HKJSBO Round 1 Competition Explanation Key

5. A virus was found violating Chargaff's rules with the base proportion shown below.

Organism	% A	% G	% C	% T
Virus B	24.0	23.3	21.5	31.2

Which of the following is the most likely explanation for that finding?

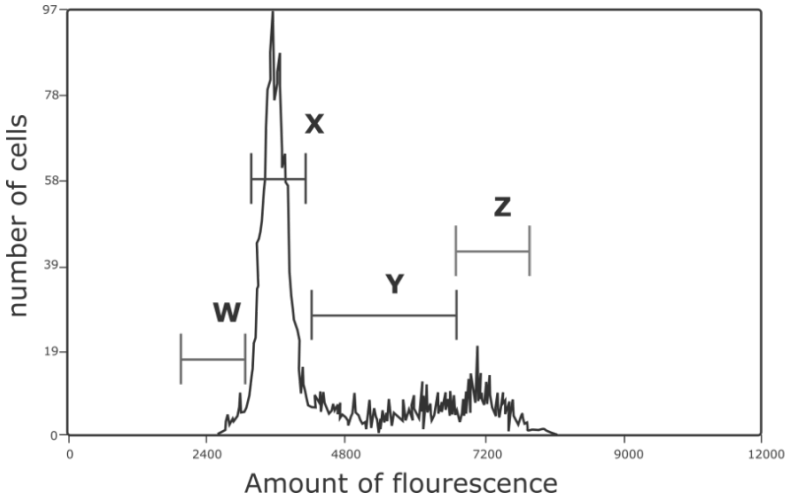
A. The base pairing rules between the two strands of DNA do not apply in this virus.
B. The DNA of the virus B is single-stranded.
C. The genetic material of the virus is RNA.
D. The virus undergoes many mutations in its DNA.

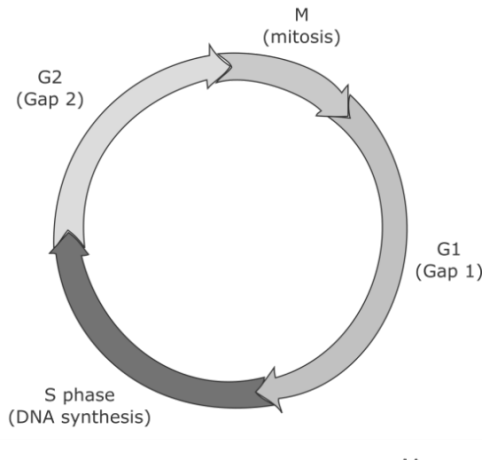
Response	Frequency	Percent
A	96	22.48
*B	64	14.99
C	96	22.48
D	170	39.81
No Response	1	0.23

Explanation

Individual viruses contain either DNA or RNA, which can be single-stranded or double-stranded Statement A is incorrect as the base pairing rules apply to all double stranded DNA viral genome. Statement C is incorrect as the nitrogenous bases of RNA are A, U, C and G. Statement D is incorrect because if the organism carries double stranded DNA, the mutation load is up to 7% of nucleotides change with lots of mismatches throughout the genome. For the ratio provided in the table, the virus cannot survive.

Directions: Question 7 and 8 refers to the diagrams below. When the DNA of a cell is stained by a fluorescent dye, the amount of fluorescence a cell emits indicates the amount of DNA inside the cell. The graph below shows the fluorescence emitted by a population of cells at different phases of the cell cycle.





Phases of cell cycle

7. Which phase(s) of the cell cycle are most of the cells in X and Z?

	X	Z
A	S	M
B	**G1**	**G2 and M**
C	S	G1
D	G1	S

Response	Frequency	Percent
A	150	35.13
*B	136	31.85
C	65	15.22
D	76	17.80

Explanation

The amount of fluorescence indicates the amount of DNA inside the cell. The figure indicates that the amount of DNA inside the cells in Z double that of the cells in X. Thus cells in X have an unreplicated DNA and are therefore in G1 phase. Cells in Z have replicated DNA and are therefore in G2 and M phase.

12. Below is the RNA codon table, which shows the amino acids encoded by the 3-base codons on mRNA.

Codons in mRNA

First Base	Second Base								Third Base
	U		C		A		G		
	UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine	U
U	UUC	Phenylalanine	UCC	Serine	UAC	Tyrosine	UGC	Cysteine	C
	UUA	Leucine	UCA	Serine	UAA	Stop	UGA	Stop	A
	UUG	Leucine	UCG	Serine	UAG	Stop	UGG	Tryptophan	G
	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine	U
C	CUC	Leucine	CCC	Proline	CAC	Histidine	CGC	Arginine	C
	CUA	Leucine	CCA	Proline	CAA	Glutamine	CGA	Arginine	A
	CUG	Leucine	CCG	Proline	CAG	Glutamine	CGG	Arginine	G
	AUU	Isoleucine	ACU	Threonine	AAU	Asparagine	AGU	Serine	U
A	AUC	Isoleucine	ACC	Threonine	AAC	Asparagine	AGC	Serine	C
	AUA	Isoleucine	ACA	Threonine	AAA	Lysine	AGA	Arginine	A
	AUG	Methionine or start	ACG	Threonine	AAG	Lysine	AGG	Arginine	G
	GUU	Valine	GCU	Alanine	GAU	Aspartic Acid	GGU	Glycine	U
G	GUC	Valine	GCC	Alanine	GAC	Aspartic Acid	GGC	Glycine	C
	GUA	Valine	GCA	Alanine	GAA	Glutamic Acid	GGA	Glycine	A
	GUG	Valine	GCG	Alanine	GAG	Glutamic Acid	GGG	Glycine	G

A protein is translated from the template strand of a DNA consisting of the following segment:

5' - AGCGAACTAGGATCGCGAAGATCC- 3' coding strand

3' - TCGCTTGAT **C**CT AGC**G**CTTCTAGG- 5' template strand

1 4 7 10 13 16 19 22 nucleotide number

What would happen to the protein when the following two mutations occur simultaneously in the template strand of this segment of DNA:

- Substitution of C by T at nucleotide number 10
- Deletion of G at nucleotide number 16.

1. The glycine encoded by the codon at nucleotide number 10-12 is replaced by an arginine.
2. Most of the original amino acids will change to other amino acids after the nucleotide number 16.
3. The protein likely loses its function.

A. 1 only

B. 1 and 2 only

C. 2 and 3 only

D. 1, 2 and 3

Response	Frequency	Percent
A	38	8.90
B	85	19.91
C	187	43.79
*D	114	26.70
No Response	3	0.70

Explanation

The template strand is used for the synthesis of mRNA by complementary base pairing. The coding strand is complementary to the template strand and thus has the same sequence of mRNA except that it has nucleotide T instead of U.

mRNA sequence before mutation: AGC GAA CUA GGA UCG CGA AGA UCC

amino acid sequence before mutation: Ser Glu Leu Gly Ser Arg Arg Ser

mRNA sequence after mutation: AGC GAA CUA AGA UCG GAA GAU CC

amino acid sequence after mutation: Ser Glu Leu Arg Ser Glu Asp

In the newly synthesized amino acids, the glycine at nucleotide number 10-12 is replaced by an arginine. The deletion of G at nucleotide number 16 cause a shift of positions of the downstream nucleotides. The resulting amino acids change drastically and the resulting protein likely loses its function. All three statements are correct.

Directions: Questions 19 and 20 refer to the following formula of the Bray-Curtis index (BC_d). This index is used to express the *ecological dissimilarity* between two different sites.

$$BC_d = \frac{\sum |x_i - x_j|}{\sum (x_i + x_j)}$$

here,

X_i is the number of individuals of each species found at site i;

X_j is the number of individuals of each species found at site j;

$\sum |x_i - x_j|$ is the sum of the differences of number of individuals of each species between two sites i and j, without regard to its positive or negative signs.

$\sum (x_i + x_j)$ is the sum of the total numbers of individuals of each species in the two sites i and j

19. What is the Bray-Curtis index between site L and M?

Species	Site L	Site M
rabbits	10	0
voles	4	5
squirrels	0	3
mice	0	6
sparrows	6	2
toads	2	2
TOTAL	22	18

A. 0.1

B. 0.3

C. 0.6

D. 0.9

Response	Frequency	Percent
A	225	52.69
B	33	7.73
*C	153	35.83
D	16	3.75
No Response	0	0.00

Explanation

Bray-Curtis index = $\frac{\text{the sum of the differences of number of individuals of each species between two sites i and j}}{\text{the sum of the total numbers of individuals of each species in the two sites i and j}}$

$= \frac{10+1+3+6+4+0}{10+9+3+6+8+4}$

$= 0.6$

20. Which of the following is correct when the Bray-Curtis index is 0 between two sites?

1. The two sites have the same species of organisms.
2. The two sites have the same number of species.
3. The two sites have the same number of individuals of each species.

A. 1 only

B. 1 and 3 only

C. 2 and 3 only

D. 1, 2 and 3

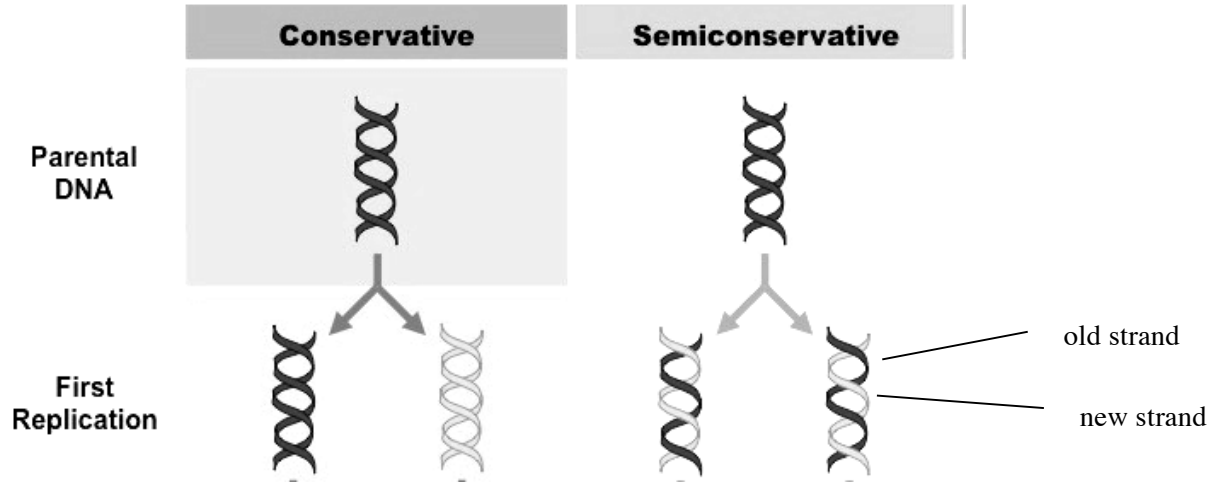
Response	Frequency	Percent
A	47	11.01
B	85	19.91
C	156	36.53
*D	137	32.08
No Response	2	0.47

Explanation

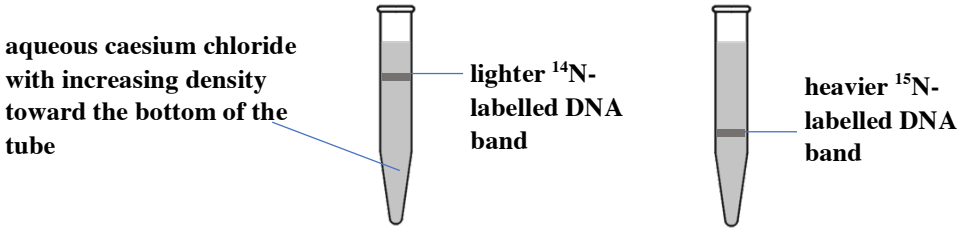
Bray-Curtis index is the index of ecological dissimilarity and it takes the value from 0 to 1. It is used to compare the species composition between two sites. The value of 0 means the two sites share the same species composition and the value of 1 means the two sites do not share the same species composition. If the two sites share all the same species of organisms and same number of species, the ecological dissimilarity is 0.

According to the given equation, if the two sites have the same number of individuals of each species, $X_i - X_j = 0$ and the Bray-Curtis index become 0.

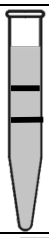
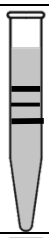
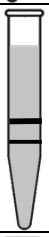
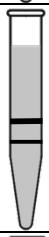
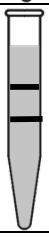
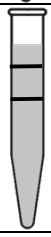
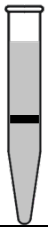
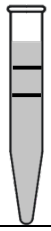
Direction: Questions 21 -22 refer to the experiment performed by Meselson and Stahl in 1958. They aimed to find out whether DNA replication is conservative or semi-conservative. In the conservative mechanism, a new DNA consisting of two new strands is produced. In a semi-conservative mechanism, each new DNA consists of one new and one old strand.



In their experiment, the bacteria were first incubated for 14 generations in a medium containing radioactive $^{15}NH_4Cl$ as the only nitrogen source. As such, the bacterial DNA consisted of ^{15}N. Then, the medium was abruptly changed to ^{14}N. From this time on, the newly synthesized DNA consisted of ^{14}N, which was a little lighter than the DNA consisted of ^{15}N. To separate the heavier and lighter DNA, the bacterial DNA was then sampled at regular intervals and centrifuged in caesium chloride solution. The caesium chloride solution forms a density gradient upon centrifugation so that the heavier DNA molecules will stop at lower position. The positions of the DNA bands were observed under ultraviolet radiation.

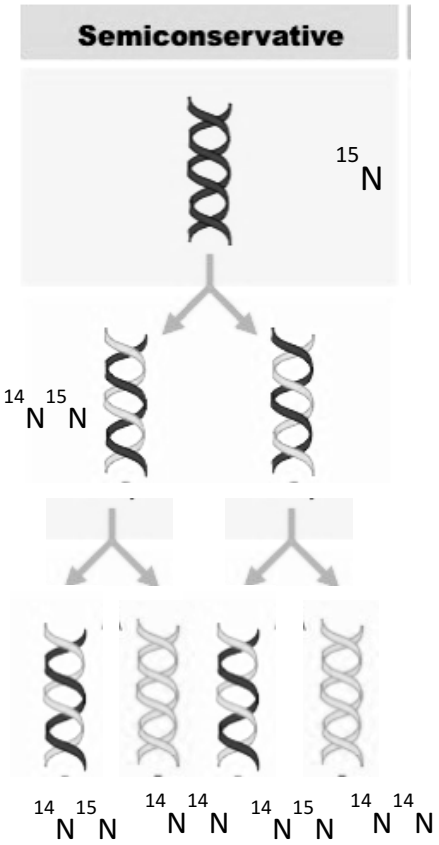


21. Which of the following shows the expected observations for conservative or semi-conservative replication, assuming that all the bacteria are replicating their DNA at the same time?

	Proposed mechanism of DNA replication	Before replication in the ^{14}N medium	after 1st replication in the ^{14}N medium	after 2nd replication in the ^{14}N medium
A	conservative			
B	conservative			
C	semi-conservative			
D	**semi-conservative**			

Response	Frequency	Percent
A	101	23.65
B	87	20.37
C	125	29.27
*D	114	26.70
No Response	0	0.00

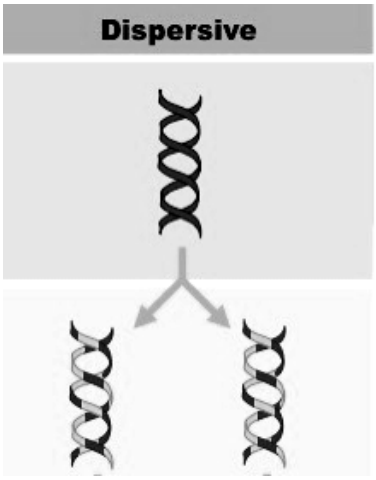
Explanation

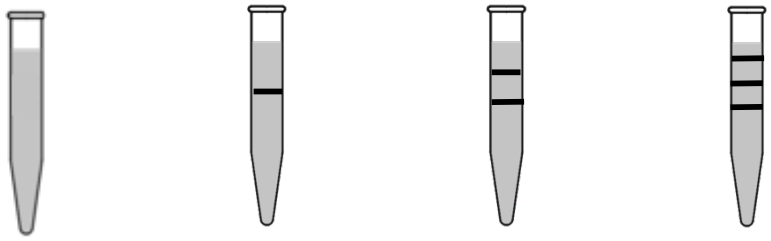


In semiconservative mechanism, each DNA strand acts as a template to make new complementary strand. It results in two DNA molecules with one new strand (^{14}N) and one old strand (^{15}N) after 1st replication. Therefore a single band ($^{14}N^{15}N$) with intermediate in density between heavy ^{15}N DNA and light ^{14}N DNA is resulted. No $^{15}N^{15}N$ band remains.

After 2nd replication, two bands, one with intermediate in density ($^{14}N^{15}N$) and one with lighter in density ($^{14}N^{14}N$) are resulted.

22. At the time, there was a third model of DNA replication proposed - dispersive model. This model hypothesizes that the old DNA materials are distributed randomly in the newly replicated DNA. According to the dispersive model, what is the expected observation obtained from the above experiment after the 2nd replication in the ^{14}N medium?





A **B** C D

Response	Frequency	Percent
A	39	9.13
* B	90	21.08
C	140	32.79
D	157	36.77
No Response	1	0.23

Explanation

In the dispersal model, the old DNA materials are distributed randomly in the two newly replicated DNA, which have similar proportion of ^{15}N and ^{14}N Therefore, the newly replicated DNAs are similar in density and thus only one band will be observed although the band may be more diffuse due to random distribution The DNA band will become lighter in density after each replication since the DNA will contain more ^{14}N.

24. Some people argue that giant pandas are an evolutionary dead-end. That means, even without the interference of humans, it is doomed to extinction naturally. Which of the following supports that giant pandas are driven to extinction because of human interference rather than a natural process of evolution?

1. Giant pandas started to eat bamboos as their main food about 2 million years ago. The bamboos eaten by giant pandas will naturally flower and die off every 15 to 100 years.
2. Giant pandas have relatively high levels of genetic variation.
3. The habitats of giant pandas have been seriously fragmented by roads and farmlands.

A. 1 only

B. 3 only

C. 1 and 3 only

D. 1, 2 and 3

Response	Frequency	Percent
A	28	6.56
B	307	71.90
C	56	13.11
*D	36	8.43
No Response	0	0.00

Explanation

The fact that pandas have survived the cycles of bamboo flowering and dying for 2 million years ago suggests this natural process is not the cause of their extinction.

If pandas are endangered due to their not adapting well to the natural environmental changes in history, they should show low genetic variation. Their relatively high genetic variation indicates that they are able to cope with natural changes through evolution. So their small population size now is more likely a result of human interference that occurs recently.

Fragmentation of the habitats can drive pandas to extinction.

26. Which of the following are needed for the occurrence and spread of vancomycin resistant bacteria?

1. Vancomycin is increasingly used to treat bacterial infections.
2. Some bacteria had taken up the plasmids with vancomycin resistant genes.
3. Random mutations occur in the genes of the bacteria, making them resistant to vancomycin.
4. The vancomycin resistant bacteria survive and reproduce better than the same strain of bacteria without the resistance in any environment.

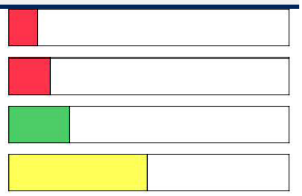
A. 1 and 2 only

B. 3 and 4 only

C. 1, 2 and 3 only

D. 1, 2, 3 and 4

Response	Frequency	Percent
A	47	11.01
B	67	15.69
* C	97	22.72
D	213	49.88
No Response	3	0.70

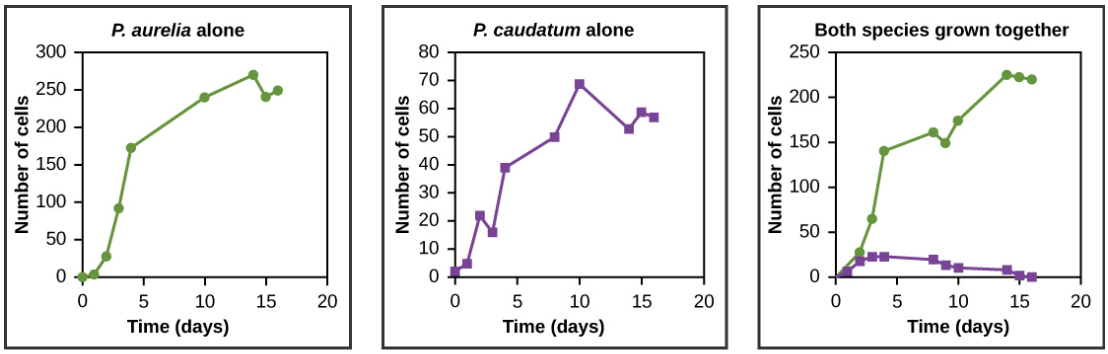


Explanation

Statements 1 to 3 are the cause of the occurrence and spread of vancomycin resistant bacteria. Statement 4 is incorrect because the vancomycin resistant bacteria survive and reproduce better than the same strain of bacteria without the resistance only in the presence of vancomycin.

Direction: Questions 27-28 refer to the results of the experiment below. The graphs below show how the population size of two species of *Paramecium* (single-celled organisms) changes over time when growing alone and when grown together in glass flasks filled with liquid growth media.

A paramecium



(a) (b) (c)

27. Which of the following can support that the two species of Paramecium is having competition when grown together?

1. When grown together, *P. aurelia* grows faster than *P. caudatum*.
2. *P. caudatum* grows more slowly when grown with *P. aurelia* than when it is grown alone.
3. *P. aurelia* grows more slowly when grown with *P. caudatum* than when it is grown alone.

A. 1 only

B. 1 and 2 only

C. 2 and 3 only

D. 1, 2 and 3

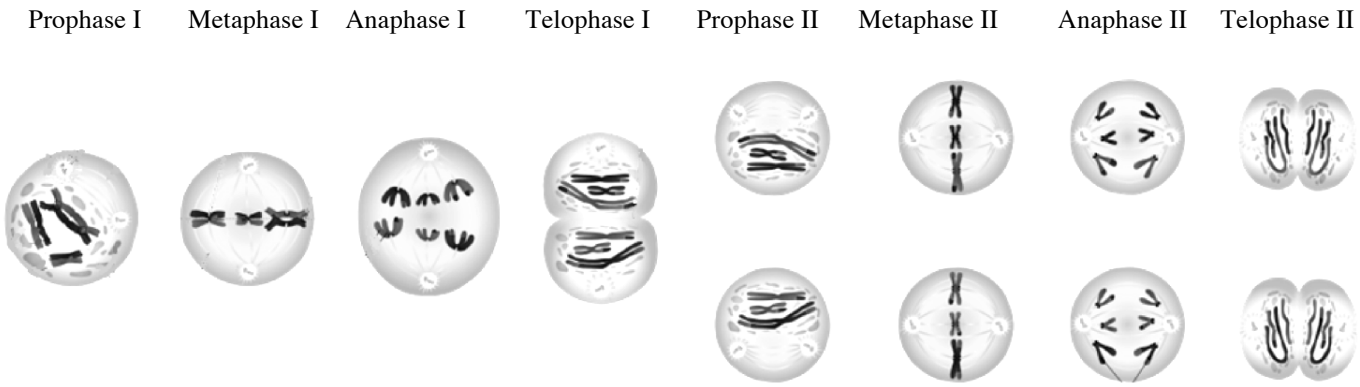
Response	Frequency	Percent
A	33	7.73
B	167	39.11
* C	140	32.79
D	87	20.37

Explanation

Statement 1 is incorrect. Even *P. aurelia* grows faster than *P. caudatum* , it does not support that they are in competition.

Statement 2 and 3 are correct as shown in fig. (a) and (c); fig. (b) and (c)Please note that the scales of the Y axis of the three graphs are different.

30. The figure below shows the different phases of meiosis. If the chromosome number of a cell right before a meiotic division is represented as 2N, in which of the phases of the meiotic division do the cells have a chromosome number represented as N?



A. Metaphase I and the phases after it

B. Telophase I and the phases after it

C. Metaphase II and the phases after it

D. Telophase II

Response	Frequency	Percent
A	36	8.43
*B	157	36.77
C	63	14.75
D	170	39.81
No Response	1	0.23

Explanation

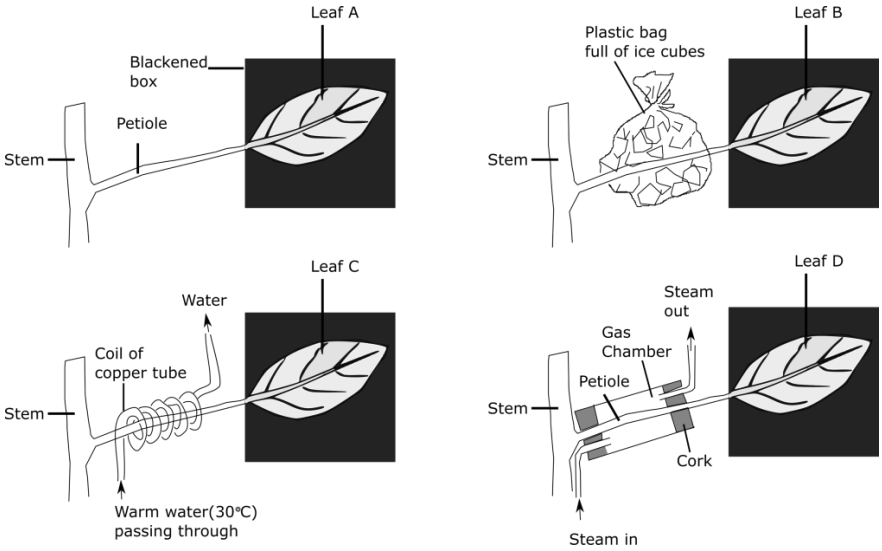
A cell which contains two sets of chromosomes, i.e. a pair of homologous chromosome, is said to be diploid which represented as 2n.

As shown in the figure, in prophase I and metaphase I, the cell consists of 3 pairs of homologous chromosome, thus the cell has a chromosome number of 2n (n=3)

In anaphase I, two members of each pair of homologous chromosome separate and move towards the two poles of the cell.

In telophase I, two members of each pair of homologous chromosome reach the two poles. A single set of chromosome (N) is at each pole, with only one of the members of each pair of homologous chromosome. A nuclear membrane form around each set of chromosome. Thus the cell in telophase I and the phases after it is said to be haploid (N).

32. In photosynthetic experiments, the plants need to be first destarched in a dark box. The following experiment investigates how the rate of destarching a leaf is affected by treating the petiole with different temperatures.



When the experiment was done in a valid way, what would be the expected results if the transport of sugars in petiole is an active process by living cells?

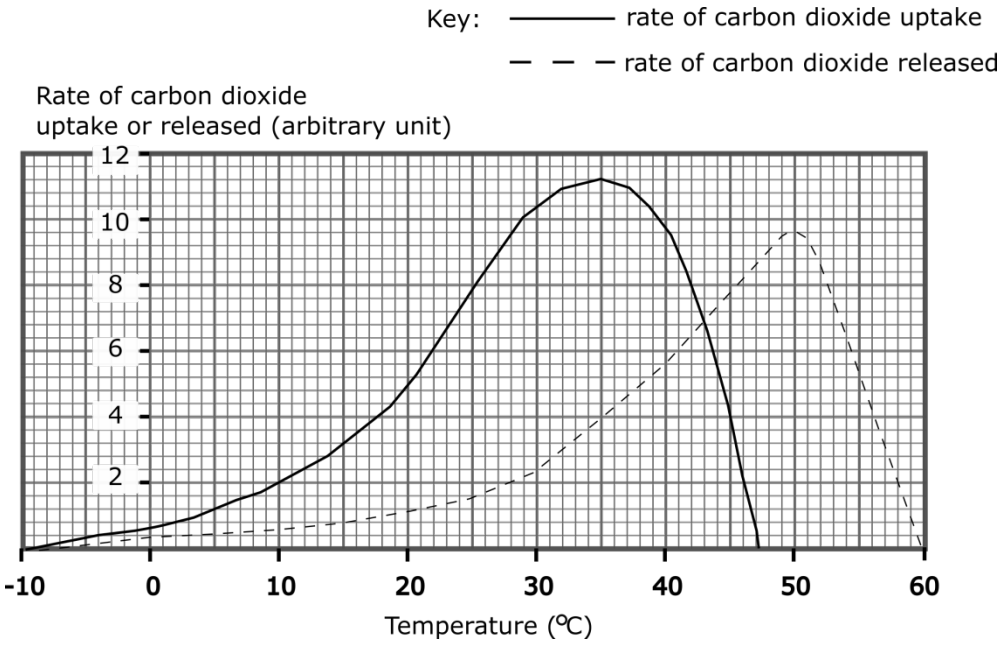
	Time needed for destarching the leaf ***(from the longest to the shortest time)***
A	A -> B -> C -> D
B	B -> D -> C ->A
C	B -> A-> C -> D
D	**D -> B-> C -> A**

Response	Frequency	Percent
A	34	7.96
B	64	14.99
C	224	52.46
* *D*	104	24.36
No Response	1	0.23

Explanation

The rate of destarching depends on the rate that the simple sugars are translocated out of the leaves through petiole.The tranlocation of sugars in phloem is an active process that requires energy from living cells. In D, the living cells of the phloem in the petiole have been killed by the hot steam so that the sugars in leaves cannot be translocated out. As a result, it takes the longest time for destarching. In B, the cooling of the petiole slows down the enzymes and metabolism of the phloem cells and thus slows down the translocation of the sugars. In C, the petiole is warmed to 30°C, which may have faster or slower translocation rate than in A, depending on the environmental temperature.

33. In a study about the growth of a plant in a greenhouse, the rate of carbon dioxide uptake by photosynthesis and the rate of carbon dioxide released by respiration at different temperatures were determined. The results are shown in the graph below:



With reference to the above results, what is the optimum temperature for the growth of the plant?

A. 31°C

B. 35°C

C. 43°C

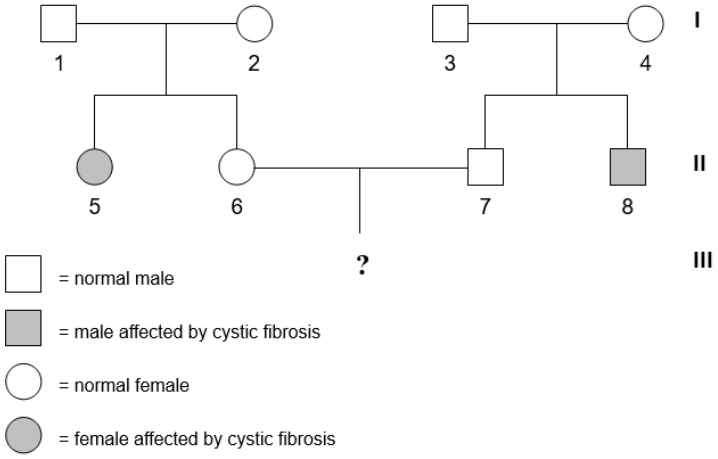
D. 50°C

Response	Frequency	Percent
*A	96	22.48
B	209	48.95
C	103	24.12
D	17	3.98
No Response	2	0.47

Explanation

The net uptake of carbon dioxide at 31°C = 10.8 – 2.8 = 8 arbitrary unit; 35 °C = 11.2 – 4 = 7.2 arbitrary; 43°C = 0 arbitrary unit; 50°C = 0 arbitrary unit. Therefore, the plant has a maximum net uptake of carbon dioxide at 31°C, which indicates the greatest net food production and growth of the plant

39. Cystic fibrosis is an inherited disorder in humans. This disorder is due to a recessive allele of CFTR gene on the chromosome 7. The following diagrams show the pedigrees of two random families who are associated by marriage (individuals 6 & 7):



Individual 6 and 7 are planning to have a child. With no prior genetic diagnosis, what is the chance of this couple to have a child with cystic fibrosis?

A. 6% **B. 11%** C. 25% D. 50%

Response	Frequency	Percent
A	61	14.29
*B	45	10.54
C	178	41.69
D	143	33.49

Explanation

Couple 1,2 and couple 3,4 must be heterozygous as they must have given a CF allele to the CF child and a normal allele to the normal child. So the chance of 6 and 7 to be heterozygous is 2/3 (Not 2/4 since they are known to be normal). The chance of heterozygous 6 and 7 giving a child with cystic fibrosis is 1/4. Therefore, the chance of this couple having a child with cystic fibrosis is 2/3 x 2/3 x 1/4 = 1/9 = 11%.

Direction: Questions 41-42 refer to the story of James Lind who conducted probably the first clinical trial in history. He wanted to know how to treat a mysterious disease called scurvy that was often found among sailors.

The experiment involved 12 similar sailors with scurvy, who were put in the same room of the ship and given the same basic diet for two weeks. The 12 men were divided into six groups and each group of two were given one of the following six treatments:

(1) 1100ml of cider (an alcohol drink made from apple) every day.

(2) 25 ml of dilute sulphuric acid every day.

(3) 18 ml of vinegar three times a day.

(4) 280ml of sea water every day.

(5) two oranges and one lemon every day.

(6) a medicine made up of garlic, mustard seed, dried radish root and gum myrrh every day.

After 6 days of the experiment, only the two men in Group 5 became much better, but the men in other groups were still sick. At that time, people knew nothing about vitamins and deficiency diseases.

41. Which of the following conclusion(s) could be reasonably made from the results of the experiment at the time of James Lind?

1. Vitamin C is an essential component of a healthy diet.
2. Fresh fruits can cure scurvy.
3. Oranges can cure scurvy.

A. 1 only.

B. 2 only.

C. 2 and 3 only.

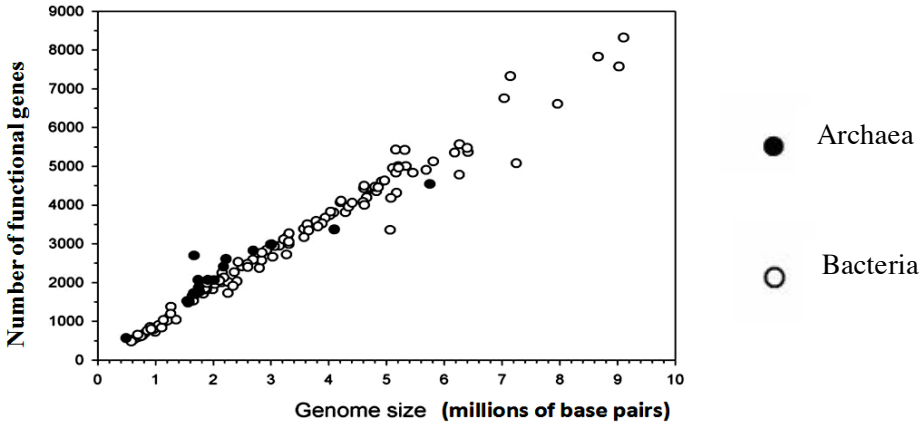
D. none of them

Response	Frequency	Percent
A	72	16.86
B	87	20.37
C	162	37.94
*D	106	24.82

Explanation

1 is wrong because the experiment was only about the effect of fresh orange and lemon but not vitamin C. 2 is wrong because there was no control group using fruits that were not fresh. Also, it may not be applicable to all kinds of fruits. 3 is wrong because the effect of orange had not been isolated from that of lemon.

48. The figure below shows the relationship between genome size and number of functional genes in bacteria and Archaea.



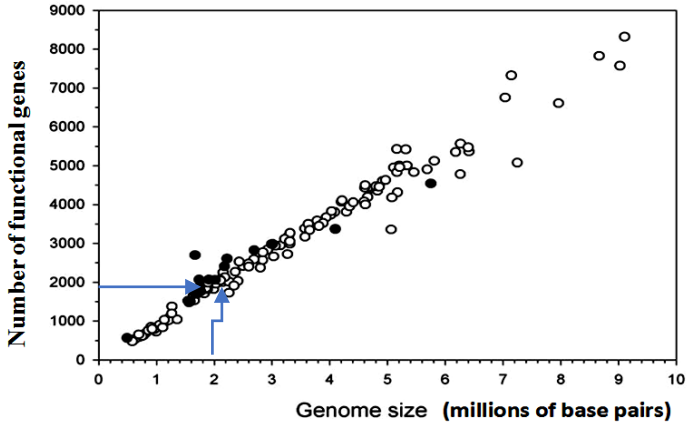
Which of the following statement(s) is/are correct based on the above graph?

1. Some bacteria have larger genome size than Archaea.
2. The number of functional genes is positively correlated with the genome size in both archaea and bacteria.
3. The average size of a functional gene is about 1000 base pairs in Archaea, assuming that the genome does not have non-functional genes.

A. 1 only
B. 1 and 2 only
C. 2 and 3 only
D. <u>1, 2 and 3</u>

Response	Frequency	Percent
A	43	10.07
B	299	70.02
C	28	6.56
*D	57	13.35
No Response	0	0.00

Explanation

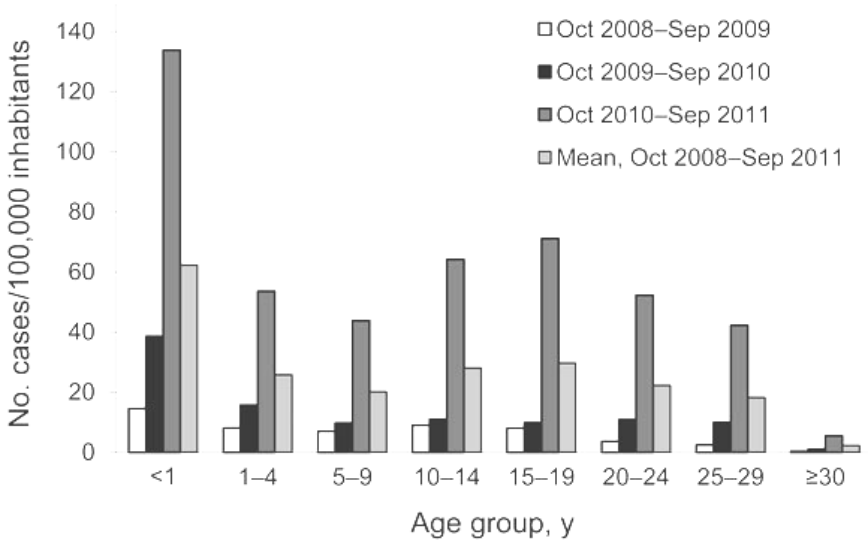


2000 genes = 2000 kb (2 millions = 2000 kb)

1 gene = 1 kb

1 gene = 1000 bp

Direction: Questions 49-50 refer to the figure below. It shows the number of measles cases during the 3 epidemic outbreaks in France in 2008-2011. Measles can be prevented by vaccine, but the two doses are normally taken after the first year of birth and in 4-6 years of age.



49. Which of the following statement(s) is/are correct explanation(s) of the measles outbreaks shown in the above graph?

1. Children under 1 year of age had the highest numbers of measles cases than other age groups because most of them had not been vaccinated against measles.
2. From 2008 to 2011, the measles outbreaks became increasingly larger because the measles virus had developed resistance to the vaccine.
3. People at the age of 30 or above were least infected by measles because they have fully developed immune system.

A. <u>1 only</u>
B. 2 only
C. 2 and 3 only
D. 1, 2, 3

Response	Frequency	Percent
*A	118	27.63
B	19	4.45
C	35	8.20
D	254	59.48
No Response	1	0.23

Explanation

Statement 1 is correct as children under 1 year of age had not been vaccinated against measles while the maternal antibodies which are transferred via the placenta during pregnancy can only provide a weak protection.

Statement 2 is incorrect as viruses do not develop resistance. Resistant strains are selected for among a wide spectrum of variants.

Statement 3 is incorrect as people's immune system is largely mature before they reach teenage years. The lower rate is due to prior exposure has primed them and got them immunized.

50. The first dose of measles vaccine is recommended to be taken one year after birth. It was found that the presence of antibodies in blood will weaken the action of the respective vaccine. Which of the following statement(s) is/are correct about why the first dose of measles vaccine should be taken 12 months after birth?

1. The mother's antibodies will enter the baby's body through placenta and inhibit the antibody production stimulated by the measles vaccine.
2. The baby's immune system is not fully developed in the first 12 months and therefore cannot produce full immunity when stimulated by the antigen in the vaccine.
3. In the first 12 months after birth, the baby is still protected by the mother's antibodies against measles.

A. 1 only
B. 2 only
C. 2 and 3 only
D. **1, 2 and 3**

Response	Frequency	Percent
A	47	11.01
B	158	37.00
C	118	27.63
*D	103	24.12
No Response	1	0.23

Explanation

All statements are correct.

Direction: Questions 53-54 is about **epistasis**, which is a phenomenon in which the phenotypic effect of a gene is masked by the genetic status of another gene. The coat colour of a dog, Labrador retrievers, is an example of epistasis. The coat colour can be black, brown and yellow, which is determined by two genes B and E. B gene determines if the coat color is black or brown with the dominant allele (B) for black and the recessive allele (b) for brown. Gene E affects whether gene B will have its phenotypic effect. When gene E is homozygous recessive, gene B will not express its phenotype and the coat color is yellow.

54. If Labrador retrievers heterozygous at both loci are crossed, what will be the phenotypic ratio of the offspring?

	Black		***Brown***		***Yellow***
A.	12	:	3	:	1
B.	**9**	**:**	**3**	**:**	**4**
C.	3	:	12	:	1
D.	3	:	9	:	4

Response	Frequency	Percent
A	113	26.46
*B	159	37.24
C	91	21.31
D	63	14.75
No Response	1	0.23

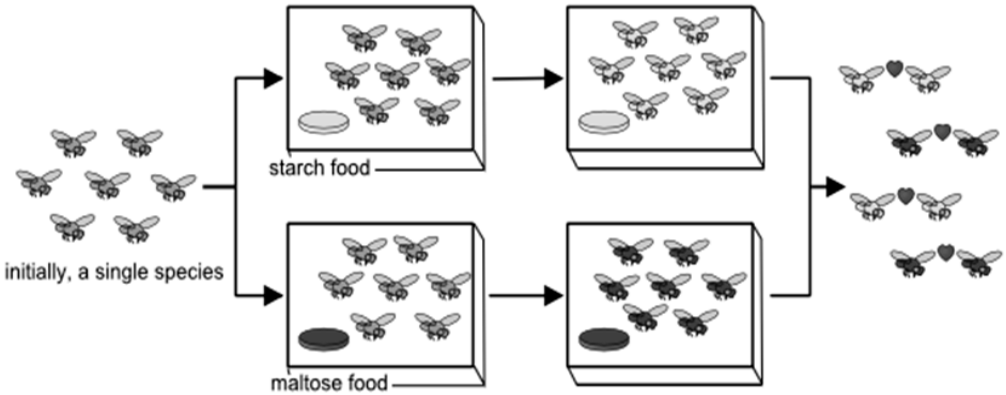
Explanation

BbEe x BbEe

	¼ BE	¼ bE	¼ Be	¼ be
¼ BE	BBEE	BbEE	BBEe	BbEe
¼ bE	BbEE	bbEE	BbEe	bbEe
¼ Be	BBEe	BbEe	BBee	Bbee
¼ be	BbEe	bbEe	Bbee	bbee

9 Black : 3 Brown : 4 Yellow

55. A population of the fruit fly was divided into two equal populations. One population was reared on a starch medium and the other on a maltose medium. After many generations, the two populations were put together again. It was found that two populations had less interbreeding than within their own population.



Which of the following is the cause of the observation that the two populations of fruit flies had less interbreeding than within their own population after many generation of separated rearing?

A. The different foods, starch or maltose, had induced changes of the genes of the fruit flies, which made them reproduce differently.
B. The breeding between fruit flies that eat the same type of food is an advantage that their offspring only need one type of food.
C. The two populations of fruit flies had become two different species through evolution by natural selection.
D. <u>Different mutations occurred randomly in the two populations when they were reared separately. These mutations make them somewhat reproductively incompatible.</u>

Response	Frequency	Percent
A	99	23.19
B	82	19.20
C	109	25.53
*D	136	31.85
No Response	1	0.23

Explanation

A is a wrong Lamarckian view by stating that the mutations are induced by the food.

B is a wrong teleological view by stating the benefits of the breeding as a cause of the evolutionary changes.

C is wrong since the flies will only be considered to be two different species when they are not unable to interbreed completely.

D is correct by pointing out random mutations as the agent to faciliate speciation as a result of evolution. The different foods provided to the two populations of flies may serve as the needed natural selection pressure to keep thetwo populations more adaptive to different food sources.