

Physik



Acht Experimente für Schüler und Lehrer

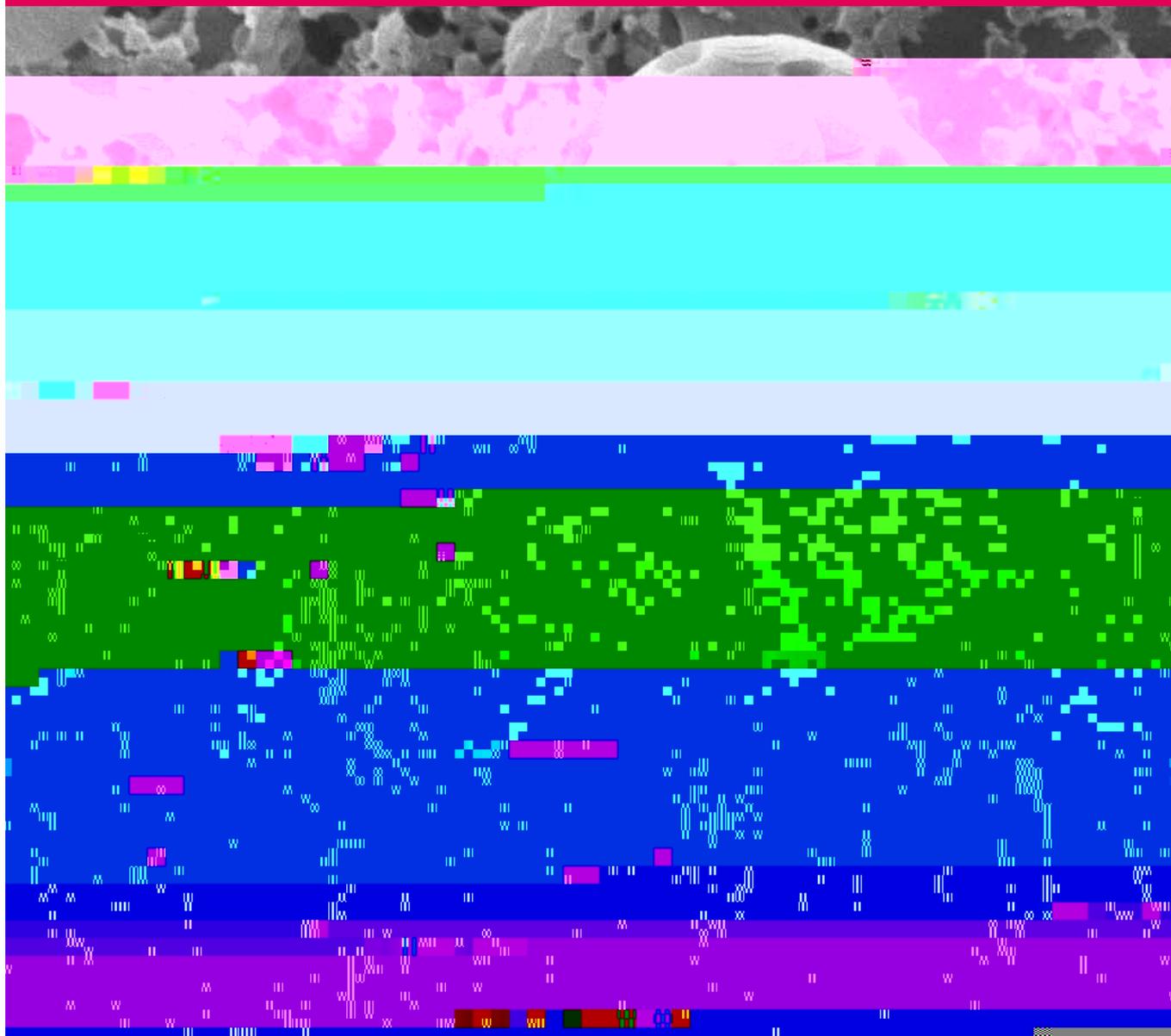


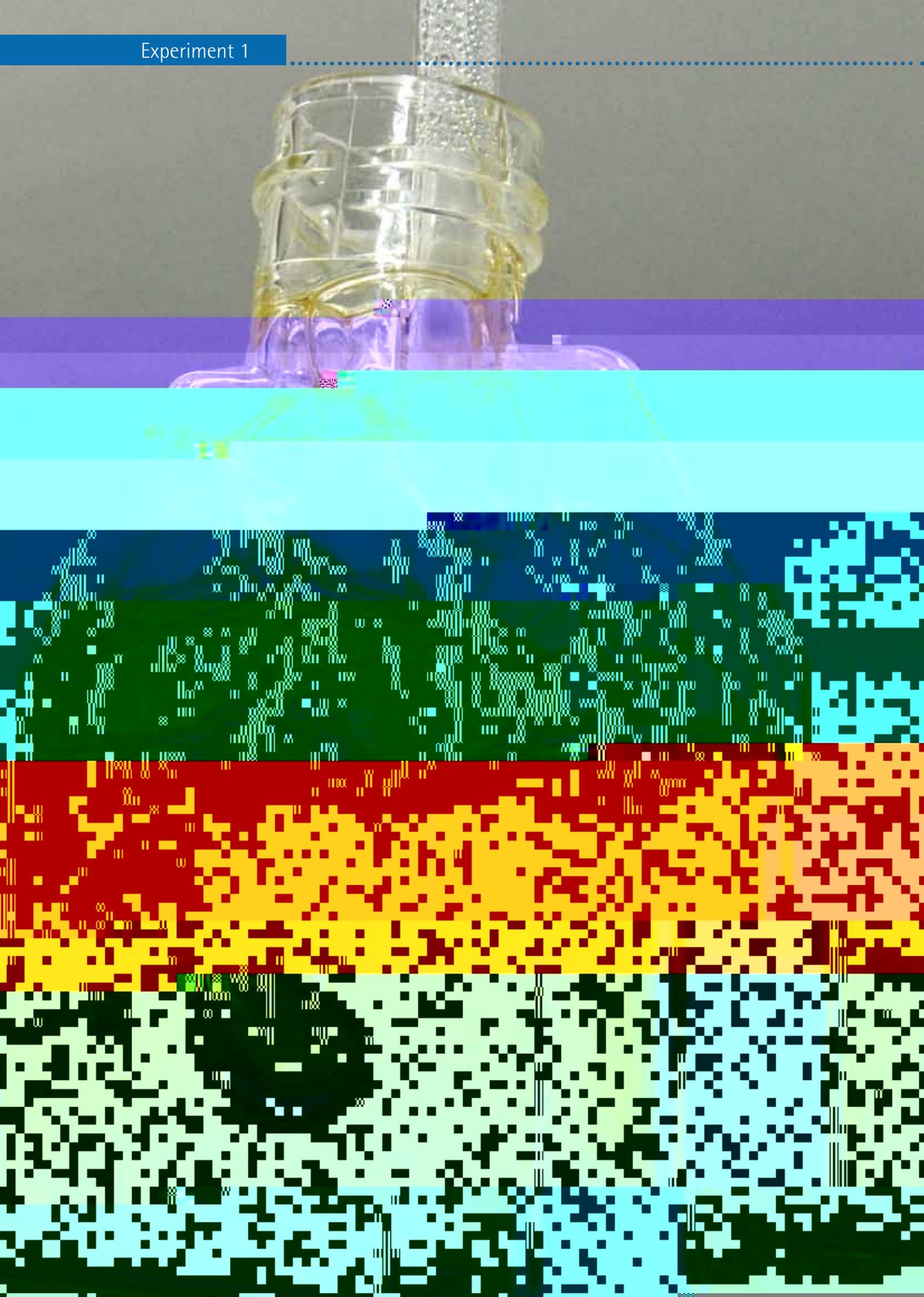
Physik

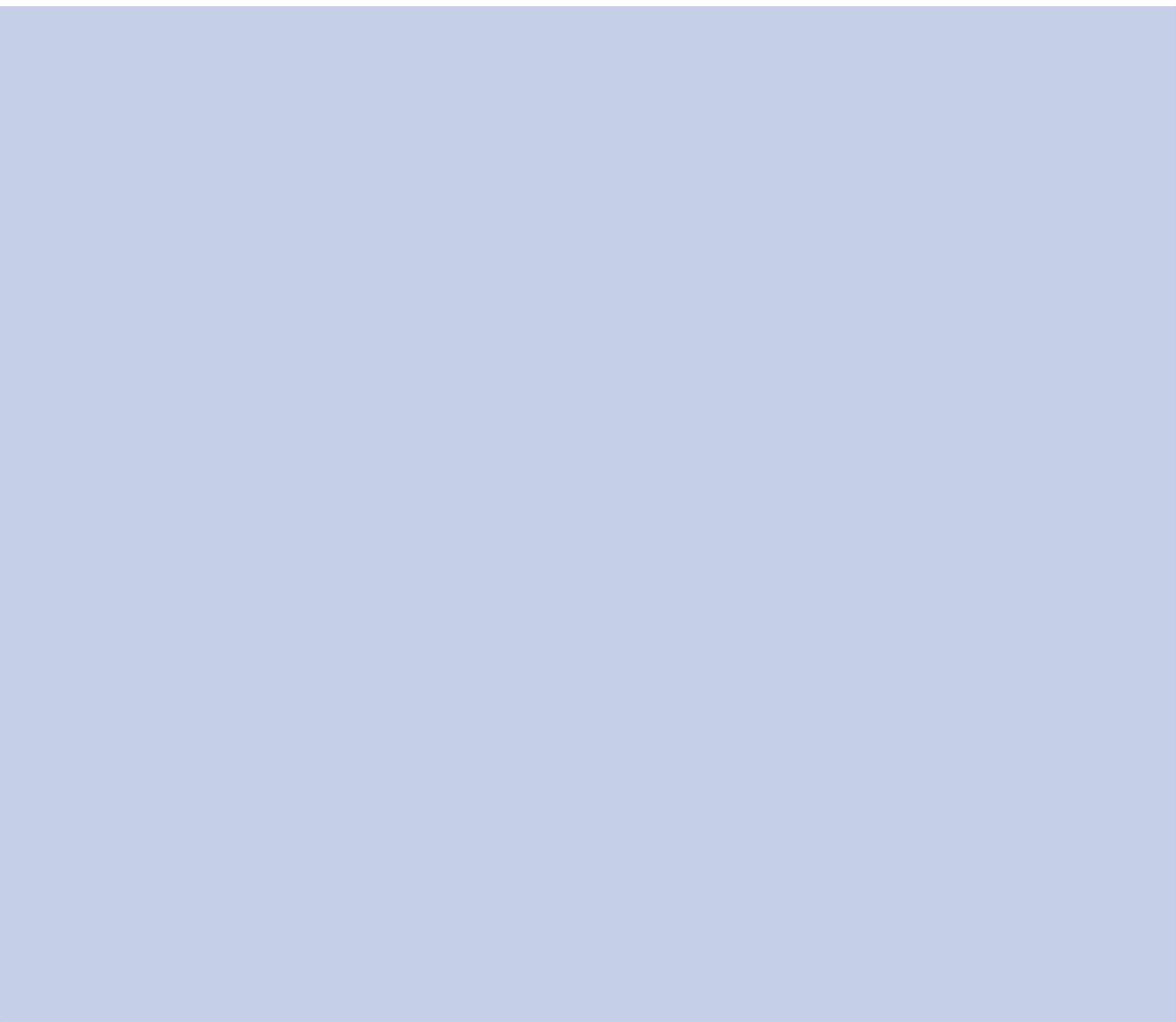


• • • t t pt • • • M t -
, t • • t t t t t p tN
t • , 2 t, t pt • t •
t p M .
t t t t t W t t p • t p • M ,
t t t t t t p t t
• p t 201 t , • W -
W M t t - -
t t, t t p t. W t t, t t p -W t.
• t t t M t t • t
• t t t M • .

Die Coccolithophoride *Calcidiscus* heute...







1. \bullet t tW .
 t t W ,
 t M .
 p tt t ,
 W \bullet t t .
 M t t .
 t W .

2. t t t t . t
 t \bullet ,
 \bullet t tt , \bullet $p - W$ t
 W \bullet t t .
 t , \bullet \bullet t
 t .

3. t \bullet t tW
 t p t , t t W

A

1. W \bullet , W p t t , t \bullet \bullet -
t. t t , t 2 \bullet t t \bullet t W \bullet .
t t \bullet , M t 2 t
t 2- \bullet W , \bullet t , t t t 2 t p .



4

2. p t \bullet t W t t t
t t p . t W t \bullet M t t \bullet
t t \bullet M t . t
 \bullet t p .

W \ddagger E \ddagger

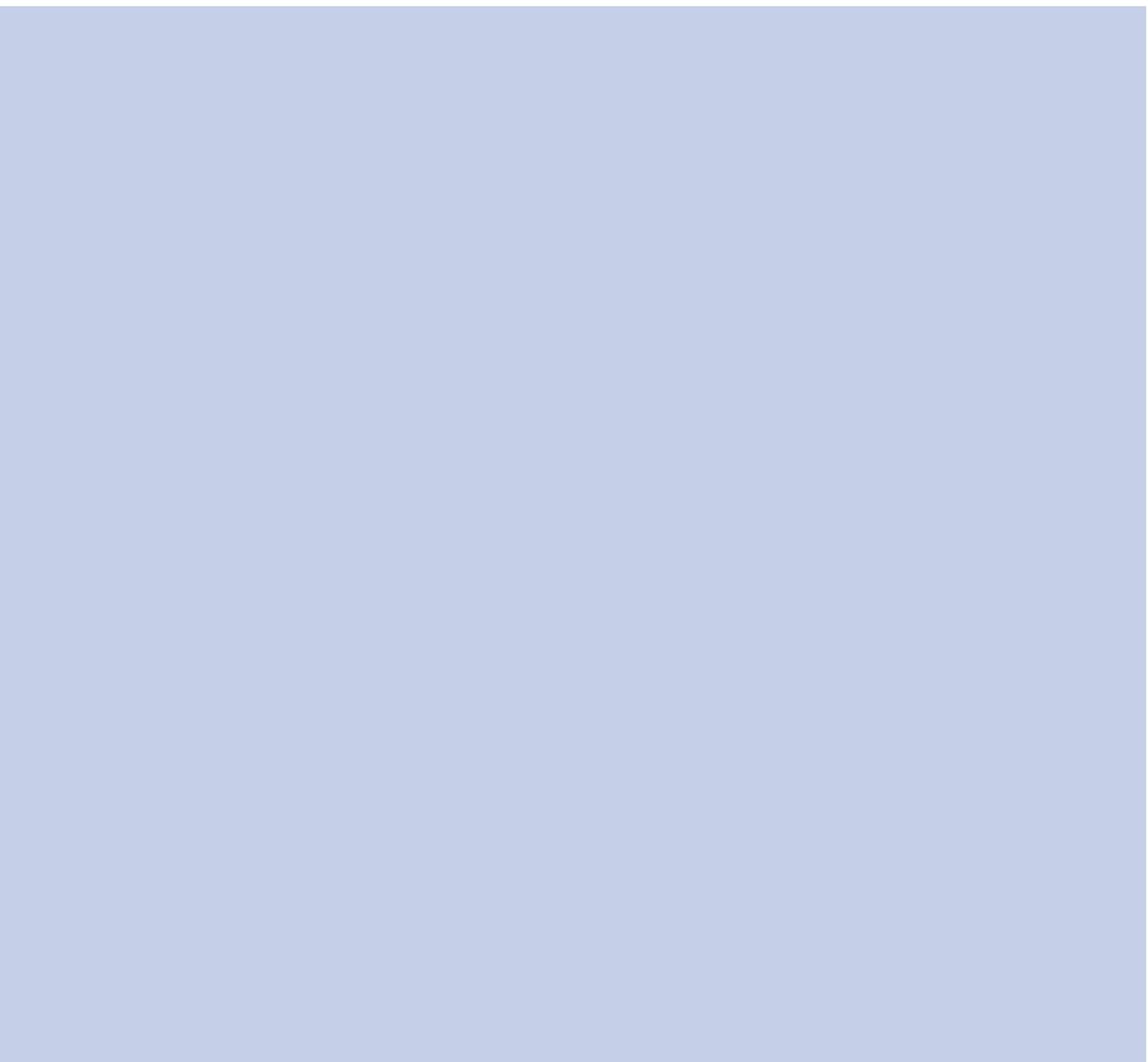
1. \bullet t \bullet \bullet t t W , t -
M . t t W \bullet t t M -
, t () t t , \bullet t t .

2. \bullet t t \bullet \bullet W \bullet t t t t ,
t W . \bullet t \bullet t t .N
 \bullet , \bullet t \bullet t t , \bullet \bullet
1. t .N \bullet p t \bullet t ,
t \bullet t t \bullet t \bullet 2 t t .



V G O A₁

, M t t t • • t W -
 • . • p t M t t (2) t W t -
 2 t p t t t p . t t
 • t • • t t p t t , W • •



1. t t t M t -
t . t
t W . t t .
t t ,
. W t .
, t t , t .
t , W
t t.

2. t t t t
W . t -
tt . -
, t t .
t . t ,
t W p -
t t t
t W .

3. 0 0 22 2 t 2 0 0 0 4 1 0 0 0 0

16(2D35L5-2B73)TJ 022032 172r0244 32 172r05J3030202r023730 b56 W172034A

A

1. $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$

$\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$
2. $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$

$\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$
3. $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$

$\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$
4. $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$

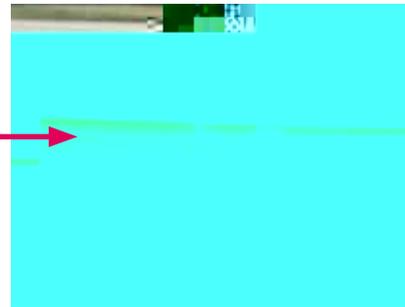
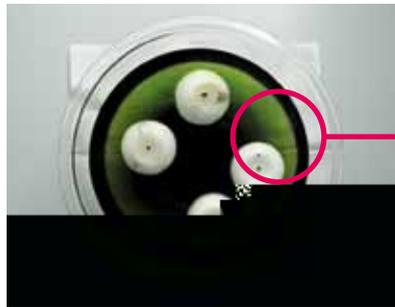
$\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$

V



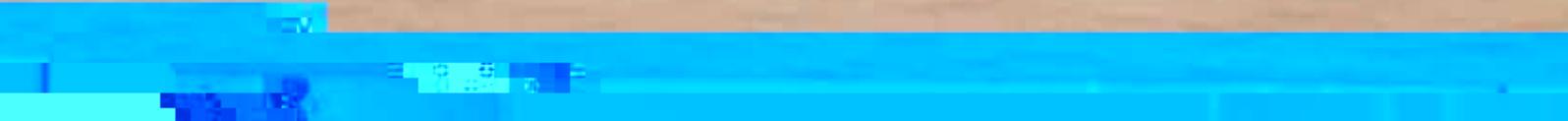
N



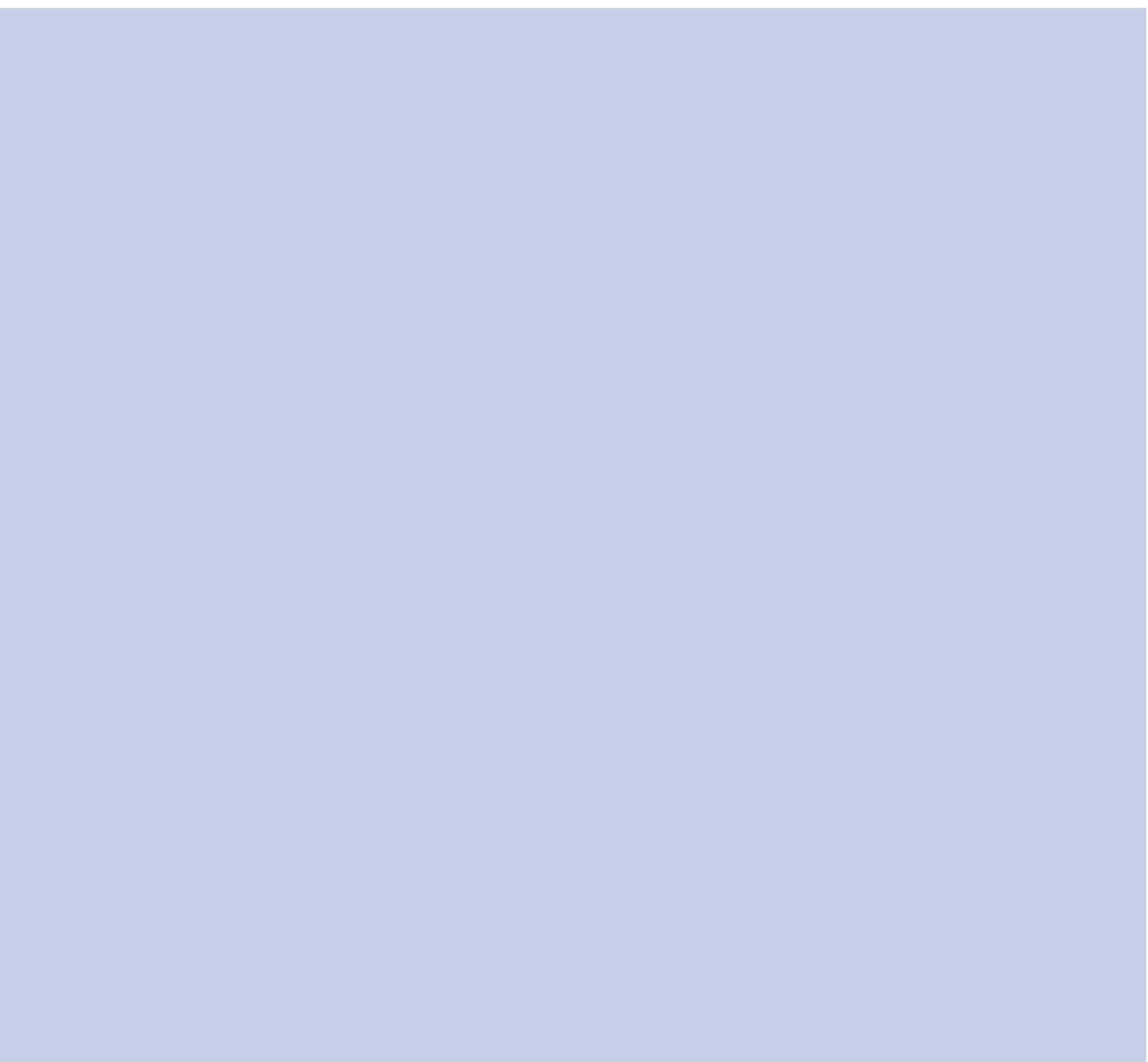
$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$
 $\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$
 $\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$
 $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$

W \uparrow E \uparrow

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$
 $\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$
 $\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$
 $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$



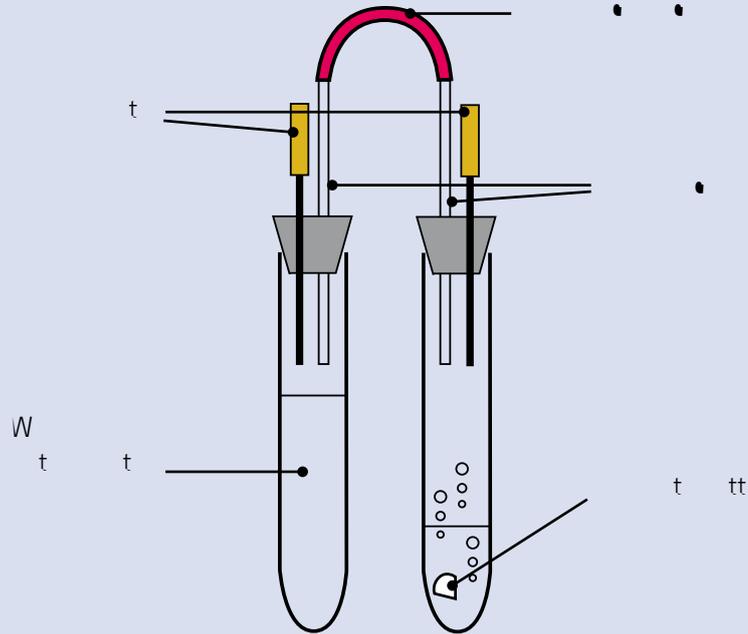
V M -
 D K f f A f
 t - t t t • t • t •
 t (2)



1. $t \bullet$ -
 t $t p$ -
 \bullet t \bullet \bullet

2.

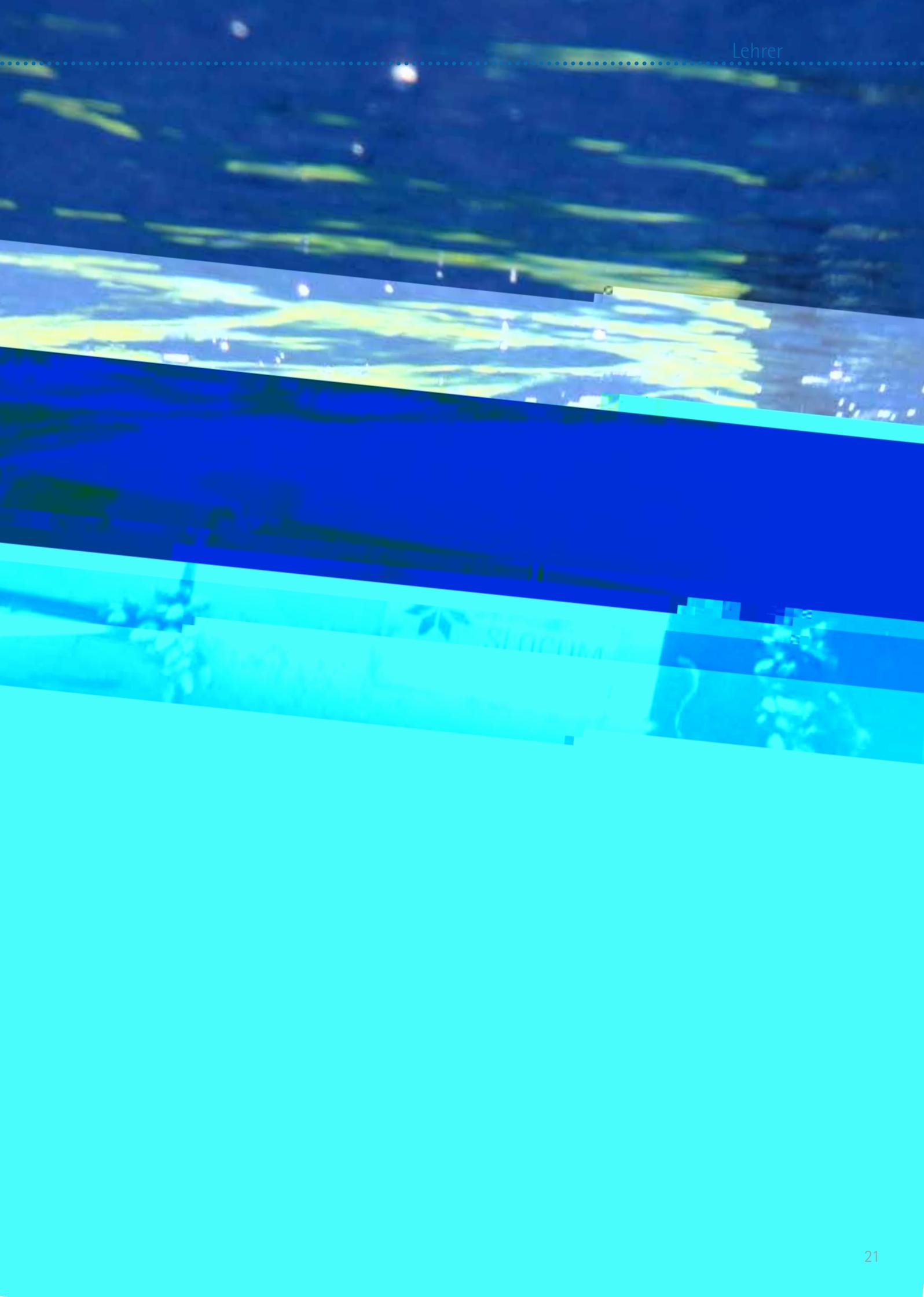
V



	0		1/4		1/2		3/4		1		1 1/4	
	p ()	/p										

E

- 1.
- 2.
- 3.





W † T † L • † CO₂ W ?

t t t (2) t p , t t • t
 • p t t . t W t p t p t -
 t t W , 2 W t
 • t
 • p t t t, • t W .
 t • , M -
 . t t 2- p • . t
 t p t M 2 t p . Mt • W . p -
 . W t , t 2 t . p t t t t

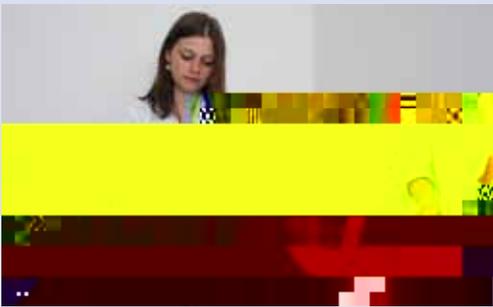
I †

Ar 10 M t
 te 1 20 M t
 11 1
 - , - p t • t, • • t t t
 20 M t
 JO 030002 3 0 5 5 0 0.0 (3) 2 0 + 0 0 3 at

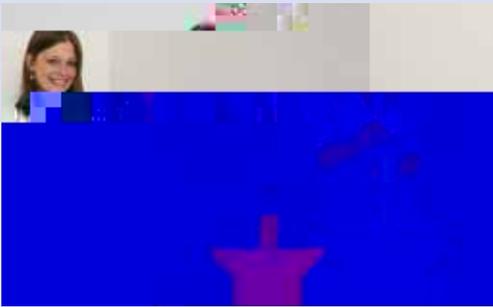
V



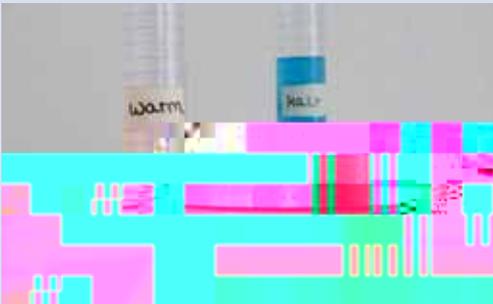
1: t t t



2: t t



3: t t M
p t.



4: t M
t W t t

1. W t t t t
W .

2. M t W
t t p
W t . t , W
p p t , t t .
t t t -
M .
t . N
t t , t

3. t M . p t
t t . t
M t . t
t t .

4. t t t t . t .
t t t . W . t ,
t t t pt
t . N t t
t t . W
t .

5. t W t

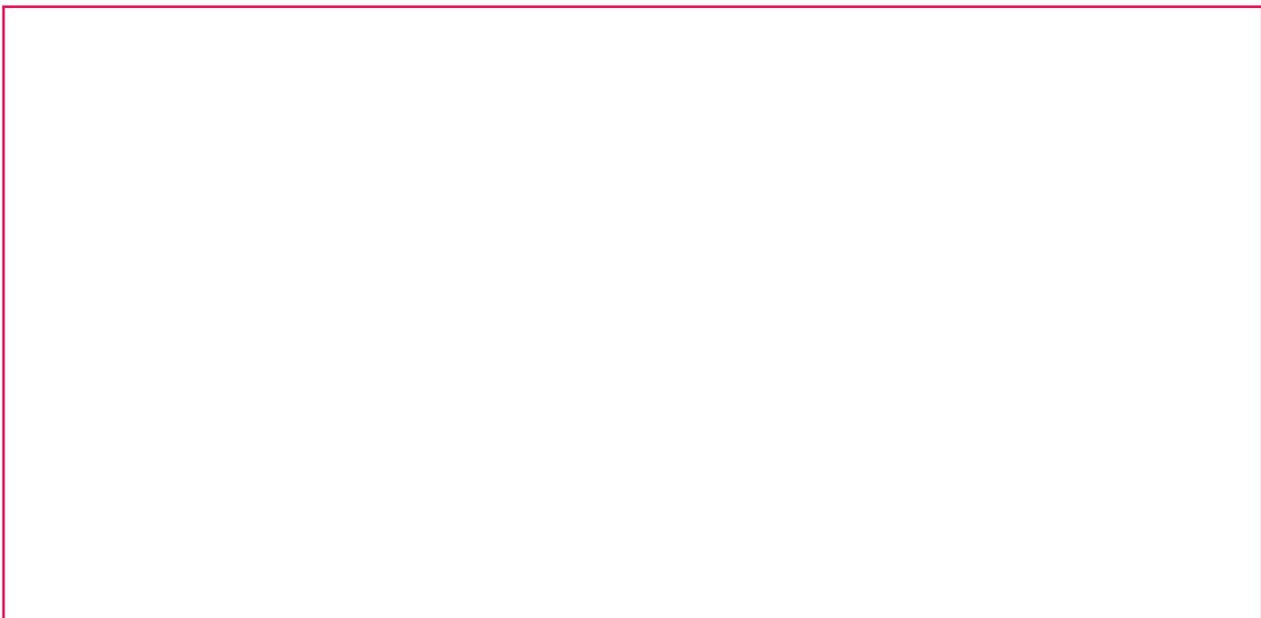
1		
2		
3		

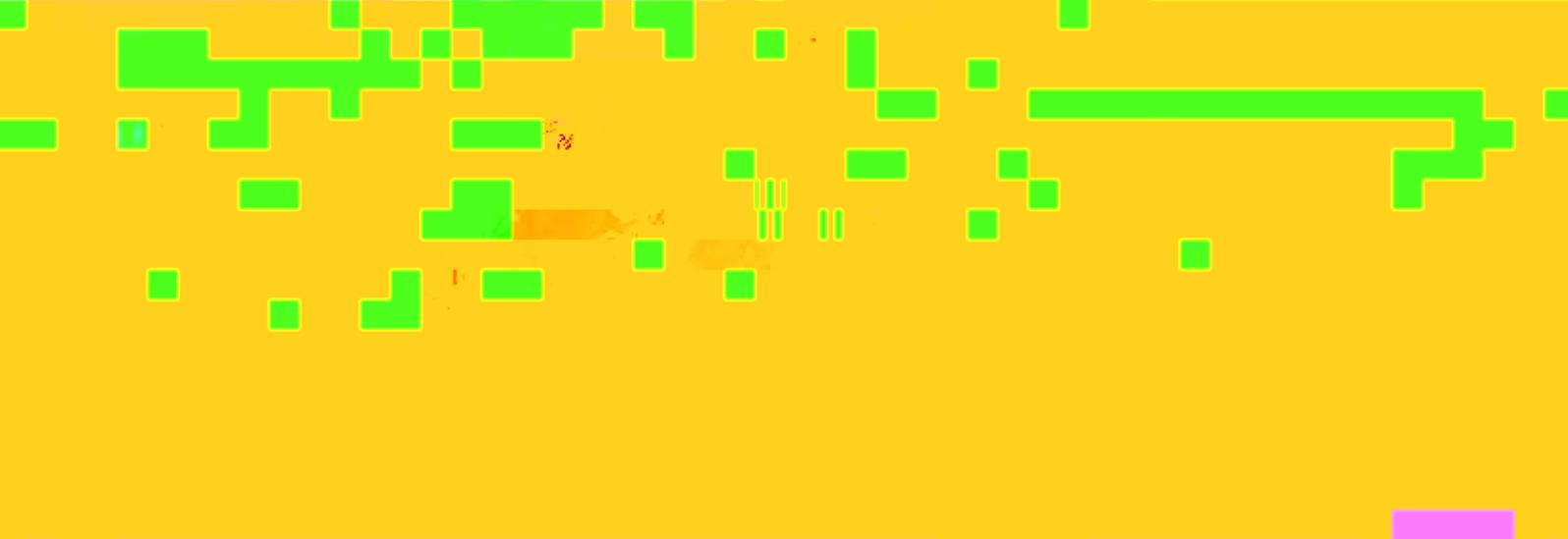
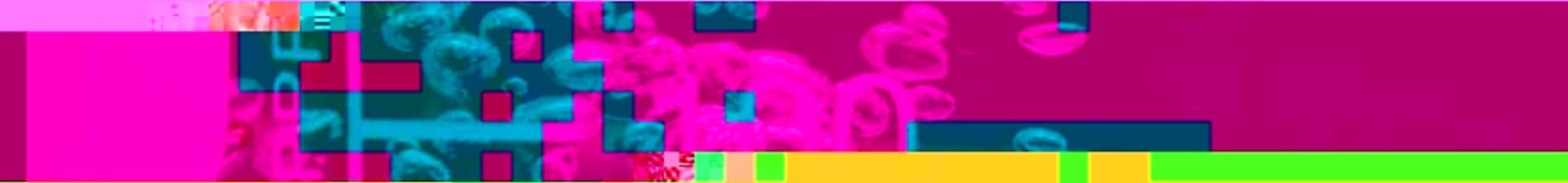
E

A

1. W • t tt t , 2 . t t ,
 • M t, tp • t 2(), • t W t
 t W • , t tt t t, t • t , t
 t • tW • t

2.





D F W CO₂-G L M

M 0 t tW t t t t !N
 t t t t t t M .W
 t t t t p p -W t M
 M (2) , t W t t t,
 M t t . t t,
 p t t t W W , t
 t t t t M , , t 2- t t .

I

1 M t
 30 M t
 11 1
 t t, t t t
 30 M t
 - - t
 M tt
 t t t , t p t t t
 t t

M

1 t p t
 2 t (00 M t)
 2 p -M t
 p p
 2 t t 2 t p t t
 t t W , M *
 t
 t t
 t pp
 * W t t N t t , t t - t W
 t t .

V

1. \bullet t tM
 t t t t W $.$
 W t p p \bullet
 p t $.$ t $,$
 \bullet t p $t.$

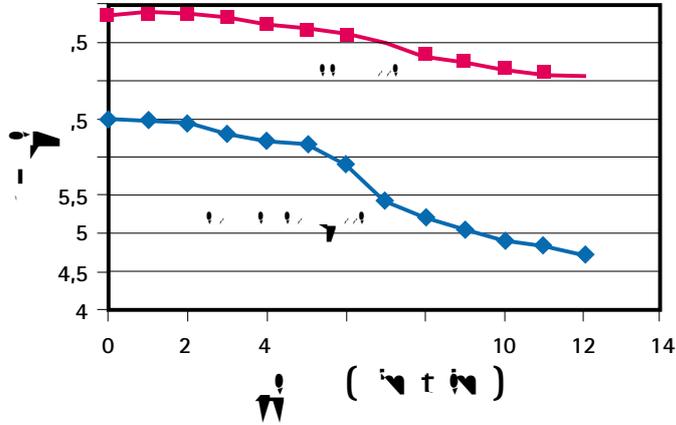
2. t $p - t$ \bullet
 t $p - M t$ $.$
 t t $.$

3. t \bullet t t
 \bullet $.$ \bullet t
 t t $.$ t \bullet t $,$
 \bullet p p t
 $t.$ $p - M t$ \bullet $,$
 \bullet t $t.$

4. M t M t M t
 $p - W$ t t $.$ $M -$
 \bullet tp $($ \bullet 0 30 0.3 $))$ $($ t $)$

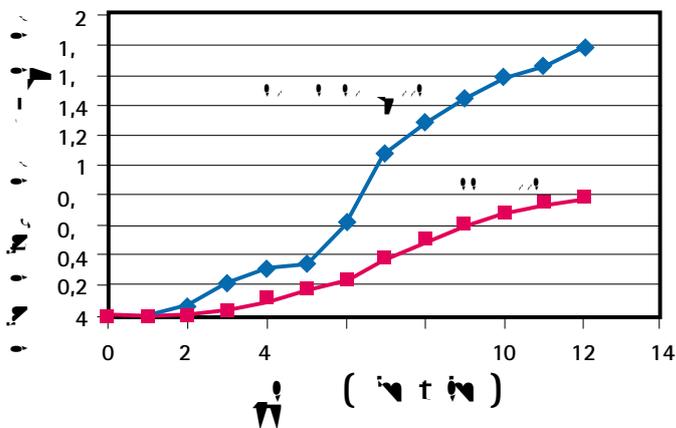
A

1.



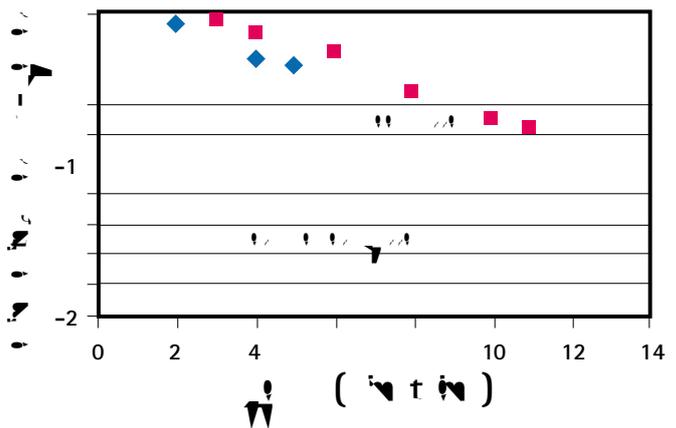
p -W t

p t p -W t t t W M t , 4 ,
 p -W t M , 0 t p -W t -
 t p -W t p t (p t0) p -W t t t
 tp t(p t). tt t t t t p -W t

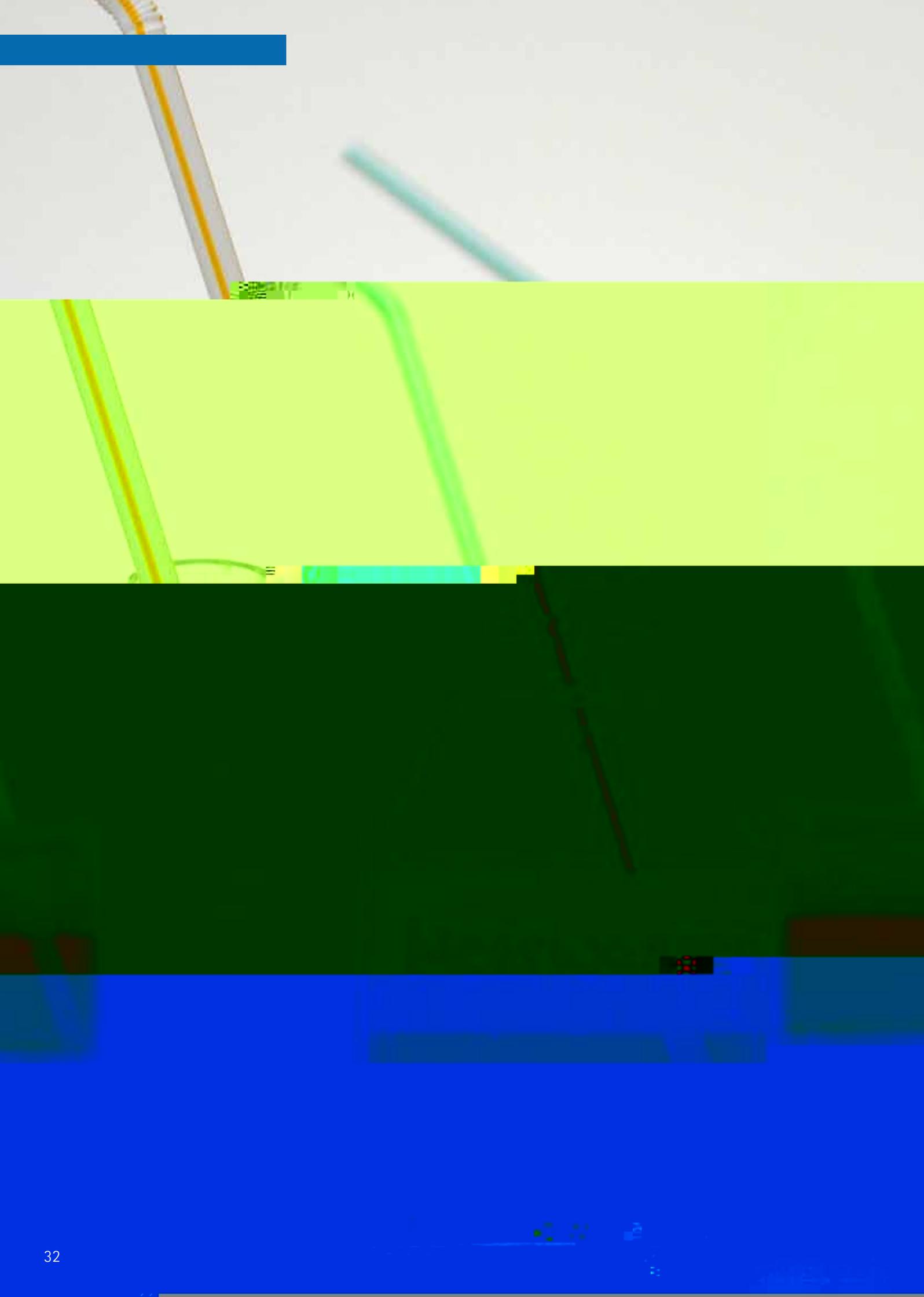


t p -W t

t, p -W t , t, W t t-1 tp . t



t p -W t



H-R H M (HCO₃⁻) : D R K (CO₃²⁻)

t (,) t t t t
 . p t W t (2) t- (3⁻)
 t- (3²⁻). p -W t M t , • M t -
 t t . t p -W t t • • , • ,
 ,. W t 3- . t t p -W t, t t t t
 t- .W • 2 M t, p -W t t.
 • • t W t t t (2 3). t t t t t t .
 W t - , t t , t t -
 t. t t t- t • .
 t t • t M • M t •
 • p -W t t , t • • t t .
 t- t t M t t - -
 . t t t t (, 3), M t , • M • • , -
 t t M t . p t t • t t •
 • , t t p -W t M , t
 • t .

I

M t
 30 M t
 12 1
 • - t • t, • • t t t
 20 M t
 - - t , t
 M t t
 t t t, t • • •
 t • t • t .

M

3 • • t •
 t t W
 M
 •
 N t t(N 2 3)
 N t t(• p , N t) (N 3)
 t (M •) t t
 • p t t
 • t • (p t)

V

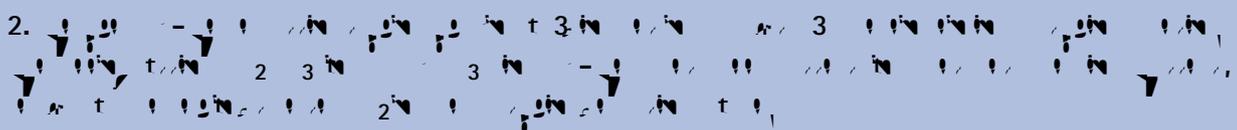
1. t t t W t t M N t -

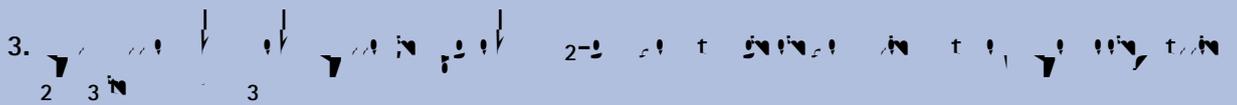
2. t W

3. t

E

1. 

2. 

3. 

A

1. N_2 3 t tt M t 3^{2-} $($ tt
 $t t,$ W t
 $t.$ t t W t t

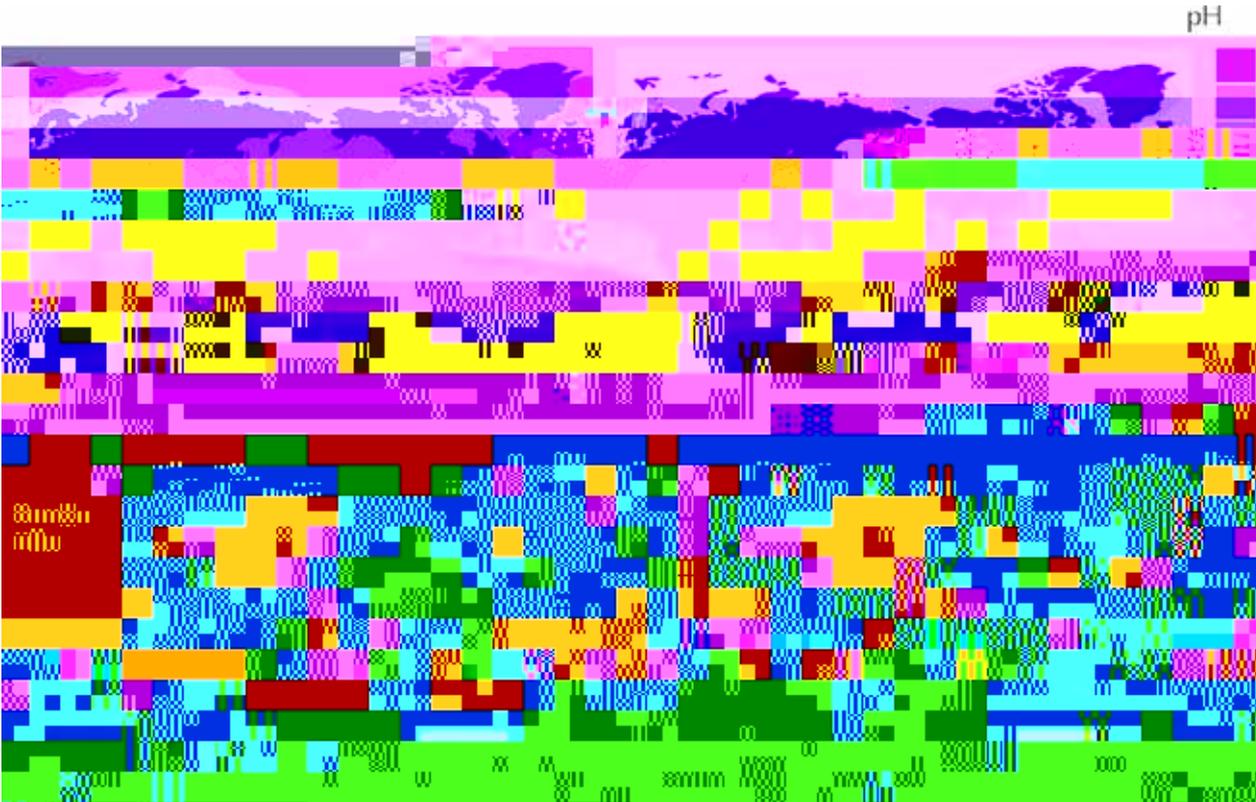
2.

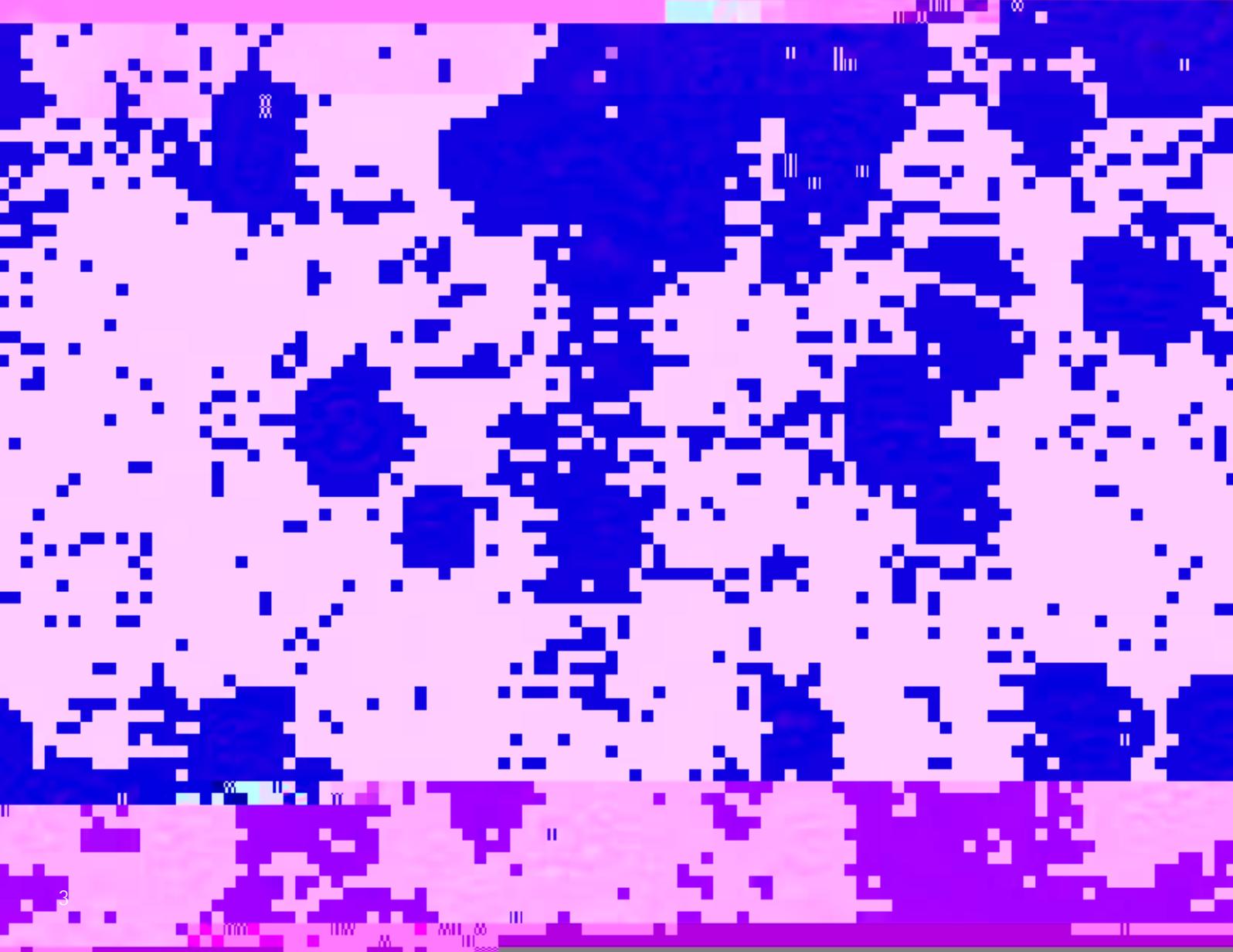
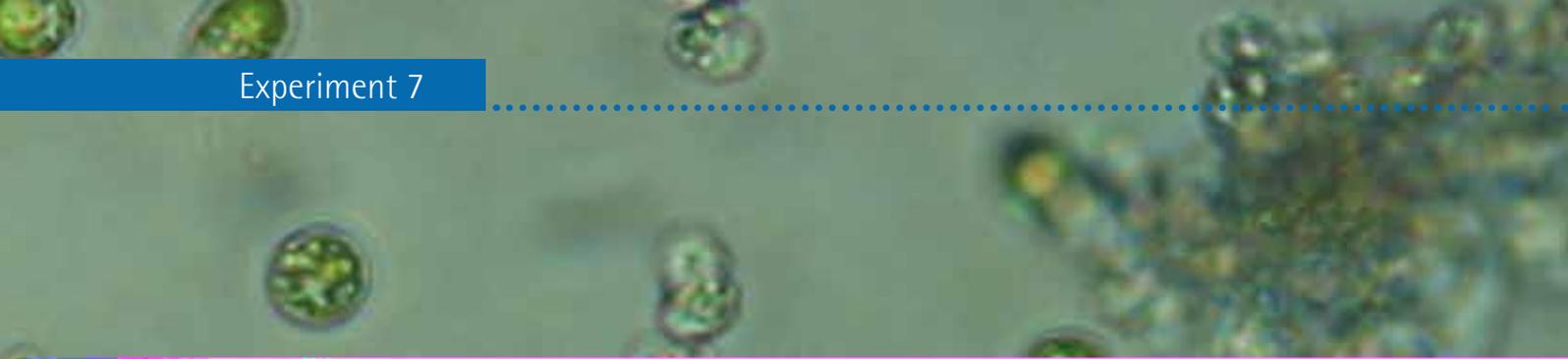
W † **E** †

1. N_2 3 tt $p - W t$ $t t t W$ t $p - W t$
 M $2 t$ t N_2 3 tt $p - W t$
 M 2 $t M$ 3^{2-} $t t t$

2. p $t t W p$ p
 $t W p t N_3 p t$ $t N_2 3$
 $t W p t N_2 3 p t$ $t N_3$
 $t - t$ $p - W t W$ t
 3^{2-} $tt W t$
 $t N_2 3$ tt $t t$
 $p t$

3.1 (3) 3 1 5,1 5, 2050 20 5.
 t p (200)





K **-D** **M** **-K** † (*Dunaliella* sp.)

M M t, , M t (2),
 . . , 2 t t , t t
 , t ' . p t t t, • t 2 W • t M
Dunaliella p. M t. , p t t , • • t

V

1. $t \quad t \quad t \quad t \quad t \quad p \quad t \quad \bullet \quad t \quad - \quad t \quad .$
 $t \quad t \quad \bullet \quad t \quad \bullet \quad t \quad W \quad \bullet \quad t \quad M \quad .$

2. $t \quad t \quad \bullet \quad t \quad \bullet \quad .$
 $W \quad N \quad t \quad 1 \quad M \quad t \quad N \quad t \quad N \quad t \quad \bullet \quad p \quad t \quad t$
 $M \quad t \quad 00 \quad M \quad t \quad t \quad \bullet \quad .$

3. $t \quad t \quad M \quad t \quad t \quad t \quad . \quad M \quad t$
 $\bullet \quad t \quad t \quad . \quad t \quad t \quad , \quad t \quad \bullet \quad \bullet \quad ,$
 $\bullet \quad t \quad t \quad . \quad W \quad \bullet \quad W \quad t \quad \bullet \quad t \quad , \quad t \quad , \quad ,$
 $\bullet \quad t \quad , \quad t \quad .$

4. $p \quad t - \quad t \quad t \quad t \quad t \quad 1 \quad 0 - M \quad t -$
 $M \quad t \quad t \quad t \quad . \quad t \quad t \quad \bullet \quad .$

p .

1 (1): $2 - \quad t \quad \bullet$
 2 (2): $2 - \quad t \quad t \quad - \quad W \quad t \quad t \quad p$
 $\bullet \quad , \quad \bullet \quad t \quad t \quad , \quad 2 -$
 $t \quad t \quad t$
 3 (3): $t - \quad t \quad W \quad t \quad \bullet \quad , \quad \bullet \quad t \quad \bullet \quad t$
 $\bullet \quad t \quad t$

5. $t \quad \bullet \quad t \quad t \quad \bullet \quad t \quad . \quad t \quad 1 \quad 3 \quad t \quad t \quad t,$
 $\bullet \quad t \quad t \quad t \quad . \quad 2 \quad t \quad 30 \quad 0 \quad t \quad t$
 $t \quad .$

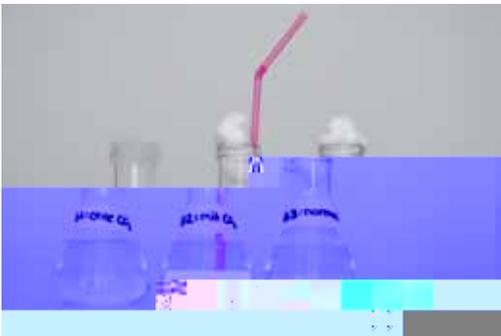
E



A

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

0 N
 4 t 2
 2, t 1 3
 10 2, 3 1
 13 2, 3 t 2, 1 t
 14 t 2 3, 1 t t 2 3,
 t t



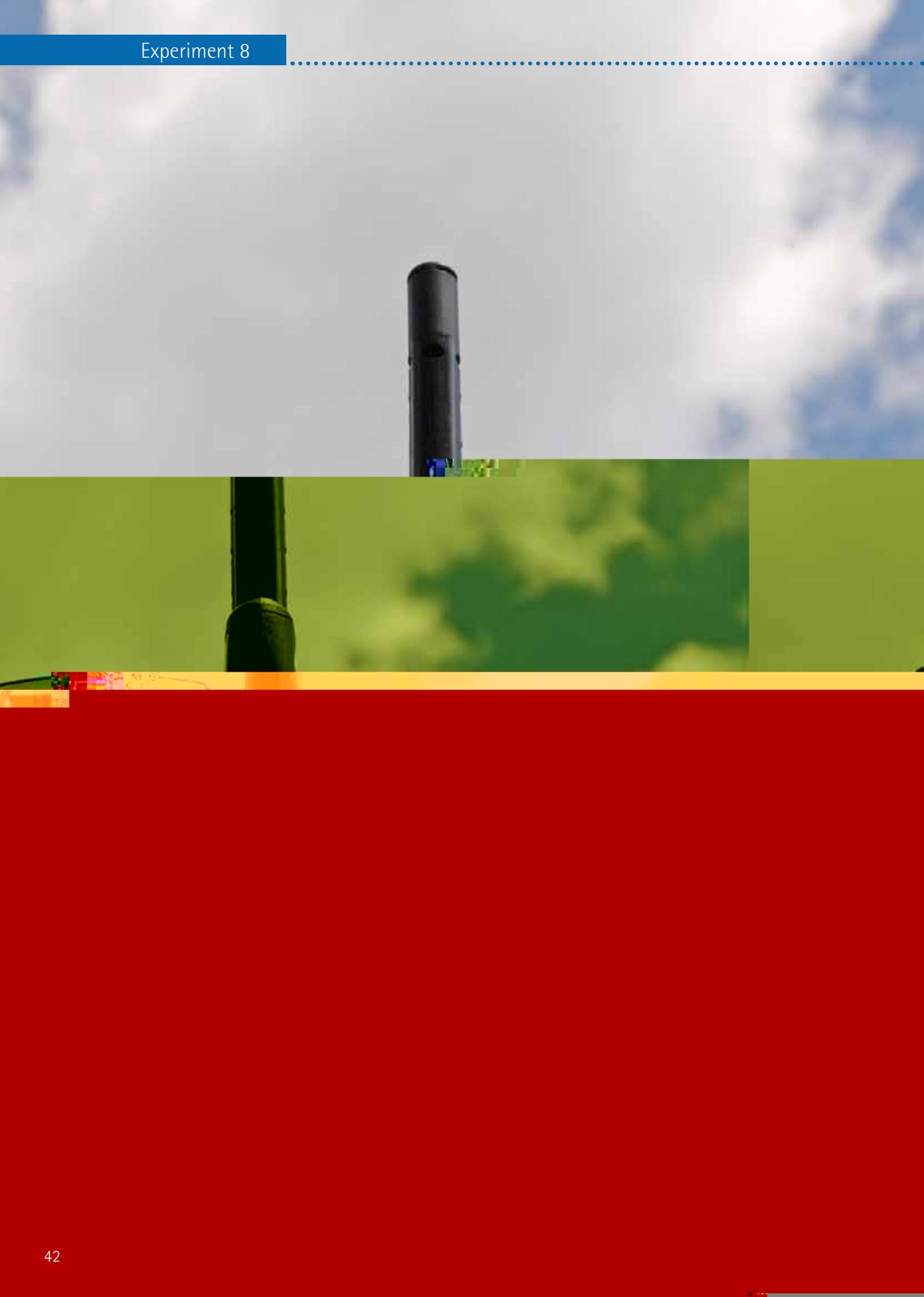
1.
 t (1), t 2 t
 t (2) t t (3) t t
 p t.



2.
 t 1, 2 3 t t
 t t t t
 t - t t 2 t t
 t



3.
 t 1, 2 3 14 . 2
 3 t t, 1 t t
 t W t



W K f K ?

W (2) t t t W • t
 2 tt t, • 2- t p t t •
 • 2- t t t (• W •) t -
 • 2- t t • t • p t (• W •)

I f

te - W • M , W •
 t p t
 10 1
 pp t , , M t . • -
 tt

te tt
 1 4 t • t t
 p t
 • tt •
 t tt , t p t t • t
 • • t

M f

2- t t p • (p t t - • 3)
 t t t
 p t

t
 , t •

W M
 p -M t t
 p p , t • • , tp

V

1.

tt • , • t • t 2- tt • t
 • • t t 2- p W t
 • , p t, t t • • , •
 t tt .

2.

t
 W • t t t , • t t •
 t • • pp
 t • • , t tt t
 M t • • , t • t ,
 tt t t t
 t • , t t p t t
 t
 p t • • , p t • tt t
 • t • • , t •
 W tt t •
 W M • • t W
 W t t W
 W
 W tt •
 W W tt (, t, • te.)
 •

3.

t t 2-
) M t t t 2- t t t t
 • , t • t • t • t • t
) t t t t t t • t
 • , t (1).
 •) W t t , • p t t • t t
 •
) • t , t t t
 t p t t
) M t t p , 2- t t p • t.



1- 2- t t, t t
 t t t
 t • t
 t • t

4. - p t

Lehrer

5. W
tt
t
t
(3).

2-
pp
t t
t
2-
t t
N
W

3.

| |
|--|
| |
| |
| |
| |
| |
| |

5. W

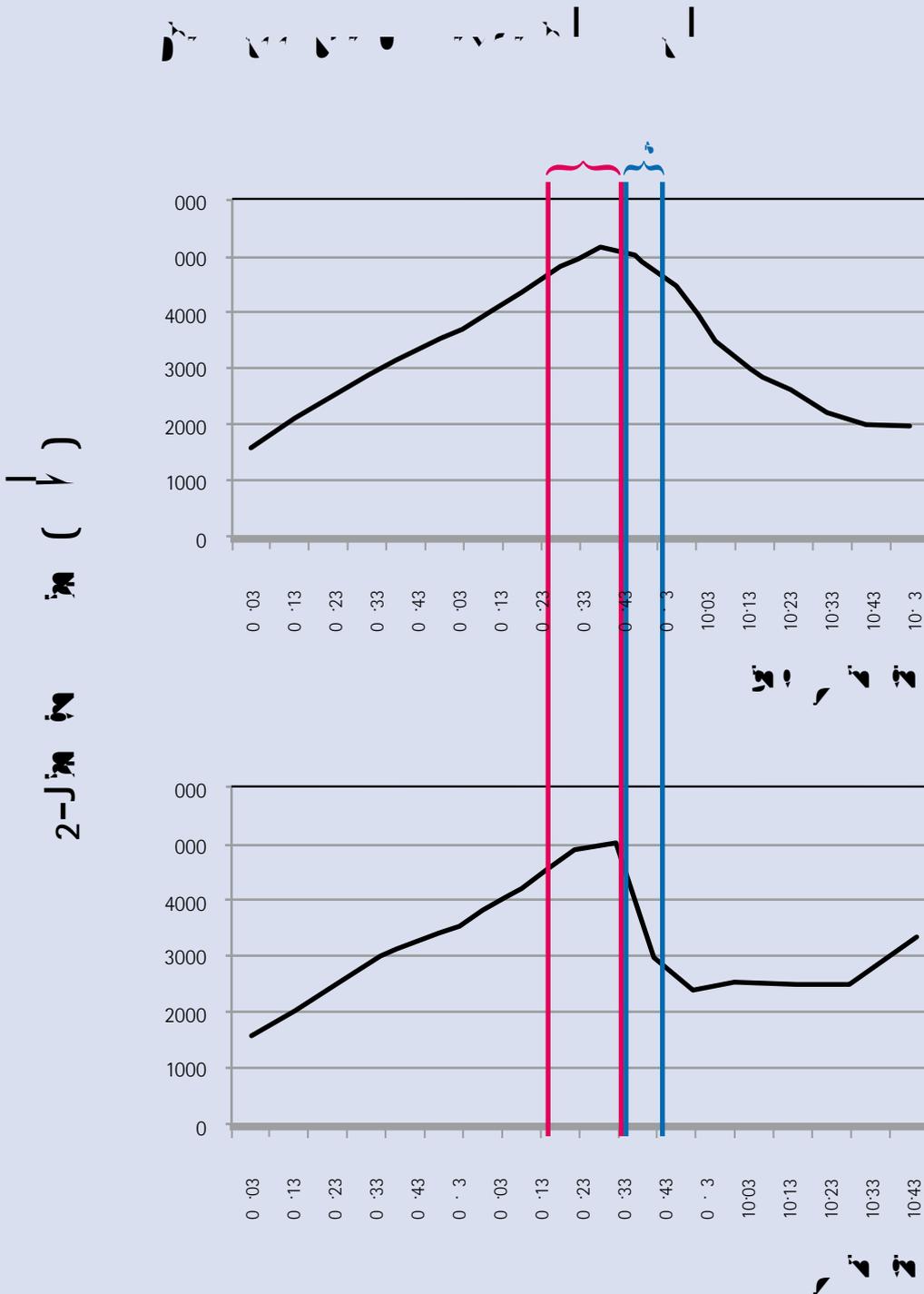
t •
•
• t •
p t t
t •
(4).

t
• 1 M t
t t tt , t
• t
t • •
t •

• . t t
• t t p
• t •

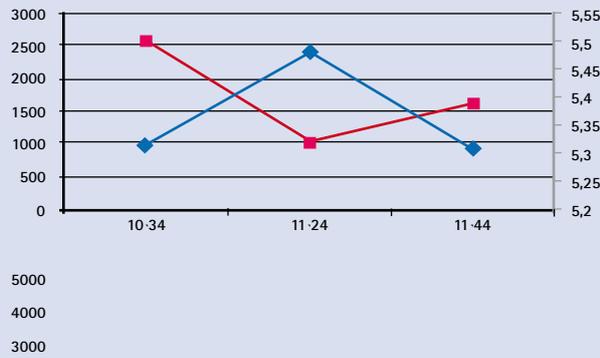
4.





5. W
 t t 2- t t
 t t
). t t p, t t W (M -
 t t t t p -M t W t -
 • p -W t (). t p -W t W t 2- t t t

V



t 2 p -W t W . t t 2- t t t, t p -W t W .



Arbeitsbögen für Schüler



D G f u M A f

W t t e
 . e t t, t W t .N p -
 t t t t W , 2 M -
 e p e s t t 2
 p t t, t W W t ,
 e e t W t t t t, e p -W t W t e
 , p t s t. t e t , t e e
 , 2 t 2 t.

D f

3 e e (, M t)
 3 M e , e p
 1
 1 p tt

V

G

• • †

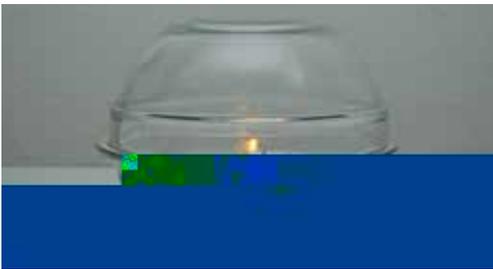
•

O

A †



2. t t W .



3. t t .t.N M t

2. t t
W . t
tt . t
t p t . t
t t .
t p .M
W p t
t, t W .

3. t, t p t
t t t
W t .W t
W t ,
t

E

- 1.
- 2.

W † T † L • † CO₂ W ?

t t t (2) t p , t t • t
• p t t . t W t p t p t -
t t W , 2 W t
• t
• p t t , • t W .

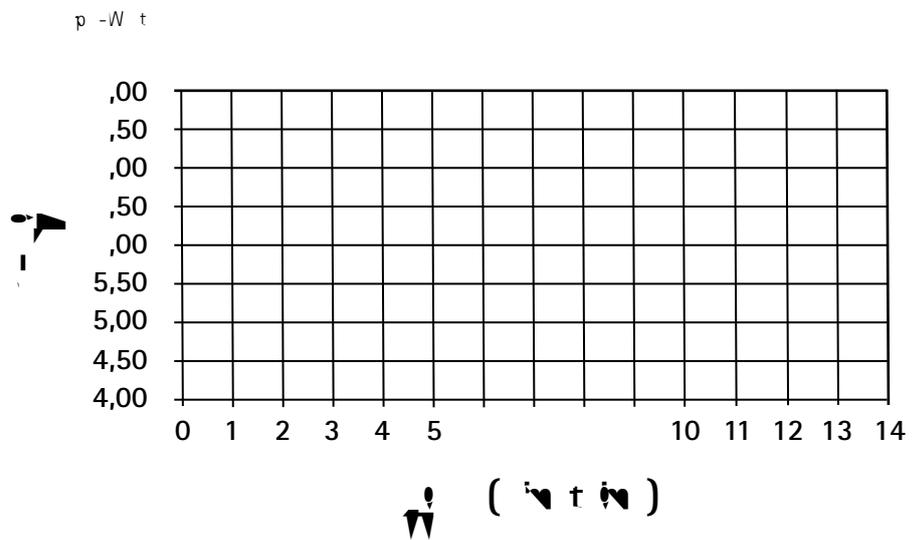
4. t tt t • t . t tt t • W . • t, •
t t pt t.N t t t
t .W • .

5. • , t W t t

E

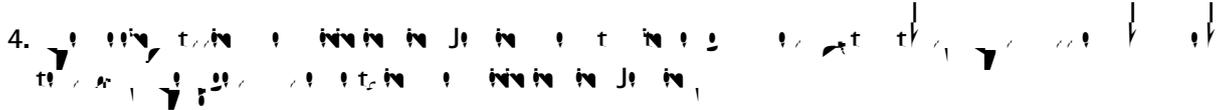
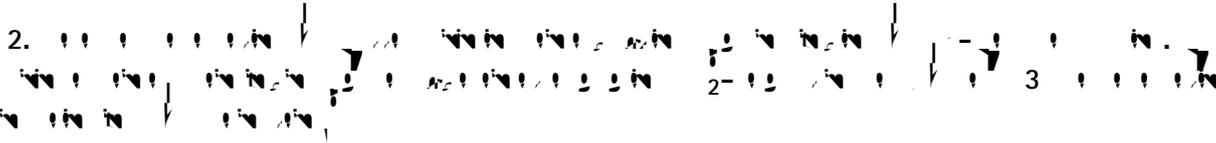
D F W CO₂-G L M
‡ ‡ ‡ ‡ ‡ ‡

| h (m) | p (Pa) | W (N) |
|---------|----------|---------|
| 0 | | |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| | | |
| | | |
| | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |



$W = M \cdot g \cdot h$
 $p = \frac{W}{A}$

E

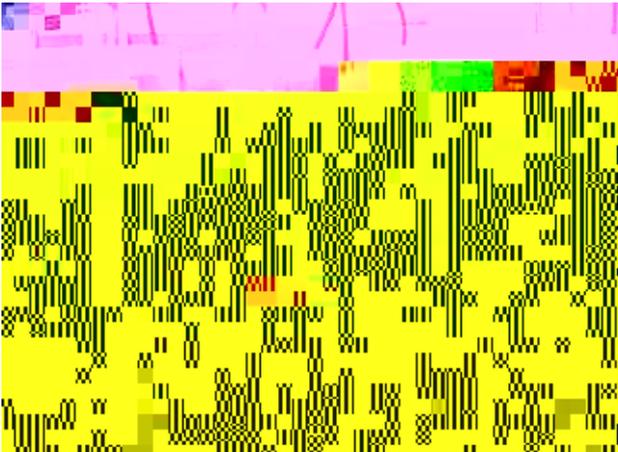


W f E f

1. t t, t p -W t • t -
 , • t t t t • t , t t

2. • , • t W • t • , , •
 W ' , t W .

3. • • t W t • t, • M
 t



p t - t • t • t-



S f

1. t 200 M t M
 W . t M
 N t t . t M
 N t t .

2. W t



1. t

3. 20 p t t t p -W t

4. t t , W t t



2. t

5. t , 2 . t 20 p -W t t

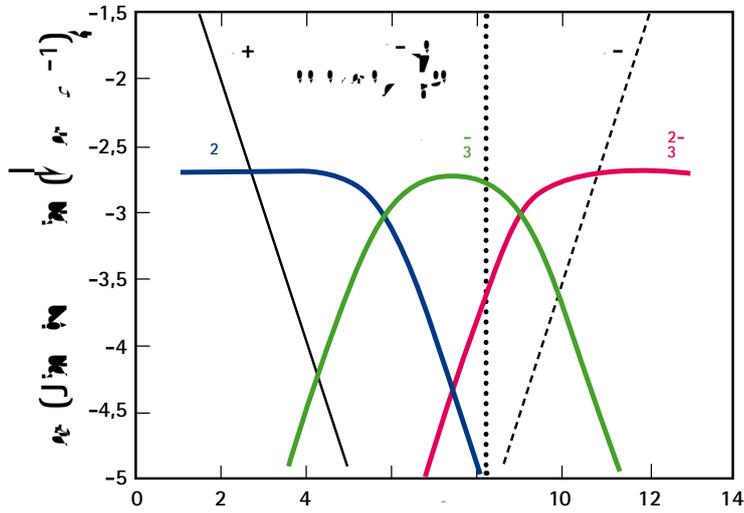
. 40 0 t t t t t t t

T

E

E

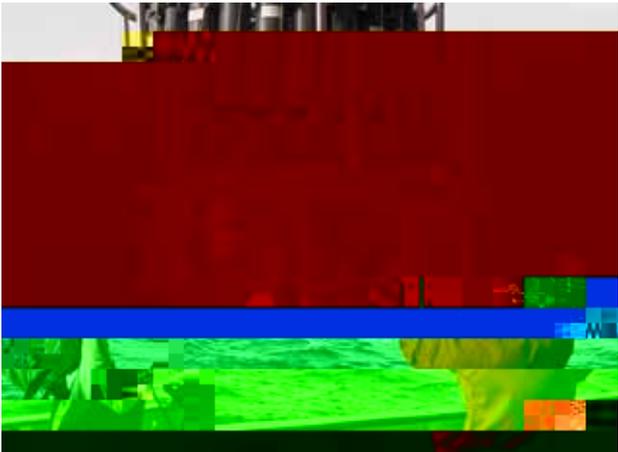
$$3 \cdot M t t \quad p - W t t t$$



W f E f

1. t p -W t t t t W , t • • N 3
 t t W • M t t t • W p t t
 p -W t

2. t p t W • t p t W p t N 3,
 t • N 2 3 W p t t W p t N 2 3, t •
 N 3



$$4 \cdot M t \quad p$$

K **-D** **M** **-K** † (*Dunaliella* sp.)

M M t, , M t (2),

, t p t t t, • t 2 W • t M

Dunaliella p. M t.

D †

t - (200 M t)

Mt • t p

(t t • • t • t W tt t p)

p tt

t - t

t p p

- t ()

W tt •

t • - , M (t 3) • (t 1)

N t t • N t t (N 3), p t (4

D B

f

A

f

1 (1): 2- t
 •

2 (2): 2- t t -
 W tt t p • , •
 t • t , 2-
 t t t

3 (3): t - t W tt • ,
 • t • t • t t

5. t • t . 1 . t t t t, •
 • t t • t . 3 t t t t

W

K

f

K

?

W (2) t t t
2 t t t W • 2- t
t M t •

W • t
p t t t t -
t .

D

f

t 2- t t p •
t t t
p t
t

S

f

1. • t 2-M t,
0 t t () t 2 (W t) 2 , t 2- t t • t
t 2 (W t)) t t t

und For



I

2. / t - t • (M)
2012
p t . , • , M (p t3 p t t . , W
t N , tt t •)
t t • M N • , M
t • M N • , • 2 t p • / W / , . 4 / • . 4 / • . . . ,
. 21 • M M , . 3 , . • t t , . 2 • , . 3 • , . • M t N
(M)
t t M , t

W L

• .
• . p .
• . p • -p • t.
• . • • t . . .
M • ttp// -p • t.

