AP® Biology
2005 Scoring Guidelines

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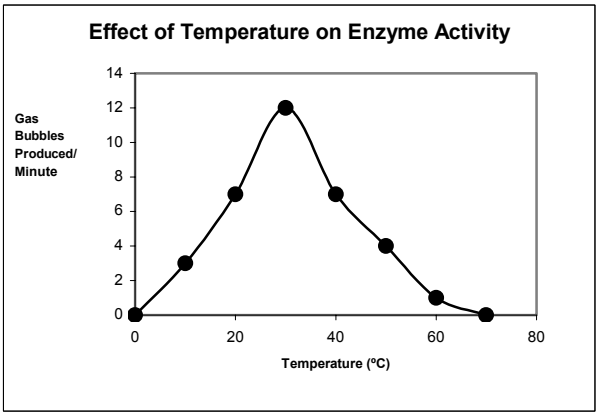
Question 1

Part A: Graph and Optimum Temperature (3 points maximum)

Graph Setup (1 point)

Must contain:

- Title/Legend and Y-axis [Bubbles of gas/Min]
- X-axis [Temperature (°C)]
- Correct measurement units and scaling for axes



Data Plotted (1 point)

- Correctly plotted points in proper orientation
- Points may or may not be connected with a line
- Bar graph acceptable

Optimum Temperature (1 point)

- 30° C, or between 20° C and 40° C either clearly indicated on the graph or in a sentence

Part B: Analyze and Explain the Results
(4 points maximum)

Analysis (1 point)

- Provide range of the change in respiration activity (increase and decrease) to temperature change (increase and decrease)

Explanations (1 point each)

- Below optimum—Increase in molecular movement leads to increase in reaction rate
- Above optimum—Denaturing of enzymes leads to decrease in reaction rate

Elaboration (2 points maximum, 1 point each)

- Relating enzyme function (effect on reaction rates) to allosteric site, active site, H^+ bond, R groups
- Gas production due to respiration (can use either aerobic respiration or fermentation)
- Induced fit
- Lowering energy of activation
- Enzyme specificity

Part C: Experimental Design (4 points maximum)

NOTE: Experiment must be feasible. Must include sugar solutions of varying pH and an organism. If experiment is not reasonable, no points are awarded in the design structure section below.

Design Structures (3 points maximum, 1 point each)

- Two experimental constants—constant amounts of yeast or sugar, or temperature held constant
- Independent variable tested—reasonable pH range must be stated, including acid through base

Question 1 (continued)

- Control—identification of a control treatment, e.g., no sugar, no yeast, pH 7
- Measurable product per unit of time—gas production, color change, etc.
- Multiple trials—repeat trials, several samples, stats, etc.

Prediction (1 point)

- Designate a pH at which enzymes will function optimally

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Question 2

Part A (5 points maximum)		
Component	**Structure: 1 point/component**	**Function: 1 point/component**
Chromatids	2/sister/pair/identical DNA/genetic information	Distribution of one copy to each new cell
Centromere	Noncoding/uncoiled/narrow/constricted region/determines arm ratio	Joins/holds/attaches chromatids together
Nucleosome concept	Histones, DNA wrapped around special proteins	Packaging compacting
Chromatin form (heterochromatin/ euchromatin)	Condensed/supercoiled → Loosely coiled →	Proper distribution in cell division (not during replication) Gene expression during interphase/replication occurs when loosely packed
Kinetochores	Disc-shaped proteins	Spindle attachment/alignment
Genes or DNA	Brief DNA description	Codes for proteins or for RNA
Telomeres	Tips, ends, noncoding repetitive sequences	Protection against degradation/ aging, limits number of cell divisions

NOTE:

- No points for just naming the component.
- No points for stating that chromosomes are made of genes.
- A diagram alone will not suffice but can be used for clarification.

Question 2 (continued)

Part B (4 points maximum, 2 points per theme)	**Part C** (4 points maximum)

• allows for **genetic variation**
  o through independent assortment (brief description)
  o through crossing over (brief description)
  o leads to variation in gametes
• allows for **genetic stability**
  o efficiency of transfer of genetic information
  o prevents loss of genetic information
  o offspring get same number of chromosomes
  o maintains integrity of chromosomes
  o linked genes tend to be inherited together
• allows for **gene regulation**
  o increased complex structure
  o histone acetylating
  o methylation
• allows for **complexity**
  o allows for more genes
  o evolution of new genes can occur/transposons
  o intron/exon allows for alternate splicing
• allows for **diploid/polyploid**
  o genetic fitness
  o minimizes the effect of harmful alleles/backup copy
  o extra set(s) of alleles
  o heterozygosity
	• **shape** (circular/nonlinear/loop)
	• **less complex** (no histones/less elaborate structure/folding)
	• **size** (smaller size/less genetic information/fewer genes)
	• **replication method** (single origin of replication/theta replication)
	• transcription/translation may be coupled
	• generally few or no **introns** (noncoding)
	• majority of genome expressed
	• **operons**—gene regulation
	
	No points for plasmids—more common but not unique to prokaryotes/not part of prokaryote chromosome.

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Question 3

Part A (6 points maximum)

NOTE: These examples are not all-inclusive, merely the most frequently encountered.

Structure AND Function (1 point)		**Evolutionary Significance** (1 point)
Flower	Sexual reproduction	Increases probability of fertilization Increases genetic diversity Protects embryo
Petals	Attract pollinators	Increase probability of pollination
Sepals	Protect developing flower	Increase probability of reproduction
Stamen	Male reproductive structure/produces pollen	Increases probability of pollination Reproductive isolation/pollen-stigma recognition
Anther (micro-sporangium)	Produces pollen/male gametophyte	Increases probability of pollination
Filament	Positions anther/pollen to pollinator	Increases probability of pollination
Pollen	Packages and delivers male gamete	Increases probability of pollination/ eliminates the need for free water
Pollen structure	Dispersal aid	Increases genetic diversity/ variability
Pollen tube	Delivers sperm to ovule	Increases probability of fertilization
Carpel/Pistil	Female reproductive structure/produces ovule/protects embryo	Increases survival of embryo Pollen recognition/compatibility/ reproductive isolation
Stigma	Pollen trap/collector	Increases probability of pollination pollen recognition/compatibility
Style	Positions stigma, pollen tube guide	Increases fertilization rate
Ovary	Produces/protects ovule/seed dispersal/ fruit	Increases survival rate
Ovule (mega-sporangium)	Produces female gamete/gametophyte	Protection of gamete/increased probability of fertilization
Embryo sac	Receives sperm nuclei/double fertilization	Protection and development of embryo
Seed	Nourishes, encloses, protects plant embryo	Increased survivorship of embryos
Fruit	Promotes seed dispersal/protects seed/ seed dormancy	Avoids inbreeding depression/ increased survivorship/ increased dispersal to avoid competition
Endosperm	Nourishes embryo	Increased survival of embryo
Nectary	Produces nectar	Increases probability of pollination
Asexual reproduction (vegetative propagation/ cloning)	Stem modifications/root/leaves	Rapid multiplication of a highly fit phenotype in a stable environment

Question 3 (continued)

Part B (2 points maximum, 1 point each)

- Nonvascular plants—lack of vascular system which limits water uptake and transport, linked to how this limits distribution
- Flagellated sperm require water for fertilization, linked to how this limits distribution
- Spores (limited nutrient/energy stores)—limited longevity limits dispersal, linked to how this effects distribution
- Gametophyte = dominant generation—genetic limitations due to haploidy/sporophyte dependent on gametophyte, thereby limiting distribution

Part C (5 points maximum, 1 point each)

- Gametophyte AND sporophyte
- Haploid/monoploid (n) AND diploid (2n)
- Proper dominant generation (1 point max)
    - sporophyte (2n) in angiosperms
    - gametophyte (n) in bryophytes
- Role of meiosis (1 point maximum)
    - diploid to haploid
    - produce spores
- Role of fertilization—haploid to diploid
- Spores form gametophytes (n)
- Elaboration (1 elaboration point maximum) including, but not limited to, the following:
    - Bryophytes—antheridium/archegonium OR angiosperms—pollen grain or tube/embryo sac
    - Expand on role of mitosis: spore → mitosis→ gametophyte → mitosis→ gametes; zygote → mitosis → sporophyte

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Question 4

NOTE: One point is awarded for each bulleted item; maximum of 4 points for each section.

Provides an immediate nonspecific immune response (4 points maximum)

- Physical barrier (e.g., skin or mucous membranes [or blood clot]) with explanation that barrier prevents pathogens and parasites from entering the body. Resident microflora prevents pathogen attachment. Saliva, mucous, or tears wash away harmful entities; also vomiting/diarrhea purge harmful agents.
- Chemical barriers (low pH, salt, fatty acids of skin inhibit microbial growth, antimicrobial agents [e.g., lysozyme kills bacteria by digesting bacterial wall]).
- Inflammatory response: blood vessels dilate (precapillary arterioles dilate and postcapillary venules constrict), producing redness, edema, heat (fever), pain, and leading to an increase in white blood cells and clotting factors.
- Chemical agents:
    i. Interferons from cells infected with viruses stimulate nearby cells to produce chemicals that inhibit viral reproduction, OR chemokines activate monocytes to develop into macrophages.
    ii. Histamines cause increase in permeability of capillaries with an increased blood flow that results in more clotting and more white blood cells, OR histamines secreted by mast cells, OR prostaglandins increase blood flow.
    iii. Pyrogens induce fever that inhibits pathogen.
- Phagocytosis: ingestion by white blood cells (e.g., neutrophils, macrophages, or monocytes)
- Lysis of cells: Eosinophils or natural killer cells
- Complement system: leads to the lysis of microbes, or aids in recruitment of white blood cells.
- Elaboration of any one of the above (e.g., a second physical or chemical barrier)

Activates T and B cells in response to an infection (primary immune response)
(4 points maximum)

- Macrophages/white blood cells engulf and/or display antigens (may say: epitope) from infection.
- Antigen-presenting cell binds helper T cells to activate or stimulate helper T cells.
- Antigen-presenting cell activates or stimulates cytotoxic T cells.
- Antigen binding to B cell activates B cell.
- Helper T cell activates/stimulates B cell and/or cytotoxic T cell.
- Interleukin—1 (from macrophages) activates helper T cells.
- Interleukin—2 and/or cytokines (from helper T cells) activate B cells or cytotoxic T cells.
- CD4 on helper T cell enhances binding of helper T with antigen-presenting cell; leads to activated T cells.
- CD8 on cytotoxic T cell enhances binding and enhances activation of cytotoxic T cell.
- Elaboration point for explaining one of the following:
    i. MHC in primary immune response.
    ii. B (or plasma) cells produce/secrete antibody.
    iii. Cytotoxic T cells destroy infected cells.
    iv. Antibody mechanism of action (i.e., neutralization/agglutination/precipitation).

Question 4 (continued)

Responds to a later exposure to the same infectious agent (secondary immune response) (4 points maximum)

- Mediated by memory cells (T and/or B).
- Memory cells are specific for the same antigen encountered previously.
- Memory cells receptors/antibodies have greater affinity for the antigen.
- Production of antibodies/response is faster and/or to a greater extent.
- Origin of memory cells:
    i. Helper T cell → Memory Helper T → Memory B and T cells
    ii. Activated B cell → Memory B cell
    iii. Activated Cytotoxic T cell → Memory T cell
- Role of major histocompatibility complex (MHC), cytokines, IL-1, or IL-2 as related to secondary immune response.
- Memory cells are more numerous (or antibody concentration is higher).
- Memory cells are long-lived.
- Elaboration of why measles, mumps, chicken pox do not recur (vaccines), or common cold/flu do recur.

Distinguishes self from nonself (4 points maximum)

- All cells have unique ID tags (flags, markers, proteins, glycoproteins, MHC, etc.).
- Origin of "self" markers of MHC by multiple alleles (polymorphic antigen receptors).
- Developmental selection in bone marrow and/or thymus where antigen receptors are tested (self-antigen receptors are eliminated, or inactivated/clonal selection).
- Mechanism of recognition (binding elicits immune response).
- Illustrate self/nonself incompatibilities: (e.g., autoimmune disease such as MS, transplant incompatibility; blood types, and pathogens mimicking MHC molecules, or cloaking with host cell membrane).
- Elaboration of:
    i. MHC (or human leukocyte antigens)
    ii. Distinguish between MHC I and II
    (e.g., MHC I—all nucleated cells; MHC II—dendritic cells, macrophages, B cells).