Key

Math Review – AP Biology Exam

1. The frequency of two alleles in a population is 0.2 (B) and 0.8 (b). What is the percentage of heterozygotes and homozygous dominant individuals in the population?

$p = 0.2$
$q = 0.8$

Q = % $2pq$ and % p^2

$2(0.2)(0.8)$
0.32
32%

$(0.2)^2$
0.04
4%

2. In roses, black petal color is governed by a dominant allele; while red is the recessive allele. A random sample of 1,000 roses reveal that 824 are black and 176 are red. What are the frequencies of the black and red alleles? Also, find the percentage of black roses in the population.

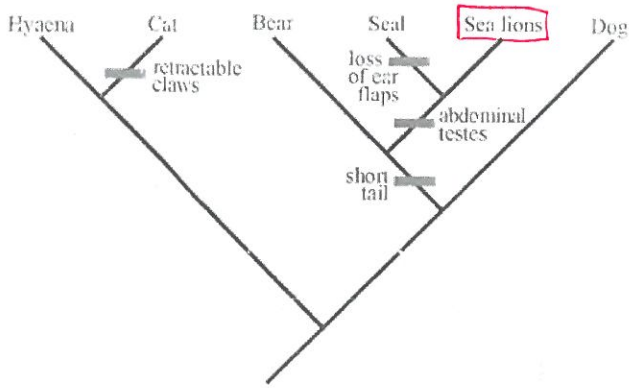
1000 total
824 BB | Bb
176 bb

Q = find $p + q$ and % BB and % Bb

$\sqrt{q^2} = \sqrt{176/100}$
$q = 0.419$
$p + q = 1$
$p + 0.419 = 1$
$p = 0.581$

$p^2 + 2pq$
$(0.581)^2 + 2(0.581)(0.419)$
$0.337 + 0.486$
0.824 82%

3. In the cladogram to the right, assume that the ancestor has a long tail, ear flaps, external testes, and fixed claws. Based on the tree and assuming that all evolutionary changes in these traits are shown, what traits does a sea lion have?



short tail
ear flaps
abdominal testes
fixed claws

4. You have two different types of fruit flies: wildtype phenotype of gray bodies and red eyes and mutant phenotype of black bodies and cinnabar eyes. If you mix the wildtype with the mutant phenotype, you see 100% gray bodies and red eyes. A test cross was performed on those offspring and the following offspring were observed:

Gray body, red eyes	*455*
Black body, cinn eyes	*432*
Gray body, cinn eyes	*42*
Black body, red eyes	*47*

Are the genes for body color and eye color linked? Provide mathematic evidence to support your answer.

(*) If genes were linked, you would see low #'s of recombinants. Calculate the recombinant frequency & if it's less than 50% they are linked.

976 total offspring w/ 89 recombinant phenotypes

$89/976 = 0.091 = 9\%$ recombinant frequency

Yes, genes are linked.

5. Which cell will be able to diffuse waste and absorb nutrients more effectively? A 2cm x 2cm x 2cm cube or a 5cm x 5cm x 5cm cube? Why?

SA: (L×W)×6
V: (L×W×H)

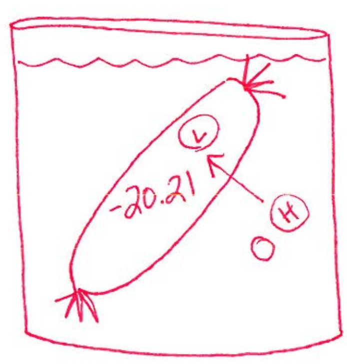
↑ SA/V ratio is best.

2×2×2 cube
SA = (2×2)×6 = 24
V = (2×2×2) = 8
24/8 = 3

5×5×5 cube
SA = (5×5)×6 = 150
V = (5×5×5) = 125
150/125 = 1.2

2×2×2 cube is more effective because it has the higher surface area to volume ratio

6. A dialysis bag is inside an open beaker of distilled water. Inside the bag is a 0.4M solution of NaCl. At 31 degrees Celsius. What type of tonicity is this and mathematically justify which way the water will move.



Beaker
$\psi = \psi_p + \psi_s$
$\psi = 0$

Bag
$\psi = \psi_p + \psi_s$
$\psi = 0 + \psi_s$
$\psi = 0 + -20.21$
$\psi = -20.21$

$\psi_s = -iCRT$ (given)
$\psi_s = -(2)(0.4)(0.0831)(304)$
↑ NaCl splits into Na^+ and Cl^- ions
↑ 31°C + 273 = K

$\psi_s = -20.21$ barrs

Water moves through osmosis from H→L so water will move into the bag = hypotonic

7. What is the probability that the cross: aaBbCC x AABbcc will produce AaBbCc?

aa × AA → Aa (1, 1) = 100%

Bb × Bb → Bb: 1/4 + 1/4 = 2/4 = 1/2

AaBbCc
1 × 1/2 × 1 = 1/2 = 50%

8. You have a group of 381 kids in front of you that are the result of multiple dihybrid crosses between heterozygote parents. The traits you awkwardly observe are: tongue-rolling ability (yes vs. no) and earwax type (wet vs. dry). Upon further creepy analysis of the group, you observe 216 tongue-rollers with wet earwax, 79 tongue-rollers with dry earwax, 65 non-tongue-rollers with wet earwax, and 21 non-tongue-rollers with dry earwax. Determine whether your observed phenotype frequencies are what would be expected under simple Mendelian inheritance patterns, or whether Mendel's laws have been violated. In other words, your H_0 is there is not a significant difference between the observed phenotypes and simple Mendelian inheritance patterns and your H_A is that there is a significant difference…
To test your hypotheses, use Chi-square analysis and expected probabilities. (*However, for Chi-square analysis, frequencies may not be used in the calculation. Instead, expected frequency phenotypes must be converted into units of people, like the observed data.)*

expected: In a dihybrid cross, you would expect a 9:3:3:1 ratio if following Mendels patterns.

TtEe x TtEe

*don't need to make this punnet square. Dihybrid crosses will yield a 9:3:3:1 ratio if genes are not linked. (aka follows mendel)

	TE	Te	tE	te
TE	TTEE	TTEe	TtEE	TtEe
Te	TTEe	TTee	TtEe	Ttee
tE	TtEE	TtEe	ttEE	ttEe
te	TtEe	Ttee	ttEe	ttee

probabilities =
- 9/16 can roll, wet
- 3/16 can roll, dry
- 3/16 can't roll, wet
- 1/16 can't, dry

381 total people so:
- 9/16 = 0.5625 x 381 = 214.3 can, wet
- 3/16 = 0.1875 x 381 = 71.4 can, dry
- 3/16 = 0.1875 x 381 = 71.4 can't, wet
- 1/16 = 0.0625 x 381 = 23.8 can't, dry

observed: given to us in the problem

Phenotype	obs	exp	χ^2 calculation
can, wet	216	214.3	$(216-214.3)^2/214.3 = 0.013$
can, dry	79	71.4	$(79-71.4)^2/71.4 = 0.809$
can't, wet	65	71.4	$(65-71.4)^2/71.4 = 0.574$
can't, dry	21	23.8	$(21-23.8)^2/23.8 = 0.329$

$\Sigma\ \chi^2 = 1.725$

d.f. = 3 (4 options - 1)

pvalue = 0.05 or 5%. (constant for Biology)

look @ chart & find c.v.

$\chi^2 < c.v.$

$1.725 < 7.82$

* means data is not sign. different from expected (H_0).

Fail to reject the H_0, it does follow mendel