Biol 3301 Exam 2 Spring 2011

1) Recessive genes a, b, c, d, e, and f are closely linked on a chromosome, but their order is unknown. Three deletions in the region are examined. On deletion uncovers a, d, e; another uncovers c, d, f; and a third uncovers b and c. What is the order of the genes?
a) a b c d e f
b) a e d f c b
c) a d e c f b
d) c f d e a b
e) none of the above

2) The petal color in flowers of the railroad vine are determined by a series of alleles at one autosomal locus (c): c^d = dark purple, c^m = medium purple, c^l = light purple, and c^{vl} = very pale purple (almost white). The order of dominance is $c^d > c^m > c^l > c^{vl}$. If a heterozygous female with a light purple phenotype is crossed to a heterozygous dark purple male, what phenotypic ratio among the their offspring is possible?
a) all dark purple
b) all medium purple
c) 1 dark purple : 1 light purple
d) 1 medium purple: 1 light purple
e) all are possible

3) What is characteristic of a bacterial insertion (IS) sequence?
a) size approximately 10 nucleotide pairs
b) only one copy per genome
c) found on only on the bacterial chromosome and not plasmids
d) has inverted repeats
e) none of the above

4) Which of the following somatic cell chromosome numbers is most likely to represent a trisomic individual?
a) 16 b) 27 c) 31 d) 62 e) 9

5) In mice, the alleles at an autosomal locus determine whether individuals have agouti (A) or solid (a) coats. A gene on a different chromosome, is epistatic to the A and a color alleles: the Z allele results in a cream coat, the z allele has no effect on the expression of the color locus. If two mice of genotype A/a; Z/z are crossed, what phenotypic ratio is expected in the offspring?
a) 9 cream; 3 solid, 4 agouti
b) 1 agouti: 2 cream: 1 solid
c) 9 agouti: 6 solid: 1 cream
d) 9 agouti: 4 cream: 3 solid
e) 12 cream: 3 agouti: 1 solid

6) You measure MN blood type among your genetics classmates. You find that 110 individuals are MM, 84 are MN, and 6 are NN. What is the frequency of the M allele?
a) 0.76 b) 0.74 c) 0.50 d) 0.41 e) 0.38

7) In *Drosophila*, the phenotype bar-eye is due to a tandem duplication of several bands on the X chromosome. Occasionally (1 out of 1600), all true breeding stocks of bar-eyed flies yield an even more extreme phenotype called ultrabar, which is due to a triplication of this chromosomal segment. The hypothesis used to explain ultrabar's origin is that a slight mispairing of chromosomes can occur whenever there is a duplication. What other evidence, not involving cytological observation, would support this hypothesis?
a) pseudodominant expression of genes close to tandem duplication
b) equal frequencies of wild type and ultrabar males per generation
c) reduced recombination in the vicinity of the tandem duplication
d) the presence of a fragile site in the region of the tandem duplication
e) all of the above

8) The eyes of houseflies are normally green. Several purple-eyed strains have been isolated as spontaneous variants (mutants) and the purple phenotype has been shown to be inherited as a Mendelian autosomal recessive in each case. Crosses are made between all mutant strains are the results are given in the figure below (a "+" indicates green eyes, a p indicates purple eyes in the offspring).

	a	b	c	d	e	f	g	h	i	j	k
a	p	+	p	+	+	+	p	+	+	+	p
b		p	+	+	p	+	+	p	+	+	+
c			p	+	+	+	p	+	+	+	p
d				p	+	p	+	+	p	p	+
e					p	+	+	p	+	+	+
f						p	+	+	p	p	+
g							p	+	+	+	p
h								p	+	+	+
i									p	p	+
j										p	+
k											p

Based on the data in the table, how many different genes are represented by the mutant strains?
a) one b) two c) three d) four e) you can't tell

9) You measure MN blood types among your genetics classmates. You find that 70 individuals are MM,110 are MN, and 20 are NN. What is the expected frequency of the MM genotype under Hardy Weinberg Equilibrium?
a) 0.500 b) 0.836 c) 0.700 d) 0.625 e) 0.391

10) Which of the following is part of the transposable element life cycle?
a) horizontal transfer to another species
b) rapid increase in copy number
c) gradual loss of functional elements through mutation
d) gradual reduction in transposition rate
e) all of the above

11) In *Drosophila*, the eye color peach is determined by an autosomal recessive allele p (the normal eye color is red). On a different chromosome, the autosomal recessive allele s suppresses peach, restoring the red eye color. When two homozygous red strains A and B are crossed to each other, the F_1 is red. But when the F_1 is backcrossed to strain A, the phenotypic ratio of the offspring is 3/4 red and 1/4 peach flies. The genotype of strain A is best represented as:
a) p+/p+; s+/s+ b) p+/p; s/s c) p/p; s/s d) p/p; s+/s+ e) p+/p; s+/s

12) What enables us to determine the genetic basis of a quantitative trait?
a) offspring have half of their genome in common with each parent
b) quantitative phenotypes have a normal distribution
c) most individuals are heterozygous at multiple loci
d) every offspring has two parents
e) quantitative traits often show continuous rather than discrete variation

13) In corn, R is a gene for red aleurone; its recessive allele r determines colorless aleurone. A cross is made between a diploid r/r female and a trisomic R/r/r male. If trisomic pollen grains are inviable, what is the expected ratio of red to colorless kernels in the offspring?
a) 1 red: 1 colorless
b) 1 red: 2 colorless
c) 1 red: 3 colorless
d) 1 red: 5 colorless
e) none of the above

14) In chickens, the creeper phenotype is characterized by extremely short legs. It is also impossible to develop a pure-breeding strain of creepers. The allele responsible for the creeper phenotype is best described as:
a) lethal recessive
b) haplosufficient
c) incompletely dominant
d) dominant negative
e) haploinsufficient

15) In *Drosophila*, Curly wings are caused by a dominant allele (Cy) of a gene on the second chromosome. A Cy/+ male was irradiated with X rays, crossed to a +/+ female, and the Cy/+ sons were mated individually with +/+ females. From one such cross, the offspring were 146 curly males, 0 wild type males, 0 curly females, 163 wild type females. What abnormality in chromosome structure is the most likely explanation for these results? (Remember that recombination does not occur in male *Drosophila*.
a) deletion of the wild type allele at the curly locus
b) deletion of the curly allele at the curly locus
c) translocation of the wild type allele at the curly locus to the Y chromosome
d) translocation of the curly allele at the curly locus to the Y chromosome
e) translocation of the curly allele at the curly locus to the X chromosome

16) In a tribe of Inuit in northwestern Canada, the frequencies of the alleles determining the ABO blood groups were estimated as 0.74 for i, 0.16 for IA, and 0.10 for IB. Assuming random mating, what is the expected frequency of the A phenotype?
a) 0.2624 b) 0.0256 c) 0.16 d) 0.90 e) none of the above

17) In guinea pigs, two common coat colors are cinnamon (reddish-brown) and gray. You cross a female from a pure-breeding grey strain to a male from a pure-breeding cinnamon strain. The offspring are all black. This is an example of:
a) epistasis
b) incomplete dominance
c) multiple alleles
d) a quantitative trait
e) a transposable element induced phenotype

18) An allotetraploid plant species is produced by an interspecific hybridization event between diploid parents that had a fixed difference at a locus affecting height (one parent was homozygous for an allele producing tall plants, i.e., t/t; while the other was homozygous short, i.e., T/T). These alleles are incompletely dominant, so that plants with mixtures of the two alleles will be intermediate. If two allotetraploids of genotype T/T/t/t are crossed to each other, what is the expected phenotypic ratio in the offspring, if parental chromosomes pair assortatively during meiosis?
a) 1 tall: 1 short
b) 1 tall: 2 intermediate: 1 short
c) all intermediate
d) 3 tall: 1 short
e) none of the above

19) Which of the following statements, if any, is <u>false</u>?
a) A nonautonomous element cannot transpose on its own.
b) When a transposable element inserts into a gene it can cause a mutation.
c) Transposons are capable of horizontal transmission.
d) Transposon-induced mutations are unstable.
e) Transposable elements are not active in the human genome.

20) In tomatoes, the traits of potato leaves, yellow fruit, hairy stems, oblate fruit, and white petals are each caused by a dominant allele at a different autosomal locus. You grow 100 individuals that are hetrozygous for each locus under a range of environmental conditions (soil nitrogen concentration), the number of individuals that showed the expected phenotype is given in the table below.

trait \ nitrogen	3%	5%	7%	10%
potato leaf	100	100	100	100
yellow fruit	85	85	85	85
hairy stem	75	80	85	95
oblate fruit	95	90	85	80
white petals	95	95	100	100

Which of the traits displays variable expressivity?
a) all of them
b) all but potato leaf
c) all but potato leaf and yellow fruit
d) only potato leaf and yellow fruit
e) you can't tell because the alleles are dominant

21) Internode length in little bluestem is controlled by four independently assorting genes; each dominant allele contributes equally (across loci) to the phenotype (i.e., each dominant allele increases the phenotype by the same increment, each recessive allele adds nothing). If two individuals that are heterozygous at all four loci are crossed, how many different phenotypes will be observed in the offspring?
a) one
b) three
c) six
d) nine
e) sixteen

22) A standard chromosome can be represented as abc*defgh (where *represents the centromere), and from this, a chromosomal aberration arises that can be represented as abc*degfh. This is known as a:
a) deletion
b) duplication
c) inversion
d) translocation
e) transposition

23) A population of lab rats recently escaped into the sewer system of Dallas. A brave researcher sampled this population, and estimated the following phenotypic frequencies (which were caused by a single gene with two alleles): 613 normal eyes (EE), 262 cross-eyed (Ee) and 131 blind (ee) from a total sample of 1000 rats. She calculated a goodness-of-fit chi-square, and obtained a value of 4.96. Based on the table below, what do you conclude?

Table 2-2 Critical Values of the χ^2 Distribution

	P								
df	0.995	0.975	0.9	0.5	0.1	0.05	0.025	0.01	0.005
1	.000	.000	0.016	0.455	2.706	3.841	5.024	6.635	7.879
2	0.010	0.051	0.211	1.386	4.605	5.991	7.378	9.210	10.597
3	0.072	0.216	0.584	2.366	6.251	7.815	9.348	11.345	12.838
4	0.207	0.484	1.064	3.357	7.779	9.488	11.143	13.277	14.860
5	0.412	0.831	1.610	4.351	9.236	11.070	12.832	15.086	16.750
6	0.676	1.237	2.204	5.348	10.645	12.592	14.449	16.812	18.548
7	0.989	1.690	2.833	6.346	12.017	14.067	16.013	18.475	20.278
8	1.344	2.180	3.490	7.344	13.362	15.507	17.535	20.090	21.955
9	1.735	2.700	4.168	8.343	14.684	16.919	19.023	21.666	23.589
10	2.156	3.247	4.865	9.342	15.987	18.307	20.483	23.209	25.188

a) the chi-square value is significant and you reject the null hypothesis of Hardy Weinberg Equilibrium
b) the chi-square value is significant and you accept the null hypothesis of Hardy Weinberg Equilibrium
c) the chi-square value is not significant and you reject the null hypothesis of Hardy Weinberg Equilibrium
d) the chi-square value is not significant and you accept the null hypothesis of Hardy Weinberg Equilibrium
e) there's not enough information to answer the question

24) In corn, two independent genes are involved in kernel color. When both dominant alleles are present (C/- ; R/-), the color is brown; when either is recessive (C/- ; r/r or c/c ; R/-), the color is yellow; if both are recessive (c/c ; r/r) the color is white. You make a cross between a homozygous yellow plant that is know to have unstable color (i.e., you typically see yellow kernels with brown spots) due to an Ac insertion, and a homozygous white strain that lacks Ac elements. If you cross the resulting F_1 offspring, what phenotypic ratio do you expect in the F_2?
a) 9 yellow with brown spots: 3 white with yellow spots: 3 yellow: 1 white
b) 9 yellow with brown spots: 3 white with yellow spots: 3 yellow with white spots: 1 white
c) 9 yellow with brown spots: 3 white with brown spots: 3 yellow: 1 white
d) 9 yellow with brown spots: 3 brown with yellow spots: 3 yellow: 1 white
e) 12 yellow with brown spots: 3 yellow: 1 white

25) Ornamental carp may be red, orange, yellow or white in color. The table below gives information on several families of parents and offspring (the parental genotypes are unknown).

	parents male x female		offspring	
1	red	white	red ♂♂	red ♀♀
2	red	yellow	orange ♂♂	red ♀♀
3	white	yellow	yellow ♂♂	white ♀♀
4	orange	red	½ red ♂♂ ½ orange ♂♂	½ red ♀♀ ½ yellow ♀♀
5	yellow	red	orange ♂♂	yellow ♀♀

On the basis of these data, what are the genotypes of family 2?

a) c^r/c^r male, c^y/c^y female

b) c^r/c^o male, $c^y//c^o$ female

c) c^r/Y male, $c^y//c^o$ female

d) c^r/c^r male, c^y/Y female

e) $c^r//c^o$ male, c^y/Y female