Define and explain the following terms (4 points each).

Clone (include examples of at least two distinct types of clone united by your definition)

SNP

DNA footprinting

target site duplication
(8 points) Outline the steps involved in initiation of transcription. For each step, discuss regulation and the possible role of transcription factors such as sigma in *E. coli* or the general transcription factors in eukaryotes.

Questions 1-11. (3 points each). In each of the following there are two or more statements. One is true (generally, it is taken directly from your textbook) and the other is bogus. These others have been modified so as to be untrue or misleading. Circle, check or otherwise designate the correct statement. Ambiguous marks (checking both, placing a mark between the two statements, etc.) will be considered wrong.

1. a) Close to 60% of *E. coli* DNA encodes proteins.
   b) Close to 75% of *E. coli* DNA encodes proteins.
   c) Close to 90% of *E. coli* DNA encodes proteins.

2. a) A DNA sequencing machine distinguishes the different terminating dideoxynucleotides by small differences in mass between them.
   b) A DNA sequencing machine uses a special detector that can distinguish the different colors associated with each terminating dideoxynucleotide.

3. a) In shotgun sequencing, fragments are sequenced using an oligonucleotide primer that is complementary to a vector sequence that is immediately adjacent to the unknown insert.
   b) In shotgun sequencing, fragments are sequenced by annealing random oligonucleotide primers to the unknown insert.

4. a) Preimplantation genetic diagnosis (in humans) remains both illegal and so technically difficult as to be effectively impossible.
   b) Preimplantation genetic diagnosis is enabled by PCR-based DNA amplification and has resulted in over 200 normal births.
5. a) In a typical human gene (and population) about 1 nucleotide in 1,000 differs between two alleles.
   b) In a typical human gene (and population) about 1 nucleotide in 200 differs between two alleles.
   c) In a typical human gene (and population) about 1 nucleotide in 50 differs between two alleles.

6. a) Less than 5% of human DNA encodes proteins.
   b) About 10% of human DNA encodes proteins.
   c) About 20% of human DNA encodes proteins.

7. a) Exon sizes vary more between species (e.g. humans and fruit flies)
   b) Intron sizes vary more between species (e.g. humans and fruit flies).

8. a) Deamination can change cytosine to uracil.
   b) Deamination can change cytosine to adenine.

9. a) Anticipation occurs when less severely affected premutation carriers transmit unstable trinucleotide repeat alleles to their offspring.
   b) Anticipation occurs when the transmission of alleles to older children in a family can be used to predict which alleles will be transmitted to future offspring.

10. a) Whether or not transcription terminates at an attenuator depends on phosphorylation of the carboxyterminal tail of RNA polymerase by TFIH.
    b) Whether or not transcription terminates at an attenuator depends on how the translation machinery reads the secondary structure of the RNA leader.

11. a) *E. coli*’s heat shock response depends on the regulation of transcription by alternative sigma factors.
    b) *E. coli*’s heat shock response depends on the regulation of translation by basepairing involving the small subunit ribosomal RNA.

Questions 12-14 (2 points per item; think of each question as multiple true/false statements). Circle, check or otherwise designate each correct statement (i.e. check all that apply). Again, ambiguous marks (checking both, placing a mark between the two statements, etc.) will be considered wrong.

12. The F plasmid
   a) is a conjugative plasmid.
   b) contains three different IS transposable elements
   c) forms an Hfr bacterium upon integration into the *E. coli* chromosome.
   d) integrates into a single preferred location on the *E. coli* chromosome.
   e) contains genes for lysis of the host cell.
   f) contains genes for synthesizing connections between donor and recipient cells.
   g) is the basis for the vector used in construction of BAC clones.

13. Meiotic recombination is mediated by
   a) double-strand break repair.
   b) base excision repair
   c) illegitimate recombination
   d) retrotransposons.
14. The fidelity of replication in vivo is increased about 100-fold by
   a) the 3’-to-5’ exonuclease activity of DNA polymerase itself
   b) mismatch repair
   c) recBCD.
   d) double-strand break repair

15 (6 points) Define, compare and contrast microsatellite and SNPs as markers in human genetics. Include information about frequency and degree of polymorphism and describe how each type of marker has been used.

16. (8 points) Briefly describe each of the following vectors for molecular cloning. Your description should include the host and the approximate size range for inserts:
   1) plasmids (such as pUC); 2) lambda; 3) BAC; 4) YAC.