GENOME371 EXAM 2A WHITE KEY Autumn 2003

1A) (*3 points*) b. autosomal

1B) (*3 points*) a. D3/d1

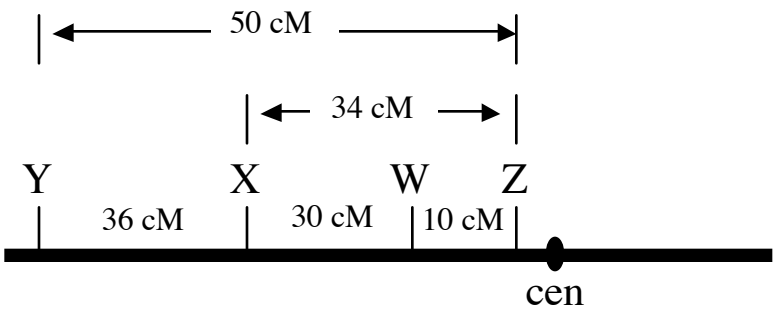
1C) (*1 point each*)
Recombinant type 1 = D1 15%
Recombinant type 2 = d3 15%

1D) (*6 points*) 70%. Explanation: The possible gametes from parent II-3 are D1 = 15%, d3 = 15%, D3 = 35%, and d1 = 35%. We know that son III-1 inherited the d2 allele from his Dad and he has the "3" allele from his Mom. The probability that he is "D" is 35%/ [35% + 15%] = 70%.

2) (*1 point each*)

Events at Meiosis	Earth	Mars
A. The stage at which homologues are paired.	B	4
B. The division where ploidy is reduced.	C	5
C. The division when sister centromeres separate.	E	1
D. The stage at which heteroduplexes are present.	B	4
E. The division when cohesin is cleaved.	C	1
F. The stage when resolvase functions.	B	4
G. The stage when breaks in the DNA are made.	B	4
H. The division when alleles of centromere-linked genes segregate.	C	5
I. The division where homologues segregate from one another.	C	5
J. The stage when chromosome replication occurs.	none	none

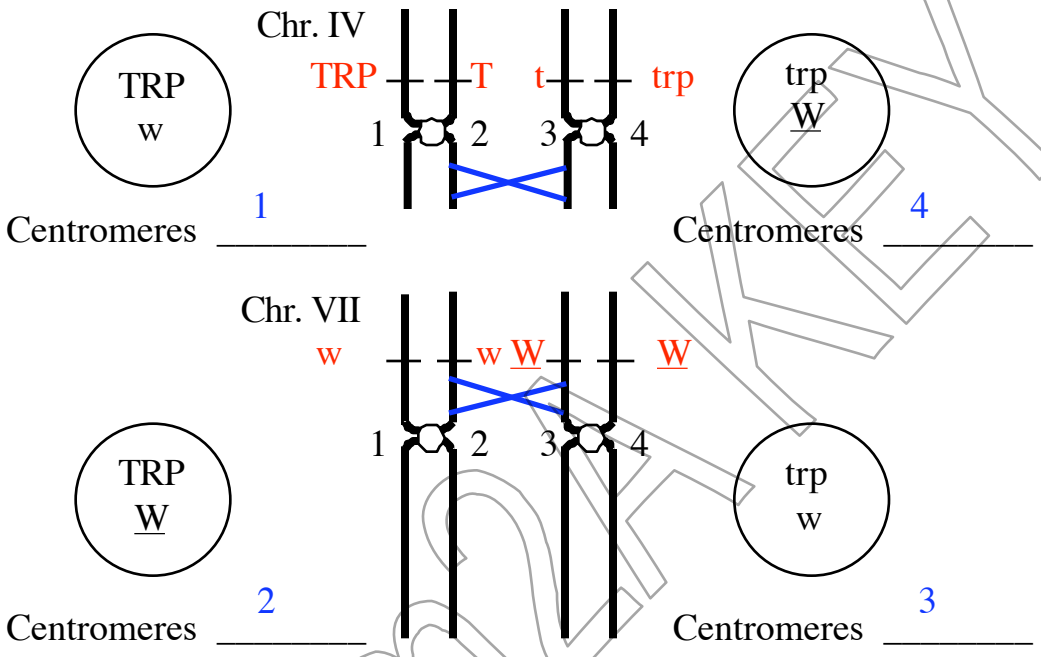
3A) (*6 points*)



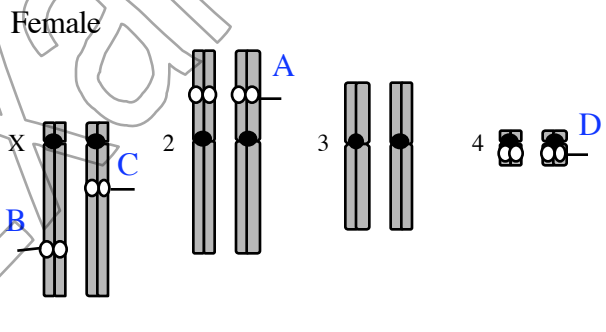
3B) *(2 points)* 66 cM

3C) *(6 points)* The "Z" gene is closest to the centromere. It is the only gene with no crossovers (no tetratypes and P = NPD) amongst its 12 tetrads.

3D) *(6 points)*



4A) *(2 points each)*



4B) *(2 points)* Segregation

4C) *(2 points)* Non-disjunction

4D) *(2 points)* Transposition

4E) *(2 points)* Segregation

4F) *(2 points)* Deletion

4G) *(2 points)* Crossing-over

5A1) (*3 points*) A nonsense mutation in the *ade2* gene creates a stop codon in the mRNA that terminates production of the Ade2 protein.

5A2) (*4 points*) The revertant carries a dominant, gain-of-function mutation in the tRNA gene that would normally insert an amino acid when the ribosome reaches that site in the mRNA. Its anti-codon loop now recognizes the aberrant stop codon in *ade2* and inserts an amino acid, allowing continued translation and production of a functional Ade2 protein.

5A3) (*4 points*) *ade2/ADE2; SUP/sup*, where *ade2* is the original mutation in the starting red colony, *ADE2* is the wild-type gene from the wild-type parent, *SUP* is the dominant gain-of-function tRNA gene from the revertant, and *sup* is the wild-type tRNA from the wild-type parent.

5A4) (*4 points*) Red spore: *ade2; sup*, White spore 1) *ade2; SUP*; White spore 2: *ADE2; sup;* White spore 3: *ADE2; SUP*.

Those who created second mutations in the *ade2* gene, thereby restoring enzyme function (*ade2*^{rev}), received partial credit. Such a reversion mutation cannot give a red spore after mating with wild type; all spores will be white and able to grow on – adenine plates.

5B1) (*3 points*) Any loss-of-function mutation in the *ade2* gene that disrupts the production or activity of the Ade2 protein.

5B2) (*4 points*) The revertant carries a second, loss-of-function mutation in the *ade3* gene. Loss of Ade3 protein or activity means that the precursor X does not build up and get converted to red pigment by "Gene ?".

5B3) (*4 points*) *ade2/ADE2; ade3/ADE3*, where *ade2* is the original mutation in the starting red colony, *ADE2* is the wild-type gene from the wild-type parent, *ade3* is the loss-of-function allele from the revertant, and *ADE3* is the wild-type allele from the wild-type parent.

5B4) (*4 points*) Red spore: *ade2;ADE3 (requires adenine for growth)*, White spore 1) *ade2; ade3 (requires adenine for growth)*; White spore 2: *ADE2; ade3 (requires adenine for growth);* White spore 3: *ADE2; ADE3 (does not need adenine for growth).*

6A) (*3 points*) b. Notch is dominant and sex-linked.

6B) (*3 points*) e. Cannot determine from the above data.

6C) (*3 points*) b. 1, 2 and 3 are co-dominant and sex-linked.