Name_____

Use complete sentences when requested. There are 100 possible points on this exam. The multiple choice questions are worth 2 points each. All other questions have the points indicated.

Exam Memory Bank

$$V_0 = \frac{V_{max} \times [S]}{K_m + [S]}$$

$$V_{max} = k_{cat} \times E_t$$

$$k_{cat} = \frac{kT}{h} \times e^{\frac{-G^{\ddagger}}{RT}}$$

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta G^{\circ\prime} = -nF\Delta E^{\circ\prime}$$

$$\Delta G^{\circ\prime} = -RT\ln K_{eq}^{\circ\prime}$$

$$\Delta G_t = RT\ln\frac{c_2}{c_1}$$

$$\Delta G_t = RT\ln\frac{c_2}{c_1} + ZF\Delta\psi$$

R = 8.314J/molxK

F = 96,500J/Vxmol

Boltzman constant, $k=1.381\times10^{-23}$ J/K

Plank's constant, $h=6.626\times10^{-34}$ Jxsec

Avogadro's number, 6.02×10^{23}/mol

$\ln x = 2.303\log_{10} x$

calorie=4.184J

1. Based on Chargaff's rules, which of the following are possible base compositions for double-stranded DNA?

	%A	%G	%C	%T	%U
A)	5	45	45	5	0
B)	20	20	20	20	20
C)	35	15	35	15	0

D) all of the above
E) none of the above

2. In the Watson-Crick model of DNA structure (now called B-form DNA):

A) a purine in one strand always hydrogen bonds with a purine in the other strand.
B) A–T pairs share three hydrogen bonds.
C) G–C pairs share two hydrogen bonds.
D) the 5′ ends of both strands are at one end of the helix.
E) the bases occupy the interior of the helix.

3. The double helix of DNA in the B-form is stabilized by:

A) covalent bonds between the 3′ end of one strand and the 5′ end of the other.
B) hydrogen bonding between the phosphate groups of two side-by-side strands.
C) hydrogen bonds between the riboses of each strand.
D) nonspecific base-stacking interaction between two adjacent bases in the same strand.
E) ribose interactions with the planar base pairs.

4. Triple-helical DNA structures can result from Hoogsteen (non Watson-Crick) interactions. These interactions are primarily:

A) covalent bonds involving deoxyribose.
B) covalent bonds involving the bases.
C) hydrogen bonds involving deoxyribose.
D) hydrogen bonds involving the bases.
E) hydrophobic interactions involving the bases.

5. The ribonucleotide polymer (5′)GTGATCAAGC(3′) could only form a double-stranded structure with:

A) (5′)CACTAGTTCG(3′).
B) (5′)CACUAGUUCG(3′).
C) (5′)CACUTTCGCCC(3′).
D) (5′)GCTTGATCAC(3′).
E) (5′)GCCTAGTTUG(3′).

6. (5 points) Describe qualitatively how the t_m (melting temperature) for a double-stranded DNA depends upon its nucleotide composition.

7. Restriction enzymes:

A) act at the membrane to restrict the passage of certain molecules into the cell.
B) are highly specialized ribonucleases that degrade mRNA soon after its synthesis.
C) are sequence-specific DNA endonucleases.
D) are very specific proteases that cleave peptides at only certain sequences.
E) catalyze the addition of a certain amino acid to a specific tRNA.

8. The biological role of restriction enzymes is to:

A) aid recombinant DNA research.
B) degrade foreign DNA that enters a bacterium.
C) make bacteria resistant to antibiotics.
D) restrict the damage to DNA by ultraviolet light.
E) restrict the size of DNA in certain bacteria.

9. The *E. coli* recombinant plasmid pBR322 has been widely utilized in genetic engineering experiments. pBR322 has all of the following features *except*:

A) a number of conveniently located recognition sites for restriction enzymes.
B) a number of palindromic sequences near the *Eco*RI site, which permit the plasmid to assume a conformation that protects newly inserted DNA from nuclease degradation.
C) a replication origin, which permits it to replicate autonomously.
D) resistance to two different antibiotics, which permits rapid screening for recombinant plasmids containing foreign DNA.
E) small overall size, which facilitates entry of the plasmid into host cells.

10. (3 points) Current estimates indicate that humans have about _____ genes.

11. (12 points) A plasmid that encodes resistance to ampicillin and tetracycline is digested with the restriction enzyme *Pst*I, which cuts the plasmid at a single site in the ampicillin-resistance gene. The DNA is then annealed with a *Pst*I digest of human DNA, ligated, and used to transform *E. coli* cells.

(a) What antibiotic would you put in an agar plate to ensure that the cells of a bacterial colony contain the plasmid?

(b) What antibiotic-resistance phenotypes will be found on the plate?

(c) Which phenotype will indicate the presence of plasmids that contain human DNA fragments?

12. (10 points) Describe RFLPs and STRs . How is each one used in forensics? Is one better than the other? Why?

13. (15 points) What is a DNA microarray? Describe an experiment that uses a DNA microarray. Use complete sentences.

14. (4 points) Circle the fatty acid in each pair that has the higher melting temperature.

(a) $18{:}1^{\Delta 9}$ $18{:}2^{\Delta 9,12}$

(b) $18{:}0$ $18{:}1^{\Delta 9}$

(c) $18{:}0$ $16{:}0$

(d) $20{:}4^{\Delta 5,8,11,14}$ $22{:}6^{\Delta 4,7,10,13,16,19}$

15. (5 points) Draw the structure for oleic acid, what is the shorthand notation for oleic acid?

16. (5 points) What is an ω-3 fatty acid? What is the significance of increasing the amount of dietary ω-3 fatty acids? Give a specific example of anω-3 fatty acid.

17. (5 points) Why is triacylglycerol a good storage form of energy?

18. (20 points) Stem Cells and the Technology of Next Generation DNA Sequencing were presented by students in class. Summarize two of these presentations. You may select one from each topic or two from the same topic. Provide specific details from the presentations. It is ok to summarize your own presentation(s). Use complete sentences.