New 2018

Civilittee

اللجنة الأكاديمية للهندسة المدنية

دفتر

فيزياء 1

عمار الكبش

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Chapter (1)

وحدات اساسية

Basic Unite

1 Mass — الكتلة — Kilograms (Kg)

2 length, distance — المسافة , الطول — meters (M)

3 Time — الوقت , الزمن — seconds (s)

Derived Units

وحدات مشتقة

1 Velocity — السرعة — m/s — L/T

2 Forec — القوة — kgm/s²

3 accebration — التسارع — m/s^2 — L/T^2

4 Momention — زخم خطي — kg.m/s

5 work — الشغل — نيوتن N.m

Dimensions 8- الأبعاد

Mass = M

length = L

Time = T

* Note

Volume الحجم → m^3

عدد ضرب ثلاثة أبعاد

area مساحة → m^2

~~Dimensieual~~

Dimensieual amulysis 8-

التحليل البعدي

معادلة

In any equation:-

The dimension of the right hand side = the dimension of the left hand side

سرعة velocity, تسارع accelaration

(ex):- show that $(x = \frac{1}{2} v . t + \frac{1}{2} a t^2$

إزاحة displacment

$$L = \frac{L}{T} * T + \frac{L}{T^2} \times T^2$$

$$L = L + L$$

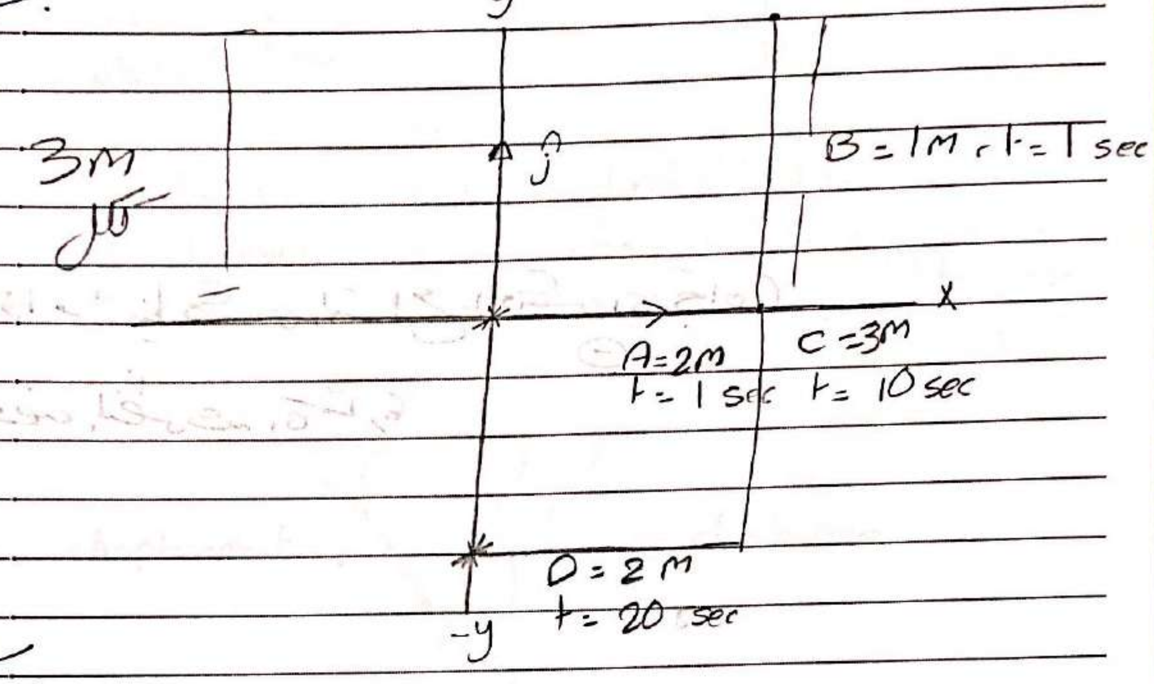
$\boxed{L = L}$ correct deminsionally

بالوحدة وليست بالقيمة

Example 8 - ((الجسم ليس له بعد))

a partical moves in the X-Y plane as showen

جسم



مسافة

Distance = 8 m

Displacement = 2 meters on the negative y-axis = $-2\hat{j}$

* avarge speed = $\frac{8}{32}$ m/s بدون اتجاه

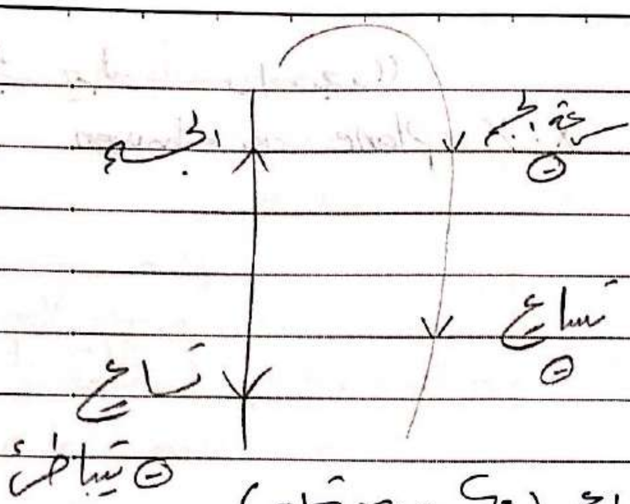
* avarge velocity = $\frac{-2\hat{j}}{32}$ في النظام الدولي نحسب طاقته فقط

تسارع = ⊖ تباطؤ (عكس السرعة) ← في الرياضيات

θ دائما سالب

في الفيزياء سالب تسارع ⊖ = تباطؤ في حال انه كان عكس الحركة فقط

3



مع اتجاه الحركة

* اذا مشينا عكس التسارع (عكس الاتجاه)
(-)

نقص بالسرعة والتسارع

Chapter (2)

Motion in one _ Dimension

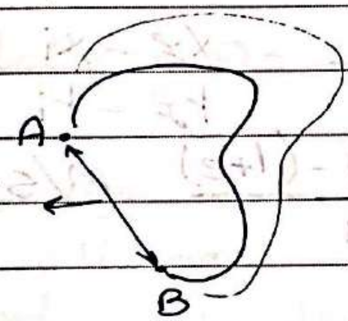
الحركة في بعد واحد

* ٣ كميات لوصف الحركة
سرعة، تسارع، موضع

1. distance :- مسافة (كمية قياسية) $\oplus$
2. displacement :- ازاحة (كمية متجهة) $\ominus, \oplus$ $x_f - x_i = \Delta x$
3. Position :- موضع (x)

موضع نهائي — موضع ابتدائي

displacement



distance

* average speed = $\frac{\text{distance}}{\text{time}}$

* الزمن الابتدائي ليس دائماً صفر

* average Velocity = $\frac{\text{displacement}}{\text{time}}$

distance = d
time = t

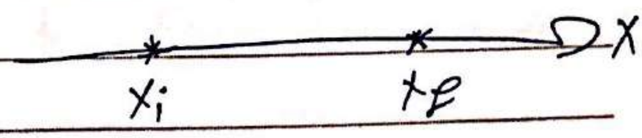
* avarge speed = $v_{avg} = \frac{d}{t}$

المتجهة

* avarge Velocity = $v_{x,avg} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$

متوسط السرعة المتجهة

$\Delta x = x_f - x_i$



* instantaneos Velocity السرعة اللحظية

$$v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

* e هو العدد النيبري (e)

(ex) :- a particle Moves with $x(t) = t^2 + e^t$

Find 1- the velocity between $t = 1$, $t = 2$

$$v_{x,avg} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

* لما تحدد زمنين (Avarge)

$$= \frac{(4 + e^2) - (1 + e)}{2 - 1} \ m/s$$

* لما تحدد زمن واحد (سرعة لحظية)

2- the velocity at $t = 3\,sec$

$$v_x = \frac{dx}{dt} = 2t + e^t$$

$$v_x = 2 \times 3 + e^3 = 6 + e^3 \ m/s$$

Motion in one Dimension

موضع — سرعة — سرعة متجهة — تسارع

Position avg speed avg velocity acceleration

ازاحة
كمية متجهة displacement

مسافة
كمية قياسية distance

x_1 → x_2 $\Delta x = x_2 - x_1$ displacement

avg s → distance (+)

avg speed → v_{avg}
avg velocity → $v_{x,avg}$
Instantaneous speed → $v = |v_x|$

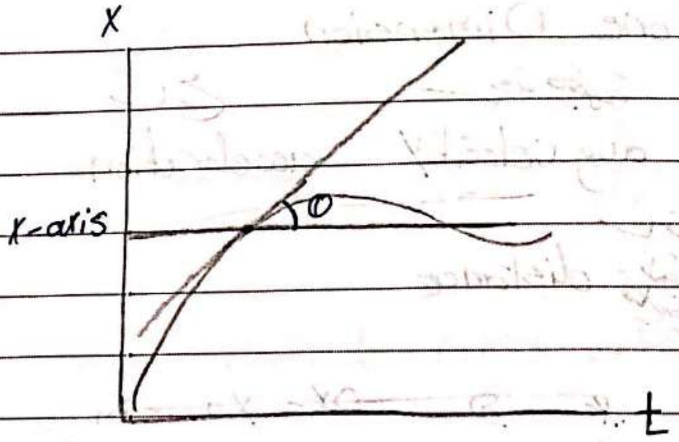
* accelaration → يعبر عن التغير في الحركة
* Velocity → التغير في الازاحة

averge acceleration → $a_{x,avg} = \frac{\Delta v_x}{\Delta t}$

inistancous acceleration →

$$a_x = \lim_{\Delta t \to 0} \frac{\Delta v_x}{\Delta t} = \frac{dv_x}{dt} = \frac{d^2x}{dt^2}$$ مشتقة ثانية

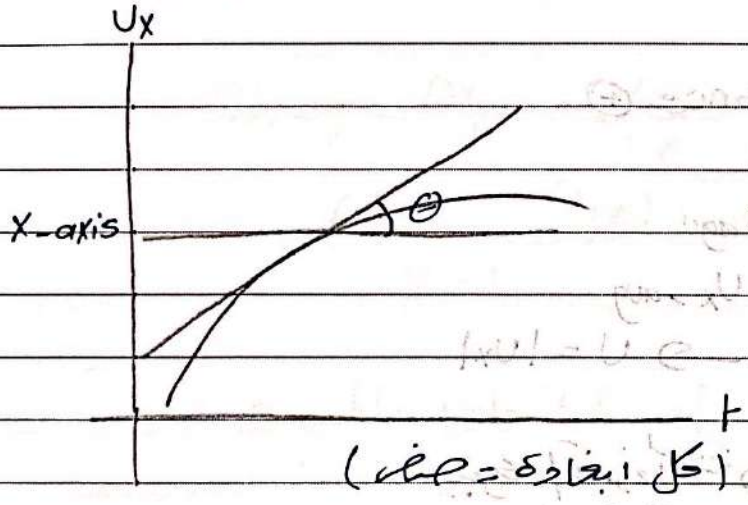
* الإزاحة (عكس الحركة) (−)



slope

$\tan\theta$ = ميل = U_x

ميل المماس = السرعة



$\tan\theta = a_x$

* الجسم ليس له بعد (كل ابعاده = صفر)

ex → the position of a particle is given by

$X(t) = -t^2 + 2t + 1$

ⓐ find the displacment between $t=1$ and $t=2$

$\Delta X = X_2 - X_1$

$X_2 = -4 + 4 + 1 = 1m$

$X_1 = -1 + 2 + 1 = 2m$

$\Delta X = 1 - 2 = -1m$

ⓑ Find the velocity between $t=1$ and $t=2$

$$v_{x,avg} = \frac{\Delta x}{\Delta t} = \frac{-1}{2-1} = 1\, m/s$$

ⓒ Find the velocity at 3sec

$$v_x = \frac{dx}{dt} = 2t + 2$$

$$v_x(3) = -2 * 3 + 2 = -4\, m/s$$

ⓓ Find the average acceleration between $t=0$

$$a_{x,avg} = \frac{\Delta v_x}{\Delta t} = \frac{v_{x2} - v_{x1}}{1}$$

$$\left.\begin{aligned} v_{x2} &= -2 * 1 + 2 = 0 \\ v_{x1} &= -2 * 0 + 2 = 2 \end{aligned}\right] \quad a_{x,avg} = \frac{0-2}{1} = -2\, m/s$$

ⓔ Find the acceleration at $t = 1$sec and at $t = 10$ s

$$a_x = \frac{dv_x}{dt} = -2$$

$$a_x(1) = -2\, m/s^2$$

$$a_x(10) = -2\, m/s^2$$

سرعة ثابتة

* Motion with constant speed or Velocity

$U_x = U_{x,avg} = \frac{\Delta X}{\Delta t}$

$\Delta X = U_x \Delta t$

$x_2 - x_1 = U_x \Delta t$

$x_2 = x_1 + U_x \Delta t$ → إذا كانت السرعة ثابتة

تسارع = ⊕ تسارع
= ⊖ تباطؤ

* Motion with constant acclartion

الحركة بتسارع ثابت

التسارع ثابت (مقداراً واتجاهاً)

$a_x = \frac{du_x}{dt}$, $a_{x,avg} = \frac{\Delta U_x}{\Delta t}$

لما التسارع ثابت → $\frac{a_x}{1} = a_{x,avg}$ → $\frac{\Delta U_x}{\Delta t} = \frac{U_{xf} - U_{xi}}{\Delta t}$

$U_{xf} - U_{xi} = a_x \Delta t$ اذا كان التسارع ثابت

لو كان الزمن الابتدائي صفر (تحليل جهة) بدل ⊕ Δt

$U_{xf} = U_{xi} + a_x \Delta t$ —— (1)

* لما تكون الزيادة منتظمة مثل ١ ، ٢ ، ٣ (تسارع ثابت) نوخذ أول كمية وآخر كمية وبعدين نقسم على (2) ؟ حال طلب المتوسط

$U_{x,avg} = \frac{U_{xf} + U_{xi}}{2} = \frac{\Delta X}{\Delta t}$

$2\Delta X = (U_{xi} + U_{xf}) \Delta t$

displacement ← $\Delta X = \frac{1}{2}(U_{xi} + U_{xf}) \Delta t$

نعوض المعادلة (1) بدل (U_{xf})

$\Delta X = \frac{1}{2}(U_{xi} + U_{xi} + a_x \Delta t) \Delta t$

$$= (U_{xi} + \frac{1}{2} a_x \Delta t) \Delta t$$

$$\Delta X = U_{xi} \Delta t + \frac{1}{2} a_x \quad \text{---- (2)}$$

معادلة (1)

$$\Delta t = \frac{U_{xf} - U_{xi}}{a_x}$$

$$\Delta X = U_{xi} \frac{(U_{xf} - U_{xi})}{a_x} + \frac{1}{2} a_x \left(\frac{(U_{xf} - U_{xi})}{a_x} \right)^2$$

$$= \frac{U_{xi} U_{xf}}{a_x} - \frac{U_{xi}^2}{a_x} + \frac{1}{2} \cancel{a_x} \frac{(U_{xf}^2 + U_{xi}^2 - 2U_{xi} U_{xf})}{a_x^2}$$

$$\Delta X = \cancel{\frac{U_{xi} U_{xf}}{a_x}} - \frac{U_{xi}^2}{a_x} + \frac{1}{2} \frac{U_{xf}^2}{a_x} + \frac{1}{2} \frac{U_{xi}^2}{a_x} - \cancel{\frac{U_{xi} U_{xf}}{a_x}}$$

$$\Delta X a_x = -U_{xi}^2 + \frac{1}{2} U_{xf}^2 + \frac{1}{2} U_{xi}^2$$

$$= -\frac{1}{2} U_{xi}^2 + \frac{1}{2} U_{xf}^2$$

$$\boxed{2 a_x \Delta X + U_{xi}^2 = U_{xf}^2}$$

ex → A drunk driver moves with 120 Km/h in a straight street, suddenly a dog passed the street the driver hit breaks at 100 m from the dog, with accelaration 2 m/s² Does he hit dog

تكون سرعة النهاية = صفر

اذا ازاحته تكون اقل من ١٠٠

$a_x = -2 m/s^2$

$U_{xi} = 120$ Km/h $\quad U_{xf} = 0$ استنتاج

$\Delta X = ?$ الشارع ثابت يعني لم يتغير

اكمل

$U_{xf}^2 = U_{xi}^2 + 2a_x \Delta x$

* اذا كانت سرعة = 0 / ⊖

$120\ km/h \rightarrow \frac{120 * 1000}{60 * 60} = \frac{1200}{36}\ m/s$

تعني ابطئ السيارة التوقف

بالتعويض

$0 = \left(\frac{1200}{36}\right)^2 + 2 * -2\ \Delta x$

$\Delta x = \frac{(1200/36)^2}{4} = 277\ m$

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* ـ نعتبر ان نعتبر الأجسام التي تقذف للأسفل تسارعها ثابت حسب تسارع الجاذبية الأرضية ونهمل بإهمال المقاومة الهواء

y

$-y$

* Free falling objects السقوط الحر

* (التسارع نيشأ عن السقوط) يطبق عليها معادلات الحركة

$a_y = g = 9.8\ m/s^2$ ← تسارع الجاذبية

معادلات الحركة

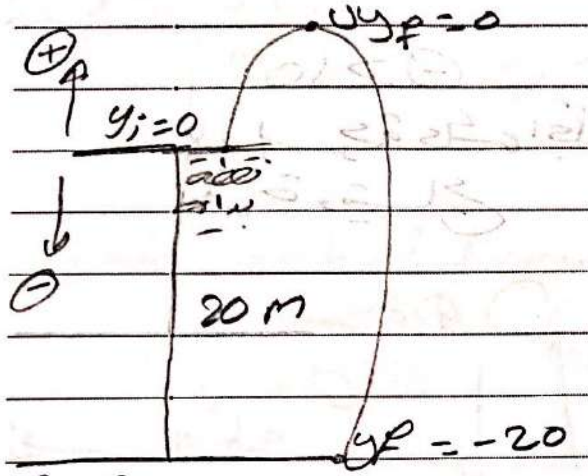
$U_{yf} = U_{yi} + y\Delta t$ —— ①

$\Delta y = U_{yi}\,\Delta t + \frac{1}{2} g (\Delta t)^2$ —— ②

$U_{yf}^2 = U_{yi}^2 + 2g\,\Delta y$ —— ③

Example8- A person throws upward from the top of a building of height 20m with intial velocity 10(m/s).

Finds 1_ The maximum hight from the ground
2 The time for the stone to hit the ground
3 The velocity at wich the stone hit :- -



* (دائماً نقطة بداية = صفر)
$y = 0$

١- حدد نقطة (صفر) ⊕↑
٢- حدد السرعة الابتدائية $v_{iy} = 10\,m/s$
٣- $a_y = 9.8\,m/s^2$
$\simeq 10\,m/s^2$

أقصى ارتفاع

1) $v_{yf}^2 = v_{yi} + 2 g \Delta y$

* نعتبر $a_y \simeq 10\,m/s^2$
* نضع ⊖ عند شد
لاتجاه الجاذبية عكسية

$0 = 100 + 2 * -10 (y_f - 0)$

$y_f = \frac{100}{20} = 5\,m$

* The maximum hieght $= 5 + 20 = 25\,m$

2) $\Delta y = v_{iy} t + \frac{1}{2} g t^2$

$-20 = 10t - 5t^2 \Rightarrow 5t^2 \; 10t \; 20 = 0$

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$t = \frac{10 \pm \sqrt{100 - 4 * 5 * 20}}{2 * 5}$

$\frac{-10 \pm \sqrt{500}}{10} = 1 \pm \sqrt{5} = 3,2$

$-1,2$ تهمل

لأن الزمن لا يمكن أن يكون سالب

3) السرعة النهائية

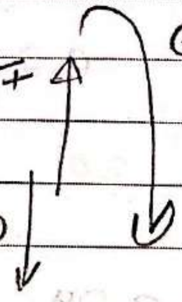
$v_{yf} = v_{yi} + gt$

$= 10 - 10 * 3,2$

$v_{yf} = -22\ m/s$

⊖ > 10

لأن السرعة عكس اتجاه الحركة وبتسارع



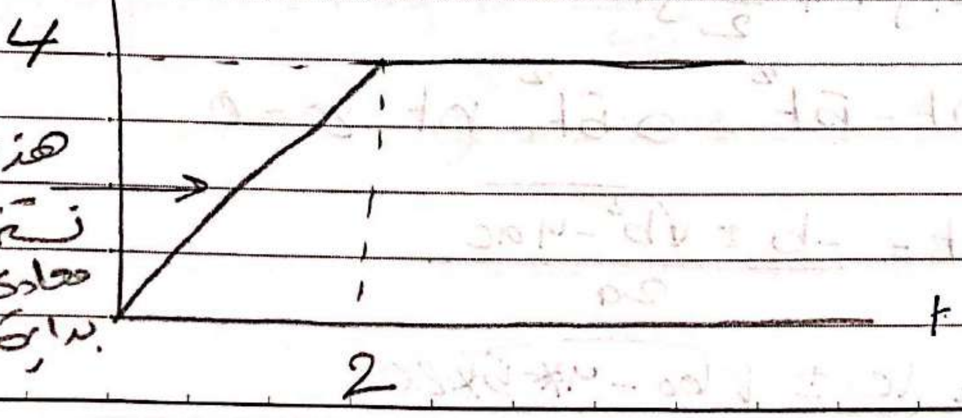
نفس الإشارة

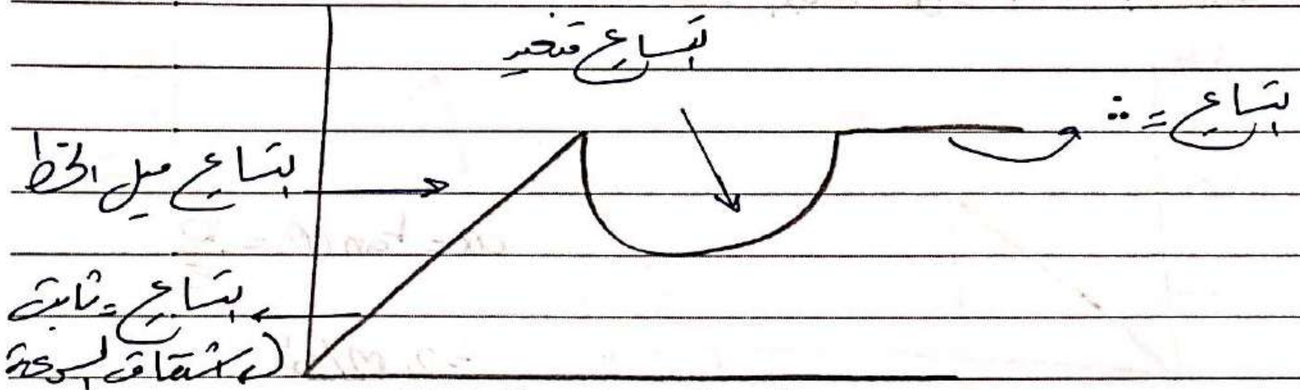
ذلك لأن مع اتجاه السرعة أما إذا كانت

⊖ (تباطؤ) التسارع

Example 8 - Cart liews starts the 100 m race and accelartion as in the figure :-

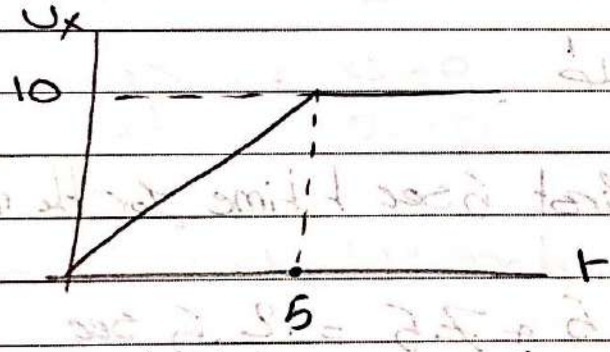
هذا الجزء نستخدم معادلات في بداية التشابه





* ممكن ما يعطي تسارع كالرسم ممكن كالرسمة ونطلع منها.

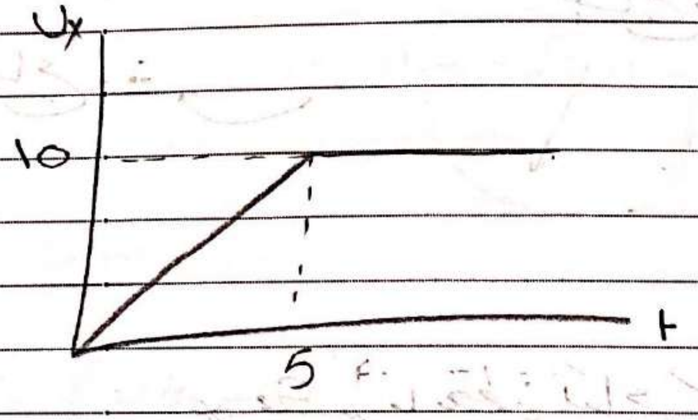
Examples- one hundred racer acceloration and his Velocity is shown in the figure.



1- * Find the distance coverd by the racer in the first 5 sec.

2- * How Much time racer heads to cover 100 meters.

1- $\Delta X = ??$ $t = 5$ / $U_{x_i} = 0$



$a_x = \tan(\theta) = \frac{10}{5}$

$= 2\ m/s^2$

$\Delta X = U_{x_i} t + \frac{1}{2} a_x t^2$

$= 0 + \frac{1}{2} * 2 * 25 = 25\ m.$

2- طلعنا من الرسمة 5 وبقي

75

time = time for first 5 sec + time for the rest 75

$= 5 + \frac{75}{10} = 5 + 7.5 = 12.5$ sec

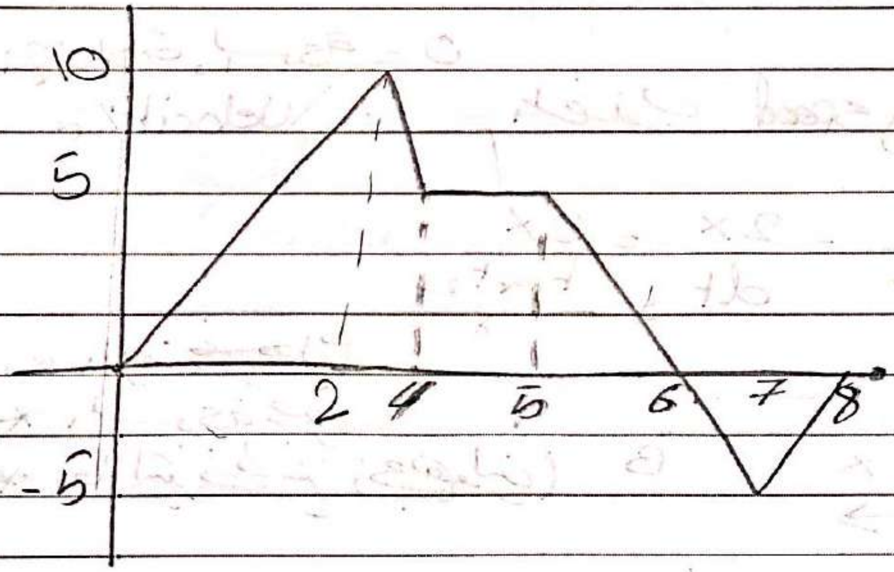
مسافة

سرعة

المسافة = 10 ، إزاحة 0 لما رجع لنقطة البداية

ما يكون تسارع $\Rightarrow$ $\Delta X = U_x t$

يعني أو السرعة ثابتة



(A) avarage velocity betwen $t=0$, $t=2$

$$U_x = \frac{\Delta x}{\Delta t} = \frac{10-0}{2-0} = 5\ m/s$$

(b) avarege velocity between $t=4$, $t=7$

$$U_x = \frac{\Delta x}{\Delta t} = \frac{-5-5}{7-3} = \frac{-10}{4} = 4.44\ m/s$$

لو طلب avg speed ← حركة مرتين عكس displacement
= distance

[illegible]

(g) find the velocity and ~~accel~~ acc at $t = 6$ sec

$$U_x = \text{slope} = \frac{-5-5}{7-5} = \frac{-10}{2} = -5$$

$a_x = 0$ ← اشتقاق مرتين (U_x)

***

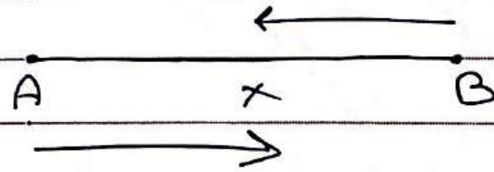
(سؤال مهم)

proplem (3)

الإزاحة والسرعة = 0

avg speed المطلوب Velocity

① $U_{avg} = \frac{d}{\Delta t} = \frac{2x}{dt} = \frac{2x}{t_1+t_2}$



* الزمن غير معلوم

* السرعة مجهولة

* معادلتين خطيتين (مجهولين)

$x = 5t_1 \rightarrow t_1 = \frac{x}{5}$

$x = 3t_2 \rightarrow t_2 = \frac{x}{3}$

$U_{avg} = \frac{2\cancel{x}}{\frac{\cancel{x}}{5}+\frac{x}{3}} = \frac{2}{\frac{8}{15}} = \frac{30}{8}$ m/s

Vectors and scalars

physical quantities

قياسية → scalars

You need only

مقدار, Magnetude

* length, distance

tempreture

متجهة → Vectors

You need both

magnetude and direction اتجاه

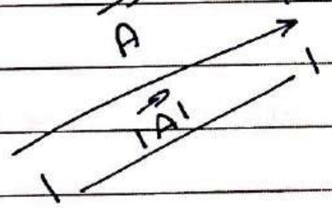
* Velocity, force

accelartion

* Any vector quantity = $\vec{A}$, $|\vec{A}|$ magnetude of $\vec{A}$
* scalar = A

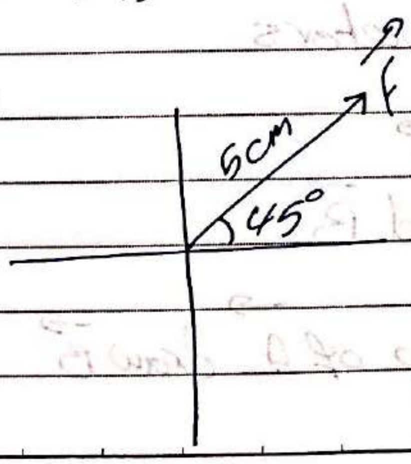
* Graphical representation

direction



Example:- Force 10 N at 45° above the x-axis

* every 2N = 1cm

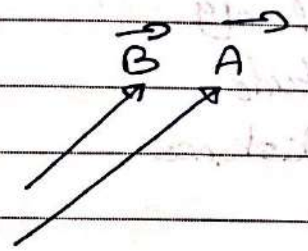


* properties of vectors

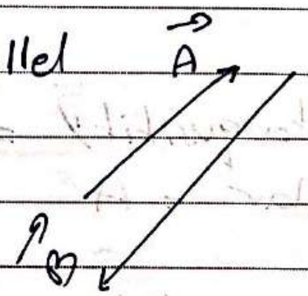
① $\vec{A} = \vec{B}$ if
and $|\vec{A}| = |\vec{B}|$
direction of $\vec{A}$ is same direction of $\vec{B}$

توازي
Parllel

② $\vec{A} \parallel \vec{B}$ if
they have the same direction

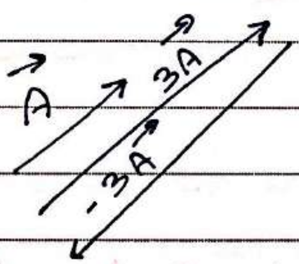


③ $\vec{A}$ and $\vec{B}$ are anti_parallel



الضرب
④ multiplication by ascalar

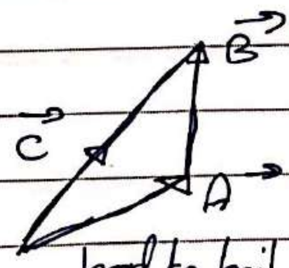
$3\ \vec{A}$
scaler vector



⑤ addition of vectors

$\vec{A} + \vec{B} = \vec{C}$

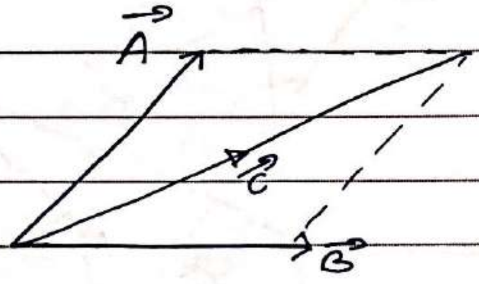
* to add $\vec{A}$ and $\vec{B}$
① draw $\vec{A}$
② From the top of $\vec{A}$ draw $\vec{B}$



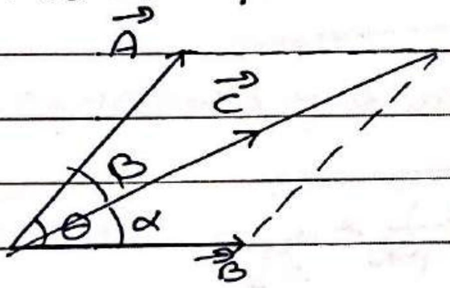
head to tail
Method

or using the parallelogram method

① draw $\vec{A}$ and $\vec{B}$ from the same point



* Addition of tow vectors mathmaticlly :-



$$|\vec{C}| = \sqrt{A^2 + B^2 + 2|\vec{A}||\vec{B}|\cos\theta}$$

قانون الجتا ← مقدار

$$\frac{\sin\alpha}{A} = \frac{\sin(\pi-\theta)}{C}$$

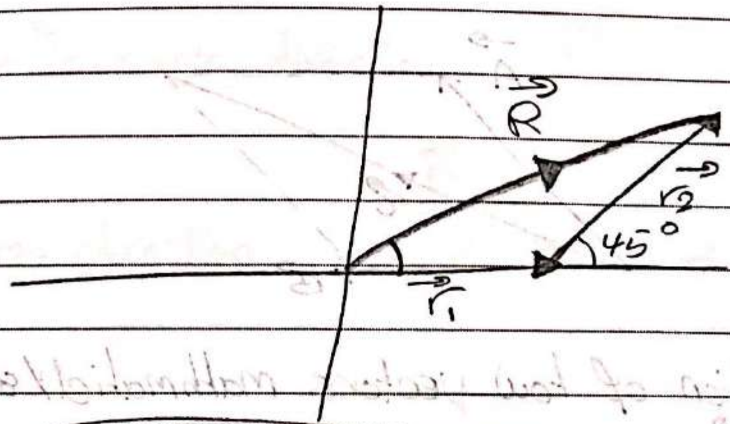
قانون الجيب
اتجاه

$$\frac{\sin\alpha}{A} = \frac{\sin\theta}{C}$$

$$\sin\alpha = \frac{A}{C}\sin\theta$$

$$\sin\beta = \frac{B}{C}\sin\theta$$

Examples: a car moves east 10 Km and then it moves east_North another 10 Km. Find the resultant displacement
علاقة



$$|\vec{R}| = \sqrt{r_1^2 + r_2^2 * 2 r_1 r_2 \times \cos\theta}$$

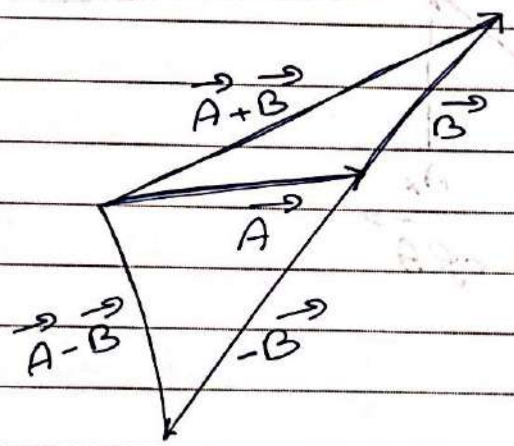
$$= \sqrt{100 + 100 * 2 * \frac{1}{100} \times \frac{1}{\sqrt{2}}}$$

زاوية ← $\sin\alpha = \frac{r_2}{R} \sin 45°$

$$= \frac{10}{\sqrt{\ }} \times \frac{1}{\sqrt{2}} = x$$

$$\alpha = \sin^{-1} x$$

~~addition~~ Subtrching vectors

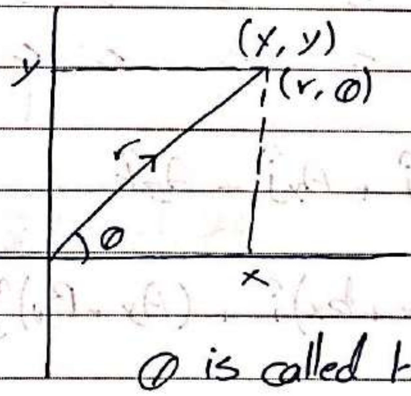


* Components of a vectors

$r^2 = x^2 + y^2$

$r = \sqrt{x^2 + y^2}$

$\tan\theta = \frac{y}{x}$



θ is called the polar angle

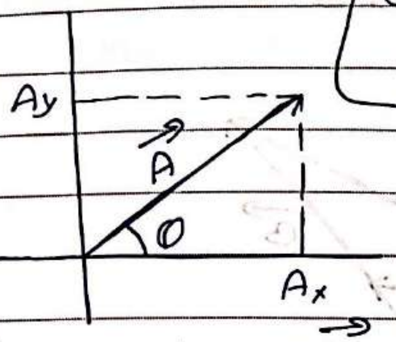
$x = r.\cos\theta$
$y = r.\sin\theta$

*Example $\begin{array}{cc} x & y \\ (3, & -3) \end{array}$

$r = \sqrt{9 + 9} = \sqrt{18}$

$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\frac{-3}{3} = \tan^{-1}(-1) = -45^\circ$
$= 360 - 45$
315°

* القريبة $\cos\theta$
* البعيدة $\sin\theta$



A_x, A_y are the compents of $\vec{A}$

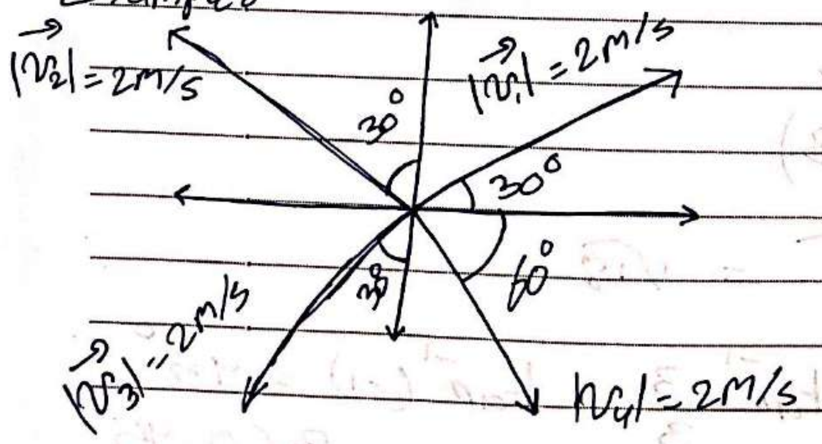
$A_x = A\cos\theta$
$A_y = A\sin\theta$

define $\hat{i}$ = unite vector toword the positive x-axis
$\hat{j}$ = " " " " " " y-axis
$\hat{k}$ = " " " " " " Z-axis

* $\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$

$\vec{A} + \vec{B} = (A_x + b_x)\hat{i} + (A_y + B_y)\hat{j} + (A_z + B_z)\hat{k}$

Example 8-



$v_{1x} = v_1\cos\theta$
$= 2 * \cos 30°$
$= 1.74$
$v_{1y} = v_{1y}\sin\theta$
$= 2 * \sin 30°$
$= 1$
$\vec{v}_1 = 1.74\hat{i} + \hat{j}$

$$V_{2x} = V_2 \cos 120^\circ$$
$$= 2 * \frac{1}{2} = 1$$

$$V_{2y} = V_2 \sin 12^\circ$$
$$= 2 * 0.87 = 1.74$$

$$\vec{V_2} \cancel{7} = \hat{i} + 1.74\hat{j}$$

$$V_{3x} = V_3 \cos 240^\circ = 2 * \frac{-1}{2} = -1$$

$$V_{3y} = V_3 \sin 240^\circ = 2 * 0.87 = -1.74$$

$$\vec{V_3} = -\hat{i} - 1.74\hat{j}$$

$$V_{4x} = V_4 \cos 300^\circ = 2 * \frac{1}{2} = 1$$

$$V_{4y} = V_4 \sin 300^\circ = 2 * -0.87 = -1.74$$

$$\vec{V_4} = \hat{i} - 1.74$$

$$\vec{V_1} + \vec{V_2} + \vec{V_3} + \vec{V_4} = \vec{V}$$

$$= (1.74 - 1 - 1 + 1)\hat{i} + (1 + 1.74 - 1.74 - 1.74)\hat{j}$$

$$= 0.74\hat{i} - 0.74\hat{j}$$

$$V = \sqrt{(0.74)^2 + (-0.74)^2}$$

$$\theta = \tan^{-1} \frac{-0.74}{0.74} = \tan^{-1}(-1) = 360 - 45$$

$$315$$

Find

$$\vec{C} = 2\vec{V_1} - 3\vec{V_2} + 6\vec{V_3} - \vec{V_4}$$

$$2\vec{V_1} = 2*1.74\hat{i} + 2*1\hat{j}$$
$$= 3.48\hat{i} + 2\hat{j}$$

$$-3\vec{V_2} = (-3*-1)\hat{i} + -3*1.74\hat{j}$$

$$6\vec{V_3} = (6*-1)\hat{i} + (6*-1.74)\hat{j}$$

$$-V_4 = (-1*1\hat{i}) + (-1*-1.74)\hat{j}$$

Chapter (3)

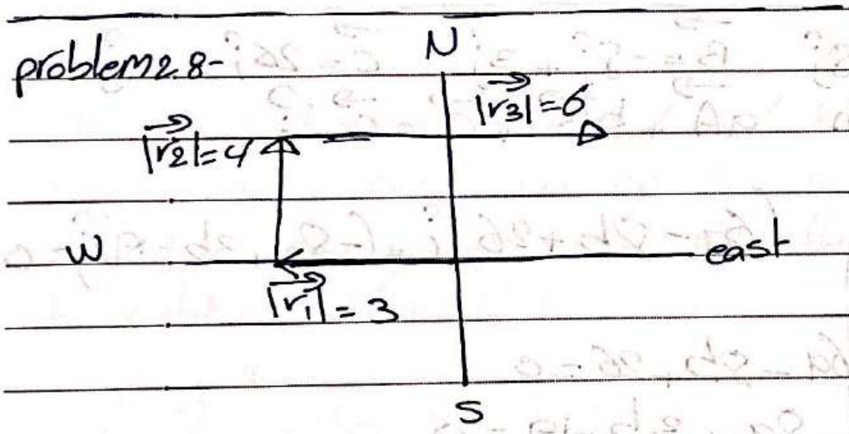
(1)
Problem 8- $\underbrace{r = 5.5 \quad / \theta = 240^\circ}$

* Polar coordinates
* ده احداثيات قطبية

* what are the cartesian coordinates
(x, y)

$x = r\cos\theta = 5.5 * \cos 240$
$y = r\sin\theta = 5.5 * \sin 240$

problem 2.8-



$\left.\begin{array}{l} r_{1x} = -3 \\ r_{1y} = 0 \end{array}\right\} \vec{r_1} = -3\hat{i}$

$\left.\begin{array}{l} r_{2x} = 0 \\ r_{2y} = 4 \end{array}\right\} \vec{r_2} = 4\hat{j}$

$\left.\begin{array}{l} r_{3x} = 6 \\ r_{3y} = 0 \end{array}\right\} \vec{r_3} = 6\hat{i}$

$\vec{r} = \vec{r_1} + \vec{r_2} + \vec{r_3}$
$= 3\hat{i} + 4\hat{j}$

$|\vec{r}| = \sqrt{9 + 16} = \sqrt{25} = 5$

$\theta = \tan^{-1}\frac{4}{3}$

problem 23 8- $\vec{A} = 3\hat{i} - 2\hat{j}$ $\vec{B} = -\hat{i} - 4\hat{j}$

ⓐ $\vec{A} + \vec{B} = 2\hat{i} - 6\hat{j}$

$|\vec{A} + \vec{B}| = \sqrt{4+36} = \sqrt{40}$

$\theta = \tan^{-1}\frac{-6}{2} = \tan^{-1} -3 = 360 - 71.5 = 288.5°$

ⓑ $\vec{A} - \vec{B} = 4\hat{i} + 2\hat{j}$

$|\vec{A} - \vec{B}| = \sqrt{20}$ $\theta = \tan^{-1}\frac{\cancel{4}2}{\cancel{2}4} = \tan^{-1}\frac{1}{2} = \cancel{63.4}°$ $26.5°$

problem 37 8- $\vec{A} = 6\hat{i} - 8\hat{j}$ $\vec{B} = -8\hat{i} + 3\hat{j}$ $\vec{C} = 26\hat{i} - 19\hat{j}$

find a and b such $a\vec{A} + b\vec{B} + \vec{C} = \vec{0}$?

$a\vec{A} = 6a\hat{i} - 8a\hat{j}$

$b\vec{B} = -8b\hat{i} - 3b\hat{j}$

$\vec{C} = 26\hat{i} - 19\hat{j}$

$(6a - 8b + 26)\hat{i} + (-8a + 3b - 19)\hat{j} = 0$

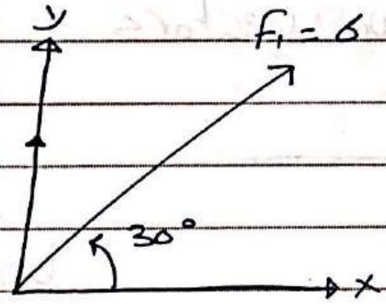
$6a - 8b + 26 = 0$

$-8a + 3b - 19 = 0$

$a = -1.6$

$b = 2$

Problem 23



$f_{1x} = f_1 \cos 30 = 3\sqrt{3}$

$f_{1y} = 6 * \sin 30 = 3$

$\vec{f_1} = 3\sqrt{3}\,\hat{i} + 3\hat{j}$

$\vec{f_2} = 5\hat{j}$

$\vec{f_1} + \vec{f_2} = 3\sqrt{3}\,\hat{i} + 8\hat{j}$

$|\vec{F_1} + \vec{F_2}| = \sqrt{27 + 64}$

$\phi = \tan^{-1} = \dfrac{8}{3\sqrt{3}}$

(Chapter 2) 8- Example 8- A guy try to hit a theif at the top of abuilding by stone. the guy throws the stone with inital velocity from the ground 2m/s. Does the stone hit the theif of the height of bulding 20m.

$V_{yf}^2 = V_{yi}^2 - 2g\,\Delta y$

$0 = 4 - 20\,\Delta y$

$\Delta y = \dfrac{4}{20} = \dfrac{1}{5}\ m$

* ممكن يقولي ايش السرعة المطلوبة عشانه تضرب اللص

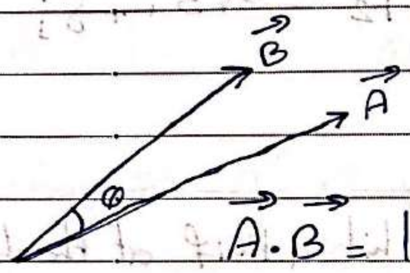
بعوض $20 = \Delta y$ وبوجد V_{yi}

* Multiplication of two vectors

فيزكس

Scalar product
(dot product)
$\vec{A} \cdot \vec{B}$ = scaler

Vector product
(cross product)
$\vec{A} \times \vec{B}$ = Vector = $\vec{C}$



$\vec{A} \cdot \vec{B} = |\vec{A}|\,|\vec{B}| \cos \theta$ = Scaler كد

$= A_x B_x + A_y B_y + A_Z B_Z$ = Scaler كد

*Example :- $\vec{A} = 2i - j + k$ $\quad \vec{B} = 4i + k$
Whats the ~~and~~ angle between them :-

$\vec{A} \cdot \vec{B} = 2 * 4 + -1 * 0 + 1 * 1$

$= 8 + 1 = |9|$

$\vec{A} \cdot \vec{B} = |\vec{A}|\,|\vec{B}| \cos \theta$

$9 = \sqrt{2^2 + (-1)^2 + (1)^2} * \sqrt{4^2 + 0^2 + 1^2} * \cos \theta$

$9 = \sqrt{6} * \sqrt{17} \cos \theta \rightarrow \cos \theta = \frac{9}{\sqrt{102}}$

$\theta = \cos^{-1} \frac{9}{\sqrt{102}}$

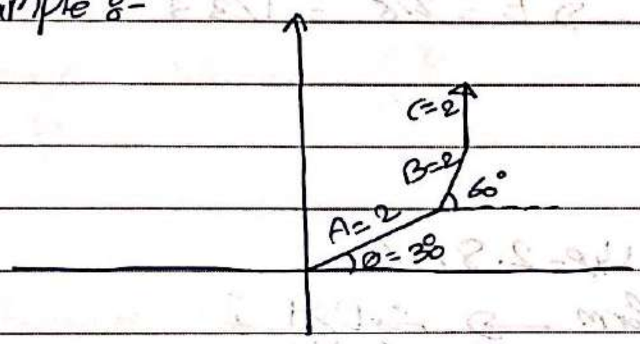
*Rules:- $\vec{A} = \hat{i}$ $\vec{A} \cdot \vec{B} = 0$ $\vec{A}, \vec{B}, \vec{C}$

$\vec{B} = \hat{j}$ $\vec{A} \cdot \vec{C} = 0$ $i \quad j \quad K$

$\vec{C} = \hat{K}$ $\vec{B} \cdot \vec{C} = 0$ are perpenducular

متعامدات بزاوية 90

*Example:-



$A_x = A\cos 30 = 2 * \frac{\sqrt{3}}{2} = \sqrt{3}$

$A_y = A\sin 30 = 2 * \frac{1}{2} = 1$

$\vec{A} = \sqrt{3}i + j$

$\vec{C} = 2\hat{j}$

$B_x = B\cos 60 = 2 * \frac{1}{2} = 1$

$B_y = B\sin 60 = 2 * \frac{\sqrt{3}}{2} = \sqrt{3}$

$\vec{B} = i + \sqrt{3}j$

$\vec{A} + \vec{B} = (\sqrt{3} + 1)i + (1 + \sqrt{3})j$

$(\vec{A} + \vec{B}) \cdot \vec{C} = (1 + \sqrt{3}) * 2$

* chapter 2 proplem 20 :-

$x(t) = 3t^2 - 2t + 3$ → find the time at wich the object changes direction

$v_x = \frac{dx}{dt} = 6t - 2 = 0$ → $t = 2/6 = 1/3\ s$

* problem 28 :-

$\Delta x = 40\,m$, $\Delta t = 8.5$, $v_{xf} = 2.8\ m/s$

* smothlY :- constant :- Uniform → تسارع ثابت

$v_{xf} = v_{xi} + a_x \Delta t$

$2.8 = v_{xi} + a_x * 8.5$ --- (1)

$\Delta x = v_{xi}\,\Delta t + 1/2\, a_x\, \Delta t^2$

$40 = v_{xi} * 8.5 + 1/2\, a_x\, (8.5)^2$ --- (2)

(1) $2.8 = v_{xi} + 8.5\, a_x$

(2) $40 = v_{xi} * 8.5 + 36.1\, a_x$

$v_{xi} = 6.6$

$a_x = -0.4$

chapter 4

* Motion in tow and three dimension *

	one dimension	tow and three dimension
1_ position	X or y or Z	X and y and Z position vector $= \vec{r} = x\hat{i} + y\hat{j} + Z\hat{k}$
2_ average velocity	$v_{x,avg} = \frac{\Delta x}{\Delta t}$	$v_{avg} = \frac{\Delta \vec{r}}{\Delta t}$ $\frac{\Delta x\hat{i}}{\Delta t} + \frac{\Delta y\hat{j}}{\Delta t} + \frac{\Delta Z\hat{k}}{\Delta t}$
3_ instaneous velocity	$v_x = \frac{dx}{dt}$	$\vec{v} = \frac{d\vec{r}}{dt}$ $\frac{dx\hat{i}}{dt} + \frac{dy\hat{j}}{dt} + \frac{dZ\hat{k}}{dt}$
4_ avarge accelaration	$a_{x,avg} = \frac{\Delta v_x}{\Delta t}$	$\vec{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t}$
5_ instaneous accelaration	$a_x = \frac{dv_x}{dt}$	$\vec{a} = \frac{d\vec{v}}{dt}$

* Motion with constant accel *

1- $\vec{v}_f = \vec{v}_i + \vec{a}\, t$

$v_{xf} = v_{xi} + a_x t$

$v_{yf} = v_{yi} + a_y t$

$v_{zf} = v_{zi} + a_z t$

2- $\Delta\vec{r} = \vec{v}_i t + 1/2\, \vec{a}\, t^2$

3- $|\vec{v}_f|^2 = |\vec{v}_i|^2 + 2\vec{a} \cdot \Delta\vec{r}$

Scanned with CamScanner

Example: an airplane moves in the sky as
$\vec{r}(t) = (t)^2\hat{i} + \sin(t)\hat{j} + \hat{k}$

Find the averge accl between $t = 0$, $t = \pi/2$

$\vec{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t} \Rightarrow \vec{v} = \frac{d\vec{r}}{dt} = 2t\hat{i} + \cos(t)\hat{j}$

$v_f = \pi\hat{j}$, $v_i = \hat{j} \Rightarrow a_{avg} = \frac{\pi i - j}{\pi/2} = \boxed{2i - \frac{2}{\pi} j}$

Find the acel $t = \pi/2$

$\vec{a} = \frac{d\vec{v}}{dt} = 2i - \sin(t)j$

$\vec{a} = 2\hat{i} - \hat{j}$ / $|\vec{a}| = \sqrt{4+1} = \boxed{\sqrt{5}}$

$\theta = \tan^{-1}(-1/2) = 360 + (-26.5) = \boxed{333.5}$

Example: A partical starts to move initial velocity $\vec{v}_i = 2\hat{i} - \hat{j} + \hat{k}$
If the motion was uniform accel $\vec{a} = 2\hat{i} - \hat{k}$
① Find disp. after 2sec

$\vec{\Delta r} = \vec{v}_i t + 1/2 \vec{a} t^2$

$\vec{\Delta r} = (2i - j + k)2 + 1/2(2\hat{i} - k) * 4$

$= 4i - 2\hat{j} + 2k + (4\hat{i} - 2k)$

$\vec{\Delta r} = 8i - 2j$

$|\vec{\Delta r}| = \sqrt{64+4}$

$= \sqrt{68}$

$\theta = \tan^{-1}\frac{-2}{8} = \tan^{-1}\frac{-1}{4}$

$360 - \quad =$

$\vec{A} \cdot \vec{B} = |\vec{A}| \cdot |\vec{B}| \cos\theta$ تعريف بدون

$\vec{V_f} \cdot \vec{i} = |V_f| \cdot |i| \cos\alpha$

2- find the magnitude and direction of the Velocity after 2sec.

$\vec{V_f} = \vec{V_i} + \vec{a}t$

$= (2i - j + k) + (2i - k) * 2$

$= (2i + k - j + 4i - 2k$

$= 6i - j - k \longrightarrow |\vec{V_f}| = \sqrt{36 + 1 + 1} = \sqrt{38}$

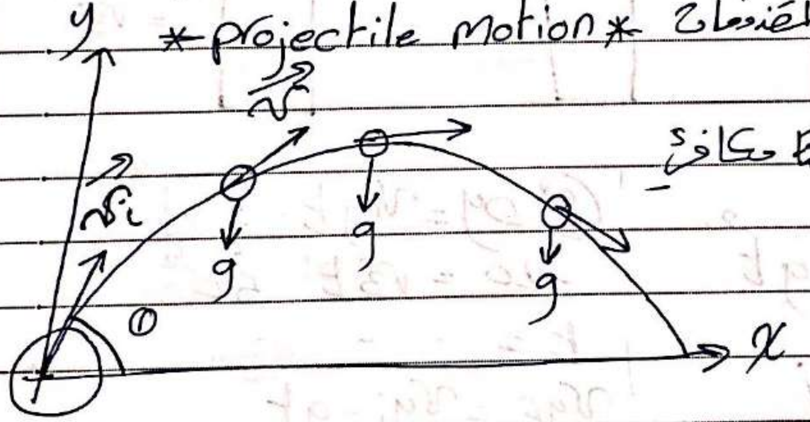
$v_f \cdot i = (6\hat{i} - \hat{j} - \hat{k}) \cdot i$

$= 6 \longrightarrow 6 = |V_f| |i| \cos\alpha$

$6 = \sqrt{38} \cos\alpha \longrightarrow \cos\alpha = \frac{6}{\sqrt{38}}$

$\alpha = \cos^{-1} \frac{6}{\sqrt{38}}$

projectile motion حركة المقذوفات



$\vec{a} = -gj$

on the x-axis

$x = V_x * t$ — (1)

مركبة v في x-axis

V_{ix}

V_{fx}

V high Max

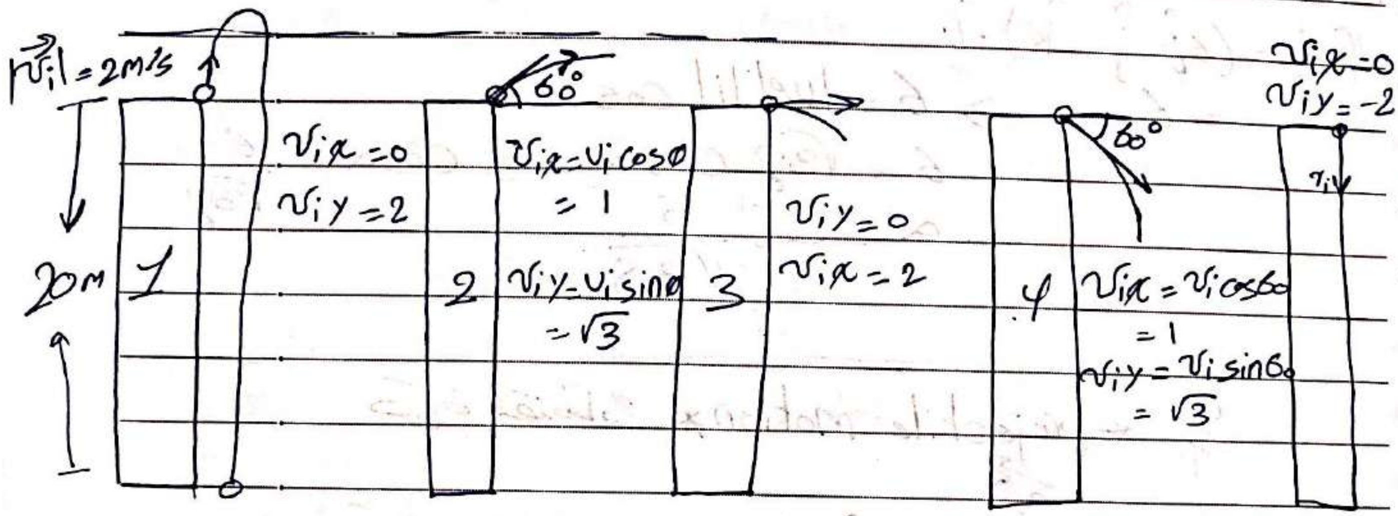
$x = V_x * t = V_i \cos t$

on the y- axis the motion is just freely falling object

1- $v_{yf} = v_{yi} - gt$

2- $v_{yf}^2 = v_{yi}^2 - 2g\Delta y$

3- $\Delta y = v_{yi} - 1/2\, g t^2$



① Range = 0

$\Delta y = v_{iy} t - 1/2\, g t^2$

$-20 = 2t - 5t^2$

$t = \frac{2}{10} \pm \sqrt{\frac{4}{100} + 4}$

$v_{fy} = v_{iy} - gt$

$= 2 - 10 * \left(\frac{2}{10} + \sqrt{\frac{4}{100} + 4}\right)$

R = 0

speed = $|v_{iy}|$

② $\Delta y = v_{iy} t - \frac{1}{2} g t^2$

$-20 = \sqrt{3}\, t - 5t^2$

$t = ---$

$v_{yf} = v_{yi} - gt$

$= \sqrt{3} - 10t$

speed = $|v|$

$= \sqrt{v_{fx}^2 + v_{fy}^2}$

$= \sqrt{1^2 + v_{fy}^2}$ ---

$\boxed{R = v_x t} = 1 * t$

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Example 8- an F-16 fighter moves horizantly with $x(t) = 10t$. The fighter relays a rocket at hight 10 km trying to hit a ground target. Find the range of the rocket.

$v_i = \frac{dx}{dt} = 10$

$v_{ix} = 10$
$v_{iy} = 0$

10000 m

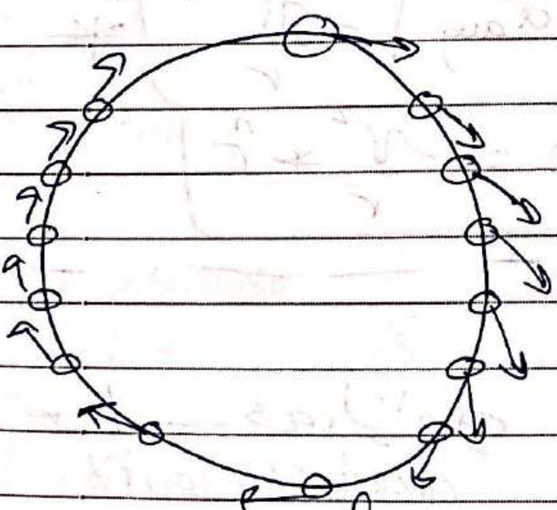
$\Delta y = -10000$
$= \cancel{v_{iy}t} - 1/2 g t^2$
$\cancel{-}10000 = \cancel{-}5t^2$
$t^2 = 2500 \Rightarrow t = \sqrt{2500}$

$R = v_x t = 10 * \sqrt{2500}$

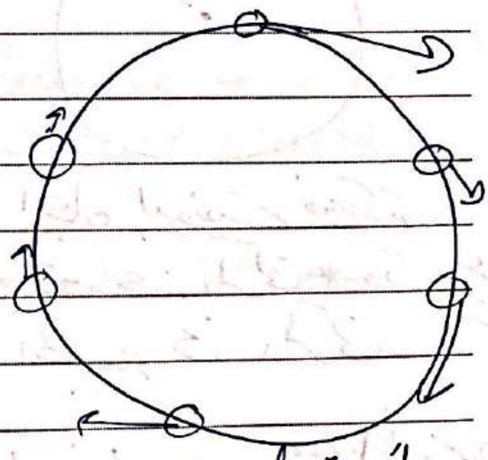
Circular motion
الحركة الدائرية

Uniform motion

non-uniform motion

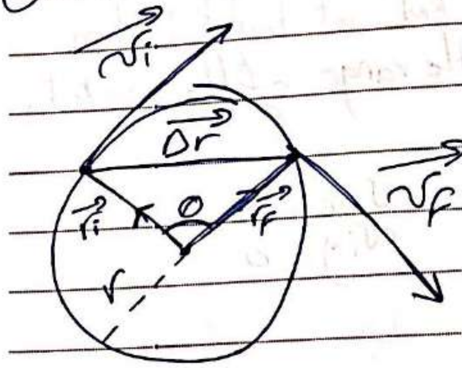


speed is costant



speed isn't costant

Uniform circular motion: المنتظمة

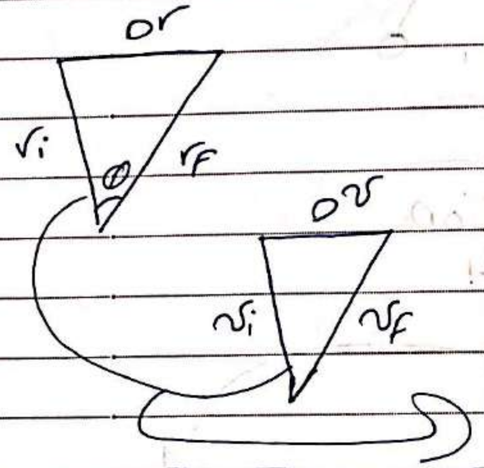


$$\vec{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t}$$

$$|\vec{a}_{avg}| = \left|\frac{\Delta \vec{v}}{\Delta t}\right|$$

$$|\vec{r_i}| = |\vec{r_f}| = r$$

نصف القطر



$$|\vec{v_i}| = |\vec{v_f}| = v$$

$$\vec{\Delta r} = \vec{r_f} - \vec{r_i}$$

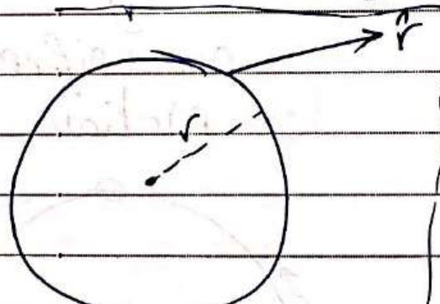
$$\vec{r_i} + \vec{\Delta r} = \vec{r_f}$$

$$\frac{\Delta v}{\Delta r} = \frac{v}{r}$$

$$\Delta v = \frac{v}{r} * \Delta r$$

$$\boxed{|\vec{a}_{avg}| = \frac{v^2}{r}} \ *$$

$$\boxed{a_c = -\frac{v^2}{r} * \hat{r}}$$



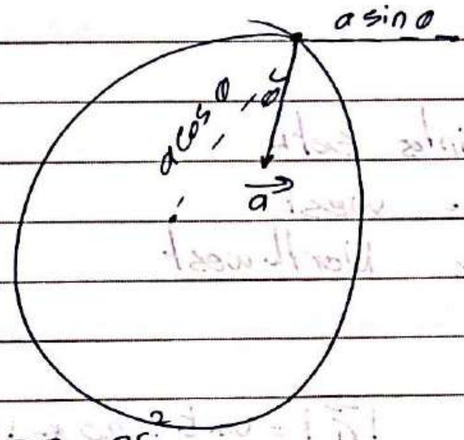
اتجاه اليونت فيكتور
متجه نحو المركز * وتسارع
الجسم نحو المركز

Period time * الزمن الدوري

$$\boxed{T = \frac{2\pi r}{v}}$$

* السرعة الزاوية
angular velocity

$$\omega = \boxed{\frac{2\pi}{T}} = \boxed{\frac{v}{r}}$$

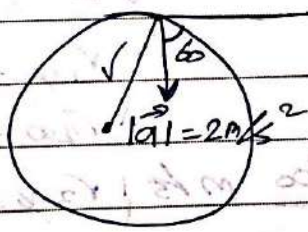


$a\cos\theta = a_c = \frac{v^2}{r}$

$a\sin\theta = a_t$ زيادة في مقدار

$a_t = \frac{|dv|}{dt}$ $\qquad$ $a = \sqrt{a_t^2 + a_c^2}$

(ex) a particle moves in circular motion as the figure:-



find
a_c , a_t
ثابت زيادة
مقداره نقص

Find the radius of the circular when the velocity = 10 m/s

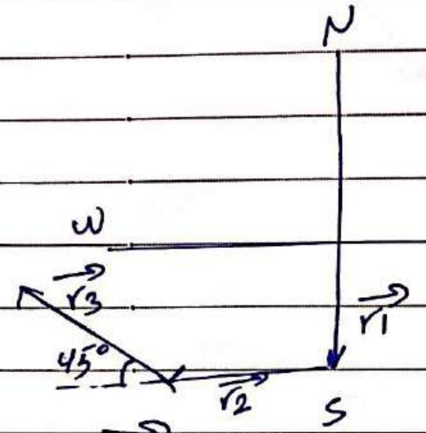
$a_c = a\sin 60$
$= 2 * \frac{\sqrt{3}}{2} = \sqrt{3}$

$a_c = \frac{v^2}{r} \Rightarrow 1 = \frac{100}{r} \Rightarrow r = 100\,m$

$a_t = a\cos 60$
$= 2 * \frac{1}{2} = 1$

* problme :- 1

Velocity = 20 m/s for 3 mints soth
= 25 m/s for 2 " west
= 30 m/s for 1 " North west



$|\vec{r_1}| = V * t = 20 * 180 = 3600$
$|\vec{r_2}| = V * t = 25 * 120 = 3000$
$|\vec{r_3}| = V * t = 30 * 60 = 1800$

(a) $\vec{R} = \vec{r_1} + \vec{r_2} + \vec{r_3}$
$= \left(-3000 - \frac{1800}{\sqrt{2}}\right)\hat{i} + \left(-3600 + \frac{1800}{\sqrt{2}}\right)\hat{j}$

(b) average speed $= \frac{d}{\Delta t}$
$= \frac{3600 + 3000 + 1800}{6 * 60}$ m/s

$r_{1x} = 0$ / $r_{1y} = 3600$
$r_{2x} = -3000$ / $r_{2y} = 0$
$r_{3x} = r_3 \cos 45$
$= \frac{1800}{\sqrt{2}}$
$r_{3y} = r_3 \sin 45$
$= \frac{1800}{\sqrt{2}}$

(c) $\vec{V}_{avg} = \frac{\vec{R}}{\Delta t}$
$= \frac{\left(-3000 - \frac{1800}{\sqrt{2}}\right)\hat{i} + \left(-3600 + \frac{1800}{\sqrt{2}}\right)}{6 * 60}$

*problme 68-

$\vec{a} = 3\hat{j}$ m/s
$\vec{v}_i = 5i$

ⓐ find the vector position at any time

$\vec{\Delta r} = \vec{v}_i t + 1/2 \vec{a} t^2$
$r(t) = 5t\hat{i} + \frac{3}{2} t^2 \hat{j}$ * Position at any time *

ⓑ $\vec{v} = \frac{dr}{dt} = 5\hat{i} + 3t\hat{j}$

ⓒ $\vec{r}(t=2) = 10i + 6j$

$\boxed{(10, 6)}$

ⓓ $\vec{v}(t=2) = 5i + 6j$

speed $= \sqrt{25 + 36} = 7.8$

*problme 98-

$\vec{v}_i = 4\hat{i} + \hat{j}$
$\vec{r}_i = 10\hat{i} - 4\hat{j}$
$t = 20$ sec / accl = Costant
$v_f = 20\hat{i} - 5\hat{j}$

ⓐ What is the direction of the accl with respect to ..

$\vec{v}_f = \vec{v}_i + \vec{a}t$

$20i - 5j = (4i + j) + 20\vec{a}$

$16i - 6j = 20\vec{a} \Rightarrow \boxed{\vec{a} = \frac{16}{20}\hat{i} - \frac{6}{20}\hat{j}}$

ⓒ $\Delta\vec{r} = \vec{v}_i t + 1/2\,\vec{a}t^2$

$\vec{r}_f - \vec{r}_i = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$

$\vec{r}_f = \vec{v}_i t + \vec{r}_i + \frac{1}{2}\vec{a}t^2$ ---

$v_f^2 = v_i^2 + 2\vec{a}\cdot\Delta\vec{r}$

$v_{fx}^2 = v_{ix}^2 + 2\vec{a}_x\,\Delta x$ $\qquad$ $v_{fy}^2 = v_{iy}^2 + 2\vec{a}_y\,\Delta y$

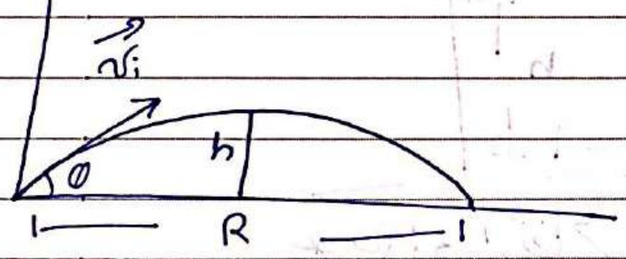
$\Delta x = x_f - x_i$

$\Delta y = y_f - y_i$

$\vec{v}_f = \vec{v}_i + \vec{a}t$

$= (4i + j) + \left(\frac{20}{10}i - \frac{6}{20}j\right) * 25$

* problme 15



$R = 3h$

$v_{fy} = v_{iy} - gt$

$0 = v_i \sin\theta - 10t \rightarrow \boxed{t = \frac{v_i \sin\theta}{10}}$

$\Delta y = h = v_{iy} \sin\theta t - 1/2\, gt^2$

$= v_{iy} \sin\theta \left(\frac{v_i \sin\theta}{10}\right) - 5 * \left(\frac{v_i^2 \sin^2\theta}{100}\right)$

$\boxed{= \frac{v_{iy}^2 \sin^2\theta}{20}}$ — 1

$T = 2t = \frac{v_i \sin\theta}{5}$

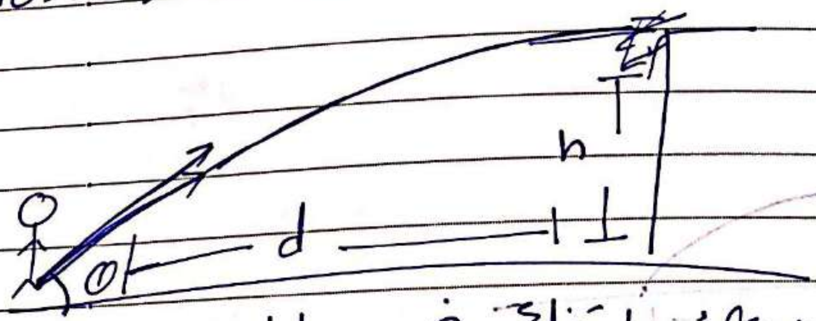
$R = v_{ix} T = v_i \cos\theta * \frac{v_i \sin\theta}{5}$

$3h = R = \boxed{\frac{v_i^2 \sin\theta \cos\theta}{5}}$ — 2

$3 = \frac{\cos\theta}{\sin\theta} \frac{\frac{1}{5}}{\frac{1}{20}} = 4 \cot\theta$

$\tan \frac{4}{3} \Rightarrow \theta = 40^\circ$

* problme 21 :-



* كان في ارتفاع ضرب الباب المبنى *

وده الارتفاع بدلالة v_i , θ , d

$\Delta y = h = v_{iy} t - 1/2\, g t^2$

$\boxed{= v_i \sin\theta\, t - 5t^2}$ — (1)

$x = R = v_{ix} t$

$\boxed{d = v_i \cos\theta\, t}$ — (2)

from [2] $t = \dfrac{d}{\cos\theta}$

$$h = \cancel{v_i} \sin\theta * \frac{d}{\cancel{v_i} \cos\theta} - 5\left(\frac{d^2}{v_i^2 \cos^2\theta}\right)$$

$$h = d\tan\theta - \frac{5d^2}{v_i^2 \cos^2\theta}$$

* problme 41 8-

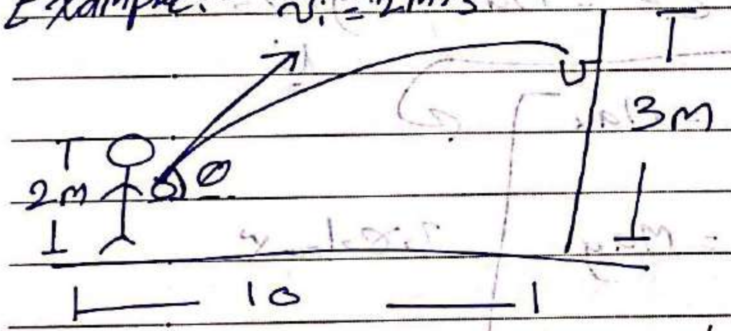
$v_i = 90$, $t = 15$
$v_f = 50$, $r = 150$

$a_c = \frac{v^2}{r} = \frac{2500}{1.5}\ km/h^2$

$a_t = \frac{\Delta v}{\Delta t} = \frac{50-90}{\frac{15}{60*60}} = km/h^2$

$a = \sqrt{a_c^2 + a_t^2}$

Example:- $v_i = 2m/s$



$\Delta y = v_{iy} t - 1/2 g t^2$

$1 = v_i \sin\theta t - 5t^2$

$1 = 2\sin\theta t - 5t^2$ --- (1)

$\Delta x = v_{ix} t$

$= v_i \cos\theta t$

$10 = 2\cos\theta t$

$t = \frac{5}{\cos\theta}$ --- (2)

$1 = \frac{2\sin\theta 5}{\cos\theta} - 5\left(\frac{25}{\cos^2\theta}\right)$

$1 = 10\tan\theta - \frac{125}{\cos^2\theta}$

$1\ \cancel{\cos}\ \cos^2\theta = 10\sin\theta\cos\theta - 125$

كمل التعويض

* Newton's laws of motion :-

* first law :-

The motion state of an object stays the same unless a resultant force acts on it (with respect to initial frame of references)

*اطار اسناد قصوري *

* second law :-

محصلة القوى : $\sum \vec{F} \propto \vec{a}$

$\sum \vec{F} = \underline{\underline{\text{constant}}}\ \vec{a} \Rightarrow \boxed{\sum \vec{F} = m\vec{a}}$ $(kg\,m/s^2)$ N

Mass
كتلة

[1] $\sum F_x = m a_x$

[2] $\sum F_y = m a_y$ ٣ معادلات

[3] $\sum F_z = m a_z$

* Third law :-

for every action there is a reaction equal in magnitude and opossite in direction.

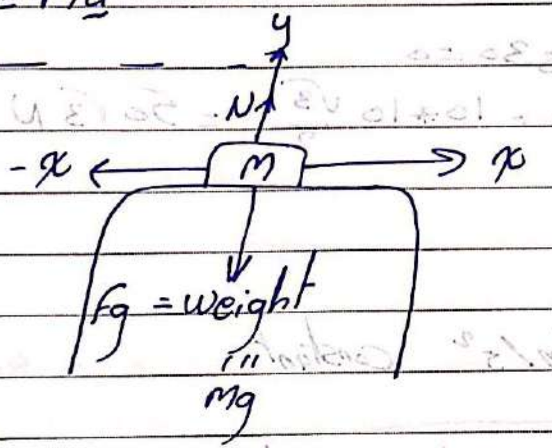
* How to solve proplems using newton's law.

① do free body diagram (all forces)

② analyze the forces

③ apply $\sum \vec{f} = m\vec{a}$

Example:-



$\sum f_y = N - mg$

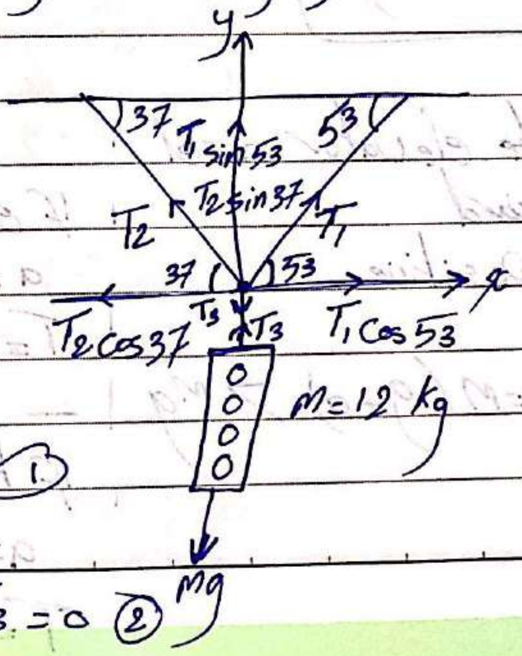
$N = mg$

Consider the traffic light in the figure if ropes [1] and [2] stands 100 N. does the traffic light remin hanging

$\sum f$ traffic light $= 0$

$T_3 - mg = 0$

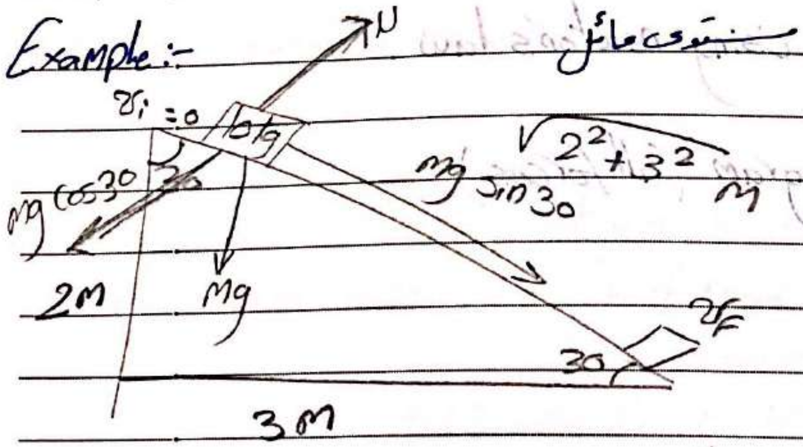
$T_3 = mg = 12 * 10 = 120$



$\sum f_x$ net $= T_1 \cos 53 - T_2 \cos 37 = 0$ ①

$\sum f_y$ net $= T_1 \sin 53 + T_2 \sin 37 - T_3 = 0$ ②

Example:- مستوى مائل



$\sum F_y = 0 = N - Mg\cos 30 = 0$

$N = Mg\cos 30 = 10 * 10 \frac{\sqrt{3}}{2} = 50\sqrt{3}\ N$

$\sum F_x = Ma_x$

$Mg\sin 30 = Ma_x$

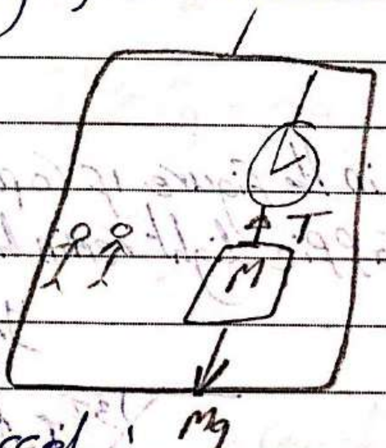
$a_x = 10 * \frac{1}{2} = 5\ m/s^2$ constant

Example:- wheighing a fish in elevator:-

$\sum F = ma$

$T - Mg = ma$

$\boxed{T = M(a+g)}$

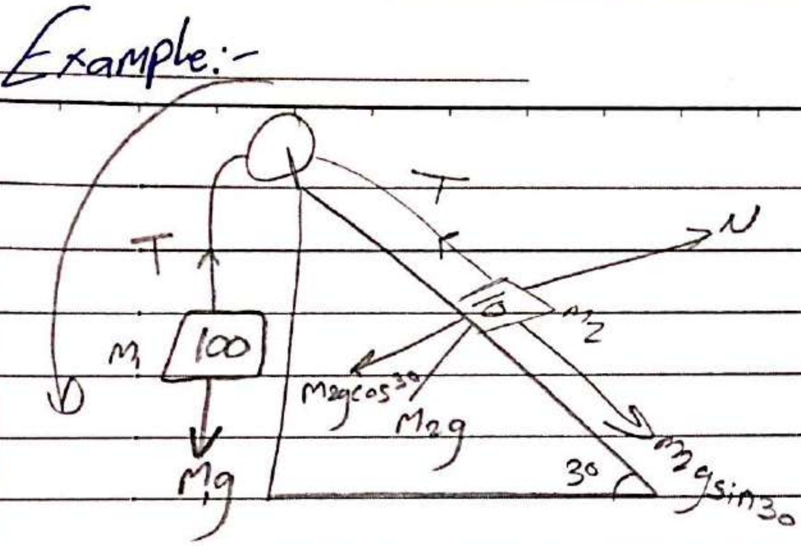


* If the elevator accel upward
  a = positive
  $T = M(g+a) > Mg$

If elevator accel down ward
a = negative
$T = M(g - |a|) < Mg$

If the accel constant speed
$a = 0$
$T = Mg$

Example:-



$$N - M_2 g\cos 30 = 0$$

$$N = M_2 g\cos 30 = 50\sqrt{3}\ N$$

$$T - M_2 g\sin 30 = M_2 a \quad \ldots (1)$$

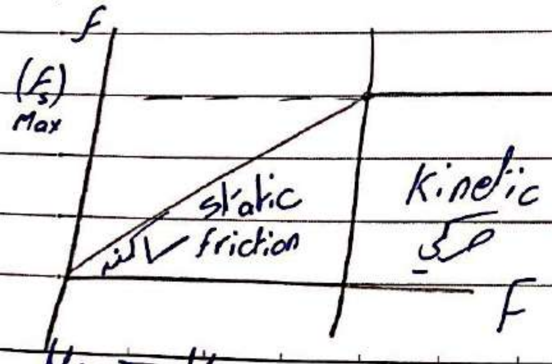
$$M_1 g - T = M_1 a \quad \ldots (2)$$

$$M_1 g - M_2 g\sin 30 = (M_1 + M_2)a$$

$$a = \frac{M_1 g - M_2 g\sin 30}{M_1 + M_2}$$

$$= \frac{1000 - 100 \times 1/2}{110} = \frac{950}{110} = \frac{95}{11}\ m/s^2$$

* Forces of friction:-



$(f_s)_{Max} = \mu_s N$

ثم معامل الاحتكاك
السكوني

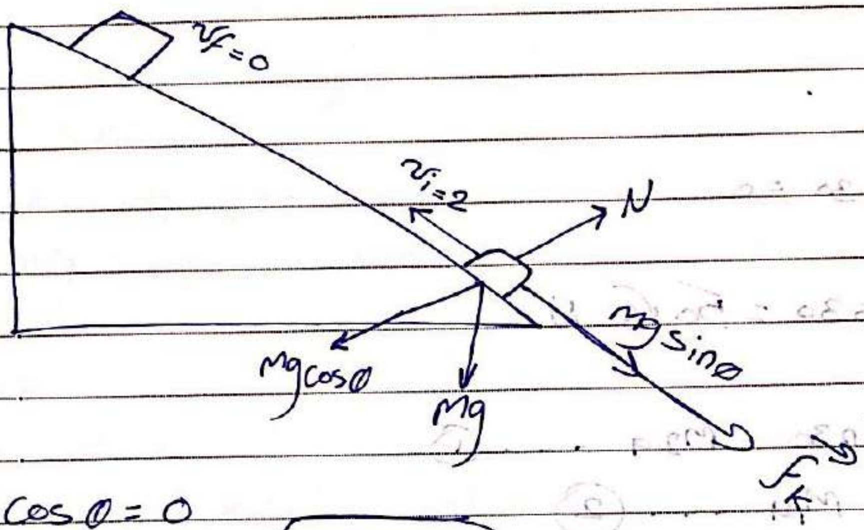
$f_k = \mu_k N$

ثم معامل الاحتكاك
الحركي

$\mu_s > \mu_k$

$0 \le \mu_s , \mu_k \le 1$

Example:- if toss an object of Mass 10 kg up an incline with coefficient of friction 0.5 with initial velocity 2 m/s How much distance the object reach until it stops - The angle of the incline is 30°



$N - Mg\cos\theta = 0$

$N = Mg\cos\theta \rightarrow \boxed{50\sqrt{3}\ N}$

$-f_k - Mg\sin\theta = Ma$

$-\mu_k \cancel{M}g\cos\theta - \cancel{M}g\sin\theta = \cancel{M}a$

$a = -0.5 * 10 * \frac{\sqrt{3}}{2} - 10 * \frac{1}{2}$

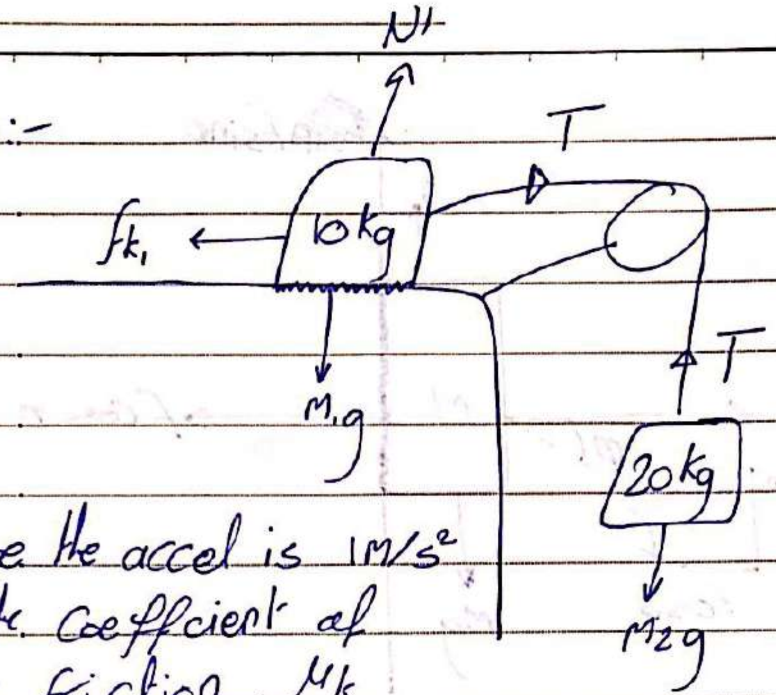
$= -\left(\frac{5\sqrt{3}}{2} + 5\right) = \boxed{-9.3\ m/s^2}$

$v_f^2 = v_i^2 + 2a\,\Delta x$

$0 = 4 + 2 * -9.3\,\Delta x$

$\boxed{\Delta x = \frac{4}{2*9.3}}$

Example:-



suppose the accel is $1 m/s^2$
find the coefficient of kinetic friction. μ_k

$N_1 - m_1 g = 0 \Rightarrow N_1 = m_1 g = \boxed{100\,N}$

$T - f_{k_1} = m_1 a$

$T - \mu_k m_1 g = m_1 a$ ---- 1

+

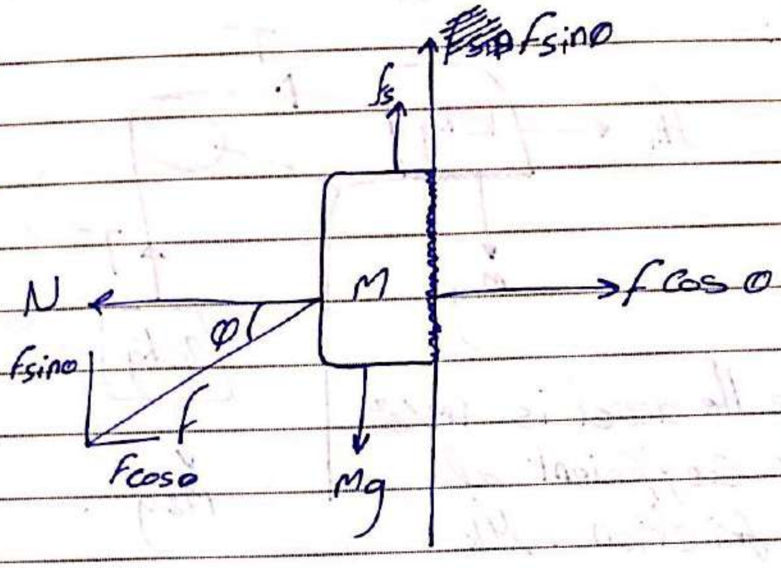
$m_2 g - T = m_2 a$ ---- 2

$m_2 g - \mu_k m_1 g = (m_1 + m_2) a$

$$\mu_k = \frac{(m_1 + m_2) a - m_2 g}{-m_1 g}$$

$$= \frac{30 - 200}{-100} = \frac{-270}{-100} = \boxed{2.7}$$

Example:-



$$N - f\cos\theta = 0$$

$$Mg - f_s - f\sin\theta = 0$$

$$f_{min} = \frac{Mg - f_s}{\sin\theta}$$

$$f_{min} = \frac{Mg - \mu_s f_{min} \cos\theta}{\sin\theta}$$

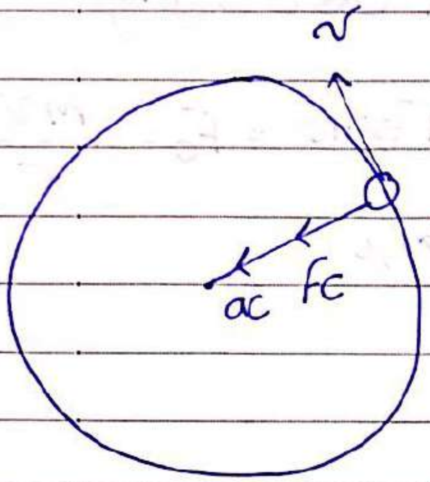
$$f_{min} + \overset{\mu_s}{\uparrow} f_{min} \cos\theta = \frac{Mg}{\sin\theta}$$

$$f_{min} = \frac{Mg}{\sin\theta(1 + \mu_s \cos\theta)} = \frac{Mg}{\sin\theta + \mu_s \cos\theta}$$

Chapter 6

6-1

Uniform circular Motion



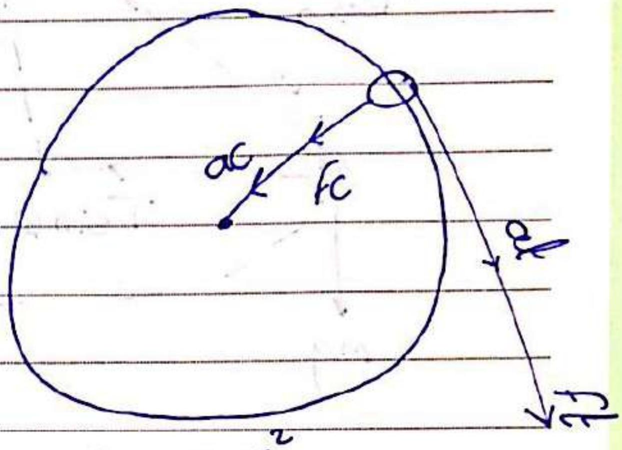
$$ac = \frac{v^2}{r}$$

$$fc = \frac{Mv^2}{r}$$

central force قوة مركزية

6-2

Non uniform circular Motion

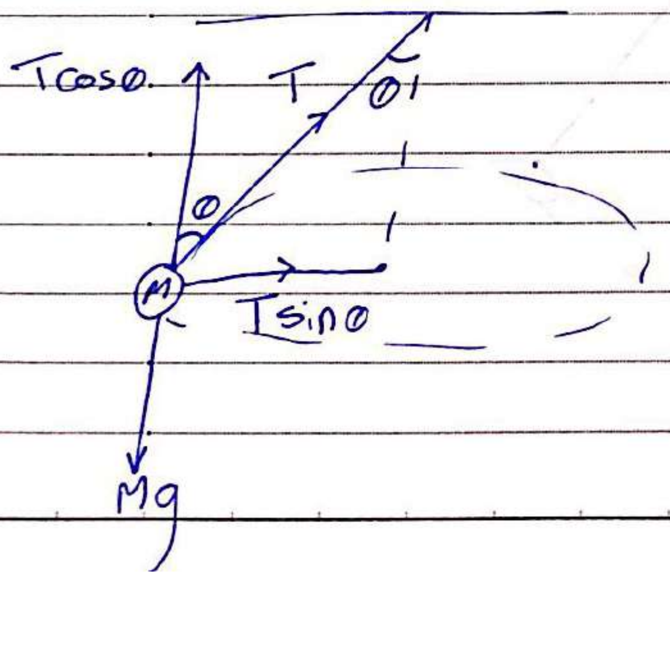


$$fc = \frac{Mv^2}{r}$$

$$ft = Mat$$

$$f = \sqrt{fc^2 + ft^2}$$

Example :- Conical pendulum



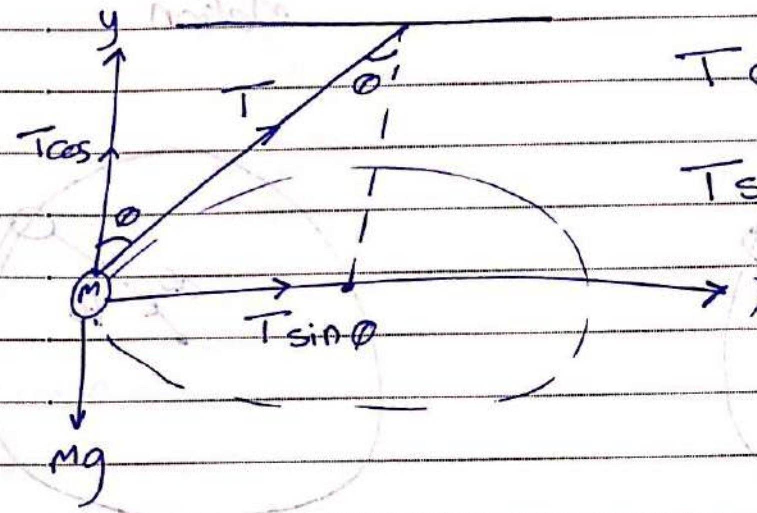
$$T\cos\theta = Mg$$

$$T\sin\theta = fc = \frac{Mv^2}{r}$$

$$T = \frac{Mv^2}{r\sin\theta}$$

* Application on circular Motion :-

① Conical pendulum :-



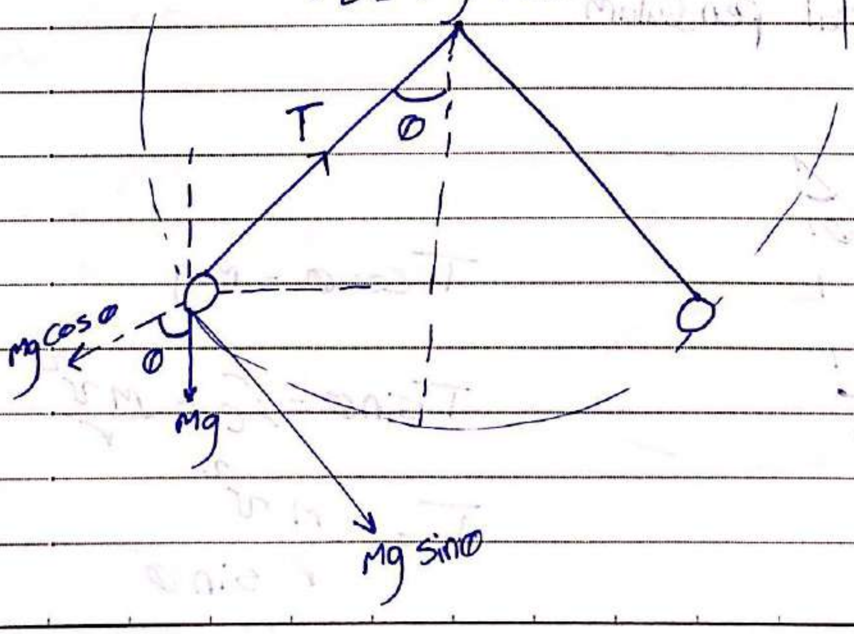
$$T\cos\theta = mg$$

$$T\sin\theta = F_c = \frac{mv^2}{r}$$

② regular pendulum :-

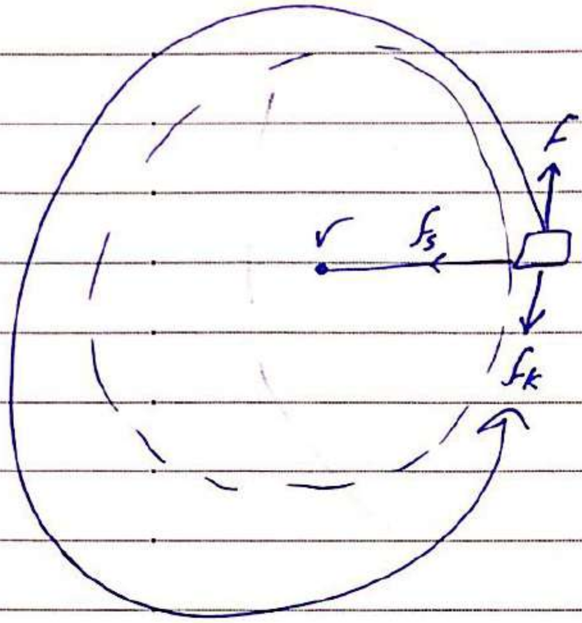
$$F_c = T - mg\cos\theta = \frac{mv^2}{r}$$

$$F_t = mg\,\cancel{\cos}\sin\theta = ma_t$$



③ Banking angle :-

* if there is no banking angle :-

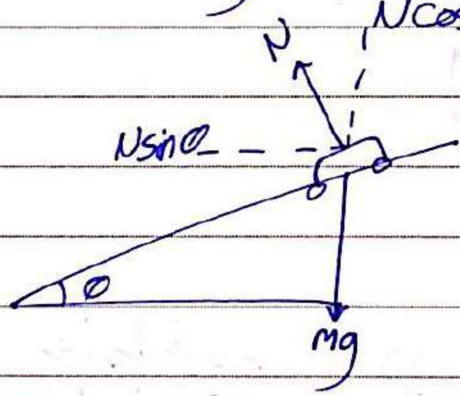


$N = mg$

$F - f_k = ma_t$

$f_s = \frac{mv^2}{r} = f_s$

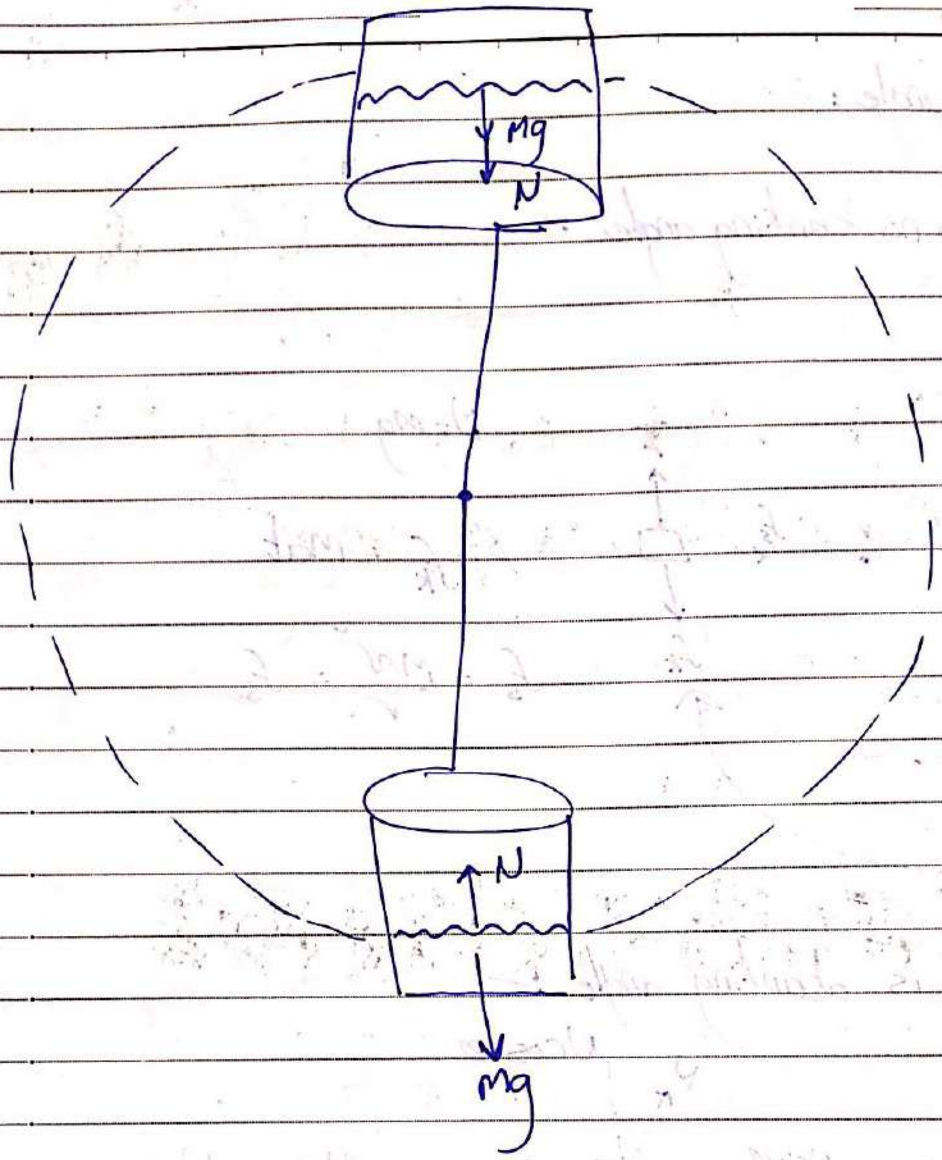
* if there is a banking angle :-



$mg = N\cos\theta$

$f_c = N\sin\theta = \frac{mv^2}{r}$

④



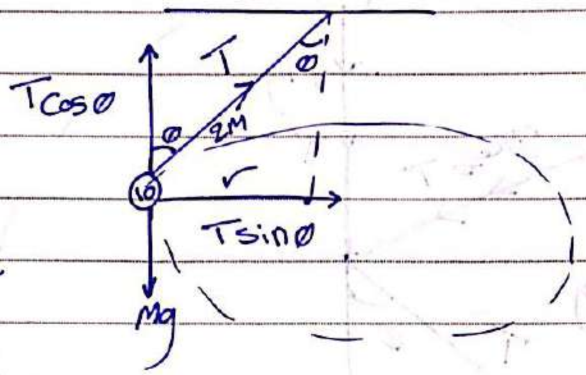
$$F_C = N + Mg = \frac{Mv^2}{r}$$

$$N = \frac{Mv^2}{r} - Mg$$ → عندما يكون الدلو في اعلى

If $N = 0$ → $v = \sqrt{gr}$

$$F_C = N - Mg = \frac{Mv^2}{r}$$ → عندما يكون الدلو في اسفل

Example:- for a conical pendulum if the length of the rope connected is 2 meters and the mass connected is 10 kg and the velocity is 2 m/s find the angle of the pendulum.



$T\cos\theta = mg$

$T\sin\theta = \frac{mv^2}{r}$

$\tan\theta = \frac{v^2}{rg} = \frac{4}{10 * 2\sin\theta}$

$\sin\theta = \frac{r}{2} \longrightarrow r = 2\sin\theta$

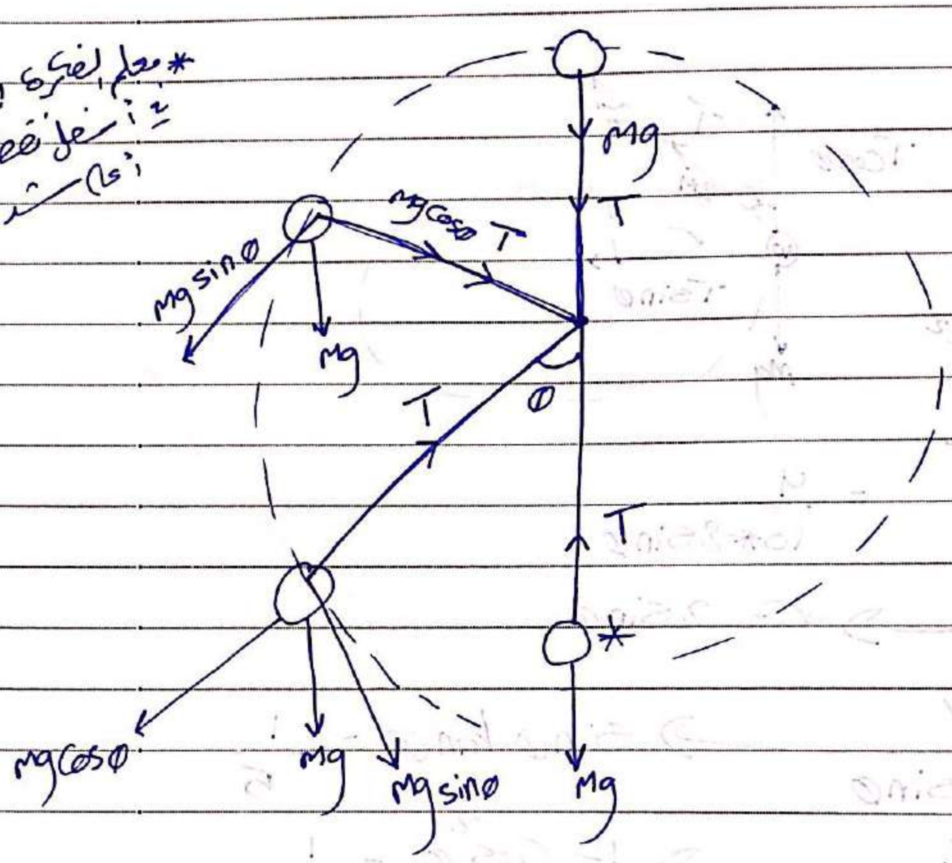
$\tan\theta = \frac{4}{20\sin\theta} \longrightarrow \sin\theta\tan\theta = \frac{1}{5}$

$\frac{\sin^2\theta}{\cos\theta} = \frac{1}{5} \longrightarrow \frac{1-\cos^2\theta}{\cos\theta} = \frac{1}{5}$

$1-\cos^2\theta = \frac{1}{5}\cos\theta$ معادلة تربيعية *

Example:: for a regular pendulum with length 2m, if the rope stands 100N and mass of 8kg is connected does the pendulum break? assum the velocity at the lowest point is 2m/s.

*معلم الفترة إنه وقت يكون بأسفل نقطة بتكون أكبر شد ومسار



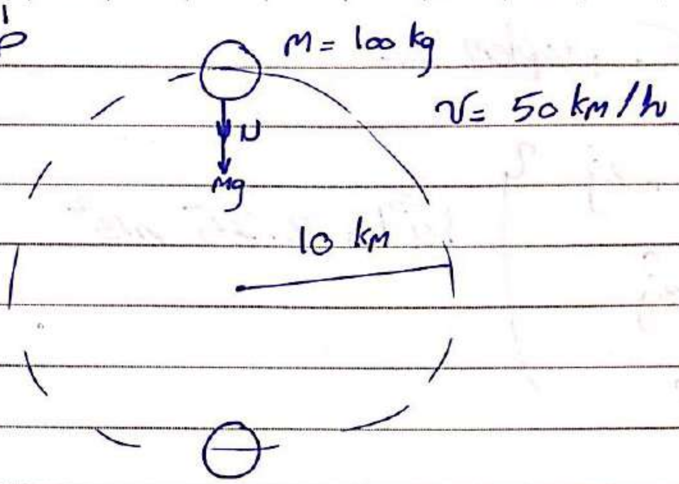
$$T - Mg = \frac{Mv^2}{r}$$

$$T = Mg + \frac{Mv^2}{r} \longrightarrow 8*10 + \frac{8*4}{2}$$

$$80 + 16 = 96 < 100$$

مش هينقطع، وطالما تحت مش هينقطع
إذا غيره ما ينقطع بأي مكان ثاني.

Example :- ع, L'

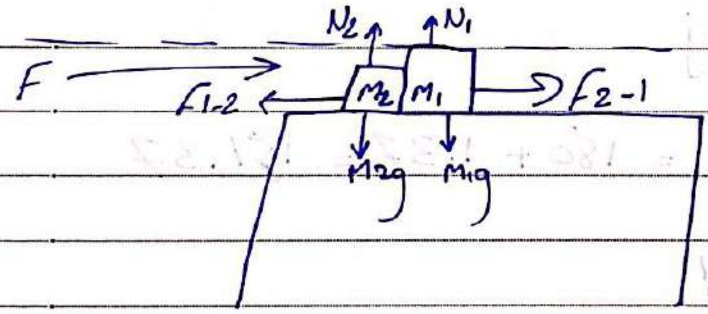


$$N + Mg = \frac{Mv^2}{r}$$

$$N = \frac{Mv^2}{r} - Mg \longrightarrow \frac{100 * 50^2}{10} - 100 * 10 * \frac{1}{1000 * \left(\frac{1}{60*60}\right)}$$

$$= < 0$$

$$> 0$$



$$F = (M_1 + M_2)\,a$$

$$a = \frac{F}{M_1 + M_2}$$

$$N_1 = Mg_1$$

$$f_{2-1} = M_1 a = \frac{M_1 F}{M_1 + M_2}$$

$$f_{1-2} = f_{2-1} = \frac{M_1 F}{M_1 + M_2}$$

Chapter 5. proplem 22

$\vec{f_1} = -2\hat{i} + 2\hat{j}$

$\vec{f_2} = 5\hat{i} - 3\hat{j}$ $\quad |\vec{a}| = 3.75 \, m/s^2$

$\vec{f_3} = -45\hat{i}$

① what is the direction of $\vec{a}$

② whet is the Mass

③ if $\vec{v_i} = 0$, find the speed after 10s

④ whet is the computer of velocity after 10s

1- $\vec{\Sigma f} = m\vec{a}$

$\vec{\Sigma f} = \vec{f_1} + \vec{f_2} + \vec{f_3} = -42i - j$

$\theta = \tan^{-1}\frac{-1}{-42} = \tan^{-1}\frac{1}{42} = 180 + 1.37 = 181.37$

2- $|\vec{\Sigma f}| = |m\vec{a}| = m|\vec{a}|$

$\sqrt{42^2 + 1^2} = m * 3.75$

$m = \frac{\sqrt{42^2 + 1^2}}{3.75} = \boxed{11.2}$

4- $v_x = \frac{-420}{11.2}$

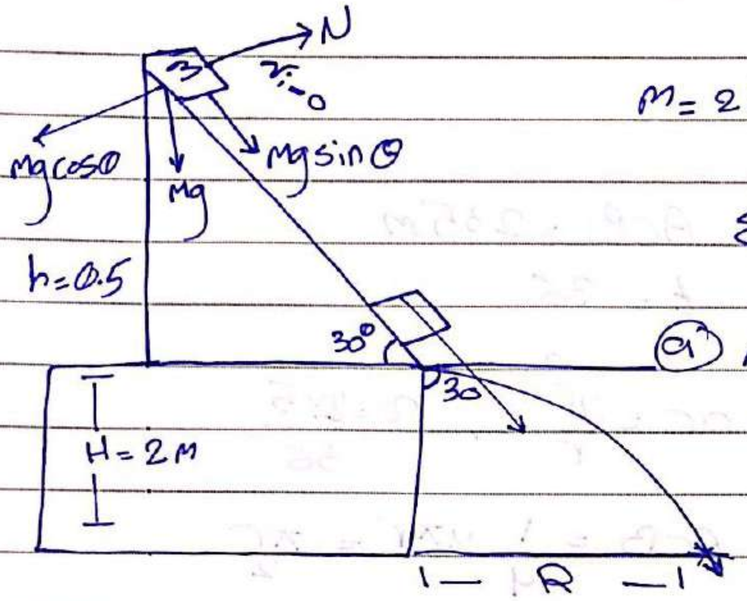
$v_y = \frac{-10}{11.2}$

3- $\vec{v_f} = \vec{v_i} + \vec{a} * t$

$= 0 + \frac{\Sigma f}{m} * t = \frac{-42i - j}{11.2} * 10$

Speed $= |v_f| = |\vec{a}| t$

$= 3.75 * 10$



$M = 2 Kg$

$\Sigma f_x = Ma$

(a) $mg \sin\theta = Ma$

$a = g \sin\theta$

$= 10 * \frac{1}{2} = 5 m/s^2$

(b) $v_f^2 = v_i^2 + 2a\Delta h$

$= 0 + 2 * 5 * 0.5 * \frac{1}{2}$

$v_f^2 = 2.5 \rightarrow v_f = \sqrt{2.5}$

$R = v_x t$

$= v_i \cos 30 t$

$\sqrt{2.5} * \frac{\sqrt{3}}{2} * t$

$\Delta y = v_{iy} t - \frac{1}{2} g t^2$

$-2 = -v_i \sin 30 t - 5t^2$

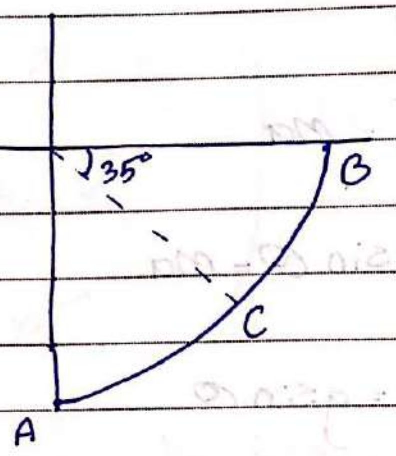
$t = \Longrightarrow \longleftarrow T = \sqrt{\frac{1}{10}} + t$

$\Delta x = v_i t + \frac{1}{2} a t^2$

$0.5 * \frac{1}{2} = 0 + \frac{1}{2} * 5t^2$

$t^2 = \frac{1}{10} \rightarrow t = \sqrt{1/10}$

chapter 6 . problem 6



$ACB = 235\,m$

$t = 36$

$a_c = \frac{v^2}{r}$, $v = \frac{235}{36}$

$ACB = \frac{1}{4} 2\pi r = \frac{\pi r}{2}$

$235 = \frac{\pi r}{2} \Rightarrow \boxed{r = 470/\pi}$

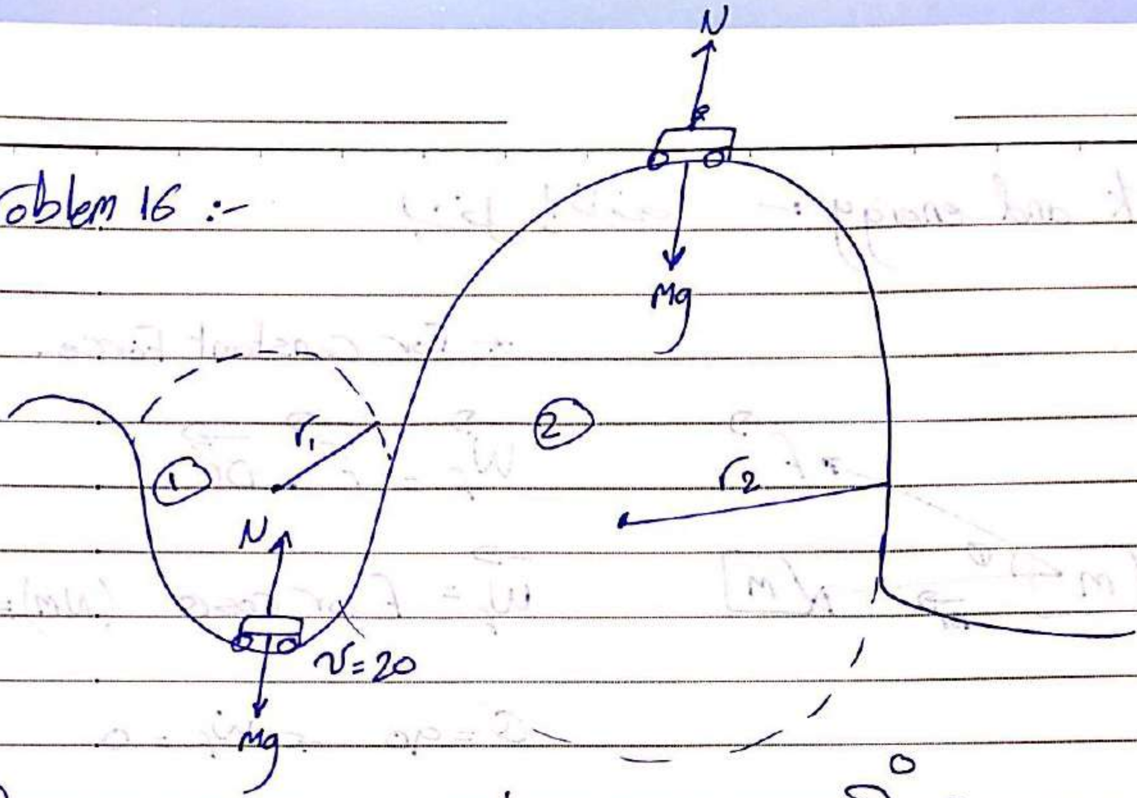
$a_c = \left(\frac{235}{36}\right)^2 \Big/ \frac{470}{\pi}$

$a_x = a\cos 145$

$a_y = a\sin 145$

$\vec{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t} \Rightarrow \vec{a}_{avg} = \frac{\frac{235}{36}(j - i)}{36}$

problem 16 :-



(1)

$$N - Mg = M\frac{v^2}{r}$$

$$N = Mg + M\frac{v^2}{r}$$

$$= 5000 + 5000 * \frac{20^2}{10}$$

(2)

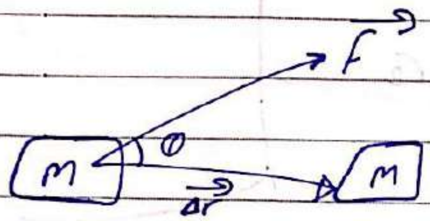
$$Mg - \cancel{N}^{\,0} = \cancel{M}\frac{v^2}{r}$$

$$v_{min} = \sqrt{rg}$$

$$= \sqrt{15 * 10} = \boxed{12.2}$$

* Work and energy :- الشغل والطاقة

* For Constant Force.



$$\vec{W}_F = \vec{F} \cdot \vec{\Delta r}$$

$$\vec{W}_F = F \Delta r \cos\theta \quad (NM) \equiv J$$

$$\theta = 90 \rightarrow W_F = 0$$

(eg)