Vocabulary Refresher

Group A  Directions - Match the correct definition for the following terms:

1. L____DNA

2. F____Chromosome

3. E____Gene

4. M____Protein

5. H____Trait

6. A____Nitrogen bases

7. I____Double helix

8. D____Template

9. K____DNA replication

10. B____Nucleotide

11. C____Protein synthesis

12. N____Deletion

13. J____Crossing over

14. G____Gene expression

A. Four molecules (represented by A, T, C, and G) that provide the codes for amino acids and ultimately, proteins within living organisms. These molecules are complimentary to each other with A binding to T and C binding with G.

B. Building block of DNA consisting of a sugar, a phosphate group, and a nitrogen base (A, C, T, or G).

C. A process where a genetic code found in DNA is copied and converted into a chain of amino acids.

D. A pattern that provides the basis for an identical copy to be made.

E. A sequence of nitrogen bases within a DNA molecule that code for a particular protein.

F. A tightly packed coil of DNA that is found in the nucleus of a cell.

G. A process where the genetic information found within DNA is changed into a functional product like a protein. This protein may take the form of a physical feature or a functional chemical.

H. A characteristic (structure or function) that an organism exhibits as a result of the genetic code within its DNA.

I. A twisted ladder-like structure with a backbone of sugar and phosphate and internal rungs made of complimentary nitrogen bases.

J. The process where chromosomes overlap and sections of these chromosomes are exchanged during meiosis resulting in genetics variations.

K. A process where two identical DNA molecules are synthesized from an original DNA molecule.

L. An organic molecule that contains a unique genetic code within the sequences of its nitrogen bases for each living organism.

M. An organic molecule that is composed of a sequence of amino acids that plays a vital role in the function of all living organisms. An example is an enzyme.

N. A mutation where part of the genetic code is missing or incomplete.
**Vocabulary Refresher**

**Group B  Directions** - Match the correct definition for the following terms:

1. **Asexual reproduction**
   
2. **Sexual reproduction**
   
3. **Mitosis**
   
4. **Meiosis**
   
5. **Ribosome**
   
6. **Amino acid**
   
7. **Mutation**
   
8. **Mutagenic agent**
   
9. **Selective breeding**
   
10. **Restriction enzyme**
   
11. **Genetic engineering**
   
12. **Clone**
   
13. **RNA**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asexual reproduction</td>
<td>Molecules that when arranged in specific sequences act as building blocks of proteins. There are 20 different types of these.</td>
</tr>
<tr>
<td>Sexual reproduction</td>
<td>A form of cell division that takes place within the sex organs of organisms and results in the formation of gametes (sex cells) having one-half the original chromosomes of the parent cell.</td>
</tr>
<tr>
<td>Mitosis</td>
<td>Any factor such as chemicals or radiation, that leads to a change in the genetic code.</td>
</tr>
<tr>
<td>Meiosis</td>
<td>A process where a parent organism divides into two new genetically identical offspring. Examples include budding and binary fission.</td>
</tr>
<tr>
<td>Ribosome</td>
<td>A sudden change in the genetic code or sequence of nitrogen bases within DNA.</td>
</tr>
<tr>
<td>Amino acid</td>
<td>An enzyme that locates a particular gene sequence on DNA and “cuts” the DNA at that site, creating DNA fragments of various sizes. These enzymes are used in many biotech processes.</td>
</tr>
<tr>
<td>Mutation</td>
<td>An exact genetic copy. The process can be applied to a cell or to a whole organism.</td>
</tr>
<tr>
<td>Mutagenic agent</td>
<td>A form of cell division where two daughter cells are produced from a parent cell that are genetically identical to the parent.</td>
</tr>
<tr>
<td>Selective breeding</td>
<td>A single stranded nucleic acid which contains the nitrogen bases, A, U, C and G. This molecule plays a vital role in the synthesis of proteins.</td>
</tr>
<tr>
<td>Restriction enzyme</td>
<td>A process involving two parent organisms that produce offspring, which may resemble but are genetically different from the parent organism.</td>
</tr>
<tr>
<td>Genetic engineering</td>
<td>A process where organisms with desirable traits are bred to enhance or maintain a trait, or increase variety.</td>
</tr>
<tr>
<td>Clone</td>
<td>A cell organelle that serves as the site for protein synthesis.</td>
</tr>
<tr>
<td>RNA</td>
<td>A process where a gene from one organism is inserted into the DNA of another organism. The new recombinant DNA will express that inserted gene.</td>
</tr>
</tbody>
</table>
1. The instructions for the traits of an organism are coded in the arrangement of
   (1) glucose units in carbohydrate molecules
   (2) bases in DNA in the nucleus
   (3) fat molecules in the cell membrane
   (4) energy-rich bonds in starch molecules

2. Scientific studies show that identical twins who were separated at birth and raised in different homes may vary in height, weight, and intelligence. The most probable explanation for these differences is that
   (1) original genes of each twin increased in number as they developed
   (2) one twin received genes only from the mother while the other twin received genes only from the father
   (3) environments in which they were raised were different enough to affect the expression of their genes
   (4) environments in which they were raised were different enough to change the genetic makeup of both individuals

3. For centuries, certain animals have been crossed to produce offspring that have desirable qualities. Dogs have been mated to produce Labradors, beagles, and poodles. All of these dogs look and behave very differently from one another. This technique of producing organisms with specific qualities is known as
   (1) gene replication
   (2) natural selection
   (3) random mutation
   (4) selective breeding

4. Which process will increase variations that could be inherited?
   (1) mitotic cell division
   (2) active transport
   (3) recombination of base subunit sequences
   (4) synthesis of proteins

5. The diagram below shows a process that can occur during meiosis.

   ![Diagram of meiosis]

   The most likely result of this process is
   (1) a new combination of inheritable traits that can appear in the offspring
   (2) an inability to pass either of these chromosomes on to offspring
   (3) a loss of genetic information that will produce a genetic disorder in the offspring
   (4) an increase in the chromosome number of the organism in which this process occurs

6. Which statement best describes human insulin that is produced by genetically engineered bacteria?
   (1) This insulin will not function normally in humans because it is produced by bacteria.
   (2) This insulin is produced as a result of human insulin being inserted into bacteria cells.
   (3) This insulin is produced as a result of exposing bacteria cells to radiation, which produces a mutation.
   (4) This insulin may have fewer side effects than the insulin previously extracted from the pancreas of other animals.
7. Individual cells can be isolated from a mature plant and grown with special mixtures of growth hormones to produce a number of genetically identical plants. This process is known as
   (1) cloning
   (2) meiotic division
   (3) recombinant DNA technology
   (4) selective breeding

8. Which statements best describe the relationship between the terms chromosomes, genes, and nuclei?
   (1) Chromosomes are found on genes.
   (2) Chromosomes are found in nuclei.
   (3) Genes are found on chromosomes.
   (4) Genes are found in nuclei.

9. The diagram below represents a section of a molecule that carries genetic information.

   The pattern of numbers represents
   (1) a sequence of paired bases
   (2) the order of proteins in a gene
   (3) folds of an amino acid
   (4) positions of gene mutations

10. Asexually reproducing organisms pass on hereditary information as
    (1) sequences of A, T, C, and G
    (2) chains of complex amino acids
    (3) folded protein molecules
    (4) simple inorganic sugars

11. In sexually reproducing species, the number of chromosomes in each body cell remains the same from one generation to the next as a direct result of
    (1) meiosis and fertilization
    (2) mitosis and mutation
    (3) differentiation and aging
    (4) homeostasis and dynamic equilibrium

12. Enzymes are used in moving sections of DNA that code for insulin from the pancreas cells of humans into a certain type of bacterial cell. This bacterial cell will reproduce, giving rise to offspring that are able to form
    (1) human insulin
    (2) antibodies against insulin
    (3) enzymes that digest insulin
    (4) a new type of insulin

13. A change in the base subunit sequence during DNA replication can result in
    (1) variation resulting from changes within the genetic code
    (2) rapid evolution of an organism
    (3) synthesis of antigens to protect the cell
    (4) recombination of genes within the cell

14. Plants inherit genes that enable them to produce chlorophyll, but this pigment is not produced unless the plants are exposed to light. This is an example of how the environment can
    (1) cause mutations to occur
    (2) influence the expression of a genetic trait
    (3) result in the appearance of a new species
    (4) affect one plant species, but not another
15. If the ribosomes of a cell were destroyed, what effect would this most likely have on the cell?
(1) It would stimulate mitotic cell division.
(2) The cell would be unable to synthesize proteins.
(3) Development of abnormal hereditary features would occur in the cell.
(4) Increased protein absorption would occur through the cell membrane.

16. Which statement describes asexual reproduction?
(1) Adaptive traits are usually passed from parent to offspring without genetic modification.
(2) Mutations are not passed from generation to generation.
(3) It always enables organisms to survive in changing environmental conditions.
(4) It is responsible for many new variations in offspring.

17. A change in the order of DNA bases that code for a respiratory protein will most likely cause
(1) the production of a starch that has a similar function
(2) the digestion of the altered gene by enzymes
(3) a change in the sequence of amino acids determined by the gene
(4) the release of antibodies by certain cells to correct the error

18. In sexually reproducing organisms, mutations can be inherited if they occur in
(1) the egg, only
(2) the sperm, only
(3) any body cell of either the mother or the father
(4) either the egg or the sperm

19. A product of genetic engineering technology is represented.
Which substance was needed to join the insulin gene to the bacterial DNA as shown?
(1) a specific carbohydrate
(2) a specific enzyme
(3) hormones
(4) antibodies

20. DNA samples were collected from four children. The diagram below represents the results of a procedure that separated the DNA in each sample.

Band X represents the
(1) largest fragment of DNA that traveled the fastest
(2) smallest fragment of DNA that traveled the fastest
(3) largest fragment of DNA that traveled the slowest
(4) smallest fragment of DNA that traveled the slowest

21. Which process can produce new inheritable characteristics within a multicellular species?
(1) cloning of the skin cells
(2) mitosis in muscle cells
(3) gene alterations in gametes
(4) differentiation in nerve cells
22. Offspring that result from meiosis and fertilization each have
(1) twice as many chromosomes as their parents
(2) one-half as many chromosomes as their parents
(3) gene combinations different from those of either parent
(4) gene combinations identical to those of each parent

23. Which statement concerning the reproductive cells in the diagram is correct?
(1) The cells are produced by mitosis and contain all the genetic information of the father.
(2) If one of these cells fertilizes an egg, the offspring will be identical to the father.
(3) Each of these cells contains only half the genetic information necessary for the formation of an offspring.
(4) An egg fertilized by one of these cells will develop into a female with the same characteristics as the mother.

24. A mutation that can be inherited by offspring would result from
(1) random breakage of chromosomes in the nucleus of liver cells
(2) a base substitution in gametes during meiosis
(3) abnormal lung cells produced by toxins in smoke
(4) ultraviolet radiation damage to skin cells

25. The diagram below represents single-celled organism A dividing by mitosis to form cells B and C. Cells A, B, and C all produced protein X. What can best be inferred from this observation?
(1) Protein X is found in all organisms.
(2) The gene for protein X is found in single-celled organisms, only.
(3) Cells A, B, and C ingested food containing the gene to produce protein X.
(4) The gene to produce protein X was passed from cell A to cells B and C.

26. The diagram below represents levels of organization within a cell of a multicellular organism.

The level represented by X is composed of
(1) four types of base subunits
(2) folded chains of glucose molecules
(3) twenty different kinds of amino acids
(4) complex, energy-rich inorganic molecules

27. A chemical known as 5-bromouracil causes a mutation that results in the mismatching of molecular bases in DNA. The offspring of organisms exposed to 5-bromouracil can have mismatched DNA if the mutation occurs in
(1) the skin cells of the mother
(2) the gametes of either parent
(3) all the body cells of both parents
(4) only the nerve cells of the father
28. Sexually produced offspring often resemble, but are not identical to, either of their parents. Explain why they resemble their parents but are not identical to either parent.

- Offspring are not identical to either parent because they receive genetic material from each parent.
- Chromosomes from each parent.
- Every genetic information from each parent.

29. If 20% of a DNA sample is made up of cytosine, C, what percentage of the sample is made up of adenine, A? __30%__

30. Arrange the following structures from largest to smallest.

- a chromosome
- a nucleus
- a gene

Largest: nucleus

Smallest: gene

31. a) Which amino acid chain would be produced by the DNA base sequence below?

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(1) Val Gly Phe Asp Thr Asp (3) Val Gly Phe Asp Asp Thr
(2) Val Pro Phe Asp Asp Thr (4) Val Gly Phe Thr Asp Asp

b) Identify one environmental factor that could cause a base sequence in DNA to be changed to a different base sequence. __UV light or radiation or x-rays or chemicals__

c) Describe how a protein would be changed if a base sequence mutates from GGA to TGA.

The amino acid sequence would be changed or the protein would contain threonine instead of proline or the shape of the protein would change or the protein produced may not function properly or function at all.
Scientists are increasingly concerned about the possible effects of damage to the ozone layer.

32. Damage to the ozone layer has resulted in mutations in skin cells that lead to cancer. Will the mutations that caused the skin cancers be passed on to offspring? Support your answer.

Answer: **NO**

Supporting statement: Any mutation to skin cells due to ozone depletion resulting in more UV exposure will not be passed on to offspring. Gametes are the only cells responsible for the passing of genetic information. The mutation would have to occur in these sex cells in order to get passed to the offspring.

33. A child is born with a genetic disorder to parents who show no symptoms of the disorder. Explain the type of information a genetic counselor might provide to these parents. In your answer, be sure to:

   a) explain why the child exhibits symptoms of the genetic disorder even though the parents do not nondisjunction / mutation / child may have inherited 2 recessive alleles

   b) identify one technique that can be used to detect a genetic disorder

      Amniocentesis / karyotyping / blood screening / electrophoresis

   c) identify one genetic disorder

      Down Syndrome / sickle-cell anemia / hemophilia

34. Scientists have successfully cloned sheep and cattle for several years. A farmer is considering the advantages and disadvantages of having a flock of sheep cloned from a single individual. Discuss the issues the farmer should take into account before making a decision. Your response should include:

   a) how a cloned flock would be different from a noncloned flock

      There would be no variation.

   b) one advantage of having a cloned flock

      All sheep would have one or more desired trait that the original individual possessed.

   c) one disadvantage of having a cloned flock

      Sheep may have a genetic flaw

   d) one reason that the farmer could not mate these cloned sheep with each other to increase the size of his flock

      They would all be the same sex, so they could not mate with each other.

   e) one reason that the offspring resulting from breeding these sheep with an unrelated sheep would not all be the same

      - Both parents contribute genes to the offspring.
      - Different gene combinations will result.
35. Use appropriate letters to write a 9-base DNA sequence that could represent a portion of a gene.

CTACGATT or AACCTGCTC or CCTACG66C

Base your answers to question 36 on the information and diagram below.

The four wells represented in the diagram were each injected with fragments that were prepared from DNA samples using identical techniques.

36. a) This laboratory procedure is known as

[Blank]

gel electrophoresis

b) The arrow represents the direction of the movement of the DNA fragments. What is responsible for the movement of the DNA in this process?

electrical current or charges on DNA or DNA has negative charge.

c) The four samples of DNA were taken from four different individuals. Explain how this is evident from the results shown in the diagram.

- Bands in different positions in each column
- Different banding patterns
- Different number of bands in columns

d) Identify the substance that was used to treat the DNA to produce the fragments that were put into the wells. Enzymes or restriction enzymes

37. Mutations are often referred to as the “raw materials” of evolution.

State one reason that mutations are often referred to as the “raw materials” of evolution.

They result in the production of a new variation

38. The segments of DNA below were extracted from two different species of plants. The segments represent the same region of DNA that codes for a particular pigment (color) in these species.

Plant Species A: ACCGCAGGGATTCCGC
Plant Species B: ACCGGAGCGATTCCGC

A restriction enzyme is used to cut the DNA from species A and B. The enzyme binds to the sequence GGGATT and cuts between G and A. State how many cuts will be made in the DNA sequences of each species when this enzyme is used.

Plant species A cuts: 0 Plant species B cuts: 0
1. Meiosis and fertilization are important processes because they may most immediately result in
   (1) many body cells
   (2) immune responses
   (3) genetic variation
   (4) natural selection

2. In the diagram below, strands I and II represent portions of a DNA molecule.

   Strand I: [Diagram]
   Strand II: [Diagram]

   Strand II would normally include
   (1) AGC   (3) TAC
   (2) TCG   (4) GAT

3. The letters in the diagram represent genes on a particular chromosome. Gene B contains the code for an enzyme that cannot be synthesized unless gene A is also active. Which statement best explains why this can occur?
   (1) A hereditary trait can be determined by more than one gene.
   (2) Genes are made up of double-stranded segments of DNA.
   (3) All the genes on a chromosome act to produce a single trait.
   (4) The first gene on each chromosome controls all the other genes on the chromosome.

4. In Siamese cats, the fur on the ears, paws, tail, and face is usually black or brown, while the rest of the body fur is almost white. If a Siamese cat is kept indoors where it is warm, it may grow fur that is almost white on the ears, paws, tail, and face, while a Siamese cat that stays outside where it is cold, will grow fur that is quite dark on these areas. The best explanation for these changes in fur color is that
   (1) the gene for fur color is modified by interactions with the environment
   (2) the location of pigment-producing cells determines the DNA code of the genes
   (3) skin cells that produce pigments have a higher mutation rate than other cells
   (4) an environmental factor influences the expression of this inherited trait

5. Which statement best describes a chromosome?
   (1) It is a gene that has thousands of different forms.
   (2) It has genetic information contained in DNA.
   (3) It is a reproductive cell that influences more than one trait.
   (4) It contains hundreds of genetically identical DNA molecules

6. Which statement is true of both mitosis and meiosis?
   (1) Both are involved in asexual reproduction.
   (2) Both occur only in reproductive cells.
   (3) The number of chromosomes is reduced by half.
   (4) DNA replication occurs before the division of the nucleus
7. What determines the kind of genes an organism possesses?
   (1) type of amino acids in the cells of the organism
   (2) sequence of the subunits \( A, T, C, \) and \( G \) in the DNA of the organism
   (3) size of simple sugar molecules in the organs of the organism
   (4) shape of the protein molecules in the organelles of the organism

8. If a set of instructions that determines all of the characteristics of an organism is compared to a book, and a chromosome is compared to a chapter in the book, then what might be compared to a paragraph in the book?
   (1) a starch molecule
   (2) an egg
   (3) an amino acid
   (4) a DNA molecule

9. People with cystic fibrosis inherit defective genetic information and cannot produce normal CFTR proteins. Scientists have used gene therapy to insert normal DNA segments that code for the missing CFTR protein into the lung cells of people with cystic fibrosis. Which statement does not describe a result of this therapy?
   (1) Altered lung cells can produce the normal CFTR protein.
   (2) Altered lung cells can divide to produce other lung cells with the normal CFTR gene.
   (3) The normal CFTR gene may be expressed in altered lung cells.
   (4) Offspring of someone with altered lung cells will inherit the normal CFTR gene.

10. The diagrams below represent some steps in a procedure used in biotechnology.

   \[
   \text{Bacterial DNA} \xrightarrow{X} \text{Foreign DNA} \xrightarrow{Y} \text{Foreign DNA}
   \]

   Letters \( X \) and \( Y \) represent
   (1) hormones that stimulate the replication of bacterial DNA
   (2) biochemical catalysts involved in the insertion of genes into other organisms
   (3) hormones that trigger rapid mutation of genetic information
   (4) gases needed to produce the energy required for gene manipulation

11. Plants in species \( A \) cannot fight most fungal infections. Plants in species \( B \) make a protein that kills many fungi. One possible way for humans to produce species \( A \) plants with the ability to synthesize this protein would be to
   (1) mutate fungal DNA and introduce the mutated DNA into species \( B \) using a virus
   (2) add DNA from species \( B \) into the soil around species \( A \)
   (3) insert the gene for the protein from species \( B \) into a chromosome in species \( A \)
   (4) cross species \( A \) and a fungus to stimulate the synthesis of this protein

12. A small amount of DNA was taken from a fossil of a mammoth found frozen in glacial ice. Genetic technology can be used to produce a large quantity of identical DNA from this mammoth's DNA. In this technology, the original DNA sample is used to
   (1) stimulate differentiation in other mammoth cells
   (2) provide fragments to replace certain human body chemicals
   (3) act as a template for repeated replication
   (4) trigger mitosis to obtain new base sequences
13. Compared to human cells resulting from mitotic cell division, human cells resulting from meiotic cell division would have
(1) twice as many chromosomes
(2) the same number of chromosomes
(3) one-half the number of chromosomes
(4) one-quarter as many chromosomes

14. The diagram represents a process that occurs during human reproduction. The process represented by the arrow will ensure that the
(1) zygote contains a complete set of genetic information
(2) gametes contain a complete set of genetic information
(3) zygote contains half of the genetic information
(4) gametes contain half of the genetic information

15. The diagrams below represent portions of the genes that code for wing structure in two organisms of the same species. Gene 1 was taken from the cells of a female with normal wings, and gene 2 was taken from the cells of a female with abnormal wings.

<table>
<thead>
<tr>
<th>Gene 1</th>
<th>Gene 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>A</td>
<td>T</td>
</tr>
<tr>
<td>A</td>
<td>T</td>
</tr>
<tr>
<td>T</td>
<td>A</td>
</tr>
<tr>
<td>T</td>
<td>C</td>
</tr>
</tbody>
</table>

The abnormal wing structure was most likely due to
(1) an insertion
(2) a substitution
(3) a deletion
(4) normal replication

16. Which situation would most directly affect future generations naturally produced by a maple tree?
(1) Ultraviolet radiation changes the DNA sequence within some leaves of the tree.
(2) Ultraviolet radiation changes the DNA sequence within the gametes of some flowers of the tree.
(3) An increase in temperature reduces the number of cell divisions in the roots.
(4) Rapidly growing cells just under the bark are exposed to radiation, causing changes in genetic material.

17. Some steps involved in DNA replication and protein synthesis are summarized in the table below.

<table>
<thead>
<tr>
<th>Step A</th>
<th>DNA is copied and each new cell gets a full copy.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step B</td>
<td>Information copied from DNA moves to the cytoplasm.</td>
</tr>
<tr>
<td>Step C</td>
<td>Proteins are assembled at the ribosomes.</td>
</tr>
<tr>
<td>Step D</td>
<td>Proteins fold and begin functioning.</td>
</tr>
</tbody>
</table>

In which step would a mutation lead directly to the formation of an altered gene?
(1) A
(2) B
(3) C
(4) D

18. During meiosis, crossing-over (gene exchange between chromosomes) may occur. Crossing-over usually results in
(1) the production of an extra amino acid
(2) the formation of an extra chromosome
(3) the formation of identical twins
(4) new combination of inheritable traits
19. Which phrases best identify characteristics of asexual reproduction?

1) one parent, union of gametes, offspring similar to but not genetically identical to the parent
2) one parent, no union of gametes, offspring genetically identical to parents
3) two parents, union of gametes, offspring similar to but not genetically identical to parents
4) two parents, no union of gametes, offspring genetically identical to parents

20. To determine the identity of their biological parents, adopted children sometimes request DNA tests. These tests involve comparing DNA samples from the child to DNA samples taken from the likely parents. Possible relationships may be determined from these tests because the

1) base sequence of the father determines the base sequence of the offspring
2) DNA of parents and their offspring is more similar than the DNA of nonfamily members
3) position of the genes on each chromosome is unique to each family
4) mutation rate is the same in closely related individuals

21. One way to produce large numbers of genetically identical offspring is by

1) cloning
2) fertilization
3) changing genes by agents such as radiation or chemicals
4) inserting a DNA segment into a different DNA molecule

22. The diagram below shows a process that affects chromosomes during meiosis.

This process can be used to explain

1) why some offspring are genetically identical to their parents
2) the process of differentiation in offspring
3) why some offspring physically resemble their parents
4) the origin of new combinations of traits in offspring

23. Throughout the history of life on Earth, many processes have resulted in new traits in organisms. Which list shows some of these processes in order from the oldest to the most recently used?

1) gene manipulation, natural selection, selective breeding
2) natural selection, selective breeding, gene manipulation
3) natural selection, gene manipulation, selective breeding
4) selective breeding, gene manipulation, natural selection

24. The diagram can be used to illustrate cellular changes.

Which row of terms in the chart below best completes the diagram?

<table>
<thead>
<tr>
<th>Row</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>atmospheric oxygen</td>
<td>mutations</td>
<td>increased mitochondria</td>
</tr>
<tr>
<td>(2)</td>
<td>radiation</td>
<td>cancer</td>
<td>mutations</td>
</tr>
<tr>
<td>(3)</td>
<td>salt water</td>
<td>more cytoplasm</td>
<td>two nuclei</td>
</tr>
<tr>
<td>(4)</td>
<td>less sunlight</td>
<td>extra genes</td>
<td>decreased mutations</td>
</tr>
</tbody>
</table>
25. Mustard gas removes guanine (G) from DNA. For developing embryos, exposure to mustard gas can cause serious deformities because guanine
(1) stores the building blocks of proteins
(2) supports the structure of ribosomes
(3) produces energy for genetic transfer
(4) is part of the genetic code

26. Three structures are represented in the diagram below.

![Diagram with structures]

What is the relationship between these three structures?
(1) DNA is made up of proteins that are synthesized in the cell.
(2) Protein is composed of DNA that is stored in the cell.
(3) DNA controls the production of protein in the cell.
(4) The cell is composed only of DNA and protein.

27. The human liver contains many specialized cells that secrete bile. Only these cells produce bile because
(1) different cells use different parts of the genetic information they contain
(2) cells can eliminate the genetic codes that they do not need
(3) all other cells in the body lack the genes needed for the production of bile
(4) these cells mutated during embryonic development

28. The Y-chromosome carries the SRY gene that codes for the production of testosterone in humans. Occasionally a mutation occurs resulting in the SRY gene being lost from the Y-chromosome and added to the X-chromosome, as shown in the diagram below.

Based on the diagram, which statement is correct?
(1) The production of testosterone influences the development of male characteristics.
(2) Reproductive technology has had an important influence on human development.
(3) Normal female characteristics develop from a single X-chromosome.
(4) Male characteristics only develop in the absence of X-chromosomes.

29. The sequence of subunits in a protein is most directly dependent on the
(1) region in the cell where enzymes are produced
(2) DNA in the chromosomes in a cell
(3) type of cell in which starch is found
(4) kinds of materials in the cell membrane

30. If 15% of a DNA sample is made up of thymine, T, what percentage of the sample is made up of cytosine, C?
(1) 15%  (3) 70%
(2) 35%  (4) 85%
31. Which sequence best represents the relationship between DNA and the traits of an organism?

32. Which row in the chart best describes what happens when some DNA bases are deleted from a gene?

33. The diagram represents stages in the development of an embryo. The process of mitosis is involved in all shown steps.

If cell A has 46 chromosomes, how many chromosomes will most likely be found in each cell of stage G?

34. Four different segments of a DNA molecule are represented.

There is an error in the DNA molecule in

(1) segment 1, only
(2) segment 3, only
(3) segments 2 and 3
(4) segments 2 and 4
35. Give an appropriate title for the accompanying diagram.

**genetic engineering**

36. Place the correct phase number inside the appropriate box of the flowchart below.

Phase 1 – Increased chance of cancer
Phase 2 – Exposure of cells to radiation
Phase 3 – Increase rate of mutation

Base your answers to question 37 on the statement below.

Selective breeding has been used to improve the racing ability of horses.

37. a) Define selective breeding and state how it would be used to improve the racing ability of horses.

Selective breeding: choose parents with the desired trait to breed

Improvement: fast male bred to a fast female & offspring may inherit the fast-running traits of both parents.

b) State one disadvantage of selective breeding.

decreased variation

38. Compare asexual reproduction to sexual reproduction. In your comparison, be sure to include:

a) Which type of reproduction results in offspring that are usually genetically identical to the previous generation and explain why this occurs.

Type of reproduction: asexual

Explanation: offspring receive all genetic info from one parent

b) Give one other way these methods of reproduction differ.

sexual reproduction involves a sperm & egg
39. The diagram illustrates some of the changes that occur during gamete formation. Give a statement on the amount of DNA in stage 1 cell compared to the amount of DNA in stage 4 cell.

There is \( \frac{1}{2} \) the amount in stage 4 compared to stage 1.

Base your answers to question 40 on the diagram below, which illustrates some steps in genetic engineering.

40. a) What is the result of step 3? DNA from different organisms is joined together

b) State one way that enzymes are used in step 2. Enzymes used to cut DNA

Base your answers to question 41 on the information below.

To demonstrate techniques used in DNA analysis, a student was given two paper strip samples of DNA. The two DNA samples are shown below.

Sample 1: ATTCGGTAATCCGTAATGCGGATAATACCTCCTGTAATATC
Sample 2: ATTCGGTAATCCGTAATGCGGATAATACCTCCTGTAATATC

The student cut between the C and G in each of the shaded CCGG sequences in sample 1 and between the As in each of the shaded TAAT sequences in sample 2. Both sets of fragments were then arranged on a paper model of a gel.

41. a) The action of what kind of molecules was being demonstrated when the DNA samples were cut? Enzymes / Proteins

b) State one way the arrangement of the two samples on the gel model would be different. Number of bands would be different
Base your answers to question 42 on the information and diagram below.

DNA samples were collected from four children. The accompanying diagram represents the results of a procedure that separated the DNA in each sample.

42. a) Identify the procedure used to obtain these results.

**electrophoresis**

b) Band X represents the:
   1) largest fragment of DNA that traveled the fastest
   2) smallest fragment of DNA that traveled the fastest
   3) largest fragment of DNA that traveled the slowest
   4) smallest fragment of DNA that traveled the slowest

   \[ \text{Band X} \]

b _______

c) The DNA is most similar in which two children? \[ \text{B and D} \]

Support your answer: most similar because they have the most bands in common.

d) State one way information obtained from this procedure can be used.

**to determine paternity/imaternity**

43. A sample of body cells and samples of sex cells received from four members of a species are screened for the presence of a specific gene mutation. The results of the gene-testing procedure conducted on the cells are shown in the table below.

<table>
<thead>
<tr>
<th>Species Member Tested</th>
<th>Type of Cells Tested and the Result (+ = mutation present, – = mutation absent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Body Cells</td>
</tr>
<tr>
<td>1</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>4</td>
<td>+</td>
</tr>
</tbody>
</table>

Which species member would be unlikely to pass the gene mutation on to its offspring? \[ 4 \]

Explain your choice: mutation is present in body cells

44. In the past, diabetics used horse or cow insulin to control their glucose levels. Today, as a result of genetic engineering, human insulin can be synthesized by bacteria. State one advantage for a person with diabetes to receive genetically engineered insulin rather than insulin taken from a horse or cow.

**human insulin may have fewer side effects.**
45. A small village that is heavily infested with mosquitoes was sprayed with an insecticide once a week for several months. Changes in the size of the mosquito population are shown in the accompanying graph.

State one way that the population of mosquitoes present 7 months after spraying differs genetically from the population of mosquitoes present before the spraying began. 7 months later, there is a higher frequency in the population of the gene for resistance to the insecticide.

Base your answers to question 46 on the information below.

The sequences below represent the same portions of a DNA molecule from the same gene used by a student to study the relationship between two plant species. A biological catalyst that recognizes the CCGG site is used to cut the DNA molecules into pieces. The catalyst cuts the DNA between the C and G of the site.

46. a) Draw lines in the sequences below for species 1 and species 2 to show where the catalyst would cut the DNA.

Species 1: TACCGGATTAGTTATGGCCGGATCG
Species 2: TACGGGATGCGCGGATCGGAAATTCG

b) Complete the data table below to show the results of the action of the catalyst.

<table>
<thead>
<tr>
<th>Results of Catalyst Action</th>
<th>Number of Cuts</th>
<th>Number of Resulting Pieces of DNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Species 2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

c) Are the two species of plants closely related? **NO**

Support your answer. 15/24 bases are different.

47. An alteration of genetic information is shown below.


This type of alteration of the genetic information is an example of **deletion**.