Quiz 2 Genetics summer 2008Explanations and some answers

Note: I have written some long explanations here for your benefit. I would NOT want you to do that on a quiz. I just want answers with the necessary work from you

1. Two parental strains are crossed. The resulting F1 is test-crossed. The resulting progeny are in the following phenotypes and numbers.

ADG	42
adg	43
ADg	140
adG	145
Adg	6
aDG	9
AdG	305
aDg	310

The largest numbers give the phenotype of the parental strains. The parental strains HAVE to be homozygous and since this was a test crossed F1, you can assume that the organism is diploid. The data here is already set up in nice reciprocal pairs, so you don't have to do that.

So, parental strains are AAddGG and aaDDgg

The smallest numbers must be the DCOs (double cross-overs). In a double crossover only the gene in the middle is changed. So, comparing AdG and aDg (parentals) to the DCOs Adg and aDG you can see that only the alleles for G are different from the parental phenotypes. So G is in the middle.

Once you know that G is in the middle, you know that you only need to calculate the distance from A to G and from G to D, as they will be the smaller, more accurate distances. The parental combinations are AG and ag, so all Ag and aG will be A to G recombinants. The reverse is true of A and D, parental is Ad and aD, recombinant is AD and ad. The total number of offspring is 1,000. Imagine that! A nice round number.

A --> G = (140 + 145 + 6 + 9) / 1,000 = 300/1,000 = 0.3 or 30 map units

G --> D = (42 + 43 + 6 + 9) / 1,000 = 100/1,000 = 0.10 or 10 map units

map A 30 G 10 D

With A->G = 0.30 and G-->D = 0.10 you'd expect 0.30 x 0.10 double crossovers or 0.03 double crossovers. Time 1,000 that would be 30. But there are only 6 +9 = 15

1- 15/30 = 0.50 or 50% interference here

2. What is the order of the substances in this enzymatic pathway?

substance added:		A	B	C	D	E	F
mutant	1	-	-	-	+	+	+
	2	+	-	-	+	+	+
	3	-	-	-	+	-	+
	4	+	-	+	+	+	+
	5	-	-	-	+	-	-

Nothing grows on B, so it is likely not part of the pathway. It may even be toxic. For the rest, every mutation is in a gene. The mutations inactivate the gene product. The genes make enzymes that catalyze steps in the biochemical reaction. When an enzyme is defective, the organism can't do that particular reaction. So the organism g=can only grow on substances that are AFTER the blocked spot. The enzymes catalyze the reactions that convert one substance to the next. So for instance mutant 5 can only grow on D because it would normally catalyze the last step that makes D from F. Since the mutant can't do that, giving it any of the other substances results in a block at F.

So

4 2 1 3 5

----> C ----> A ----> E ----> F ----> D

3. You have isolated 8 yeast mutants that cannot grow on minimal media, but which can grow if you add the amino acid leucine. A complementation test was performed with the following results:

Mutant	a	b	c	d	e	f	g	h
a	-	+	+	-	+	+	+	+
b	+	-	+	+	+	+	+	+
c	+	+	-	+	+	+	-	-
d	-	+	+	-	+	+	+	+
e	+	+	+	+	-	-	+	+
f	+	+	+	+	-	-	+	+
g	+	+	-	+	+	+	-	-
h	+	+	-	+	+	+	-	-

a) What are the complementation groups and what are their members?
1) a,d 2) b 3) c,g,h 4) e,f

b) How many genes have you found involved in the synthesis of adenine?
four

c) You sporulate (that means caused them to go through meiosis) some of the diploids made by mating mutant **a** to the others and dissected the tetrads to produce haploid offspring colonies on media with adenine. You then checked to see what percent of the colonies could also grow on minimal media with the following results:

a & b	24%	a & f	25%	e & g	10%
a & e	26%	a & h	24%	f & h	9%

in the AB example, from meiosis expect AB, ab, Ab, and aB in equal numbers if the genes are unlinked. Of these, on AB will grow. So expect 25% roughly for unlinked genes. If the genes are linked, as in the EG example, recombinants are rare. EG and eg would be the recombinants. 10% would mean that ½ of the recombinants = 10% so the genes are linked at about 20 map units apart

4. The *h* allele causes neurospora to require histidine for growth, *a* causes neurospora to require adenine for growth. The following are the results of ordered octad analysis from individual asci. The octads are combined so that you see the original result of meiosis.

Spore pair	**1**	**2**	**3**	**4**	**5**	**6**
1 - 2	*h* *a*	*h* *a*	*h* *a*	*h* *a*	*h* +	*h* +
3 - 4	*h* *a*	*h* +	+ +	+ *a*	*h* +	+ +
5 - 6	+ +	+ *a*	+ *a*	+ +	+ *a*	*h* *a*
7 - 8	+ +	+ +	*h* +	*h* +	+ *a*	+ *a*
total	**4**	**24**	**4**	**30**	**120**	**18**
Tetrad type	**NPD**	**T**	**T**	**T**	**PD**	**T**
MII for *h* ?	**no**	**no**	**yes**	**yes**	**no**	**yes**
MII for *a*?	**no**	**yes**	**yes**	**no**	**no**	**no**

a) What were the parental strain types? *h* a^+, h^+ *a* The biggest number gives the PD

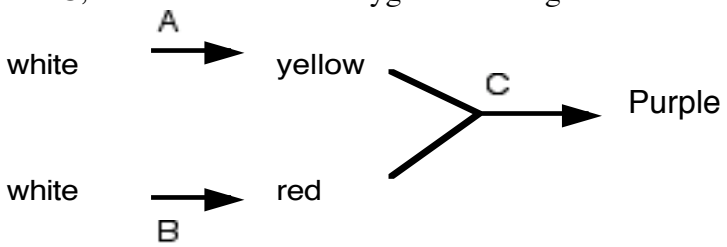
h--> a = (½ T + NPD) / total = (½ (76) + 4) / 200 = 46/200 = 23/100 = 23 mu

h --> cen = (½ MII) / total = (½ 56)/200 = 28/200 = 14/100 = 14 mu

a --> cen = (½ 28)/200 = 14/200 = 7/100 = 7 mu

a 7 (cen) 14 h

5. Below is the pathway for flower color in a plant. All colors are dominant to white. Yellow and red together make orange. Strain 1 is a homozygous null mutant in genes A and C, and strain 2 is homozygous null in gene B.



Give the phenotypes (and proportions where applicable) for each of the following:

a) Strain 1 red b) Strain 2 yellow c) F1s purple

d) F2s 1/16 aabb white, 3/16 A_bb yellow, 3/16 aa B_ red

9/16 x 3/4 A_B_C_ = 27/64 purple, 9/16 x ¼ A_B_cc = 9/64 orange