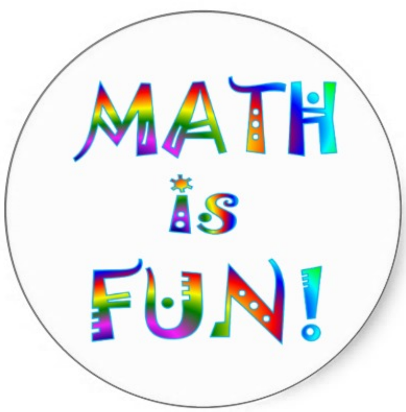
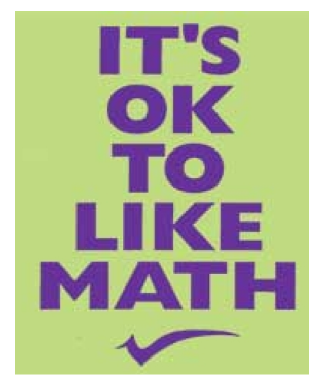
AP BIOLOGY MATH REVIEW

- Take out an approved calculator and formula sheet.
- You will solve each problem and enter your answers on a grid-in sheet.



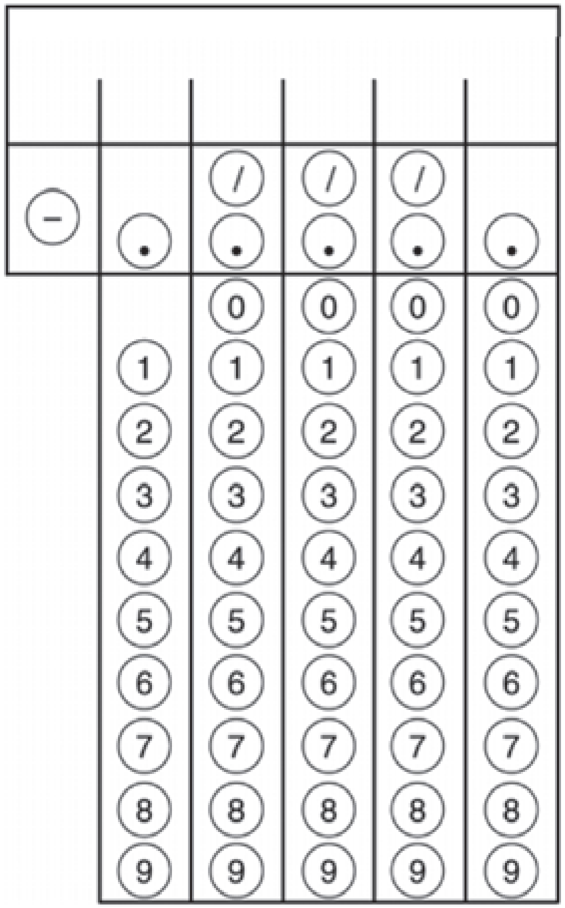


Grid-In Tips

- Grid left to right
- Use the formula sheet
- ***Don't round until the end***

- Look at **HOW** the answer should be given ("provide your answer to the nearest…").

- You may be asked to provide your answer as a whole number, decimal, or fraction.



.123

- The 1 is in the tenths place
- The 2 is in the hundredths place
- The 3 is in the thousandths place

Q1: Chi-Square

A heterozygous red-eyed female fruit fly was crossed with a red-eyed male fruit fly. The offspring produced are shown in the table. Red eyes are sex-linked dominant to white eyes.

Phenotype	# Flies
Red-Eyed Females	89
Red-Eyed Males	45
White-Eyed Males	66

Determine the chi-square value. Provide your answer to the nearest hundredth.

Chi-Square Strategy

- Given Data = "Observed"

- You have to determine the expected values. Usually you will use a Punnett square to figure this out.

- Calculate: $X^2 = \frac{(o-e)^2}{e} + \frac{(o-e)^2}{e} + \frac{(o-e)^2}{e}$

- Degrees of Freedom (df) = n - 1

- Chi-Square value must be **SMALLER** than value in the 0.05 row on formula sheet in order to accept a null hypothesis (*differences due to chance alone*).

Observed = 89 Red-Eyed Females, 45 Red-Eyed Males, and 66 White-Eyed Males

Expected:

	X^R	X^r
X^R	X^R X^R	X^R X^r
Y	X^R Y	X^r Y

2 : 1 : 1 ratio

89 + 45 + 66 = 200

100 Red-Eyed Females

50 Red-Eyed Males

50 White-Eyed Males

Chi-Square:

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

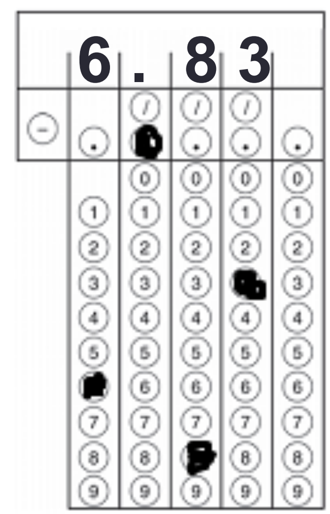
$$X^2 = \frac{(89-100)^2}{100} + \frac{(45-50)^2}{50} + \frac{(66-50)^2}{50}$$

$$X^2 = 1.21 + 0.5 + 5.12$$

$$X^2 = 6.83$$

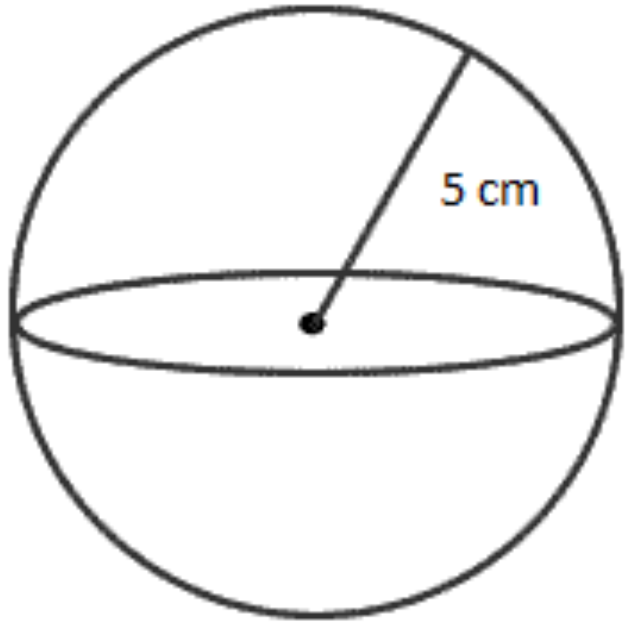
$$df = 3 - 1 = 2$$

REJECT Null Hypothesis
(*Differences are* ***NOT*** *due to chance alone.*)



Q2: Surface Area-to-Volume Ratio

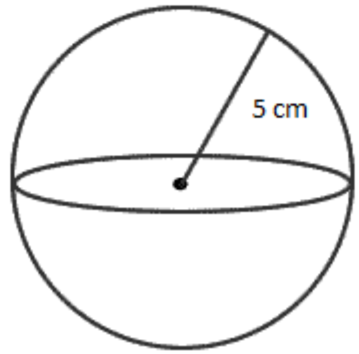
What is the surface area-to-volume ratio for this cell? Provide your answer to the nearest hundredths.



$SA = 4\pi r^2$

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

$= 314$



Sphere

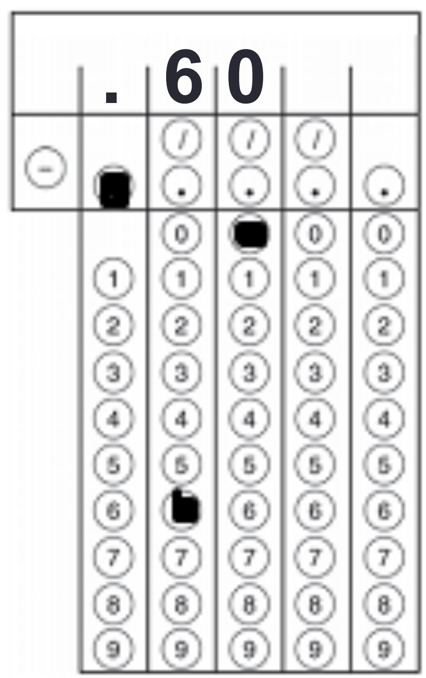
Surface Area

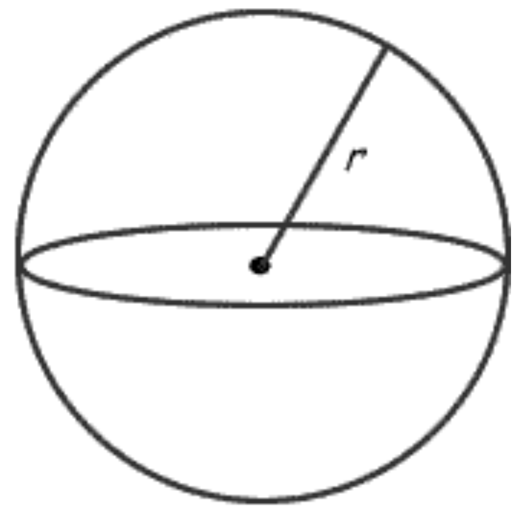
$A = 4\pi r^2$

$V = 4/3\pi r^3$

$= (4/3)(3.14)(5^3)$

$= 523.3333$





$SA/V = 314/523.3333$

=.60

Volume

$V = \frac{4}{3}\pi r^3$

Q3: Water Potential

$$\Psi = \Psi_P + \Psi_S$$

$$\Psi_S = -iCRT$$

- *i* = The number of particles the molecule will make in water (*sucrose or glucose = 1; NaCl = 2*)
- *C* = Molar concentration (*usually provided in the problem*)
- *R* = Pressure constant = 0.0831 liter bars/mole K
- *T* = Temperature in Kelvin = 273 + °C

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° Celsius. Provide your answer to the nearest tenths.

Q3

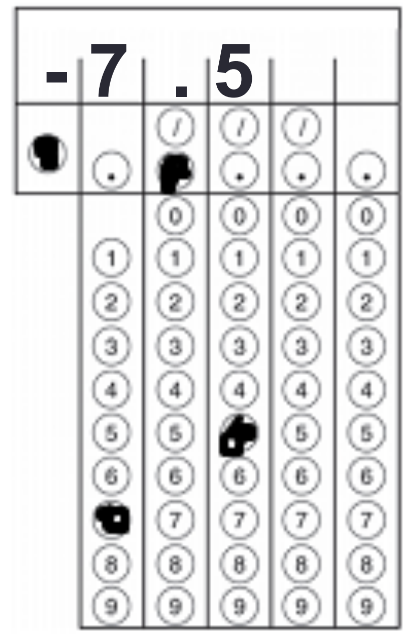
Solute potential= $-iCRT$

$i = 1$

$C = 0.3$

R = Pressure constant = 0.0831

$T = 27 + 273 = 300K$



Solute potential = -7.5

Q4: More Water Potential

$$\Psi = \Psi_P + \Psi_S$$

$$\Psi_S = -iCRT$$

- i = The number of particles the molecule will make in water (*sucrose or glucose = 1; NaCl = 2*)
- C = Molar concentration (*usually provided in the problem*)
- R = Pressure constant = 0.0831 liter bars/mole K
- T = Temperature in Kelvin = 273 + °C

Problem:

At 20°C, a cell containing 0.6M glucose is in equilibrium with its surrounding solution containing 0.3M glucose in an open container. What is the cell's Ψ_P? Provide your answer to the nearest tenth.

Q4

$$\Psi_P + \Psi_S = \Psi_P + \Psi_S$$

$$Cell = \Psi_S = -iCRT$$

$$Cell = \Psi_S = -(1)(0.6M)(.0831)(293K)$$

$$Cell = \Psi_S = -14.60898$$

$$Solution = \Psi_S = -iCRT$$

$$Solution = \Psi_S = -(1)(0.3M)(.0831)(293K)$$

$$Solution = \Psi_S = -7.30449$$

$$-14.60898 + \Psi_P = -7.30449 + 0$$

$$\Psi_P = 7.30449 = 7.3$$

Q5: 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 Hardy-Weinberg equilibrium, what is the frequency of the dominant allele? Provide your answer to the nearest hundredth.

Hardy-Weinberg Strategy

- Figure out what you are given in the problem:
  - Allele (p or q) or Genotypes (p^2, $2pq$, q^2)
- Figure out what you are solving for

Q5: Solving for *p* (*dominant allele*)

Homozygous Recessive = q^2 = 24/87 = .2759

$$q^2 = .2759$$

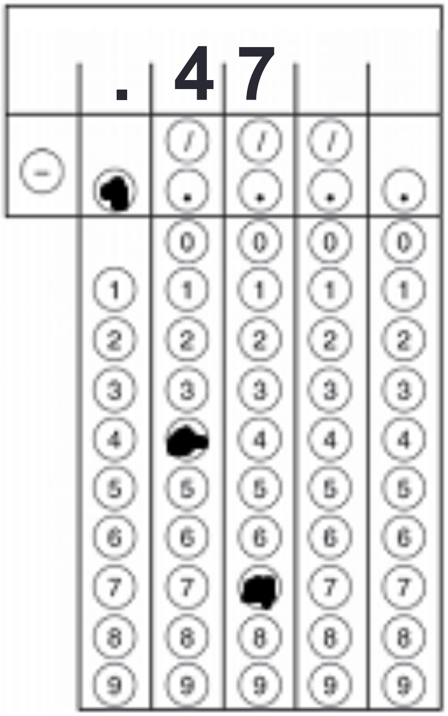
$$q = \sqrt{.2759}$$

$$q = .5253$$

$$p = 1 - q$$

$$p = 1 - .5253 = .4747$$

$$p = .47$$



Q6: More Hardy-Weinberg

In Africa, 9% of a certain population has a severe form of sickle-cell anemia (*ss*), a recessive genetic disease.

What **percentage** of the population will be more resistant to malaria because they are heterozygous (*Ss*) for sickle-cell anemia? Provide your answer to the nearest whole number.

Q6: Solving for 2*pq* (*heterozygous genotype*)

Homozygous Recessive = *ss* = q^2 = .09

$$q^2 = .09$$

$$q = \sqrt{.09}$$

$$q = .3$$

$$p = 1 - q$$

$$p = 1 - .3 = .7$$

$$p = .7$$

$$Ss = 2pq = (2)(0.7)(0.3) = .42 = 42\%$$

Q7: Rate

Hydrogen peroxide is broken down to water and oxygen by the enzyme catalase. The following data were recorded over five minutes. What is the rate of enzymatic reaction in mL/min from 2 to 4 minutes? Provide your answer to the nearest hundredths.

Time (mins)	Amount of O_2 Produced (mL)
1	2.3
2	3.6
3	4.2
4	5.5
5	5.9

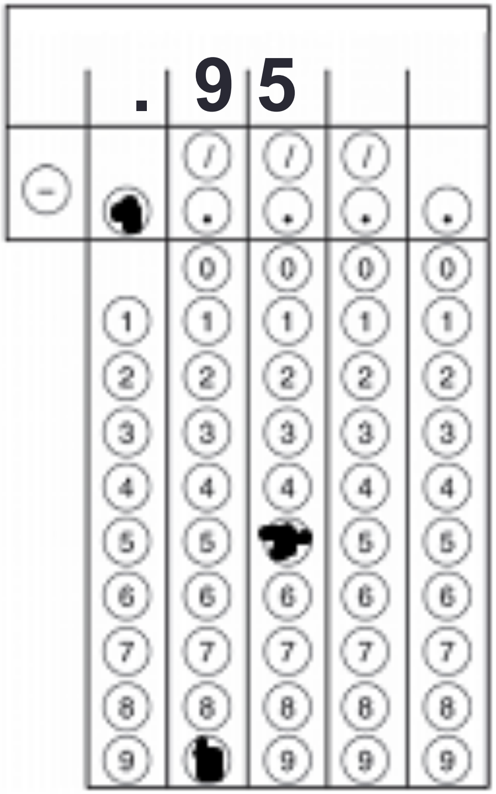
Q7

Rate = Rise/run = Slope = dY/dt

Rate = (5.5-3.6)/(4-2)

Rate = 1.9/2

Rate = .95



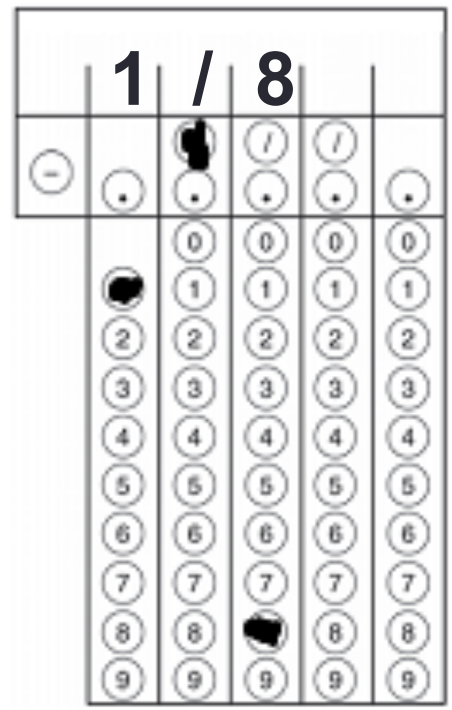
Q8: Laws of Probability

If a couple has three children, what is the probability that all three would be born female? Provide your answer as a fraction.

Q8

- Probability of a female child is ½
- Probability of a female child AND a female child AND a female child

$$\frac{1}{2} X \frac{1}{2} X \frac{1}{2} = 1/8$$



Q9: Population Growth

N = total number in population   *r* = rate of growth

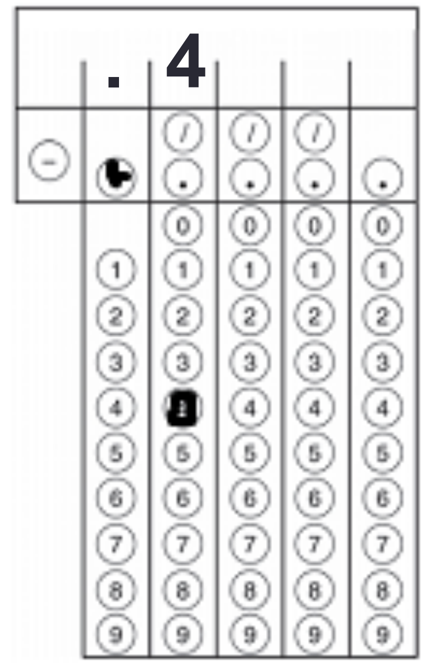
There are 2,000 mice living in a field. If 1,000 mice are born each month and 200 mice die each month, what is the **per capita growth rate** of mice over a month? Provide your answer to the nearest tenths.

Q9

N = 2000

$r_{max} = (1000-200)/2000 = 800$

$r_{max} = 800/2000 = 0.4$



Q10: More Population Growth

One dandelion plant can produce many seeds, leading to a high growth rate for dandelion populations. A population of dandelions is currently 40 individuals and r_{max}=80 dandelions/month.

Predict *dN/dt* if these dandelions are experiencing exponential growth. Provide your answer to the nearest whole number.

Q10

$$\frac{dN}{dt} = r_{\max}N = (80)(40)$$

$$\frac{dN}{dt} = 3200$$

Q11: Even More Population Growth

One dandelion plant can produce many seeds, leading to a high growth rate for dandelion populations. A population of dandelions is currently 40 individuals and r_{max}=80 dandelions/month.

Assume these dandelions cannot grow exponentially due to lack of space. The carrying capacity for their patch of lawn is 70 dandelions. What is their *dN/dt* under these logistic growth conditions? Provide your answer to the nearest whole number.

Q11

$$\frac{dN}{dt} = r_{\max} N \left(\frac{K - N}{K} \right) = (80)(40)\left(\frac{70 - 40}{70} \right)$$

$$\frac{dN}{dt} = (3200)(0.42857)$$

$$\frac{dN}{dt} = 1371.424 = 1371$$

Q12

The net annual primary productivity of a particular wetland ecosystem is found to be 8,000 kcal/m^2. If respiration by the aquatic producers is 12,000 kcal/m^2 per year, what is the gross annual primary productivity for this ecosystem, in kcal/m^2 per year? Provide your answer to the nearest whole number.

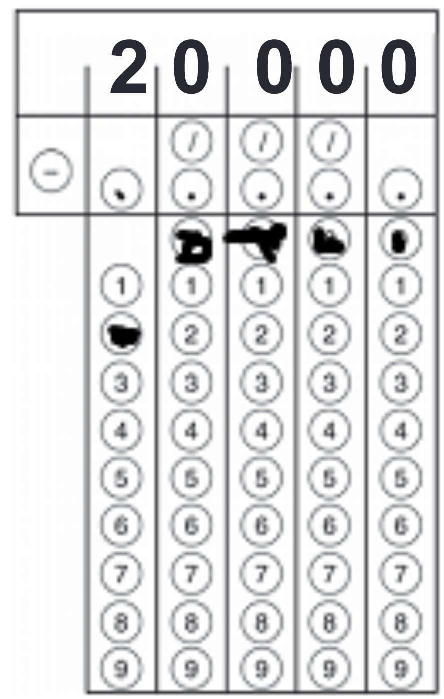
Q12

NPP = GPP - R

8,000 = GPP - 12,000

8,000 + 12,000 = GPP

20,000 = GPP



Q13: Mean

- Grasshoppers in Madagascar show variation in their back-leg length. Determine the **mean** length of a grasshopper leg based on this data. Provide your answer answer to the nearest tenth.

- Lengths (*cm*): 2.0, 2.2, 2.2, 2.1, 2.0, 2.4, 2.5

Q13

Mean = (2.0 + 2.2 +2.2+2.1+2.0 +2.4 +2.5)/7 = **2.2**

Q14: Dilution

A student 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? Provide your answer to the nearest tenths.

Q14

We are looking for V_i:

$$C_iV_i = C_fV_f$$

$$2V_i = 1(3)$$

$$V_i = \mathbf{1.5}$$