BIOLOGY
SECTION II
Time—1 hour and 30 minutes

Directions: Answer all questions.

Answers must be in essay form. Outline form is not acceptable. Labeled diagrams may be used to supplement discussion, but in no case will a diagram alone suffice. It is important that you read each question completely before you begin to write. Write all your answers on the pages following the questions in the pink booklet.

1. Meiosis reduces chromosome number and rearranges genetic information.

   (a) **Explain** how the reduction and rearrangement are accomplished in meiosis.

   (b) Several human disorders occur as a result of defects in the meiotic process. **Identify** ONE such chromosomal abnormality; what effects does it have on the phenotype of people with the disorder? **Describe** how this abnormality could result from a defect in meiosis.

   (c) Production of offspring by parthenogenesis or cloning bypasses the typical meiotic process. **Describe** either parthenogenesis or cloning and **compare** the genomes of the offspring with those of the parents.

2. Darwin is considered the "father of evolutionary biology." Four of his contributions to the field of evolutionary biology are listed below.

   - The nonconstancy of species
   - Branching evolution, which implies the common descent of all species
   - Occurrence of gradual changes in species
   - Natural selection as the mechanism for evolution

   (a) For EACH of the four contributions listed above, **discuss** one example of supporting evidence.

   (b) Darwin's ideas have been enhanced and modified as new knowledge and technologies have become available. **Discuss** how TWO of the following have modified biologists' interpretation of Darwin's original contributions.

   - Hardy-Weinberg equilibrium
   - Punctuated equilibrium
   - Genetic engineering

GO ON TO THE NEXT PAGE.

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Question 1

(a) **Explain** how the reduction and rearrangement are accomplished in meiosis.
(5 points maximum)

REDUCTION
1 point: **(homologous) chromosomes pair, then separate** and move to opposite poles during 1st meiotic division
1 point: **chromatids separate** during 2nd meiotic division

OR

1 point: two rounds of cell (nuclear) division but only one replication of the chromosomes

REARRANGEMENT
1 point: **crossing over** (in proper context)
1 point: **random alignment (independent assortment)** of tetrads
1 point: **elaboration (e.g.: correct mechanism/description or consequences** of one of the above) *

*NOTE: Diagrams that are clearly labeled and are described in the essay portion are acceptable and may receive a point

(b) Several human disorders occur as a result of defects in the meiotic process. **Identify** ONE such chromosomal abnormality; what effects does it have on the phenotype of people with the disorder? **Describe** how this abnormality could result from a defect in meiosis.
(4 points maximum)

CHROMOSOMAL ABNORMALITY
1 point: **Identify** one condition by name or description
(e.g.: Down or trisomy 21; Turner or XO; fragile X; cri-du-chat or 5p-; etc.)
1 point: **Phenotype** of the example given above

DESCRIBE
1 point: **Name or identify the meiotic event** (e.g.: nondisjunction, unequal crossing over, inversion, mispairing)
1 point: **Description** of the meiotic event *

(c) Production of offspring by parthenogenesis or cloning bypasses the typical meiotic process. **Describe** either parthenogenesis or cloning and **compare** the genomes of the offspring with those of the parents.
(3 points maximum)

CLONING OR PARTHENOGENESIS
1 point: **Definition**
- **Parthenogenesis**: development of an unfertilized egg into an adult; often the adult is haploid

OR

- **Cloning**: using a somatic cell or cells from a multicellular organism to make one or more genetically identical individuals (or inducing a diploid body cell of an organism to revert to its embryonic state and then develop into a complete adult organism without fertilization)

1 point: **Description** of an example or the process in a plant or animal (parthenogenesis is rare in plants)
1 point: **Comparison** of the genomes of offspring and parents (e.g. identical for cloning)