AP Biology Math Review 2013

1) Take out an APPROVED calculator and formula sheet.

2) Pick a grid sheet. You will solve each problem and grid in the answer.
Tips

• Grid LEFT to right
• Use the formula sheet
• Don’t round until the end

• Look at HOW the answer should be given “round to nearest…”

.123
The 1 is in the **tenths** place
The 2 is in the **hundreds** place
The 3 is in the **thousandths** place
Q1: Chi Square

A hetero red eyed female was crossed with a red eyed male. The results are shown below. Red eyes are sex-linked dominant to white, determine the chi square value. Round to the nearest hundredth.

<table>
<thead>
<tr>
<th>Phenotype</th>
<th># flies observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Eyes</td>
<td>134</td>
</tr>
<tr>
<td>White Eyes</td>
<td>66</td>
</tr>
</tbody>
</table>
Chi Square Strategy

• Given—observed

• You have to figure out expected. Usually to do a Punnett square to figure this out

• Plug in

\[ X^2 = \frac{(o-e)^2}{e} + \frac{(o-e)^2}{e} + \frac{(o-e)^2}{e} \]
Observed—134 red eyes, 66 white eyes

<table>
<thead>
<tr>
<th></th>
<th>$X^R$</th>
<th>$X^r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X^R$</td>
<td>$X^R X^R$</td>
<td>$X^R X^r$</td>
</tr>
<tr>
<td>$Y$</td>
<td>$X^R Y$</td>
<td>$X^r Y$</td>
</tr>
</tbody>
</table>

Expected

3:1 ratio

134+ 66 = 200

150 red

50 white

Chi-Square

\[
X^2 = \frac{(o - e)^2}{e} + \frac{(o - e)^2}{e}
\]

\[
X^2 = \frac{(134-150)^2}{150} + \frac{(66-50)^2}{50}
\]

\[
X^2 = 1.70666 + 5.12
\]

\[
X^2 = 6.83
\]
Q2: Surface Area and Volume

- What is the $SA/V$ for this cell? Round your answer to the nearest hundredths.
Q2

Surface Area

\[ A = 4\pi r^2 \]

Volume of a sphere

\[ V = \frac{4}{3} \pi r^3 \]

Surface Area = 4 \( \pi \) \( r^2 \)

= 4(3.14) \( 5^2 \)

= 314

Volume of a sphere = \( \frac{4}{3} \pi \) \( r^3 \)

= \( \frac{4}{3} \) (3.14) \( 5^3 \)

= 523.33

\[ \frac{SA}{V} = \frac{314}{523.33} \]

= 0.60
Q3: Water Potential and Solution Potential

- Solute potential = $-iCRT$

- $i$ = The number of particles the molecule will make in water; for NaCl this would be 2; for sucrose or glucose, this number is 1
- $C$ = Molar concentration (from your experimental data)
- $R$ = Pressure constant = 0.0831 liter bar/mole K
- $T$ = Temperature in degrees Kelvin = 273 + °C of solution

Sample Problem

- The molar concentration of a sugar solution in an open beaker has been determined to be 0.3M. Calculate the solute potential at 27 degrees celsius. Round your answer to the nearest tenths.
Q3

- Solute potential = \(-iCRT\)
- \(i = 1\)
- \(C = 0.3\)
- \(R = \text{Pressure constant} = 0.0831\)
- \(T = 27 + 273 = 300K\)

Solute concentration = -7.5
Q4: Hardy Weinberg

• A census of birds nesting on a Galapagos Island revealed that 24 of them show a rare recessive condition that affected beak formation. The other 63 birds in this population show no beak defect. If this population is in HW equilibrium, what is the frequency of the dominant allele? Give your answer to the nearest hundredth
Hardy Weinberg Strategy

- Figure out what you are given
- Allele (p or q) or Genotypes (p², 2pq, q²)
- Figure out what you are solving for
- Manipulate formulas to go from given to solving for
- Always dealing with decimals
Q4: Looking for p—dominant allele

- Homozygous Recessive = $q^2 = \frac{24}{87} = .2758$

\[ q^2 = \sqrt{.2758} \]
\[ q = .5252 \]
\[ p + q = 1 \]

\[ p = .47 \]
Q5: Rate

Hydrogen peroxide is broken down to water and oxygen by the enzyme catalase. The following data were taken over 5 minutes. What is the rate of enzymatic reaction in mL/min from 2 to 4 minutes? Round to the nearest hundreds

<table>
<thead>
<tr>
<th>Time (mins)</th>
<th>Amount of $O_2$ produced (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>2</td>
<td>3.6</td>
</tr>
<tr>
<td>3</td>
<td>4.2</td>
</tr>
<tr>
<td>4</td>
<td>5.5</td>
</tr>
<tr>
<td>5</td>
<td>5.9</td>
</tr>
</tbody>
</table>
Q5

• Rise/run = rate = 5.5-3.6/4-2
• Rise/run = rate = 1.9/2
• Rise/run = rate = .95
Q6: Laws of Probability

• Calculate the probability of tossing three coins simultaneously and obtaining three heads. Express in fraction form.
Q6

- Probability of a heads is $\frac{1}{2}$
- Probability of heads AND a heads AND a heads

$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$
Q7: Population Growth

N—total number in pop       r—rate of growth

• There are 2,000 mice living in a field. If 1,000 mice are born each month and 200 mice die each month, what is the per capita growth rate of mice over a month? Round to the nearest tenths.
• $N = 2000$
• $r_{\text{max}} = 1000 - 200 = 800$
• $800/2000 = 0.4$
Q8

• The net annual primary productivity of a particular wetland ecosystem is found to be 8,000 kcal/m². If respiration by the aquatic producers is 12,000 kcal/m² per year, what is the gross annual primary productivity for this ecosystem, in kcal/m² per year? Round to the nearest whole number.
Q8

• \( \text{NPP} = \text{GPP} - \text{R} \)
• \( 8,000 = \text{GPP} - 12,000 \)
• \( 8,000 + 12,000 = \text{GPP} \)
• \( 20,000 = \text{GPP} \)
Q9: $Q_{10}$

- Data taken to determine the effect of temperature on the rate of respiration in a goldfish is given in the table below. Calculate $Q_{10}$ for this data. Round to the nearest whole number.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Respiration Rate (Minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>21</td>
<td>22</td>
</tr>
</tbody>
</table>
\[ Q_{10} = \left( \frac{k_2}{k_1} \right)^{\frac{10}{t_2-t_1}} \]

\[ Q_{10} = \left( \frac{22}{16} \right)^{10/(21-16)} \]

\[ Q_{10} = (1.375)^2 \]

\[ Q_{10} = 2 \]
Q10: Standard Deviation

- Grasshoppers in Madagascar show variation in their back-leg length. Given the following data, determine the standard deviation for this data. Round the answer to the nearest hundredth.

Length (cm): 2.0, 2.2, 2.2, 2.1, 2.0, 2.4 and 2.5
• Average = 2.0 + 2.2 + 2.2 + 2.1 + 2.0 + 2.4 + 2.5/7 = 2.2
• Dev = -.2 + 0 + 0 + -.1 + -.2 + .2 + .3
• Dev Squared = .04 + 0 + 0 + .01 + .04 + .04 + .09 =
• Sum of the Devs Squared = 0.22
Q11: Dilution

• Joe has a 2 g/L solution. He dilutes it and creates 3 L of a 1 g/L solution. How much of the original solution did he dilute? Round to the nearest tenths.
We are looking for $V_1$:

$$C_1V_1 = C_2V_2$$

$$2V_1 = 1(3)$$

$$V_1 = 1.5$$
Q12: log

• What is the hydrogen ion concentration of a solution of pH 8? Round to the nearest whole number
Q12

• $[\text{H}^+]$ if pH = 8.0

• $[\text{H}^+] = 10^{-\text{pH}}$

• $[\text{H}^+] = 10^{-8.0}$

• $1 ÷ 10^8 = 0.000000001$
Q13: Gibbs Free Energy

PICK THE BEST CHOICE:

A chemical reaction is most likely to occur \textbf{spontaneously} if the

a) Free energy is negative
b) Entropy change is negative
c) Activation energy is positive
d) Heat of reaction is positive
Q13

• Answer: A