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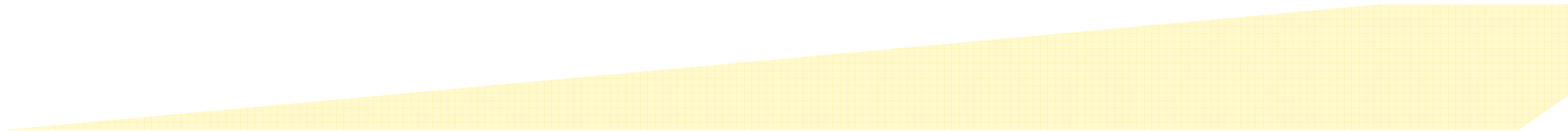
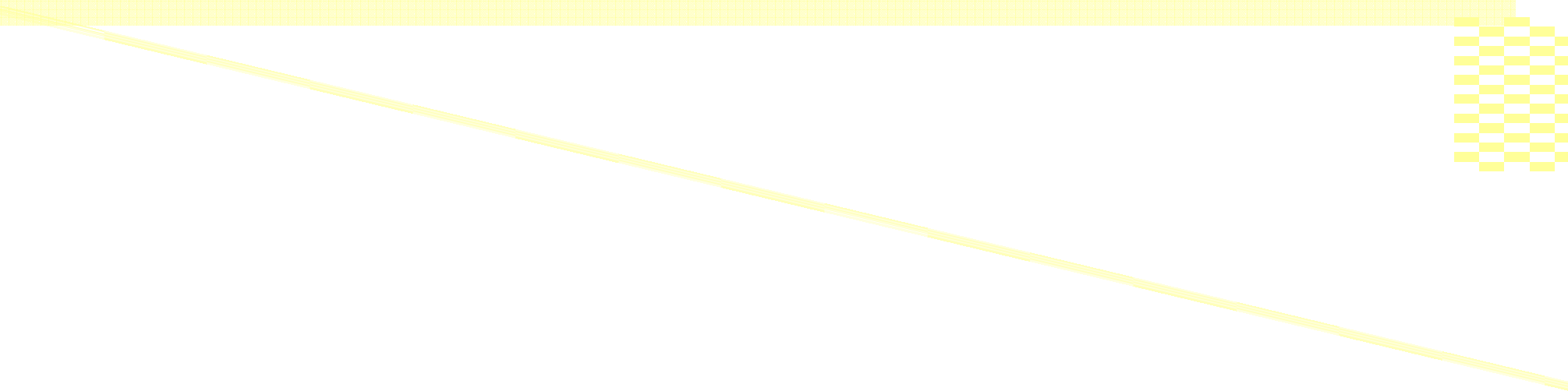
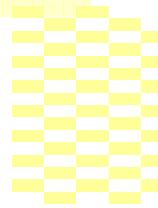
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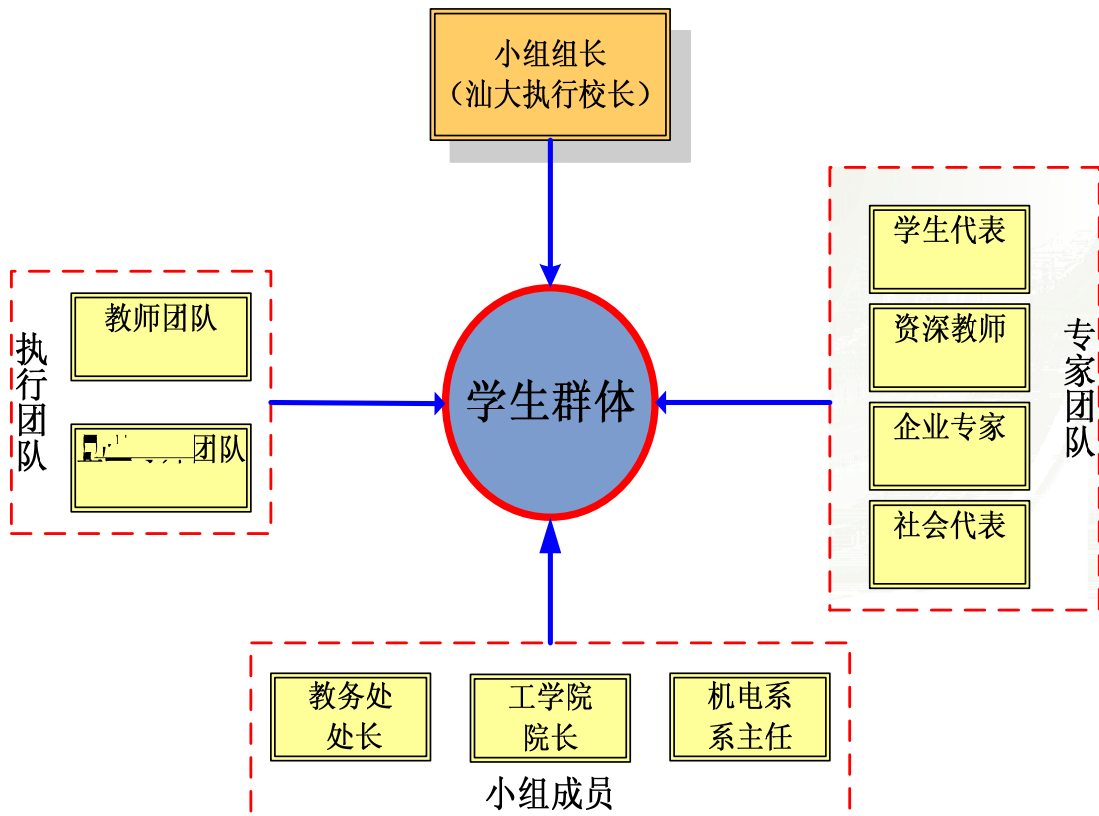
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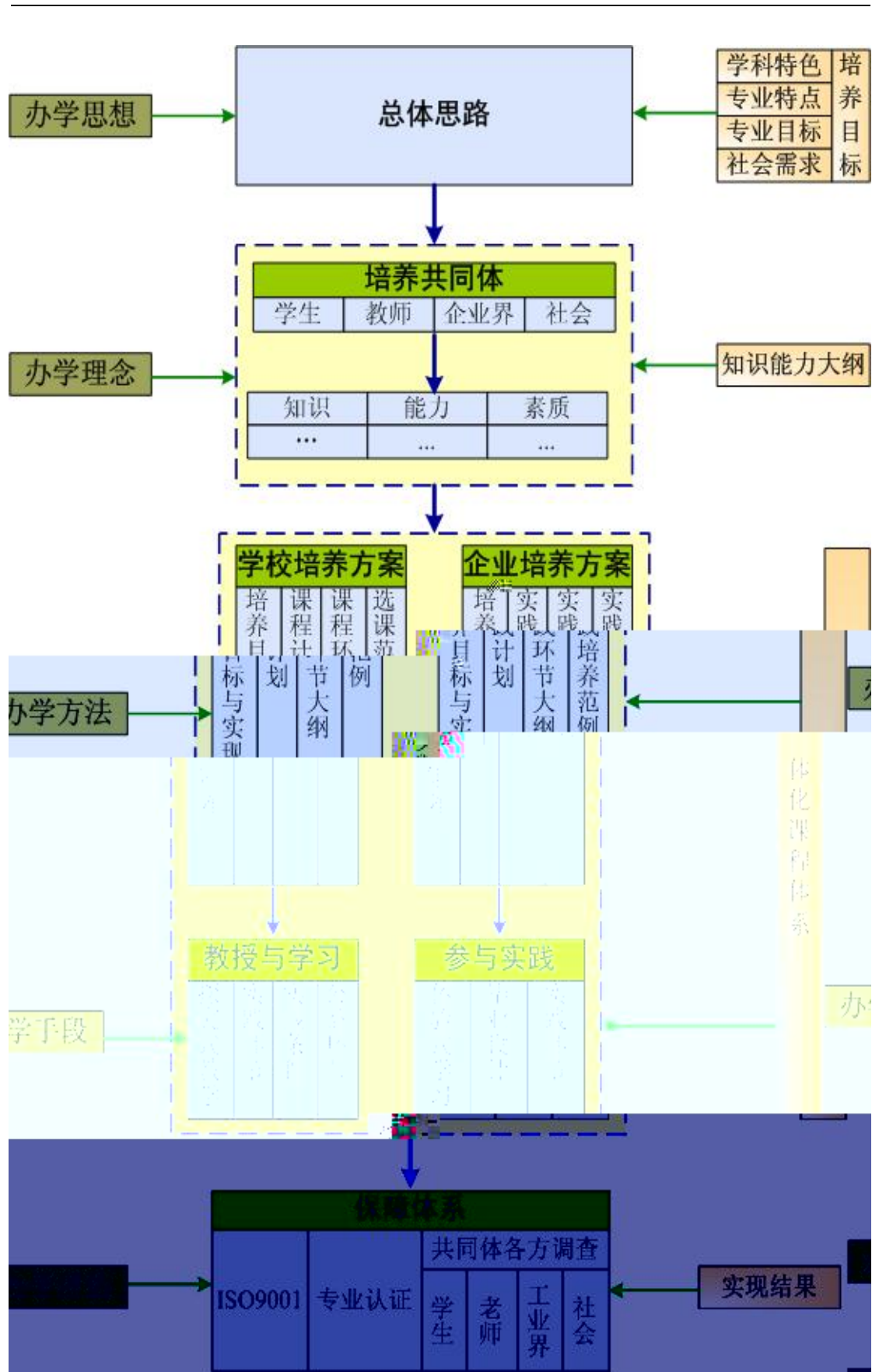
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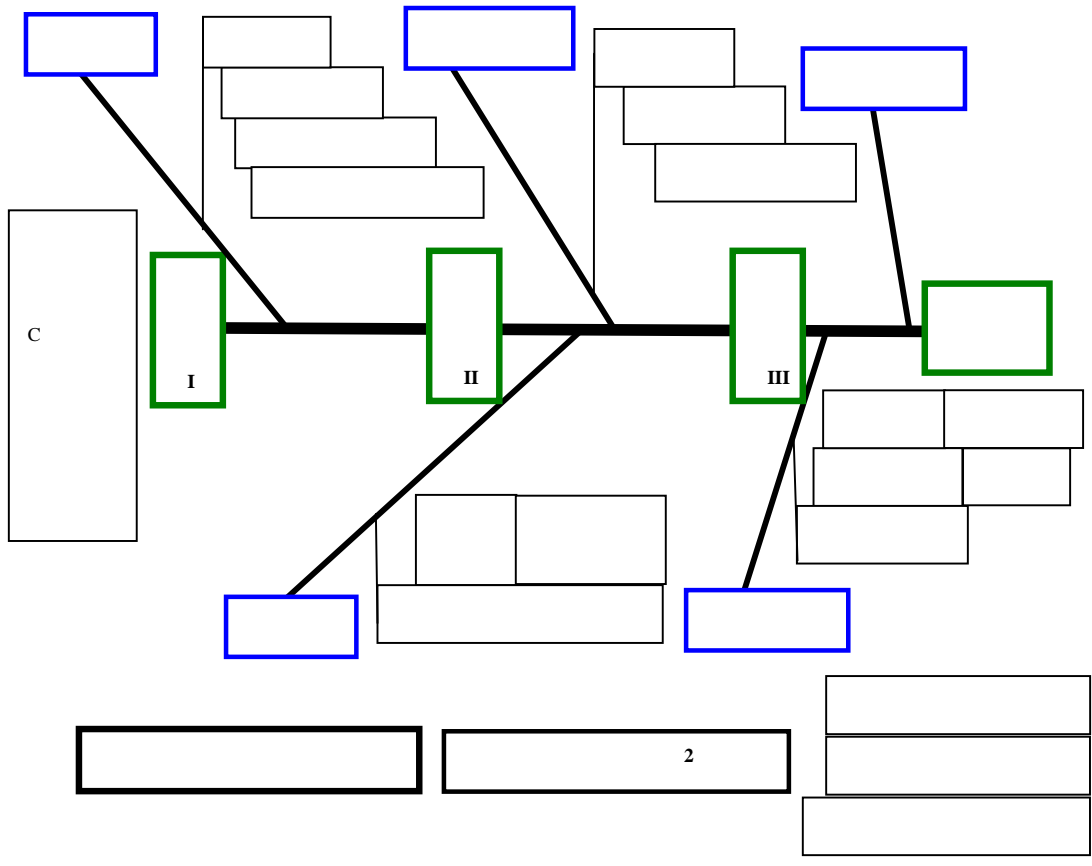
		3+1	3
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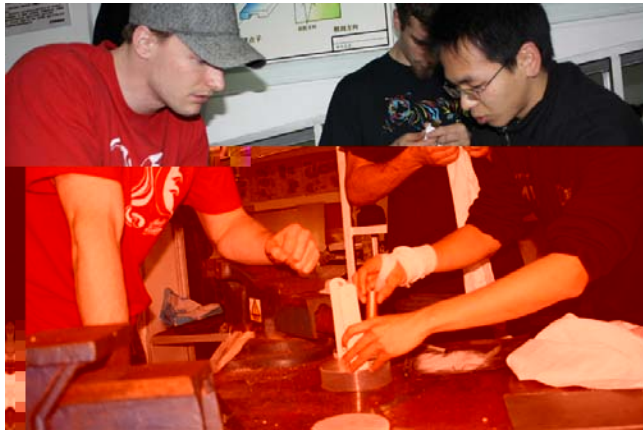
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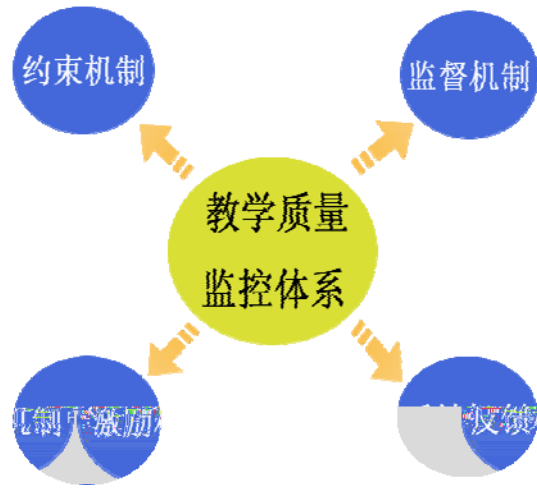


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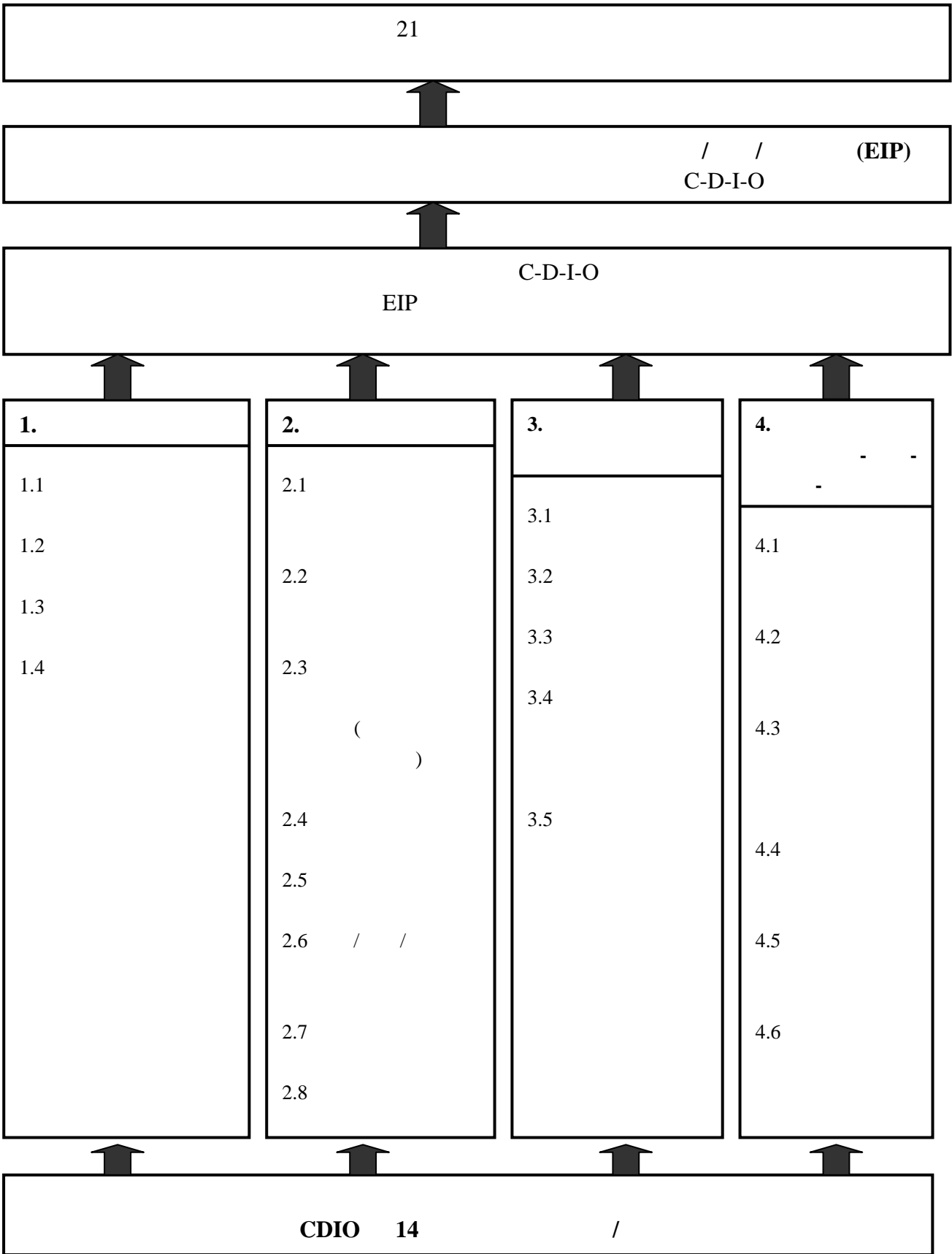
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C-D-I-O

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1.1.1 ()

1.1.2

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1.2.1

1.2.2

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1.2.6

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1.2.9

1.2.10

1.2.11

1.2.12

1.2.13

1.3

1.3.1

1.3.2

1.3.3

1.3.4

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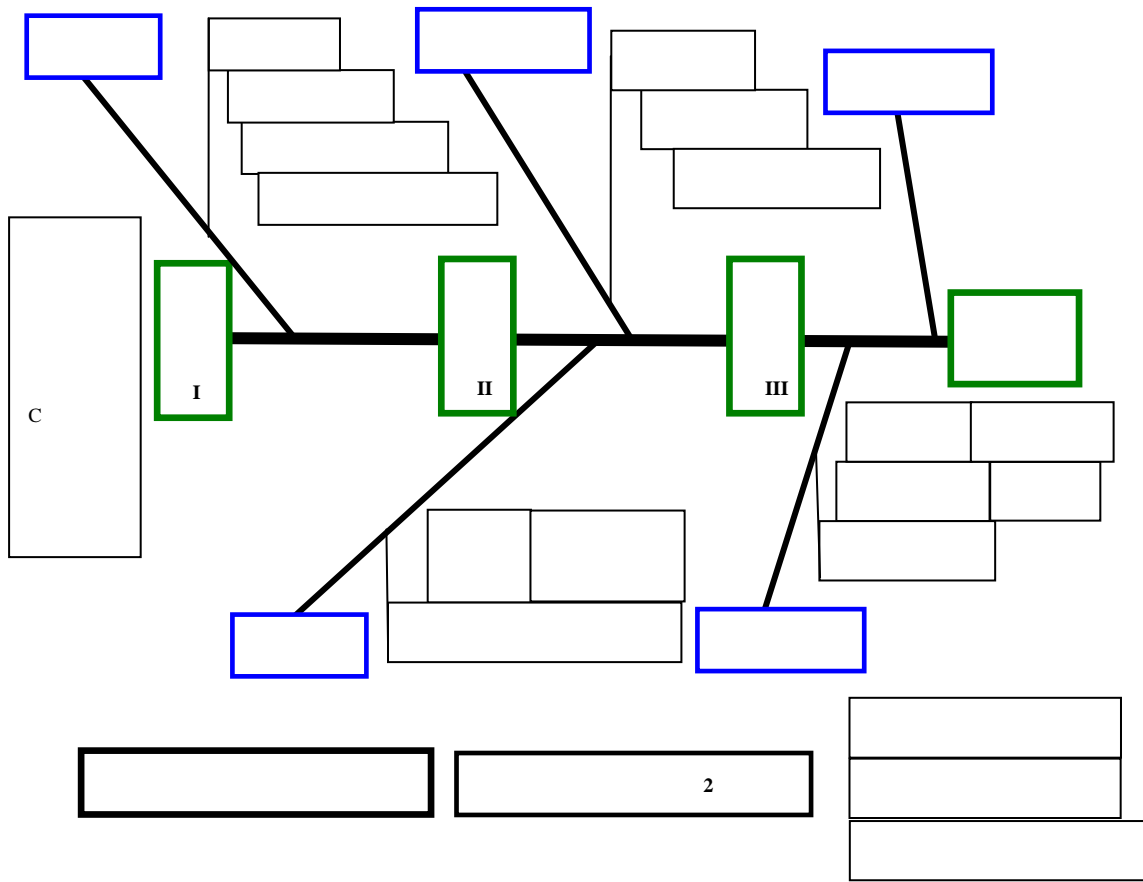
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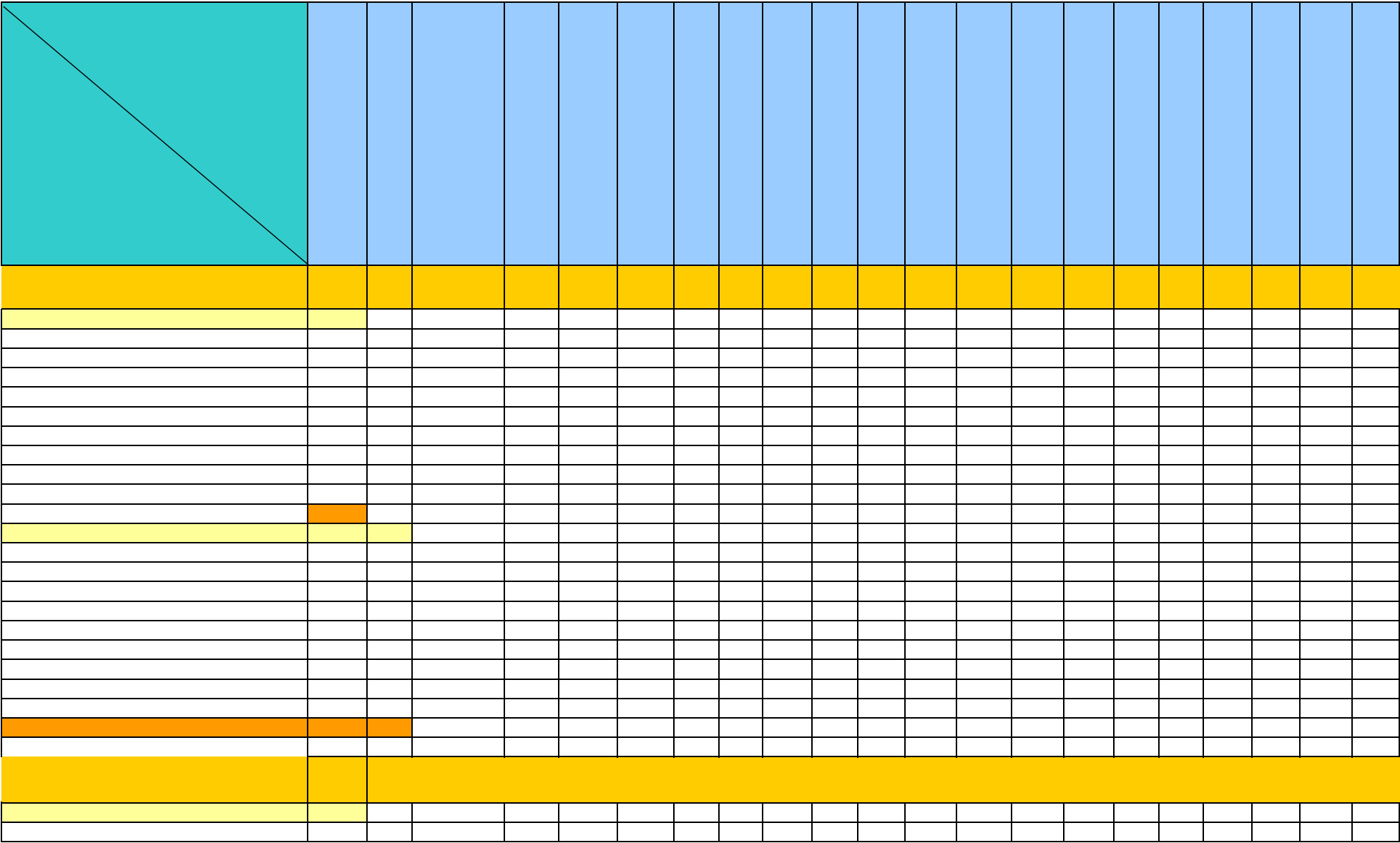
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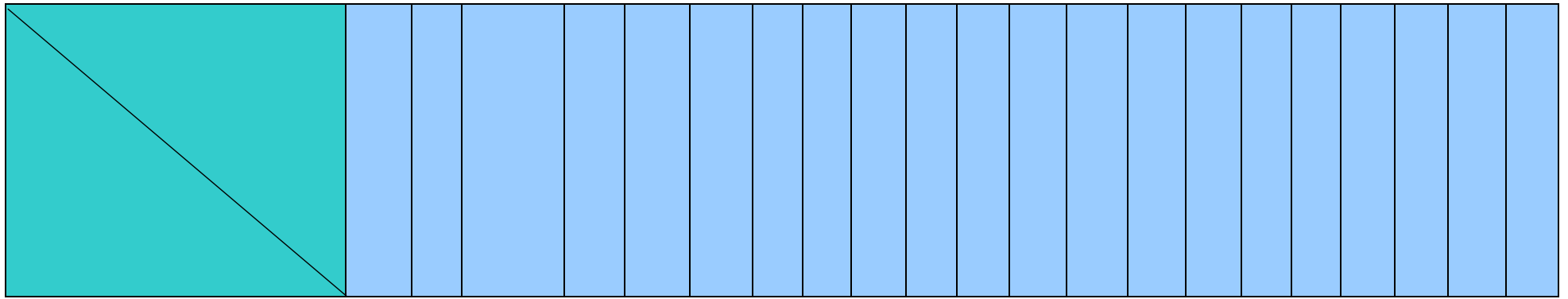
(Bloom's Taxonomy)

1() 2 3 4 5 6()

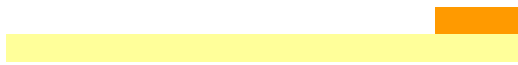
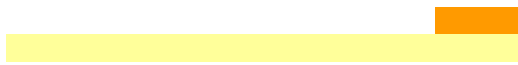
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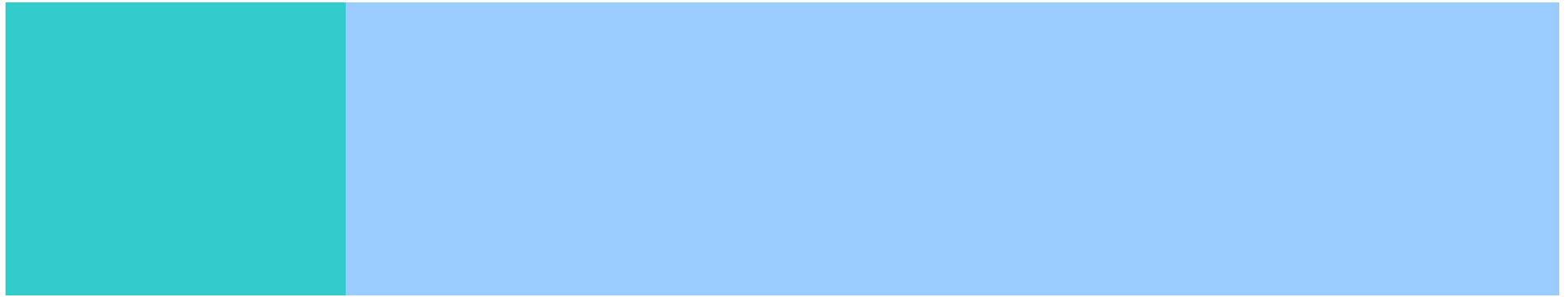
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	Synthesis		Design() Create() Organize() Reconstruct()	() ()
	Analysis		Analyze() Break down() Identify() Present() Formulate() Subdivide()	() ()
	Application		Apply() Conduct() Solve() Use()	
	Comprehension	“ ”	Explain() Distinguish() Paraphrase() Summarize() Generalize()	
	Knowledge	,	Define() Label() List() Recite() Select()	





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	Evaluation		Appraise() Interpret() Criticize() Justify() Support()	()
	Synthesis		Design() Develop() Create() Compose() Organize() Reconstruct()	()
	Analysis		Analyze() Break down() Identify() Present() Formulate() Subdivide()	()
	Application		Apply() Conduct() Solve() Demonstrate() Compute() Relate() Use()	
	Comprehension	”	Explain() Distinguish() Paraphrase() Summarize() Generalize()	“
	Knowledge	,	Define() Label() List() Recite() Select()	

	2.1	2.1.1	4	()
			3	()
			3	()
			2	()
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	2.2			()
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			4	()
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 c

$$c = \frac{dq}{dT} \quad c = \frac{dq}{dt}$$

$$dq = du + pdv \quad dq = dh - vdp$$

$$dp = 0$$

$$c_p = \frac{dq}{dT} = \frac{dh - vdp}{dT} = \frac{\partial h}{\partial T}_p$$

$$c_p$$

$$dh = \frac{1}{m} dQ_p$$

$$c_p \Big|_{t_1}^{t_2} = \frac{Q_p}{m(t_2 - t_1)}$$

$$m_w = \frac{p_w(V/\tau)}{R_w T_0}$$

R_w

$$R_w = 461$$

T_0

$$m_g = \frac{p_g(V/\tau)}{RT_0}$$

R

$$R = 287$$

Q_p'

$$Q_p = UI$$

Q_p

t_1

t_2

t_1

t_2

t_1

t_2

t_0

t_w

$$V = 36 / \tau$$

 τ

$$m_g = \frac{(1 - y_w)(1000B_1 + 9.81\Delta h) \times (36 / \tau)}{287(t_0 + 273.15)}$$

$$m_w = \frac{y_w(1000B_1 + 9.81\Delta h) \times (36 / \tau)}{461.5(t_0 + 273.15)}$$

$$\begin{array}{cccccc} t_0 = & t_w = & t_f = & B_t = & t_1 = & t_2 = \\ \tau = & \Delta h = & Q_p & & t_0 & t_w & \varphi = \\ d = & & & & & & \end{array}$$

$$y_w = \frac{6.3 / 622}{1 + 6.3 / 622}$$

$$Q'_p = 3.6 \times Q_p = 3.6 \times 41.842 = 150.632$$

$$m_g = \frac{(1 - 0.010027) \times (1000 \times 99.727 + 9.81 \times 16) \times 36 / 69.96}{287(8 + 273.15)} = 0.63048$$

$$m_w = \frac{0.010027(1000 \times 99.727 + 9.81 \times 16) \times 36 / 69.96}{461.5(8 + 273.15)} = 0.0039755$$

$$Q_w = 0.0039755 [1.833(240.3 - 8) + 1.556 \times 10^{-4} (240.3^2 - 8^2)] =$$

$$c_{pm} \Big|_8^{240.3} = \frac{150.632 - 1.728}{0.63048(240.3 - 8)} = 1.0167$$

v

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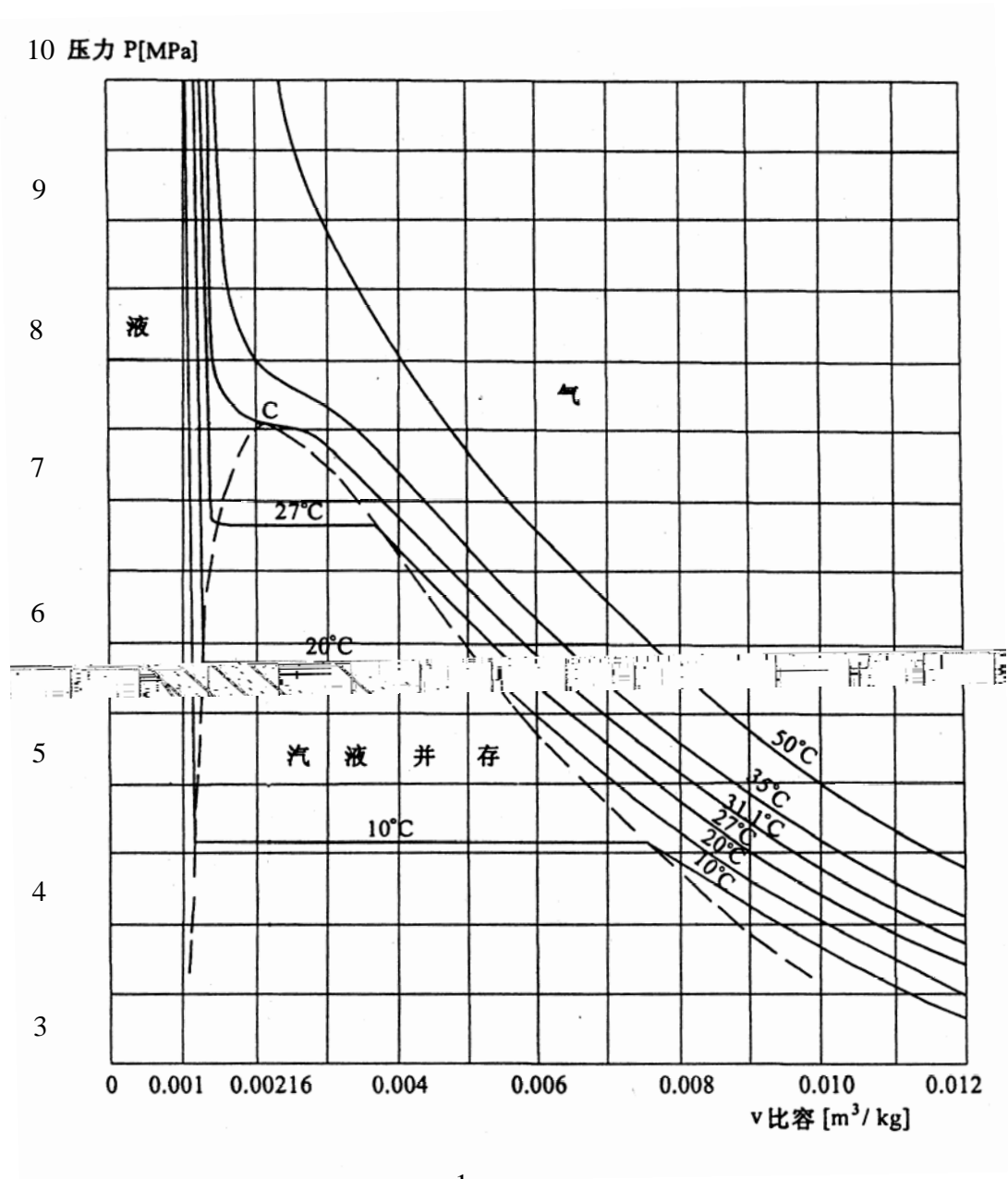
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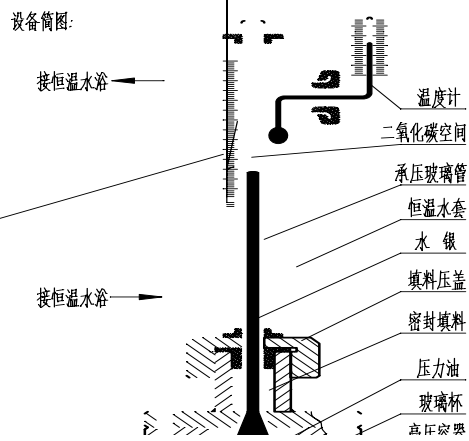
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v v v v v v



v

v

v

	Δh	$v = \frac{\Delta h}{k}$			Δh	$v = \frac{\Delta h}{k}$			Δh	$v = \frac{\Delta h}{k}$	

() CO₂ () CO₂

1 CO₂ 25 7.8MPa V = 0.00124 m³/kg

2 25 7.8MPa 7.7 MPa CO₂ Δ ,

h₀— () h'—

3 m— A— () h—

K—

$$v = \frac{\Delta h_0 * A}{m} = 0.00124 m^3 / kg$$

Δ Δ Δ

$$v = \frac{h - h_0}{m/A} = \Delta h / K$$

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L

$$h_f = \frac{p_1}{\gamma} - \frac{p_2}{\gamma} = \Delta h$$

$$h_f = \lambda \frac{L}{d} \cdot \frac{v^2}{2g}$$

λ

$$\lambda = \frac{2gdh_f}{Lv^2}$$

()

()

()

7 8

()

3 4

13

()

d= _ mm

L= _ mm

NO	h_3 (cm)	h_4 (cm)	h (cm)	V (cm ³)	Q (cm ³ /s)	v (cm/s)	λ
1							
2							
3							

()

() (30° 45°) ;
 ()



(l_1 l_2)

h_{u1}

$$h_{u1} = \frac{p_5 - p_6}{\gamma} = \Delta h_1$$

(l_1 l_2)

h_{u2}

$$h_{u2} = \frac{p_7 - p_8}{\gamma} = \Delta h_2$$

$$\xi = \frac{2(h_7 - h_8) - (h_5 - h_6)}{v^2 / 2g}$$

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13

()

	h_5 cm	h_6 cm	Δh_1 cm	h_7 cm	h_8 cm	Δh_2 cm	$2\Delta h_2 - \Delta h_1$ cm	v cm/s	Q cm ³ /s

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$$\frac{p_1}{\gamma} + \frac{a_1 v_1^2}{2g} = \frac{p_2}{\gamma} + \frac{a_2 v_2^2}{2g} \quad (1)$$

$$v_1 \omega_1 = v_2 \omega_2 = Q \quad (2)$$

$$a_1 = a_2 = 1$$

() ()

$$Q = \frac{\frac{\pi d_2^2}{4}}{\sqrt{1 - \left(\frac{d_2}{d_1}\right)^4}} \cdot \sqrt{2g \cdot \frac{p_1 - p_2}{\gamma}}$$

$$\frac{P_1 - P_2}{\gamma}$$

Δh

$$k = \frac{\pi d_2^2}{4} \cdot \sqrt{2g} \cdot \sqrt{1 - \left(\frac{d_2}{d_1}\right)^4}$$

$$Q = k \cdot \sqrt{\Delta h}$$

Δh

Q_0

Q_0

$$u = \frac{Q_0}{Q}$$

u

u

Q_0

()

d_1 d_2

k

()

()

()

()

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()

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NO	h_1 (cm)	h_2 (cm)	h (cm)	V (cm ³)	Q (cm ³ /s)	v (cm/s)
1						

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$$\frac{p_1}{\gamma} + \frac{v_1^2}{2g} = \frac{p_2}{\gamma} + \frac{v_2^2}{2g} + \zeta \frac{v_2^2}{2g}$$

$$\zeta = \frac{\frac{p_1 - p_2}{\gamma} + \frac{v_1^2 - v_2^2}{2g}}{\frac{v_2^2}{2g}}$$

NO	h_{10} (cm)	h_9 (cm)	h (cm)	V (cm ³)	Q (cm ³ /s)	v (cm/s)
1						
2						
3						

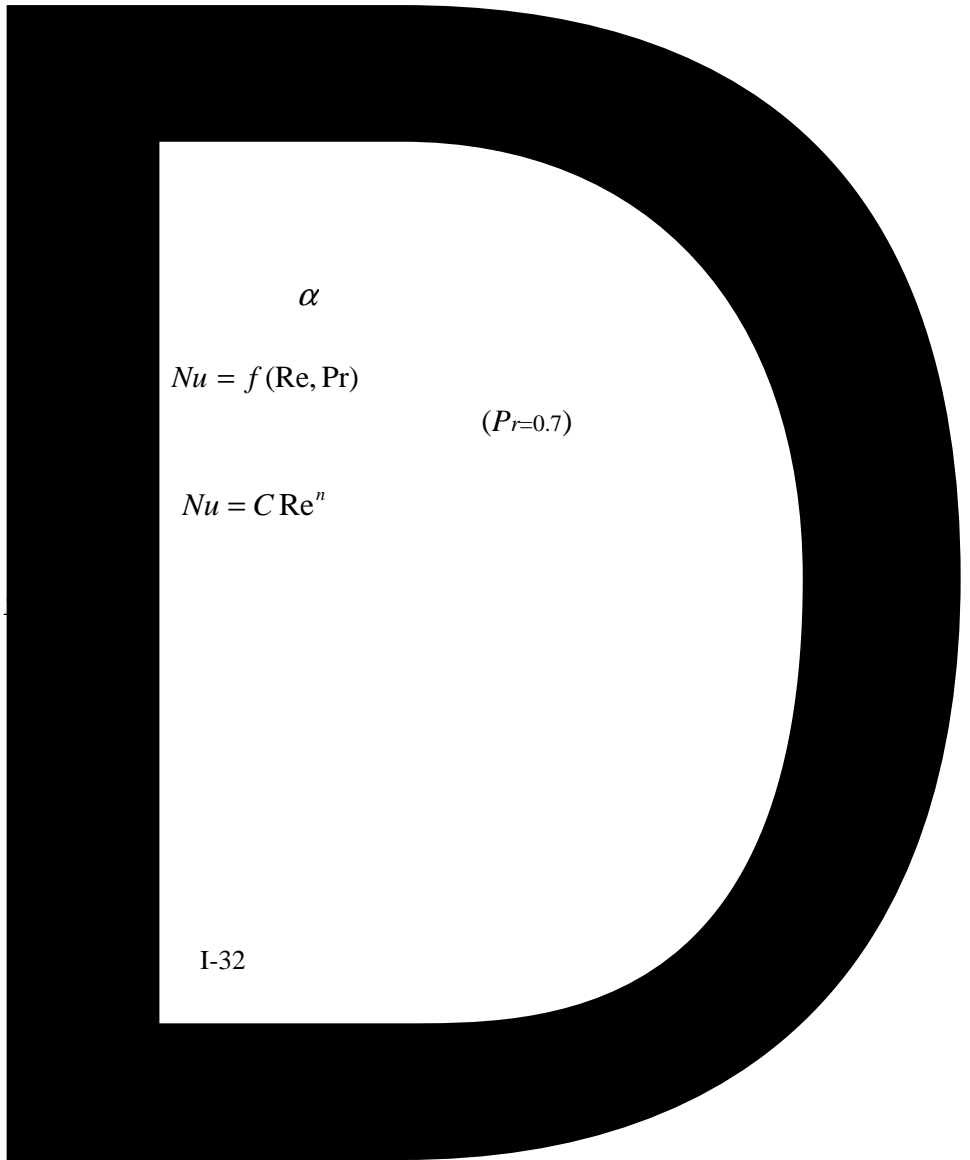
()

$$\frac{p_3}{\gamma} + \frac{v_3^2}{2g} = \frac{p_4}{\gamma} + \frac{v_4^2}{2g} + \zeta \frac{v_4^2}{2g}$$
$$\zeta = \frac{\frac{p_3 - p_4}{\gamma} + \frac{v_3^2 - v_4^2}{2g}}{\frac{v_4^2}{2g}}$$

NO	h_{11} (cm)	h_{12} (cm)	h (cm)	V (cm ³)	Q (cm ³ /s)	v (cm/s)
1						
2						
3						

1
2
3

α



α

$$Nu = f(Re, Pr)$$

$(Pr=0.7)$

$$Nu = C Re^n$$

C,n

Nu

$Nu =$

Re

[m/s]

[m²/s]

$$t_m = \frac{1}{2}(t_w + t_f)$$

[]

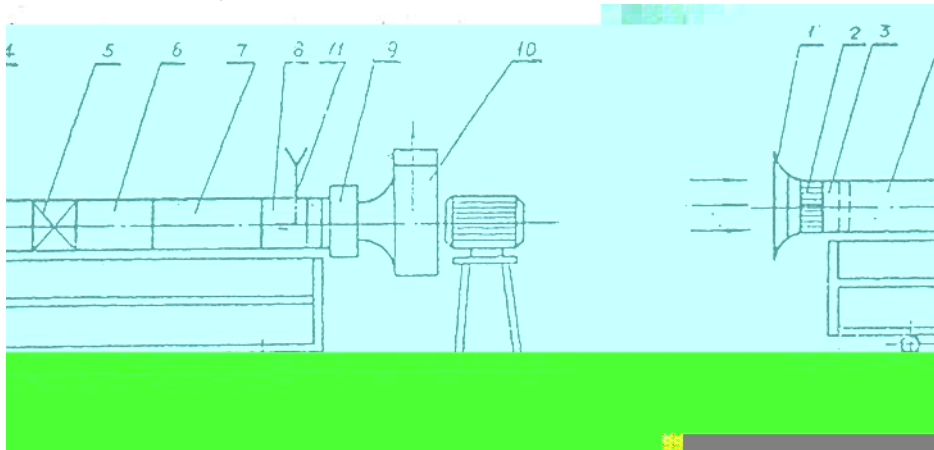
C n

I V t_w t_f h α

Re Nu

Nu Re

5-13 ()



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- 3-
- 4-
- 5-
- 6-
- 7-
- 8-
- 9-
- 10-
- 11-

1

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3

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180V

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Re

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α

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Q

$$Q_c = Q - Q_r = W - Q_r$$

$$Q_r = \epsilon C_0 A \left[\left(\frac{T_w}{100} \right)^4 - \left(\frac{T_f}{100} \right)^4 \right]$$

Q_r

[W]

W

[W]

=0.6~0.7

C_0

$C_0 = 5.67 [w/(m^2 K^4)]$

T_w

[K]

T_f

[K]

A

[m²]

$$\alpha = \frac{Q_c}{(T_w - T_f)A} \quad [W/m^2]$$

α

Nu

2

t_m

v

$$\omega(m/s) = \sqrt{\frac{2P(pa)}{\rho(kg/m^3)}}$$

$$Re = \frac{\omega d}{\nu}$$

3

Nu

Re

lgC

n

$$\lg N_u = \lg C + n \lg Re$$

$$n = \frac{\lg N_{u_2} - \lg N_{u_1}}{\lg Re_2 - \lg Re_1}$$

$$C = \frac{N_u}{Re^n}$$

$$N_u = C Re^n$$

[]

C, n

C, n

1

2

$$N_u = C Re^n$$

1.

2.

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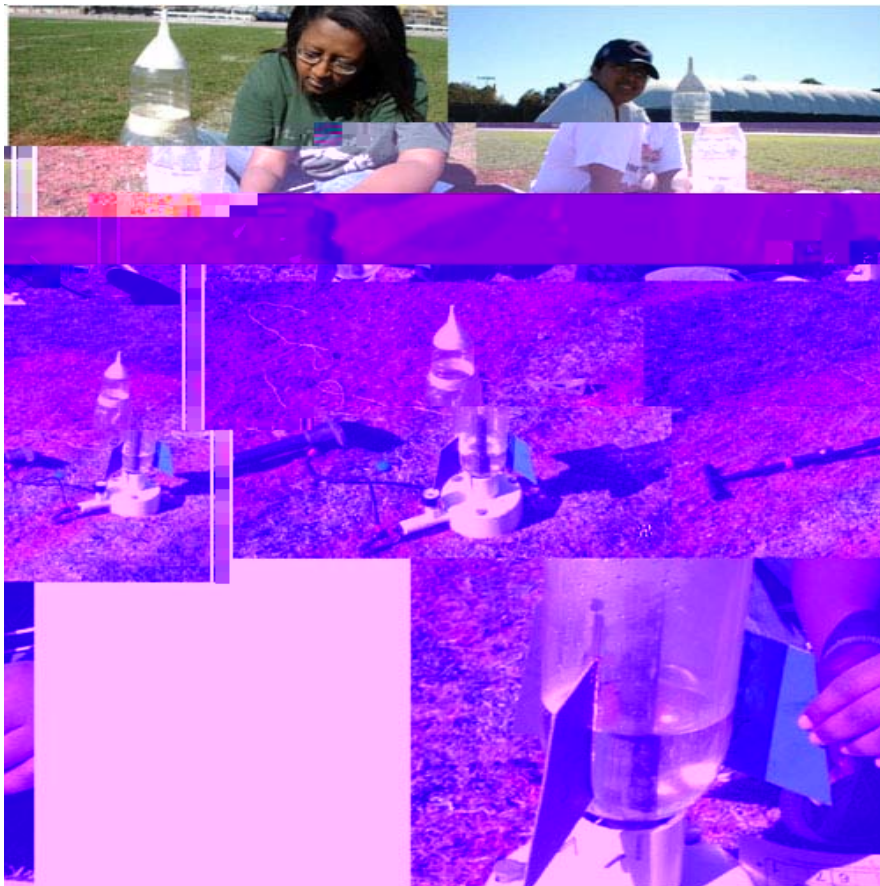
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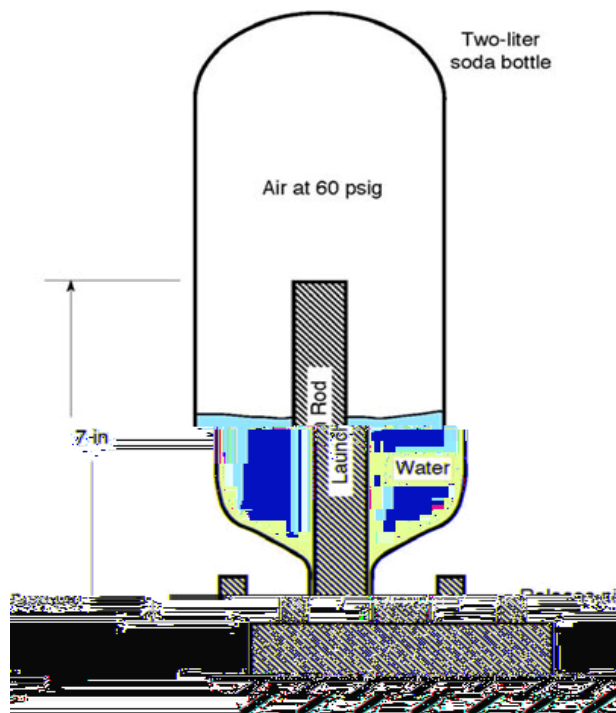
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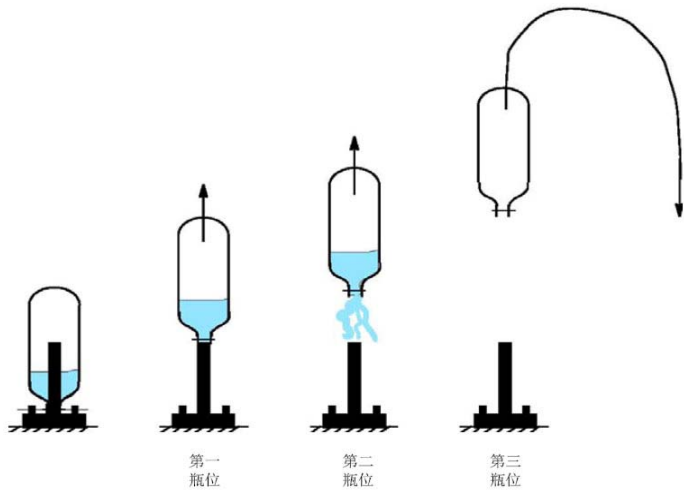
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	h	
	V	
	T	
	g	
	$Pair$	
	C_D	
	A_{bottle}	
	m	
	p_{water}	
	u_e	
	A_{throat}	
	p	
	p_{atm}	
	Vol	

$$h_i = V_i$$

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⑪