1. Heredity and Evolution

Part-A

1. Question

Mendel observed 7 pairs of contrasting characters in Pisum sativum. Which one of the following is not a part of that?

A. Tall and dwarf

B. Yellow and green seed colour

C. Terminal and axial flower

D. Smooth and rough stem

Answer

Seven pair of contrasting characters of pea plant selected by Mendel—

i. Seed shape - Round / Wrinkled

ii. Seed colour - Yellow / Green

iii. Flower colour - Violet / WhitePod

iv. shape - Full / ConstrictedPod

v. colour - Green / YellowFlower

vi. position - Axillary / Terminal

vii. Stem height - Tall / Dwarf

2. Question

Primitive man evolved in _____

A. Africa

B. America

C. Australia

D. India

Answer

Fossils of man- like primates found in Tanzania and Ethiopia (East Africa). They ate fruit and were 4 feet tall. They walked upright and hunted with stones.

3. Question

Which of the following is inheritable?

A. an altered gene in sperm

B. an altered gene in liver cells

C. an altered gene in skin cells

D. an altered gene in udder cells

Answer

An altered gene in sperm is inheritable because the genes are transferred by sperm and egg so if there was any alteration in sperm with the egg than that alteration will be inherited by the child. Liver cells, skin cells, and udder cells are somatic cells but sperm is a reproductive cell. So, variation or mutation or alteration in the reproductive cell only passes on.

4. Question

The theory of Natural Selection was proposed by _____ .

A. Charles Darwin

B. Hugo de Vries

C. Gregor Johann Mendel

D. Jean Baptise Lamarck

Answer

Charles Darwin proposed the theory of natural selection in 1859. He defined natural selection as "the populations which are a better fit in an environment will be selected by nature and will survive more."

5. Question

Somatic gene therapy causes _____.

A. changes in sperm

B. changes in progeny

C. changes in body cell

D. changes in ovum

Answer

Gene therapy is the method that allows correction of gene defect diagnosed in a child or embryo.

In somatic gene therapy, normal(therapeutic) genes are transferred into any body cell other than a stem cell, gametocyte, gamete or germ cells.

It basically focuses on genetic disorders like hemophilia, thalassemia etc.

6. Question

In a pea plant, the yellow colour of the seed dominates over the green colour. The genetic makeup of the green colour of the seed can be shown as _____:

A. GG

B. Gg

C. Yy

D. yy

Answer

As we know that yellow colour of seed is dominant over green colour.

So the genotype of yellow seed colour will be YY/ Yy.

And the genotype of green seed colour will be homozygous recessive that is yy.

7. Question

Some people can roll their tongue and this is a genetically controlled auto-somal dominant character. [Roller = RR / Rr and Non-roller = rr]

A child who can roll the tongue has one brother who is a non-roller and two sisters who are rollers. If both the parents are rollers, the genotypes of their parents would be ____.

A. RR x RR

B. Rr x Rr

C. RR x rr

D. rr x rr

Answer

If the genotype of the parents is Rr x Rr

Then by using the punnet square, we can find the genotype of the children.

By using punnet square we will get RR, Rr, Rr, rr genotype. RR, Rr, and Rr are the genotypes of child and two sisters who can roll their tongues and rr is the genotype of brother who is non-roller.

Genotype of Roller = RR / Rr and

Genotype of Non-roller = rr

8. Question

Hydra, a multi-cellular invertebrate of phylum Cnidaria (Coelenterata) can give rise to new offspring by various methods. Choose the method by which the offspring are produced with significant variations.

A. budding

B. regeneration

C. sexual reproduction

D. asexual reproduction

Answer

Asexual reproduction, budding, and regeneration produces offspring with minor variations but organisms produce offspring with sexual reproduction show significant and visible variations. During sexual reproduction, the genetic information from each parent get mixed and tranfer to the offspring which leads to variety in offsprings.

9. Question

The following are the events in the formation of the first cloned animal – the sheep Dolly.

a) Removal of haploid nucleus from the ovum.

b) Implantation of ovum with diploid nucleus into the surrogate mother.

c) Collection of udder cell from the sheep.

d) Injection of diploid nucleus of udder cell into the enucleated ovum.

e) Development of a young clone.

The correct sequential order of these events is _____ .

A. abcde

B. cabed

C. cadbe

D. edcba

Answer

The sheep Dolly was the first cloned mammal from an adult somatic cell. Dolly was developed by Dr.Ian Wilmut and his colleagues in Roselind Institute in Scotland in July 1996. There was no gentic modification carried out on donor nucleus. The scientists used the nucleus of udder cell which contains, diploid number(2n) of chromosomes. She was created by the technique of somatic cell nuclear transfer.

10. Question

The following are statements about stem cells:

a) There are unspecialised / undifferentiated cells.

b) They can be transformed into any type of body cell.

c) They can multiply rapidly to form a large number of similar types of cells.

d) They cannot transform into cardiac cells or nerve cells.

e) They are obtained from reproductive progeny only.

The correct statements are _____:

A. a, b, c only

B. c, d, e only

C. a, c, e only

D. b, c, e only

Answer

Stem cells are biological cells that have the potency to give rise to the tissue and organs. These cells have the tendency of multiplying into numerous numbers of the same type of cell by mitosis. In mammals two types of stem cells are present—

i. Embryonic stem cells

ii. Adult stem cells

11. Question

In persons suffering from insulin-dependent diabetes, _____ the cells of the pancreas degenerate.

A. Alpha

B. Beta

C. Gamma

D. Delta

Answer

Pancrease is a composite gland. It consist of two type of cells—

i. Alpha cell - secreate glucogon (increase sugar level in blood)

ii. Beta cell - secreate insulin (reduce blood sugar level)

If beta cell degenerates than there will be less secreation of insulin, leads to more glucose(sugar) in blood Which leads to diabetes mellitus.

12. Question

Identical twins are born as a result of fertilization between_____.

A. two eggs and two sperms

B. two eggs and one sperm

C. one egg and one sperm

D. one egg and two sperms

Answer

Identical twins are represented as monozygotic. Identical twins are of the same sex as they developed from the single zygote, which forms two embryos.

13. Question

Identify the incorrect statement about identical twins.

A. developed from a single zygote

B. always of the same sex

C. look alike in many aspects

D. differ in their blood groups

Answer

Identical twins are represented as monozygotic. Identical twins are of the same sex as they developed from the single zygote(contain male or female sex chromosomes), which form two embryos. Identical twins have the same DNA. They also have the same blood group.

14. Question

The correct statement about Neanderthal man is:

A. the first human-like hominid

B. started agriculture

C. ate meat and walked erectly

D. buried the dead

Answer

The neanderthal man is also known as *Homo sapiens neanderthals*. Their fossils found in east and central Asia. They used hides to protect the body and buried their dead. Their brain size is 1400cc.

15. Question

The inheritance of characteristics through generation is called “heredity”. In Mendel's Pisumsativum plant, the genetic material responsible for heredity is _____.

A. DNA

B. RNA

C. Protein

D. Cytoplasm

Answer

Heredity is the transfer of characters from one generation to next.

DNA is a thread like a chain of nucleotides that carry genetic information. It is always double-stranded and contains nitrogen bases(adenine, guanine, thymine, and cytosine). It is the genetic material of almost all living organisms.

Part-B

1. Question

Mendel has observed Tallness as a dominant character in the garden pea plant.

Similarly, tongue rolling is a dominant character in man. In a group of 60 students,

45 can roll their tongue and 15 are non-rollers.

i) In the above context, calculate the percentage of dominant and recessive characters.

Answer

Total number of students = 60

Students who can roll their tongue(dominant) = 45

Non- roller students(recessive) = 15

Percentage of Students who can roll their tongue(dominant)

$$= \frac{45}{60} \times 100 = 75\%$$

Percentage of Non- roller students(recessive) $= \frac{15}{60} \times 100 = 25\%$

Percentage of dominant and recessive character is 75:25

= 3:1

2. Question

The inheritable characters vary in different species and within the same species. Name the variation in the following cases.

The eye colour among the human beings are varied as blue, black, brown, green, etc.

i) This is called as _____variation.

The dentition in the rabbit and the elephant are not the same.

ii) This is called as _____ variation.

Answer

(i) Intraspecific variation

It is defined as the differences that occur within the species.

(ii) Intergeneric variation

It is defined as the differences that occur between two or more genera.

3. Question

Sexually reproducing organisms produce offspring with marked, significant and visible variation. Asexually reproducing offspring show minor variations.

i) Do you agree with the above statements?

ii) Among the following organisms point out the asexually reproducing organism.

(Cockroach, Euglena, Earthworm and Bird)

Answer

(i) Yes, i agree with the above statements

Asexual reproduction produces offspring with minor variations but organisms reproducing offspring through sexual reproduction show significant and visible variations. During sexual reproduction the genetic information from each parent gets mixed and transfer to the offspring which leads to variety in offspring. In sexual reproduction two parents are involved and both the parents have different genetic information (DNA).

(ii) Euglena

Euglena undergo asexual reproduction and reproduce by binary fission. Binary fission is the division of cells into two daughter cells.

4. Question

Here are certain important hereditary jargons. Fill in the blanks by choosing a suitable one from the list given. (allele, variation, speciation, gene, allelomorphs)

i) _____ are the factors which form the physical basis of inheritance.

ii)_____ is the alternate forms of the same gene.

iii)_____ are the expressions of contrasting pair of alleles.

Answer

i) Gene are the factors which form the physical basis of inheritance.

ii) Allele is the alternate forms of the same gene.

iii) Allelomorphs are the expressions of contrasting pair of alleles.

5. Question

A change that affects the body cell is not inherited. However, a change in the gamete is inherited. The effects of radiation at Hiroshima have been affecting generations.

Analyze the above statements and give your interpretation.

Answer

Radiation at Hiroshima has been affected generations because the radiation at Hiroshima had altered the genes of germ cells. And the alternation in the germ cells(gametes) is inheritable.

6. Question

Sequentially arrange the different species of man from primitive to modern man.

(Neanderthal man, Homo habilis, Homo erectus, Homo sapiens)

Answer

Sequentially arrange of the different species of man from primitive to modern man are as follow—

Homo habilis

Homo erectus

Neanderthal man

Homo sapiens

Homo habilis

They are the first human-like. Their brain capacity was 600-800 cc. They did not eat meat and their fossils found in Africa. Appeared about 2 million years ago.

Homo erectus

They are also known as Java man. They ate meat and their brain capacity was 900 cc. Appeared about 1.5 million years ago.

Neanderthal mam

Their brain capacity is 1400 cc. They used hides to protect their body and buried their dead. Appeared about 100,000 years ago.

Homo sapiens

They are the modern man. They started human civilization, agriculture and cave art. Appeared about 50,000 years ago.

7. Question

Biotechnology, the modern science in biology, has helped in producing different types of products. One of the following groups does not have a product of biotechnology.

Pick out and give reasons.

i) enzymes, organic acids, steroids, vaccines

ii) vaccines, enzymes, antibiotics, inorganic acids

iii) antibiotics, hormones, steroids, vaccines

iv) steroids, enzymes, antibodies, vaccines

Answer

In the 2 group (vaccines, enzymes, antibiotics, inorganic acids.) Inorganic acid is not the product of the biotechnology.

Reason

Inorganic acid are also known as mineral acid. The mineral acid is an acid derived from one or more inorganic compounds.

8. Question

What do you mean by phenotype and genotype of an individual? Explain.

Answer

Genotype - the genetic constitution of an organism.

Phenotype - the external morphological characteristics of an organism.

9. Question

What are variations? Mention their types.

Answer

Variation defined as the differences in the characteristics of the individual of a progeny from each other or from their parents.

Or

Difference between a member of the same population or a different population.

Types of variation are—

i. Somatic variation

ii. Germinal variation

i. **Somatic variation**

The variation in the somatic cells (Cells beside sex cells) which is acquired by the individual in their life and not passed in their progenies.

ii. **Germinal variation**

The variation in the germ cells (Sex cells) of an organism and it is inheritable. Germinal variation leads to evolution.

10. Question

Who proposed the theory of Natural Selection? Mention the two principles of this theory.

Answer

Charles Darwin proposed the theory of natural selection in 1859. He defined natural selection as "the populations which are a better fit in an environment will be selected by nature and will survive more."

Natural selection based on—

i. Population size

ii. Variation inherited

iii. Limited natural resources

The two principles of this theory are—

i. Survival of the fittest

ii. Struggle for existence

11. Question

What are monoclonal antibodies? Mention its use.

Answer

Monoclonal antibodies

These are the antibodies that are made up of identical immune cells which are clones of the unique parent cell. These are produced by hybridoma technology.

These antibodies have a monovalent affinity.

Uses—

i. It is used for the treatment of autoimmune diseases like rheumatoid arthritis, Crohn's disease etc.

ii. It is used in cancer treatment.

12. Question

What is a clone? In what way is the cloning technique useful in the field of veterinary science?

Answer

Clone

It is a group of individual of same species(morphologically and genetically similar)

Or

It is defined as the exact copies of the single genetical parent.

Clones are of two types—

i. Natural clone

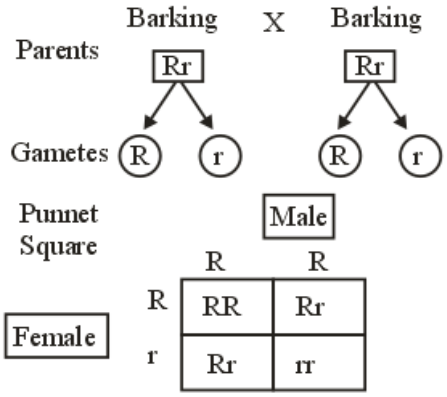
ii. Induced clone

The cloning technique useful in the field of veterinary science as valuable animals can be cloned from desirable adult cells.

13. Question

In dogs, the barking trait is dominant over the silent trait. Using Punnet Square, work out the possible puppies born to two barking parents with genotype (Rr).

Answer



RR – Barking

Rr – Barking

rr – Silent

Phenotypic ratio	Barking : Silent
	3 : 1
Genotypic ratio	RR : Rr : rr
	1 : 2 : 1

14. Question

In Dr. Ian Wilmut’s cloning experiment, did the new born 'Dolly' resemble the udder cell donor Dorset white sheep or the surrogate mother sheep? Give reasons.

Answer

The new born 'Dolly' resemble *the udder cell donor Dorset white sheep.*

Because the udder cell from the ovum has a diploid nucleus of the Dorset white sheep. The new born "Dolly" show all the characters of the Dorset white sheep.

15. Question

The excessive use of pesticides has only resulted in the occurrence of more resistant varieties of pests rather than their complete eradication. How can you link this with Darwin’s theory of Natural Selection and Evolution?

Answer

If we Continuously use pesticides against pests then With the passage of time, some pests develop resistance against the pesticides by bringing modification in their structures. The pests which become resistant survived and thus selected by nature. It is an example of natural selection which shows the process of evolution.

16. Question

The first clinical gene therapy was given in 1990 to a four-year-old girl suffering from Adenosine Deaminase Deficiency (ADA). Could you suggest a possible cure for such a disorder with the knowledge of gene therapy and its types?

Answer

Gene therapy means the correction of defect gene diagnosed in a child or embryo.

It is used to treat defects in somatic(body) or gametic(sperm/egg) cells.

M. Please and W. F. Andresco Attempted gene therapy on a 5-year-old girl who is suffering from adenosine deaminase deficiency.

ADA caused due to the deletion of adenosine deaminase gene.

It can be cured by bone marrow transplantation. But this method is not fully curative.

So we grow lymphocytes from patient's blood in a culture.

Functional ADA DNA was introduced in the lymphocytes with the help of retroviral vector.

Then these Lymphocytes were transferred into the patient's body.

Diseases can be cured by gene therapy are—

i. Cystic fibrosis

ii. Cancer

iii. Parkinson's diseases, etc.

Type of gene therapy are—

i. **Somatic gene therapy**

In Somatic gene therapy, the Defective gene is replaced by therapeutic genes in somatic cells. The change is not passed on to the next generation.

ii. **Germ line gene therapy**

In this, germ cells are modified or corrected by introducing functional genes into their genomes. The changes are passed to the next generation.

17. Question

Find the unmatched pairs:

Nif genes	Nitrogen Fixation
tt	Alleles
Biochips	Biological computer manufacturing
Interferon	Antiproteins of Bacteria
stem cells	Unspecialised mass of cells

Answer

The unmatched pair is—

Interferon — Antiproteins of bacteria

Reason

Interferons are Anti-Viral Proteins which is produced by Virus-infected cells

18. Question

For the experimental research, Dr. Ian Wilmut used the nucleus of the udder cell from a six-year-old Finn Dorset white sheep and preserved the diploid nucleus (2n). He took an ovum from the ovary of another sheep. The haploid ovum was removed. The diploid nucleus of the udder cell was injected into the cytoplasm of the enucleated ovum. Then the diploid nucleus ovum was implanted into the uterus of the surrogate mother sheep. The diploid ovum developed into a young one, named “Dolly”.

i) Why did Wilmut select the udder cell?

ii) Define the terms haploid and diploid.

Answer

(i) Wilmut selects the udder cell because the nucleus of udder cell contains a diploid number(2n) of chromosomes with all the genes.

(ii) Haploid

i. The cell/organism that has half the usual number of chromosomes or a single set of chromosomes. (n)

ii. Gamete cells are haploid in humans.

iii. Meiotic cell division results in haploid cells.

Diploid

i. The cell/organism that has double the number of chromosomes or two sets of chromosomes. (2n)

ii. Somatic cells are diploid.

iii. Mitotic cell division result in diploid cells.

19. Question

Match the following by identifying the pair:

(medicines, fuel, microbes, metabolism, organic acids)

i) vaccine ii) natural gas iii) citric acid

iv) monoclonal antibodies v) vitamins

(special case: to no upload without explanation)

Answer

	Correct Match	Explanation
i) vaccine	Microbes	Vaccine is made of weakened/killed disease causing microbes which provides us with weakened acquired immunity
ii) natural gas	Fuel	Natural Gas is naturally occurring gas mainly consisting of methane which is used as fuel for vehicles as well as for cooking and electricity generation
iii) citric acid	Organic acid	Citric Acid is a weak organic acid which is naturally found in citrus fruits. Its chemical formula is:- $C_6H_8O_7$
iv) monoclonal antibodies	Medicines	Monoclonal Antibodies are made by identical immune cells having monovalent affinity and are used for the treatment of cancer and many autoimmune disease.
v) vitamins	Metabolism	Vitamins play a vital role in metabolism as they are known to boost our metabolism aiding in weight loss apart from that some vitamin are known to improve immune system

20. Question

Mention the dominant and recessive traits observed by Mendel in the garden pea plant with respect to the seed and flower.

Answer

The dominant and recessive traits observed by Mendel in the garden pea plant with respect to the seed and flower—

i. Seed shape - Round / Wrinkled

ii. Seed colour - Yellow / Green

iii. Flower colour - Violet / White

iv. Flower position- Axillary / Terminal

Part-C

1. Question

Human evolution has undergone a record of changes during the past 15 million years.

i) Name the different species of mankind in chronological order from primitive to modern man.

ii) When were the primitive caves developed?

iii) Narrate the life led by an early man-like hominids.

Answer

Dryopithecus

They were more ape-like. They ate leaves and fruits and have a hairy body. Walked like gorillas and chimpanzees.

Appeared around 20-25 million years ago.

Ramapithecus

They have teeth like modern man. They were more man-like.

Appeared around 14-15 million years ago.

Australopithecus

Their fossils found in East Africa. They are four feet tall and walked upright. They ate fruit and their brain capacity was 400-600 cc.

Appeared around 3-5 million years ago.

Homo habilis

They are the first human-like. Their brain capacity was 600-800 cc. They did not eat meat and their fossils found in Africa. Appeared about 2 million years ago.

Homo erectus

They are also known as Java man. They ate meat and their brain capacity was 900 cc. Appeared about 1.5 million years ago.

Neanderthal mam

Their brain capacity is 1400 cc. They used hides to protect their body and buried their dead. Appeared about 100,000 years ago.

Homo sapiens

They are the modern man. They started human civilization, agriculture and cave art. Appeared about 75,000-10,000 years ago.

(ii) *primitive caves developed around 18,000 years ago.*

A variety of cave painting was done by Cro-Magnon man. Cro-Magnon man was the ancestor of the modern living man.

(iii) Hominids are classified in the genus Australopithecus and genus Homo habilis.

Life led by hominids—

i. They hunted with stone weapons.

ii. Fossils found in East Africa.

iii. They did not eat meat.

iv. They walked upright.

2. Question

Describe in brief Mendel’s monohybrid cross.

Answer

Mendel select garden pea plant(Pisum sativum) for his experiment.

Mendel took garden pea plant because of the following reason—

i. It is easy to pollinate pea flowers.

ii. Flowers are bisexual and self pollinating.

iii. It produces a large number of seeds in one generation.

iv. Pea plant has a short life cycle.

Mendel took homozygous tall pea plant and cross it with homozygous drawf pea plant. In F1 generation all the pea plants are tall.

He then self-pollinated F1 generation plants to generate F2 generation plants.

In F2 generation he found 75% of the plants are tall and 25% are drawn.

Observations

i. F1 progenies show one of the parent's trait and trait of other parents was not seen.

ii. F2 stage show both of the parent trait in proportion 3:1.

iii. The contrasting traits did not show any blending at F1 and F2 stage.

3. Question

Find out who I am?

i) I am an acid used as a preservative and I have a sour taste.

ii) I am organic and present in citrus fruits and I give immunity.

iii) I am a cholesterol containing steroid obtained from bread mould. I am the steroid.

iv) I am an enzyme and I cut DNA at specific sites.

v) I am the paste enzyme that joins segments of DNA.

Answer

(i) Vinegar

(ii) Citric acid

(iii) prednisolone (steriod drugs)

(iv) Restriction endonucleases

(v) DNA ligase

4. Question

State whether true or false. Correct the statements that are false.

i) Variations give the organisms an individuality of their own.

ii) Charles Darwin postulated the use and disuse theory.

iii) To understand evolution, a branching diagram or a tree diagram is used to show the inferred evolution and the relationship among various biological species.

iv) Genetic engineering is the modification of the genetic information of living organisms by manipulation of DNA by adding, removing or repairing part of the DNA and changing the phenotype

Answer

(i) The statement is True.

(ii) The statement is False.

Correction

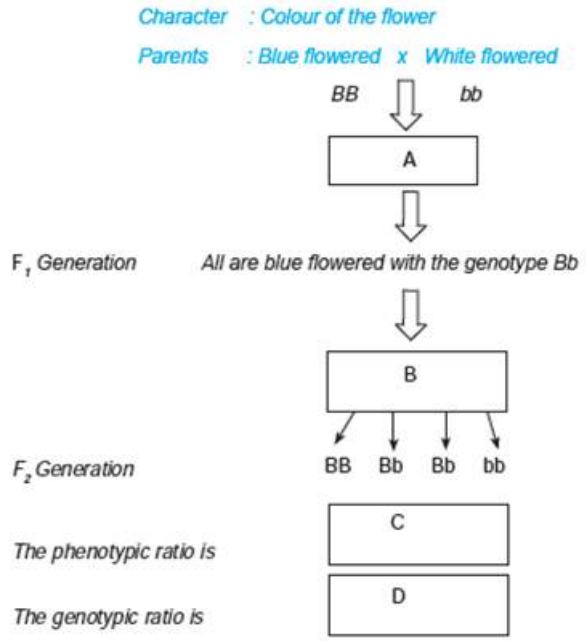
Jean Baptist Lamarck give the theory of use and disuse of organ. Charles darwin give the darwinian theory. The main concept of darwinian theory is natural selection and branching descent.

(iii) The statement is True.

(iv) The statement is True.

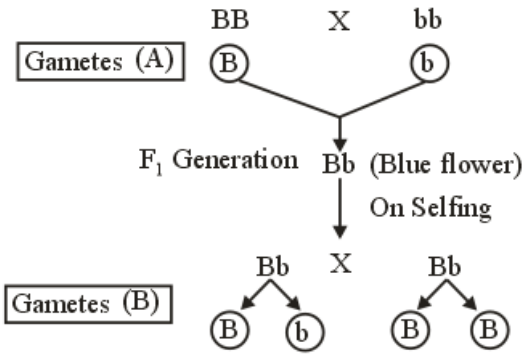
5. Question

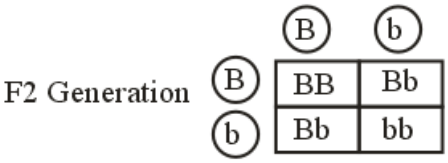
Observe the flow-chart of a monohybrid cross in a clitoria plant and write the answers for A, B, C, D



Answer

Character : Colour of the flower
Parents : Blue flower × White flower
(BB) (bb)





The phenotypic ratios is (C)	Blue flower : White flower 3 : 1
The genotypic ratio is (D)	BB : Bb : bb 1 : 2 : 1

A = gametes for F1 generation that are B and b.

B = F1 generation go on selfing and form gametes for F2 generation that are B, B, b and b.

C = phenotypic ratio that is

blue flowered : white flowered = 3:1

D = genotypic ratio that is

BB : Bb : bb = 1:2:1