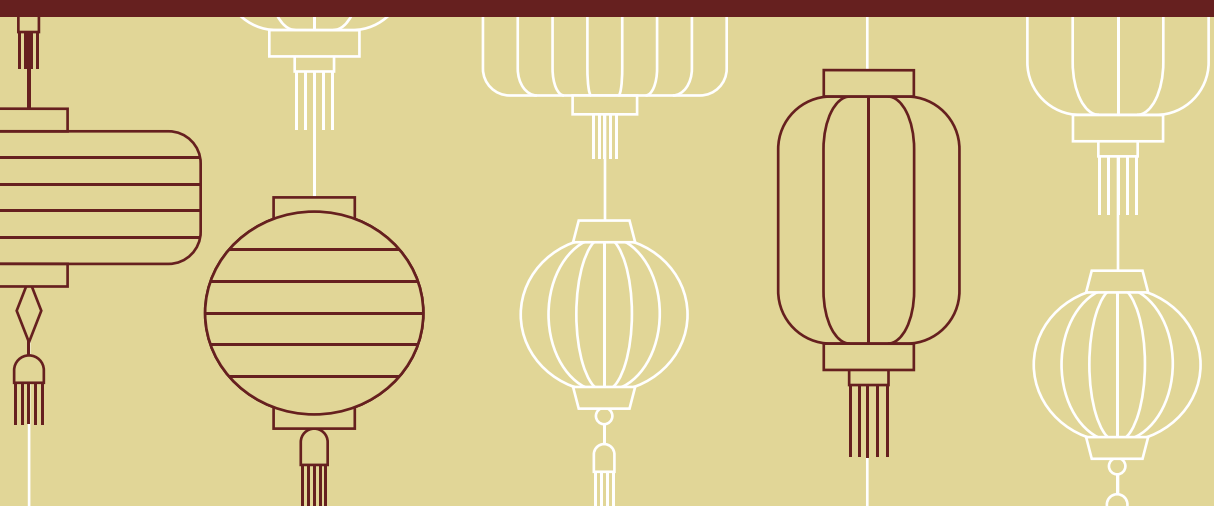
物理笔记

高一1班

韩一萱



物理 1- Dimensioned Motion

Concepts

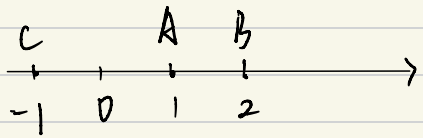
1. Mass point 质点 (ideal Model)
2. Reference system 参考系 (the floor 地面)
3. Coordinate system 坐标系 => locate
   (position axis 位置轴)

Change in position.

$\vec{\Delta x} = x_f - x_i$

final initial

e.g.



$x_A = 1m$

$x_B = 2m$

$x_C = -1m$

$\Delta x_{AB} = x_B - x_A = (2-1)m = 1m$

$\Delta x_{BC} = x_C - x_B = (-1-2)m = -3m$

displacement 位移 & distance 路程
(path length)

magnitude 大小
direction 位置

[VECTOR] 矢量
Force, Velocity, acceleration.

[SCALAR] 标量
Mass, Resistance, speed, temperature, Work, Energy, Density, Volume, Area length, time

一维运动里，位移的大小≤路程的大小

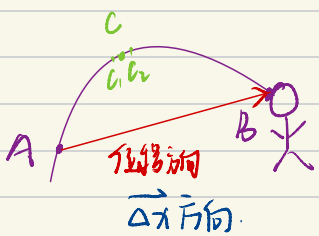
velocity : rate of change in position

velocity 速度 = $\frac{\text{change in position}}{\text{time interval}}$ → 位移 displacement

[VECTOR] $\vec{v} = \frac{\vec{\Delta x}}{\Delta t}$ (m/s)

average velocity : $\vec{v}_{avg} = \frac{\vec{\Delta x}}{\Delta t}$

e.g.

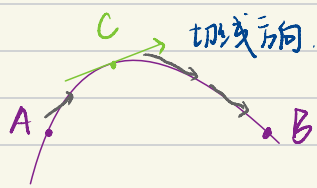


instantaneous velocity 瞬时速度 : $\vec{v}_{ins} = \lim_{\Delta t \to 0} \frac{\vec{\Delta x}}{\Delta t}$

↓

切线方向

tangential 切线



速率 speed [SCALAR]

$v = \frac{s}{\Delta t}$ 例如：时速：跑圈 无方向

$v = \frac{s}{\Delta t}$ { average speed

instantaneous speed $= \lim_{\Delta t \to 0} \frac{s}{\Delta t}$

$$|\vec{v}| = \frac{|\Delta \vec{x}|}{\Delta t} \leq \frac{s}{\Delta t} = v$$

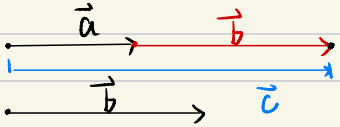
瞬时速度：$|\vec{v}| = v$

change in velocity

$\vec{\Delta v} = \vec{v_f} - \vec{v_i}$ $\Rightarrow$ vector.

Vectors addition

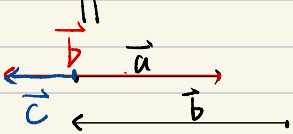
① same direction

做图 

列式 $\vec{c} = \vec{a} + \vec{b}$

1-d problem.

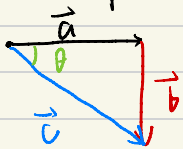
② opposite direction



$\vec{c} = \vec{a} + \vec{b}$

$-5 = +3 + (-8)$

③ 2-d problem

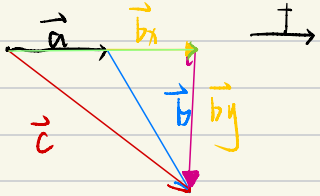


$\vec{c} = \vec{a} + \vec{b}$ $\quad |\vec{c}| = |\vec{a} + \vec{b}|$

$c = \sqrt{a^2 + b^2}$ (如果上)

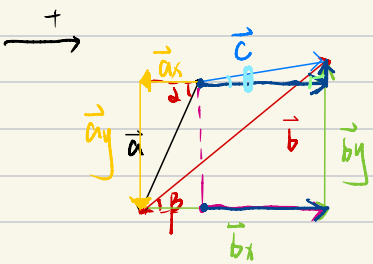
has θ below positive direction with $\tan\theta =$ _____.

证明 (可忽略):



$\vec{b} = \vec{b_x} + \vec{b_y}$

$\vec{a} + \vec{b} = (\vec{a} + \vec{b_x}) + \vec{b_y}$

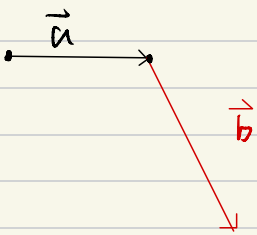


$\vec{a} = \vec{a_x} + \vec{a_y}$

$\vec{b} = \vec{b_x} + \vec{b_y}$

$\vec{c} = \vec{a} + \vec{b} = \vec{a_x} + \vec{a_y} + \vec{b_x} + \vec{b_y} = (\vec{a_x} + \vec{b_x}) + (\vec{a_y} + \vec{b_y})$

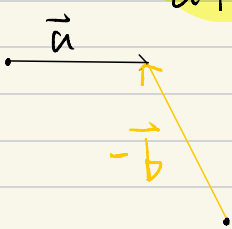
$|\vec{c}| = \sqrt{|\vec{a_x} + \vec{b_x}|^2 + |\vec{a_y} + \vec{b_y}|^2}$



$\vec{d} = \vec{a} - \vec{b}$

($\vec{b}$) $\vec{c} = \vec{a} + \vec{b}$

$\vec{a} + (-\vec{b})$



rate of change in velocity

$\overrightarrow{\text{acceleration}} = \frac{\Delta \vec{v}}{\Delta t}$

↳ 可能加，减，变速

附加内容：

if x means displacement

$v = \frac{dx}{dt}$

$a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$

$\text{jerk} = \frac{da}{dt} = \frac{d^2v}{dt^2}$

（瞬时变化率）

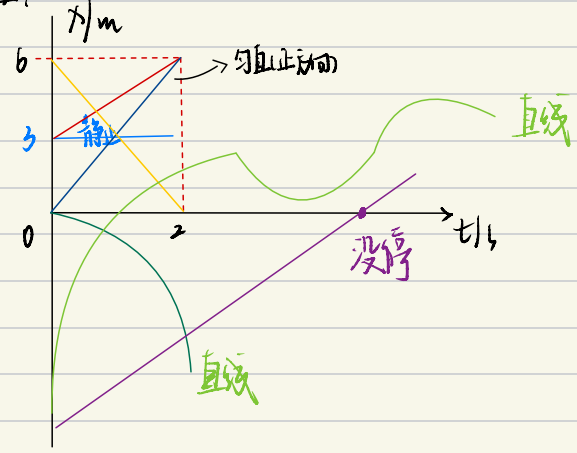
$= \frac{d^3x}{dt^3}$

对应符号：

position	x
displacement	$\Delta \vec{x}$
velocity	$\vec{v}$
change in velocity	$\Delta \vec{v}$
acceleration	$\vec{a}$

Graphs (1-D Motion)

1.

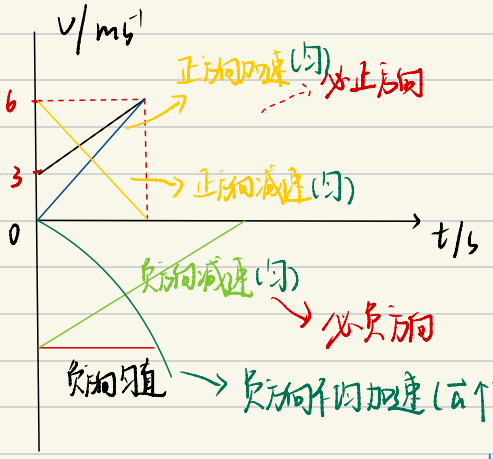


斜率 slope $= \frac{\Delta \vec{x}}{\Delta t}$

↓

velocity

2.



slope $= \frac{\Delta \vec{v}}{\Delta t}$

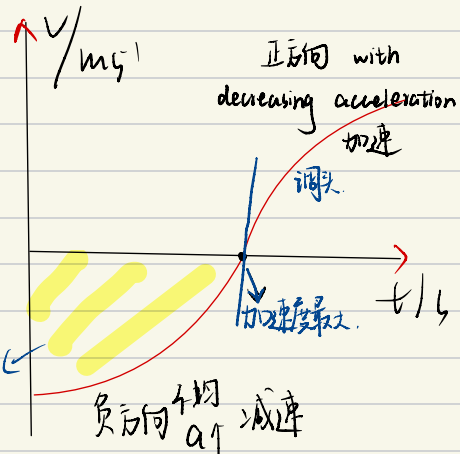
↓

acceleration

nonconstant acceleration

accelerating

3.



调头：减速

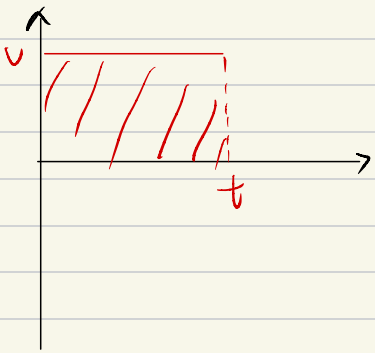
v=0时有 $\vec{a}$

$\int_0^{t_1} v(t)\,dt$ Area

注：1. 匀速圆周 ↓ 速率

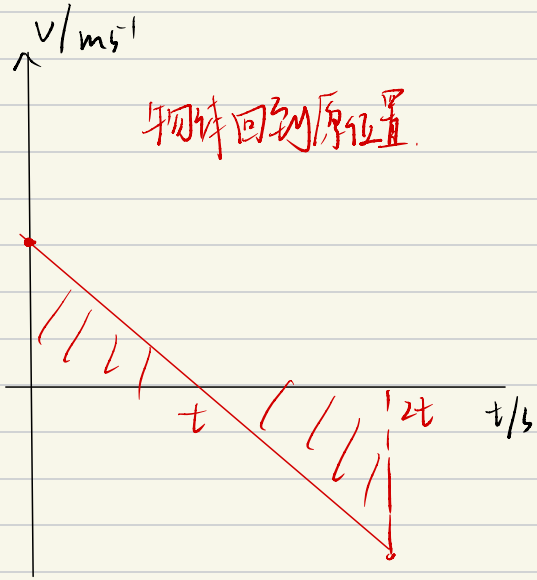
2. 匀速必直线

1



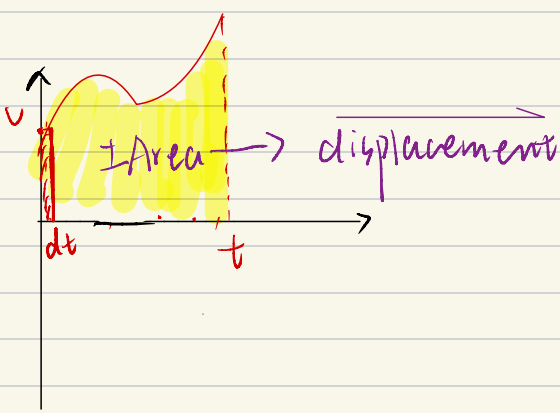
Area = $v \cdot t = \Delta \vec{x}$ 位移.

2.



物体回到原位置.

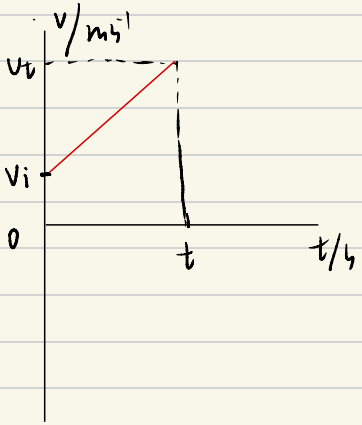
3.



思考：物体做减速运动的条件？

↳ speed

1-D motion with constant $\vec{a}$ ($\vec{a} \neq 0$)　　才是 displacement



① $\vec{v} = \vec{a}t + \vec{v}_i$　(注意正负 加减选)

② $\Delta\vec{x} = \frac{1}{2}(\vec{v}_i + \vec{v}_f)\cdot t$ ↓ 代入

③ $\Delta\vec{x} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$

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

④ $\Delta\vec{x} = \frac{\vec{v}^2 - \vec{v}_i^2}{2\vec{a}}$

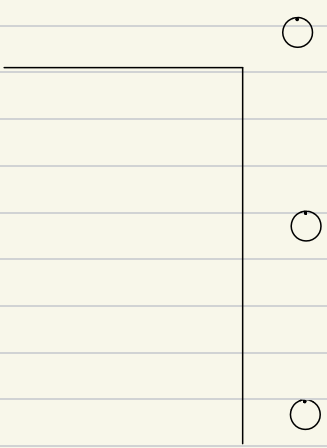
(a, v_i 不变量)

parabolic 抛物线

(t, x, v 变量)

linear

Sample



free fall　(只有 gravity 作用)

$a = g$

$v_i = 0$

① $\vec{v} = \vec{g}t \Rightarrow v \propto t$　(正比)

② $\vec{h} = \frac{1}{2}\vec{v}_i t$　下落高度

③ $\vec{h} = \frac{1}{2}gt^2 \Rightarrow h \propto t^2$

④ $\frac{v^2}{2g} = h \Rightarrow h \propto v^2$

1-D 公式汇总

1. $\vec{\Delta x} = \vec{x_f} - \vec{x_i}$

2. $\vec{v} = \frac{\vec{\Delta x}}{\Delta t}$ (m/s)

3. average velocity: $\vec{v}_{avg} = \frac{\vec{\Delta x}}{\Delta t}$

4. instantaneous velocity: $\vec{v}_{ins} = \lim_{\Delta t \to 0} \frac{\vec{\Delta x}}{\Delta t}$

5. speed $v = \frac{s}{\Delta t}$ (average speed 相同)

6. instantaneous speed $= \lim_{\Delta t \to 0} \frac{s}{\Delta t}$

7. $\vec{\Delta v} = \vec{v_f} - \vec{v_i}$

8. $\overrightarrow{\text{acceleration}} = \frac{\vec{\Delta v}}{\Delta t}$

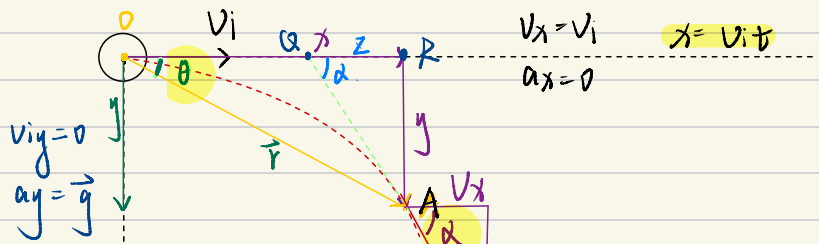
9. Area $= v \cdot t = \Delta \vec{x}$ 位移.

注: vectors addition, 1D motion with constant $\vec{a}$ 和 free fall 公式见前面具体笔记.

2-1 Motion.

注：[redacted]部分为重点，其余为推导过程可省略

horizontally projected



$$|\vec{r}|=\sqrt{x^2+y^2}=\sqrt{(v_it)^2+(\frac{1}{2}gt)^2}$$

$$\vec{y}=\frac{1}{2}\vec{g}t^2$$

$$v_y=gt$$

(free fall)

1. $\tan\theta=\frac{y}{x}=\frac{\frac{1}{2}gt^2}{v_it}=\frac{gt}{2v_i}$

$$\vec{v}_A=\vec{v}_{Ax}+\vec{v}_{Ay}$$

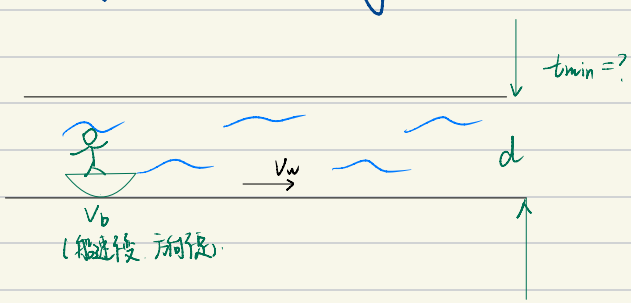
$$|\vec{v}_A|=\sqrt{v_{Ax}^2+v_{Ay}^2}=\sqrt{v_i^2+(gt)^2}$$

2. $\tan\alpha=\frac{v_{Ay}}{v_{Ax}}=\frac{gt}{v_i}$

3. $DQ=QR$

4. 抛物线OA表达式：$y=\frac{g}{2v_i^2}x^2$

思考：



$$t_{min}=\frac{d}{v_b}$$

2-D 公式汇总

1. $\tan\theta = \frac{y}{x} = \frac{\frac{1}{2}gt^2}{v_i t} = \frac{gt}{2v_i}$

2. $\tan\alpha = \frac{v_{oy}}{v_{ox}} = \frac{gt}{v_i}$

3. $DQ = QR$

4. 抛物线OA表达式（物体运动轨迹）：$y = \frac{g}{2v_i^2}x^2$

5. 水平方向表达式（匀速）：$x = v_i t$

6. 竖直方向表达式（free fall）：$\vec{y} = \frac{1}{2}\vec{g}t^2$

7. 竖直方向速度表达式：$v_y = gt$