AP® BIOLOGY
2006 SCORING GUIDELINES (Form B)

Question 1

Sexual reproduction requires that half of the chromosomes in a zygote come from one parent and the other half from the second parent.

(a) Describe the process by which a germ cell's complement of chromosomes is halved in the formation of the gametes. **(6 points maximum)** One point for each of the following:
- Correct description of meiosis (simply rephrasing the question earns no point)
- Sister chromosomes pair in prophase I
- Spindles move chromosomes pairs to poles in anaphase I
- Two cycles/rounds of division in meiosis
- Sister chromatids separate to poles in anaphase II
- 1 germ cell yields 4 gametes
- DNA replicates in interphase
- No additional replication before meiosis II

(b) Choose **one** organism or group of organism the reproduce **asexually**. Describe the mode of asexual reproduction in that organism and explain the advantages to the organism of asexual reproduction. **(3 points maximum)**
- One point for correct organism or group of organisms that produce asexually
- One point for mode for any of the following (1 point maximum)
  - Plant → cuttings, others possible, e.g., runners
  - Fungi → budding or fission
  - Hydra → budding
  - Bacteria → fission
  - Viruses → uses host machinery
  - Insects/others using parthenogenesis
- One point for advantages for any of the following (1 point maximum)
  - Allows faster reproduction/more efficient
  - Genetic information is identical to parent ("offspring is clone" credited unless already used above)

(c) Choose **one** organism or group of organisms that reproduce **sexually**. Describe the mode of sexual reproduction in that organism and explain the advantages to the organism of sexual reproduction. **(3 points maximum)**
- One point for correct organism or group of organisms that produce sexually
- One point for mode; any of the following acceptable (1 point maximum)
  - Two different parents (male and female)
  - Egg and sperm combine in fertilization
  - Gametes (1n) combine to form zygote (2n), embryo (2n)
  - Fertilization is random
  - Description of fertilization process
- One point for advantages; any of the following acceptable (1 point maximum)
  - Increases genetic diversity/combinations/variations (simply stating "variation" is insufficient, unless linked to genes/genotypes/alleles)
  - Offspring are genetically unique/different from parents
  - Allows individuals/populations to carry recessive lethal

BIOLOGY
SECTION II
Time—1 hour and 30 minutes

1A1

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 goldenrod booklet.

1. Sexual reproduction requires that half of the chromosomes in a zygote come from one parent and the other half from the second parent.
   (a) Describe the process by which a germ cell's complement of chromosomes is halved in the formation of gametes.
   (b) Choose **one** organism or group of organisms that reproduce **asexually**. Describe the mode of asexual reproduction in that organism and explain the advantages to the organism of asexual reproduction.
   (c) Choose **one** organism or group of organisms that reproduce **sexually**. Describe the mode of sexual reproduction in that organism and explain the advantages to the organism of sexual reproduction.

(a) Germ cell's complement of chromosome is halved during meiosis. First, in prophase, chromatin is condensed into chromosomes and nuclear membrane and nucleolus disappear. And then, each chromosomes are paired with their homologous chromosome. Then cross-over (exchange genes between homologous chromosomes) occurs. In metaphase, Homologous chromosome pairs are aligned in equatorial plate and are separated to each pole during anaphase. After anaphase, telophase occurs in which cytokinesis occurs. Thus, this two daughter cell become haploid. And each cell proceeds meiosis II - it is identical to mitosis - in which, sister chromatids are separated to each four daughter cells. In result of meiosis, 4 daughter cells of haploid are formed, thus chromosomes are halved.

(b) Bacteria usually reproduces asexually. Their most common reproducing method is fission. Fission is the process in which circular chromosome of bacteria attaches to cellular membrane, copied in two identical chromosome

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and be separated to each two daughter cells as the cell wall elongates to different direction and be separated. These resulting genetically identical progeny are called clone. This fission finishes fast - It takes only 20 minutes for cytokinesis after DNA is replicated. And as two progenies are from one parent, bacteria can make many of its clones through fission. These advantages enable bacteria to be proliferate if the environment is favor to that bacteria.

(c) Human is one of organisms which reproduces sexually. Male produces sperm as a gamete in its reproductive organ while female produces ovum in its reproductive organ. Female and Male mate together and one gamete from each male and female fertilize and forming a zygote. This zygote is implanted to uterus in female and after going through development, becomes one organism and be born out. Since two haploid gamete cells fused together to form zygote, sexual reproduction causes genetic variation in organism. (Also, cross-over during meiosis also contributes to this). Due to advantage of genetic variation, organisms can adapt to environment although the environment slightly changes. And genetic variation may contributes to increase in reproductive ability in organisms.

BIOLOGY
SECTION II
Time—1 hour and 30 minutes

1B1

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(a) By meiosis. The first stage it undergoes is prophase 1 where the chromosomes condenses and nucleolus disapears. During this time the formation of the microtubule spindle begins. The the cell enters metaphase 1 and the chromosome aligne themselves across the equator of the formed spindle. Then anaphase 1 begins during which the chromosome attached to the bivalent goto separate ends of the spindle. In Telophase 1, the nucleus is formed at both ends of the spindle and the cell divides giving 2 daughter cells with random assortment of chromosomes. The daughter cell then undergoes ~~from~~ prophase, metaphase ~~to~~ anaphase, and telephase except this time in metaphase the ~~&~~ centromere splits causing the sister chromatids to goto opposite ends. Hence in the end you get 4 daughter cells ~~not~~ with haploid(N).

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1B2

(b) Bacteria. They reproduce asexually by a mode called binary fission where the parent ~~gives rise to~~ divides into 2 identical daughter bacteria. The advantages of asexual reproduction are: firstly, energy is converted more efficiently into the offspring unlike meiosis where millions gametes are produced. Secondly, the survival success of the offspring is twice as much since it has the same genes as it's parent and is living in the same habitat. Thirdly, fewer offsprings are reproduced by they are larger hence enhancing survival success.

(c) Humans reproduce sexually by a mode known as viviparity where the offspring develops in the mother and recieves all its nutrients from her. The advantages of sexual reproduction are: firstly, random assortment of genes result in genetic variability which may give rise to heterozygous advantage ie. it recieves advantageous traits from both parents, hence making it more genetically fit to survive and reproduce. Secondly, sexual reproduction can result in dispersion to more suitable enviorments ie. less competition as in plants release their pollen grains in the air for them to disperse and start a new population. ~~It helps keep the~~

BIOLOGY
SECTION II
Time—1 hour and 30 minutes

1C1

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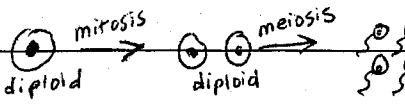
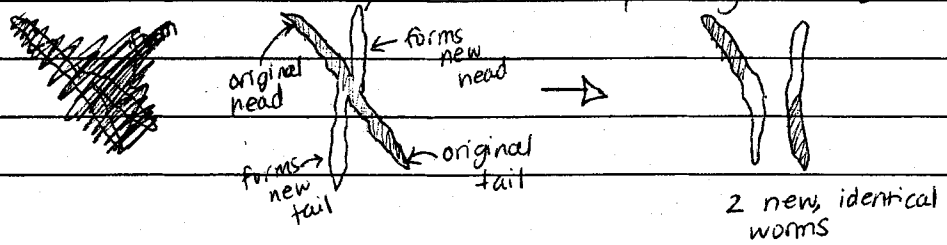
(a) a cell's chromosomes must be halved when forming gametes. The eggs and sperms must be haploid in order to fuse to form the diploid zygote. In order to form haploid gametes, a cell must undergo ~~MITOSIS~~ meiosis. This process ~~[illegible]~~ takes the two identical, diploid cells ~~[illegible]~~ formed when the original cell went through mitosis and, with a series of crossings over and DNA duplication, creates four haploid gametes.



(b) Earthworms reproduce asexually through transverse fission. They duplicate all their DNA, then create a second worm by sort of spliting in ~~[illegible]~~ two.



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1C2

The process of asexual reproduction has some advantages as oposed to sexual reproduction. One is that it can occur at a faster rate. The organism only needs it's self. (It only requires one organism.)

(c) Birds reproduce sexually forming amniotic eggs. The embryo then develops outside the female's body in a protective outer shell. The female becomes fertilized by the male's sperm and she forms her fertilized eggs and lays them in a nest.

There are many advantages of sexual reproduction to asexual reproduction. One is that the mixture of the parents' genes insures genetic stability. Differences among a species are a result of sexual reproduction.

AP® BIOLOGY
2006 SCORING COMMENTARY (Form B)

Question 1

Sample: 1A
Score: 10

This response demonstrates excellent knowledge of how chromosome number is reduced in meiosis and of the two modes of reproduction. In part (a) the response earned a point for the description of pairing of homologous chromosomes in prophase I, and a point for separation in anaphase I. One point was earned for describing the two rounds of division in meiosis, and another point for the end product being four haploid cells. In part (b) a point was earned for correctly identifying bacteria as asexually reproducing organisms; a point for the description of bacterial fission as a mode of asexual reproduction; and a point for the advantages (daughter cells are clones, and the process is rapid). In part (c) the response earned a point for indicating that humans reproduce sexually, and a point for describing the basic components of sexual reproduction: fertilization (sperm + egg → zygote) and implantation. A point was earned for genetic variation as an advantage.

Sample: 1B
Score: 6

This response incompletely answers each of the three parts. In part (a) the response earned a point for the description of two rounds of division in meiosis, and another point for sister chromatids separating in meiosis II to yield four haploid daughter cells. In part (b) the response earned a point for correctly identifying bacteria as asexually reproducing organisms, and another point for indicating that fission is more efficient. In part (c) the response earned a point for indicating that humans reproduce sexually, and a point for genetic variation as an advantage.

Sample: 1C
Score: 4

This response incompletely answers each of the three parts. In part (a) the response earned a point for indicating that meiosis yields four haploid gametes. In part (b) no points were earned for the incorrect identification of earthworms as asexually reproducing organisms. A point was earned for indicating that asexual reproduction is more rapid. In part (c) the response earned a point for indicating that birds reproduce sexually, and another point for describing the basic features of sexual reproduction. Because the response contradicts itself, saying that differences (a vague description of variability) and stability both result from sexual reproduction, a point was not earned for differences arising from sexual reproduction.