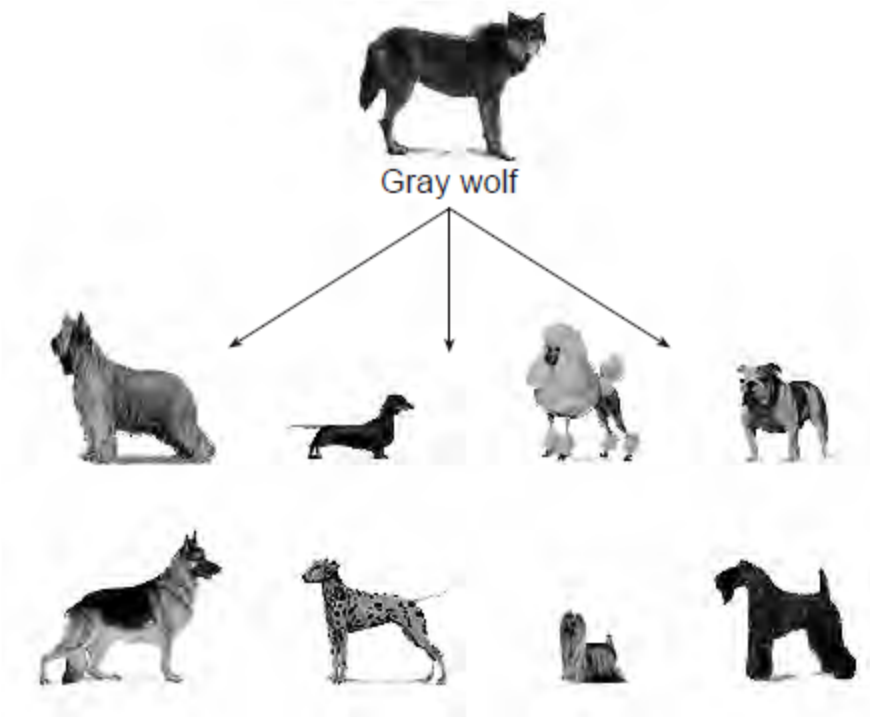

1. Which activity enables humans to produce new genetic combinations in other organisms?

- A) **selecting and breeding the organisms for specific traits**
- B) increasing the number of enzymes available to the organisms
- C) growing organisms that reproduce asexually
- D) decreasing the amount of DNA in the diet of the organisms

2. Modern dogs are direct descendants of the gray wolf. They first appeared about 130,000 years ago. Today, there are about 150 different breeds of domestic dog, a few of which are shown below.



adapted from: www.pbs.org

The great variety of modern dogs can best be explained by

- A) **selective breeding of dogs over many years**
 - B) the cloning of domestic dogs
 - C) genetic alterations in gray wolves alive today
 - D) natural selection favoring wolves over dogs
-

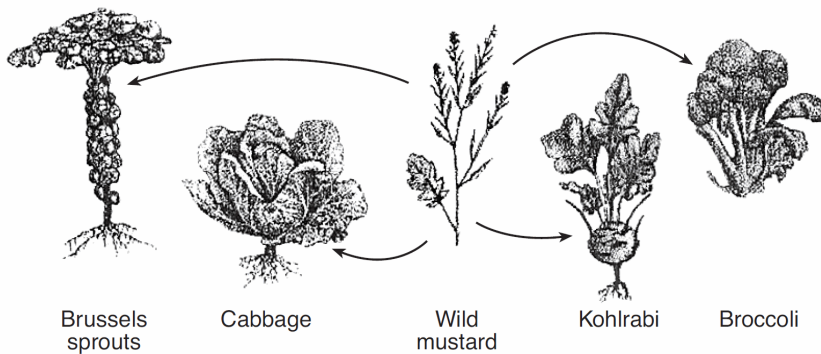
3. For those individuals who have an allergic reaction to cats, a company in Los Angeles promises relief. They offer a new line of cats genetically modified to eliminate or reduce their allergy-causing properties. The development of this new line of cats most likely involved

- A) using natural selection to produce a new variety of cat
- B) altering the reproductive rate of cats
- C) changing the behavior of cats
- D) manipulating the DNA of cats**

4. Selective breeding is a technique that is used to

- A) give all organisms a chance to reproduce
- B) produce organisms from extinct species
- C) produce offspring with certain desirable traits**
- D) keep farm crops free of all mutations

5. The arrows in the diagram below indicate the development of four different varieties of vegetable plants from wild mustard.



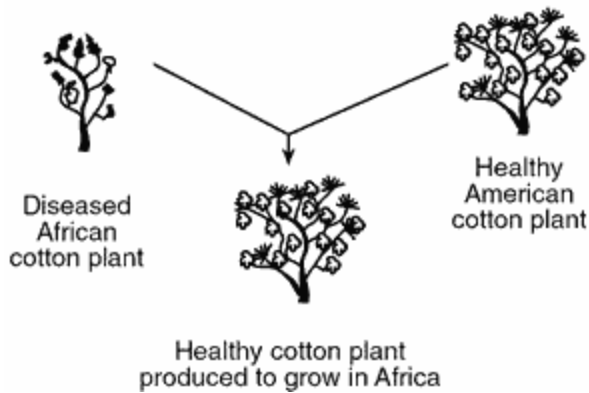
Each of these varieties was most likely produced as a result of

- A) asexual reproduction in the wild for many years
- B) changes in light availability
- C) competition between plants
- D) selective breeding over many generations**

6. Some farmers currently grow genetically engineered crops. What would be an argument *against* the use of this technology?

- A) it increases crop production
- B) it produces insect-resistant plants
- C) its long-term effects on humans are still being investigated**
- D) it always results in crops that do not taste good

7. Which statement provides accurate information about the technique illustrated below?



- A) This technique results in offspring that are genetically identical to the parents.
- B) New varieties of organisms can be developed by this technique known as selective breeding.**
- C) This technique is used by farmers to eliminate mutations in future members of the species.
- D) Since the development of cloning, this technique is no longer used in agriculture.
8. When humans first domesticated dogs, there was relatively little diversity in the species. Today, there are many variations such as the German shepherd and the dalmatian. This increase in diversity is most closely associated with
- A) cloning of selected body cells
- B) selective breeding**
- C) mitotic cell division
- D) environmental influences on inherited traits
9. A cattle breeder wished to develop a strain of cattle that would produce large quantities of meat per animal. He chose a bull and a cow that most nearly met his goals for breed size. From their calves, he again chose the male and female offspring that most nearly met his goals. After several generations of this style of breeding, the breeder developed a herd of high-yield cattle. In order to maintain this herd of high-yield cattle, which technique should the cattle breeder use?
- A) vegetative propagation
- B) hybridization
- C) genetic recombination
- D) inbreeding**

10. Artificial selection is illustrated by

- A) random mating taking place in a population
- B) the appearance of a new species on an isolated island
- C) a gardener producing a new hybrid by cross-pollinating plants**
- D) wind assisting the pollination of grass in a field
11. A common practice used by breeders to maintain a desired trait in dogs is
- A) artificial selection**
- B) regeneration
- C) vegetative propagation
- D) sporulation
12. Recently, researchers from Stanford University have changed mouse skin cells into mouse nerve cells. This was accomplished by inserting genes that control the synthesis of certain proteins into the skin cells. This type of research is often successful in advancing knowledge regarding the functioning of human cells because
- A) cells present in humans often function in similar ways to cells present in other organisms**
- B) cells from different types of organisms function differently when transplanted into humans
- C) the cells in all complex organisms contain the same genes and function in similar ways
- D) cellular research using mice can always be applied to human cells since all complex organisms produce the same proteins

13. Three human actions that have been made possible in recent times are:

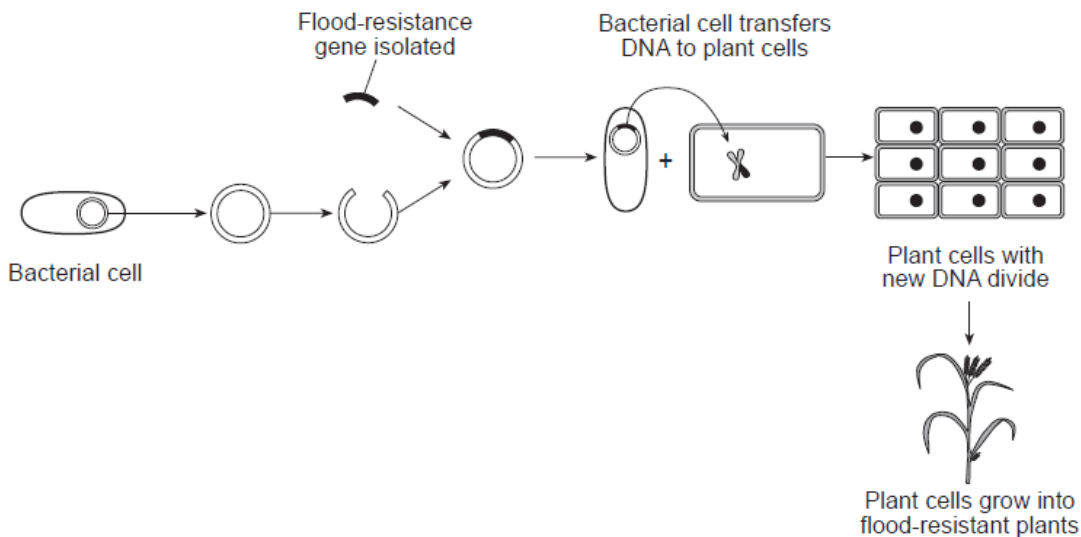
- Doctors are able to diagnose and treat some fetal problems prior to the birth of a child.
- Cloning can produce large numbers of plants that are resistant to drought.
- Male insects can be sterilized with radiation to prevent them from mating successfully.

Which statement summarizes these three actions?

- A) **Reproductive technology has medical, agricultural, and ecological applications.**
- B) Development is a highly regulated process involving mitosis and differentiation.
- C) Reproduction and development are subject to environmental effects.
- D) Human development, birth, and aging should be viewed as a predictable pattern of events.

Base your answers to questions 14 and 15 on the information below and on your knowledge of biology

Researchers have produced rice plants that can withstand being completely submerged for up to two weeks. This is good news for farmers in the flood regions of Southeast Asia. The farmers in this region rely heavily on this crop. The diagram below illustrates the process used to genetically modify plants, such as rice.



14. The best explanation for these modified rice plants being flood resistant is that

- A) **the gene for flood resistance was inserted into plant cells, which grew into plants whose cells are expressing this gene**
- B) they were produced by fertilization, using gametes from two flood-resistant bacterial cells
- C) there was a mutation in the bacterial DNA after it was inserted into the plant that caused it to be flood resistant
- D) the researchers used selective breeding for the flood-resistance trait

15. The molecules used to cut, copy, and connect the DNA segments used in this process are

- A) sugars
- B) **enzymes**
- C) indicators
- D) antigens

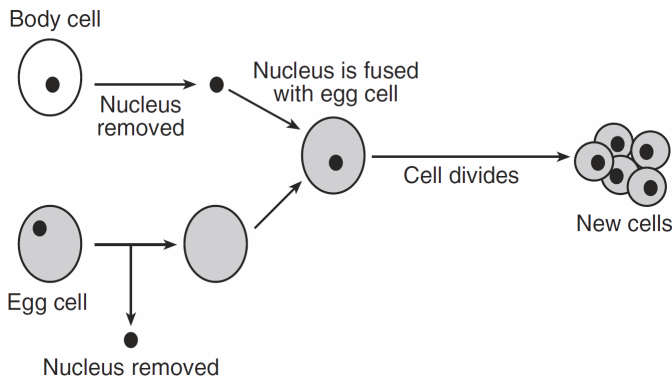
16. Farmers in India have increased the harvest yield of food crops like eggplant by growing them from seeds that have been modified to produce a bacterial toxin that is harmful to pest insects. This is an example of

- A) selective breeding of the insects
- B) spraying an insecticide on plants
- C) selective breeding of the eggplant
- D) an application of biotechnology**

17. Genetic engineering has the potential to correct human genetic disorders. In gene therapy, a defective gene is replaced by using a virus to insert a normal gene into the cells of an individual. This treatment will be most successful if the virus is inserted into cells that

- A) lack a nucleus
- B) are recycled after death, rather than removed from the body
- C) carry out one specific function, rather than multiple functions
- D) continue to divide during the life of the patient**

18. A technique used to alter cells is represented in the diagram below.



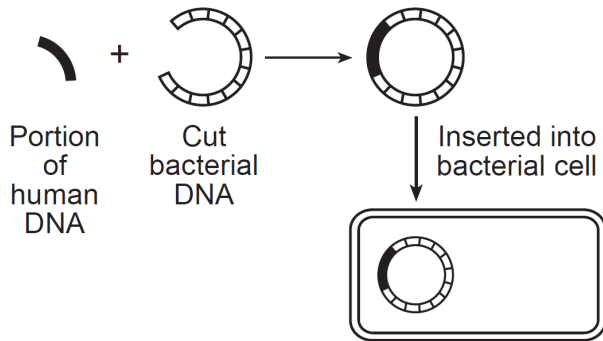
The genetic material contained in the nucleus of each of the new cells is most likely

- A) identical to that in the original body cell**
- B) identical to that in the original egg cell
- C) 50% the same as the original egg cell and 50% the same as the original body cell
- D) 25% the same as the original egg cell and 75% the same as the original body cell

19. Information in segments of human DNA can be expressed by a bacterial cell as a result of

- A) sexual reproduction
- B) random mutation
- C) genetic variability
- D) genetic engineering**

20. The diagram below represents a technique used in some molecular biology laboratories.



Which phrase best describes a possible result of this process?

- A) the production of gametes having both human and bacterial DNA
- B) the production of a human hormone by the bacterial cell**
- C) the introduction of a pathogen into a human cell
- D) the separation of DNA fingerprints in the bacterial cell

Base your answers to questions **21** and **22** on the information below and on your knowledge of biology.

Female mosquitoes spread diseases when they bite humans to obtain blood. It is only the females that do the biting. Research is being conducted to alter the DNA of male mosquitoes. These altered males could then mate with normal female mosquitoes. All of the resulting female offspring would have wing defects that prevent them from flying

21. The method used to alter the male mosquitoes is an example of an application of

- A) a feedback mechanism
- B) selective breeding
- C) biotechnology**
- D) physiology

22. One assumption from this research is that the

- A) altered males would begin to bite humans and spread the diseases
 - B) female offspring would be unable to bite humans, since they cannot fly**
 - C) altered males would not be able to reproduce
 - D) female offspring would become larger in size
-

23. Goats have been genetically modified to produce an anticlotting protein in their milk. The protein is extracted from the milk and given to people who have inherited a disorder that causes their bodies to produce blood clots, which can be fatal. A benefit of the technology used to produce this protein is that it

A) can be used to overcome the effects of a harmful mutation

B) can provide people with a new kind of nutrient-rich milk

C) will result in healthier goats with more nutritious milk for their offspring

D) will reduce blood clots in other farm animals that are modified in this way

24. Base your answer to the following question on the statement below and on your knowledge of biology.

Scientists have found a gene in the DNA of a certain plant that could be the key to increasing the amount of lycopene, a cancer-fighting substance, in tomatoes.

The ability to produce increased amounts of lycopene will be passed on to new tomato cells as a direct result of

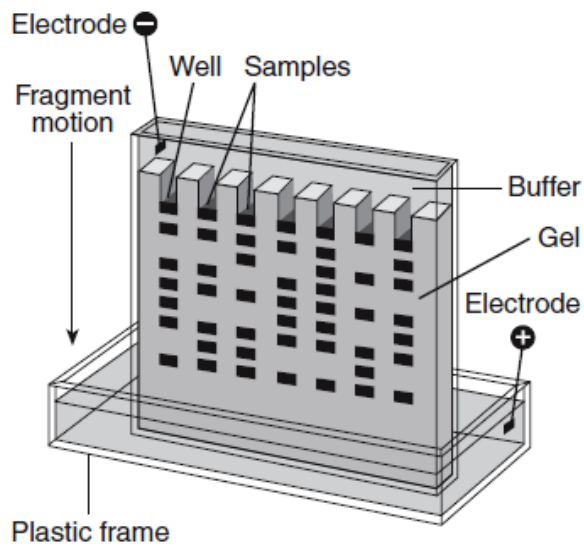
A) recycling

B) mitosis

C) enzyme action

D) gene expression

25. A student performed a gel electrophoresis experiment. The results are represented in the diagram below.



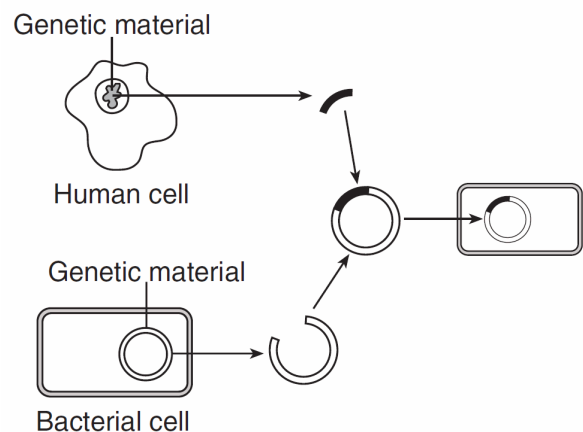
Compared to the fragments at the top of the gel, the fragments at the lower end are

- A) larger, and move slower
- B) larger, and move faster
- C) **smaller, and move faster**
- D) smaller, and move slower

26. Some goats have been genetically modified with a human gene that codes for a blood anti-clotting factor. The anti-clotting factor can then be extracted from the goat milk and used during surgery. To produce these genetically modified goats, scientists most likely

- A) injected the anticlotting factor into the milk-producing glands of the animals
- B) added modified DNA into the milk of the animals
- C) **inserted the human gene into the egg cells of the goats**
- D) altered the nutritional requirements of newborn goats

27. A laboratory technique is represented in the diagram below.



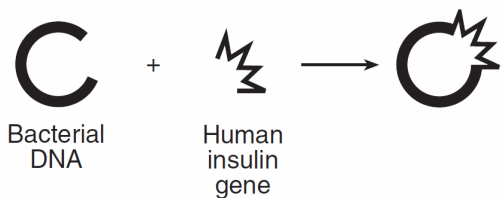
Which knowledge was needed to develop this technique?

- A) knowledge of sexual reproduction in plants
- B) knowledge of the structure of starch molecules
- C) knowledge of the development of embryos
- D) **knowledge of the structure of a DNA molecule**

28. Cotton plants produce seeds that contain high-quality protein. This protein could be used as a food source except that the seeds are poisonous to humans. Recently, scientists have inserted a section of DNA into the cotton plants that makes the cotton seeds nonpoisonous. The technique for this procedure is known as

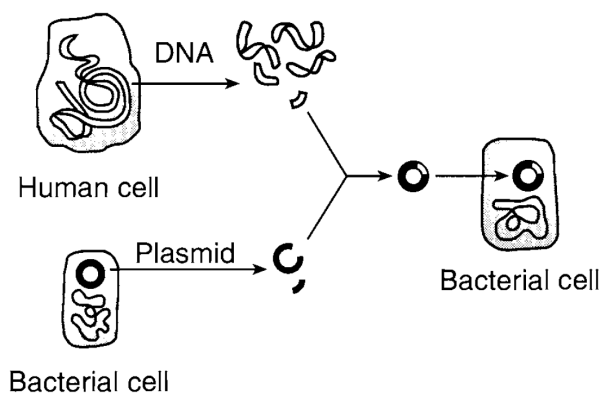
- A) **gene manipulation**
- B) cloning
- C) reproduction
- D) direct harvesting

29. Which statement would most likely be used to describe the procedure represented in the diagram below?



- A) Enzymes are used to assemble an insulin gene, which is then attached to bacterial DNA.
- B) Bacterial DNA is cut from a human DNA strand and inserted into a human cell to form an insulin gene.
- C) **The insulin gene is cut out of a human DNA strand using an enzyme and inserted into bacterial DNA, resulting in a combination of different DNA segments.**
- D) A gene is deleted from bacterial DNA to produce an insulin gene, which is then inserted into human DNA.

30. Which set of terms correctly identifies the procedure shown in the diagram below and a substance produced by this procedure?

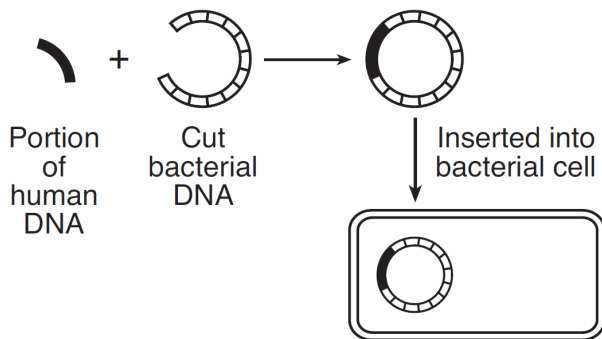


- A) selective breeding-growth hormone
- B) cloning-antibiotics
- C) **genetic engineering-insulin**
- D) replicating-glucose

31. 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

- A) mutate fungal DNA and introduce the mutated DNA into species *B* using a virus
 - B) add DNA from species *B* into the soil around species *A*
 - C) insert the gene for the protein from species *B* into a chromosome in species *A***
 - D) cross species *A* and a fungus to stimulate the synthesis of this protein
-

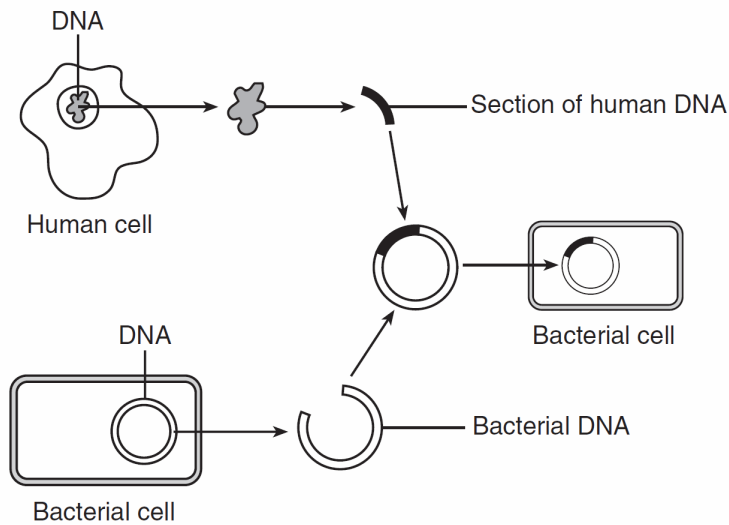
32. The diagram below represents a technique used in some molecular biology laboratories.



What is this technique an example of?

- A) chromatography
 - B) gel electrophoresis
 - C) direct harvesting
 - D) genetic engineering**
-

33. The diagram below represents one technique used in biotechnology.



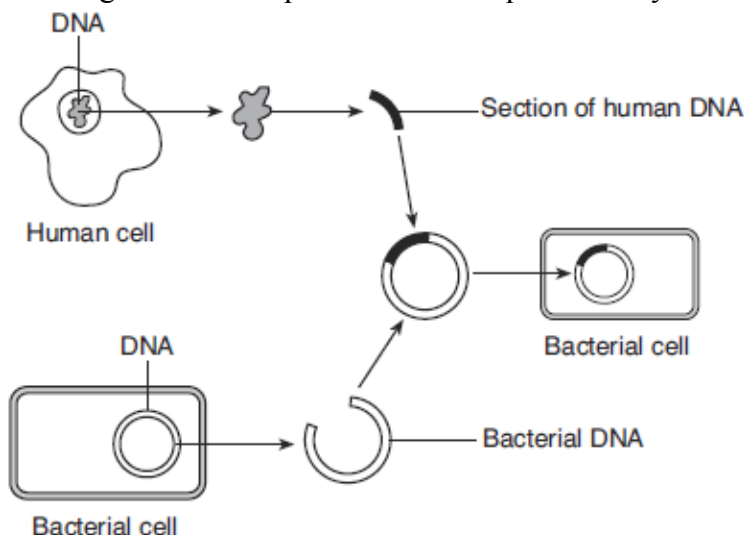
The organic compound used to cut the bacterial DNA so that the human DNA could be inserted is a

- A) molecular base
- B) carbohydrate
- C) **specific enzyme**
- D) hormone

34. If a gene is inserted into the DNA of a bacterial cell, every cell produced by that cell will have

- A) DNA that is different from that of the other cells produced
 - B) a 50% chance of having a copy of the inserted gene
 - C) **a copy of the inserted gene**
 - D) a new type of DNA base
-

35. The diagram below represents a technique currently used by scientists in the field of biotechnology.



Which statement describes a possible outcome of this technique?

- A) **The bacterium is able to produce a human hormone.**
 - B) It allows the bacterium to grow in humans, since it contains a human gene.
 - C) It allows humans to become immune to an infection from this type of bacteria.
 - D) The bacterium can now produce human cells identical to cells of the DNA donor.
36. In some people, the lack of a particular enzyme causes a disease. Scientists are attempting to use bacteria to produce this enzyme for the treatment of people with the disease. Which row in the chart below best describes the sequence of steps the scientist would most likely follow?

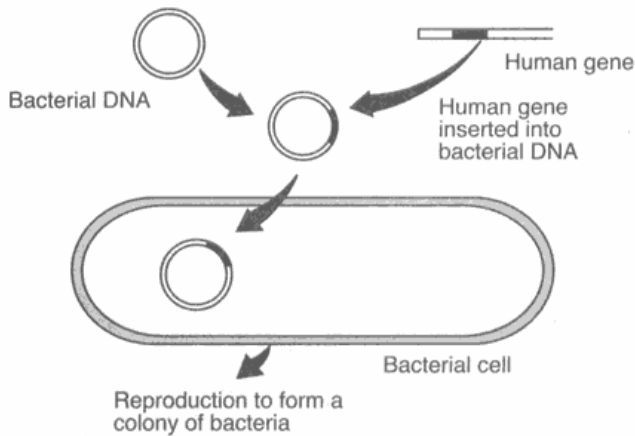
Row	Step A	Step B	Step C	Step D
(1)	identify the gene	insert the gene into a bacterium	remove the gene	extract the enzyme
(2)	insert the gene into a bacterium	identify the gene	remove the gene	extract the enzyme
(3)	identify the gene	remove the gene	insert the gene into a bacterium	extract the enzyme
(4)	remove the gene	extract the enzyme	identify the gene	insert the gene into a bacterium

- A) 1 B) 2 C) 3 D) 4

37. The DNA of a human cell can be cut and rearranged by using

- A) a scalpel B) electrophoresis
- C) hormones D) **enzymes**

38. The diagram below represents a genetic procedure.



Which statement best describes the outcome of this procedure?

- A) Bacterial cells will destroy defective human genetic material.
- B) Bacterial cells may form a multicellular embryo.
- C) The inserted human DNA will change harmful bacteria to harmless ones.
- D) The inserted human DNA may direct the synthesis of human proteins.**

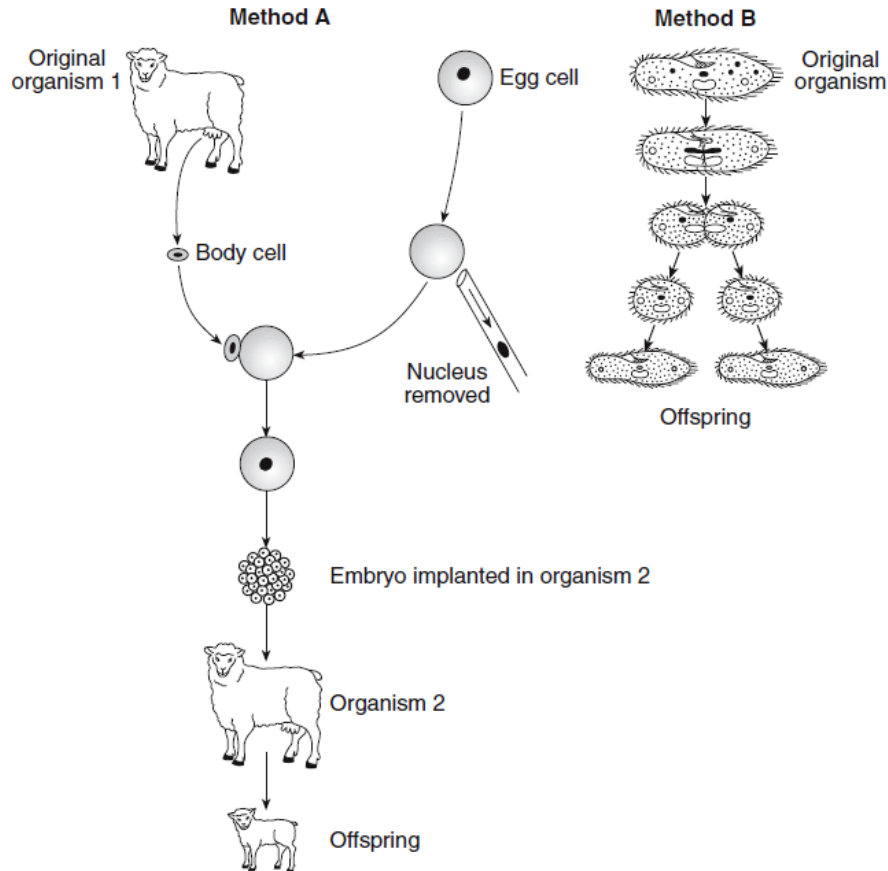
39. Which process produces only identical offspring?

- A) meiotic cell division
- B) selective breeding
- C) cloning**
- D) fertilization

40. In 1996, scientists cloned the first mammal, a sheep. This technique involved the removal of the nucleus from an egg cell. The nucleus from a cell of another adult sheep was then inserted into this egg cell. Once this cell began to develop into an embryo, it was implanted into a third female sheep that later gave birth to a healthy lamb, Dolly. Which statement concerning Dolly is correct?

- A) Her offspring would be genetically identical.
- B) Dolly and her DNA donor are genetically identical.**
- C) Two different gametes were manipulated to produce Dolly.
- D) Dolly was produced by the recombination of genetic material.

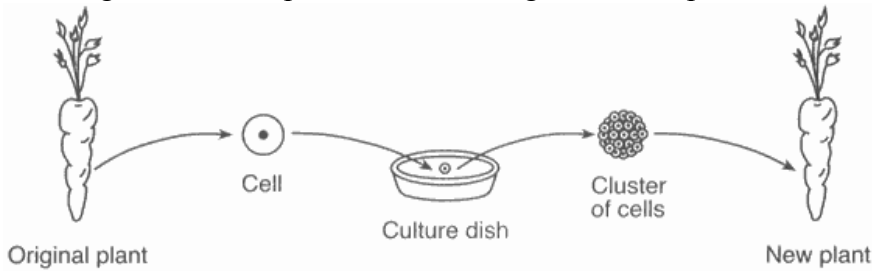
41. Two methods of reproduction are represented in the diagram below.



How does the DNA in the offspring produced by these methods compare to the DNA in the original organism?

- A) The offspring contain half the original number of chromosomes in each method.
- B) The DNA in the offspring is genetically identical to that of the original organism in both methods.**
- C) The offspring produced by method *A* contain twice the original number of genes, while those produced by method *B* contain half the original number of genes.
- D) The number of DNA bases is less than that of the original organism in method *A*, but more than the original number in method *B*.

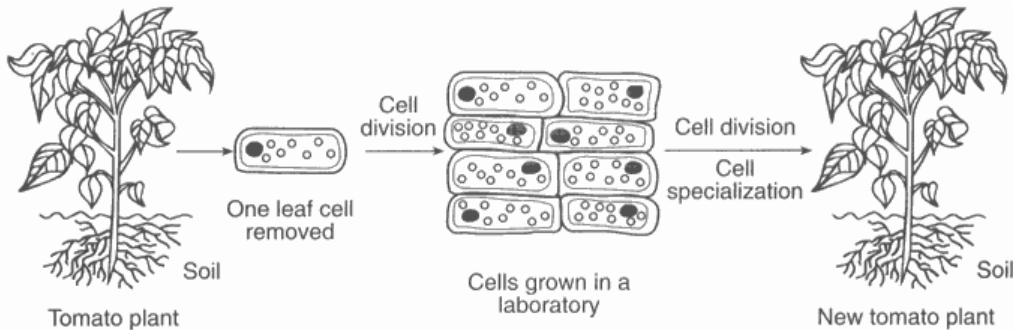
42. The diagram below represents the cloning of a carrot plant.



Compared to each cell of the original carrot plant, each cell of the new plant will have

- A) **the same number of chromosomes and the same types of genes**
- B) the same number of chromosomes, but different types of genes
- C) half the number of chromosomes and the same types of genes
- D) half the number of chromosomes, but different types of genes

43. A technique used to produce new plants is represented in the diagram below.



Which statement is *best* supported by the information in the diagram?

- A) The one leaf cell removed formed a zygote that developed into a new plant by mitotic cell division.
- B) **This procedure is used to produce new tomato plants that are clones of the original tomato plant.**
- C) The cell taken from the leaf produced eight cells, each having one-half of the genetic information of the original leaf cell.
- D) The new tomato plant will not be able to reproduce sexually because it was produced by mitotic cell division.

44. Cloning an individual usually produces organisms that

- A) contain dangerous mutations
- B) **contain identical genes**
- C) are identical in appearance and behavior
- D) produce enzymes different from the parent

Answer Key
Genetic Engineering

- | | | | |
|-----|----------|-----|----------|
| 1. | <u>A</u> | 37. | <u>D</u> |
| 2. | <u>A</u> | 38. | <u>D</u> |
| 3. | <u>D</u> | 39. | <u>C</u> |
| 4. | <u>C</u> | 40. | <u>B</u> |
| 5. | <u>D</u> | 41. | <u>B</u> |
| 6. | <u>C</u> | 42. | <u>A</u> |
| 7. | <u>B</u> | 43. | <u>B</u> |
| 8. | <u>B</u> | 44. | <u>B</u> |
| 9. | <u>D</u> | | |
| 10. | <u>C</u> | | |
| 11. | <u>A</u> | | |
| 12. | <u>A</u> | | |
| 13. | <u>A</u> | | |
| 14. | <u>A</u> | | |
| 15. | <u>B</u> | | |
| 16. | <u>D</u> | | |
| 17. | <u>D</u> | | |
| 18. | <u>A</u> | | |
| 19. | <u>D</u> | | |
| 20. | <u>B</u> | | |
| 21. | <u>C</u> | | |
| 22. | <u>B</u> | | |
| 23. | <u>A</u> | | |
| 24. | <u>B</u> | | |
| 25. | <u>C</u> | | |
| 26. | <u>C</u> | | |
| 27. | <u>D</u> | | |
| 28. | <u>A</u> | | |
| 29. | <u>C</u> | | |
| 30. | <u>C</u> | | |
| 31. | <u>C</u> | | |
| 32. | <u>D</u> | | |
| 33. | <u>C</u> | | |
| 34. | <u>C</u> | | |
| 35. | <u>A</u> | | |
| 36. | <u>C</u> | | |
-