Biology · Molecular Biology · DNA and Genetic Information

DNA in Prokaryotes and Eukaryotes, Genome Structure, Mutations

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Multiple choice questions — 58 questions

1 How many free phosphate groups are there in a plasmid?

(A) Zero (B) 1 (C) 2 (D) 4

2 What does each chromosome represent in eukaryotes?

(A) A single strand of DNA + proteins
(B) One molecule of DNA + proteins
(C) Two molecules of DNA + proteins
(D) A DNA molecule and an RNA molecule

3 Which polymers are responsible for packing long DNA molecules so that they fit in the space of the cell nucleus?

(A) Carbohydrates (B) Lipids (C) Proteins (D) Hormones

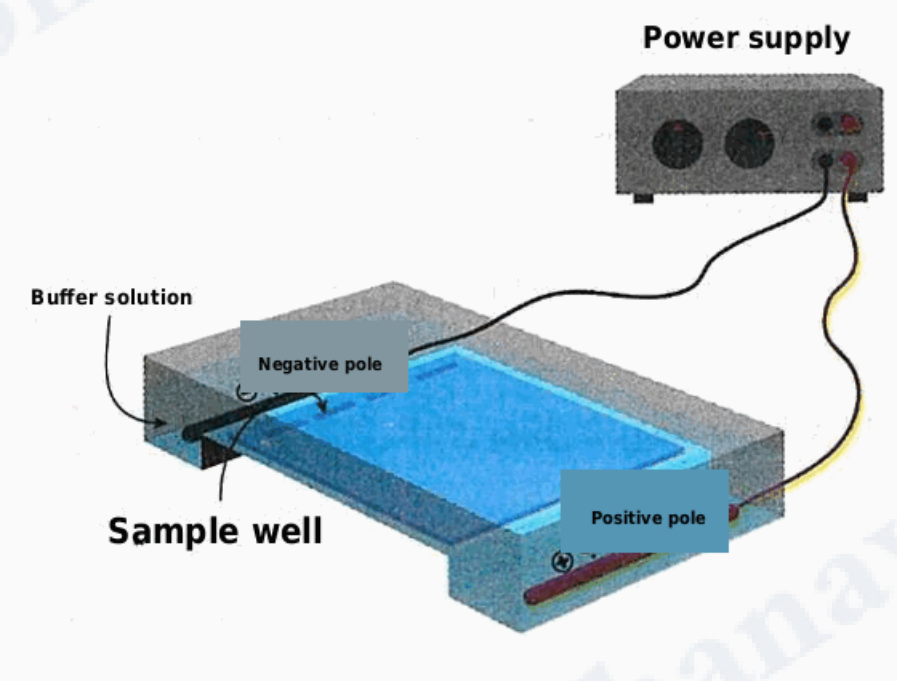
4 In which of the following is DNA organized in the form of chromosomes during cell division?

(A) Bacteria (B) Chloroplasts (C) Mitochondria (D) Amoeba

5 A type 1 diabetic patient suffers from beta cells not producing insulin. In light of what you studied, which proteins does a defect in their function lead to this?

(A) Histone and non-histone proteins
(B) Structural histone proteins
(C) Structural non-histone proteins
(D) Regulatory non-histone proteins

6 The opposite figure represents an electrophoresis apparatus, used to separate DNA, RNA and proteins; its work depends on differences in charge, size and shape. If a sample of nucleosomes is placed in this apparatus at the negative pole, which of the following do you expect to happen after it has been running for a while?



(A) DNA stays at the negative pole, while the histone moves towards the positive pole

(B) DNA moves towards the positive pole, while the histone moves towards the negative pole

(C) Both DNA and the histone stay at the negative pole

(D) Both DNA and the histone move towards the positive pole

---

7 Which of the following does NOT apply to the plasmid?

(A) A circular piece of DNA

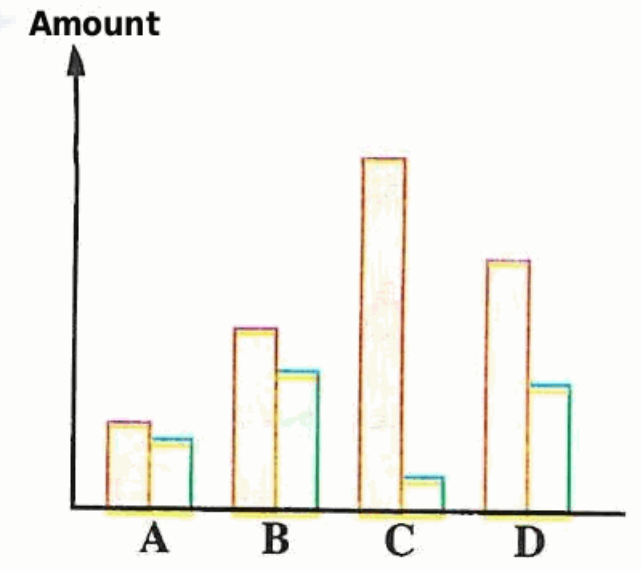
(B) It does not replicate before cell division starts

(C) It is found in some strains of bacteria

(D) It is not complexed with protein

---

8 The opposite graph shows the ratio between the amount of protein produced by the organism and the amount of DNA in four different living organisms. Which organism can represent one of the types of salamander?



9 What is the relationship between the amount of DNA and the protein produced in the cell?

(A) Direct in eukaryotes
(B) Inverse in prokaryotes
(C) There is no relationship
(D) Direct in prokaryotes and eukaryotes

10 Which of the following statements is correct?

(A) The amount of DNA increases in higher vertebrates
(B) The genome of a certain type of salamander is larger than that of humans
(C) Humans contain the largest amount of DNA
(D) There is a relationship between the advancement of the organism and the amount of DNA in its cells

11 Which of the following distinguishes Escherichia coli bacteria from the bacteriophage?

(A) The type of genetic material
(B) The presence of a plasmid
(C) The type of nucleotides
(D) The presence of phosphorus in the genetic material

12 In what is the DNA in elephant cells similar to the DNA in tomato plant cells?

(A) The types of genes on the DNA molecule

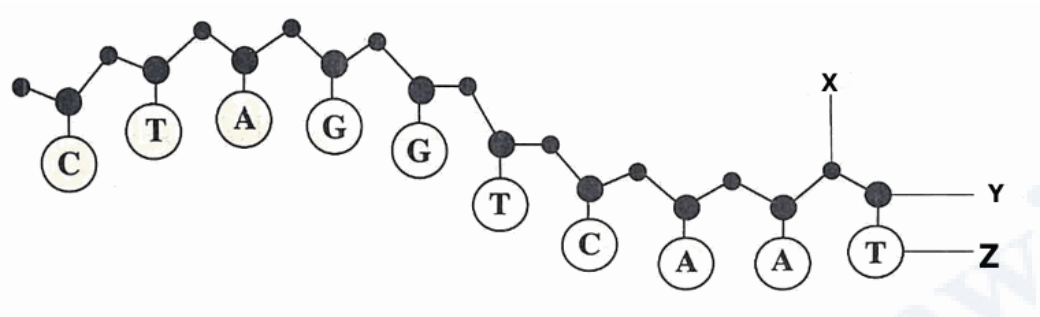
(B) The types of nucleotides in the DNA molecule

(C) The number of DNA molecules

(D) The number of genes on the DNA molecule

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13 From the following figure, which represents a DNA strand, which part carries a negative charge?

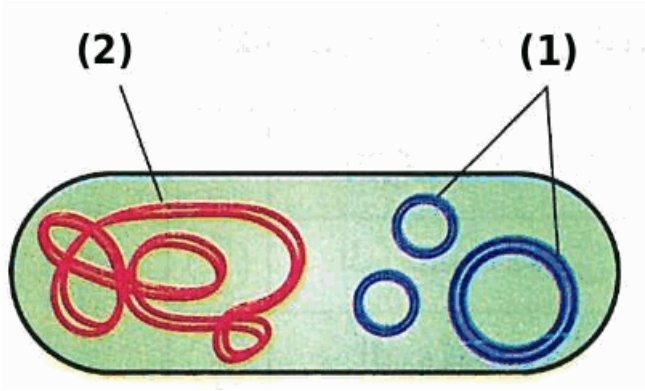


(A) X (B) Y (C) Z (D) X , Z

---

14 The opposite figure shows a bacterial cell:

Which of the choices in the following table describes structures (1) and (2) respectively?



(A) (1): circular and complexed with protein, (2): circular and not complexed with protein

(B) (1): several coils and complexed with protein, (2): several coils and not complexed with protein

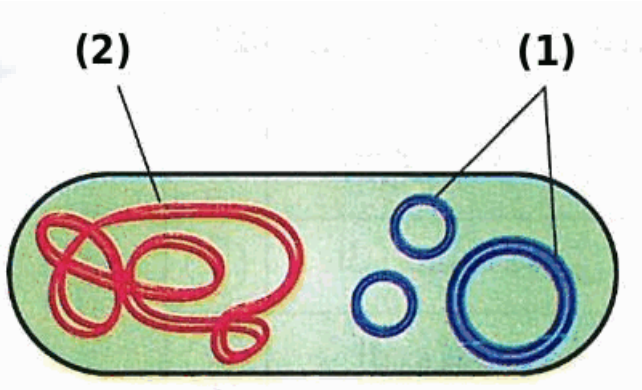
(C) (1): circular and not complexed with protein, (2): several coils and not complexed with protein

(D) (1): several coils and not complexed with protein, (2): circular and complexed with protein

---

15 The opposite figure shows a bacterial cell:

In what does structure (1) differ from structure (2)?



(A) The number of genes

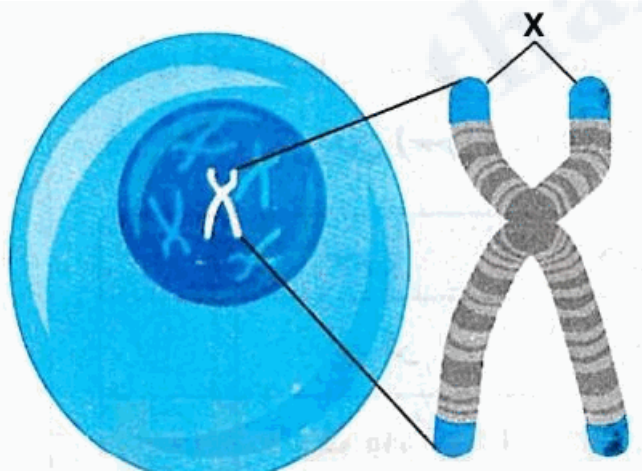
(B) The number of free phosphate groups

(C) The type of nucleic acid

(D) The type of enzymes needed for replication

---

16 In the opposite figure, which of the following is correct about structure (X)?



(A) Without it, important genetic information is lost

(B) It is found in the cells of all living organisms

(C) It carries the code for building rRNA

(D) It carries the code for building a protein

---

17 What is the correct order from complex to simple?

(A) Chromosome / gene / nucleotide / DNA

(B) DNA / gene / chromosome / chromatid

(C) Chromosome / DNA / gene / nucleotide

(D) Nucleotide / gene / DNA / chromosome

18 Which of the following is NOT a characteristic of DNA isolated from the nuclei of eukaryotic cells?

(A) It is organized in a circular form

(B) It binds with histones

(C) It is organized in the form of chromatin

(D) A mutation may happen in it

19 Which of the following polymers is NOT mainly found in the cytoplasm of yeast?

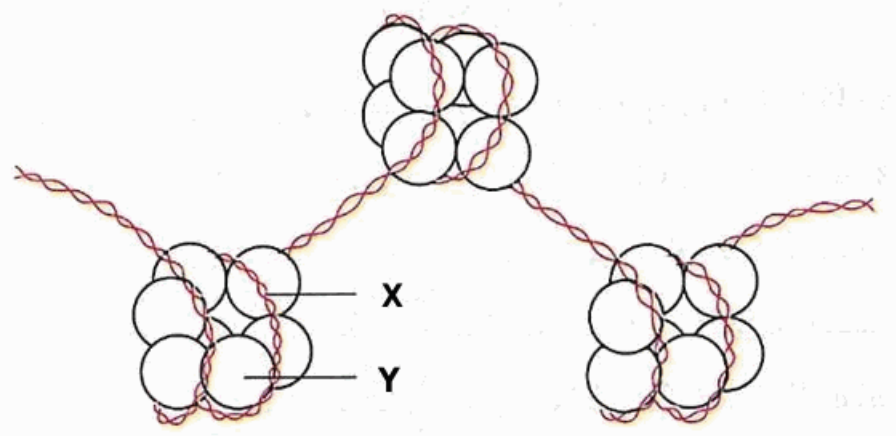
(A) Plasmids

(B) DNA polymerase enzymes

(C) Histone proteins

(D) Ligase enzymes

20 The opposite figure represents several nucleosomes in a living cell:
Which of the following organisms does NOT contain this form?



(A) Yeast

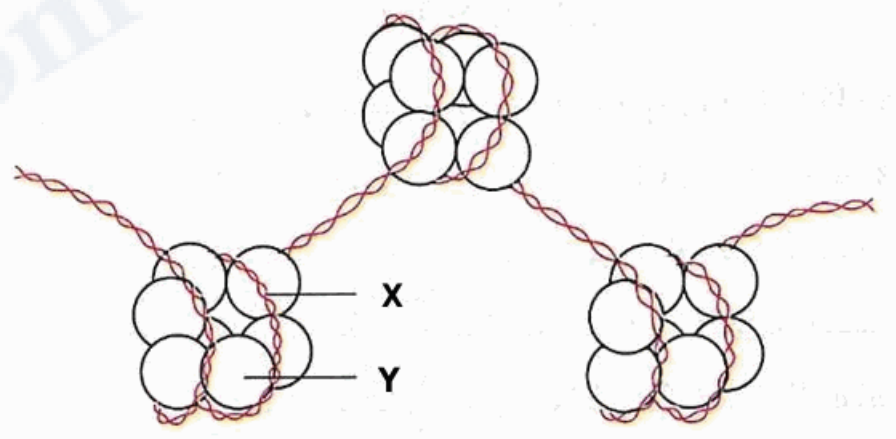
(B) E. coli bacteria

(C) Amoeba

(D) Planaria

21 The opposite figure represents several nucleosomes in a living cell:

Which of the choices in the following table shows the building unit of each of structure (X) and structure (Y)?



(A) (X): amino acid, (Y): nucleotide

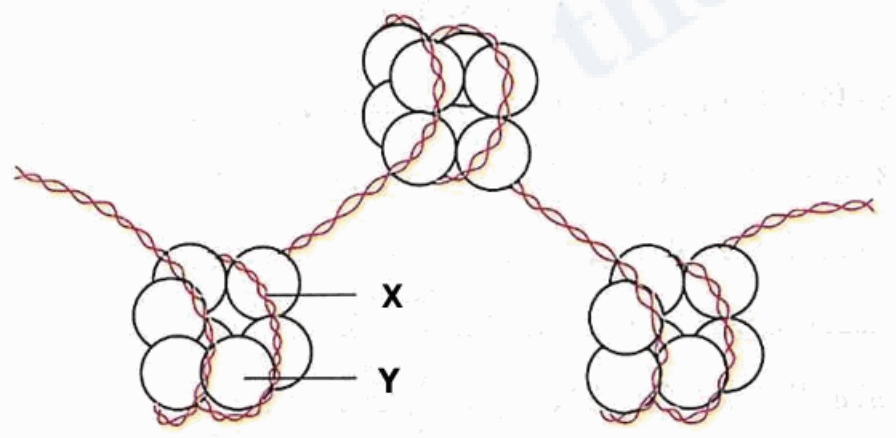
(B) (X): nucleotide, (Y): nucleotide

(C) (X): nucleotide, (Y): amino acid

(D) (X): amino acid, (Y): amino acid

22 The opposite figure represents several nucleosomes in a living cell:

What is the reason for the binding between structure (X) and structure (Y)?



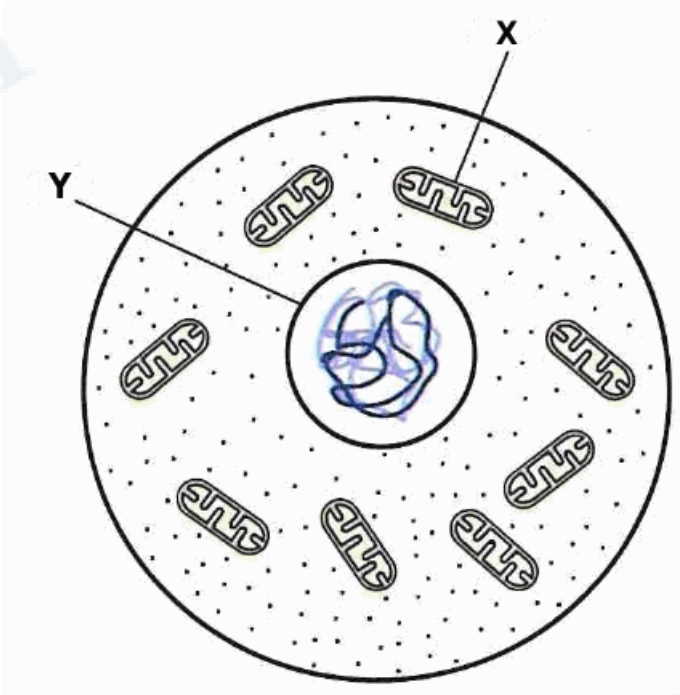
(A) The activity of ligase enzymes

(B) The difference in charges at the binding point

(C) The formation of hydrogen bonds

(D) A dehydration reaction

23 If you know that the opposite figure represents a zygote cell, which of the choices in the following table is the source of DNA in each of (X) and (Y)?



(A) (X): the male, (Y): the male and the female

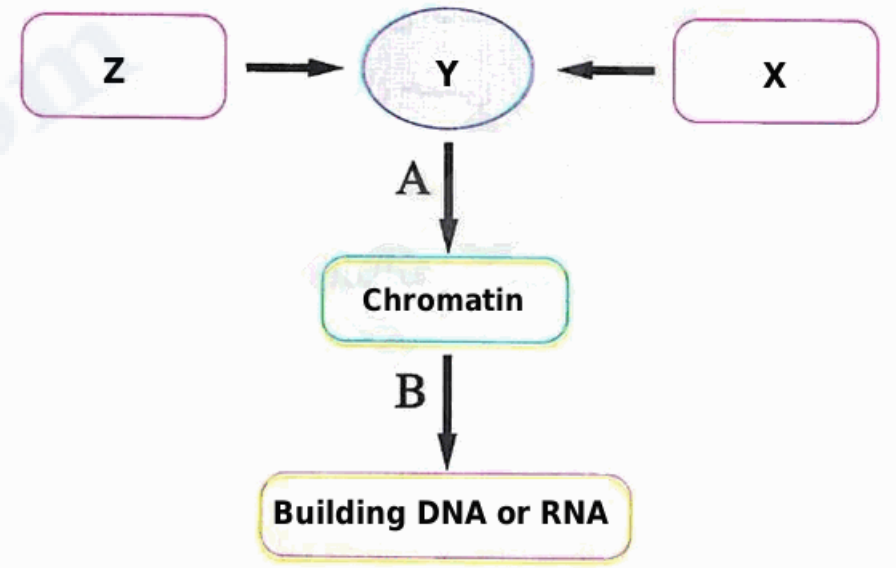
(B) (X): the male and the female, (Y): the female

(C) (X): the female, (Y): the male

(D) (X): the female, (Y): the male and the female

24 In the opposite chart:

Which of the following choices represents the letters (X), (Y), (Z) respectively?



(A) Structural proteins / RNA / regulatory proteins

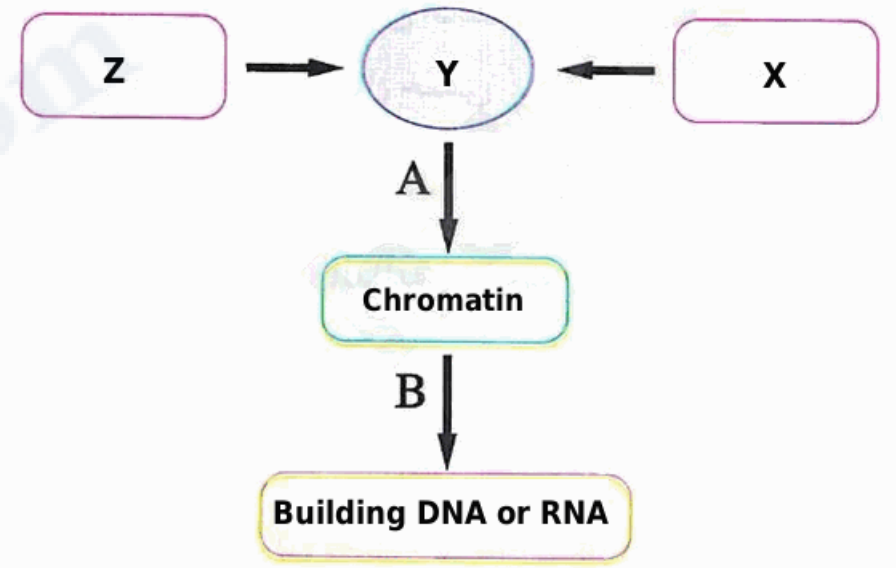
(B) Histone proteins / DNA / non-histone proteins

(C) Arginine / phosphate / lysine

(D) Plasmid / circular DNA / chromosome

25 In the opposite chart:

Which of the following applies to the two processes (A) and (B)?



(A) Opposite, where (A) represents unwinding and (B) condensation

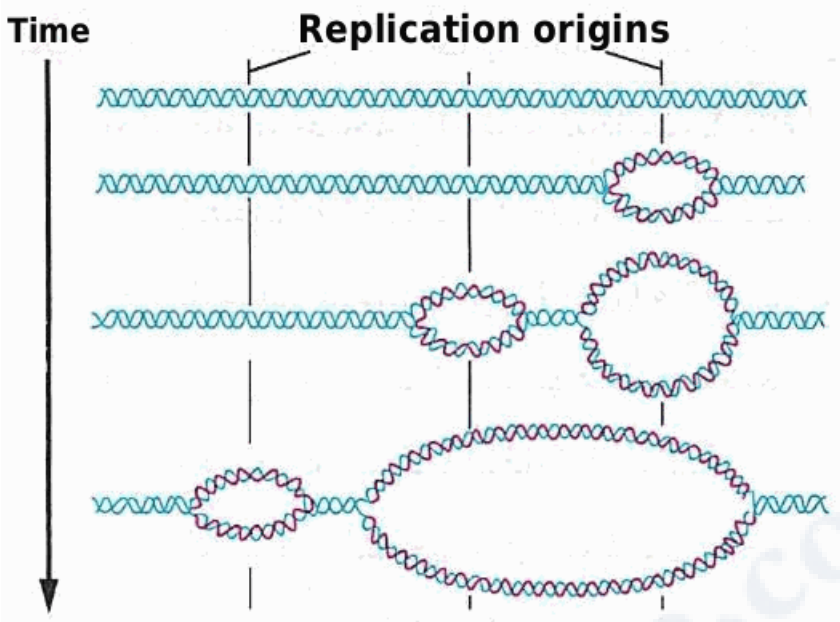
(B) Opposite, where (A) represents condensation and (B) unwinding

(C) Complementary, where (A) represents condensation and (B) unwinding

(D) Complementary, where (A) represents unwinding and (B) condensation

---

26 The opposite figure represents the replication of a DNA molecule. In which of the following cells does DNA NOT replicate in this way?



(A) A bacterial cell

(B) An amoeba cell

(C) A yeast fungus cell

(D) A human liver cell

27 Which of the following organisms has no nucleosomes?

(A) Paramecium (B) Amoeba (C) Bacteria (D) Trypanosoma

28 A body cell containing the gene for the hormone insulin indicates that .....

(A) this cell is one of the beta cells only
(B) the rest of the body cells contain the same gene
(C) some body cells contain the same gene
(D) this cell is found in the pancreas only

29 Which of the following choices represents the number of plasmids and DNA molecules respectively in each of the daughter cells produced by the division of a bacterial cell that has one plasmid?

(A) 1 / 2 (B) 2 / 1 (C) 1 / 1 (D) 2 / 2

30 In which of the following can the 3' end of the nucleic acid be clearly seen?

(A) Bacteria (B) Viruses (C) Mitochondria (D) Plasmids

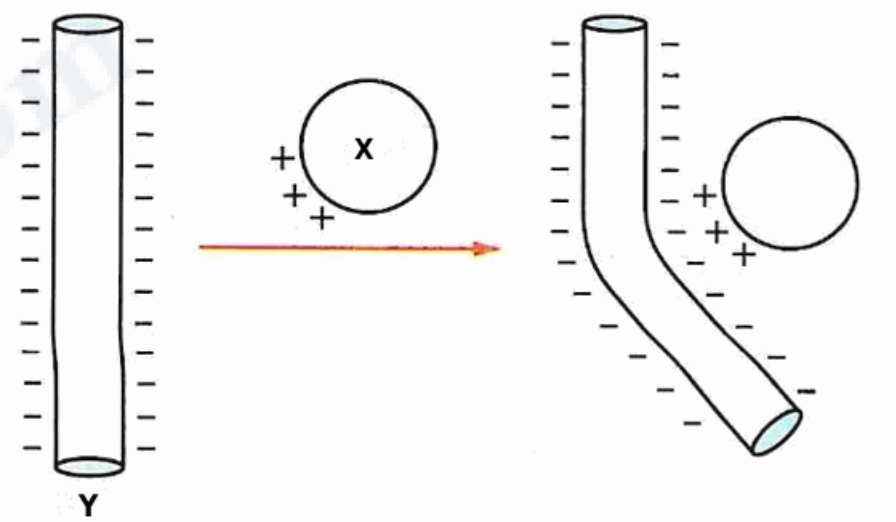
31 (A), (B), (C) are three different types of birds. If some cells in each of (A) and (C) can form enzyme (X), while some cells of (B) can form enzyme (Y), this is because the body cells in each of .....

(A) (A) and (C) have the same genetic information
(B) (B) and (C) have the same genetic information
(C) (A) and (C) have a part of the genetic material that is identical
(D) (A), (B) and (C) contain equal amounts of DNA

32 In which of the following do prokaryotes and eukaryotes agree?

(A) The presence of chromosomes (B) The degree of protein complexity
(C) The absence of mitochondria (D) The type of replication enzymes

33 Which of the following statements describes the opposite figure correctly regarding DNA condensation?



(A) (Y) separates from (X) after DNA replication

(B) The binding between (X) and (Y) is not affected by pH

(C) Binding takes place between the positive alkyl groups and the negative phosphate groups

(D) The positive charge in structure (X) is due to the side carboxyl groups

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34 The amount of nitrogenous bases in the head of the human sperm is ..... their amount in the ovum.

(A) equal to (B) less than (C) more than (D) double

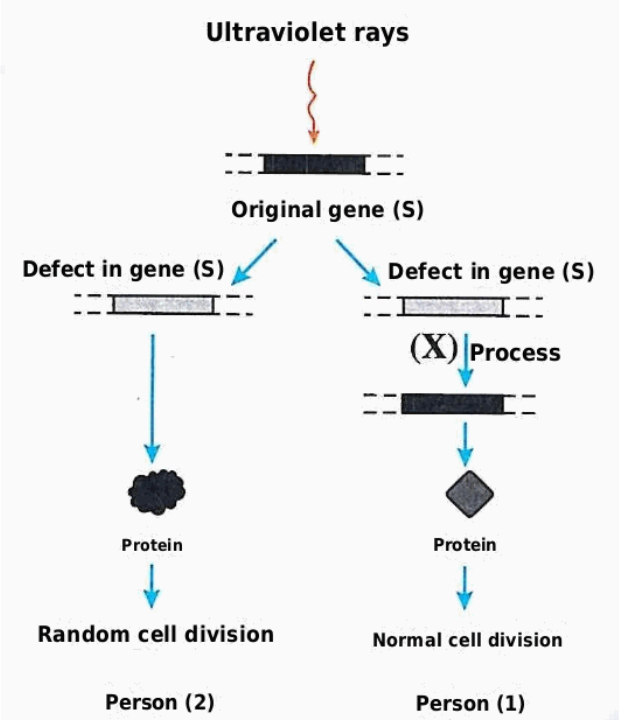
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35 If you know that the nucleus of yeast fungus contains 16 chromosomes, how many free phosphate groups are there in the DNA molecules of yeast fungus before the cell starts dividing?

(A) Zero (B) 16 (C) 32 (D) 64

---

36 The opposite figure shows the effect of exposing one of the genes (S) in two different persons to ultraviolet rays. Which of the following statements is correct?



(A) Ligase enzymes work efficiently in person (1)

(B) Ultraviolet rays affected all the genes of person (1)

(C) Person (2) suffers from cancer as a result of repeated sequences of gene (S)

(D) The mutation appears in all the body cells of person (2)

---

37 What is the reason a dominant trait sometimes changes into a recessive trait?

(A) A change in the nucleotide sequence of the gene

(B) No separating wall forms between the two daughter cells

(C) A part of a chromosome breaks and joins another chromosome

(D) An extra autosome

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38 A change in the genes of a Sertoli cell leads to a ..... mutation.

(A) true germinal

(B) non-true somatic

(C) non-true germinal

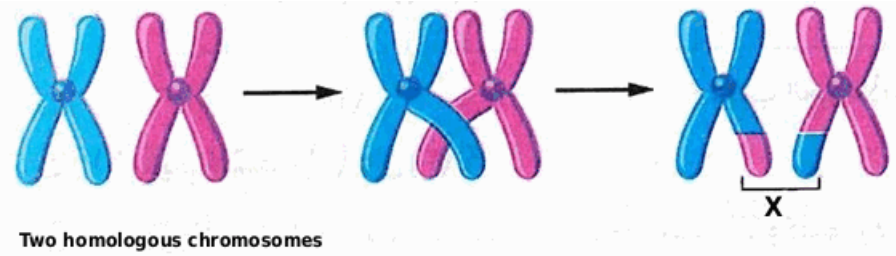
(D) true somatic

---

39 What is the similarity between the sheep mutation and the mutation of plants with large fruits?

(A) The cells in which they happen
(B) The origin
(C) Having economic importance
(D) The method of inheritance

40 What does (X) in the opposite figure indicate?



(A) A gene mutation
(B) A chromosomal mutation in the number of chromosomes
(C) A chromosomal mutation in the structure of chromosomes
(D) No mutation happened

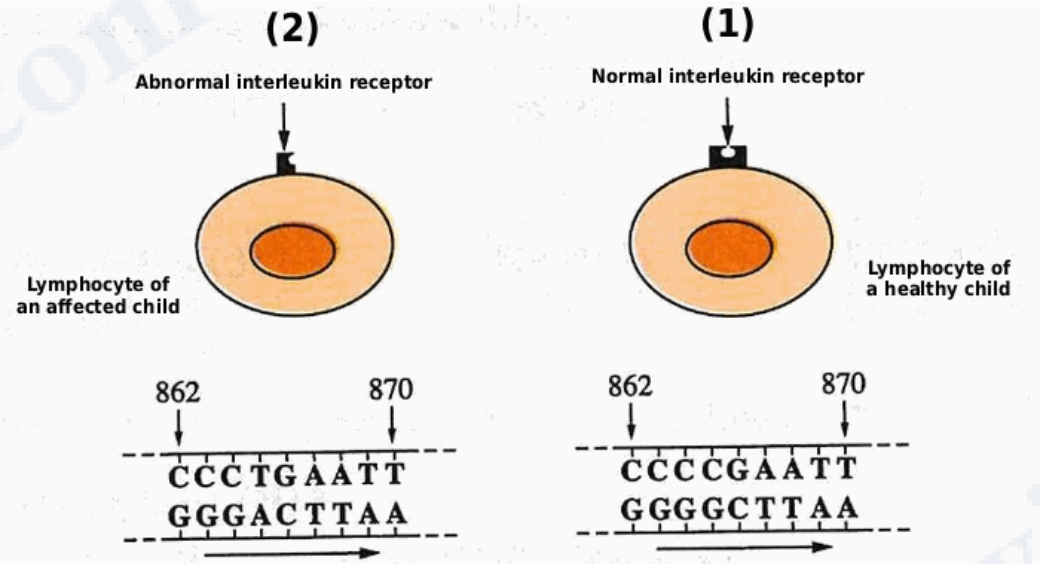
41 In humans, mutations appear in the offspring when they happen in .....

(A) muscle tissue
(B) the cells of the scrotum of the testis
(C) the primary germ cells
(D) the mammary glands

42 Two healthy parents had a son suffering from a disease caused by a dominant gene. The reason for that is a mutation that happened .....

(A) during the embryonic development of the son
(B) in the cells of the husband's scrotum before mating
(C) in the cells of the couple after fertilization
(D) in the son's cells after reaching a certain age

43 From the following two figures (1) and (2), which represent the interleukin receptor and the gene responsible for it in two children, one healthy and the other affected:
Which of the following reasons is responsible for this change?



(A) A change in the structure of the receptor due to a chromosomal mutation in the child's cells

(B) A new nucleotide was added, causing a defect in the receptor

(C) Damage to two adjacent nitrogenous bases

(D) A change in the structure of the protein forming the receptor

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44 Which of the following processes do evolution scientists benefit from in their study?

(A) Replication

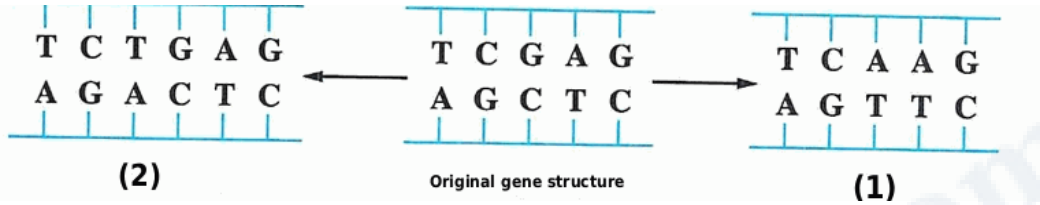
(B) RNA transcription

(C) Induced mutation

(D) Spontaneous mutation

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45 From the following sequences, answer:
In what does (1) differ from (2)?



(A) The types of nucleotides

(B) The number of nucleotides

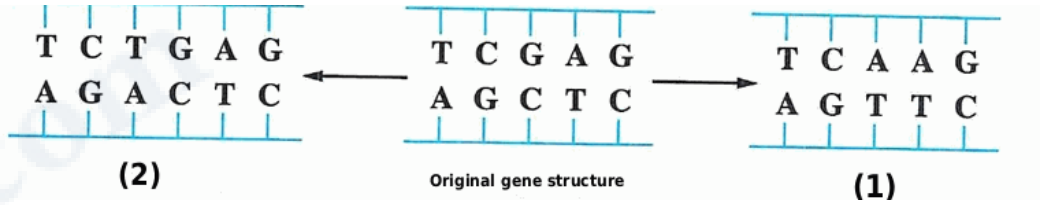
(C) The type of bonds

(D) The type of polymerase enzymes

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46 From the following sequences, answer:

What type of mutation caused the change in (1) and the change in (2) respectively?



(A) Deletion of a nitrogenous base / substitution of a nitrogenous base

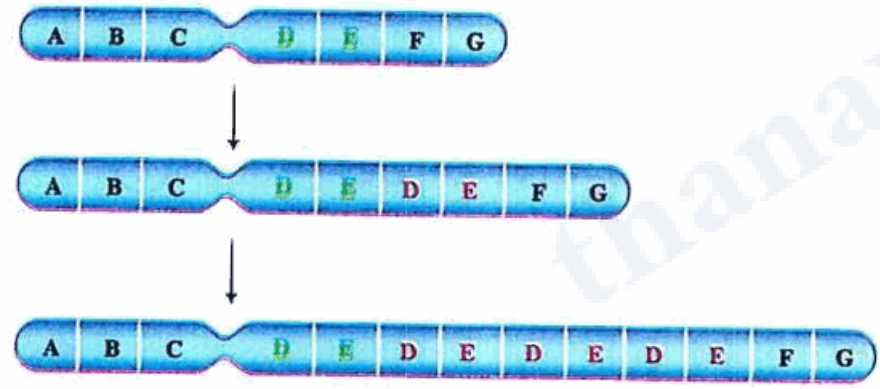
(B) Substitution of a nitrogenous base / addition of a nitrogenous base

(C) Induced / chromosomal

(D) Chromosomal / induced

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47 What is the reason for the mutation in the opposite figure?



(A) A change in the structure of the gene

(B) An increase in the number of chromosomes

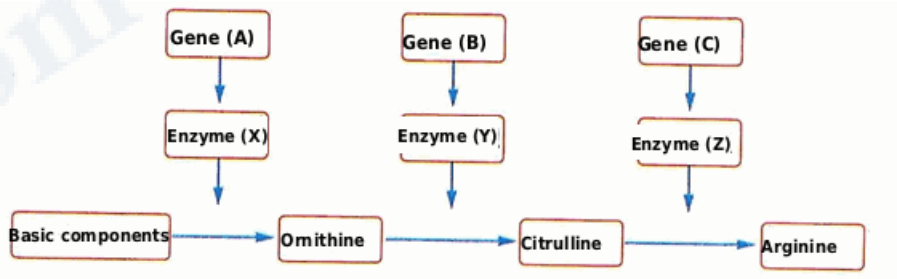
(C) Doubling of the number of chromosomes

(D) A change in the structure of the chromosome

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48 Bread mould fungus can form the amino acid arginine that it needs from its basic components, according to the system of enzyme reactions shown in the following chart:

What is the result of a mutation in gene (B)?



(A) The fungus can form arginine if it is supplied with the basic components

(B) The fungus can form arginine without enzyme (Y)

(C) The fungus can form arginine if it is supplied with enzyme (Z)

(D) The fungus will not be able to form arginine

---

49 The following events take place when DNA in the nucleus of a living cell is exposed to radiation:

X: a mutation happens.

Y: a change in the activity of the cell.

Z: a change in the structure of the protein.

L: a change in the sequence of amino acids in the polypeptide chain.

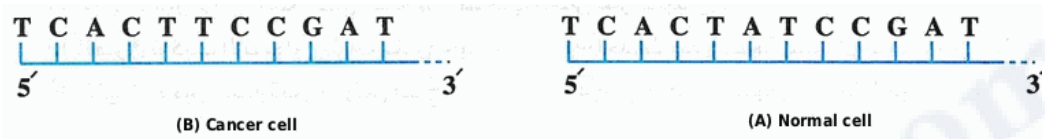
Which of the following represents the correct order of what happens?

(A) X → Y → Z → L (B) X → L → Z → Y (C) X → Z → Y → L (D) Y → L → Z → X

---

50 If you know that cell division is activated by protein (X), which stimulates DNA replication, and division stops by the action of protein (Y), which stops the action of protein (X), the following two figures show the nucleotide sequences on DNA responsible for forming protein (Y) in the two cells (A) and (B). Study them, then answer:

What is the reason for the change of cell (A) into cell (B)?



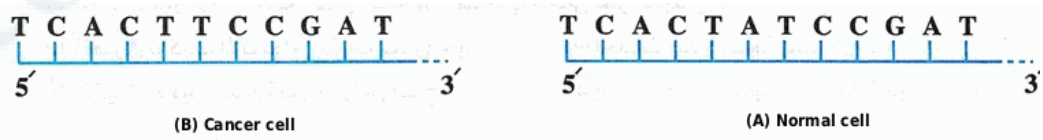
(A) Gene mutation (B) Chromosomal mutation

(C) Transforming nucleic acid (D) Induced mutation

---

51 If you know that cell division is activated by protein (X), which stimulates DNA replication, and division stops by the action of protein (Y), which stops the action of protein (X), the following two figures show the nucleotide sequences on DNA responsible for forming protein (Y) in the two cells (A) and (B). Study them, then answer:

What is the reason for the formation of cancer cells (B)?



(A) Protein (X) became inactive, so cell division stops and the cells age

(B) The activity of proteins (X) and (Y) increased more than the cell needs

(C) Protein (Y) became inactive, so the cells divide continuously and randomly

(D) A protein different from protein (X) in its physiological properties was formed

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52 Two plants were crossed: the chromosome set of the first was (4n) and that of the second was (6n), and a plant (8n) was produced. What is the reason for that?

(A) The cross was between two different types of plants

(B) The chromosomes of the first plant were not reduced during gamete formation

(C) The chromosomes of the second plant were not reduced during gamete formation

(D) The chromosomes of both plants were not reduced during gamete formation

---

53 Which of the following is a chromosomal mutation that leads to a genetic change?

(A) A piece of the chromosome separates, turns 360° and rejoins the same chromosome

(B) Loss of a small part of the end granules of some chromosomes that does not represent a code

(C) Exchange of parts between homologous chromosomes

(D) An increase in the number of sex chromosomes

---

54 Which of the following is NOT a reason for some female traits appearing in a man?

(A) A missing autosome

(B) An extra sex chromosome

(C) A high level of estrogen in the blood

(D) A low level of testosterone in the blood

---

55 Assuming that during bacterial DNA replication two opposite nitrogenous bases were damaged at the same time in a part of DNA that represents a code, what results from this defect?

(A) A mutation in the mother cell only

(B) A mutation in the daughter cells only

(C) A mutation in the mother cell and the daughter cells

(D) No mutation happens

---

56 Sequence (1) and sequence (2) represent a part of the gene responsible for producing the hormone insulin; one is normal and the other abnormal:

Normal gene (1)

C-C-G-A-A-G-A-A-G-A-T-G-T-G-A-G-G-A-T-T-C

Abnormal gene (2)

C-C-G-G-A-G-A-A-G-A-T-G-T-G-A-G-G-A-T-T-C

What is the reason diabetes appears in the person with the abnormal gene?

(A) A change in the structure of insulin due to a gene mutation

(B) A mutation due to substituting base (G) with base (A)

(C) A change in the gene with no change in the produced protein

(D) A change in the structure of the chromosome carrying the insulin gene

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57 The skin and hair of some people are white due to a defect in producing the pigment melanin in skin and hair cells. This is due to a ..... mutation in the parents.

(A) true gene

(B) non-true gene

(C) non-true chromosomal

(D) non-true spontaneous

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58 If a mutation happens in the mitochondrial DNA in the gametes of both the father and the mother, from which of the following is this inherited mutation passed?

(A) Fathers to their sons only

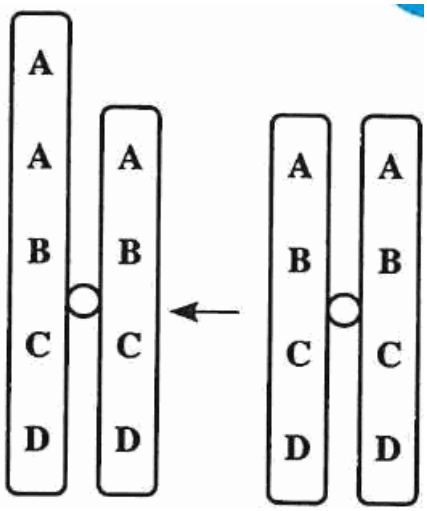
(B) Fathers to their sons and daughters

(C) Mothers to their daughters only

(D) Mothers to their sons and daughters

Essay questions — 4 questions

1 The opposite figure shows a mutation that happened in one chromosome. What is the type of mutation, and what is its cause?



2 If the sequence of nitrogenous bases in a piece of one of the two strands of a DNA molecule is:
3′... G - G - G - C - C - C - G - T - G ...5′

(1) Write the sequence of nitrogenous bases in the DNA piece complementary to the piece mentioned above.

(2) If a mutation happens that changes one of the bases of the DNA strand piece mentioned above, what is the type of this mutation, and what is its effect?

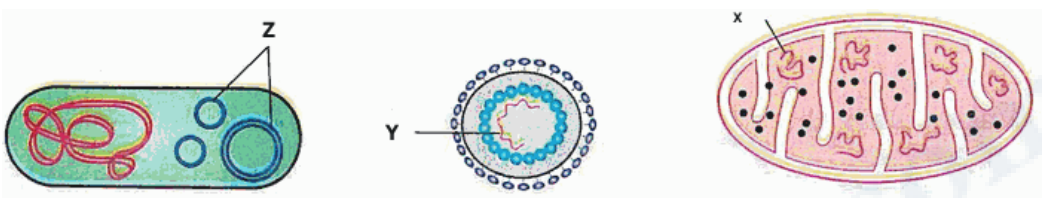
3 You saw a type of watermelon whose fruit has an unusually large weight:

(1) How do you explain the reason for this unusual large size?

(2) How can this phenomenon be made use of?

(3) What is the name of this phenomenon?

4 From the following figures, what is the common characteristic between structures (X), (Y), (Z)?



Past exam questions — 53 questions

1 Which of the following properties indicates the degree of complexity of the organism and its degree of evolution? (Trial exam / June 2021)

(A) The amount of DNA found in its cells

(B) The amount of protein formed in its cells

(C) The number of types of amino acids in its cells

(D) The many types of ribonucleic acids (RNA)

---

2 What distinguishes DNA in eukaryotes from DNA in prokaryotes? (Trial exam / June 2021)

(A) It carries the code for building the three types of RNA

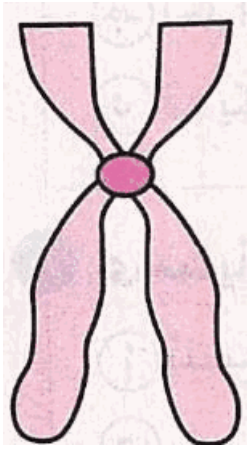
(B) It is found in the form of nucleosomes

(C) It replicates before cell division

(D) It can be cut by restriction enzymes

---

3 In front of you is a picture of a chromosome in metaphase during cell division. What type of proteins play a role in this chromosome having this form? (1st session 2021)



(A) Histone and regulatory non-histone

(B) Histone and structural non-histone

(C) Histone

(D) Structural non-histone

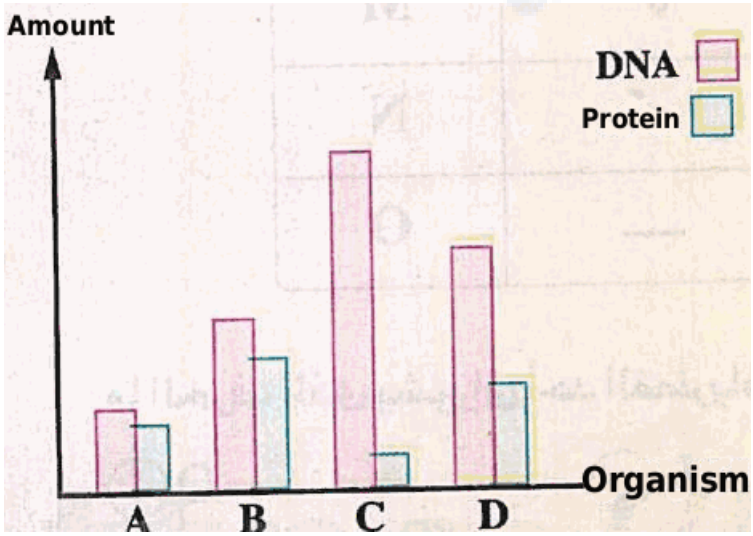
---

4 When the percentages of phosphorus and sulphur were calculated in a sample of the genetic material of four different living organisms, the percentages appeared as in the opposite table. Which number expresses bacteria? (1st session 2021)

Percentage		Organism
Sulphur	Phosphorus	
50%	50%	(1)
27%	73%	(2)
0%	100%	(3)
44%	56%	(4)

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

5 The opposite graph shows the ratio between the amount of DNA and the amount of protein produced by four cells of different living organisms. What can be deduced about organism (A)? (2nd session 2021)



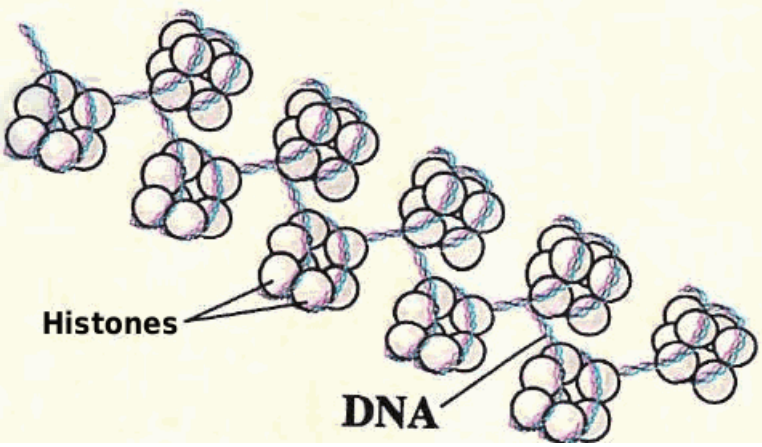
(A) It is a prokaryote

(B) It is a eukaryote

(C) It has the largest genome

(D) The amount of DNA that represents code is less than 50%

6 In which process is the structure shown in the opposite figure used? (2nd session 2021)



(A) DNA replication in the bacterial cell
(B) Division of the human cell
(C) Division of the bacterial cell
(D) DNA replication in the human cell

7 Study the opposite figure, which shows one of the forms of DNA. What can be deduced about the type of organism that contains this form? (1st session 2022)



(A) A virus
(B) A eukaryote
(C) A prokaryote
(D) It may be a prokaryote or a eukaryote

8 Which of the following is correct about the genome of the human cell? (1st session 2022)

(A) It is transcribed completely
(B) It replicates completely
(C) Most of it is transcribed
(D) All the damage that happens to it is repaired

9 What is the ratio between the genome of a skin cell of a type of salamander and a human skin cell respectively? (2nd session 2022)

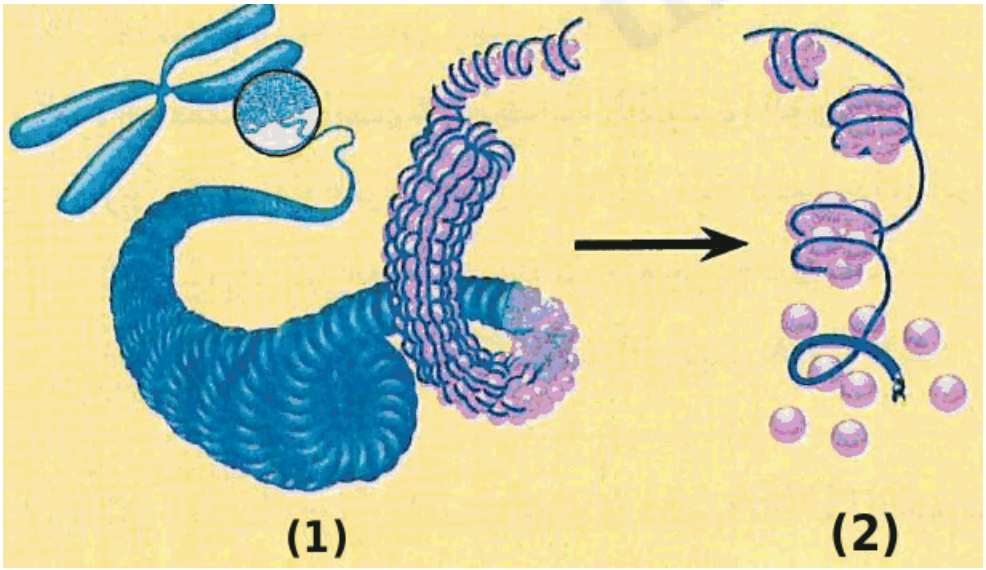
(A) 15 to 2 (B) 15 to 1 (C) 30 to 1 (D) 1 to 30

10 Study the following table, then deduce:
Which letter indicates a fungus? (1st session 2023)

Type of nutrition	Plasmids	Prokaryote-like DNA	Chromosomes	Organism
Heterotrophic	—	✓	✓	L
Autotrophic	—	✓	✓	M
Heterotrophic	✓	✓	✓	N
Heterotrophic	✓	✓	—	O

(A) O (B) L (C) M (D) N

11 Study the figure in front of you, then deduce which case requires the change from (1) to (2) in the DNA molecule. (1st session 2023, Sample exam 2025)



(A) Forming the zygospore in Spirogyra (B) Forming the primary spermatocytes
(C) Binary fission in bacteria (D) Budding in hydra

12 What is the description of repetitive DNA in the cells of the organism? (2nd session 2023)

(A) Repeated copies of the whole genome found in all body cells

(B) Nucleotides used more than once in DNA molecules

(C) DNA sequences that have several copies in the genome

(D) Nucleotide sequences that are neither transcribed nor translated into protein

---

13 Study the opposite table, then deduce where the prokaryote-like DNA is found in the organism indicated by the letter (A). (2nd session 2023)

Chlorophyll	Plasmids	Prokaryote-like DNA	Chromosomes	Organism
✓	—	✓	✓	A

(A) Plastids only

(B) Mitochondria only

(C) Plastids and mitochondria

(D) Plastids, mitochondria and the nucleus

---

14 Which of the following statements describes non-coding DNA? (1st session 2024)

(A) It is not found within the genome of the organism

(B) Pieces of DNA that are neither transcribed nor translated into protein

(C) It cannot be isolated from eukaryotic cells

(D) It is found only on some eukaryotic chromosomes

---

15 What is the difference between the DNA molecules inside the mitochondria and inside the chloroplast of a plant cell? (2nd session 2024)

(A) The final shape of the DNA molecules in both

(B) The type and number of proteins that each of them produces

(C) The two ends of each molecule are joined by covalent bonds

(D) The way each of them is transcribed into mRNA

---

16 Which of the following describes the genome in eukaryotes? (2nd session 2024)

(A) The percentage of coding parts in it is lower than in prokaryotes

(B) There is a direct relationship between the amount of genome and the complexity of the organism

(C) There are always many copies of a gene that codes for building a protein

(D) Repetitive DNA is found only at the ends of chromosomes

---

17 Which of the following expresses the genome of amoeba? (Sample exam 2025)

(A) The nucleotide sequences that build proteins

(B) The nucleotide sequences that contribute to building ribosomes

(C) The nucleotide sequences found on the chromosomes

(D) The nucleotide sequences that build mRNA

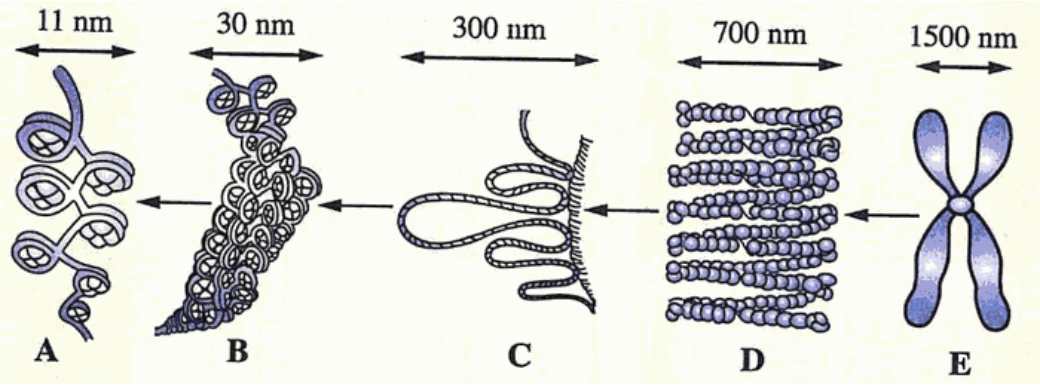
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18 Which part of the sperm contains DNA whose ends are joined? (Sample exam 2025)

(A) The head (B) The neck (C) The middle piece (D) The tail

---

19 The following drawing shows the stages of DNA condensation in eukaryotes. Which of the five stages shown in the drawing represents the stage of chromatin formation? (Sample exam 2025)



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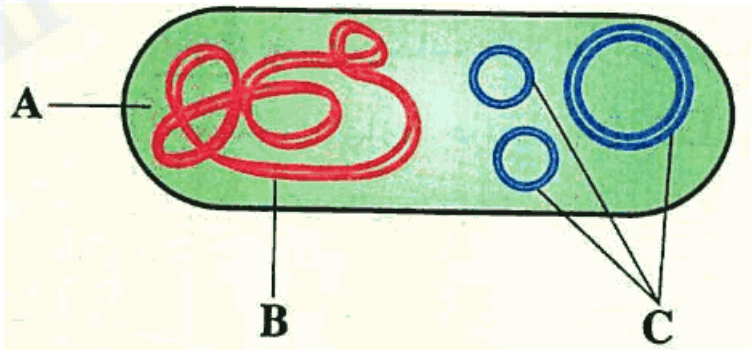
20 If you know that the nucleus of yeast fungus contains 16 chromosomes and one plasmid, how many DNA molecules will be replicated before cell division? (1st session 2025)

(A) 16 (B) 17 (C) 32 (D) 34

---

21 The opposite figure represents a bacterial cell and its genetic material.

(1) Which of the parts indicated by letters represents the genome of the cell? (1st session 2025)

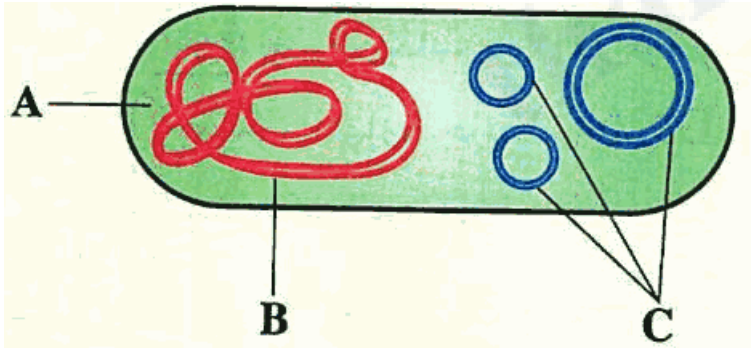


(A) (A) only
(B) (B) only
(C) (B) and (C)
(D) (A), (B) and (C)

---

22 The opposite figure represents a bacterial cell and its genetic material.

(2) Which of the following is correct about the nucleic acid molecules shown in the figure? (2nd session 2025)



(A) One single-stranded molecule
(B) One double-stranded molecule
(C) One double-stranded molecule and three single-stranded molecules
(D) Four double-stranded molecules

---

23 Which of the following statements is NOT correct about plasmids? (2nd session 2025)

(A) Circular DNA molecules
(B) They are found inside mitochondria and plastids
(C) They replicate with the same DNA replication enzymes as in eukaryotes
(D) They are a part of the genome of yeast

---

24 Plasmids in bacteria resemble DNA in eukaryotes in ..... (Sample exam 2026)

(A) their linear shape and binding to histones

(B) containing a high percentage of non-coding genes

(C) being surrounded by a nuclear membrane

(D) their ability to replicate at the same time as the main DNA molecule

---

25 Which of the following explains why the base percentages in the DNA molecules of two different tissues in the same organism are identical? (Sample exam 2026)

(A) All the body cells of one organism carry the same genome

(B) Each tissue has its own genome

(C) The structure of DNA changes according to the type of cell

(D) The order of bases differs from one tissue to another

---

26 A scientist analysed a DNA sample and found that it contains histone proteins and a number of genes with coding and non-coding sequences. Which of the following organisms has this sample? (Sample exam 2026)

(A) Bacteria (B) Polio virus (C) Yeast fungus (D) Bacteriophage

---

27 What is the importance of the nuclear membrane around DNA in eukaryotes? (Sample exam 2026)

(A) Protecting the genetic material and carrying out transcription accurately

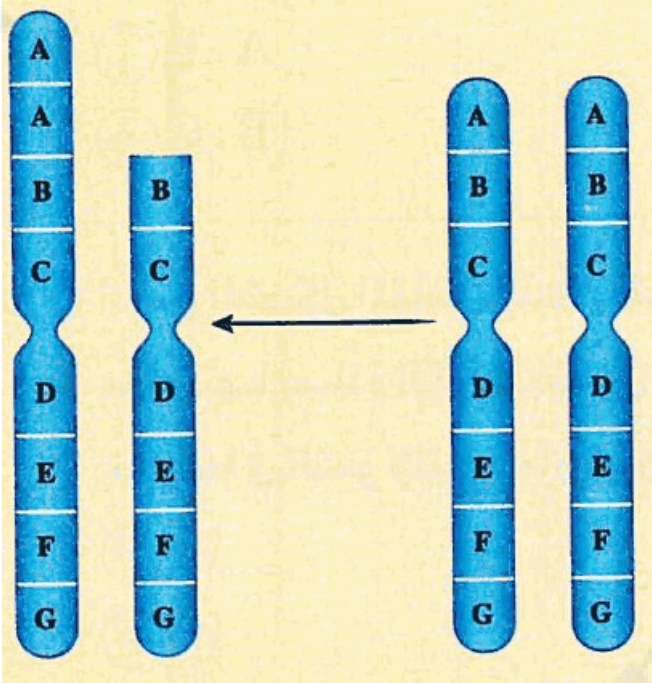
(B) Making it easier for genes to move to neighbouring cells

(C) Increasing the number of chromosomes randomly

(D) Increasing complexity by binding DNA to histone proteins

---

28 Study the opposite diagram, which shows a group of genes on a pair of homologous chromosomes during gamete formation, then deduce the result of this case. (Trial exam / June 2021)



(A) A chromosomal mutation, and the effect of gene (A) increases

(B) A gene mutation, and the order of the nitrogenous bases changes

(C) A gene mutation, and the type of protein changes

(D) A chromosomal mutation, and the effect of gene (A) does not change

---

29 What is the result of humans using radioactive materials or chemical compounds to treat the cells of plants and fungi to produce larger amounts of protein? (Trial exam / June 2021)

(A) One gene is repeated several times on the same chromosome

(B) Genes are repeated because the number of chromosomes doubles

(C) Nitrogenous bases are repeated in the same gene

(D) The type of protein produced by translation changes

---

30 A farmer noticed that some fruits grew larger than the normal size. What is the probable reason for this case? (1st session 2021)

(A) Loss of a part of one of the chromosomes

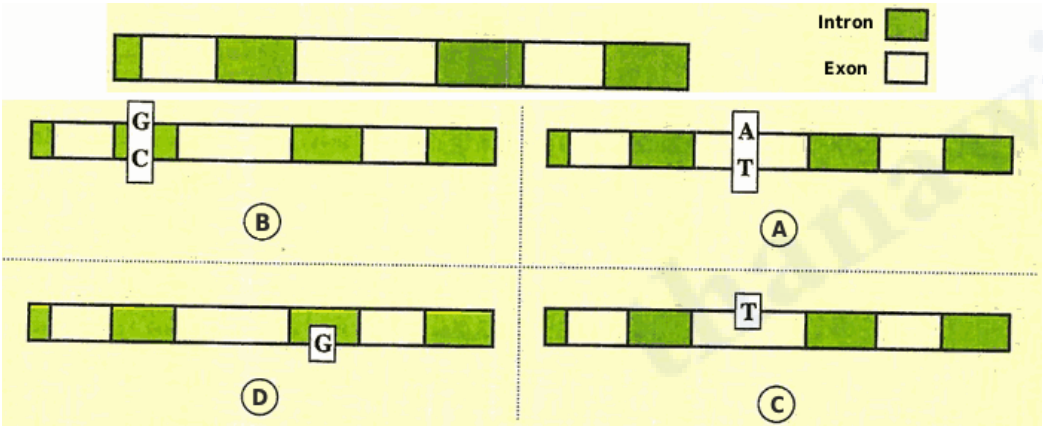
(B) A decrease in the number of chromosomes

(C) Repetition of genes

(D) The dominant gene changing into a recessive one

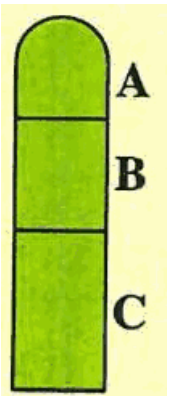
---

31 Study the following figure, which shows a section in one of the genes (DNA), showing coding regions called (exons) and non-coding regions called (introns):
Which figure expresses a defect in DNA that changes the protein produced by this gene? (1st session 2021)



---

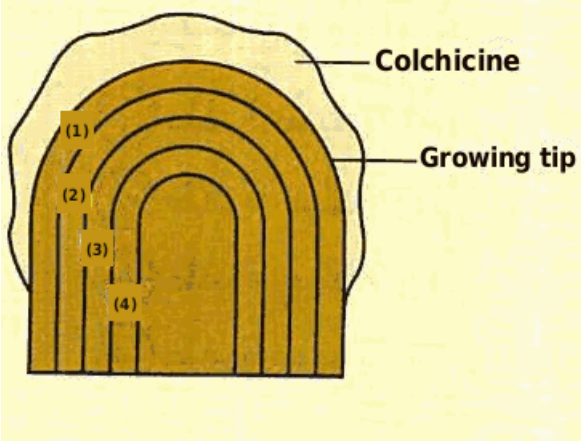
32 The opposite figure expresses the stem of a plant treated with nitrous acid. Identify in which regions the separating membrane between the cells produced by division may fail to form. (2nd session 2021)



(A) A and B (B) A (C) B and C (D) B

---

33 Study the opposite figure, which represents a growing tip of a plant treated with colchicine, then identify which regions' cells will not succeed in growing to produce large fruits. (1st session 2022)

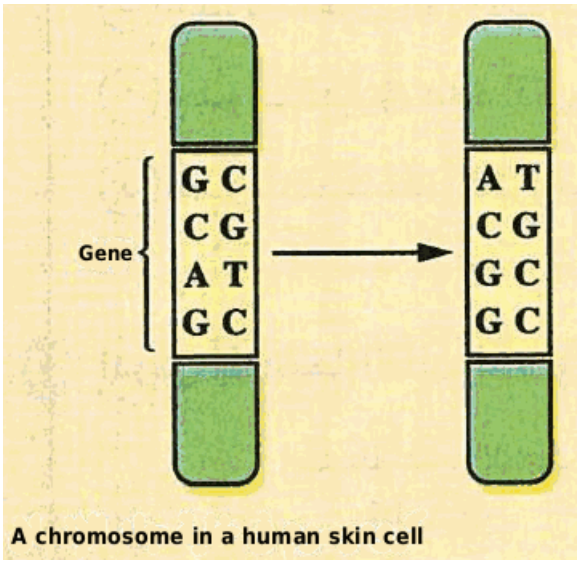


(A) (1) (B) (2) (C) (3) (D) (4)

34 Which of the following describes the difference between the mutation in the Ancon breed of sheep and the mutation in Penicillium fungus? (1st session 2022)

(A) The importance
(B) The possibility of inheritance
(C) The origin and the importance
(D) The origin and the place of occurrence

35 Study the drawing in front of you, then identify the result of this change. (2nd session 2022)



(A) A chromosomal mutation
(B) A germinal mutation
(C) A true mutation
(D) A gene mutation

36 What is the reason for a mutation that led to a recessive trait appearing in honey bee males? (2nd session 2022)

(A) A gene mutation in the sperms

(B) A chromosomal mutation in the ova

(C) A gene mutation in both the ova and the sperms

(D) A gene mutation in the ova

---

37 A small-fruited strawberry plant was self-pollinated and produced large-fruited plants. What is the reason for this case? (Trial exam 2023)

(A) Segregation of genes in meiotic division

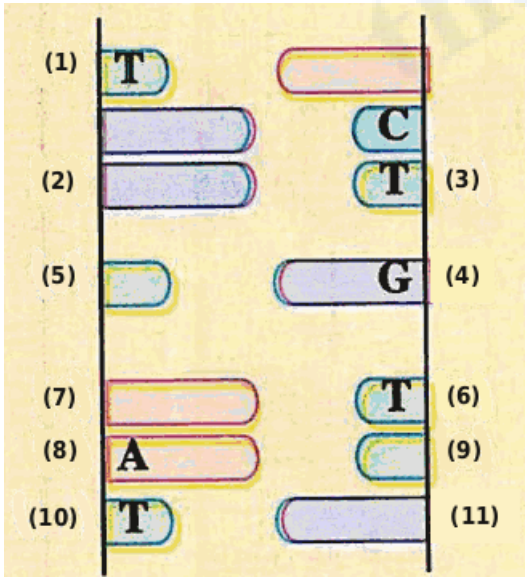
(B) A change in the place of the size gene on the chromosome

(C) Segregation of genes in mitotic division

(D) The chromatids not separating after the centromere divides

---

38 In front of you is a piece of a DNA molecule. Which of the following substitutions leads to a mutation? (Trial exam 2023, Sample exam 2025)



(A) Nucleotide (4) instead of (2)

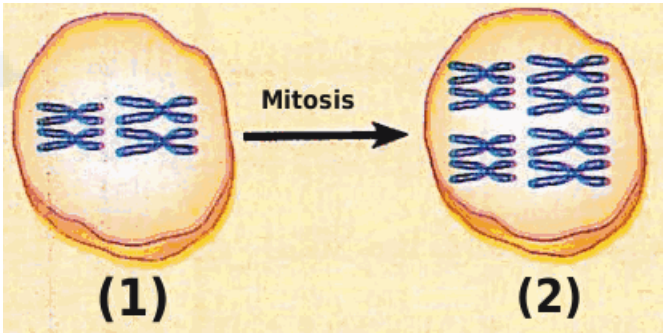
(B) Nucleotide (2) instead of (11)

(C) Nucleotide (11) instead of (8)

(D) Nucleotide (8) instead of (7)

---

39 The opposite figure shows a cell dividing mitotically. Study it, then deduce which of the following is NOT a reason for the change from (1) to (2). (1st session 2023)



(A) The aqueous medium inside the cell
(B) Chemicals and radiation
(C) A defect in cytoplasmic division
(D) A defect in forming the spindle fibres

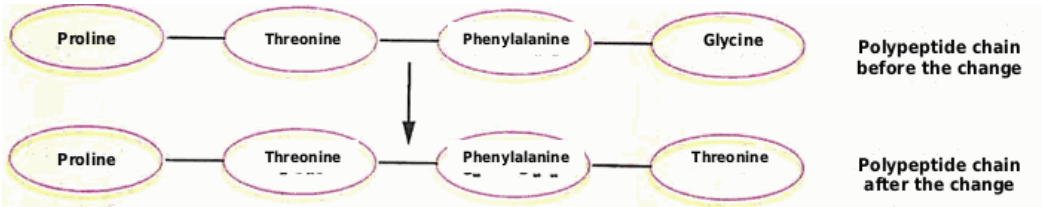
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40 Some people were exposed to high levels of radiation in a nuclear power station, which caused them to get cancer. What is the reason these people got cancer? (2nd session 2023)

(A) A change in the DNA of the gamete cells
(B) A change in the DNA of the body cells
(C) A change in the number of chromosomes of the body cells
(D) Doubling of the chromosomes in the gamete cells

---

41 Study the following chart, which shows the change that happened during the formation of a polypeptide chain, then deduce:
What type of mutation happened and led to this change? (2nd session 2023)

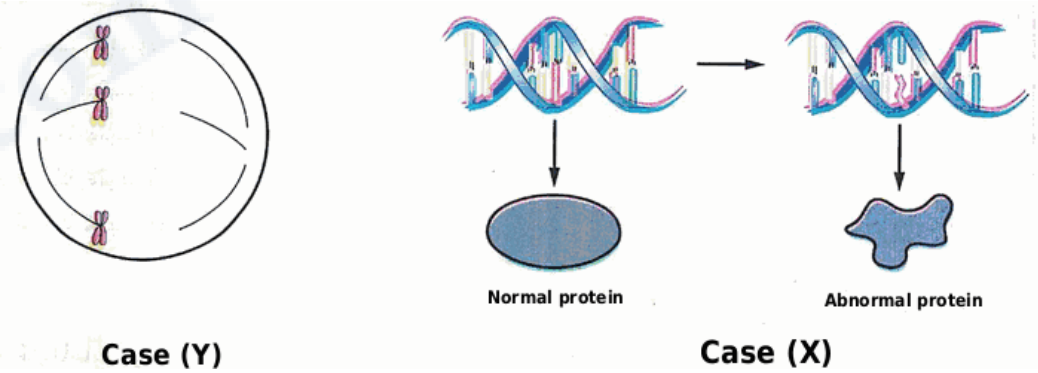


(A) A gene mutation in which the gene changed from dominant to recessive
(B) A gene mutation that resulted in forming a new protein
(C) A chromosomal mutation that resulted in repeated protein formation
(D) A chromosomal mutation that resulted in a change in the order of genes

---

42 Study the following figures, which show some types of mutations in the cells of the organism, then deduce:

What distinguishes the mutation in case (X) from the mutation in case (Y)? (1st session 2024)



(A) When it happens in plants we get larger plants

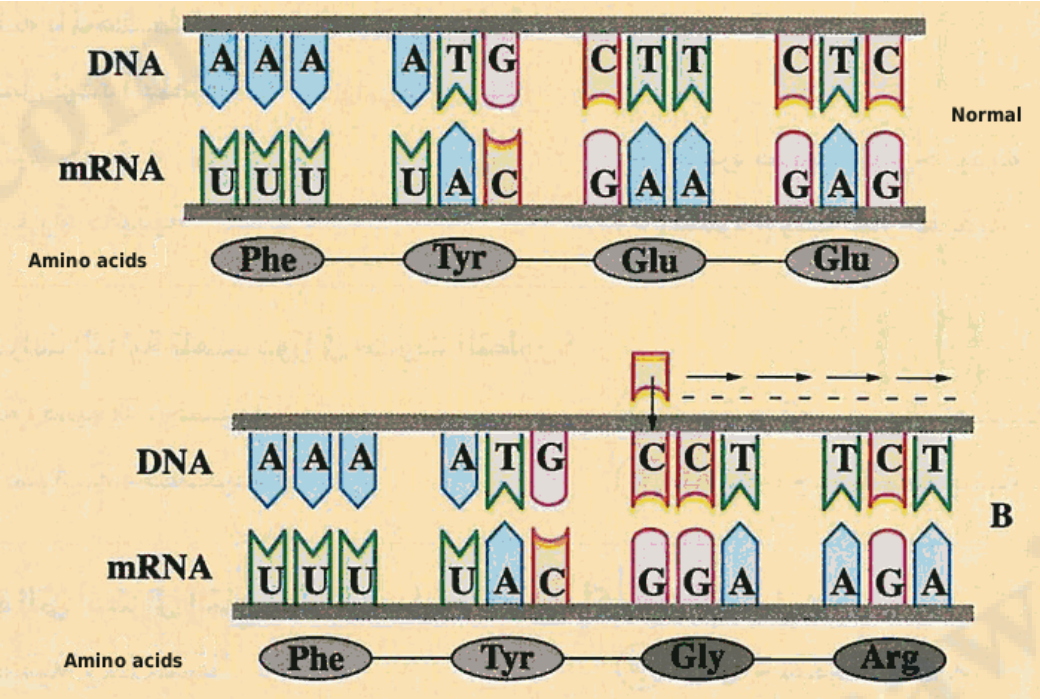
(B) It can be repaired by ligase enzymes

(C) Humans induce it using colchicine

(D) When it happens the structure of the chromosomes changes

43 Study the following figure, then deduce:

What is the reason for the mutation in case (B)? (1st session 2024)



(A) Inserting a nucleotide into the gene

(B) Substituting one nucleotide for another in the gene

(C) Deleting a nucleotide from the gene

(D) Inserting a codon into the gene

---

44 Which bonds in the DNA structure are the most likely to break when it is in the aqueous environment of the cell? (2nd session 2024)

(A) The two hydrogen bonds

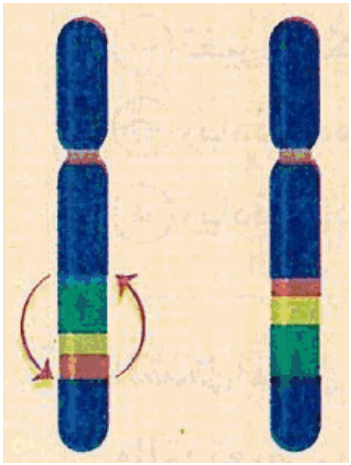
(B) The three hydrogen bonds

(C) The covalent bonds

(D) Both the hydrogen and covalent bonds equally

---

45 Study the figure in front of you, then deduce what type of mutation happened and led to this change. (2nd session 2024)

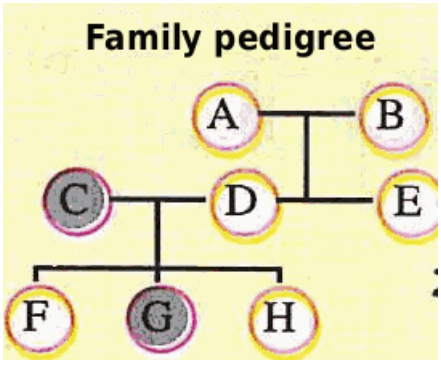


(A) Gene (B) Chromosomal (C) Somatic (D) Spontaneous

46 What type of mutation is used in industrial production to produce seedless fruits using colchicine? (2nd session 2024)

(A) Somatic only
(B) Germinal only
(C) Gene and chromosomal
(D) Chromosomal and somatic

47 The opposite chart represents the pedigree of a family; the shaded individuals in the chart were exposed to a mutation. What is the probable type of this mutation? (Sample exam 2025)



(A) A true gene mutation
(B) A non-true chromosomal mutation
(C) A true somatic mutation
(D) A non-true gene mutation

48 Which of the following types of mutations play a role in evolution? (Sample exam 2025)

(A) Induced, chromosomal, somatic
(B) Induced, gene, somatic
(C) Spontaneous, chromosomal, somatic
(D) Spontaneous, gene, germinal

49 What type of mutation led to Penicillium fungus producing larger amounts of penicillin? (Sample exam 2025)

(A) An induced somatic mutation
(B) A spontaneous somatic mutation
(C) An induced germinal mutation
(D) A spontaneous germinal mutation

50 What is the result of the centromere not separating during cell division in the grape stem? (Sample exam 2025)

(A) A germinal gene mutation
(B) A germinal chromosomal mutation
(C) A somatic chromosomal mutation
(D) A somatic gene mutation

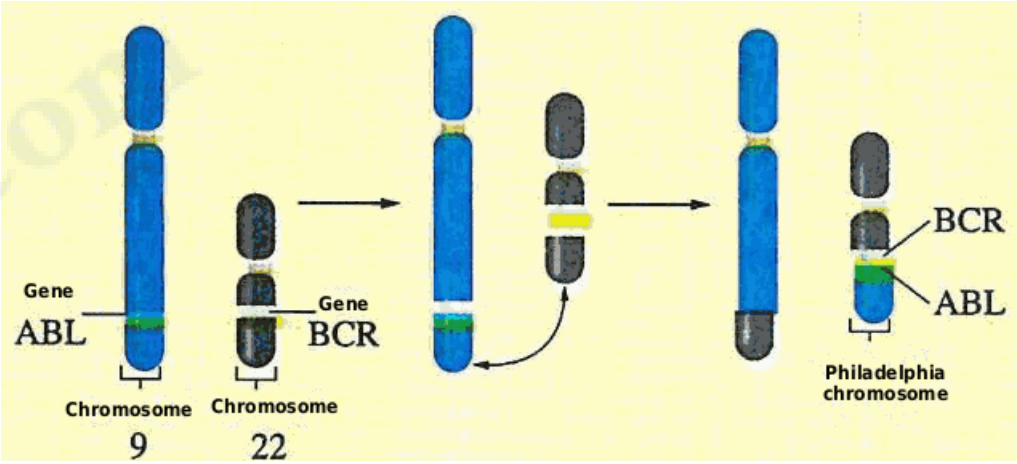
51 Mutations in humans are inherited if they are ..... mutations. (1st session 2025)

(A) gene (B) chromosomal (C) germinal (D) spontaneous

52 What is the nature of the mutation that caused the increase in the production of the antibiotic by Penicillium fungus? (2nd session 2025)

(A) A change in the order of the nitrogenous bases of the penicillin gene
(B) A change in the place of the penicillin gene on the chromosome carrying it
(C) An increase in the number of chromosomes carrying the penicillin gene
(D) An increase in the number of penicillin genes on the chromosome carrying them

53 The opposite figure shows one of the types of mutations known as the Philadelphia chromosome. What is the cause of this mutation? (Sample exam 2026)



(A) A piece of the chromosome separates and then rejoins after turning 180°

(B) Exchange of parts between non-homologous chromosomes

(C) Adding a part to the chromosome

(D) Losing a part of the chromosome

Answer key and solutions

Multiple choice questions

1 A	2 B	3 C	4 D	5 D	6 B	7 B	8 C	9 C	10 B
11 B	12 B	13 A	14 C	15 A	16 A	17 C	18 A	19 C	20 B
21 C	22 B	23 D	24 B	25 B	26 A	27 C	28 B	29 C	30 B
31 C	32 D	33 C	34 B	35 D	36 A	37 A	38 B	39 C	40 D
41 C	42 A	43 D	44 D	45 B	46 B	47 D	48 D	49 B	50 A
51 C	52 C	53 D	54 A	55 B	56 A	57 A	58 D		

1 **Answer (A)**

The plasmid is circular, so it has no free ends and no free phosphate groups.

2 **Answer (B)**

Each chromosome is one DNA molecule bound to proteins.

3 **Answer (C)**

Proteins (histones) have DNA wrapped around them, so they compact it.

4 **Answer (D)**

Amoeba is a eukaryote, while DNA in bacteria, mitochondria and plastids is circular without chromosomes.

5 **Answer (D)**

Insulin is produced when its gene is activated, and gene regulation is done by the regulatory non-histone proteins.

6 **Answer (B)**

DNA carries a negative charge, so it moves towards the positive pole.

Histones carry a positive charge, so they move towards the negative pole.

7 **Answer (B)**

The plasmid is circular DNA that replicates along with the bacterial DNA before cell division.

8 **Answer (C)**

The salamander has a large amount of DNA against a small amount of protein, which applies to C.

9 **Answer (C)**

The amount of DNA is not related to the amount of protein produced.

10 **Answer (B)**

Some types of salamander have more DNA than humans, so the amount of DNA is not related to advancement.

11 **Answer (B)**

Bacteria may contain a plasmid, while the bacterial virus does not.

12 **Answer (B)**

DNA in all organisms is made of the same four types of nucleotides.

13 **Answer (A)**

The negative charge comes from the phosphate group (X).

14 **Answer (C)**

(1) is a circular plasmid not bound to proteins.

(2) is the bacterial chromosome, coiled several times and not complexed with proteins.

15 **Answer (A)**

The plasmid carries a small number of genes, and the bacterial chromosome carries large numbers.

16 **Answer (A)**

The telomere protects the end of the chromosome, and without it genetic information is lost.

17 **Answer (C)**

The chromosome is made of DNA, DNA of genes, and the gene of nucleotides.

18 **Answer (A)**

DNA in eukaryotes is linear, not circular.

19 **Answer (C)**

Histones are found in the nucleus, not in the cytoplasm.

20 **Answer (B)**

E. coli bacteria are prokaryotes with no histones, so there are no nucleosomes.

21 **Answer (C)**

(X) is DNA, whose building unit is the nucleotide, and (Y) is the histone, whose building unit is the amino acid.

22 **Answer (B)**

DNA is negatively charged and the histone is positive, so they bind because of the difference in charges.

23 **Answer (D)**

The mitochondria come from the mother only (the female).
The nucleus comes from both the father and the mother.

24 **Answer (B)**

Chromatin = DNA + proteins, so (Y) is DNA, with (X) histone and (Z) non-histone proteins.

25 **Answer (B)**

(A) is condensation and (B) is unwinding to start building DNA or RNA, so they are opposite.

26 **Answer (A)**

Bacteria have one origin of replication, while the many forms (replication bubbles) are in eukaryotes.

27 **Answer (C)**

Bacteria are prokaryotes with no histones, so there are no nucleosomes.

28 **Answer (B)**

All body cells carry the same genes, but the gene works in beta cells only.

29 **Answer (C)**

The plasmid replicates with the bacterial DNA, so each daughter cell takes one plasmid and one DNA molecule.

30 **Answer (B)**

Viruses whose genetic material is single-stranded RNA have a clear 3' end, while DNA in bacteria, mitochondria and plasmids is circular with no free ends.

31 **Answer (C)**

The gene that forms enzyme (X) is a part of DNA shared between (A) and (C).

32 **Answer (D)**

Both use the same replication enzymes: helicase, primase, polymerase and ligase.

33 **Answer (C)**

The positive alkyl groups in histones bind strongly to the negative phosphate groups in DNA.

34 **Answer (B)**

The sperm head has only 23 DNA molecules, while the ovum has 23 DNA molecules along with mitochondrial DNA.

35 **Answer (D)**

16 DNA molecules × 2 free phosphate groups per molecule = 32 groups, then double after replication = 64.

36 **Answer (A)**

Process (X) is repair of the damaged gene, in which ligase enzymes work, so division is normal in person (1).

37 **Answer (A)**

A gene mutation changes the nucleotide sequence, so the trait changes.

38 **Answer (B)**

The Sertoli cell is a body cell not passed to the offspring, so the mutation is a non-true somatic mutation.

39 **Answer (C)**

Both mutations are beneficial and achieve an economic benefit.

40 **Answer (D)**

Exchange of parts between two homologous chromosomes does not change the genetic traits, so it is not considered a mutation.

41 **Answer (C)**

A mutation passes to the offspring only if it happens in the primary germ cells.

42 **Answer (A)**

The parents are healthy, so they did not carry the gene; the mutation happened during the embryonic development of the son.

43 **Answer (D)**

The difference is in one base only: C instead of T, so it is a substitution mutation that changes the amino acid and the structure of the protein.

44 **Answer (D)**

Spontaneous mutation happens naturally and produces the variation that evolution scientists study.

45 **Answer (B)**

(2) has an extra nucleotide, so its number of nucleotides is greater than (1).

46 **Answer (B)**

In (1) G was replaced by A, and in (2) a base T was added.

47 **Answer (D)**

The repetition of parts D and E in the chromosome changes its structure.

48 **Answer (D)**

The mutation in gene B stops enzyme (Y), so ornithine is not changed into citrulline, and arginine is not formed.

49 **Answer (B)**

The mutation happens first, then the amino acid sequence changes, then the protein structure, so the change in cell activity results.

50 **Answer (A)**

Cell (B) lost base A from the sequence, so the nucleotide sequence of one gene changed; it is a gene mutation.

51 **Answer (C)**

Protein (Y) stops division, so if it loses its activity, the cells divide continuously and randomly, forming cancer cells.

52 **Answer (C)**

The (4n) plant normally gives (2n) gametes, and the new plant is (8n), so the other gamete is (6n). That is, the chromosomes of the second plant were not reduced.

53 **Answer (D)**

An increase in the number of sex chromosomes causes a chromosomal mutation that results in a change in traits.

54 **Answer (A)**

A missing autosome does not affect the secondary sex characteristics.

55 **Answer (B)**

Damage to two opposite bases cannot be repaired because there is no intact strand, and bacteria reproduce asexually by binary fission, so the mutation appears in the daughter cells only.

56 **Answer (A)**

Base A was replaced by base G in the gene, so the amino acid and the structure of insulin changed.

57 **Answer (A)**

The defect in forming melanin results from a chemical change in the gene, and the mutation is inherited from the parents.

58 **Answer (D)**

The mitochondria in the zygote come from the mother only, so the mutation passes from mothers to their sons and daughters.

Essay questions

1 **Model answer**

A chromosomal mutation in structure, due to the addition of a small part of the chromosome, which is part (A).

2 **Model answer**

(1) The sequence of nitrogenous bases in the complementary DNA piece:
5′... C-C-C-G-G-G-C-A-C ...3′

(2) A gene mutation; it may lead to forming a different protein that causes a new trait to appear.

3 **Model answer**

(1) This happens because the number of chromosomes doubled in the watermelon plant; this doubling produces new traits, such as large fruit size.

(2) Inducing mutations that lead to forming fruit trees with large, sweet-tasting, seedless fruits.

(3) The phenomenon of polyploidy (chromosome doubling).

4 **Model answer**

Structures (X), (Y), (Z) share the building unit that forms each of them, which is the nucleotide.

Past exam questions

1 B	2 B	3 B	4 C	5 A	6 D	7 D	8 B	9 C	10 D
11 D	12 C	13 D	14 B	15 B	16 A	17 C	18 C	19 B	20 B
21 C	22 D	23 B	24 D	25 A	26 C	27 A	28 A	29 B	30 C
31 A	32 D	33 A	34 D	35 D	36 D	37 A	38 A	39 A	40 B
41 B	42 B	43 A	44 A	45 B	46 D	47 A	48 D	49 A	50 C
51 C	52 C	53 B							

1 **Answer (B)**

The amount of DNA is not related to the degree of complexity of the organism, while the proteins formed reflect its degree of complexity and evolution.

2 **Answer (B)**

DNA in eukaryotes wraps around histone proteins forming nucleosomes, which does not happen in prokaryotes.

3 **Answer (B)**

The chromosome in metaphase is highly condensed, which is done by histone proteins (forming nucleosomes) and structural non-histone proteins (the chromosome scaffold).

4 **Answer (C)**

The genetic material of bacteria is DNA, which contains phosphorus and no sulphur, so the percentage of phosphorus is 100% and sulphur zero.

5 **Answer (A)**

Organism (A) has a small amount of DNA, most of which is translated into protein (the ratio is close), so it is a prokaryote.

6 **Answer (D)**

The figure shows DNA wrapped around histones (nucleosomes), which is the structure of DNA in the human cell and is used in its replication.

7 **Answer (D)**

Circular DNA is found in prokaryotes, and also in mitochondria and plastids in eukaryotes.

8 **Answer (B)**

Before cell division the genome replicates completely, while only a small part of it is transcribed.

9 **Answer (C)**

The genome of the salamander cell is about 30 times the genome of the human cell, so the ratio is 30 to 1

10 **Answer (D)**

Fungi are eukaryotes with chromosomes and prokaryote-like DNA (in mitochondria); yeast has plasmids, and they are not autotrophic: organism N

11 **Answer (D)**

Uncoiling DNA (from 1 to 2) requires the cell to be active for replication and mitotic division, as in budding in hydra.

12 **Answer (C)**

Repetitive DNA is DNA sequences of which many copies are found in the genome.

13 **Answer (D)**

14 **Answer (B)**

Non-coding DNA is pieces that are neither transcribed nor translated into protein.

15 **Answer (B)**

Mitochondrial and plastid DNA are both circular, but each carries the code of proteins different in type and number.

16 **Answer (A)**

Most eukaryotic DNA is non-coding, so the percentage of coding parts in it is lower than in prokaryotes.

17 **Answer (C)**

The genome is the whole genetic content, that is, all the nucleotide sequences found on the chromosomes.

18 **Answer (C)**

The middle piece has mitochondria, which contain circular DNA (its ends are joined).

19 **Answer (B)**

Chromatin forms when DNA wraps around histones and condenses into fibres, which is stage C

20 **Answer (B)**

16 chromosomes = 16 DNA molecules, plus the plasmid, so the number = 17

21 **Answer (C)**

The genome of the bacterial cell includes the chromosomal DNA (B) and the plasmids (C).

22 **Answer (D)**

The bacterial chromosome (B) is a circular double-stranded DNA molecule, and the three plasmids (C) are also double-stranded DNA molecules, so the number is 4

23 **Answer (B)**

Plasmids are found in bacteria and yeast, and are not found inside mitochondria and plastids.

24 **Answer (D)**

Plasmids replicate at the same time as the bacterial chromosome, a trait that resembles DNA replication before division in eukaryotes.

25 **Answer (A)**

All the body cells of one organism carry the same genome, so the base percentages are identical.

26 **Answer (C)**

Histone proteins and coding and non-coding sequences are characteristics of eukaryotic DNA, like yeast fungus.

27 **Answer (A)**

The nuclear membrane protects the genetic material and regulates transcription accurately.

28 **Answer (A)**

Gene (A) is repeated on the chromosome: a chromosomal mutation (addition of a part), so the effect of the gene increases.

29 **Answer (B)**

Treatment with radiation or chemicals causes the number of chromosomes to double, so the genes are repeated and the amount of protein increases.

30 **Answer (C)**

The large size of the fruits is due to polyploidy, so the genes are repeated.

31 **Answer (A)**

The defect that changes the protein is the one that happens in a coding region (exon) and changes the paired base, which is figure (A).

32 **Answer (D)**

Region (B) is the region of dividing cells, so nuclear division may happen there without forming a separating membrane.

33 **Answer (A)**

Colchicine affects dividing cells, and the outer region (1) was not affected by it, so it will not produce large fruits.

34 **Answer (D)**

The Ancon mutation is spontaneous in gamete cells, and the Penicillium mutation is induced in body cells, so the difference is in the origin and the place of occurrence.

35 **Answer (D)**

The order of the nitrogenous bases in the gene changed: a gene mutation.

36 **Answer (D)**

Bee males are produced from unfertilized ova, so the recessive trait appearing in them is due to a gene mutation in the ova.

37 **Answer (A)**

With self-pollination the genes segregate in meiotic division and the recessive trait (large fruits) appears.

38 **Answer (A)**

Substituting a nucleotide that carries a different base changes the sequence, which happens in (A).

39 **Answer (A)**

Polyploidy is caused by a defect in the spindle fibres or cytoplasmic division, or by chemicals and radiation, not by the aqueous medium.

40 **Answer (B)**

Radiation changed DNA in the body cells, so they became cancerous.

41 **Answer (B)**

One amino acid in the chain changed: a gene mutation that resulted in a new protein.

42 **Answer (B)**

Case (X) is a gene mutation (a change in bases) that can be repaired by ligase enzymes, and (Y) is a chromosomal mutation that cannot be repaired.

43 **Answer (A)**

In (B) an extra nucleotide (C) entered the gene, so the reading of the codons after it changed.

44 **Answer (A)**

The two hydrogen bonds between A and T are weaker than the three bonds between G and C, so they are the most likely to break.

45 **Answer (B)**

A part of the chromosome was inverted and rejoined: a chromosomal mutation.

46 **Answer (D)**

Colchicine causes chromosome doubling (a chromosomal mutation) in body cells.

47 **Answer (A)**

The mutation passes through the generations (inherited), so it is a true gene mutation.

48 **Answer (D)**

The mutations that play a role in evolution are spontaneous, gene and germinal, because they are inherited.

49 **Answer (A)**

The Penicillium mutation was induced by humans using radiation in body cells.

50 **Answer (C)**

The centromere not separating doubles the chromosomes (a chromosomal mutation) in the body cells of the stem.

51 **Answer (C)**

Only germinal mutations are inherited.

52 **Answer (C)**

The increase in penicillin production resulted from doubling of the number of chromosomes carrying the penicillin gene.

53 **Answer (B)**

The Philadelphia chromosome results from exchange of parts between two non-homologous chromosomes (9 and 22).