上海科技大学2018年攻读硕士学位研究生

招生考试试题

科目代码：842　　科目名称：遗传学

考生须知：

1. 本试卷满分为150分，全部考试时间总计180分钟。
2. 所有答案必须写在答题纸上，写在试题纸上或草稿纸上一律无效。
3. 每道题目的中文部分均已翻译为英文，考生可在中英文中任选一种语言作答。
4. 可以使用无字典储存和编程功能的电子计算器。

一．单选题（每题4分，共40分）

1. 有些种类的线虫（nematode）的性别是由单一的X染色体决定的。雌性有两条X染色体（XX），而雄性只有一条（XO）。假设有一个位于X染色体的等位基因（allele）会造成隐形的胚胎致死表型。那么当一条野生型的雄虫和一条杂合体的雌虫交配。后代中雌雄虫的比例是？（　　）

   The sex of some nematode is determined by an *XO* chromosomal arrangement in which the males have only one sex chromosome (*XO*), and females have two (*XX*). Assume that a recessive lethal allele on the *X* chromosome causes death of an embryo in nematodes. What sex ratio would result in the offspring if a cross were made between a female heterozygous for the lethal allele and a normal male? (　　)

   A. 雌雄比4:1　　4:1 female to male
   B. 雌雄比2:1　　2:1 female to male
   C. 雌雄比3:1　　3:1 female to male
   D. 雌雄比1:1　　1:1 female to male
   E. 雌雄比1:2　　1:2 female to male

2. 真核细胞的遗传物质在细胞有丝分裂的哪个时期进行复制的？（　　）
   The genetic material of eukaryotic cells is duplicated during which stage of the mitosis.(　　)
   A. S期　　S phase
   B. G1期　　G1 phase
   C. M期　　M phase
   D. G2期　　G2 phase
   E. 以上皆非　　None of above

3. 如果一只小鼠的部分体细胞带有基因突变，以下哪种论述是正确的？（ ）
If a mouse bearing a mutation in some of its somatic cells, which of the following statements is true? ( )
A. 其后代均带有该突变
All of the animal's offspring will carry the mutation.
B. 其后代仅有部分带有该突变
Some but not all of the animal's offspring will also carry the mutation.
C. 该动物及其后代均有可能具有该突变导致的表型
Both the animal and its offspring will show the mutant trait.
D. 该动物，而非其后代可能具有带突变导致的表型
The animal but not its offspring can be affected by the mutation.
E. 以上皆否
None of above

4. 巴氏小体是 _____. （ ）
A Barr body is an _____. ( )
A. 正常的 X 染色体 active X chromosome
B. 正常的 Y 染色体 active Y chromosome
C. 失活的常染色体 inactive autosome
D. 失活的 X 染色体 inactive X chromosome
E. 失活的 Y 染色体 inactive Y chromosome

5. 一段 RNA 序列为 5'-AUGAUUGCGC- 3'，那它的互补 DNA 序列是（ ）
Given the RNA sequence 5'- AUGAUUGCGC-3', what is the complementary DNA sequence? ( )
A. 5'-ATGATTGCGC- 3'
B. 5'-GCGCAAUCAU- 3'
C. 5'-TACTAACGCG- 3'
D. 5'-UACUAACGCG- 3'
E. 5'-GCGCAATCAT- 3'

6. 如果一段双链 DNA 分子中，腺嘌呤的摩尔百分比是 24%，那其胞嘧啶的摩尔百分比是？（ ）
If the percentage of adenine in a double-stranded DNA molecule is 24%, the percentage of cytosine is? ( )
A. 24%
B. 25%
C. 26%
D. 76%
E. 0%

7. 果蝇中红眼（*W*）对白眼是显性（*w*），正常翅（*C*）对残翅（*c*）是显性。如果一个白眼正常翅的果蝇与一个红眼正常翅的果蝇交配，后代比例是 6/16 白眼直翅，2/16 白眼残翅，6/16 红眼直翅，2/16 红眼残翅。那最有可能的亲本基因型是？（　　）
In fruit fly *Drosophila*, red eye *(W)* is dominant to white eye *(w)* and normal wing *(C)* is dominant to cut wing *(c)*. When a cross happened between a white, normal wing fly and a red eye, normal wing fly, the ratio of offspring is 6/16 white eye, normal wing; 2/16 white eye, cut wing; 6/16 red eye, normal wing; 2/16 red eye, cut wing. What is the most likely genotype of the parents? ( )
A. *WWCC X wwcc*
B. *WwCc X WwCc*
C. *WwCc X Wwcc*
D. *WwCc X wwCc*
E. *WWCC X WWCC*

8. 在鸟类中，雌鸟的性染色体是 ZW 而雄鸟是 ZZ。那鸟类线粒体基因突变可以从（　　）
In birds, males are the homogametic sex (ZZ), while females are the heterogametic sex (ZW). A mutation in bird mitochondria DNA could pass ( )
A. 母鸟传到子代雌鸟　　from maternal bird to F1 female bird
B. 公鸟传到子代雄鸟　　from paternal bird to F1 male bird
C. A 和 B　　A and B
D. 以上均不可　　None of above

9. 遗传编码被称为简并的原因是( )：
The genetic code is said to be “degenerate” because （　）
A. 三联密码子总数多于其编码的氨基酸
There are more codons than amino acids.
B. 三联密码子在不同物种中编码相同的氨基酸
Different organisms use different codons to encode the same amino acid.
C. 三联密码子在不同物种中编码不同的氨基酸
Different organisms use different codons to encode the different amino acid.
D. 一些三联密码子编码不止一个氨基酸
Some codons specify more than one amino acid.
E. 一些三联密码子编码终止密码子
Some codons specify the stop codon.

10. 如果某二倍体生物中基因 X 有 4 种等位基因，那对该基因而言，某个个体最多会有几种配子？( )
If a diploid organism has 4 types of allele in gene X, then for

this locus, how many different gametes a certain individual could have （ ）
A. 1
B. 2
C. 3
D. 4
E. 12

二．判断题（请填写“对”或“错”，每题 4 分，共 20 分）

1. 通常说来，有一小部分基因是在某个个体的所有类型的细胞中均有表达。
Typically, a small subset of genes are expressed in each type of cell within an organism.

2. 通常说来，移码突变要比碱基替换突变对基因相关表型造成的影响更小。
Frameshift mutations generally have less drastic effects on the phenotype than substitutions.

3. 一血型为 B 的男性和一血型为 A 型的女性永远也不能生出一个血型为 O 型的儿子。
A man with blood type B and a woman with blood type A could never produce a son with blood type O.

4. 自身不携带转座酶的转座子在外源的同类转座酶存在的情况下也能发生转座。
A transposon without a transposase could also translocate with the help of external transposase of the same transposon.

5. 在动物中，miRNA 主要通过结合并降解目标 mRNA 来调控基因的表达。
In animals, miRNAs regulate gene expression mainly through binding and degrading target mRNAs.

三．计算题（请给出计算过程，每题 15 分，共 45 分）

1. 一位遗传学家用红花毛叶的豌豆株与白花光叶的豌豆植株进行测交。得到子代结果如下：44 株红花毛叶，36 株白花毛叶，32 株红花光叶，40 株白花光叶。他的假设是花色和叶型是由独立的两对基因控制，上述结果是否符合他的假设？请写出卡方检验的计算过程[下表提供了卡方值（x^2） 和自由度（degree of freedom）的对照表]。

A geneticist testcrossed pea plants with red flowers and hairy foliage to plants with white flowers and smooth foliage. He obtained the

following results: 44 red, hairy; 36 white, hairy; 32 red, smooth; and 40 white, smooth. Are these results consistent with his hypothesis that flower color and foliage type are controlled by independently assorting genes, each segregating two alleles? Show all work including values obtained from chi-square table.

Percentage Points of the Chi-Square Distribution

Degrees of Freedom	Probability of a larger value of x^2								
	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
6	0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
7	1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.48
8	1.647	2.733	3.490	5.071	7.344	10.22	13.36	15.51	20.09

2. 假设在一个与世隔绝的小岛上，人群的 ABO 血型**符合** Hardy-Weinberg 平衡。这个岛上 1000 个人的血型经检测如下，但是 B 型和 AB 型的人数信息遗失了：

1）请根据这些数据估算岛上人群中决定 ABO 血型的等位基因 I^A, I^B, 和 i 的基因频率。（9 分）

2）B 型和 AB 型应该各有多少人?（6 分）

血型 （Blood Type）	人数（Number of People）
A	90
B	?
AB	?
O	160

Assume that the ABO blood types in an isolated island are in Hardy-Weinberg proportions. The blood types of 1000 people from this island were determined to obtain the data （with the B type and AB type data not available)（see the table above）:

1）Estimate the frequencies of the I^A, I^B, and i alleles of the ABO blood group gene from these data.

2）How many people are B type and AB type respectively?

3. *a*, *b* 和 *c* 是果蝇位于 X 染色体上的三个基因。将携带这三个基因突变的杂合雌果蝇与三个基因都突变的纯合雄果蝇进行杂交，得到后代情况见下表：

Phenotype 表型			Number 数量
a	*b*	*c*	3
+	*b*	c	392
+	+	*c*	34
+	*b*	+	61
a	*b*	+	32
a	+	*c*	65
a	+	+	410
+	+	+	3

		Total:	1000

1）这三个基因在 X 染色体上的正确顺序是怎样的，亲本中杂合雌果蝇的基因型是什么？（5 分）
2）*a* 和 *b*，*b* 和 *c*，*a* 和 *c* 基因间的距离各是多少？（5 分）
3）并发系数（即并发率）是多少？（5 分）

Drosophila females heterozygous for three X-linked recessive mutations, *a*, *b*, and *c*, were crossed to male homozygous for all three mutations, the following progeny were obtained （listed in the table above）:

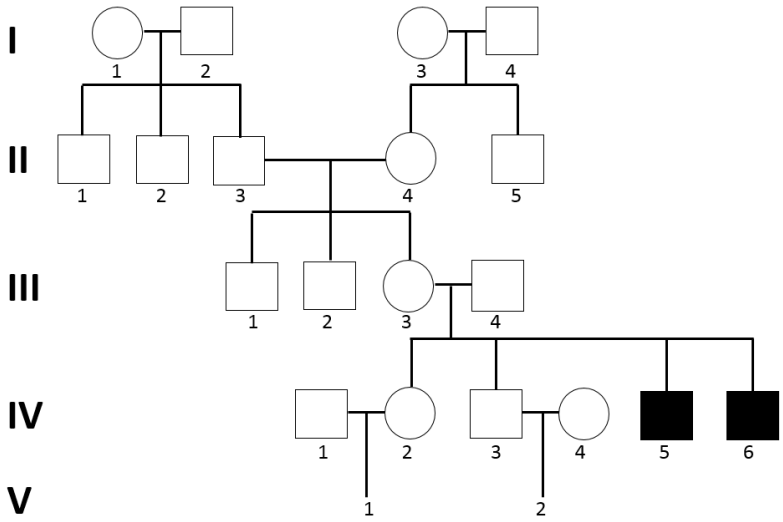
1) What is the correct order of these three genes on the X chromosome and what is the genotype of the female P0 ?
2) What are the genetic map distances between *a* and *b*, *b* and *c*, and *a* and *c* ?

3) What is the coefficient of coincidence?

四．综合问答题（回答问题并叙述理由）（每题 15 分，共 45 分）

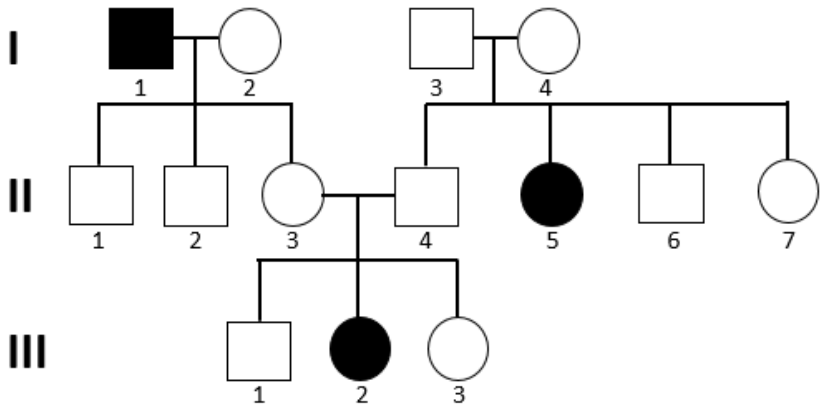
1. 杜氏肌营养不良（DMD）是一种罕见的 X 染色体连锁的隐性遗传病。患者的肌肉逐渐失去功能，一般 20 岁之前死亡。下面这个家系里的 IV-5 和 IV-6 男性是 DMD 患者，该家系如果有 V-1 和 V-2 后代的话，会各有多少概率遗传到这一疾病 ？

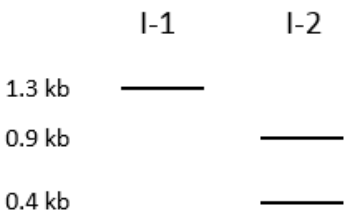
Duchenne muscular dystrophy (DMD) is caused by a relatively rare X-linked recessive allele. It results in progressive muscular wasting and usually leads to death before age 20. The males labeled IV-5 and IV-6 in the following pedigree are affected with DMD. What are the risks that V-1 and V-2 will inherit this disorder?



2.苯丙酮酸尿症是一种导致苯丙氨酸代谢降低的常染色体隐性疾病。在下图所示的苯丙酮酸尿症家系里，*PAH*基因发生点突变，导致一个限制性内切酶位点的消除。对家系里 I-1 和 I-2 个体的 *PAH* 基因进行 PCR 扩增和酶切后的电泳结果如下。如果你用同样方法鉴定这一家系里 I-3, I-4, II-3, II-4, II-5 和 III-2 个体的 *PAH*基因型，电泳结果如何？请画出。

Phenylketonuria is an autosomal recessive disease that results in decreased metabolism of the amino acid phenylalanine. In the shown Phenylketonuria pedigree, a point mutation occurs in the affected *PAH* gene leading to the loss of a certain restriction enzyme site. The gel electrophoresis result of I-1 and I-2 individuals after PCR and enzyme digestion of their *PAH* alleles is as follows. If you use the same strategy to genotype I-3, I-4, II-3, II-4, II-5 and III-2 in this pedigree below, what will be their gel electrophoresis pattern? Please draw the gel electrophoresis results.





3. 有个研究组发现在老鼠和蛇中 *Sonic Hedgehog* 基因的 ZRS 增强子区有所不同。他们猜测在进化上这是导致蛇与鼠在四肢发育过程不同的原因。如果你在这个研究组，请设计实验来验证他们的这一假说并解释。

A research group found that the *Sonic Hedgehog* genes in mice and serpents differ in the ZRS enhancer region. They hypothesize that this may be the reason for the evolution divergence of limb development between mice and serpents. If you were in this group, please design experiments to test this hypothesize and explain.