Gamete genotype problems from Useful Genetics Module 7:
(http://usefulgenetics.com/problem-sets-for-the-useful-genetics-modules/)

The questions below are from Module 7 of the online genetics course Useful Genetics (www.usefulgenetics.com). They were developed by Rosie Redfield at the University of British Columbia (redfield@zoology.ubc.ca), with assistance from various TAs and feedback from many students. The lecture videos are also available on the YouTube Useful Genetics channel. The answers are indicated in bold.

Problem 1

A man has genotype $\mathbf{A_1A_2}$. What gametes will many meioses produce, and in what proportions?

a) ¼ A_1A_1, ½ A_1A_2, ¼ A_2A_2
b) ¼ A_1, ½ A_1A_2, ¼ A_2
c) ½ $\mathbf{A_1}$, ½ $\mathbf{A_2}$
d) ⅓ A_1, ⅓ A_1A_2, ⅓ A_2
e) None of the above
f) More information is needed

Problem 2

A man has genotype $\mathbf{A_1A_1\ G_1G_2}$. The **A** and **G** genes are on the **same** chromosome. What gametes will many meioses produce, and in what proportions?

a) ½ A_1A_1, ½ G_1G_2
b) ¼ A_1A_1, ¼ A_1G_2, ¼ G_1G_2
c) ½ $\mathbf{A_1G_1}$, ½ $\mathbf{A_1G_2}$
d) ½ A_1, ¼ G_1A_2, ¼ G_2
e) None of the above
f) More information is needed

Problem 3

A man has genotype $A_1A_1\ G_1G_2$, meaning that he has two copies of the A_1 allele of gene *A*, and one copy each of the G_1 and G_2 alleles of gene *G*. The *A* and *G* genes are on **different** chromosomes. What gametes will many meioses produce, and in what proportions?

a) ½ A_1A_1, ½ G_1G_2
b) ¼ A_1A_1, ¼ A_1G_1, ¼ A_1G_2, ¼ G_1G_2
c) ½ $\mathbf{A_1G_1}$, ½ $\mathbf{A_1G_2}$
d) ½ A_1, ¼ G_1A_2, ¼ G_2
e) More information is needed.

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Problem 4

A man has genotype A_1A_2 B_1B_2. He has inherited the A_1 and B_1 alleles from his father and the A_2 and B_2 alleles from his mother. The *A* and *B* loci are on the **same** chromosome, close enough that crossovers are not a factor. What gametes will many meioses produce, and in what proportions?

a) ½ A_1A_2, ½ B_1B_2
b) ¼ A_1A_1, ¼ A_1B_2, ¼ A_2B_1, ¼ B_1B_2
c) ½ A_1B_1, ½ A_2B_2
d) ½ A_1B_2, ½ A_2A_1
e) More information is needed

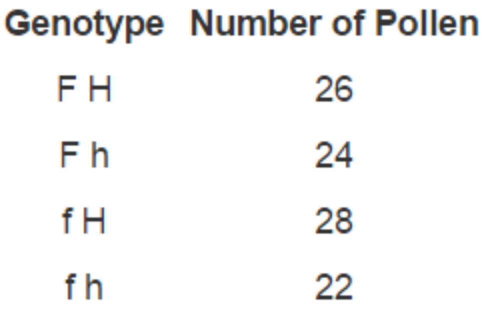
Problem 5

A woman has genotype **A_1A_1 G_1G_2**. The **A** and **G** genes are on the **same** chromosome. What gametes will a single meiosis produce?

a) 2 A_1A_1, 2 G_1G_2
b) 1 A_1A_1, 1 A_1G_1, 1 A_1G_2, 1 G_1G_2
c) 2 A_1G_1, 2 A_1G_2
d) 2 A_1, 1 G_1A_2, 1 G_2
e) More information is needed
f) None of the above.

Problem 6

Genes can be mapped using the frequency of crossovers during meiosis. In flowers, this can be done by genotyping pollen. For a certain plant species you know where gene **F** is located on chromosome 1, but you don't know the location of gene **H**, so you genotype 100 pollen grains from a plant that is heterozygous at both *F* and *H* (alleles *F/f* and *H/h*).



Genotype	Number of Pollen
F H	26
F h	24
f H	28
f h	22

Are these two genes on the same chromosome?

a) Yes, because the numbers are similar.
b) No, because the numbers are similar.
c) No, because the numbers are not identical.
d) No, because crossovers are rare.
e) Can't tell because there could be multiple crossovers.

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Problem 7

In a genetic mapping project, the genotypes of 100 sperm from one man were determined at two loci, **D** and **E**, both known to be on chromosome 2. The man was heterozygous at both loci, with the alleles ***D*** and ***d***, ***E*** and ***e***.

Genotype	Number of sperm
D E	48
D e	1
d E	4
d e	47

Which of these alleles are on the same homolog in the man? (Choose all that apply.)

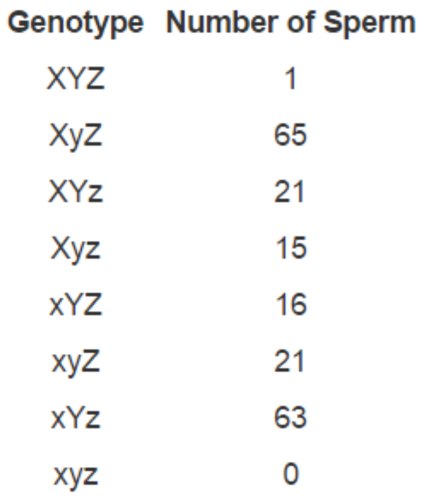
- **a) D and E**
- b) D and d
- c) E and e
- d) D and e
- e) insufficient information
- f) None of the above choices are correct.

Problem 8

In a genetic mapping project, the genotypes of the sperm from one man were determined at three loci, **X**, **Y**, and **Z**, all known to be on chromosome 14. The man was heterozygous at all three loci, with the alleles X and x, Y and y, Z and z.

Which of these alleles are on the same homolog in the man? (Choose all that apply.)

- a) X, Y, and Z
- b) X, Y and z
- c) X, y, and z
- d) x, Y, and Z
- **e) x, Y, and z**
- f) Insufficient information
- g) None of the above choices are correct.



Genotype	Number of Sperm
XYZ	1
XyZ	65
XYz	21
Xyz	15
xYZ	16
xyZ	21
xYz	63
xyz	0

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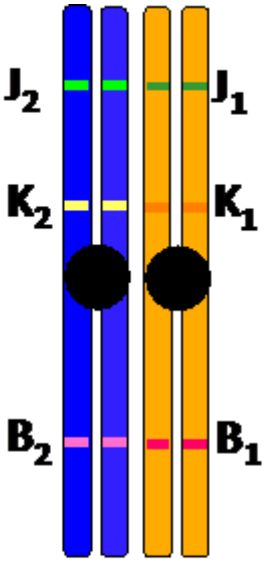
Problem 9

Which gamete genotype(s) would be the most frequent products of this meiosis? (Choose all that apply.)

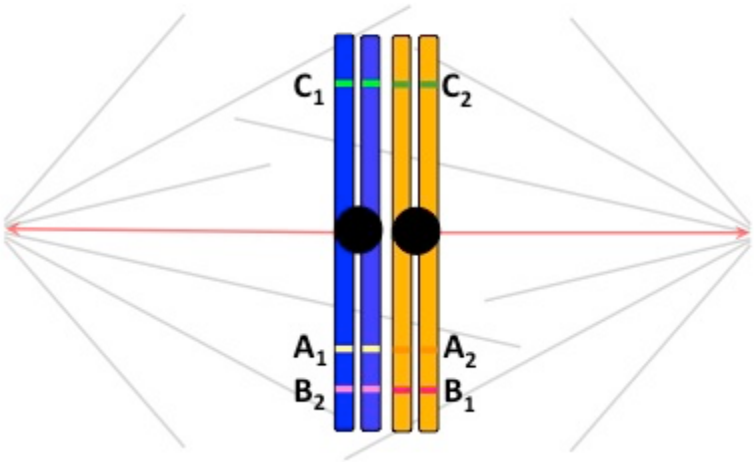


a) $J_1\ K_1\ B_1$
b) $J_2\ K_2\ B_2$
c) $J_1\ K_1\ B_2$
d) $J_1\ K_2\ B_1$
e) $J_2\ K_1\ B_1$
f) $J_1\ K_2\ B_2$
g) None of the above choices are correct.

Problem 10

Which of the listed gamete genotype(s) would be the **most** frequent products of this meiosis?

(Choose all that apply.)



a) $C_1A_1B_1$
b) $C_2A_2B_2$
c) $C_2A_2B_1$
d) $C_1A_1B_2$
e) $C_1A_2B_1$
f) $C_2A_1B_2$
g) None of the above choices are correct.

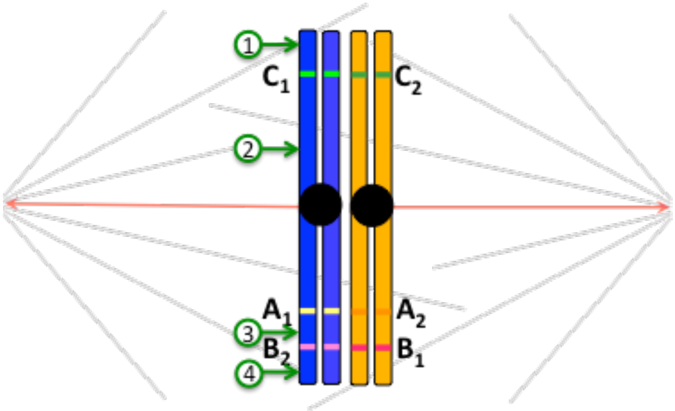
Problem 11

Using the image provided for Problem 10, which of the listed gamete genotype(s) would be the **least** frequent products of this meiosis? (Choose all that apply.)

a) $C_1A_1B_1$
b) $C_2A_2B_2$
c) $C_2A_1B_1$
d) $C_1A_1B_2$
e) $C_1A_2B_1$
f) $C_2A_1B_2$
g) None of the above choices are correct.

Problem 12

Which of these gamete genotypes could be produced by a meiosis with a single crossover at position 3? (Choose all that apply.)



- **a) C_1 A_1 B_1**
- **b) C_2 A_2 B_2**
- **c) C_1 A_1 B_2**
- **d) C_2 A_2 B_1**
- e) C_2 A_1 B_1
- f) C_1 A_2 B_2
- g) C_2 A_1 B_2
- h) C_1 A_2 B_1
- i) None of the above choices are correct.