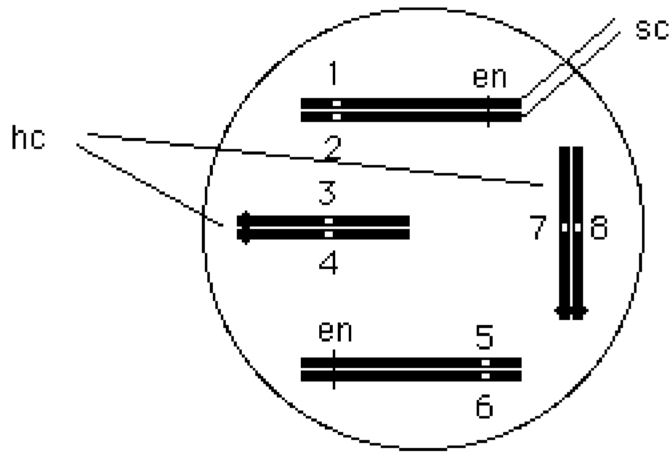
PRACTICE PROBLEMS 1
ANSWERS

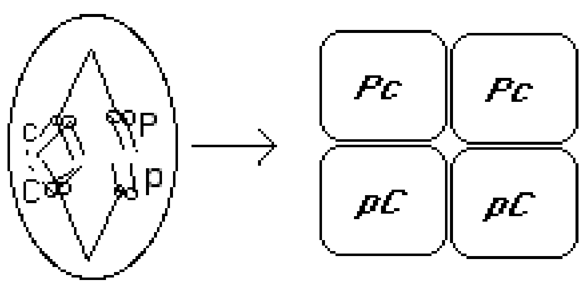
1. (a), (b), (c)



(d) 1 <u>2</u>   2 <u>1</u>   3 <u>4</u>   4 <u>3</u>

(e) 5 <u>1,2</u>   6 <u>1,2</u>   7 <u>3,4</u>   8 <u>3,4</u>

2. In the diagram below, note that vertical orientation is irrelevant and could be inverted; the only thing that is important is that C and p are attached to one pole and c and P to the other.



3. 8; 16; 2^n

4.

(a) test cross
(b) Y y X y y -> 1/2 Y y yellow   100 X 1/2 = 50 yellow
(c) Y y X y y -> 1/2 y y green   T t X t t -> 1/2 t t short
1/2 X 1/2 = 1/4green short   100 X 1/4 = 25 green short

5. The mice are already homozygous a a, so the answer is simply aa plus all possible combinations of the homozygotes produced by B b and C c, which are BB, bb, CC, and cc. You can get these by using a Punnett square to get the four combinations of BB, bb, CC, and cc (or do it in your head). The answer is:

aa BB CC   aa bb CC
aa BB cc   aa bb cc

6. Parents: probably Rr X rr, but possibly Rr X Rr. Both parents must have r to get smooth (r r) progeny. One parent must be heterozygous or homozygous to get rough progeny. Since the ratio of offspring genotypes is about 1:1, that parent is probably heterozygous. One should do a Chi-square test on this to be sure; I did, and found that the 8:7 ratio is not quite significantly different from a 3:1 ratio. On an exam, you'd not be required to do this, and if you just gave Rr X rr, I'd count it correct.

7.

(a) T T R R X t t r r

(b) Tall can be T T or T t but only the latter can produce both tall and short offspring, so the genotype we want is T t r r. The F1 is T t R r, from which the probability of getting T t is 1/2 and the probability of getting r r is 1/4. These are independent events, so the probability of T t r r is 1/2 X 1/4 = 1/8.

(c) $\frac{16!}{14!2!}(7/8)^{14}(1/8)^2 = 0.289$

8. To satisfy both, they must have either 1 girl and 2 boys or 2 girls and 1 boy. The probability of the former event is $\frac{3!}{1!2!}(1/2)^1(1/2)^2 = 3/8$; the probability of the latter is the same. These are mutually exclusive events; the probability of one or the other happening is 3/8 + 3/8 = 6/8 = 3/4.

9. (a) The probability of *bb* is 1/4 so the probability of a male *bb* is 1/8; same for female *bb*. The probability of getting something else is then 6/8. So we have

$$\frac{8!}{6!1!1!}(6/8)^6(1/8)^1\,(1/8)^1 = 0.1557$$

Note this does *not* assume that the other genotypes are also in their exact expected numbers; it includes the possibility that all the other flies are female homozygotes, for example.

(b) 1 - 0.1557 = 0.8443 Sounds hard, but if you think about it you will see that it means that *all* the flies are something else, with probability 6/8 each, so the answer is $(6/8)^8 = 0.1001$. You could also do this with the binomial equation as follows, but that reduces to the same thing!

$$\frac{8!}{8!0!0!}(6/8)^8(1/8)^0\,(1/8)^0$$

10. The parents must be heterozygotes in order to produce an albino child. The mating *A a* X *A a* gives 1/4 *a a* albino children, so the probability that the next child is *a a* is 1/4. Note that this is not affected by the fact that the first child is albino, because these are independent events. Although the fact that one child is albino affects the probabilities, that information is already taken into account when we deduced that the parents were both heterozygotes.

11. (a) Chi-square = 1.6; P ≈ 0.2; accept.
(b) Chi-square = 16; P < 0.001; reject.

12. The lethal allele must be recessive (or the parents wouldn't be alive). So the cross is L l X L l; the progeny are 3/4 L - : 1/4 l l, or 3/4 alive : 1/4 dead.