Problem Set and Sample Test Questions can be found in the Genetics in Human Affairs Course Pack (Second Edition) starting on page 41.

ANSWER KEY FOR PROBLEM SET #1

1. Metaphase: 3; microtubules (spindle fibers) bind to the centromere; migration of the centromere to the equatorial plate; shortest stage

   Telophase: 5; cytokinesis (cytoplasmic division) occurs; nuclear envelopes begin to reform; chromosomes elongate

   Interphase: 1; cell growth; replication of the DNA in each chromosome; longest stage

   Prophase: 2; nuclear envelope disappears; chromatin condenses which causes the chromosomes to appear; spindle fibers form

   Anaphase: 4; sister chromatids separate and migrate to opposite poles in the cell; shortest stage

   NOTE: Other characteristics may be acceptable

2. egg, 130, sperm, 23, 10-15 hours, 24-72 hours, upper 1/3 of the oviduct, zygote, fertilization, uterus, placenta

3. Amniocentesis: A procedure where a sample of amniotic fluid and cells is removed from a woman who has been pregnant for 14-18 weeks. The purpose of the test is to identify genetic, chromosomal, and biochemical abnormalities in a developing fetus.

   Chorionic Villi Sampling (CVS): A procedure involving the collection of a sample of cells from the outer of the two birth membranes (the chorion) and analyzed for potential genetic and chromosomal defects in the embryo/fetus. The sample is obtained at 6-10 weeks after fertilization

   Ultrasound: The fetus can be "seen" in the mother's womb. This procedure is used to detect multiples, physical defects and the position of the developing fetus and placenta. The procedure has no specific time limitations.

   Endoamnioscopy: A technique permitting direct visualization of the developing fetus. This procedure is used to detect abnormalities such as spina bifida and cleft lip. It has no specific time limitations.

4. diploid- A condition where each cell has two of each kind of chromosome; 2n=46. Body (somatic) cells are examples of cells that each contain a diploid number of chromosomes.
Haploid- A condition where each cell has only one of each kind of chromosome; n=23. An example of a haploid cell is an egg or sperm.

5. 46 chromosomes x 2 chromatids per chromosome = 92 chromatids.

6. \(2^3 = 8\).

7. metacentric, submetacentric, acrocentric.

8. total length, centromere position, secondary constrictions and differential staining bands; S phase portion of Interphase.

9. DNA is the genetic material. DNA is a triplet code, has punctuation, is a non-overlapping code, and is redundant or degenerate.

10. bases, phosphate, deoxyribose.

11. Adenine- purine, Cytosine- pyrimidine, Thymine- pyrimidine, Guanine - purine, Uracil - pyrimidine

   Thymine is found only in DNA; Uracil only in RNA

   A & T are bound by double hydrogen bonds.

   C & G are bound by triple hydrogen bonds.

12. Transcription, Translation.

13. messenger RNA - contains the coded information of a specific gene.

   transfer RNA- carries specific amino acids to the sites of protein synthesis as a result of the tRNA's anticodons matching the codons of the mRNA.

   ribosomal RNA- located in the ribosomes. . .the sites of the protein synthesis.

14. DNA template: CTATCTACAGGT

    mRNA: GAUAGAUGUCCA

    amino acid sequence: Asp-Arg-Cys-Pro
ANSWER KEY FOR TEST #1 – September 17, 2004

1.a. -Mentor of Dr. McKenzie’s
 -Created GN 301
 -Former chancellor
 -Bostian Hall, bells, etc.

b. –Procedure where 10-35 cc of amniotic fluid/cells removed from amnion
 -During first 14-18 weeks of pregnancy
 -Appx 500 gene problems/chromosome variations can be detected

c. –Sister chromatids align on central plane of cell
 -Very short phase of mitosis

d. –Found only in RNA
 -Pyrimidine
 -Double H bonds to adenine

e. –International effort to discover all of the appx. 20,000 human genes and determine the complete sequence of the 3 billion DNA bases
 -Mapping = determine location of genes
 -Sequencing = DNA base order

f. –Artificial Insemination by Donor
 -Use of donor’s sperm to inseminate woman’s egg (not the husband)

2.a. F – Fertilization
 b. T
 c. T
 d. F – preventing implantation from occurring
 e. F – Phosphate, ribose
 f. F – acrocentric
 g. T
 h. F – S-phase

3.a. E
 b. D
 c. C
 d. F

4.a. Cytosine, Codon, Gene, X Chromosome, Chromosome #1
 b. DNA in salmon sperm, Chromosomes first seen, Avery et. al, Watson & Crick, HGP

5. Well thought out and thorough Genetics in Human Affairs answer

6.a. A
b. C
c. D
d. E
e. A
f. C

7.a. F
b. D
c. Phenylketonuria (PKU)

8.a. 200 million
b. 50
c. 1. Acidic environment in vagina
   2. Some swim up wrong fallopian tube
   3. Some fertilize the first round object they find
   4. Some have mutations like 2 tails, etc.
   (Other possible answers…)

9.a. transcription, AGU, Ser
b. 3 Possibilities are: AUG-AGU, AUG-AGC, AUG-UC_ (substitute any letter for _)
c. 3 Possibilities are: UAA, UAG, UGA
d. TTG, 7
e. 38%

**ANSWER KEY FOR TEST #1 – February 9, 2005**

1.a. –Characteristic of DNA in which 3 specific code words terminate or stop the gene’s message

b. –Means of obtaining fetal cell sample for DNA, gene product, chromosomal testing
   -Using a catheter and vaginal entry to suction off tiny villi sample of cells from the outer birth membrane
   -Can identify, e.g., Down Syndrome

c. –The ball of cells – post zygote -> to embryo stage
   -By 7-10 days after fertilization, the blastocyst with 100-1000 cells implants in the uterine wall. After that, more specific tissues -> organs begin to form (i.e. embryo begins to form)

d. –Siblings of the same age.
   -Arise from two eggs each fertilized by a different sperm
   -Either can be XX or XY, hence ½ of DZ (dizygotic) twin pairs are like sex; ½ are unlike sex

e. –mRNA – messenger RNA - contains the coded information of a specific gene
   -tRNA – transfer RNA - carries specific amino acids to the sites of protein synthesis as
a result of the tRNA's anticodons matching the codons of the mRNA
-rRNA – ribosomal RNA - located in the ribosomes. . .the sites of the protein
synthesis

f. –A = T (held together by two hydrogen bonds)
   -C ≡ G (held together by three hydrogen bonds)
   -A = U (in RNA)

2. a. F – Meiosis
   b. T
   c. F – “pill” – birth control
   d. T
   e. F – largest
   f. F – S phase
   g. F - Adenine
   h. F – 2005

3. a. A,C
   b. B
   c. A
   d. D

4. a. Adenine, RNA, DNA, Protein, Chromosome
   b. Cytosine, Codon, Gene, Chromatid, Chromosome

5. a. A project set out to map and sequence the entire nuclear genetic content of a human
cell…its genome. The HGP was completed in 2003. 20,000 genes mapped to specific
chromosomal locations.

   b. 1. Will employers be allowed to conduct genetic tests on potential
      employees?...Insurance companies??
   2. Will genetic engineers be tempted to “fix” all DNA mutations, thus eliminating
      genetic variation?

6. a. C
   b. B
   c. C
   d. B
   e. A
   f. D

7. Top 3 diagrams: Anaphase, Prophase, Telophase
   Bottom 2 diagrams: Metaphase, Interphase

8. Examples from video.
9. Well thought out answer showing understanding of prenatal genetic analysis.
10. a. CGT, 8  
   b. AUG-AAU, AUG-AAC  
   c. 23%

11. a. They were shown at stop signs. Each police car was from a university campus whose 3-letter abbreviation was a stop codon: UGA (Univ. of Georgia), UAA (Univ. of Alaska at Anchorage)  
   b. B