1. Base your answer to the following question on the diagram below, which provides information related to heredity.

Which molecules are represented by box \( B \)?
1) proteins
2) amino acids
3) bases
4) simple sugars

2. A change in the base sequence of DNA is known as
1) polyploidy
2) nondisjunction
3) a gene mutation
4) a karyotype

3. DNA serves as a template for the synthesis of
1) cellulose
2) messenger RNA
3) starches
4) lipids

4. What is the complementary messenger-RNA sequence for the DNA sequence shown below?

```
C A A G G T
```
2) C-A-A-G-G-T
3) G-U-U-C-C-A
4) G-T-T-C-C-A

5. Mutations can be transmitted to the next generation only if they are present in
1) muscle cells
2) brain cells
3) body cells
4) sex cells

6. A karyotype is shown in the diagram below.

Information in this karyotype indicates that the individual is a
1) male with Tay-Sachs disease
2) female with sickle-cell anemia
3) male with phenylketonuria
4) female with Down syndrome

7. The coded information of a DNA molecule is determined by the
1) sequence of amino acids
2) sequence of the sugar-phosphate units
3) sequence of the nitrogenous bases
4) number of ribose units

8. A single gene mutation results from
1) the failure of chromosomes to separate
2) blocked nerve messages
3) a change in a base sequence in DNA
4) recombination of traits
Base your answers to questions 9 through 11 on the Universal Genetic Code Chart and on your knowledge of biology. Some DNA, RNA, and amino acid information from four similar sequences of four plant species is shown in the chart below.

Using the Universal Genetic Code Chart, fill in the missing amino acid sequence for species C in the chart below.

Using the information given, fill in the missing mRNA base sequence for species B in the chart.
Base your answers to questions 11 through 13 on the information and diagram below and on your knowledge of biology.

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

11. Identify the substance that was used to treat the DNA to produce the fragments that were put into the wells.

12. This laboratory procedure is known as
   1) cloning
   2) gel electrophoresis
   3) chromatography
   4) use of a dichotomous key

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

14. Three structures are represented in the diagram below.

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

Many people are allergic to substances in the environment. Of the many foods that contain allergens (allergy-inducing substances), peanuts cause some of the most severe reactions. Mildly allergic people may only get hives. Highly allergic people can go into a form of shock. Some people die each year from reactions to peanuts.

A group of scientists is attempting to produce peanuts that lack the allergy-inducing proteins by using traditional selective breeding methods. They are searching for varieties of peanuts that are free of the allergens. By crossing those varieties with popular commercial types, they hope to produce peanuts that will be less likely to cause allergic reactions and still taste good. So far, they have found one variety that has 80 percent less of one of three complex proteins linked to allergic reactions. Removing all three of these allergens may be impossible, but even removing one could help.

Other researchers are attempting to alter the genes that code for the three major allergens in peanuts. All of this research is seen as a possible long-term solution to peanut allergies.

How does altering the DNA of a peanut affect the proteins in peanuts that cause allergic reactions?
1) The altered DNA is used to synthesize changed forms of these proteins.
2) The altered DNA leaves the nucleus and becomes part of the allergy-producing protein.
3) The altered DNA is the code for the antibodies against the allergens.
4) The altered DNA is used as an enzyme to break down the allergens in peanuts.

Explain how selective breeding is being used to try to produce commercial peanuts that will not cause allergic reactions in people.

17. In a particular variety of corn, the kernels turn red when exposed to sunlight. In the absence of sunlight, the kernels remain yellow. Based on this information, it can be concluded that the color of these corn kernels is due to
1) a different type of DNA that is produced when sunlight is present
2) the effect of sunlight on the number of chromosomes inherited
3) the effect of environment on gene expression
4) a different species of corn that is produced in sunlight

18. DNA is a polymer consisting of repeating units known as
1) dipeptides
2) amino acids
3) organic salts
4) nucleotides

19. Which base is normally used in the synthesis of RNA but not in the synthesis of DNA?
1) cytosine
2) adenine
3) guanine
4) uracil

20. A certain species of plant produces blue flowers when the soil pH is above 7.0. However, when the soil pH is below 7.0, the flowers are pink. Which statement best explains this color change?
1) The environment influences gene action.
2) Polyploidy produces 2n gametes.
3) Mutagenic agents can alter genotypes.
4) Chromosomal mutations produce color effects.

21. The building blocks of molecule 3 are known as
1) DNA molecules
2) fatty acids
3) RNA molecules
4) amino acids

22. In plant cells, molecule 1 is found in the
1) cell wall
2) centriole
3) nucleus
4) lysosome
23. Which laboratory procedure has made possible the development of bacteria that can synthesize human insulin?
1) screening of body fluids
2) amniocentesis
3) genetic engineering
4) karyotyping

24. A product of genetic engineering technology is represented below.

Which substance was needed to join the insulin gene to the bacterial DNA as shown?
1) hormones
2) antibodies
3) a specific enzyme
4) a specific carbohydrate

25. The diagram below represents a portion of an organic molecule.

This molecule controls cellular activity by directing the synthesis of
1) minerals
2) carbohydrates
3) proteins
4) fats

26. A sequence of three nitrogenous bases in a messenger-RNA molecule is known as a
1) nucleotide
2) polypeptide
3) gene
4) codon

27. The ozone layer of Earth’s atmosphere helps to filter ultraviolet radiation. As the ozone layer is depleted, more ultraviolet radiation reaches Earth’s surface. This increase in ultraviolet radiation may be harmful because it can directly cause
1) sterility in most species of mammals and birds
2) photosynthesis to stop in all marine organisms
3) abnormal migration patterns in waterfowl
4) mutations in the DNA of organisms

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

29. Which statement best explains the fact that some identical twins appear different from one another?
1) Their DNA is very different and the environment plays a significant role in the expression of their genes.
2) Their DNA is essentially the same and the environment plays a significant role in the expression of their genes.
3) Their DNA is essentially the same and the environment plays little or no role in the expression of their genes.
4) Their DNA is very different and the environment plays little or no role in the expression of their genes.
The Human Genome Project

For a number of years, scientists at Cold Spring Harbor Laboratory have been attempting to map every known human gene. By mapping, scientists mean that they are trying to find out on which of the 46 chromosomes each gene is located and exactly where on the chromosome the gene is located. By locating the exact positions of defective genes, scientists hope to cure diseases by replacing defective genes with normal ones, a technique known as gene therapy. Scientists can use specific enzymes to cut out the defective genes and insert the normal genes. They must be careful to use the enzyme that will splice out only the target gene, since different enzymes will cut DNA at different locations.

While the human genome project should eventually improve the health of humans, many people are skeptical and apprehensive, believing that gene therapy would be working against nature and would have religious, moral, legal, and ethical implications.

Using one specific example, explain why the human genome project is considered important.

The chart below shows information about the relationship between the age of the mother and the occurrence of Down syndrome in the child.

<table>
<thead>
<tr>
<th>Age of Mother</th>
<th>Occurrence of Down Syndrome per 1000 Births</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.8</td>
</tr>
<tr>
<td>30</td>
<td>1.0</td>
</tr>
<tr>
<td>35</td>
<td>3.0</td>
</tr>
<tr>
<td>40</td>
<td>10.0</td>
</tr>
<tr>
<td>45</td>
<td>30.0</td>
</tr>
<tr>
<td>50</td>
<td>80.0</td>
</tr>
</tbody>
</table>

State one conclusion that can be drawn from the chart concerning the relationship between the age of the mother and the chance of her having a child with Down syndrome.

Animal cells utilize many different proteins. Discuss the synthesis of proteins in an animal cell. Your answer must include at least:

- the identity of the building blocks required to synthesize these proteins
- the identity of the sites in the cell where the proteins are assembled
- an explanation of the role of DNA in the process of making proteins in the cell
Scientists found members of a plant species they did not recognize. They wanted to determine if the unknown species was related to one or more of four known species, A, B, C, and D.

The relationship between species can be determined most accurately by comparing the results of gel electrophoresis of the DNA from different species.

The chart below represents the results of gel electrophoresis of the DNA from the unknown plant species and the four known species.

The unknown species is most closely related to which of the four known species? Support your answer.
1. 1
2. 3
3. 2
4. 3
5. 4
6. 4
7. 3
8. 3
9. GLY THR TYR VAL GLN
10. ACG ACG UAU GUC CAU
11. enzymes or restriction enzymes or enzymes that cut DNA.
12. 2
13. Responses include, but are not limited to: The bands are in different positions in each column; Different banding patterns; Different number of bands
14. 3
15. 1
16. Responses include, but are not limited to: Varieties of peanuts that are low in the allergens will be crossed with commercial types; Varieties of peanuts that are free of the allergens will be crossed with commercial types; A variety of peanut that has 80% less of one of the allergens will be crossed with commercial types.
17. 3
18. 4
19. 4
20. 1
21. 4
22. 3
23. 3
24. 3
25. 3
26. 4
27. 4
28. 4
29. 2
30. Examples: — Scientists hope to cure (diagnose) diseases. — Scientists can replace defective genes with normal ones (gene therapy). — it should eventually improve the health of humans.
31. Example: – The older the mother, the greater the chance of her having a child with Down syndrome.
32. Examples: – DNA codes for the amino acid sequence. – DNA provides instructions for making proteins. The building blocks are amino acids. The proteins are assembled in the cytoplasm of the cell, at the site of the ribosomes.
33. It is most closely related to species C. The bands from the DNA of species C are the closest match to those of the unknown species.
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____