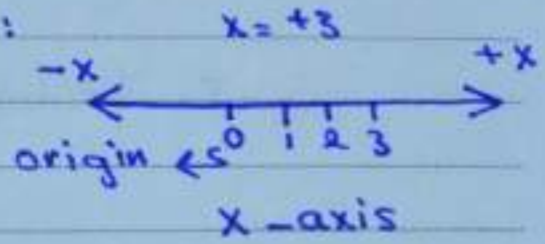
2020

No.

Medical physics :

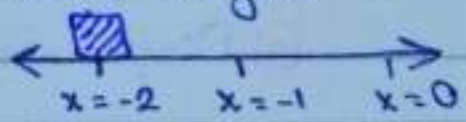
Ch. 1 :

* motion in one dimension:



* position = x
  ↳ x = How far from origin.

x = -2

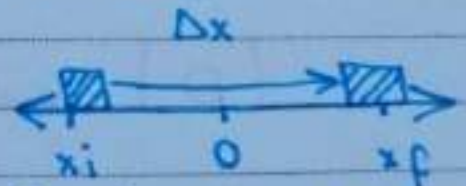


* Displacement: الإزاحة
  vector ← كمية متجهة

$\Delta x = x_f - x_i$

x_f → نقطة نهاية
x_i → نقطة البداية

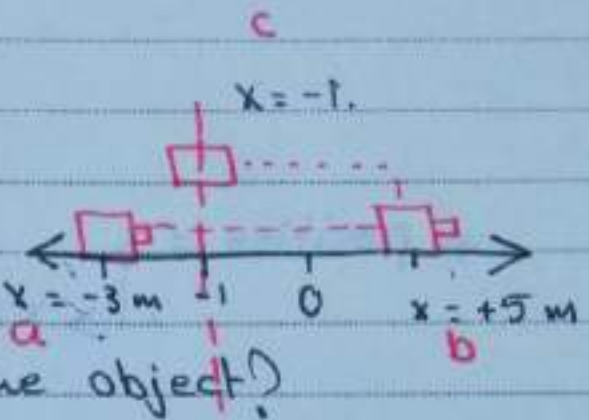
Δx < (+) / (−) يمكن أن تكون + أو -



* Distance : the length of the track طول المسار
  ↳ scalar → قياسية

** الإزاحة تعتمد على نقطتين: البداية والنهاية، بغض النظر عن الطريق المسلوك.
بينما المسافة تعتمد على المسار.

Ex: In the figure, find:



a) Displacment of the object?

$\Delta x = x_f - x_i = -1 + 3 = +2$

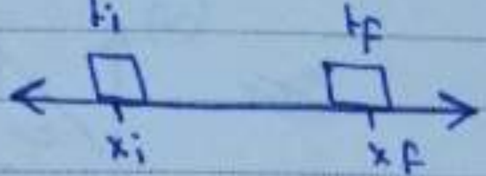
b) Distance travelled by the object?

$D = D_{a \to b} + D_{b \to c}$
$= 8 + 6 = 14\,m$

$[D] = meter = m$

$1\,km = 10^{3}\,m$
$1\,Mm = 10^{6}\,m$
$1\,cm = 10^{-2}\,m$
$1\,mm = 10^{-3}\,m$
$1\,\mu m = 10^{-6}\,m$

• Average velocity: السرعة المتوسطة المتجهة



* Insta

$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{x_2(t_2) - x_1(t_1)}{t_2 - t_1}$$ ⇒ نعوض x مع الإشارة.

$[v] = m/s$

if $\Delta t \to 0$

$\therefore v_{avg} \to v_{inst.}$ السرعة عند لحظة

$$V_{inst.} = \frac{dx(t)}{dt}$$

* عندما تقل Δt إلى الصفر تصبح بدلاً من سرعة متوسطة ← لحظية.
* عندما يعطينا فقط قيمة واحدة لـ t ⇐ لحظية.

• Average acceleration

$$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_2(t_2) - (v_1)t_1}{t_2 - t_1}$$

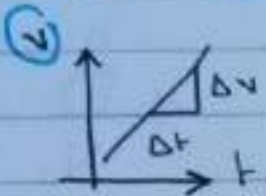
$[a] = m/s^2$

$a_{avg} \to a_{inst.}$ تسارع عند لحظة

⊖ decc. التباطؤ إشارة سالبة

⊕ acce. التسارع إشارة موجبة

~~Ex:~~



slope = a avg

slop = ainst.

[متساويان] $a_{inst.} = a_{avg}$ لأنه منتظم فكله

ainst. = slope of tangent

ميل المماس = التسارع اللحظي

* لو كان بدل v ← x ⇐ slope = v

Ex: A car moves along x-axis. It's motion is described by $x(t) = 3t^2 + 2t - 5$ (x in (m) and t (s)) find:

a) the displacment of the car for the first 5 s

$x(5) = 3(5)^2 + 2(5) - 5 = 75 + 10 - 5 = 80$ m

* $\Delta x = x(5\text{ sec.}) - x(\text{zero sec.})$

$80 - (-5) = 85$

b) the avg. velocity of the car for the time interval $t_1 = 2$ s → $t_2 = 4$ sec. ?

$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{x_2(t_2) - x_1(t_1)}{t_2 - t_1} = \frac{51 - 11}{4 - 2}$

$= \frac{40}{2} = 20$ m/s.

$x(t) \rightarrow v(t) \rightarrow a(t)$

No.

c) the velocity of the car at $t = 2sec$?

$v_{inst.}\Big|_{t=2} = ?$ تعني السرعة اللحظية

$6(t) + 2$ $\quad v_{inst.} = 6(2) + 2 = 14\ m/s$

d) the acce. of the car for the period from $t_1 = 1\ sec.$ to $t_2 = 3\ sec.$

$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_2(t_2) - v_1(t_1)}{t_2 - t_1}$

$= \frac{20 - 8}{2} = \frac{12}{2} = 6\ m/s^2$

e) the acce. of the car at $t = 3\ sec.$?

$a(t = 3\ sec.) = \frac{d\,v(x)}{dt} = 6\ m/s^2$

** Average Speed : ← متوسط مقدار السرعة

كمية قياسية

$$\text{average speed} = \frac{\text{travelled distance}}{\text{total time}}$$

$$= \frac{\text{المسافة المقطوعة}}{\text{الزمن الكلي}}$$

Ex: A car travelled 50 Km with speed of 40 km/h then travelled another 30 km with speed of 20 km/h find it's average speed.

No.

Sol. $\text{Ave. speed} = \frac{\text{distance}}{\text{time}}$

① نحسب الزمن للسرعة / المسافة الأولى و الثانية لإيجاد الزمن الكلي .

$\text{distance} = 50 + 30 = 80 \ km/h$

$t_{tot.} = t_1 + t_2$

$T_1 = \frac{S}{d} = \frac{50}{40}$ $\quad T_2 = \frac{30}{20}$

$T_{tot} = 2.75 \ h$

$\text{Ave. speed} = \frac{80}{\frac{11}{4}} = \frac{320}{11} \approx 29.1 \ Km/h = 8.08 \ m/s$

$1 \ km/h \longrightarrow \frac{1000}{3600} \ m/s$

* ممكن يحطلنا السؤال على شكل رسم بياني .
* ممكن يحطلنا سرعة و زمن و نوجد المسافة .

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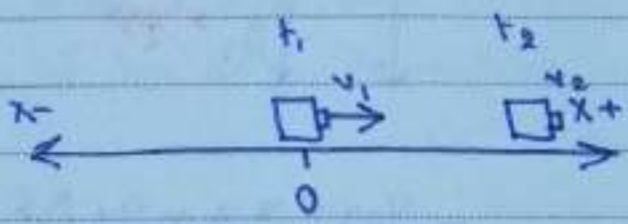
1.5 Motion in a straight line with constant acceleration : الحركة بخط مستقيم وتسارع ثابت

a is constant.   * التسارع ثابت

* Along x-axis :



$v_{2x} = v_{1x} + a_x \Delta t$ — ①   ع٢ = ع١ + ت Δز

$x_{2x} = x_1 + v_{1x} \Delta t + \frac{1}{2} a_x \Delta t^2$ ف٢ = ف١ + ع١ Δز + ½ ت Δز²

$v_{2x}^2 = v_{1x}^2 + 2a_x \Delta x$ — ③   ع٢² = ع١² + ٢ت Δف

a:
- ⊖ dicce. → تباطؤ → باتجاه ⊖x
- ⊕ acce. → تسارع → باتجاه ⊕x

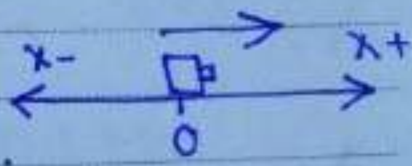
باتجاه.

Ex : A bus starts it's motion from rest towards +xaxis

⇐ $v_1 = 0$ من السكون.

إذا لم تحدد t_1 ⇐ = 0 .

Find it's velocity after 15 sec. if it acc. = 4 m/s²



$v_{2x} = v_{1x} + a_x \Delta t$

$= 0 + 4(15) = 60$ m/s.

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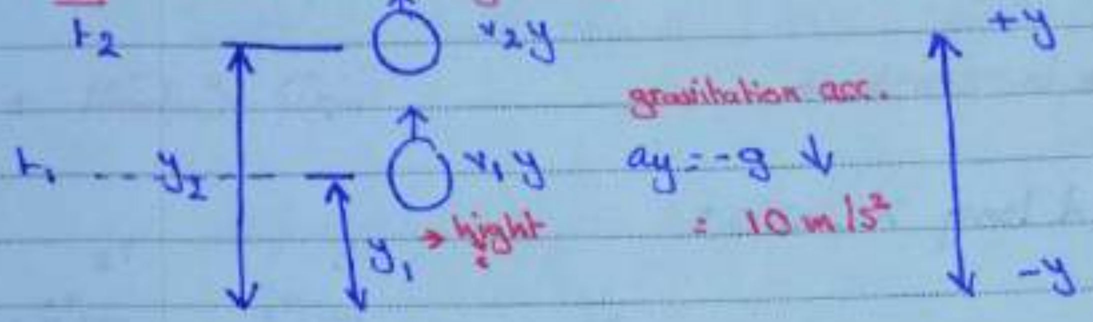
1.6 Free _ Falling objects: السقوط الحر.



①
$$v_{2y} = v_{1y} + a_y \Delta t \quad \text{— ①}$$
$$y_2 = y_1 + v_{1y} \cdot \Delta t + 1/2\, a_y (\Delta t)^2 \quad \text{— ②}$$
$$v_{2y}^2 = v_{1y}^2 + 2 a_y \Delta y \quad \text{— ③}$$

②
$$v_{2y} = v_{1y} + \underbrace{(-g)}_{\to -10} \Delta t$$
$$y_2 = y_1 + v_{1y} \cdot \Delta t + \underbrace{1/2 (-g)}_{-5} (\Delta t)^2$$
$$v_{2y}^2 = v_{1y}^2 + \underbrace{2(-g)}_{-20} \Delta y$$

← السقوط الحر لا يعني بداية الحركة من السكون

← الأجسام الساقطة سقوطاً حراً: هي الأجسام المتحركة تحت تأثير مجال الجاذبية الأرضية ولا تعني مطلقاً الأجسام التي تبدأ الحركة من السكون.

← يمكن أن يكون لها سرعة ابتدائية ≠ صفر.

② هذه القوانين تطبق مع ما يلي:

1. بالنسبة للارتفاع ⇐ فوق سطح الأرض ⊕ y ، تحت سطح الأرض ⊖ y
أي أن نقطة الصفر (المرجع) هي سطح الأرض.

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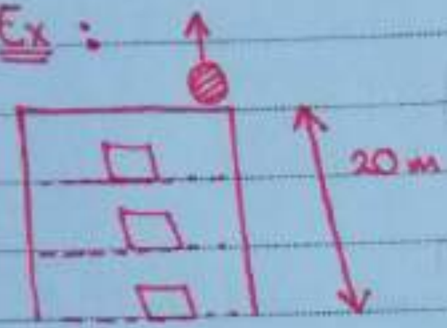
(ب) السرعة في الأجسام المتحركة للأعلى تكون سرعتها (+)

(-) " " للأسفل " "

Ex :



A ball is projected upwards with 4 m/s from a top of building 20 m high.

Find :

a. the time needed to reach the ground?

$v_{1y} = +4$ m/s

$y_1 = 20$ m $\qquad y_2 = 0$ m ⇒ الأرض

$y_2 = y_1 + v_{1y}\Delta t - 5\,\Delta t^2$

$0 = 20 + 4\Delta t - 5\,\Delta t^2$

$5\Delta t^2 - 4\Delta t - 20 = 0$

$\Delta = b^2 - 4ac = 16 + 400 = 416$

$\dfrac{-b \pm \sqrt{\Delta}}{2a} = \dfrac{-(-4) \pm \sqrt{416}}{10}$ = ~~0.8~~

$\Delta t = -1.64$ → مرفوض $\qquad \Delta t = 2.44$ s

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with respect to ground

b. The max. high that the ball can reach?

$\Rightarrow$ عند أقصى ارتفاع

$v_{1y} = 4$ m/s $v_{2y} = 0$ m/s

$y_1 = 20$ m $y_2 = ?!$

$v_{2y}^2 = v_{1y}^2 - 20\,\Delta y$

$0 = 16 - 20\,\Delta y$ $\frac{20}{20}(y_2 - 20) = \frac{16}{20}$

$y_2 - 20 = \frac{16}{20} + 20 = 20.8$ m.

$+20$

$V_{avg} = \frac{x_2(t_2) - x_1(t_1)}{t_2 - t_1}$

$V_{inst.} = \frac{dx(t)}{d(t)}$

$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_2(t_2) - v_1(t_1)}{t_2 - t_1}$

avg. speed = $\frac{\text{travelled distance}}{\text{total time}}$

$v_{2x} = v_{1x} + a_x \Delta t$

$v_{2x}^2 = v_{1x}^2 + 2a_x \Delta x$

$x_{2x} = x_{1x} + v_{1x}\Delta t + \frac{1}{2}a_x \Delta t^2$

$v_{y_2} = v_{y_1} - 10\,\Delta t$

$y_2 = y_1 + v_{y_1}\Delta t - 5\,\Delta t^2$

$v_{y_2}^2 = v_{1y}^2 - 20\,\Delta y$

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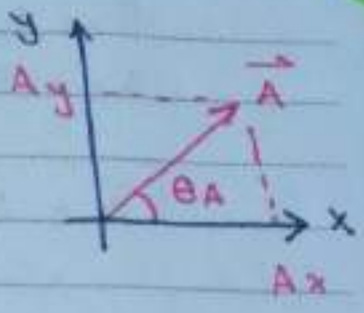
Ch3 vectors :



$\vec{A}$ ≡ vector A
≡ has magnitude
$|\vec{A}|$ and direction θ_A

$\vec{A}$ has two components : A_x = x-component
A_y = y-component.

$A_x = |\vec{A}| \cos\theta_A$ $\quad A_y = |\vec{A}| \sin\theta_A$ } θ_A ≡ mesure with respect to +x
عكس عقارب الساعة.

from ① and ② we can obtain :

$$|\vec{A}| = \sqrt{(A_x)^2 + (A_y)^2} \quad (3)$$

$$\theta_A = \tan^{-1} \frac{A_y}{A_x} \quad (4)$$

inverse

3.2 Unit vectores متجهات الوحدة.
هي متجهات لها مقدار قيمة وحدة واحدة.

$\hat{i}$ $\quad \hat{j}$ $\quad \hat{k}$

$|\hat{i}| = 1$ $\quad |\hat{j}| = 1$ $\quad |\hat{k}| = 1$

direction +x $\quad$ +y $\quad$ +z

Ex: If $\vec{A}$ is a vector which has $A_x = +3$, $A_y = -4$, $A_z = +5$. write $\vec{A}$ using the unite vector.

$$\left[\vec{A} = A_x \hat{i} + A_y \hat{j} + A_z \hat{k}\right]$$
$$= 3\hat{i} + -4\hat{j} + 5\hat{k}$$
$$= 3\hat{i} - 4\hat{j} + 5\hat{k}$$

2.3 Resultant vector:

if $\vec{A}, \vec{B}, \vec{C}$, etc. are vectors, then

$R \equiv$ the resultant vector can be calculated as follows.

① Finding the x componant of all vector

$A_x = |\vec{A}| \cos \theta_{Ax}$

-يجب أن تكون الزاوية بالنسبة لـ +x.

$B_x = |\vec{B}| \cos \theta_{Bx}$

$C_x = |\vec{C}| \cos \theta_{Cx}$

② Finding the y componant of all vector

$A_y = |\vec{A}| \sin \theta_{Ay}$

$B_y = |\vec{A}| \sin \theta_{By}$

$C_y = |\vec{A}| \sin \theta_{Cy}$

* يجب التأكد على أن كل الزوايا لمختلف المتجهات يجب أن تقاس من / بالنسبة لمحور +x عكس عقارب الساعة.

* عند استخدام الآلة الحاسبة يجب التأكد من أن تكون الزاوية مقاسة بالدرجات لأن الآلة الحاسبة لها 3 أنماط لحساب الزاوية.

③ Finding the Rx – x – componant of the result that vector, by adding the x – componants of all vectors.

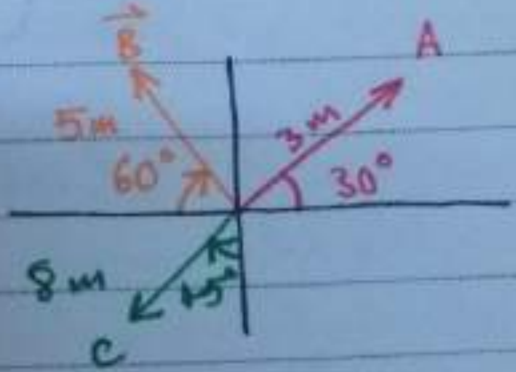
$$Rx = Ax + Bx + Cx + \dots$$

④ Ry will be: $Ry = Ay + By + Cy$.

⑤ the magnitud of $\vec{R}$ will be $|\vec{R}| = \sqrt{(Rx)^2 + (Ry)^2}$

⑥ the direction of R will be $\theta_R = \tan^{-1}\left(\frac{Ry}{Rx}\right)$

Ex: In the figuer $\vec{A}, \vec{B}, \vec{C}$ are vectors. Find the result vector.



$|\vec{A}| = 3m, \ \theta_A = 30^\circ$
$|\vec{B}| = 5m, \ \theta_B = 120^\circ$
$|\vec{C}| = 8m, \ \theta_C = 225^\circ$

$A_x = 3\cos(30) = 2.59 \quad A_y = 3\sin(30) = 1.5$
$B_x = 5\cos(120) = -2.5 \quad B_y = 5\sin(120) = 4.33$
$C_x = 8\cos(225) = -5.65 \quad C_y = 8\sin(225) = -5.65$

$R_x = -5.55 \text{ m} \quad |\vec{R}| = \sqrt{(R_x)^2 + (R_y)^2}$
$R_y = 0.17 \text{ m} \quad = 5.55$
$\theta_R = -1.75^\circ$

** Finding the resultant by unit vectors:

If $\vec{A} = A_x\hat{i} + A_y\hat{j}$ + ~~$A_z\hat{k}$~~ $\quad \vec{B} = B_x\hat{i} + B_y\hat{j}$

$$\vec{R} = R_x\hat{i} + R_y\hat{j}$$

$|\vec{R}| = \sqrt{(R_x\hat{i})^2 + (R_y\hat{j})^2}$
$\theta = \tan^{-1}\left(\frac{R_y\hat{j}}{R_x\hat{i}}\right)$

4//

** Vector product :-

1. Dot product (scalar product)

← مقدار بدون اتجاه.

Cas 1: If $\vec{A}$ and $\vec{B}$ are vectors, then

$$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta_{AB}$$

Cas 2: If
$$\left.\begin{aligned}\vec{A} &= A_x\hat{i} + A_y\hat{j} \\ \vec{B} &= B_x\hat{i} + B_y\hat{j}\end{aligned}\right\} \quad \vec{A}\cdot\vec{B} = (A_x \cdot B_x) + (A_y \cdot B_y)$$

Ex: If $\vec{A} = 3\hat{i} - 2\hat{j} + 4\hat{k}$, $\vec{B} = 6\hat{i} + \hat{j} - 5\hat{k}$ Find the angle bet. $\vec{A}, \vec{B}$

$$\vec{A}\cdot\vec{B} = |\vec{A}||\vec{B}|\cos\theta_{AB} \rightarrow \cos\theta_{AB} = \frac{\vec{A}\cdot\vec{B}}{|\vec{A}||\vec{B}|} \quad — (1)$$

$$|\vec{A}| = \sqrt{(A_x)^2 + (A_y)^2 + (A_z)^2} = \sqrt{3^2 + -2^2 + 4^2} = 5.3 \quad — (2)$$
$$|\vec{B}| = \sqrt{B_x^2 + B_y^2 + B_z^2} = \sqrt{6^2 + 1^2 + -5^2} = 7.8 \quad — (3)$$

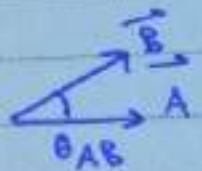
$$\vec{A}\cdot\vec{B} = A_x * B_x + A_y * B_y + A_z * B_z$$
$$= -4 \quad — (4)$$

2, 3, 4 in (1) we get $\cos\theta_{AB} = \frac{-4}{5.3(7.8)}$

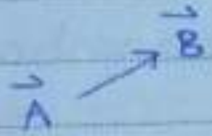
$$\theta_{AB} = 95.5^\circ$$

* Cross product: if $\vec{A}$ and $\vec{B}$ are vectors, then

$$|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}| \sin\theta_{AB}$$



← مقدار الضرب الاتجاهي

$\vec{A} \times \vec{B} \rightleftharpoons$ 

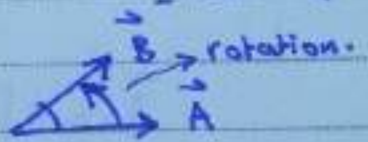
من $\vec{A}$ إلى $\vec{B}$

ملاحظة: This means that the direction can be found as follows: عكس عقارب الساعة

① If the rotation from $\vec{A}$ to $\vec{B}$ is counter clo... as shown in the figure then the direction of $\vec{A} \times \vec{B}$ will be out of page (perpendicular) → عمودي.

⊙

عكس عقارب الساعة



② If the rotation from $\vec{A}$ to $\vec{B}$ is clockwized as showen in the figure then the direction of $\vec{A} \times \vec{B}$ will be inside of page ⊗ into page.

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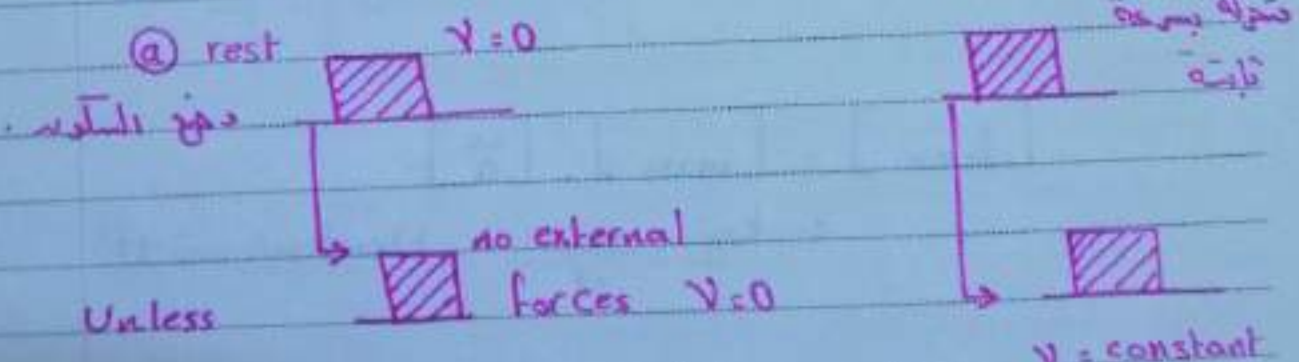
Ch 4. Newton's Laws :
"Dynamics"

* Newton's first law ≡ [law of inertia] discussing the static situation of objects and it state's that the object @ rest / moving with constant/uniform velocity remains @ rest or moving with constant/ Uniform velocity Unless an external forces act(s) on the object and leads to change it's static situation.

** [mass —why?→ inertia]



$|\vec{a}| = zero$ — التسارع = صفر في كل الحالات

V = constant = uniform motion. — حركة منتظمة

exert → أثّر

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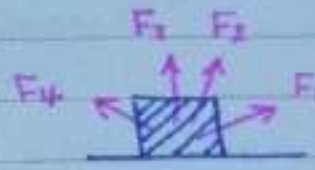
* Newton second law — كمية متجهة

Force concept law



$\vec{F}_{resultant} = \sum \vec{F} \propto \vec{a}$

$\vec{ق} \propto \vec{ت}$ $\propto$: direct proportion

تناسب طردي.

$\left[\sum \vec{F} = \vec{F}_{resultant} = m . \vec{a} \right]$: — القوة المحصلة

موازي ⇔   direction: تسارع

① $\vec{F}$ resultant ⇈ motion $\vec{a} \to \oplus \Rightarrow$ acceleration

تباطؤ.

② $\vec{F}$ resultant ⇅ motion $\vec{a} \to \ominus \Rightarrow$ acceleration.

↳ Ex: Friction force قوة الاحتكاك

$[\text{Force}] = [\text{mass}] . [\vec{a}]$

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

$[F] = \frac{g . cm}{s^2} = \text{dyne}.$

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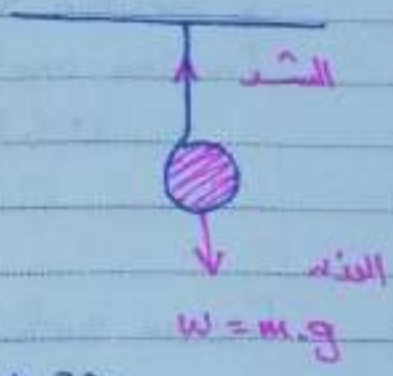
* Forces:

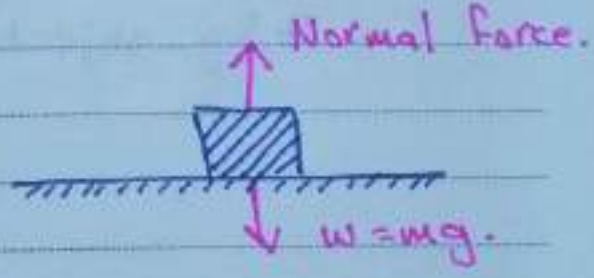


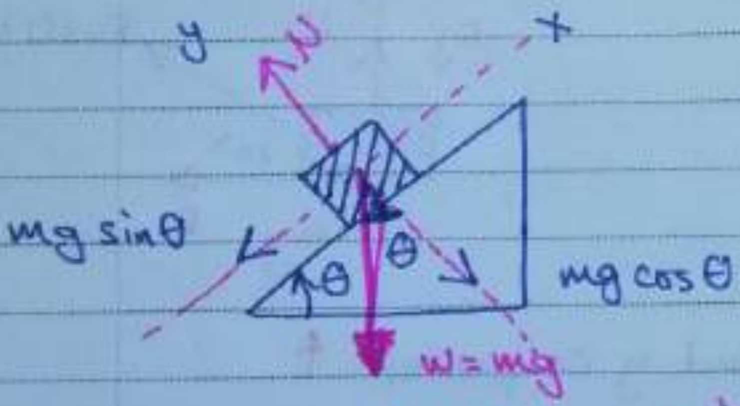
① weight.

② Tension = T قوة الشد

③ Normal force = $\vec{N}$ القوة العمودية

$\vec{N} \perp$ surface.





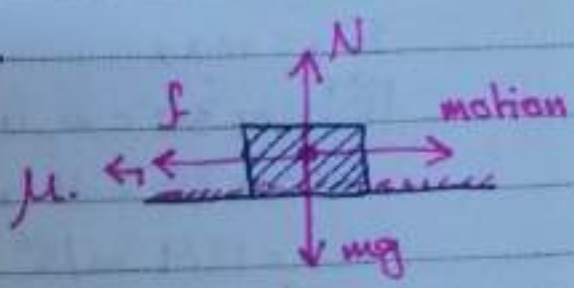
سطح مائل.

④ Friction قوة الاحتكاك

• اتجاهها عكس اتجاه الحركة.

surface

smooth	rough
no friction.	friction.



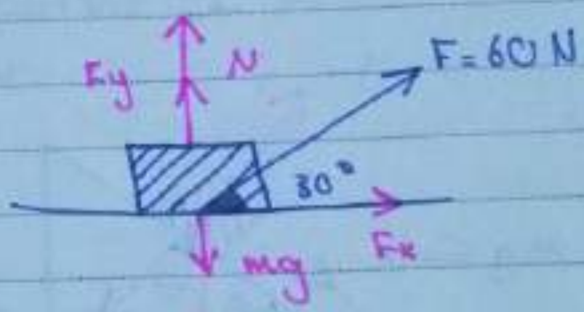
* for the ~~sur~~ tough surfaces, there is friction coefficiant :

$0 \le \mu \le 1$

. smooth surface ⇐ $\mu = 0$ bine

Friction surface $= |\vec{f}| = \mu . |\vec{N}|$

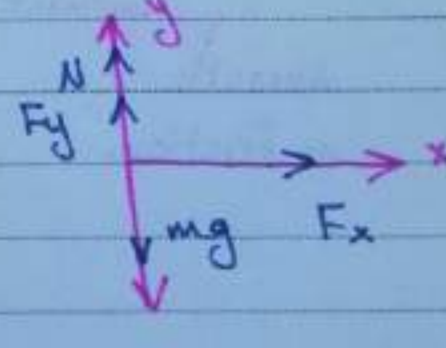
<u>Ex</u>: In the figuer, Find the acceleration of 4 kg object?



① Find the x and y component

② Drawing free-body Diagram.

③ Applying Newton secound law.



• x-axis :

$\Sigma F_x = m a_x$

$|\vec{F}| \cos 30 = m . a_x$

$60 \cos 30 = 4 a_x$

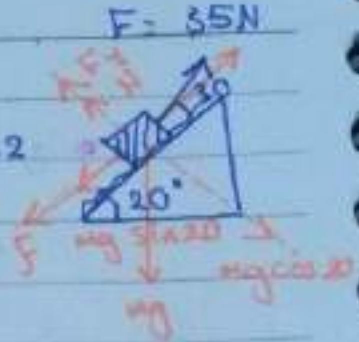
$a_x = 12.9 \ m/s^2$

- y- axis :

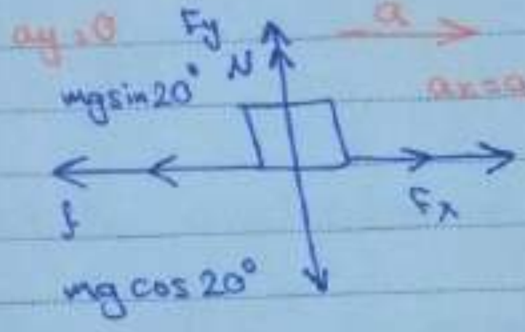
$\Sigma F_y = m a_y \Rightarrow$ التسارع = 0

لا يوجد حركة على محور الصادات .

No.



Ex: In the figuer, find the acceleration of the 6kg object? $\mu = 0.2$



x-axis:

$\Sigma F_x = ma_x$

$F_x - f - mg \sin 20$

$35 \cos 30 - \mu . N - mg \sin 20 = ma$

$35 . 0.86 - 0.2 N - 6 \times 10 (0.34) = 6a$

$30.1 - 0.2N - 20.4 = 6a$

$9.7 - 0.2N = 6a$ ——— (a)

y-axis:

$\Sigma F_y = ma_y$

$F_y + N - mg \cos 20 = m(0)$

$F_y + N - mg \cos 20 = 0$

$|\vec{F}| \sin 30 + N - mg \cos 20 = 0$

6 $35 . \frac{1}{2} + N - 6 \times 10 \times 0.9 = 0$

FIVE APPLE

$17.5 + N - 54 = 0$

$N = 36.5$

$6a = 9.7 - 0.2N$

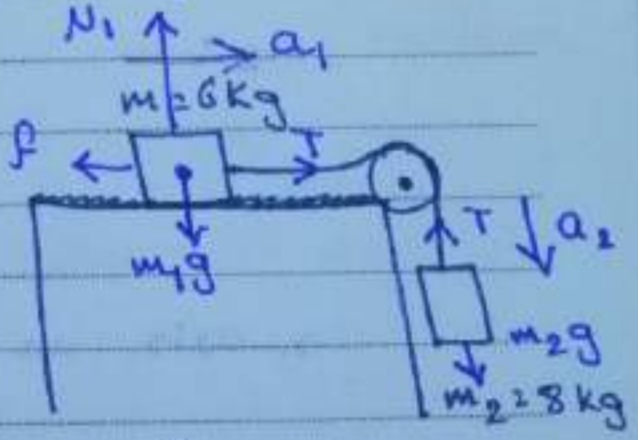
$6a = 9.7 - 0.2(36.5)$

$\frac{6a}{6} = 9.7 - 7.3 = \frac{2.4}{6}$

$a = 0.4\ m/s^2$

(b) $f = ?!$

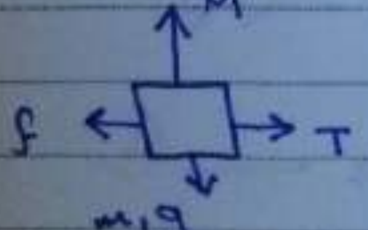
$|\vec{f}| = \mu . N = 0.2(36.5) = 7.3$



Ex:

In the figure, a system of two masses m_1 and m_2 which one connected by a string over a frictioless pulley. find the acce. of the system?

m_1:-



x-axis:

$\Sigma F_x = m_1 a_x$

$T - f = m_1 a_1$

$T - \mu . N_1 = m_1 a_1$

$T - 0.3 N_1 = 6 a_1$ —— ①

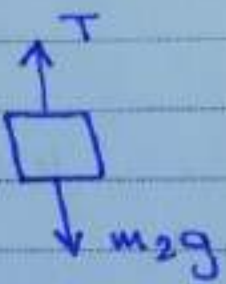
y-axis:

$\Sigma F_y = m_1 a_y = 0$

$N_1 = m_1 g$

$N_1 = 60 N$ —— ②

m_2:



x-axis no motion

y-axis: $T - m_2 g = m_2 a_2$

$T - m_2 g = 8 a_2$ —— ③

$T = 80 + 8 a_2$ —— ③

$T - 0.3(60) = 6a_1$

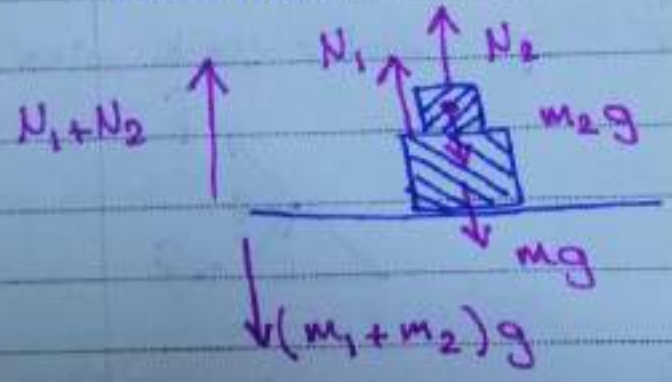
$80 + 8a - 18 = 6a$

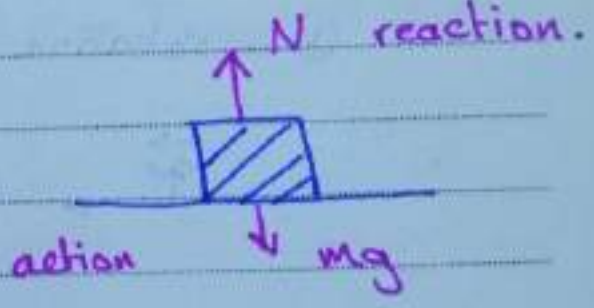
$(8-6)a = 18-80$

$\frac{2a}{2} = \frac{-62}{2}$ $a = -30\ m/s^2$

• Newton's third law: (Action reaction law)

Each action has a reaction, in which both are equal in magnitude and opposite in direction.

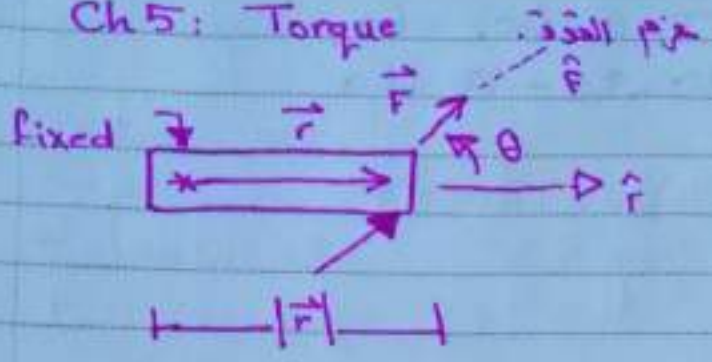




Chapter 4

No.

Ch5: Torque

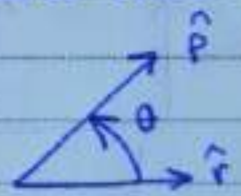


$\vec{\tau} = \vec{r} \times \vec{F}$ $\qquad$ $|\vec{\tau}| = |\vec{r}|\,|\vec{F}| \sin\theta$

* Direction:

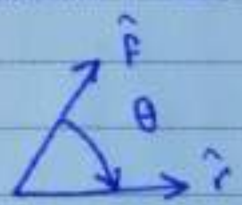
① rotation $\hat{r} \rightarrow \hat{F}$ ⇒ counter clock wise

$\vec{\tau} \rightarrow \odot$



② rotation $\hat{r} \rightarrow \hat{F}$ ⇒ clock wise

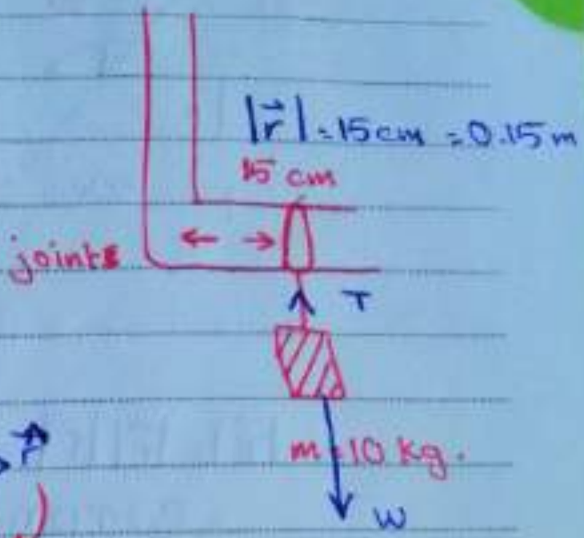
$\vec{\tau} \rightarrow \otimes$



$[\vec{\tau}] = [r][F] = N.m$

FIVE APPLE

Ex: In the figuer find the torque done by the 10 kg mass.



Sol.

$|\vec{\tau}| = |\vec{F}||\vec{r}| \sin\theta$

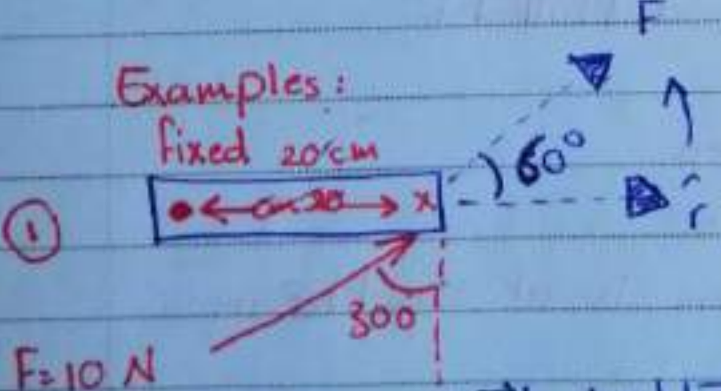
$= 10\ (10) = 100\ N \times 0.15 \times \sin 90° = 15\ N.m$

Direction: clock wise

$\vec{\tau} = 15\ N.m$ ⊗

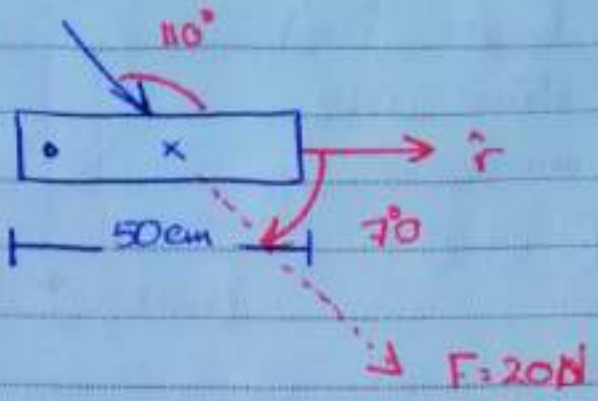
(عمودي) F إذا r مع

Examples:



Find $\vec{\tau}$? $|\vec{\tau}| = |\vec{r}||\vec{F}| \sin\theta$

$= 1.72\ N.m$

② 

$|\vec{\tau}| = |\vec{r}||\vec{F}| \sin\theta$
$= 0.25(20) \sin 70$

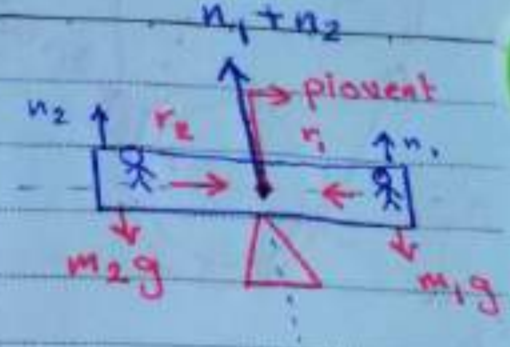
5.2 : Static and Equilibrium :

Conditions : ① the forces must be at equilibrium
$\Sigma F = 0$
② $\Sigma \tau = 0$

* Equilibrium exists if the following conditions are fulfilled :

① $\Sigma \vec{F} =$ Zero
② $\Sigma \vec{\tau} =$ Zero
then the system is at equilibrium

No.



ذو وزنين مختلفين ⇐

إذا كانت الكتلتين متساويتين

ومتقابلة على نفس البعد

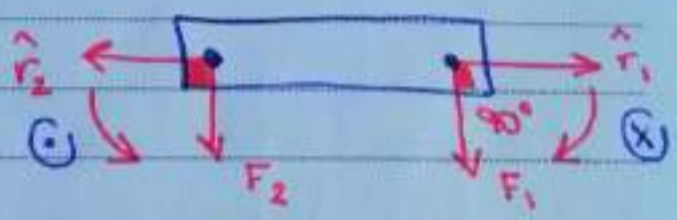
← يتحقق الاتزان.

اذا كانت المسافات متغيرة - علمه معادلة الاختلاف بال $\vec{\tau}$

Ex:

① $\sum \vec{F} = 0$

② $\sum \vec{\tau} = 0$



$\tau_1 + \tau_2 = 0$ ✓

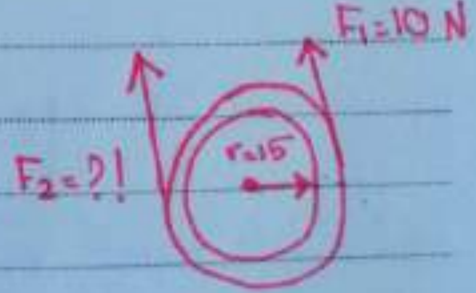
$r_1 F_1 \sin\theta_1 = r_2 F_2 \sin\theta_2$

$|\tau_1| = |\tau_2|$

$r_1 m_1 \cancel{g} \cancel{\sin 90} = r_2 m_2 \cancel{g} \cancel{\sin 90}$

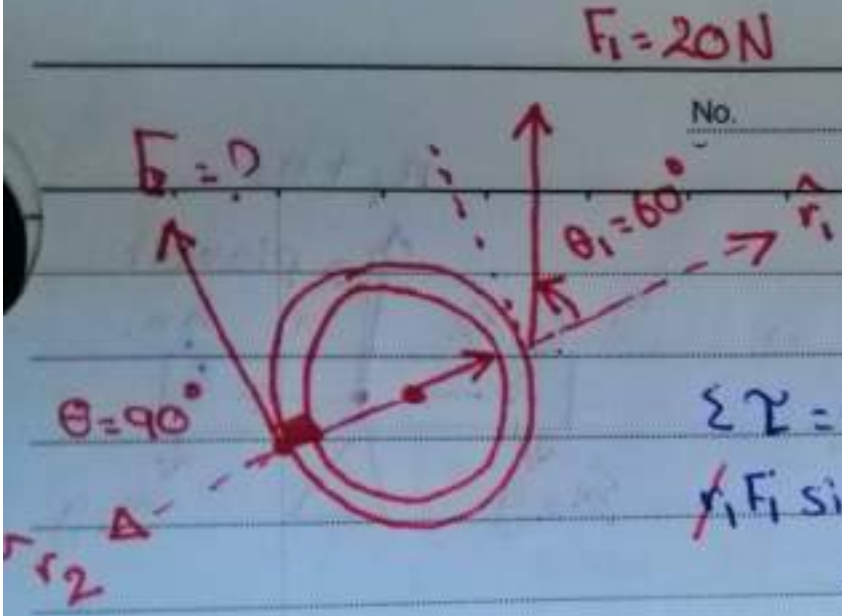
$r_1 m_1 = r_2 m_2$

Ex: Find F_2 for equilibrium?



$F_2 = 10\ N$.

تساوت القوتان لأنه كلاهما مماسيان.



حالة ثانية :-

$$\Sigma \tau = 0$$

$$r_1 F_1 \sin 60 = r_2 F_2 \sin 90 \quad (\sin 90 = 1)$$

$$F_1 \sin 60 = F_2$$

$$F_2 = 20 \times 0.86 = 17.2\ N$$

5

Chapter 5

Ch6 : work and energy :-

work: form of energy (gained) (w)
lost

* work done by force / forces acting on an Object leading to displace the object from place to another ~~one~~ ~~to~~ can be ~~calls~~ calculated as follows:

$W = \vec{F} \cdot \Delta\vec{r}$ $\quad\quad$ $w = |\vec{F}_{net}| \cdot |\Delta\vec{r}| \cdot \cos\theta$

If $\vec{F} = F_x\hat{i} + F_y\hat{j} + F_z\hat{k}$ and the object is moved from $\vec{r}_1 = r_{1x}\hat{i} + r_{1y}\hat{j} + r_{1z}\hat{k}$ to $\vec{r}_2 = r_{2x}\hat{i} + r_{2y}\hat{j} + r_{2z}\hat{k}$ then the work will be

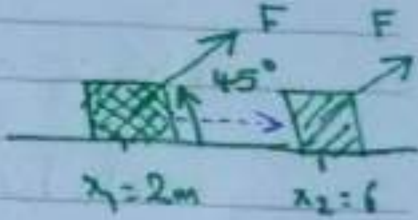
$$W = \vec{F} \cdot \Delta\vec{r} = (F_x\hat{i} + F_y\hat{j} + F_z\hat{k}) \cdot (\Delta x\hat{i} + \Delta y\hat{j} + \Delta z\hat{k})$$
$$= (F_x \Delta x) + (F_y \Delta y) + (F_z \Delta z)$$

$[W] = [F][\Delta r] = N \cdot m = J.$

الشغل كمية قياسية علامة تكون + أو -

كسب طاقة ← فقد طاقة.

Ex 1 In the figure find the work done by $\vec{F}$



$W = |F| |\Delta r| \cos\theta$

$= 20 \times (6-2) \cos 45^\circ$

$= 20 (4) \cos 45 \quad = 56.5 \text{ J}.$

$F_1 = 6\hat{i} + 8\hat{j} - 3\hat{k}$
$F_2 = -2\hat{i} + 6\hat{j}$

Ex 2: If the following forces are acting on 6 Kg object. The object is therefore moved from point $r_1 = (2, 6, -1)$ to point $r_2 (1, -1, 5)$. Find the work done on the object?

$\vec{F}_{net} = \vec{F_1} + \vec{F_2}$

$= (6\hat{i} + 8\hat{j} - 3\hat{k}) + (-2\hat{i} + 6\hat{j} + 0\hat{k})$

$= 4\hat{i} + 14\hat{j} - 3\hat{k}$

$\Delta r = r_2 - r_1$

$= (1\hat{i} - 1\hat{j} + 5\hat{k}) - (2\hat{i} + 6\hat{j} - 1\hat{k})$

$= 1\hat{i} - 1\hat{j} + 5\hat{k} - 2\hat{i} - 6\hat{j} + 1\hat{k}$

$= -\hat{i} - 7\hat{j} + 6\hat{k}$

$W = \vec{F}_{net} \cdot \vec{\Delta r} = (4\hat{i} + 14\hat{j} - 3\hat{k}) \cdot (-\hat{i} - 7\hat{j} + 6\hat{k})$

$= -4 - 98 - 18$

$= -120 \text{ J} \rightarrow$ lost work.

حالات الشغل:

① w → max → θ = Zero

② w → Zero → θ = 90°

③ w → min → θ = 180°

w — ⊕ → gained

w — ⊖ → lost.

... fi

2) cos 45°

4) cos 45

Ex2: If the following

... 6i + 8j + 3k | on 6 Kg object. The

- potential Energy $\equiv U \rightarrow J$

  ↳ gravitational p.E

أي جسم له ارتفاع وكتلة له طاقة مخزنة. ←

$U = m \cdot g \cdot y$ → hight.

- العلاقة بين طو والشغل ← عكسية

$W = -\Delta U$

* work by object → lose some of U ~~work~~

work done on the object → goind some of U

- kinetic Energy $\equiv K \rightarrow J$.

$K = \frac{1}{2} m v^2$ → velocity.

m ↓ mass

- العلاقة بين طح والشغل ← طردية

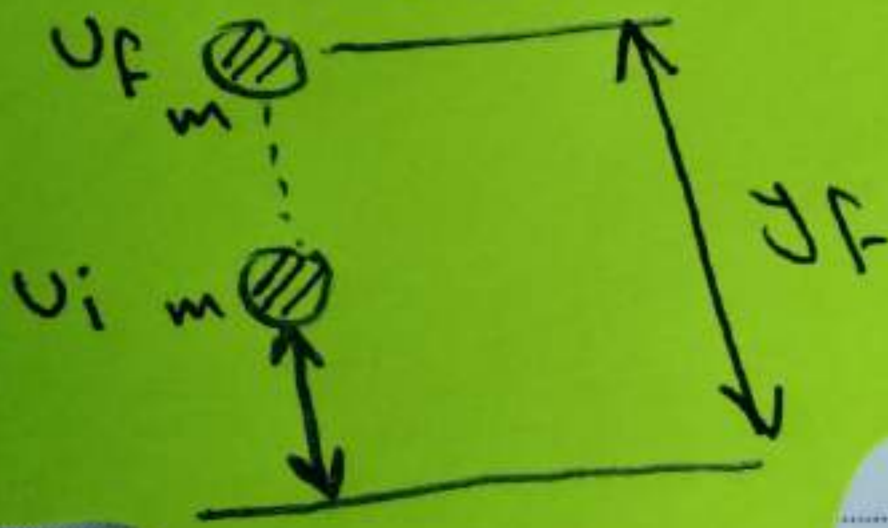
$W = {}^{+}\Delta K$

Relation between w and P.E :

$$w = -\Delta U$$

$$= -(U_f - U_i)$$

$$= -(mgy_f - mgy_i)$$



• العلاقة بين ط.و والشغل ← عكسية

→ lose some of U ~~work~~

ect → goind some of U

= K → J.

velocity

Relation ship between work and K.E :

$$w = +\Delta K$$

$$= +(K_f - K_i)$$

$$= +(\tfrac{1}{2} m v_f^2 - \tfrac{1}{2} m v_i^2)$$

No.

* work mechanical [Energy theory]

$E = k.E + p.E$ → نظام محافظ
→ نظام غ. محافظ

① Conservation system :
- No energy loss.
- No friction احتكاك

this gives that E = constant → conserved

⇒ $\Delta E = Zero$

* we know that:

$w = -\Delta U = +\Delta K$

$-(U_2 - U_1) = (k_2 - k_1)$

$-U_2 + U_1 = k_2 - k_1$

$k_1 + U_1 = k_2 + U_2$ $E_1 = E_2$

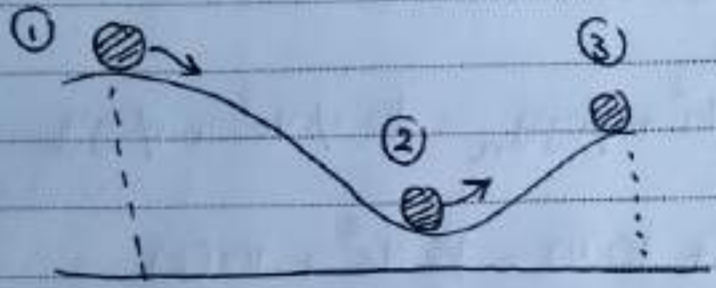
$\Delta E = 0$

② non-conversation motion :
نظام غير محافظ

- there is Energy loss.
- Energy is not conserved.

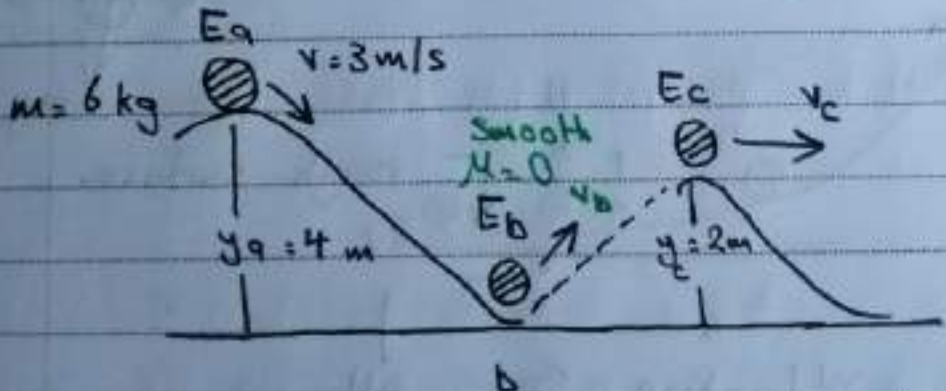
$E_1 \neq E_f$ $\Delta E \neq 0$

- Ex: friction.



* In the figure, E is conserved and it change from K.E to P.E and U.a²

- Conversation law of energy:



$E_a = E_b = E_c = \ldots$ $k_a + U_a = k_b + U_b$

$\frac{1}{2} m v_a^2 + mgy_a = \frac{1}{2} m v_b^2 + mgy_b$

Ex: In the figure a 6 Kg object starts it's motion at point a, with v = 3 m/s moving to b then c, find it's velocity at point c?!

$E_a = E_b = E_c$

$E_a = E_c$

$K_a + U_a = K_c + U_c$

~~1/2 m...~~

$\frac{1}{2} m v_a^2 + m g y_a = \frac{1}{2} m v_c^2 + m g y_c$

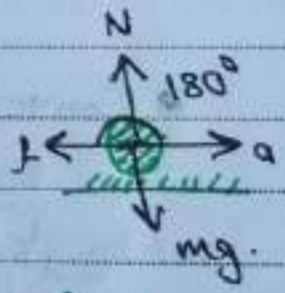
$= \frac{1}{2}(3)^2 + 10(4) = \frac{1}{2} v_c^2 + 10(2)$

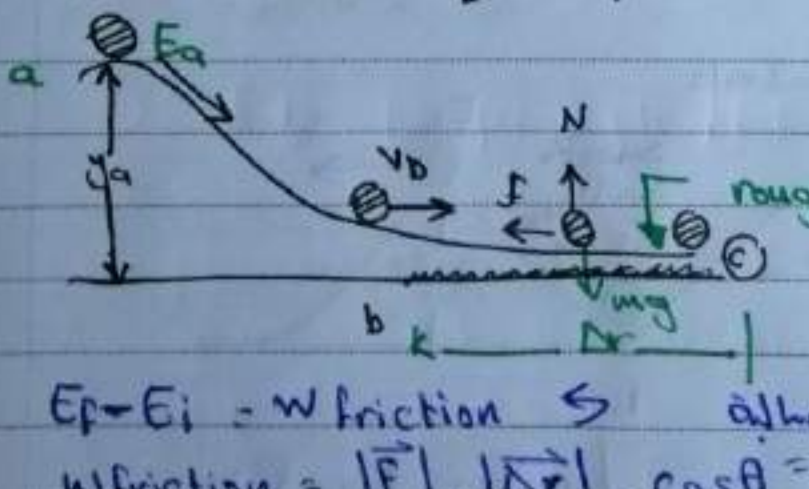
$4.5 + 40 = \frac{1}{2} v_c^2 + 20$

$24.5 \times \frac{v_c^2}{2} \qquad v_c = \sqrt{49} = 7\ m/s$

- **Non-conversative system:**

there is friction $\Rightarrow \Delta E \neq 0$





$E_f - E_i = W_{friction}$

$W_{friction} = |\vec{F}| \cdot |\vec{\Delta r}| \cdot \cos\theta \quad \theta = 180°$

$= \mu \cdot N \cdot \Delta r \cdot -1$

$W_{friction} = -\mu \cdot N \cdot \Delta r$

Power :

power : معدل إنجاز الشغل / نقل طاقة

$$\text{Power} = \frac{\text{work}}{\text{time}} = \frac{w}{t} = \frac{E}{t}$$

كمية قياسية لها مقدار وليس لها اتجاه .

$$P_{avg} = \frac{\Delta w}{\Delta t} \quad (1)$$

خلال فترة زمنية ← $P_{avg.}$

P_{avg}: quantity of work Δw is done during a time Δt. the average work done per unit time or average poteer is defined to be: $P_{avg} = \frac{\Delta w}{\Delta t}$

** لإيجاد قيمة القدرة عند لحظة نشتق العلاقة الأصلية :

$$P_{inst.} = \lim_{t \to 0} \frac{d\,\Delta w}{d\,\Delta t} = ~~|\vec{F}||\vec{v}|\cos\theta~~$$

$[P] = J/s = \text{watt} = W$ ← صغيرة

kw / hourse power

$1\,hp = 746 = 0.746\,kw$

$1\,hp \approx 3/4\,kw$

* اذا كانت القوة ثابتة مع الزمن ⇐

$p = \frac{w}{t} = \frac{\text{force} \cdot \text{displacment}}{t}$

$\therefore p = \text{force} \cdot \frac{\text{displacment}}{t} = \text{Force} \cdot \text{velocity}$

$p = \text{force} \cdot \text{velocity} = \vec{F} \cdot \vec{v} = F \cdot v \cdot \cos\theta$ (F, v)

Examples:

If a pump lifts water of mass m from a depth h in time Δt then the power of the motor is given by:

$p = w / \Delta t$ — ①

$w = mgh$ — ②

2 and 1 ⇒ $p = mgh / \Delta t$ — ③

Example:

A pump is used to lift 500 kg of water from a depth of 80 m in 10s. Calculate the power of the pump? $m = 500\,kg$ $h = 80\,m$ $t = 10\,s$

$w = mgh = 4 \times 10^5$

$p = \frac{w}{t} = 4 \times 10^4$ watt $= 40$ Kw.

No.

Example:

A 60 kg jogger runs up a long flight of stairs in 4 s. The vertical height of the stairs is 4.5 m. (a) Estimate the jogger's power output in watts and hourse power. (b) How much energy did this require?

Sol.

(a)

$W = mgh = 60\,(10)(4.5) = 2700\ J$

(0.9)

$p = W/\Delta t = \frac{2700}{4} = 675\ watt. = 0.51\ hp.$

(b) $p = \frac{E}{t}$ $E = 675\,(4) = 2700\ J$ //

Example:

A 700 N marine in basic traning climbs a 10 vertical rope a constant speed of 8 s. what is his power?

$v = d/t = 10/8 = 1.25\ m/s$

$p = F.\,v.\cos\theta = 1.25\,(700)\,(1) = 875\ W$

No.

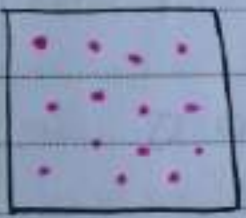
Ch 13 : Non viscous Fluids :

- Fluid : is a substance that flows.
- So Fluid < liquid / gas

المادة الصلبة لا يعلى أو تكون من الموائع .

- Gases are compressible, the volume of a gas is easily increased or decreased.

قابل للانضغاط لأن حجم الغاز يأخذ حجم الوعاء الموجود فيه .



container

- Liquid are nearly incompressible, the molecules are packed closely, yet they can move around.

لا يقبل ضغط السوائل

No.

Density: the mass density is the ratio of mass to volume:

$$\rho = \frac{m}{V}$$

$\rho = kg/m^3$

← الكثافة تتغير بتغير الحرارة و الضغط

13.2 : pressure

القوة المؤثرة على وحدة المساحة

$$P = \frac{\text{Force } (F_n)}{\text{area } (A)}$$

A fluid in a container presses with an outward force against the walls of that contanier.

* The pressure is defined as the ratio of the force to the area on which the force is exerted ↩ بدل.

- The SI units of pressure are N/m^2

  $1\ Pa = 1\ N/m^2$.

  $1\ atm = 101.300\ Pa = 101.3\ kPa$

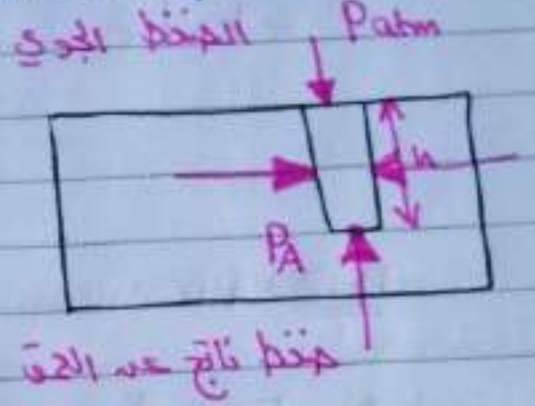
  $760\ mmHg = 1\ atm$

  $1\ atm = 760\ torr$

  $1\ mmHg = 1\ torr$

13.3 pressure in Liquids:

The force of gravity (the weight of the liquid) is responsible for the pressure in the liquid.



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

pressure caused by liquid. — atmospheric pressure.

Example:

The diagram shows 2 fishes in water. The density of the water is 1025 kg/m³. The surface area of fish A is 300 cm² and the surface area of fish B is 2000 cm². Find:

a. the pressure exerted by water on fish A.
b. the pressure " " " " B.
c. the force " by the water on fish A.
d. " " " " " " " B.

No.

نقسم على 1000

سم^2 ← م^2

Sol.

(a) $P_a = h\rho g = 2(10)(1025) = 20500\ Pa$

(b) $P_b = h\rho g = 2(10)(1025) = 20500\ Pa$

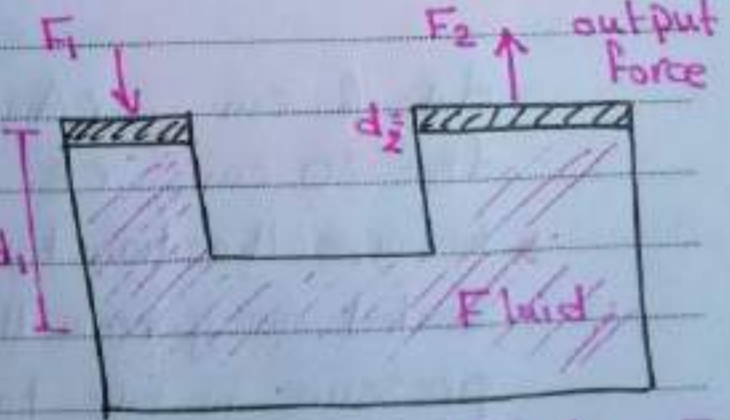
لا علاقة بين الضغط والحجم وإنما على كثافة السائل والعمق.

(c) $F = PA = 20500(0.03) = 615\ N$.

(d) $F = PA = 20500(0.2) = 4100\ N$.

13.4: Pascal's principle:

In a fluid at rest in a closed container, a pressure change in one part is transmitted without loss to every portion of the fluid and to the walls of the container.



$P_1 = \frac{F_1}{A_1}$

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

$F_2 = \frac{A_2}{A_1} F_1$

multiplication of force.

$P_2 = \frac{F_2}{A_2}$

No

$P_{out} = P_{in}$

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

the mechanical advantage of hydrolic left.

Example:

A system of two tanks are connected by a skinny pipe and the system is sealed from the outside. Air is pumped into tank "A" on the left. This increases the pressure at opening "A". A hydraulic fluid is moved into tank "B" and pressure up on opening "B". If a 2550 kg car is to be lifted by the cylinder at opening "B" then what pressure and force that must be exerted at opening "A"?

$d_A = 6$ cm $r_A = 3$ cm

$d_B = 60$ cm $r_B = 30$ cm $m = 2550$ kg.

→ because the two tanks are connected and sealed away from the enviroment, then the pressure in one tank is the same in

5/

No.

→ Use pascals principle to find F_A.

$$P_A = P_B$$

$$\frac{F_A}{A_A} = \frac{F_B}{A_B}$$

$$\frac{F_A}{\pi(r_A)^2} = \frac{F_B}{\pi(r_B)^2}$$

$$\frac{F_A}{\pi(r_A)^2} = \frac{W_B}{\pi(r_B)^2}$$

$$\frac{F_A}{\pi(r_A)^2} = \frac{m_b g}{\pi(r_b)^2}$$

$$\frac{F_A}{\pi(0.03m)^2} = \frac{2550\,(9.8)\,\frac{m}{s^2}}{\pi(0.30m)^2}$$

$$F_A = 249.9\ N$$

13.5 Blood Pressure :

- Blood pressure is measrued by pressurizing a cuff around a patent's arm.

- The cuff squeezes the artery shut. when the cuff pressure drops below the systolic (max) blood pressure, the artery pushes blood through in pulses, which can be hard through a stethoscope

- when the cuff pressure drops below the diastolic pressure, blood flows smoothly.

$F_A = 249.9$ N

e :

meas

علوية
له قراءتين > سفلية

الطبيعي (max 120 _ min 80)

حتى أقيس الضغط بطريقة
صحيحة نضعه على ذراع اليد القريبة
من مستوى القلب لرؤية النبض
في الشريان.

pushe ... ses,

through ... pe

ssure drops below the diastolic

ows smoothly.

→ The patient's arm is held at about the same height as her heart?

The hydrostatic pressure of a fluid varies with height. Although flowing blood is not in hydrostatic equilibrium, it is still true that blood pressure increases with the distance below the heart and decreases above it. Because the upper arm when held beside the body is at the same height as the heart, the pressure here is the same as the pressure at the heart. If the patient held her arm straight up, the pressure cuff would be a distance $d \simeq 25$ cm above her heart and the pressure would be less than the pressure at the heart by $\Delta p = \rho_{blood}\, g d \approx 20$ mmHg.

* الضغط لدى مائع يتغير
مع تغير الارتفاع ⟸
بالتالي الضغط تختلف حسب
موقع القياس ⟸ لازم
أحافظ على نفس مستوى القلب

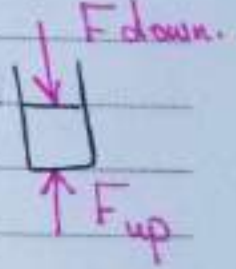
* بما أن الدم في حالة حركة دائمة فإنه
لا يكون في حالة اتزان لكن عند قياس
الضغط بالقرب من
القلب نقول
أنه متزن
تقريبا

لها علاقة بطفو الأجسام
على سطح المائع.

13.6 Buoyancy: الطفو

is the upward force of a liquid.

→ The pressure in a liquid increases with depth, so the pressure in a liquid-filled cylinder is greater at the bottom than at the top.
The pressure exerts a net upward force on a submerged cylinder of:



$F_{net} = F_{up} - F_{down}$

$\hookrightarrow = F_B$.

** $F_B = W$

← اتجاه قوة الطفو عمودية للأعلى ← تنتج من دفع المائع الجسم للأعلى ← بحيث تتزن مع الجسم أو السفينة في المائع.

← يزداد الضغط كلما زاد عمق السائل.

∴ يكون عندي ضغطين: ① ضغط من قاع البحر أو السائل أعلى من ضغط ال Top.
② الضغط عند السطح أقل من الضغط عند العمق وهو من الأسفل > هو من الأعلى.

عند الاتزان: قوة الطفو = الوزن.

13.7 : Archimedes principle:

states that the upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the wight of the fluid that the body displaces.

$\rho = \frac{m}{V}$ $m = \rho V$

$$F_B = \rho_f V_f g$$

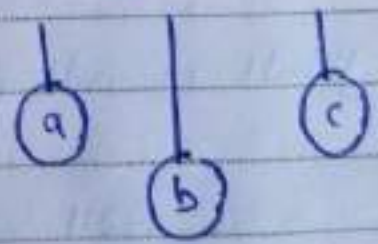
Fluid density ← ρ_f V_f → Fluid volume.

$F_B \Rightarrow N$

Example ①

Blocks a, b and c are all the same size. Which is the correct order of the scale readings?

a) 40 g b) 40 g c) 50 g



c > a = b.

* هل يرتبط الطفو بالارتفاع ؟ لا .

No.

Ex 2 :

8.2g in water

A piece of metal weights 9.25 g in air, and 8.36 g when immersed in gasoline?

ⓐ What is the density of the metal?

$9.25 - 8.20 = \underline{1.05\,g}$

$\rho = \frac{m}{v}$ $v = \frac{1.05}{1} = 1.05\ cm^3$

the density $= \frac{9.25}{1.05} = 8.81\ g/cm^3$.

H.w ⓑ what is the density of the gasoline?

$m \rightarrow 9.25 - 8.36 = 0.89$

the density $= \frac{0.89}{1.05} = 0.85\ g/cm^3$

H.w : An object weighs 36 g in air, $v = 8\ cm^3$. What will be it's apparent weight when immersed in water?

$w = 36$ in air $v = 8\ cm^3$ $\rho = 1\ g/cm^3$

$36 - x = 8$ $x = 28\,g$.

FIVE APPLE

Chapter 7

Ch 14 Fluids and motion:

- The fluid is
  - compressible → gases.
  - Incompressible → liquids.

ثابت

→ The flow is steady, the fluid velocity at each point in the fluid is constant → is called **laminar flow**.

→ The flow is unsteady, the fluid velocity changes with time → is called **turbulent flow**.

اللزوجة

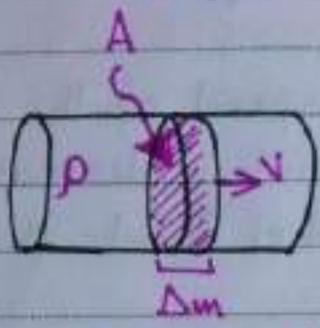
viscosity

- viscous: resistance to flow.
- non viscous: motion of particle is frictionless. Ex: water, gas

* Gases have very low viscosity and even many liquids are well approximated as being non viscous.

14.2 Fluid mass flow rate Q

is the mass of a fluid which passes per unit of time. (kg/sec)



$Q = \frac{\Delta m}{\Delta t} = \rho . A . v$ → flow ~~rate~~ speed

(ρ ↓ Fluid density; A ↓ area)

14.3 : The Equation of Continuity:

The volume of an incompressible fluid entering one part of a tube or pipe must be matched by an equal volume leaving downstream.

حركة ⇐ معادلة حركة مبنية على مبدأ حفظ الكتلة
الداخل = الخارج.

inlet: $Q_1 = \rho_1 A_1 v_1$ outlet: $Q_2 = \rho_2 A_2 v_2$

$Q_1 = Q_2$

$\therefore A_1 v_1 = A_2 v_2$ ⇒ حفظ الكتلة.

العلاقة عكسية بين المساحة و السرعة.

** Flow is faster in narrower parts of a tube, slower in wider parts.

14.4 Bernouli's Equation:

⇐ معادلة الطاقة.

increase in the speed of the fulic occurs simultaneously with a decrease in pressure or a decrease in the fluids potenial energy.

OR

In a horizontal pipe, the highest fluid pressure is in the section where the flow speed is the lowest, and the lowest pressure is at the section where the flow speed is the ~~sp~~ biggest.

← ↓ اختلاف بالارتفاعات ⇐ اختلاف بالضغط.

← زيادة السرعة في التدفق تحدث بشكل متزامن مع نقصان الضغط.

الطاقة عند المدخل = الطاقة عند المخرج.

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2 \quad (14.5)$$

→ mass conversation principle ⇒ the equation of continuity.

→ Energy conversation principle ⇒ Bernoulli's Equation.

$P_1 > P_2$

$A_1 > A_2$

$V_1 < V_2$

$\rho_1 A_1 V_1 = \rho_2 A_2 V_2$

إذا كان عندي سائلين

مختلفين بستخدم هذا

القانون.

⇐ خارج ستخدمها.

... the speed of ... ...rs

...eously with a decre... ...ssure

or a decrease in the fluids potential energy.

OR

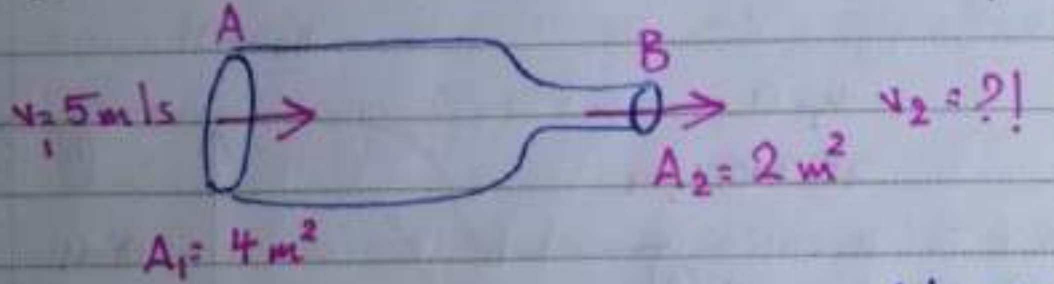
in a horizontal pipe, the highest fluid pressure

is in the section where the flow speed

Example ① :

water flows through a horizontal pipe with a cross sectional area of $4\,m^2$ at a speed of 5 m/s
300000
with a pressure of 300 Pa at point A. At point B, the cross sectional area is $2m^2$.

ⓐ what is the speed of water at point B?



$A \downarrow \Rightarrow v \uparrow$

$A_1 v_1 = A_2 v_2$

$4(5) = 2 v_2$

$\frac{20}{2} = v_2 \qquad v_2 = 10\,m/s$

ⓑ Calculate the pressure at point B?

$A_1 = 4\,m^2 \quad P_1 = 300\,Pa \quad 300000 \qquad A \downarrow \quad v \uparrow$

$P = \frac{F}{A}$

$P_1 + \rho g h_1 + 1/2 \rho v_1^2 = P_2 + \rho g h_2 + 1/2 \rho v_2^2$

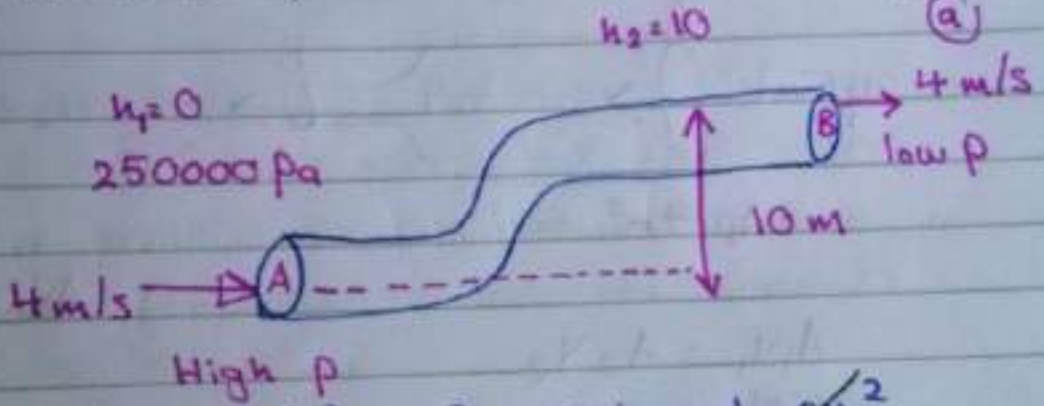
$300000 + \frac{1}{2}(1000)(5)^2 = P_2 + \frac{1}{2}(1000)(10)^2$

$P_2 = 262{,}500\,Pa.$

Example ②:

water flows through a circular ~~radius~~ pipe with a constant radius of 10 cm. The speed and pressure at point A is 4 m/s and 250,000 Pa respectively.

ⓐ What is the speed of the fluid at point B?



$$P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2$$

$$250000 = P_2 + 1000\,(9.8)(10)$$

$$250000 = P_2 + 98000 \qquad P_2 = 152000\ \text{Pa}$$ ⓑ

ⓑ What is the pressure at point B which is 10 m higher than point A? ↑

14.5 : Energy Conversation:

Conversation of energy

↓

Fluid

Countinuity Equation	Bernoulli's Equation
↓	↓
$A_1 V_1 = A_2 V_2$	$P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2$

H.W:

water circulates througout a house in a hot water heating system. If the water is pumped at a speed of 0.50 m/s through a 4 cm diameter pipe in the basement under a pressure of 3 atm. what will be the flow speed and pressure in a 2.6 cm diameter pipe on the second floor 5 m above? Assume the pipes do not divide into branches.

⇐ حتى يجي

$$v_2 = \frac{A_1 v_1}{A_2} = \frac{v_1 (\pi (r_1)^2)}{\pi (r_2)^2} = 1.2 \text{ m/s}.$$

$$P_1 + \rho h_1 g + \frac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2$$

$$P_2 = P_1 + \rho g (h_1 - h_2) + \frac{1}{2}\rho (v_1^2 - v_2^2)$$

$$= 2.5 \times 10^5 \text{ N/m}^2$$

Chapter 8

No

Ch 15: Temperature

15.1 Temperature:

→ the temperature is a measure of hotness or coldness expressed in terms of any of several arbitrary scales.

→ Indicating the direction in which heat energy will spontaneously flow.

← مقياس سخونة أو برودة.

** Temperature is not heat and heat is one of energy forms. ← هي شكل من أشكال الطاقة.

15.2 Thermometers:

A thermometer is a device/instrument that measures temperature.

thermometer work based on → physical phenomenon

- most materials exhibit a change in size with changes in temperature.

بعض المواد تغير شكلها تغير حرارتها.

- Common thermometer is used today are liquid in glass type and bimetallic strip.

FIVE APPLE

15.3 Temperature Scales:

There are three temperature scales in use today: Celsius, Fahrenheit and Kelvin.

C → F $\quad F^\circ = \frac{9}{5} C^\circ + 32$

k → F $\quad F^\circ = \frac{9}{5}(k - 273) + 32$

F → C $\quad C^\circ = \frac{5}{9}(F^\circ - 32)$

C → k $\quad k = C^\circ + 273$

k → C $\quad C^\circ = k - 273$

F → k $\quad k = \frac{5}{9}(F^\circ - 32) + 273$

Example ①:

$98.6^\circ F \rightarrow C^\circ$

$C^\circ = \frac{5}{9}(98.6 - 32) = 37^\circ$

Example ②: $10^\circ C \rightarrow F^\circ$

$F^\circ = \frac{9}{5}(10) + 32 = 18 + 32 = 50 F^\circ$.

Example (3):

The boiling temperature of liquid oxygen at normal pressure at $-182.96\,^{\circ}C$ what is the value in K?

$K = C + 273.15$

$K = 90.19\ K.$

Example (4):

$C = 25\,^{\circ}C \rightarrow K$

$K = C^{\circ} + 273.15 = 298.15$

Ex (5)

$K \rightarrow F^{\circ}$

$K = 293$

$F^{\circ} = \frac{9}{5}(K - 273) + 32 = 68^{\circ}F$

Ex (6)

$F = 98.6\,^{\circ}F \rightarrow K$

$K = \frac{5}{9}(F - 32) + 273 = 310.15\ K.$

Chapter 9

Ch 30: Nuclear physics

Introduction : Atomic structure.

- The atomic nucleus is a very small dense object. It's size is $\approx$ 1 fm (1 fm = 10^{-5} m), 10^{-4} x the size of an atom. The nucleus is made up from two kinds of nucleons : protons and neutrons. The proton has a positive electrical charge equal in magnitude the electrons charge and a mass about 1840 times the mass of $\bar{e}$. The neutron (dicovered by james chadwick in 1932) is a neutral particle slightly heavier than the p.

- A nucleus is specified by atomic number Z (number of protons) and its mass number A (number of neutrons and protons A = N + Z). The number of neutrons is then N = A - Z.

FIVE APPLE

Example :

The 238, U-238 or $^{238}_{92}U$ has 238 nucleons, of which 92 are protons and 238 - 92 = 146 n.

Nuclides which have the same atomic number but different number of neutrons are called isotopes such as Deuterium $^{2}_{1}H$ and tritium $^{3}_{1}H$, isotopes of the hydrogen nuclide $^{1}_{1}H$.

30.1 Radioactivity :

In 1896 Henri Becquerel noted that uranium compounds produce invisible radiations that can penetrate opaque containers and expose photografic emulsion. Many other radionuclides were subsequently found.

اضمحلال

The radioactivity or radioactive decay: is a spontaneous and random process in which three kinds of particles can be emitted :

- Gamma decay : a photon of high energy is emitted. (greater than those of x-rays) mass less

No.

- **Alpha decay**: emission of the particle alpha ^4_2He (process followed with a nuclear transmutation).

- **Beta decay**: an electron β^- or positron β^+ can be emitted with a neutrino.

محرقة / الإشعاعي	Radioactivity	nuclear reaction	
	Alpha	$^{238}_{92}U \rightarrow ^{234}_{90}Th + ^4_2He$	A transmutation of th uranimu-238 into thorium-234
	Beta (β^+) Transmutation of a proton into proton	$^{18}_{9}F \rightarrow ^{18}_{8}O + e^+ + \nu_e$	Transmutation of th the fluorine-18 into oxygen
	Beta (β^-) Transmutation of a neutron into proton.	$^{60}_{27}Co \rightarrow ^{60}_{28}Ni + e^- + \bar{\nu}$	Transmutation of the cobalt-60 into Ni-60.
	Gamma	$^{60}Ni^* \rightarrow ^{60}Ni + 2\gamma$	Unstable Nickel emits γ-ray, the nucleus remains the same.

**The radioactive decay of nuclei produces several types of Ionizing radiation with several mega electron volts per particle. It was found that when these radiations pass through the body, they can cause biological hazardous such as cell damage, skin burns and cancer.

- Ionizing radiation have the ability to penetrate matter. لديه القدرة على اختراق المواد.

أقل طاقة. - Alpha particles are stopped by a sheet of paper.
- Beta particles can be stopped with a thin foil of Tin or aluminum.

الأكثر خطرا ↑ E - Gamma radiation is dampened when it penetrates matter. Gamma rays can be stopped from 4 meters of lead (رصاص). Tungsten and tungsten alloys can stop Gamma radiation with much less mass than lead.

No.

• Half_life:

الأشتقاق مهم

A nuclear decay is a random process, we cannot predict in any way when a specific nucleus will decay. Nevertheless, the process can be characterized by a specific parameter: the half life

• If at time $t=0$ there are N_0 nuclei, then on a half time later, T, an average of $\frac{N_0}{2}$ will remain.

• At $t=2T$, when two half life lives have elapsed, half of these, or $N_0/4$ nuclei will be left; At $t=3T$. $N_0/8$ will be left, and so one.

• Depending on the nuclide, the half-life may vary from a small fraction of second to billions of years.

when the elapsed time is not an integer mutiple of the half-life, we can find the number of nuclei remaining as follows:

The change of the number of nuclei ΔN in a small time Δt is proportional to N and Δt:

$$\Delta N = -\lambda N \Delta t.$$

half life كـ مقلوب زمن

→ The last equation implies that if at $t=0$ there are N_0 nuclei, later at time t the number of remaining nuclei is given by the equation:

$$N = N_0 \, e^{-\lambda t}$$

تذاكرمي

- This equation is called the exponential decay formula
- λ is the constant decay.
- In terms of fraction of radioactive nuclei remaining after time t we get: $\frac{N}{N_0} = e^{-\lambda t}$
- A graphical representation of $\frac{N}{N_0}$ is shown in fig.

we can easily show that the decay constant is releated to the half-life time by:

$$\boxed{\lambda T = \ln(2)}$$

مطلوب

$\ln 2 = 0.69$

Examples :

①

Plutonium decays with a half-life of 24000 years If plutonium is sorted for 72000 years, the fraction of it that remains is

(a) 1/2 (b) 1/3
(c) 1/4 (d) 1/8

Sol. : The half-life of plutonium is given to be 24000 years. It is sorted for a period of 72000 years. So, the number of half-life periods = 72000/24000 = 3

The fraction that remains is given by 1/2 = 1/8

②

The decay constant (λ) and the half-life (T) of a radioactive isotope are related as :

(a) $\lambda = 1/\log_e 2T$ (b) $\lambda = 1/\log_e 2$
(c) $\lambda = 2/T$ (d) $\lambda = \log_e 2/T$

Sol. : the relation between the half-life the decay constant is given by half-life

$T = 0.693/\lambda$

$\Rightarrow \lambda = \log_e 2/T$

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تابع ←

③

An isotope is:

(a) an atom with a different number of $\bar{e}$.
(b) an atom with a different number of proton.
(c) an atom with a different number of neutrons
(d) an atom with a different number of p & n.

④

Cobalt has an atomic mass of 59 and atomic number of 27. what does this information reveal about most cobalt atoms?

(a) They contain more neutrons than protons.
(b) " naturally have a net negative charge.
(c) " attract protons more strongly than $\bar{e}$.
(d) " form ions with a charge of +27 in compounds.

⑤

The atomic mass is:

(a) the number of $\bar{e}$ in an atom.
(b) " " " p " " "
(c) " " " n " " "
⑧ (d) " " " p+n " ".

FIVE APPL

⑥

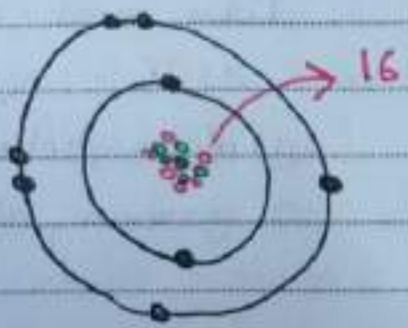
علل خارج الجدول الدوري

which is the correct symbol for the atom with 42 protons and 49 neutrons?

a. $^{49}_{42}In$ ⓑ $^{91}_{42}MO$ ⓒ $^{91}_{49}Mo$ d. $^{91}_{42}In$

⑦

which is the correct symbol for the following atom?



a. $^{24}_{16}O$ b. $^{16}_{24}Cr$

c. $^{24}_{16}S$ ⓓ $^{16}_{8}O$

⑧

مهم The half-life of an isotope is the time required for half the nuclei in a sample to:

تعريف half_life

ⓐ undergo radioactive decay. اضمحلال ✓

b. undergo nuclear fission.] اندماج

c. " " fusion.] وانشطار

d. react chemically. كيميائية

No.

(9)

which type of nuclear radiation can be blocked by a piece of paper?

(a) alpha   b. beta   c. gamma   d. none can be blocked by paper

(10)

which of the following lists ranks nuclear radiation from most massive (size wise) to least massive?

آخرك   بلك.

(a) alpha, beta, gamma.   b. beta, gamma, alpha.
c. gamma, alpha, beta.   d. gamma, beta, alpha

(11)

The half-life of for decay of strontium-90 is 28.8 years A milk sample is found to contain 10.3 ppm strontium-90. How many years would pass before the strontium-90 concentration would drop to 1.0 ppm? particle per million

a. 92.3   b. 0.112   c. 186   d. 96.9

Given data: - the half-life beta decay of Strontium-90 is 28.8 years.

No.

- The initial concentration of strontium -90 is 10.3 ppm
- the final concentration of strontium -90 is 1.0 ppm

Radioactive beta decay always follows first order kinetics.
Therefor the half-life can be used to calculate the rate of reaction using the formula shown below.

$$\lambda = \frac{0.693}{t_{1/2}}$$

where, λ is the rate constant for the beta decay.
$t_{1/2}$ is the half-life of the decay.

Substitute the values in the above formula.

$$\lambda = \frac{0.693}{28.8 \text{ years}} = 0.024 \text{ years}^{-1}$$

The integrated form of a first order reaction is shown below.

$$N = N_0 e^{-kt}$$

where, N is the final concentration.
N_0 is the initial concentration.
λ is the rate constant.
t is the time.

No.

Substitute the known values in the above formula.

$10.3 \text{ ppm} = 1 \text{ ppm} \times e^{-0.024 \text{ years}^{-1} \times t}$

$e^{-0.024 \text{ years}^{-1} \times t} = 10.3$

$-0.024 \text{ years}^{-1} \times t = \ln(10.3)$

$t = \frac{-2.332}{-0.024 \text{ years}^{-1}}$

Therefore, $t = 97.166$ years

Hence, the time required for the concentration of strontium-90 to decrease to 1.0 ppm is 97.166 years.

$N(t) = N_0 * e^{(-\text{lamda} * t)}$ → lamda = 0.024 1/y = $0.24 y^{-1}$

$1 = 10.3 (e^{-(0.024^* t)}$

~~1/10~~ $-(0.024^* 1)$

$1/10.3 = e^{-(0.024^* t)}$

$0.097 = e^{-(0.024 * t)}$

$\ln 0.097 = \ln e$

(12) $-2.33 = -0.024 t$ $t = 97$ years

FIVE APPLE

No.

(12)

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The half-life of | is 0.220 years. How much of a 500.0 mg sample remains after 24 hours?

a. 496 mg ✓ b. 560 mg c. 219 mg d. 405 mg

$T = 0.22$ $y = 0.22 \times 365 \times 24 = 1927\ h$

$N_0 = 500\ mg \xrightarrow{t = 24\ h} N = ?\ mg$

$N = 500\ mg \times (1/2)^{24/1927} = 496\ mg.$

(13)

أسأل الله لكم التوفيق 🤍