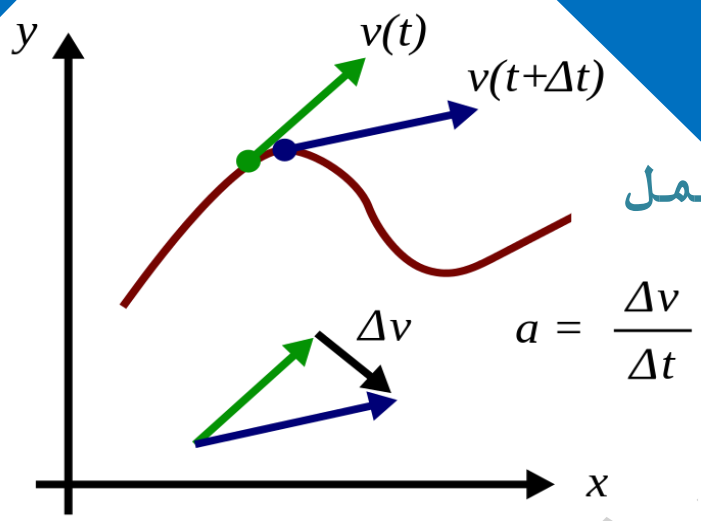
Physics 101



أطلب المكمل

Version 3

Chapter 2

Motion in One Dimension

Pages

21 out of 21

Done by :

Ahmad Al-Azzam

Agricultural Engineering at JUST

Haitham Taha

Civil Engineering at JUST

References

- Physics for Scientists and Engineers with Modern Physics, Eighth Edition
- Doctors Note
- Past Years Questions

قال تعالى :

" قل هل يستوي الذين يعلمون والذين لا يعلمون إنما يتذكّر أولو الألباب "

ثاني شابتر بمادة الفيرست

عن الحركة بإتجاه واحد

شرحتوا بطريقة حلوة وسهلة بتفهمك المادة بكل بساطة انشالله أكون اني قدرت أفيدكم بهاد الشرح أنا اعملت كلشي بقدر عليه منشان أفيدكم ... بالتوفيق للجميع

عملتلكم أسئلة مكملة للشرح اطلبوهم من المكتبة

دعواتكم

للإستفسار أو للمساعدة التواصل معي :

Facebook :

Haitham Taha

WhatsApp :

0780938042

كلمات كثيررررر مهمة لازم تكون عارفهم منشان تقدر تحل أي سؤال عن الشابتر

Motion	حركة	Building	بناء
Displacement	إزاحة	Total time	الوقت الكلي
Velocity	سرعة	upward	لأعلى
Time interval	فترة زمنية	Straight line	خط مستقيم
rest	سكون	Change	تغير
final	نهائي	Instantaneous	لحظي
dropped	أفلت	Instantaneous velocity	السرعة اللحظية
Height	إرتفاع	Initial	إبتدائي

stone	حجر	How long	كم الزمن
Thrown	رمي	Calculate	حساب
downward	لأسفل	Strikes	إرتطم
Position	موقع	to reach	حتى يصل
Average	معدل	ground	الأرض
Constant acceleration	تسارع ثابت	Vertically	عمودي
from	من	How far	كم المسافة
to	إلى		

2.1 Displacement

Displacement : change in position

$$\Delta x = x_f - x_i$$

x_i : موقع الجسم الإبتدائي (يعني الموقع يلي انطلق منو الجسم)

x_f : موقع الجسم النهائي (يعني الموقع يلي وصل لإلو)

Unit of the displacement in MKS is Meter (m)

Displacement is a vector quantity الإزاحة كمية متجهة

Distance is a vector quantity المسافة كمية قياسية

2.2 Average velocity

Average velocity is a vector quantity

Unit of the Average velocity in MKS is Meter/Second (m/s)

$$\overline{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

x_i : الموقع الإبتدائي x_f : الموقع النهائي

t_i : الوقت الإبتدائي t_f : الوقت النهائي

$$Average\ speed = \frac{total\ distance\ traveled}{total\ time}$$

Average Speed is a Scaler quantity

- معدل السرعة هو السرعة يلي بحسبها عند زمنين (زمن إبتدائي وزمن نهائي)
- بدك تنتبه هون لازم تعرف انو الـ **Average velocity** كمية متجهة والـ **Averege speed** كمية قياسية .
- يعني الـ **Average velocity** بنوخدها مقاطعة يعني نقطة البداية ونقطة النهاية بس
- أما الـ **Average speed** بنوخدها كاملة يعني كل فترة لحال مو نقطة بداية ونهاية بس

2.3 Instantaneous velocity

❖ هون لازم تعرف انو المشتقة الأولى للإزاحة (displacement) بتعطينا السرعة (velocity)
❖ السرعة اللحظية هي السرعي يلي بحسبها عند زمن واااااحد (لحظة زمنية معينة)

Ex : The position a particle moving on the x-axis is given by $x = 16 + 18t - 6t^2$:

1. What is the average velocity during the interval $t = 1.0\ s\ to\ t = 3.0\ s$?

2. Determine the instantaneous of the particle at $t = 4.0\ s$

Answer:

1. $\overline{v} = \dfrac{\Delta x}{\Delta t} = \dfrac{x_f - x_i}{t_f - t_i}$

$x_f = x_{(3)} = 16 + 18(3) - 6(3)^2 = 16\ m$

$x_i = x_{(1)} = 16 + 18(1) - 6(1)^2 = 28\ m$

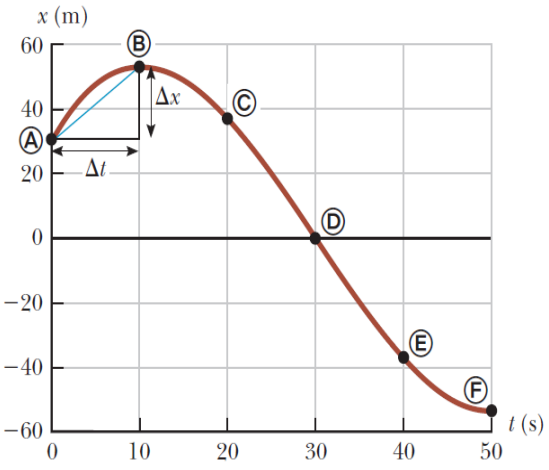
$\overline{v} = \dfrac{16 - 28}{3 - 1} = \dfrac{-12}{2} = -6\ m/s$

2. $v = \dfrac{dx}{dt} = 18 - 12t$

$v_{(4)} = 18 - 12(4) = 18 - 48 = -30\ m/s$

Ex : See the figure and the table and find the following :

Position	t (s)	x (m)
Ⓐ	0	30
Ⓑ	10	52
Ⓒ	20	38
Ⓓ	30	0
Ⓔ	40	−37
Ⓕ	50	−53



1 . Displacement in the interval between positions A and F

2 . The average velocity of the car in the interval between positions A and F

3 . The average speed of the car in the interval between positions A and F

Answer :

1 . $\Delta x = x_f - x_i$

$\Delta x = -53 - 30 = -83\ m$

2 . $\overline{v} = \frac{\Delta x}{\Delta t} = \frac{-83}{50-0} = -1.7\ m/s$

3 .

$$Average\ speed = \frac{total\ distance\ traveled}{total\ time}$$

$$Average\ speed = \frac{22+14+38+37+16}{10+10+10+10+10} = \frac{127}{50} = 2.5\ m/s$$

2.4 Acceleration

Average acceleration is a vector quantity

The average acceleration is :

$$\overline{a} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$

v_i : السرعة الإبتدائية v_f : السرعة النهائية

t_i : الوقت الإبتدائي t_f : الوقت النهائي

Unit of the acceleration in MKS is (m/s^2)

Instantaneous acceleration

ركز معي هون منيح : 

- المشتقة الثانية للإزاحة (Displacement) بتعطينا التسارع (acceleration)
- المشتقة الأولى للسرعة (velocity) بتعطينا التسارع (acceleration)

Ex : If the position of a particle is given as function of time as $x_{(t)} = 3t^2 - 2t + 4$

Find :

1 . The average velocity in the time interval [2,4] s

2 . The average acceleration in the time interval [2,4] s

3 . The acceleration at (t=3 s)

Answer:

1 . $x_f = 3(4)^2 - 2(4) + 4 = 44\ m$

$x_i = 3(2)^2 - 2(2) + 4 = 12\ m$

$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{44-12}{4-2} = 16\ m/s$

2. $\bar{v} = \frac{dx}{dt} = 6t - 2$

$v_f = 6(4) - 2 = 22\ m/s$

$v_i = 6(2) - 2 = 10\ m/s$

$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i} = \frac{22 - 10}{4 - 2} = 6\ m/s^2$

3 . $\bar{a} = \frac{dv}{dt} = 6$

$\bar{a} = 6\ m/s^2$

Ex : Two cars are $200\ kilometers$ apart and traveling toward each other. One car is moving at $60\ km/h$ and the other is moving at $40\ km/h$ mph. After how many hours they will meet ?

إنتبه منيح بهيك أسئلة :

- إذا كان الجسمين بتحركوا عكس إتجاه بعض ← → بجمع السرعتين مع بعض $(v_1 + v_2)$
- وإذا كان الجسمين بتحركوا مع إتجاه بعض → → بطرح السرعتين من بعض $(v_1 - v_2)$

Answer :

$$Ave.speed = \frac{\sum x}{\sum t}$$

$$60 + 40 = \frac{200}{t}$$

$$t = \frac{200}{100} = 2\ hr$$

Ex : A dog and a rabbit are $30\ meters$ apart and the dog ran behind the rabbit at $10\ m/s$, then the rabbit Runway from the dog at $5\ m/s$ .After how many times they will meet ?

Answer :

$$Ave.speed = \frac{\sum x}{\sum t}$$

$$10 - 5 = \frac{30}{t}$$

$$t = \frac{30}{5} = 6\ s$$

Ex : Which one of the following is not a vector quantity ?

A) Displacement **B) Average speed**

C) Average velocity **D) Instantaneous velocity**

Answer : B) Average speed

Ex : A particle moves along the x-axis from x_i to x_f. Which one of the following values of the initial and final coordinates represents a negative displacement ?

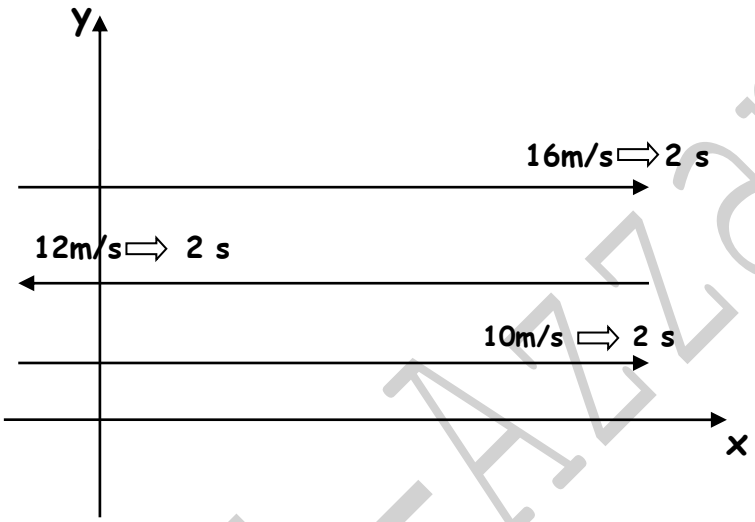
A) $x_i = -4m\ , x_f = -2m$ **B)** $x_i = 4m\ , x_f = 6m$

C) $x_i = -4m\ , x_f = 2m$ **D)** $x_i = -4m\ , x_f = -8m$

Answer : D) $x_i = -4m\ , x_f = -8m$

Ex : An object moves along the x-axis with a speed of 10 m/s for 2 seconds, then it moves against the x-axis with a speed of 12 m/s for 2 seconds, and then it moves along the x-axis with a speed of 16 m/s for 2 seconds. What is the magnitude of the object average velocity ?

Answer :



$$x_1 = v * t = 10 * 2 = 20\ m$$

$$x_2 = v * t = 12 * 2 = 24\ m$$

$$x_3 = v * t = 16 * 2 = 32\ m$$

$$\overline{v} = \frac{\Delta x}{\Delta t} = \frac{x_1 - x_2 + x_3}{t_1 + t_2 + t_3} = \frac{20 - 24 + 32}{2 + 2 + 2} = \frac{28}{6} = 4.7\ m/s$$

2.5 Motion at constant acceleration

$$v_f = v_i + at$$

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

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

$$\Delta x = \left(\frac{v_f + v_i}{2}\right)t$$

$$\Delta x = v_f t - \frac{1}{2}at^2$$

هدول القوانين احفظهم زي اسمك لانو رح تضل تستخدمهم للفاينل

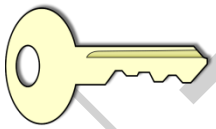
كلمات مفتاحية لازم تكون عارفهم

at rest Or from rest :

V_i = 0 (ZERO)

to rest Or stop

V_f = 0 (ZERO)



How long : بدو الزمن

How far : x بدو المسافة يعني

Slow down هون التسارع بنعطيه إشارة سالبة (لأنو بتناقص)

* بس أجي أطبق ع أي قانون من هدول القوانين الخمسة لاااااازم يكون معي 3 معطيات على الأقل وإلا ما رح أعرف أحل

Ex : A car moving with a velocity of (20 m/s), its stops after a distance of (80 m) . what is the constant acceleration of the car ?

Answer :

Stop $\Longrightarrow$ v_f = 0

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

$$0 = 400 + 2a(80 - 0)$$

$$a = \frac{-400}{160} = -2.5\ m/s^2$$

Ex : An object is moving with 24 m/s on a straight line to slow down at a rate of 5 m/s^2 . How long will the object travel before it comes to stop ?

Answer :

$$v_f = v_i + at$$

$$0 = 24 + (-5)t$$

$$t = \frac{-24}{-5} = 4.8\ s$$

Ex : A car traveled (100 m) in (10s) with a constant acceleration (2m/s^2) Find its final velocity ?

Answer :

$$\Delta x = v_f t - \frac{1}{2}at^2$$

$$100 = v_f(10) - \frac{1}{2}(2)(10)^2$$

$$v_f = 20\ m/s$$

Ex : A car is moving with constant acceleration a long a straight road. How long does it take the car to increase its velocity from 30 m/s to 50 m/s in a distance of 200 m ?

Answer :

$$\Delta x = \left(\frac{v_f + v_i}{2}\right)t$$

$$200 = \left(\frac{50 + 30}{2}\right)t$$

$$t = 5\ s$$

Ex : A particle moves along x-axis with constant acceleration from x=2m to x=8m during a 2.5 s time interval. If the particle velocity at x=8m is 2.8 m/s, What is the acceleration ?

Answer :

$$\Delta x = v_f t - \frac{1}{2} a t^2$$

$$8 - 2 = (2.8)(2.5) - \frac{1}{2} a (2.5)^2$$

$$6 = 7 - 3.125\, a$$

$$a = 0.32\ m/s^2$$

Ex : A car accelerated from rest to (100 km/hr) in 8 seconds. Find the car accelerated ?

Answer :

$$v = 100 \frac{km}{hr} = 100 * \frac{1000\ m}{60*60\ s} = 27.8\ m/s$$

$$v_f = v_i + at$$

$$27.8 = 0 + a * 8$$

$$a = 3.5\ m/s^2$$

Ex : A car starting from rest, travels 0.40 km in 11.0 s. What is the magnitude of its constant acceleration?

Answer :

$$0.4\ km = 400\ m$$

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

$$400 = 0 + \frac{1}{2} a (11)^2$$

$$400 = 60.5\, a$$

$$a = 6.61\ m/s^2$$

2.7 Falling Objects

The magnitude of free fall acceleration is $a = g = 10\ m/s^2$

$$v_f = v_i - gt$$

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

$$v_f^2 = v_i^2 - 2g\Delta y$$

لا تحفظ هدول القوانين بمجرد انك تحفظ
قوانين الحركة يلي بصفحة 9 بتقدر تحل
عليهم بس عوض التسارع - 10 م/ث²

$$g = a = -10\ m/s^2$$

كلمات مفتاحة لازم تكون عارفهم

Dropped :

السرعة الإبتدائية بتساوي صفر ($v_i = 0$)

Thrown :

السرعة عند أعلى ارتفاع بتساوي صفر

Ex : A stone is dropped from a bridge and strikes the water in 5 seconds
Find :

1 . The speed with which it strikes water

2 . The height of the bridge

Answer :

1 . $v_f = v_i + at$

$v_f = 0 + (-10)(5)$

$v_f = -50\ m/s = 50\ m/s$ *downward*

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

$0 - x_i = 0 + \frac{1}{2}(-10)(25)$

$x_i = 125\ m$

Ex : A stone is released from rest the top of a 100 meter high building. How long does it take the stone to reach the ground ?

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

$$0 - 100 = 0 + \frac{1}{2}(-10)t^2$$

$$t = 4.5\ s$$

Ex : A stone is thrown vertically up from a top of a building with 20 m/s initial velocity. If the stone reaches the ground 9 seconds later, How high is the building ?

Answer :

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

$$0 - x_i = 20(9) + \frac{1}{2}(-10)(81)$$

$$x_i = 225\ m$$

Ex : A stone is thrown from the edge of 300 m high building. If the stone reaches the ground 10 seconds later, what is the initial velocity of the stone?

Answer :

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

$$0 - 300 = 10 v_i + \frac{1}{2}(-10)(100)$$

$$200 = 10 v_i$$

$$v_i = 20\ m/s \qquad upward$$

Ex : A boy catches a ball 3 seconds after throwing the ball upward. What is the initial velocity of the ball ?

Answer :

هسا بالسؤال حكالي انو الولد التقط الكرة بعد 3 ثواني من رميها لأعلى (يعني الكرة راحت لفوق وردت رجعت لتحت لعند الولد) يعني 1.5 ثانية وهي طالعة و 1.5 ثانية وهي نازلة وبدنا نعرف كمان انو السرعة عند أعلى إرتفاع بتساوي صفر

$$v_f = v_i + at$$

$$0 = v_i + (-10)(1.5)$$

$$v_i = 15\ m/s$$

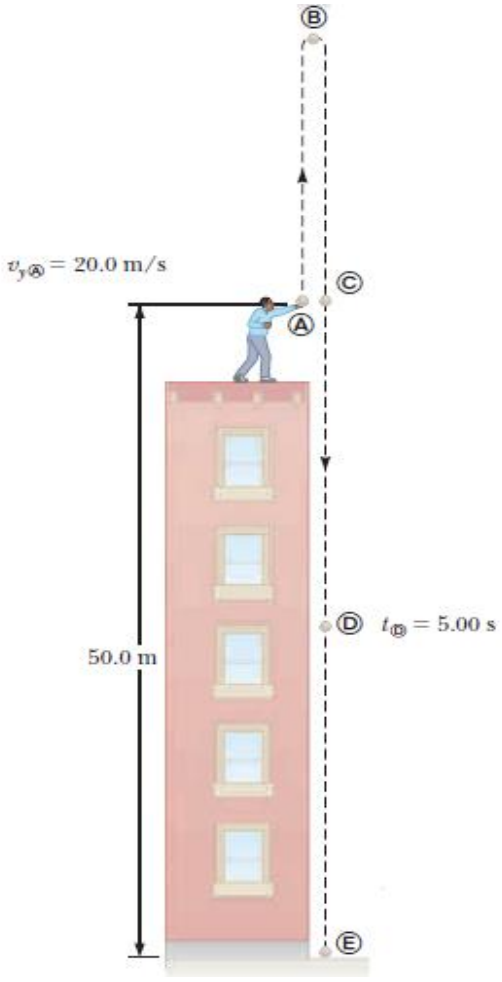
حل آخر :

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

$$0 - 0 = v_i * 3 + \frac{1}{2}(-10) * 9$$

$$v_i = 15\ m/s$$

Ex : A stone is thrown from the top of building of (50 m) height with initial velocity of (20 m/s) upward as shown in the figure. Find :



1 . The time needed the stone to reach its maximum height at point B.

2 . The maximum height at point B.

3 . The time and velocity needed the stone to back to its starting points at point C.

4 . The velocity after (5 seconds) at point D.

5 . The velocity just before hit the ground at point E.

6 . The total time the stone in air at point E.

Answer :

1 . عند أعلى إرتفاع السرعة بتكون صفر

$$v_f = v_i + at$$

$$0 = 20 + (-10)t$$

$$t = 2\ s$$

2 .

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

$$x_f - 50 = 20(2) + \frac{1}{2}(-10)(4)$$

$$x_f = 70\ m$$

3 .

هسا الكرة احتاجت ثانيتين لحتى طلعت لفوق (عند أعلى إرتفاع) ، وبالتالي ستحتاج كمان ثانيتين لحتى ترجع لنفس النقطة يلي انطلقت منها (يعني ثانيتين وهي طالعة وثانيتين وهي نازلة)

$$t = 2 + 2 = 4\ s$$

$$v_f = v_i + at$$

$$v_f = 20 + (-10)(4)$$

$$v_f = -20\ m/s \ = 20\ m/s \quad downward$$

4 .

$$v_f = v_i + at$$

$$v_f = 20 + (-10)(5)$$

$$v_f = -30\ m/s \ = 30\ m/s \quad downward$$

5 .

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

$$v_f^2 = 400 + 2(-10)(0 - 50)$$

$v_f^2 = 1400$

$v_f = \pm 37.4\ m/s \ = -37.4\ m/s \ = 37.4\ m/s$ ***downward***

6 .

$v_f = v_i + at$

$-37.4 = 20 + (-10)t$

$$t = 5.74\ s$$

Ex : A stone is thrown vertically upward from the top of a building with an initial speed of (10m/s), the flight time is 5 s . What is the height of the building ?

Answer :

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

$0 - x_i = 10 * 5 + \frac{1}{2}(-10)(25)$

$x_i = 75\ m$

Ex : A stone is thrown vertically up from the edge of 120 m high building. The stone hits the ground 6.0 seconds later. Find the speed of the stone as it hits the ground .

Answer :

$\Delta x = v_f t - \frac{1}{2} a t^2$

$0 - 120 = v_f * 6 - \frac{1}{2}(-10)(36)$

$-120 = 6\ v_f - (-180)$

$-300 = 6\ v_f$

$v_f = \frac{-300}{6} = \ -50\ m/s \ = 50\ m/s$ ***downward***

Ex : A stone is thrown vertically upward from the edge of a 50m height building with an initial velocity of 35 m/s. How long does it take the stone to hit the ground ?

Answer :

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

$$v_f^2 = 1225 + 2(-10)(0 - 50)$$

$$v_f^2 = 2225$$

$$v_f = \sqrt{2225} = \pm 47.2\ m/s$$

$$v_f = v_i + at$$

$$-47.2 = 35 + (-10)t$$

$$t = 8.2\ s$$

أطلب المكمل

Chapter review

$$\Delta x = x_f - x_i$$

اشتقاق Displacement (Δx) رح يعطينا velocity (v)

$$\overline{v} = \frac{\Delta x}{\Delta t}$$

اشتقاق velocity (v) رح يعطينا acceleration (a)

$$\overline{a} = \frac{\Delta v}{\Delta t}$$

قوانين نيوتن بالحركة

$$v_f = v_i + at$$

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

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

$$\Delta x = \left(\frac{v_f + v_i}{2}\right) t$$

كلمات مفتاحية لازم تكون عارفهم

at rest Or from rest :

V_i = 0 (ZERO)

to rest Or stop

V_f = 0 (ZERO)

How long : بدو الزمن

How far : x بدو المسافة يعني

Slow down هون التسارع بنعطيه إشارة سالبة (لأنو بتناقص)

* ركزوا على القانون الرابع كثير مهم وبيجي عليه دايما سؤال

السقوط الحر

بالنسبة لقوانين السقوط الحر لا تحفظوهم بس احفظو قوانين الحركة وعوضو التسارع (a) $-10m/s^2$

كلمات مفتاحة لازم تكون عارفهم

Dropped :

السرعة الإبتدائية بتساوي صفر ($v_i = 0$)

Thrown :

السرعة عند أعلى ارتفاع بتساوي صفر

Laws review

Displacement :

$$\Delta x = v_f - v_i$$

Average velocity :

$$\overline{v} = \frac{\Delta x}{\Delta t}$$

Average acceleration :

$$\overline{a} = \frac{\Delta v}{\Delta t}$$

Motion at constant acceleration laws :

$$v_f = v_i + at$$

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

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

$$\Delta x = \left(\frac{v_f + v_i}{2}\right) t$$

$$\Delta x = v_f t - \frac{1}{2} a t^2$$

Falling object laws :

$$v_f = v_i - gt$$

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

$$v_f^2 = v_f^2 - 2g\Delta y$$