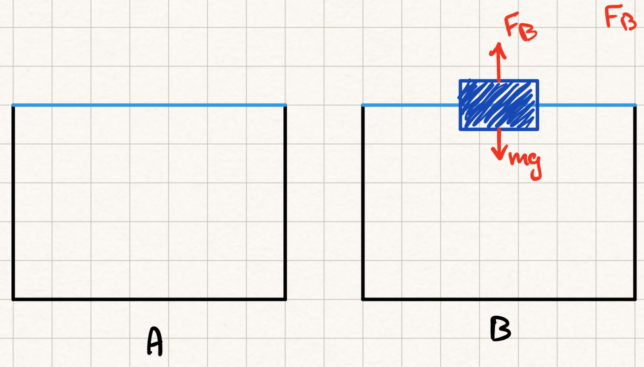
$$F_R = (\rho_F - \rho_o) V g$$

$\rho_F > \rho_o \Rightarrow F_R > 0 \uparrow$ object floats

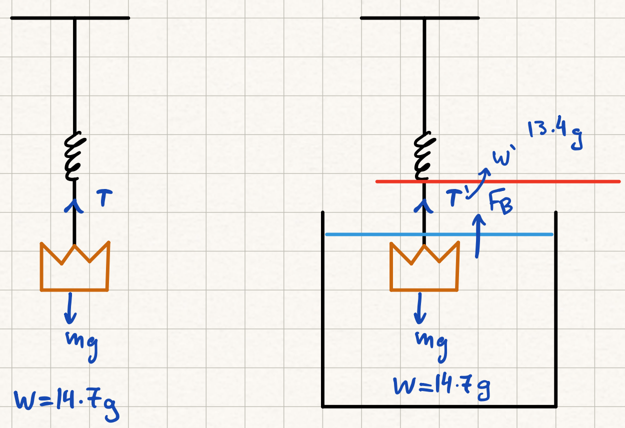
$\rho_F < \rho_o \Rightarrow F_R < 0 \downarrow$ object sinks

m = displaced fluid

$F_B = mg$



<u>ex</u>



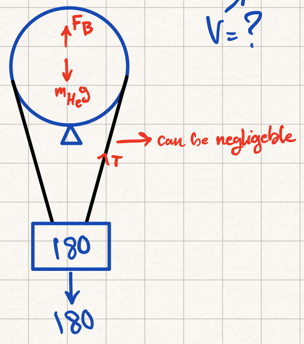
$$W = T = mg = \rho_o V g \qquad W = \rho_o V g \quad ①$$

$$W = W' + F_B \qquad W - W' = F_B = \rho_F V g \qquad W - W' = \rho_F V g \quad ②$$

$$\frac{W}{W - W'} = \frac{\rho_o}{\rho_F} = \frac{14.7g}{14.7g-} \Rightarrow \rho_o = 11300\, kg/m^3$$

$F_B = \rho_F V g$ تعتمد على كثافة السائل

ex



$V = ?$ → ballon

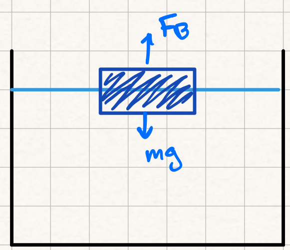
$\overset{+}{\uparrow}$ $F_B - m_{He}g - 180 = 0$

$\rho_{air} V \cancel{g} - \rho_{He} V \cancel{g} - 180 \cancel{g} = 0$

$(\underset{1.29}{\rho_{air}} - \underset{0.179}{\rho_{He}}) V = 180$

$V \sim 162\ m^3$

partial Submeision



V_s = submerged Volume

static equilibrime

$\overset{+}{\uparrow}$ $F_B = mg$

$\rho_F V_s \cancel{g} = \rho_o V \cancel{g}$

$$\boxed{\frac{\rho_o}{\rho_F} = \frac{V_s}{V}}$$

V = volume of the object

$\rho_{ice} \sim 0.9 \rho_{water}$

$\frac{\rho_{ice}}{\rho_{water}} = \frac{V_s}{V} \sim 0.9$

Q of the He goto voice

Fluids in motion

① laminar flow (streamline) ≋ — parts don't cross

② turbulent flow

↓

Q blood

two assumptions

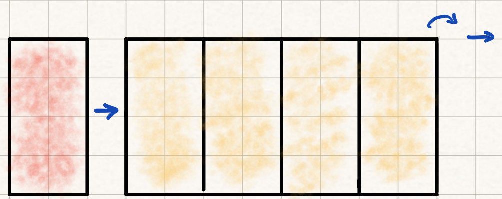
① laminar flow

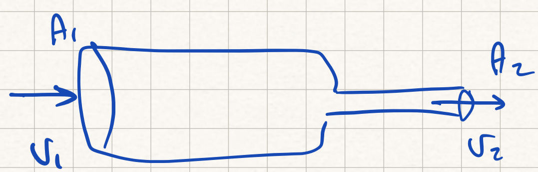
② non compressible fluid

incompressible

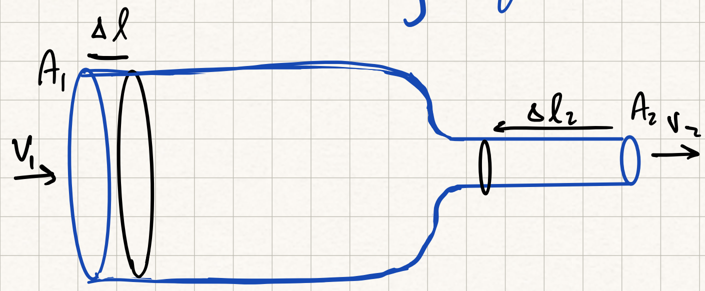
(no change in volume under pressure)

③ Nonviscous fluid





Continuity Equation



Incompressible fluid

$$\frac{\Delta V_1}{\Delta t} = \frac{\Delta V_2}{\Delta t}$$ Volume flow rate

$$\rho_1 \frac{\Delta V_1}{\Delta t} = \frac{\Delta m_1}{\Delta t}$$ mass flow rate

$$\rho_1 \frac{\Delta V_1}{\Delta t} = \rho_2 \frac{\Delta V_2}{\Delta t}$$

$$\boxed{\rho_1 A_1 V_1 = \rho_2 A_2 V_2}$$

$$\rho_1 A_1 \frac{\Delta l_1}{\Delta t} = \rho_2 A_2 \frac{\Delta l_2}{\Delta t}$$

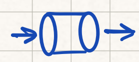
Incompressible fluide $\Rightarrow \rho_1 = \rho_2 = \rho$

$$\boxed{A_1 V_1 = A_2 V_2}$$ معادلة الاستمرارية $\frac{m^3}{s}$

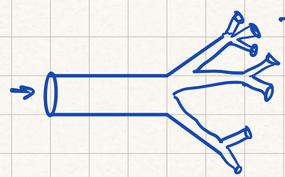
ex

heart ⇒ artal ⇒ arteuros ⇒ Capillivace

$r_a = 1.2\,cm$



$V_a = 40\,cm/s$
$= 0.4\,m/s$



$\rightarrow r_c = 4\times10^{-4}\,cm$

$V_c = 5\times10^{-4}\,m/s$

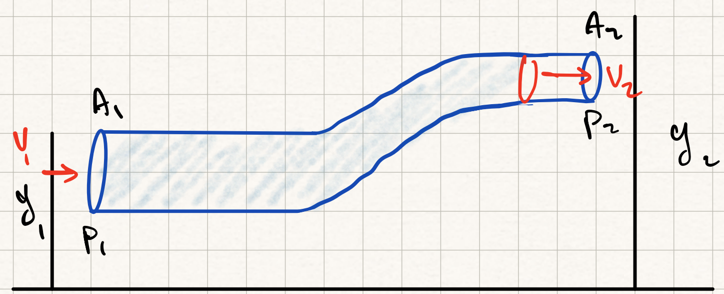
$A_a V_a = A_{tot} V_c$ For all capillivacy

$A_a V_a = N A_c V_c$ one cappiliary

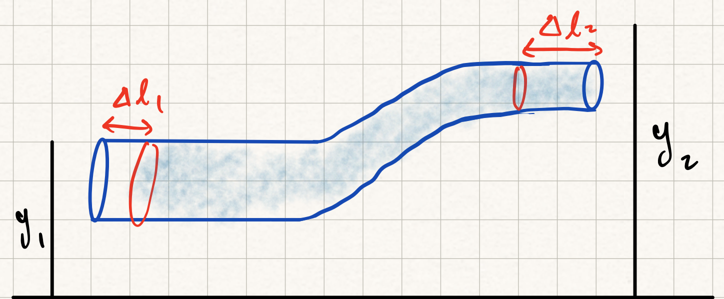
$$N = \frac{A_a V_a}{A_c V_c} = \frac{\pi r_a^2 V_a}{\pi r_a^2 V_c}$$

$N \sim 7\times10^{9}$

Bernoullils Equatan



$W_{total} = \Delta K = \frac{1}{2} m \Delta v^2$



$$P_1 A_1 \Delta l_1 - P_2 A_2 \Delta l_2 - (m y_2 g - m y_1 g) = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$$

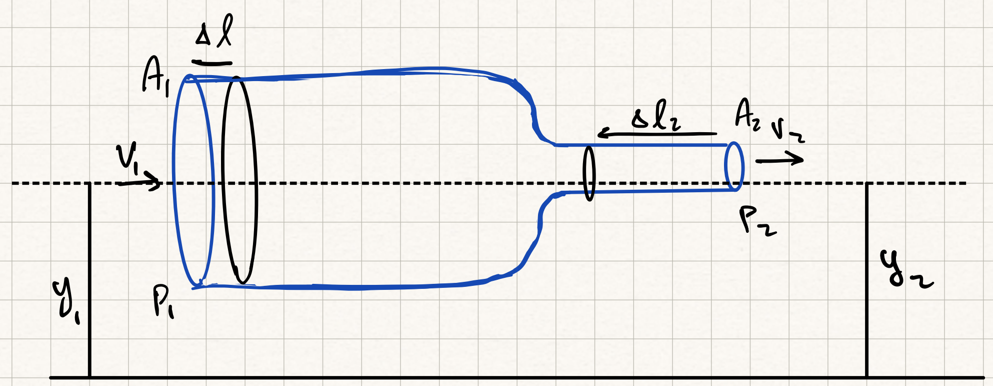
$$P_1V - P_2V + mgy_1 - mgy_2 = \frac{1}{2}mV_2^2 - \frac{1}{2}mV_1^2$$

$\frac{N}{\cancel{m^2}}\cdot \cancel{m^3}$ $$P_1V + mgy_1 + \frac{1}{2}mV_1^2 = P_2V + mgy_2 + \frac{1}{2}mV_2^2 = \text{Constant}$$

N.m J J J

$$\div V \Rightarrow \boxed{P_1 + \rho g y_1 + \frac{1}{2}\rho V_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho V_2^2} \rightarrow \text{Final Form}$$

* Incompressible & nonviscous

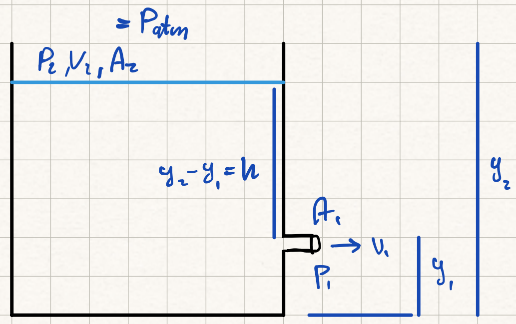


$$P_1 + \rho g y_1 + \frac{1}{2}\rho V_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho V_2^2$$

$$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \frac{1}{2}\rho V_2^2$$

$$V_2 > V_1 \Rightarrow P_1 > P_2$$

Torricellill principle



$A_2 >> A_1$

$$P_1 + \rho g y_1 + \frac{1}{2}\rho V_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho V_2^2$$

$$A_1 V_1 = A_2 V_2$$

$$V_2 = \frac{A_1}{A_2} V_1 \sim 0$$

~ 0

$$\cancel{P_{atm}} + \rho g y_1 + \frac{1}{2}\rho V_1^2 = \cancel{P_{atm}} + \rho g y_2 + 0$$

$$\frac{1}{2}\cancel{\rho} V_1^2 = \cancel{\rho} g (y_2 - y_1)$$

$$V_1^2 = 2g(y_2 - y_1)$$

$$V_1 = \sqrt{2gh}$$

TIA

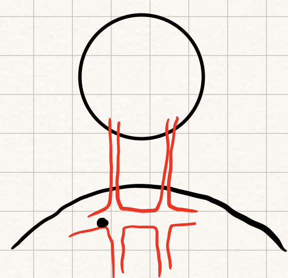
Transient

Ischomic

attack

V↑ P↓

V↓ P↑



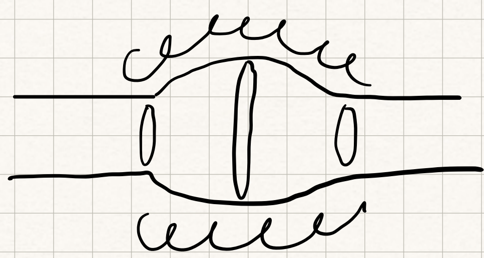
Poiseuill's eqn

- viscosity ↑ Volum flow rate ↓

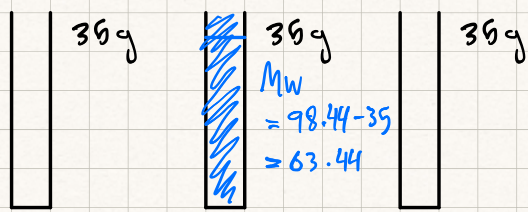
$$Q = \frac{\pi R^4 (P_1 - P_2)}{8 \eta l}$$

$$R \rightarrow \frac{R}{2}$$

$$Q \rightarrow \frac{Q}{16}$$



Q5)

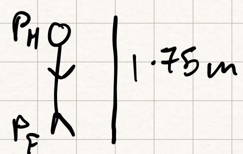


$M_W = 98.44 - 35 = 63.44$

$M_F = 89.22 - 35 = 54.22g$

$$SG = \frac{\rho_F}{\rho_w} = \frac{M_F/V}{M_W/V} = 0.855$$

10)

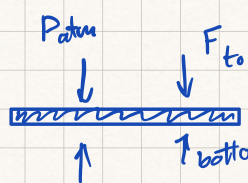


$P_F = P_H + \rho_{blood} gh$

$= 18170 \text{ Pa} \times \frac{760}{1.013 \times 10^5}$

$= 136.3 \text{ mmHg}$

11)



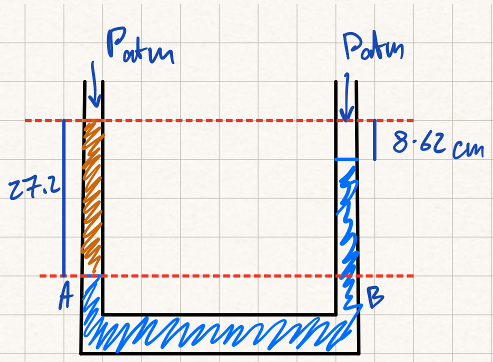
$F_{top} = P_{atm} \cdot A$

$F_{bottom} = P_{atm} \cdot A$

$F_{top} = 1.013 \times 10^5 \text{ N}/\cancel{m^2} \cdot (1.7 \times 2.6 \cancel{m^2})$

$= 44776 \text{ N}$

18]



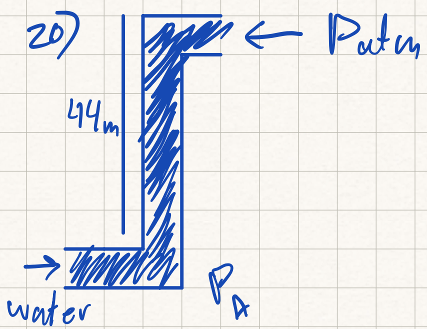
$$P_A = P_B$$

$$P_{atm} + \rho_{oil}\, g\,(27.2 \times 10^{-2}) =$$

$$P_{atm} + \rho_{water}\, g\,(27.2 - 8.62 \times 10^{-2})$$

$$\rho_{oil} = 683\ kg/cm^3$$

20)



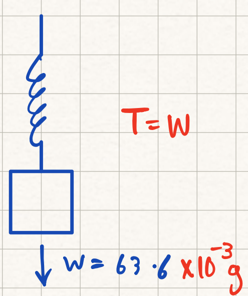
$$P_{abs} = P_{atm} - P_{gage}$$

$$P_A = P_{atm} + \rho_{water}\, g h$$

$$P_A - P_{atm} = \rho_w g h$$

$$= 431200\ Pa$$

27)



$T = W$