Biology 4605/7220 Name________________________
2 October 2002 Exam #1

1. An ecological geneticist, P.F. Brussard, calculated heterozygosity (H_Dpseu = %) of the fruitfly *Drosophila pseudoobscura*, in relation to altitude (Elev = ft), from data reported in 1948 by Theodosius Dobzhansky at mountainous locations in Yosemite Park in California. Calculate the expected heterozygosity at an elevation of 10000 ft, assuming

H_Dpseu = 0.712 − 0.000004 * Elev

Heterozygosity at 10000 ft = H_Dpseu(10000 ft) = _____________ (1)

Write a data equation, for an observed value of H_Dpseu = 0.2 (20%) at 10000 ft

____________ = ______________ + _____________ (3)

β_{Elev} = −0.000004 is a parameter with units of ______________ (1)

β_{Elev} = −0.000004 is a parameter with dimensions of ______________ (1)

In words, what does β_{Elev} measure ? ____(1)

2. Set up a pair of statistical hypotheses (H_A and H_o) concerning whether heterozygosity changes with altitude. Use β_{Elev} to form both hypotheses.

(1)

3. For the following situations would you accept or reject the null hypothesis (H_o), that the observed outcome is JUST LUCK ? p is the probability of the observed outcome, calculated from a frequency distribution that applies when the H_o is true.

Circle one.

α = 10%	p = 40 %	Accept H_o	Reject H_o	(1)
α = 5 %	p = 5.5%	Accept H_o	Reject H_o	(1)
α = 5 %	1 − p = 93%	Accept H_o	Reject H_o	(1)

4. Running speed scales with body size (mass) as $Mass^{0.25}$
Hence a doubling in body mass will
increase running speed by a factor of $2^{.25}$ = ______ (1)

If body mass increases tenfold,
by what factor will running speed increase ? _______ (1)

5. The Poisson distribution describes the frequency of events that are random and rare (*i.e.*, average success rate under 5 per sampling unit). Using the cumulative distribution given to you for a Poisson distribution with mean of 0.2, fill in the 2 blank values of the probability density function (pdf). K = no events per unit, 1 event per unit, 2 events per unit, *etc.* (2)

```
MTB > cdf;
SUBC> poisson .2.

    POISSON WITH MEAN =    0.200
   K      P( X LESS OR = K)  P(X = K)
                cdf          pdf
   0            0.8187       __________
   1            0.9825
   2            0.9989       __________
   3            0.9999
   4            1.0000
```

6. What is the probability of 2 or fewer spruce trees per unit, if the mean number is 0.2 spruce trees per sampling unit ?
__________ (1)

7. Survival percentage is defined as $e^{-z * t}$ where z is the mortality rate (% / day) and t is measured in days. When the mortality is 60% / day, what is the survival percentage after a week ? __________ (1)

8. For the following quantity, construct a frequency distribution (8).

Pulse = P = [69 66 68 65 69 67 61 68 68 67 68] $\cdot$ beats$\cdot$min^{-1}

K	F(P=K)
__61-62___	__________
__________	__________
__________	__________
__________	__________
___69-70___	__________

9. The scope is defined as the ratio of the largest to smallest value of a quantity.

What is the scope of the Pulse data ________ (1)

What units will the scope (of the Pulse data) have ? _________(1)

10a. The median is defined as the observation that has an equal number of observations above and below it. For the pulse data, what is the median ? _________(1)

10b. Rescale the Pulse data from a ratio scale to a nominal scale by scoring a value positive if it is <u>above</u> the median (see next question) (place + or − sign beneath each value)

Pulse = P = [69 66 68 65 69 67 61 68 68 67 68] $\cdot$ beats$\cdot$min^{-1}

(2)

11. The median is defined as the observation that has an equal number of observations above and below it. The mean is defined as the sum of the observations, divided by the number of observations. The mode is defined as the most frequently occurring observation. Calculate these three measures of central tendency, for the pulse data.

Mean(Pulse) = ________________ (1)

Median(Pulse) = ________________ (from above)

Mode (Pulse) = ________________ (1)

Which of these three measures of central tendency is smallest ______________________(1)

Is the distribution symmetrical ? (Circle one) Yes No (1)

Discuss how symmetry or its lack affects the 3 measures of central tendency. (2)

12. Calculate the following quantities.

3000 km = ______________ megameters (1)

6 Joules = ________ calories (1 kiloJoule = 4.186 kilocalories) (1)

$(500\ \text{cm})^{1.3}$ = __________________________ (Report units here as well as a value) (2)

7 km * 500 m = __________ km^2 (1)

600 mm * $(2\ \text{mm})^{0.3}$ = ____________ (Report units here as well as a value) (2)

13. Fill in the blanks in the following table (5).

```
MTB > pdf;
SUBC> binomial 10 0.5.

    BINOMIAL WITH N =  10   P = 0.500000
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K	P(X=K) pdf	$P(X \le K)$ cdf	F(X = K)
0	0.0010	________	
1	0.0098	________	________
2	0.0439	________	
3	0.1172		
4	0.2051		
5	0.2461		
6	0.2051		
7	0.1172		________
8	0.0439		
9	0.0098		
10	0.0010	1.000	________
			5000

14. The probability of finding a mitotic cell is 0.5 (50%) in a rapidly growing tissue.
What is the probability of finding
exactly 3 meiotic cells in a sample of 10 cells ? ________ (1)

What is the probability of finding
9 or more meiotic cells in a sample of 10 cells ? ________(1)