**Genetics Practice Problems Review with Answers**

**Part I- One Trait Crosses**

1. Cystic fibrosis is carried on the recessive allele.  Normal is dominant. A normal man and a woman with cystic fibrosis have one CF child and one normal child. What are the chances that their next child will have cystic fibrosis?

2. Sickle cell anemia is carried on the recessive allele.  Normal is dominant.  Mary is a carrier for sickle cell and Mike is normal (but not a carrier).

              A. What are the chances of Mary and Mike having a sickle cell child?

              B. What are the chances of them having a child who is a carrier?

3. In peas, yellow is dominant to green.  If a pure yellow plant is crossed with a hybrid pea plant, how many of the 100 seeds produced will be for green plants?

4. In peas, tall is dominant to short.  If a pure tall and a pure short plant are crossed, and the resulting offspring are crossed, how many of the F2 will be short if 120 plants are produced?

5. In garden peas, the offspring of a cross between two hybrid yellow parents would be: \_\_\_ yellow.

                      A. 25%                        B. 50%                        C. 75%               D. 100%

6. If dimpled cheeks are dominant over non-dimpled cheeks, what proportion of offspring with dimpled cheeks may one expect if two non-dimpled individuals are crossed?

7. Cystic fibrosis is a disease carried by a recessive allele.  If both parents are carriers, how many of their 16 children will be carriers?

8. Let the allele for tall be represented by T and the allele for dwarfs be t.

Determine the:

 a) gametes produced by the parents and

             b) the height of the offspring for each of the following crosses:

                          A. TT x tt               B. Tt x tt              C. TT x Tt                D. Tt x Tt

9. A. Cross a homozygous dominant yellow with a homozygous recessive green plant and determine the genotype and phenotype frequencies in the F1 generation.

B. Cross the F1 generation among themselves and determine the genotype and phenotype frequencies in the F2 generation.

**Part II- "Back Crosses"**

1. If cystic fibrosis is recessive to normal, what are the genotypes of everyone in the family where the mother has CF, the father does not, and they have one child who is normal and two children with CF?

2. Sally and Susie are sisters.  Both Sally and Susie have PKU disease and both of their parents are normal, both grandfathers are normal, but their grandmothers had PKU. (PKU is recessive to normal)

               A. Draw a pedigree and show the genotypes of all individuals.

               B. If Sally marries Sam, who is a carrier, how many of their children might have PKU?

3. Both Mark and Max are brothers and both are tasters for PTC. If their mother is a taster, but their father is not, what are the genotypes of all the individuals?  (Tasters are dominant to non-tasters).

4. In guinea pigs, black is dominant to white.  If two black guinea pigs are crossed and 4 black and 3 white pigs result, were the parents pure?

5. In man, brown eyes seem dominant over blue eyes.  A brown-eyed man marries a blue-eyed woman and they have 8 children, all brown-eyed.  The PROBABLE genetic makeup of father, mother and children, respectively is:\_\_\_\_\_\_\_\_

6. In a breeding experiment in which there are 200 offspring, 50% are rr.

The parents of the offspring were:

              A. Rr and rr         B. RR and rr        C. Rr and Rr          D. Rr and RR

7. A series of 3 matings between a black guinea pig and a white one resulted in 8 black offspring.  The most probable explanation is \_\_\_\_.

8. A cross between 2 black guinea pigs produces some black guinea pigs and some white guinea pigs. The gene make-up of the two parents is called \_\_\_\_\_.

9. Having freckles is dominant to not having freckles.  If one parent has freckles and the other does not, and 2 of their children have freckles and one does not, what are the genotypes of everyone in the family?

10. In man, albinism is recessive to normal.  An albino man marries a normally pigmented woman. They have 9 children, all normally pigmented.  What are the most likely genotypes of parents and children?

11. A tall plant crossed with a dwarf one produces offspring of which about one-half are tall and one-half dwarf.  What are the genotypes of the parents?  (Tall is dominant to dwarf).

12. A blue-eyed man, both of whose parents were brown-eyed, marries a brown-eyed woman. They have one child, who is blue-eyed.  What are the genotypes of all the individuals mentioned?  (Brown is dominant to blue).

13. In humans, brown eyes are usually dominant over blue eyes. Suppose a blue-eyed man marries a brown-eyed woman whose father was blue-eyed.  What proportion of their children would you predict would have blue eyes?

**Part III- Incomplete dominance**

1. When round squash are crossed with long squash, all offspring are oval in shape.  How many genotypes are produced when round squash are crossed with oval squash?

2. Crossing a plant bearing white flowers with a plant bearing red flowers produces pink offspring. This is evidence of \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

3. An embryo resulting from the mating of two albino rabbits is transplanted into the uterus of a brown rabbit.  The color of the offspring can most reasonably be expected to be \_\_\_\_. (Albino is recessive to brown)

4. In 4 o'clock flowers, red is dominant to white, but the heterozygote is pink. What is the phenotype ratio of crossing red 4 o’clock flowers and pink 4o’clock flowers?

5. In cattle, red is dominant to white, but the heterozygote is roan. If 2 roans are mated, how many of the offspring will be red if they have 12 calves?

6. A. If red 4 o’clock flowers were crossed with white 4 o’clock flowers, what would the frequency of pink flowers be in the F2 generation?

   B. If 60 offspring are obtained in the F1, how many will be white?

7. In poultry, black is dominant to white, but the heterozygote is blue. If you consistently eliminated the black and white birds which appear in your flock of Blue Andalusians, how many generations of such selection would it take to produce a true breeding flock of Blue Andalusions?

8. Yellow guinea pigs crossed with white ones always produce cream colored offspring.  Two cream colored pigs when crossed produce yellow, cream and white offspring in a ratio of 1 yellow:2 cream:1 white. How are these colors inherited?

9. In radishes, the shape may be long, round or oval.  Crosses between oval and round gave 203 oval, 199 round.  Crosses between long and oval gave 159 long, 156 oval.  Crosses between long and round gave 576 oval.  Crosses between oval and oval gave 121 long, 243 oval, and 119 round.  What type of inheritance is involved?  Determine the probable parental genotypes for each cross

**Part IV- Test Cross**

1. A farmer is told that his black bull is a thoroughbred.  Knowing that black color in cattle is dominant over red color, he decides to determine the purity of the strain by mating the bull with several red cows.  If the bull is pure what will happen?

2. Mr. Jones has a black guinea pig.  (In guinea pigs, black is dominant to white).  He wants to know if the guinea pig is pure, because he wants to breed her and raise black guinea pigs to sell.  He brings the guinea pig to you.  What would you tell Mr. Jones?  What would you do?  How would you interpret your results?

3. An organism has brown eyes (B).  A test cross was performed in order to determine the genotype of the organism.  The results were 50% brown eyes and 50% blue eyes.  What is the genotype of the organism?

**Part V- Multiple Alleles**

1. One parent is heterozygous for type A blood and one parent is heterozygous for B blood. What are all the possible blood types for their children?

2. A child has type O blood.  List all possible parental genotypes.

3. Suppose a father and mother claim that they have been given the wrong baby at the hospital. Both parents are group A.  The baby they have been given is group O.  Could the baby be theirs? If the baby had been group B, could the baby be theirs?

4. Suppose a child is blood group A, and the mother is blood group O. What group or groups may the father belong to?

5. If one parent has type AB blood and the other has type A blood, is it possible for them to have a child with type B blood?  Is it possible for them to have a child with type O blood?

6. A man has type A blood and his wife has type B blood.  A physician types the blood of their four children and is amazed to find one of each of the four blood types among them.  He is not familiar with genetics and calls upon you to explain how such a thing could happen.  What would you tell him?  Diagram and explain your answer.

7. A couple preparing for marriage has their blood typed along with the other required blood tests. Both are AB.  They ask you what types of blood their children may have.  What would you tell them and how would you explain your conclusions.

8. A woman sues a man for the support of her child.  She has type A blood, her child has type O, and the man has type B.  Could the man be the father?  Explain your answer.

9. A wealthy, elderly couple dies together in an accident.  Soon a man shows up to claim their fortune, contending that he is their only son who ran away from home when he was a boy.  Other relatives dispute this claim.  Hospital records show that the deceased couple was blood types AB and O.  The claimant was of blood type O.  Do you think that the claimant was an imposter? Explain.  If he had had blood type A would your answer be the same?

10. A man of blood type A marries a woman of type B.  They produce one child of type A and another of type O.  List the genotype for each of these four people.  What are the chances that their next child will be of blood type AB?

11. A common protein found in the blood of some people is called Rhesus factor (named after the Rhesus monkey in which it was first found) and it is usually designated as the Rh factor.  People who have this protein are said to be Rh positive (Rh+) and those who do not are said to be Rh negative (Rh-).  Rh+ is dominant and Rh- is recessive.  If an Rh- woman has an Rh+ child, there is a chance that the child could have the condition known as ERYTHROBLASTOSIS. The first Rh+ baby is usually unaffected, but the chances increase with each succeeding Rh+ child.  What are the chances of a couple having an Rh+ child if

                        a. The mother is Rh- and the father is Rh+ (heterozygous)?

                        b. both parents are heterozygous for Rh+?

**Part VI- Two Traits**

1. If black is dominant to white, and if tall is dominant to short, cross a heterozygous black and heterozygous tall pig with a short white pig. Determine the genotype and phenotype frequencies in the F-1 generation.

2. A woman with type O+ blood marries a man with type B- and they have a daughter with type O- blood.  What are the genotypes of each individual?

3. In tomatoes, red color is dominant to yellow and tall is dominant to dwarf.  The Golden Beauty variety has yellow fruit and is tall.  The Dwarf Giant is dwarf and has red fruit.

 A. If you crossed a Golden Beauty with a Dwarf Giant, what would you expect? (Hint: both varieties are homozygous for both traits).

 B. If you used the two varieties to start, could you eventually obtain a homozygous variety which was tall with red fruit?

4. If factor “a” is lethal in the doubly recessive condition “aa”, then how many offspring out of every 16 will survive from this cross: AaBb x AaBb?

5. In man, assume that spotted skin (A) is dominant over nonspotted (a) skin and that wooly hair (B) is dominant to nonwoolly (b).  List the genotypes and phenotyopes of children to be expected from a marriage of a spotted Aabb man and a woolly-haired aaBb woman. If A and B assort independently, in what proportions should the different phenotypes appear in the children?

6. Congenital deafness in man is due to the homozygous condition of EITHER OR BOTH of the recessive genes d and e.  BOTH dominant genes D and E are necessary for normal hearing.  A deaf man marries a deaf woman and all of the seven children have normal hearing. What are the genotypes of the parents and children?

**Part VII- Sex linkage**

1. In a family with parents who do not have hemophilia, one son has hemophilia.  He received

the gene for hemophilia from \_\_\_\_\_.

2. If a boy’s father has hemophilia and his mother’s cells have one gene for hemophilia, what is the chance that the boy will inherit the disease?

3. What are the possible genotypes and phenotypes of the parents of a girl who is colorblind?

4. If Jennifer is normal (and is not a carrier) but her husband, James, is colorblind, what are the chances of

        A. their daughter, Jean, being colorblind?

        B. Of their son, Joe being colorblind?

5. If Darlene is normal (but a carrier) and her husband, Dave, is normal, what are the chances

         A. of their daughter, Denise, having hemophilia?

         B. Of their son, Dennis having hemophilia?

6. Colorblindness is a recessive sex-linked trait.  A woman with normal vision and of blood type A, whose father is colorblind and of blood type O, marries a man with normal vision and of blood type O.

         A. What are the genotypes of the woman and the man?

         B. Of her father?

         C. What are the possible genotypes and phenotypes of their sons and daughters?

7. In sheep, horns are the result of a factor (H), and hornlessness of a factor (h) which are sex-linked.  White is due to a dominant factor (W) and black is recessive.  A homozygous horned white ram is crossed with a homozygous black ewe.  What would be the phenotypes of the F1 and F2?

8. A colorblind man of group O marries a normal visioned woman of group AB, whose father was colorblind.

 A.  If they have 4 sons, what will these sons most probably be in regard to vision and blood group?

 B. If the parents had 4 daughters, what would they most probably be?

**Part VIII- Probability**

1. In man keratosis (a skin abnormality) is due to a dominant factor. A man with keratosis whose father did not show the abnormality marries a woman with keratosis whose mother was free from it.

 A. If they have 3 children, what are the chances that all three children will show the condition?

 B. If they have another child, what are the chances of it being a girl who will not have keratosis?

2. In humans, 6 fingers are dominant to 5 fingers.  If Karl and Kim both have 5 fingers and they have 2 children with 5 fingers, what are the chances of their next child having 6 fingers?

3. Nancy and Ned are both carriers for cystic fibrosis, which is recessive. What are the chances of them having 2 children without cystic fibrosis?

4. If Barbara, who is nearsighted, and Bruce, who has normal vision, have a daughter, Betty, who is nearsighted, what are the chances that their next child will be a normal sighted boy? (Nearsighted is recessive)

5. Terri and Ted both have freckles and they have one daughter, Teresa, who does not have freckles.  (Freckles is dominant)

A. What are the chances that they will have a boy next?

B. What are the chances that they will have a child with freckles next?

C. What are the chances that their next child will be a girl with freckles?

D. What are the chances that their next two children will not have freckles?

E. If they have 3 more children, what are the chances that they will all be boys with freckles?

6. Diane has type A blood and Darryl has type B.  They have a son Duane with type A blood and a daughter, Dora, with type B blood.  If they have another child, what are the chances that it

              A. Will have type AB blood?

              B. Will be a girl?

              C. Will be a boy with type O blood?

7. If Ester has type O- blood, and Edwin has type AB+, and if Edwin is heterozygous for Rh factor, what are the chances that

              A. Their first baby is type A?\_\_\_\_ Rh-?\_\_\_\_

              B. Their first baby is B+?

              C. Their first baby is A- and their second baby is B-?

              D. They have 2 children, one with A+, and one with B+?

8. If freckles is dominant  and both parents are homozygous, but the mother has no freckles,

              A. What are the chances that their first baby will be a girl with freckles?

              B. If the father is heterozygous, what is the chance that their first baby will be a girl with

                   freckles?

              C. If both parents are heterozygous, what are the chances that

                             1. They have two boys with no freckles?

                             2. They have two girls and a boy all with freckles?

                             3. They have two boys and two girls; the girls have freckles and the boys do not?

9. A man and a woman who are both heterozygous for blood group A decide to produce 4 children.

              A. What are the possible phenotypes of these children?

              B. What are the possible genotypes of these children?

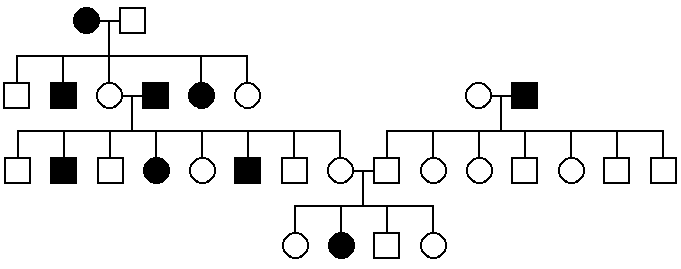
              C. What are the chances that all 4 children will be blood group A?

              D. What are the chances that 2 children will be A and 2 children will be type O?

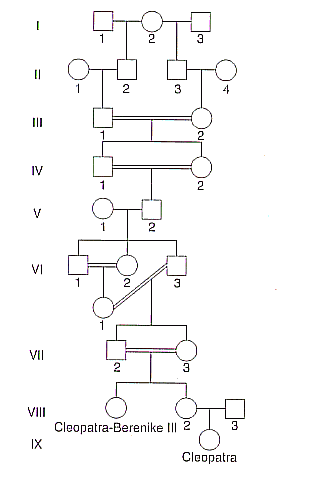
**Part IX- Pedigree Analysis & Linkage**

The below questions are from pp. 60, 68-70 of [Sinnott *et al.*](https://www.google.com/url?q=http://www.google.com/url?q%3Dhttp%253A%252F%252Fwww.mansfield.ohio-state.edu%252F~sabedon%252Fbiol1128.htm%2523sinnott_1958%26sa%3DD%26sntz%3D1%26usg%3DAFQjCNHGKi6_J26ZBTROaE8uTEnoq6sbpw&sa=D&ust=1473456285018000&usg=AFQjCNGfeymEdvCGTxUg8Dy0mYYQa_UG5A)[, 1958](https://www.google.com/url?q=http://www.google.com/url?q%3Dhttp%253A%252F%252Fwww.mansfield.ohio-state.edu%252F~sabedon%252Fbiol1128.htm%2523sinnott_1958%26sa%3DD%26sntz%3D1%26usg%3DAFQjCNHGKi6_J26ZBTROaE8uTEnoq6sbpw&sa=D&ust=1473456285019000&usg=AFQjCNEmwI4YnPW_x-tQaxGkfw2MdXmM7Q):

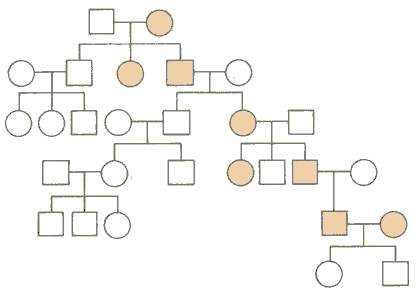
1. Which best describes the genetics of the afflicting allele in the following pedigree (it is a pedigree of taste blindness)?
2. autosomal dominant
3. autosomal recessive
4. X-linked dominant
5. X-linked recessive
6. Y-linked dominant
7. Y-linked recessive



1. Given the below pedigree, would you expect to find more of in Cleopatra-Berenike III compared with the general population? (figure from p. 283 of R. Lewis, 1998, Life Third Edition. McGraw Hill, Boston, Mass.).
2. Loci which are heterozygous
3. Loci which are homozygous for rare alleles
4. Loci which display epistasis
5. Loci which display codominance
6. Alleles
7. Loci

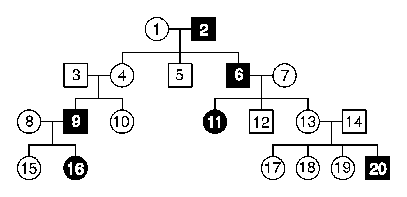


1. In *Drosophila melanogaster* there is a dominant allele for gray body color and a dominant allele of another gene for normal wings. The recessive alleles of these two genes result in black body color and vestigial wings, respectively. Flies homozygous for gray body and normal wings are crossed with flies that have black bodies and vestigial wings. The F1 progeny are then crossed, with the following results:
2. Gray body, normal wings: 236
3. Black body, vestigial wings: 253
4. Gray body, vestigial wings: 50
5. Black body, normal wings: 61
6. Would you say that these two genes are linked? If so, how many map units apart are they on the linkage map? (adapted from J.L. Gould and W.T. Keeton (1996). *Biological Science.* Sixth Edition. W.W. Norton & Company. New York. P. 443)
7. For the following pedigree, how does the afflicting allele impact on phenotype? (figure is from M.R Cummings (1988). *Human Heredity: Principles and Issues* West Publishing Company. New York. p. 113)
8. It is dominant
9. It is recessive
10. It is sex linked recessive

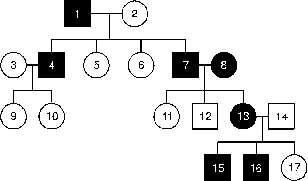


1. The recombination frequency between linked genes A and B is 40%, between B and C is 20%, between C and D is 10%, between C and A is 20%, and between D and B is 10%. What is the sequence of the genes on the chromosome? (adapted from J.L. Gould and W.T. Keeton (1996). *Biological Science.* Sixth Edition. W.W. Norton & Company. New York. P. 443)
2. What are the most likely modes of inheritance for each of the following pedigrees?

Pedigree A:



Pedigree B:



**Answers**

**Part I: One Trait Crosses**

1.  1/2

2. A. None  B. 1/2

3. None

4. 30

5. C

6. O

7. 8

8. A. gametes: T and t; tall

   B. gametes: 1/2T & 1/2t for one parent, and all t for the other parent; 1/2 tall and 1/2 short

   C. gametes: all T for one parent and 1/2T & 1/2t for the other parent; 1/2 tall and 1/2 short

   D. gametes: 1/2 T & 1/2 t for each parent; 3/4 tall and 1/4 short

9. A. genotype: 100% Dd;   phenotype: 100% yellow

   B. genotype: 1/4 DD, 1/2 Dd, 1/4 dd;        phenotype: 3/4 yellow and 1/4 green

**Part II: Back Crosses**

1. Mother: aa; Father: Aa;  Normal child: Aa; CF child: aa

2. A. Parents: Aa;  Grandfathers: A?;  Grandmothers: aa;  Sally and Susie: aa

        B. 1/2

3. Mother: T?         Father: tt         Mark and Max: Tt

4. No

5. BB

6. A

7. Black guinea pig is homozygous

8. Heterozygous

9. Parent with freckles: Aa;   Parent without freckles: aa;  Children with freckles: Aa; Child with no freckles: aa

10. Man: aa; Woman: AA;  Children Aa

11. Parents: Tt and tt

12. Parents of man: Bb;   Man: bb;        Woman: Bb;        Child: bb

13. 1/2

**Part III- Incomplete dominance**

1. 2

2. incomplete dominance

3. albino

4. 1/2 red and 1/2 pink

5. 3

6. A. 1/2 pink   B. None

7. Cannot be done

8. Incomplete dominance

9. Incomplete dominance; Oval x round: Rr x (either RR or rr);         long x oval:  (either RR or rr) x Rr

         Long x round: either RR x rr  or  rr x RR;          Oval x oval:   Rr  x Rr

**Part IV- Test Cross**

1. All of the offspring will be black.

2. Do a test cross; Mate the pig with a white guinea pig; If any white guinea pigs result, then the black guinea pig is heterozygous, and not pure.  If all the offspring are black, AND if there are sufficient numbers, then the black guinea pig is most likely pure.

3. Rr- heterozygous

**Part V- Multiple Alleles**

1. Types: A, B, O and AB

2. Either parent could be: AO, BO, OO

3. Yes; No

4. Type A or AB

5. Yes; No

6. One parent is AO and one parent is BO. This allows the following combinations:  AB, AO, BO, OO-- giving rise to one of each blood type.

7. Since both parents are AB, and since children get one allele from each parent, the possible combinations are:

        AA, AB, BB.  So, the children could have blood types: A, B or AB.

8. Yes.  If both parents are heterozygous (AO and BO) the child could get an O from each parent.

9.Yes- the deceased couple could not have a child with type O.  No- the deceased couple could have a child with type A, however, this does not mean he is not an imposter, because there are many people with type A.

10. Man: AO;          Woman BO;          Type A child: AO;           Type O child: OO

11. A. 50%         B. 75%

**Part VI-Two Traits**

1. BbTt x bbtt -->  25% for each:  BbTt, Bbtt, bbTt, bbtt

2. Mother: OO+-         Father:   BO--         Daughter: OO--

3. rrTT x RRtt          A. all tomatoes will be red and tall              B. Yes

4. 12

5. 1/4 AaBb spotted and wooly; 1/4 Aabb spotted and nonwooly; 1/4 aaBb nonspotted and wooly; 1/4 aabb nonspotted and nonwooly.

6. Parents are DDee and ddEE; and children are DdEe

**Part VII- Sex-linkage**

1. His mother.

2.  50%

3.  Mother could be either:  X-C X-c  (normal) or X-c X-c (colorblind); Father is  X-c Y

4. A. None   B. None

5. A. None  B. 50%

6. A. Woman: X-C X-c AO  Man:   X-C Y OO          B.  X-c Y OO          C. Daughters all normal, but half with type A blood and half with type O blood:  X-C X-C AO, X-C X-C OO, X-C X-c AO, X-C X-c OO;

Sons: 1/4 normal type A, X-C Y AO,  1/4 normal type O, X-C Y OO,  1/4 colorblind type A, X-c Y AO,

1/4 colorblind type O, X-c Y OO

7. (X-H Y WW   x   X-h X-h ww)  F1:  X-H X-h Ww (horned white ewe) and X-h Y Ww (hornless white ram)

F2:  females with horns and white; females without horns and white; females with horns and black; females without horns and black; males with horns and white; males without horns and white; males with horns and black, males without horns and black.

8. ( X-c Y OO x X-C X-c AB)  A. !/4 colorblind type A; 1/4 colorblind type B; 1/4 normal type A; 1/4 normal type B

**Part VIII- Probability**

1. A. 27/ 64        (3/4 x 3/4 x 3/4)        B. 1/8   (1/2 x 1/4)

2. None

3. 9/16

4. 1/4

5. A. 1/2                                   B. 3/4                                C. 3/8                    D. 1/16                  E. 27/512

6. A. 1/4                                   B. 1/2                                C. 1/8

7. A. 1/2, 1/2                            B. 1/4                                 C. 1/16                 D. 1/8

8. A. 100%                              B. 1/4                                 C-1:  1/64            C-2:  81/512            C-3:  54/4096

9. A. Type A and Type O         B.  AA, AO, OO               C. 81/256               D. 54/256

**Part IX - Pedigree Analysis and Linkage**

1.  ii, autosomal recessive.

2.  ii, Loci which are homozygous for rare alleles

3.  (50 +61) / (236 + 253 + 50 +61) = 18.5, so yes and 18.5 map units apart

4.  i, it is dominant..

*5.*A-C-D-B

6.  Pedigree A:  Autosomal recessive or X-linked recessive  Pedigree B:  Autosomal Dominant