



AP[®] Biology 2004 Scoring Guidelines

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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

1 point: two rounds of cell
OR (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)

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Question 2

(a) For EACH of the four contributions listed below, **discuss** one example of supporting evidence.
(2 points each; 8 points maximum)

<i>Contributions</i>	<i>Possible Examples of Evidence (1 point)</i>	<i>Explanation/Understanding of Phrase (1 point)</i>
The nonconstancy of species	<ul style="list-style-type: none"> ◆ Must demonstrate variation ◇ Finches, horses, dogs, whales, peppered moths, etc.... 	<ul style="list-style-type: none"> ◆ Individual variation within a species/population (can be phenotypic or genotypic) ◆ Change within species over time (not change in an individual) ◆ Change in number of species over time
Branching evolution, which implies the common descent of all species	<ul style="list-style-type: none"> ◆ Must demonstrate common ancestry ◇ Homology (embryological, structural, molecular, processes) ◇ Vestigial structure from common ancestor ◇ Hominoids, finches, etc... 	<ul style="list-style-type: none"> ◆ <u>Shared</u> or common <u>ancestor</u> ◆ Adaptive radiation concept (divergent evolution, one species becomes 2 or more)
Occurrence of gradual changes in species	<ul style="list-style-type: none"> ◆ Must demonstrate change over time (generations) ◇ Vestigial structures (pelvic bones, appendix) ◇ Fossil sequence ◇ Coat color changes ◇ Giraffes' necks ◇ Antibiotic/pesticide resistance 	<ul style="list-style-type: none"> ◆ Small changes <u>over time</u> / slow rate of change/incremental ◆ Genes mutate \longrightarrow selection occurs \longrightarrow populations evolve ◆ Accumulation of genetic/phenotypic changes
Natural selection as the mechanism for evolution	<ul style="list-style-type: none"> ◆ Must demonstrate an appropriate natural selection effect ◇ Antibiotics/pesticide resistance ◇ Finches, moths, etc... ◇ Predator/prey relationships 	<ul style="list-style-type: none"> ◆ Differential reproductive success ◆ Survivors pass genes to next generation ◆ <u>No</u> Lamarckian language (want, need...) ◆ <u>No</u> "survival of fittest" <u>alone</u>

Note:

Examples in context may earn 2 points.

Possible examples are not limited to the listings above.

An example alone, without the context of the phrase = no points.

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Question 2 (cont'd.)

(b) **Discuss** how TWO of the following have modified biologists' interpretation of Darwin's original contributions.

(3 points each; 6 points maximum)

	<i>Definition/Explanation of the Idea (1 point)</i>	<i>Description of How It Has Enhanced/Modified Interpretation of Evolution (1 point)</i> * Direct mention of Darwin's view is not necessary for points.	<i>Depth of Discussion /Expansion Point (1 point)</i> ◆ Discuss evidence ◆ Deeper description of the theory ◆ Describe applicable technology
Hardy-Weinberg Equilibrium	<ul style="list-style-type: none"> ◆ Allele (gene) frequency remains constant over time ◆ Under certain conditions no evolution occurs 	<ul style="list-style-type: none"> ◆ D - Ongoing gradual change <p>HW - Constant allele ratio (must refer to alleles or genes)</p> <p>*Hardy-Weinberg equation without explanation of variables within equation = no points</p>	<p>Examples:</p> <ul style="list-style-type: none"> ◆ <u>Five</u> conditions of Hardy-Weinberg Equilibrium cited correctly (<i>need all 5</i>) <ul style="list-style-type: none"> ○ Very large population size - no drift ○ No movement in or out of a population ○ No net mutations ○ Random mating - no sexual selection ○ No natural selection <p>Hardy-Weinberg as a null hypothesis for determining cause of change</p>
Punctuated Equilibrium	<ul style="list-style-type: none"> ◆ Sudden changes in tempo ◆ Long period of stasis then sudden change 	<ul style="list-style-type: none"> ◆ D - Gradual change <p>PE - Possible rapid change</p>	<p>Examples:</p> <ul style="list-style-type: none"> ◆ A graph of punctuated evolution vs. Darwinian evolution ◆ Discussion of fossil record reflecting a punctuated equilibrium pattern
Genetic Engineering	<ul style="list-style-type: none"> ◆ Manipulation and/or alteration of genes/DNA ◆ Others related to biotechnology 	<ul style="list-style-type: none"> ◆ D - Natural gene transfer ◆ GE - human directed gene transfer ◆ D-Gradual change ◆ GE - rapid change ◆ DNA analysis allows genomic comparisons 	<p>Examples:</p> <ul style="list-style-type: none"> ◆ Cloning process expressed ◆ RFLP analysis explained ◆ Universality of genetic code

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Question 3

(a) On the axes provided, **construct** and **label** a graph showing the results for the three samples.

(1 point each; 3-point maximum)

- ◆ Orientation of axes is correct: x-axis is time/minutes, y-axis is light transmittance/%
- ◆ Data are plotted correctly (one misplaced data point is permissible)
- ◆ Graph is accurate: must include proper scaling and correct labels and units of measurement and key

(b) Identify and explain the control or controls for this experiment.

(1 point each; 3-point maximum)

- ◆ Sample 1 is the control
- ◆ Sample 1 is in the light and has permissive temperature/functional structures (membranes, proteins, enzymes, etc.)
- ◆ Control is the basis for comparison to treatment effects (can award even if wrong sample was identified as the experimental control)
- ◆ Reliability of data/design: identical procedures, reagents, measurements, adequate sample size (must identify at least two)

(b) **Discuss** how electrons are generated in photosynthesis and why the three samples gave different transmittance results.

(1 point each; 6-point maximum)

- ◆ Chlorophyll (photosystem, reaction- or photo- center; “chloroplast” alone is not sufficient) is the link between light (photons) and the generation of electrons
- ◆ Water is the source of electrons (photolysis, oxidation, splitting)
- ◆ Electron generation, not simply photosynthesis, is proportional to DPIP reduction light transmittance
- ◆ Decreasing light availability decreases the quantity of electrons that will be generated, and/or vice versa
- ◆ Boiling disrupts functional structures (membranes, denaturation of proteins/enzymes, etc.; “chloroplast” alone is not sufficient)

Elaboration (1 point only)

photosystem II and/or I/Z-scheme
data analysis

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Question 4

- (a) **Identify** the participants involved in the symbiosis and describe the symbiotic relationship, and
 (b) **Discuss** the specific benefit or detriment, if any, that each participant receives from the relationship.

1 point maximum is awarded for a correct pair of participants involved in each example given.

Participants must be organisms.

1 point maximum is awarded for describing a correct symbiotic relationship to each example.

1 point maximum is awarded for discussing how **each** participant is involved in a specific benefit or detriment from the relationship.

Wrong participants: NO points for participants, relationship, or discussion.

Nonspecific participants: 2 points maximum for relationship and discussion.

1 point maximum for elaborating on any **one** of the four choices used. 10 points awarded only if 4 choices attempted.

<i>Example of Symbiotic Relationship</i>	<i>Participants Involved</i>	<i>Relationship Involved</i>	<i>Discussion on Each Participant</i>
Plant root nodules	Plants/legumes + <i>Rhizobium</i> /bacteria	Mutualism/both organisms benefit	Plants receive nitrogen (not N ₂) while bacteria receive CHO's and other nutrients/water and shelter/hospitable environment
Digestion of cellulose	Termites/ruminants + microorganisms (bacteria, protozoa, fungi) Plants + pathogenic bacteria/fungi	Mutualism/both organisms benefit Parasitism/one member is harmed, the other benefits	Host is able to use cellulose as a nutrient (energy source) while symbiont gains food/shelter/hospitable environment Host is infected, bacteria/fungi receives nutrients
Epiphytic plants	Large trees (plants) + epiphyte/bromeliads/orchids/some mosses/ferns Epiphyte + ants/frogs/small animals Dodder/mistletoe + plant	Commensalism/one member benefits, the others are not harmed Mutualism/both organisms benefit Parasitism/one member is harmed, the other benefits	Host is not affected or given any benefit. Symbiont has a substrate for anchoring/access to sunlight & pollinators Bromeliads provide water, shelter free of predation to many insect larva, frogs, etc.../a source of nitrogen is given to plant Host has nutrients removed while epiphyte receives nutrients
AIDS	Human + Virus/HIV/retrovirus	Parasitic/one member is harmed, the other benefits	HIV uses host to replicate while host/immune system is harmed or killed
Anthrax	Human/ruminant/horse/pig + <i>Bacillus anthracis</i> /bacteria/spores	Parasitic/one member is harmed, the other benefits	Illness or death to host; bacteria receives nutrients, habitat