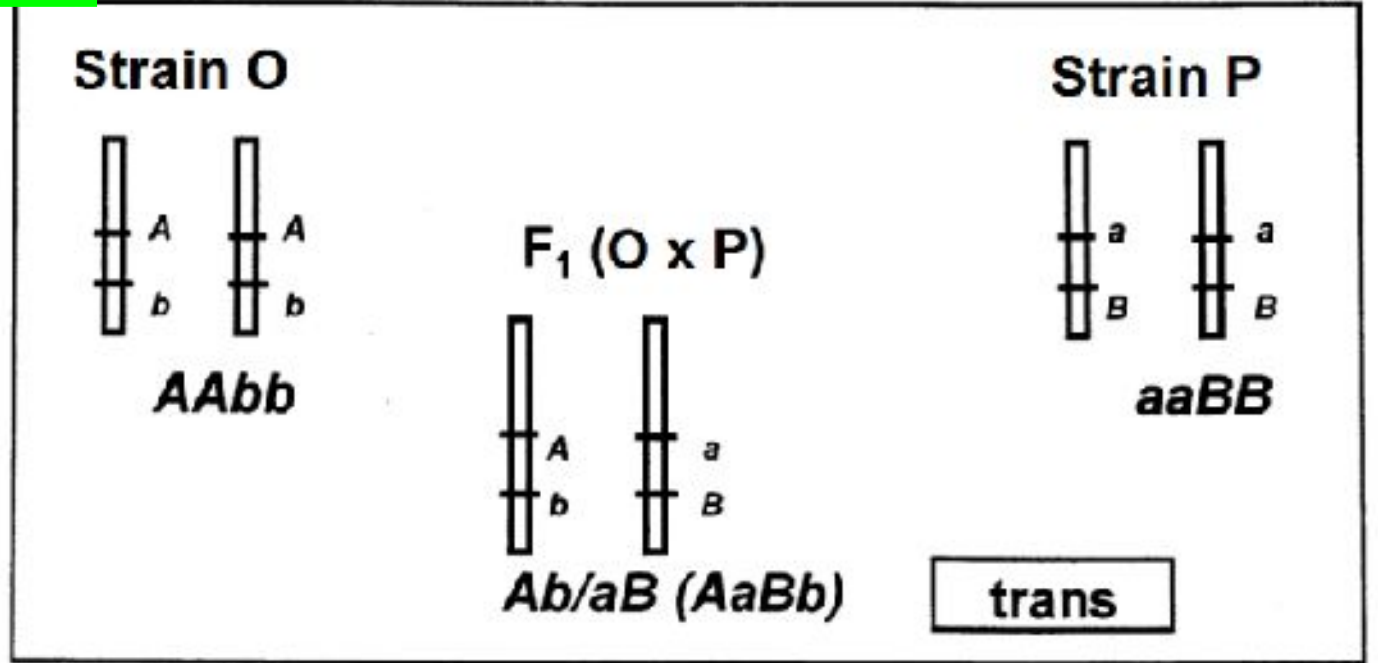
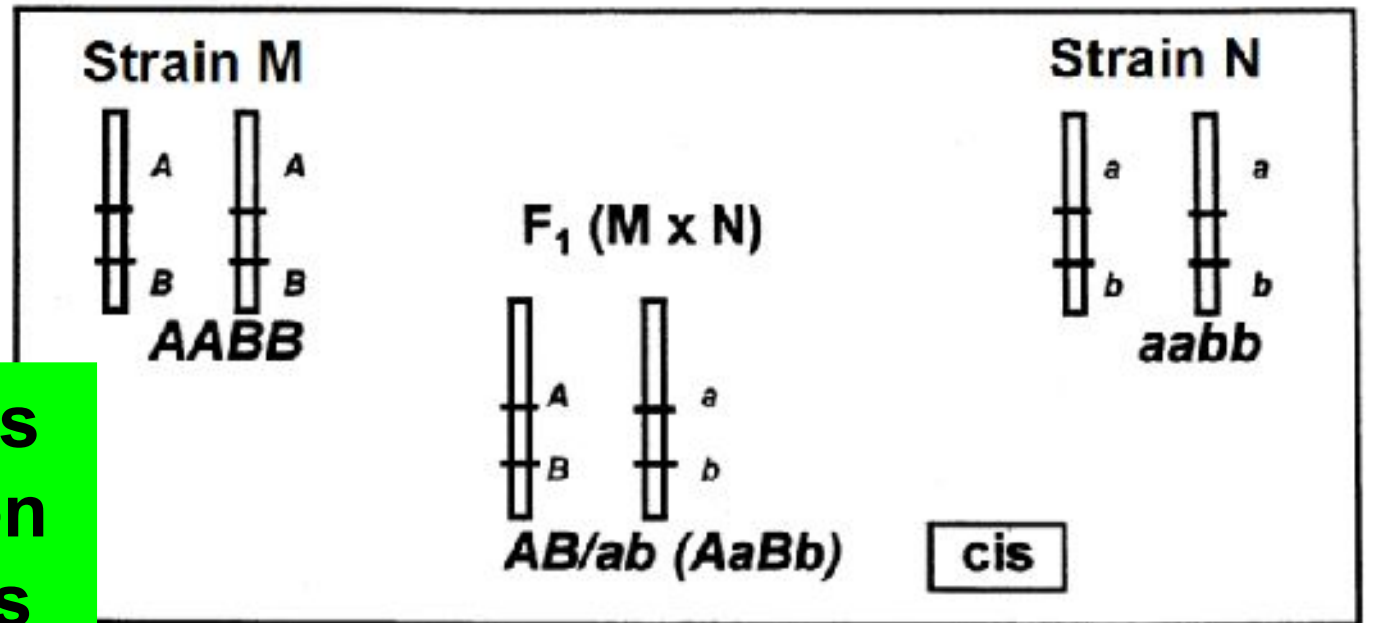


Gene linkage

© Aleš Panczak, ÚBLG 1. LF a VFN



cis and trans configuration in F₁ hybrids



Intrachromosomal recombination

P (homozygous parents)

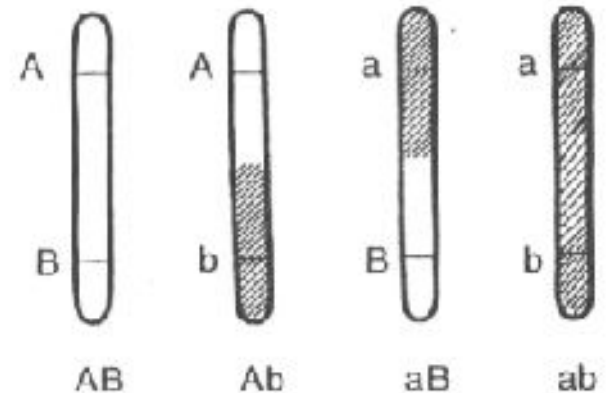
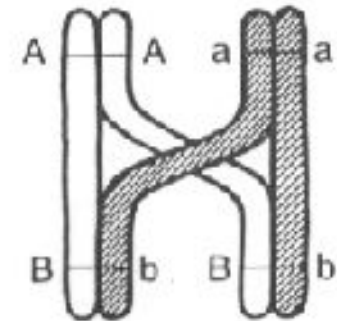
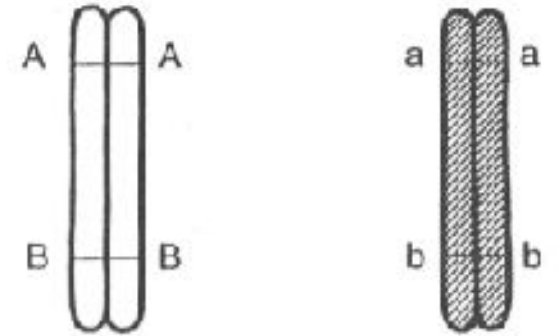
F₁ (heterozygote)

crossing-over in prophase I

disjunction and distribution of chromatids in anaphase II

chromosomes in gametes of F₁ generation



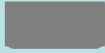
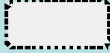
genotypes of gametes



Terminology, definitions

- The term **recombination ratio (fraction)**, Θ (Greek letter theta), is used for expression of linkage intensity (strength).
- The unit of **cM** (centimorgan) is, in contemporary textbooks, used for **map distance**.
- These two variables are identical only for small values – namely, maximum possible value of Θ is 0.5, *i.e.* 50 %, whereas the length of a chromosome after counting up of individual segments at genetic mapping can be even 120 to 150 cM.
- Roughly, we may declare that two loci are separated by genetic distance 1 cM (one centimorgan), if the recombination fraction make 1 % or $\Theta = 0,01$.
- In the text of the book the older terminology is used (linkage intensity is marked as ***p***).

Task 2, p. 99

Genes: A Traits: "shape"  (smooth)  (wrinkled)
 B "colour"  (deep)  (pale)





Back - cross (Bc) - trans configuration (repulsion)

double heterozygote (F1 hybrid) x recessive homozygote



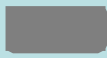

Phenotype AB  ab 

Genotype *Ab/aB* *ab/ab*

Gametes *Ab, aB* (original) *AB, ab* (recombinants) *ab*

	Distance p =	Genotype	<i>AB/ab</i>	<i>Ab/ab</i>	<i>aB/ab</i>	<i>ab/ab</i>
		Phenotype				
a)	0 cM	frequency	0	0.5	0.5	0
b)	20 cM	frequency	0.1	0.4	0.4	0.1
c)	50 cM	frequency	0.25	0.25	0.25	0.25

Task 1, p. 99

Genes: A Traits: "shape"  (smooth)  (wrinkled)
 B "colour"  (deep)  (pale)





Back - cross (Bc) - cis configuration (coupling)

double heterozygote (F1 hybrid) x recessive homozygote

Phenotype AB  ab 

Genotype *AB/ab* *ab/ab*

Gametes AB, ab (original) Ab, aB (recombinants) ab

Distance p =	Genotype	<i>AB/ab</i>	<i>Ab/ab</i>	<i>aB/ab</i>	<i>ab/ab</i>
	Phenotype				
a) 0 cM	frequency	0.5	0	0	0.5
b) 20 cM	frequency	0.4	0.1	0.1	0.4
c) 50 cM	frequency	0.25	0.25	0.25	0.25

Task 3, p. 99

P **Ab/Ab** x **aB/aB**

gametes **Ab** **aB**

F₁ **Ab/aB** ($\theta = 0,2$)

gametes		<i>AB</i>	<i>Ab</i>	<i>aB</i>	<i>ab</i>
F₂	<i>AB</i>				
	<i>Ab</i>				
	<i>aB</i>				
	<i>ab</i>				

P **Ab/Ab** x **aB/aB**

gametes **Ab** **aB**

F₁ **Ab/aB** ($\theta = 0,2$)

gametes	<i>AB</i>	<i>Ab</i>	<i>aB</i>	<i>ab</i>
frequencies	0,1	0,4	0,4	0,1
F₂ <i>AB</i> 0,1				
<i>Ab</i> 0,4				
<i>aB</i> 0,4				
<i>ab</i> 0,1				

P **Ab/Ab** **x** **aB/aB**
 gametes **Ab** **aB**
F₁ **Ab/aB** **($\theta = 0,2$)**

gametes	AB	Ab	aB	ab
frequencies	0,1	0,4	0,4	0,1
F₂	AB 0,1	AB	AB	AB
	Ab 0,4	AB	Ab	AB
	aB 0,4	AB	AB	aB
	ab 0,1	AB	Ab	aB
				ab

phenotypes

P **Ab/Ab** x **aB/aB**

gametes **Ab** **aB**

F₁ **Ab/aB** ($\theta = 0,2$)

gametes		AB	Ab	aB	ab
frequencies		0,1	0,4	0,4	0,1
F₂	AB	AB	AB	AB	AB
	0,1	0,01	0,04	0,04	0,01
	Ab	AB	Ab	AB	Ab
	0,4	0,04	0,16	0,16	0,04
	aB	AB	AB	aB	aB
0,4	0,04	0,16	0,16	0,04	
ab	AB	Ab	aB	ab	
0,1	0,01	0,04	0,04	0,01	

frequencies

P **Ab/Ab** x **aB/aB**

gametes **Ab** **aB**

F₁ **Ab/aB** ($\theta = 0,2$)

gametes		AB	Ab	aB	ab	
frequencies		0,1	0,4	0,4	0,1	
F₂	AB	AB 0,1	AB 0,01	AB 0,04	AB 0,04	AB 0,01
	Ab	AB 0,4	Ab 0,04	Ab 0,16	AB 0,16	Ab 0,04
	aB	AB 0,4	AB 0,04	AB 0,16	aB 0,16	aB 0,04
	ab	AB 0,1	Ab 0,01	Ab 0,04	aB 0,04	ab 0,01

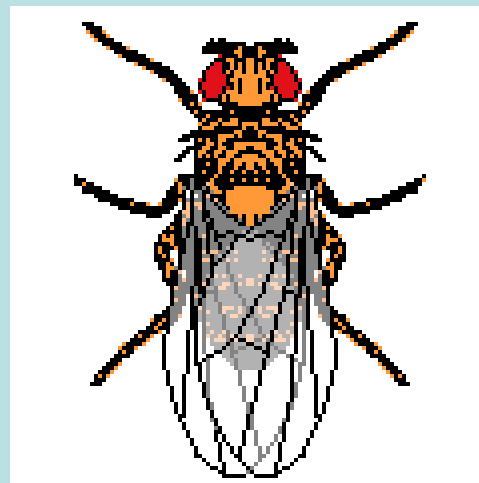
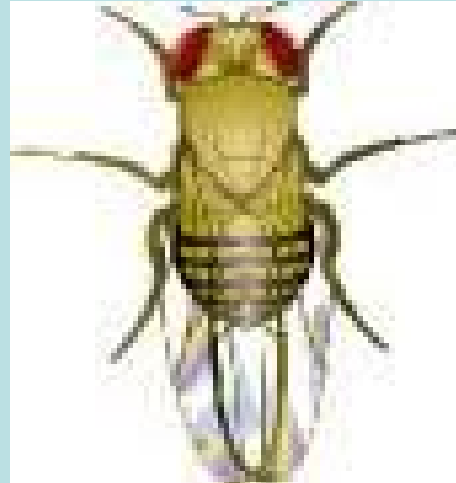
		<i>AB</i> 0,1	<i>Ab</i> 0,4	<i>aB</i> 0,4	<i>ab</i> 0,1
F₂	<i>AB</i> 0,1	AB 0,01	AB 0,04	AB 0,04	AB 0,01
	<i>Ab</i> 0,4	AB 0,04	Ab 0,16	AB 0,16	Ab 0,04
	<i>aB</i> 0,4	AB 0,04	AB 0,16	aB 0,16	aB 0,04
	<i>ab</i> 0,1	AB 0,01	Ab 0,04	aB 0,04	ab 0,01

phenotypes

frequencies

AB	0,51	= 0,01 + 4x0,04 + 4x0,16
Ab	0,24	= 0,16 + 2x0,04
aB	0,24	= 0,16 + 2x0,04
ab	0,01	

Drosophila melanogaster



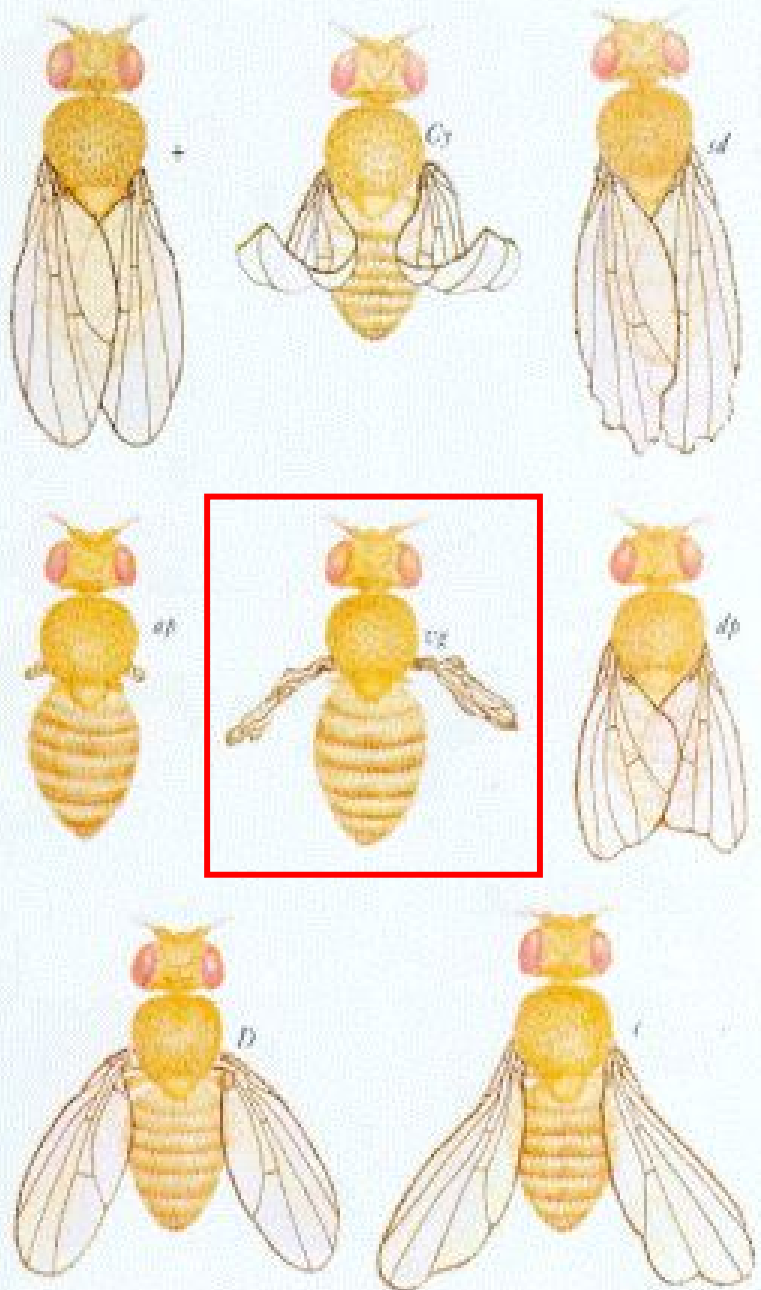
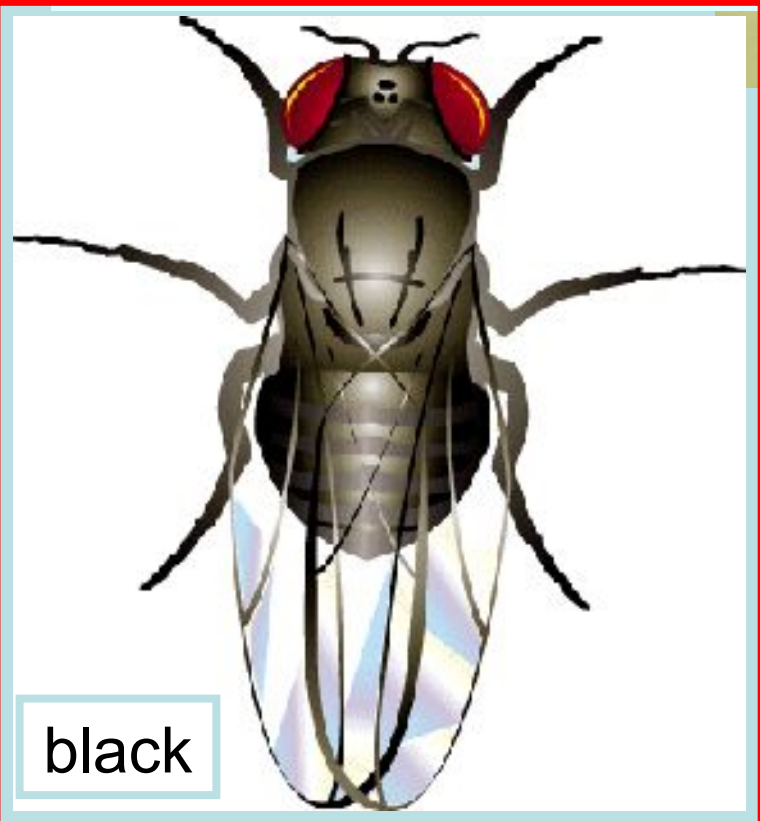
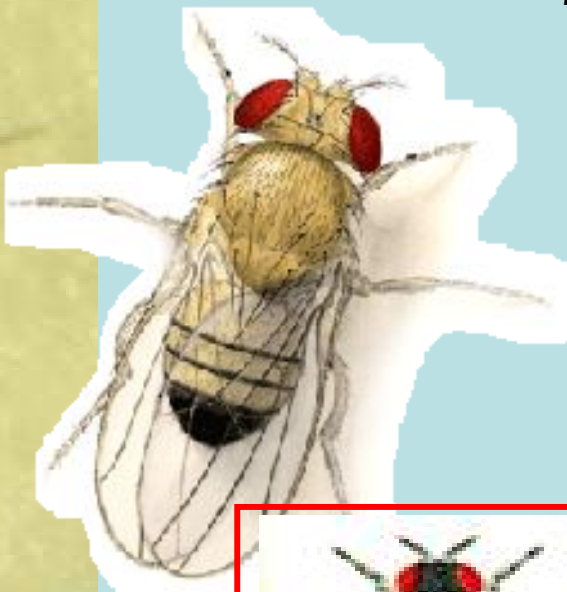


Figure 24 Wing mutations: +, wild; Cy, curly; sd, scalloped; ap, apterous; vg, vestigial; dp, dumpy; D, Dichæte; c, curved.

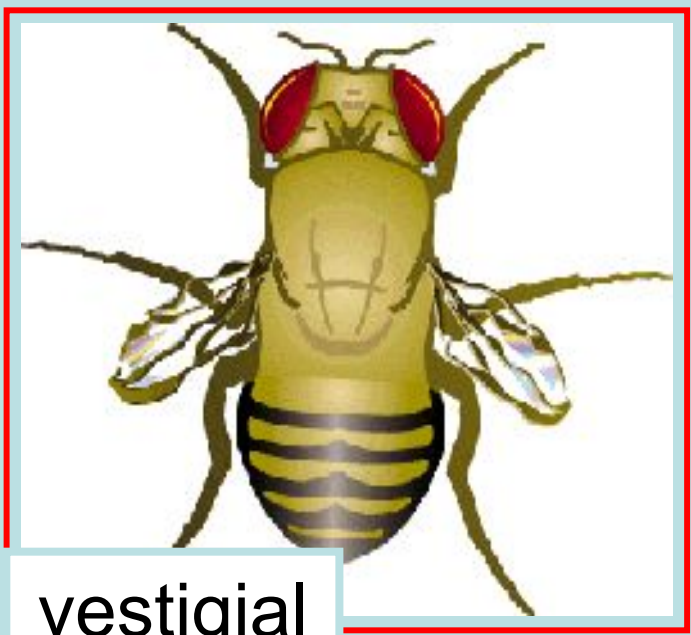


vestigial

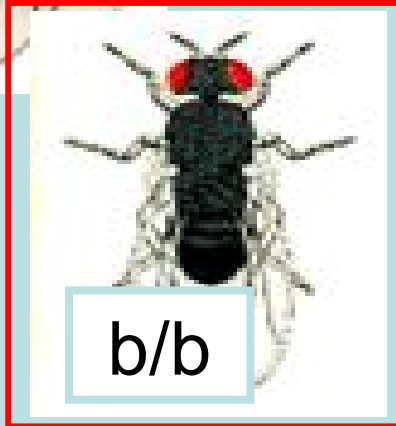




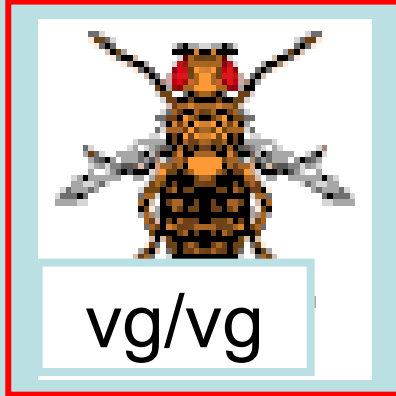
black



vestigial



b/b



vg/vg

Linkage in Drosophila - Task 5/p. 100KrOt

Phenotypes



x

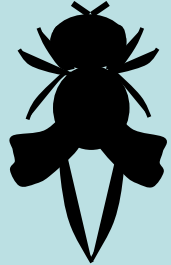
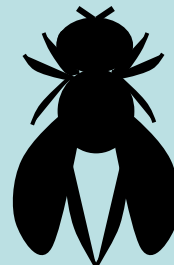


Genotypes

+ b
+ vg

b b
vg vg

Phenotypes
of Bc
population



Number

91

411

413

84

Genotypes

+ + / b vg

b + / b

+ vg / b vg

b vg / b vg

Configuration:
trans

$$\theta = \frac{\text{vg} \quad 91 + 84}{91 + 411 + 413 + 84} = \frac{175}{999} = 0.175$$