CHAPTER

9 Heredity and Evolution

CASE STUDY / PASSAGE BASED QUESTIONS

Syllabus

Heredity; Mendel's contribution- Laws for inheritance of traits: Sex determination : brief introduction.

1

Read the following and answer any four questions from 1(i) to 1(v).

Sex determination is the method by which distinction between males and females is established in a species. The sex of an individual is determined by specific chromosomes. These chromosomes are called sex chromosomes or allosomes. X and Y chromosomes are called sex chromosomes. The normal chromosomes other than the sex chromosomes of an individual are known as autosomes.

(i) In XX-XO type of sex determination
   (a) females produce two different types of gametes
   (b) males produce two different types of gametes
   (c) females produce gametes with Y chromosome
   (d) males produce gametes with Y chromosome.

(ii) A couple has six daughters. What is the possibility of their having a girl next time?
   (a) 10% (b) 50%
   (c) 90% (d) 100%

(iii) Number of autosomes present in liver cells of a human female is
   (a) 22 autosomes (b) 22 pairs
   (c) 23 autosomes (d) 23 pairs.

(iv) XX-XO type of sex determination and XX-XY type of sex determination are the examples of
   (a) male heterogamety
   (b) female heterogamety
   (c) male homogamety
   (d) both (b) and (c).

(v) Select the incorrect statement.
   (a) In male grasshoppers, 50% of sperms have no sex chromosome.
   (b) Female fruitfly is heterogametic.
   (c) Human male produces two types of sperms 50% having X chromosome and 50% having Y chromosomes.
   (d) In turtle, sex determination is regulated by environmental factors.

2

Read the following and answer any four questions from 2(i) to 2(v).

Gregor Mendel conducted hybridisation experiments on garden peas for seven years and proposed the laws of inheritance in living organisms. He investigated characters in the garden pea plant that were manifested as two opposing traits, *e.g.*, tall or dwarf plants, yellow and green seeds, etc.

(i) Among the seven pairs of contrasting traits in pea plant as studied by Mendel, the number of traits related to flower, pod and seed respectively were

(a) 2, 2, 2 (b) 2, 2, 1 (c) 1, 2, 2 (d) 1, 1, 2.

(ii) The colour based contrasting traits in seven contrasting pairs, studied by Mendel in pea plant were

(a) 1 (b) 2 (c) 3 (d) 4.

(iii) Refer to the given table of contrasting traits in pea plants studied by Mendel.

Character	Dominant trait	Recessive trait
(i) Seed colour	 Yellow	 Green
(ii) Flower colour	 Violet	 White
(iii) Pod shape	 Full	 Constricted
(iv) Flower position	 Axial	 Terminal

Which of the given traits is correctly placed?

(a) (i), (ii) and (iii) only
(b) (ii), (iii) and (iv) only
(c) (ii) and (iii) only
(d) (i), (ii), (iii) and (iv)

(iv) Some of the dominant traits studied by Mendel were

(a) round seed shape, green seed colour and axial flower position
(b) terminal flower position, green pod colour and inflated pod shape
(c) violet flower colour, green pod colour and round seed shape
(d) wrinkled seed shape, yellow pod colour and axial flower position.

(v) Which of the following characters was not chosen by Mendel?

(a) Pod shape (b) Pod colour
(c) Position of flower (d) Position of pod

3

Read the following and answer any four questions from 3(i) to 3(v).

Mendel crossed tall and dwarf pea plants to study the inheritance of one gene. He collected the seeds produced as a result of this cross and grew them to generate plants of the first hybrid generation which is called the first filial progeny or F_1. Mendel then self pollinated the tall F_1 plants and he obtained F_2 generation.

(i) In garden pea, round shape of seeds is dominant over wrinkled shape. A pea plant heterozygous for round shape of seed is selfed and 1600 seeds produced during the cross are subsequently germinated. How many seedlings would have non-parental phenotype?

(a) 1600 (b) 1200 (c) 400 (d) 800

(ii) If 'A' represents the dominant gene and 'a' represents its recessive allele, which of the following would be the most likely result in the first generation offspring when Aa is crossed with aa ?

(a) All will exhibit dominant phenotype.

(b) All will exhibit recessive phenotype.

(c) Dominant and recessive phenotypes will be 50% each.

(d) Dominant phenotype will be 75%.

(iii) Which of the following crosses will give tall and dwarf pea plants in same proportions?

(a) 

(b) 

(c) 

(d) 

(iv) What result Mendel would have got, if he self pollinated a homozygous tall F_2 plant?

(a) TT and Tt (b) All Tt

(c) All TT (d) All tt

(v) In plant, tall phenotype is dominant over dwarf phenotype, and the alleles are designated as T and t, respectively. Upon crossing one tall and one dwarf plant, total 250 plants were obtained, out of which 124 displayed tall phenotype and rest were dwarf. Thus, the genotype of the parent plants were

(a) TT × TT (b) TT × tt (c) Tt × Tt (d) Tt × tt.

4

Read the following and answer any four questions from 4(i) to 4(v).

The cross that include the inheritance of two pairs of contrasting characters simultaneously is referred as dihybrid cross. Mendel chose pure breeding plants for yellow and green seeds and round and wrinkled shape of seeds. He cross pollinated the plant having yellow round seeds with plant having green wrinkled seeds. All the plants produced in F_1 generation were having, yellow round seeds. The plants raised from these seeds were self pollinated, that resulted in production of plants having four phenotypically different types of seeds.

(i) When a cross is made between a yellow round seeded plant (YyRr) and a yellow wrinkled seeded plant (Yyrr), what is true regarding the proportions of phenotypes of the offsprings in F_1 generation?

	Proportion of yellow wrinkled seeds	Proportion of green wrinkled seeds
(a)	3/8	1/8
(b)	2/8	1/8
(c)	1/8	3/8
(d)	2/8	2/8

(ii) How many types of gametes can be produced by YYrr?

(a) 1 (b) 2 (c) 3 (d) 4

(iii) In Mendelian dihybrid cross, when heterozygous tall plant with green seeds are self crossed the progenies are

(a) TtYy, TtYY, TTYy
(b) Ttyy, TTyy, ttyy
(c) ttYy, ttyy
(d) Ttyy, TTyy.

(iv) When round yellow seeded heterozygous pea plants are self fertilised, the frequency of occurrence of RrYY genotype among the offsprings is

(a) 9/16 (b) 3/16 (c) 2/16 (d) 1/16.

(v) The percentage of yr gamete produced by YyRr parent will be

(a) 25% (b) 50% (c) 75% (d) 12.5%.

5

Read the following and answer any four questions from 5(i) to 5(v).

In human, the allele for brown eyes (B) is dominant over that for blue eyes (b). A brown eyed woman marries a blue eyed man, and they have six children. Four of the children are brown eyed and two of them are blue eyed.

(i) What is the genotype of blue eyed offspring?

(a) BB
(b) Bb
(c) bb
(d) Cannot be determined

(ii) What is the woman's genotype?

(a) BB
(b) Bb
(c) bb
(d) Cannot be determined

(iii) The ovum, produced by the mother carries the gene regarding eye colour is

(a) BB
(b) Bb
(c) B or b
(d) B only.

(iv) The ratio of brown eyed children to blue eyed children in this family is 2 : 1, which deviates from typical phenotypic ratios for monohybrid inheritance. What might be the reason?

(a) Gametes carrying the brown eyed allele are more viable then those with the blue eyed allele.
(b) A different pattern of inheritance other than monohybrid inheritance is involved.
(c) Not all of their babies survived childbirth, thus causing a distortion in the actual ratio.
(d) The actual ratio differs from the expected ratio because the sample size is too small.

(v) What is the gene carried by of the man's sperm regarding the eye colour?

(a) BB
(b) Bb
(c) b only
(d) b or B

6

Read the following and answer any four questions from 6(i) to 6(v).

Purebred pea plant with smooth seeds (dominated characteristic) were crossed with purebred pea plant with wrinkled seeds (recessive characteristic). The F_1 generation was self pollinated to give rise to the F_2 generation.

(i) What is the expected observation of the F_1 generation of plants?
- (a) 1/2 of them have smooth seeds and 1/2 of the have wrinkled seeds.
- (b) 1/4 of them have wrinkled seeds and 3/4 of them have smooth seeds.
- (c) 3/4 of them have wrinkled seeds and 1/4 of them have smooth seeds.
- (d) All of them have smooth seeds.

(ii) What is the expected observation of the F_2 generation of plants?
- (a) 1/2 of them have smooth seeds and 1/2 of them have wrinkled seeds.
- (b) 1/4 of them have wrinkled seeds and 3/4 of them have smooth seeds.
- (c) 3/4 of them have wrinkled seeds and 1/4 of them have smooth seeds.
- (d) All of them have smooth seeds.

(iii) If a genotype consists of different types of alleles, it is called

(a) homozygous (b) heterozygous (c) monoallelic (d) uniallelic.

(iv) The alternative form of gene is called

(a) dominant character (b) recessive character (c) alternative genes (d) allele.

(v) Which of the following will be the genotypic ratio of given F_2 generation?

(a) 1 : 3 (b) 3 : 1 (c) 1 : 2 : 1 (d) 1 : 1 : 1

7

Read the following and answer any four questions from 7(i) to 7(v).

In fruitflies, the gene for wing shape has two alleles, an unusual allele for curled wings (c) and the normal allele for straight wings (C). The given phenotypes are observed for each genotype.

Genotype	Phenotype
CC	Normal, straight wings
Cc	Wings curled up at the ends, has difficulty flying
cc	Unable to hatch from egg

(i) Which of the following crosses would produce live offspring from 50% of the eggs?

(a) CC × Cc (b) CC × CC (c) CC × cc (d) Cc × cc

(ii) Which of the following crosses would be able to produce offspring that would fly normally from 50% of the egg?

(a) CC × Cc (b) Cc × Cc (c) CC × cc (d) Cc × cc

(iii) Two curly winged flies are crossed, and they produce 150 eggs. What is the proportion of straight-winged flies expected among the live offspring?

(a) 25% (b) 33% (c) 50% (d) 75%

(iv) Normal straight winged flies are self crossed and they produce 120 eggs. What is the proportion of curly winged flies expected among the live offspring?

(a) 25% (b) 75% (c) 0% (d) 100%

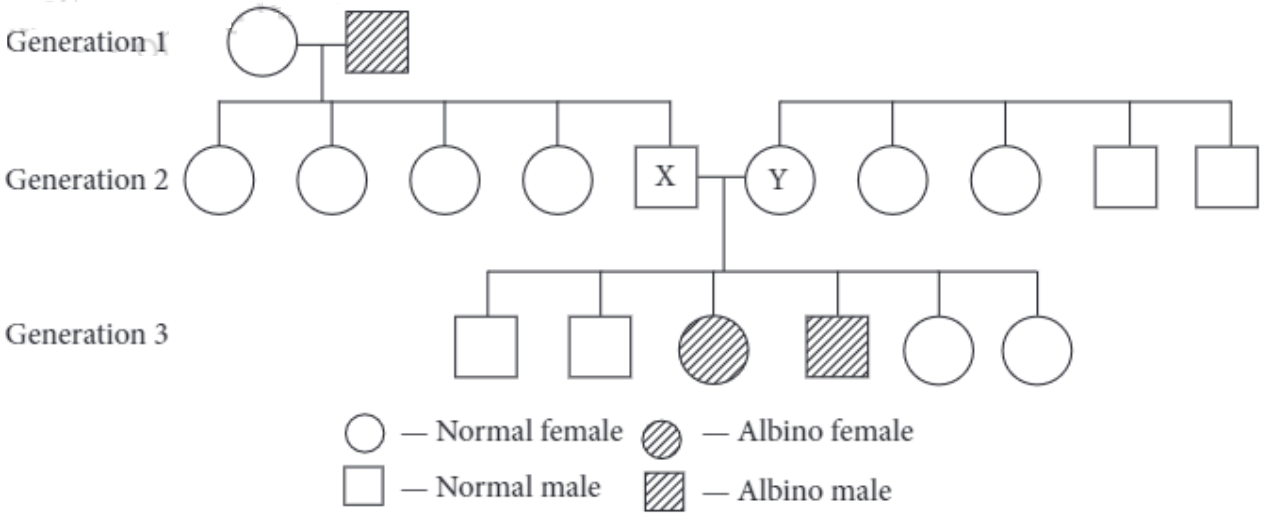
(v) Which of the following crosses would be able to produce offspring that has curled wings only?

(a) CC × Cc (b) CC × cc (c) Cc × Cc (d) Cc × cc

8

Read the following and answer any four questions from 8(i) to 8(v).

Refer to the schematic representation of the albinism that is an inherited condition caused by recessive allele (a). 'A' is the dominant allele for the normal condition. The inheritance of certain genetic traits for two or more generations is represented in a pedigree or family tree. Study the given pedigree chart and answer the following questions.



(i) Which of the following could be the genotypes of X and Y?

	X	Y
(a)	AA	AA
(b)	AA	Aa
(c)	Aa	Aa
(d)	aa	aa

(ii) Which of the following could be the genotype of generation - 1 male and female?

	Male	Female
(a)	AA	aa
(b)	aa	AA
(c)	Aa	aa
(d)	AA	AA

(iii) If X married an albino female, then what is the probability that their children would be albino?

(a) 0 (b) 0.125
(c) 0.25 (d) 0.5

(iv) If Y married a normal homozygous male, then what is the probability that their children would be albino?

(a) 0 (b) 0.125
(c) 0.25 (d) 0.5

(v) Which of the following could be the genotype of offsprings produced by cross of X and Y?

(a) AA, Aa, aa (b) aa, aa
(c) Aa, Aa (d) AA, AA

9

Read the following and answer any four questions from 9(i) to 9(v).

Refer to the given table regarding results of F_2 generation of Mendelian cross.

Plants with round and yellow coloured seeds (P)	315
Plants with round and green coloured seeds (Q)	108
Plants with wrinkled and yellow coloured seeds (R)	101
Plants with wrinkled and green coloured seeds (S)	32

(i) Which of the following would be the phenotype of F_1 generation regarding given data of F_2 generation?

(a) Plants with round and yellow coloured seeds.
(b) Plants with round and green coloured seeds.
(c) Plants with wrinkled and yellow coloured seeds.
(d) Plants with wrinkled and green coloured seeds.

(ii) Which of the following would be the genotype of parental generation regarding given result of F_2 generation?

(a) YYRR and yyrr (b) YYRR and YYRR (c) YYRR and YyRr (d) YyRr and YyRr

(iii) If plant with wrinkled and green coloured seeds (S) is crossed with plant having wrinkled and yellow coloured seeds (R), what will be the probable phenotype of offsprings?

(a) All plants with wrinkled and yellow coloured seeds.
(b) 50% plants with wrinkled and yellow coloured seeds and 50% plants with wrinkled and green coloured seeds.
(c) All plants with wrinkled and green coloured seeds.
(d) Both (a) and (b)

(iv) Which of the following will result when plant YyRr is self-pollinated?

(a) 9 : 3 : 3 : 1 ratio of phenotypes only
(b) 9 : 3 : 3 : 1 ratio of genotypes only
(c) 1 : 1 : 1 : 1 ratio of phenotypes only
(d) 1 : 1 : 1 : 1 ratio of phenotypes and genotypes

(v) The percentage of yR gamete produced by YyRR parent will be

(a) 25% (b) 50% (c) 75% (d) 12.5%

10

Read the following and answer any four questions from 10(i) to 10(v).

Pea plants can have smooth seeds or wrinkled seeds. One of the phenotypes is completely dominant over the other. A farmer decides to pollinate one flower of a plant with smooth seeds using pollen from plant with wrinkled seeds. The resulting pea pod has all smooth seeds.

(i) Which of the following conclusions can be drawn?

1. The allele for smooth seeds is dominated over that of wrinkled seeds.
2. The plant with smooth seeds is heterozygous.
3. The plant with wrinkled seeds is homozygous.

(a) 1 only (b) 1 and 2 only (c) 1 and 3 only (d) 1, 2 and 3

(ii) Which of the following crosses will give smooth and wrinkled seeds in same proportion?
(a) RR × rr (b) Rr × rr (c) RR × Rr (d) rr × rr

(iii) Which of the following cross can be used to determine the genotype of a plant with dominant phenotype?
(a) RR × RR (b) Rr × Rr (c) Rr × RR (d) RR × rr

(iv) On crossing of two heterozygous smooth seeded plants (Rr), a total of 1000 plants were obtained in F_1 generation. What will be the respective number of smooth and wrinkled seeds obtained in F_1 generation?
(a) 750, 250 (b) 500, 500 (c) 800, 200 (d) 950, 50

(v) The characters which appear in the first filial generation are called
(a) recessive characters (b) dominant characters
(c) lethal characters (d) non-mendelian characters.

ASSERTION & REASON

For question numbers 11-30, two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below :

(a) Both A and R are true and R is correct explanation of the assertion.
(b) Both A and R are true but R is not the correct explanation of the assertion.
(c) A is true but R is false.
(d) A is false but R is true.

11. **Assertion :** In humans, height is a trait which shows variation.
Reason : Some humans are very tall, some have medium height whereas others are short heighted.

12. **Assertion :** Accumulation of variation in a species increases the chances of its survival in changing environment.
Reason : Accumulation of heat resistance in some bacteria ensure their survival even when temperature in environment rises too much.

13. **Assertion :** Traits like tallness and dwarfness in pea plant are inherited independently.
Reason : When a homozygous tall pea plant is crossed with dwarf pea plant, medium sized pea plant is obtained in F_1 generation.

14. **Assertion :** Pea plant is considered ideal for hybridisation experiments.
Reason : Pea is self pollinating plant with short life cycle and bears visible contrasting traits.

15. **Assertion :** Monohybrid cross deals with inheritance of one pair of contrasting characters.
Reason : Dihybrid cross deals with inheritance of two pairs of contrasting characters.

16. **Assertion :** When pea plants (pureline) having round yellow seeds are crossed with pureline plants having wrinkled green seeds, then all pea plants obtained in F_1 generation bear wrinkled green seeds.
Reason : Round and yellow seeds are dominant to wrinkled and green seeds.

17. **Assertion :** If blood group of both mother and father is 'O' then the blood group of children will also be O.
Reason : Blood group in humans is determined by many alleles of a gene *viz.* I^A, I^B, I^O.

18. **Assertion :** In some reptiles, the temperature at which fertilised egg is incubated before hatching plays a role in determining sex of offspring.
Reason : In turtle, high incubation temperature above 33°C leads to development of female offspring whereas in lizards high incubation temperature results in male offspring.

19. **Assertion :** In humans, male (or father) is responsible for sex of the baby which is born.
Reason : Y chromosomes are present in only male gametes or sperms.

20. **Assertion :** If mother is homozygous for black hair and father has red hair then their child can inherit black hair.
Reason : Gene for black hair is recessive to gene for red hair in humans.

21. **Assertion :** Selfing of a plant for several generations helps plant breeders to obtain pure breeding varieties.
Reason : Pure breeding plants are heterozygous for many traits.

22. **Assertion :** A tall plant which always produces tall offsprings is considered heterozygous for height and is represented by genotype (Tt).
Reason : A tall plant which always produces tall offspring is homozygous dominant and will always produce only one type of gamete (T).

23. **Assertion :** A geneticist crossed two plants and got 50% tall and 50% dwarf progenies.
Reason : This cross follows Mendelian law as one of the parent plant might be heterozygous.

24. **Assertion :** A heterozygous tall plant when crossed with homozygous dwarf plant will produce tall and dwarf plants in the ratio of 3 : 1.
Reason : A heterozygous tall plant will produce two types of gametes, *i.e.*, one with T and other with t whereas homozygous dwarf plant produce all gametes with t only.

25. **Assertion :** In human males all the chromosomes are perfectly paired except X and Y chromosomes.
Reason : X and Y are sex chromosomes.

26. **Assertion :** A child which has inherited X chromosome from father will develop into a girl child.
Reason : Girl child inherits X chromosome from father and Y chromosome from mother.

27. **Assertion :** Genes present in every cell of an organism control the traits of the organisms.
Reason : Gene is specific segment of DNA occupying specific position on a chromosome.

28. **Assertion :** In grasshoppers, females are heterogametic and males are homogametic.
Reason : In grasshoppers, male has only one sex chromosome (XO) whereas the female has sex chromosomes (XX).

29. **Assertion :** Round green seeds in pea can be represented by RRyy of Rryy.
Reason : Round yellow seeds and green wrinkled seeds are parental combinations whereas round green and wrinkled yellow are recombinants.

30. **Assertion :** If mother has two dominant alleles for black hair and father has two recessive alleles for blonde hair then their child will inherit one dominant allele from mother and one recessive allele from father and will have black hair.
Reason : Progeny inherits one genes for each trait from its parents but the trait shown by progeny depends on inherited alleles.

HINTS & EXPLANATIONS

1. (i) (b) : In XX-XO type and XX-XY type of sex determining mechanisms, males produce two different types of gametes, either with or without X-chromosome (XO type), or some gametes with X-chromosome and some with Y-chromosome (XY type). Such type of sex determination mechanism is designated to be the example of male heterogamety. In both, females are homogametic and produce X type of gametes in both the cases and have XX genotype.

(ii) (b): The possibility of having a girl or boy child is equal *i.e.*, 50%, as 50% male gametes are Y type and 50% are X type. Fusion of egg with X type sperm will produce a girl child.

(iii) (b): In humans, number of autosomes are 2n = 44 or 22 pairs regardless of the sex.

(iv) (a): *Refer to answer 1 (i).*

(v) (b): Male fruitfly is heterogametic whereas female fruitfly is homogametic.

2. (i) (a): Characters studied by Mendel are as follows:

	Trait studied	Dominant	Recessive
1.	Plant height	Tall (T)	Dwarf (t)
2.	Flower position	Axial (A)	Terminal (a)
3.	Flower colour	Violet (V) or (W)	White (v) or (w)
4.	Pod shape	Full or Inflated (I) or (C)	Constricted (i) or (c)
5.	Pod colour	Green (G) or (Y)	Yellow (g) or (y)
6.	Seed shape	Round (R) or (W)	Wrinkled (r) or (w)
7.	Seed colour	Yellow (Y) or (G)	Green (y) or (g)

(ii) (c): *Refer to answer 2 (i).*

(iii) (d): *Refer to answer 2 (i).*

(iv) (c): *Refer to answer 2 (i).*

(v) (d): *Refer to answer 2 (i).*

3. (i) (c): Since this pea plant is heterozygous for round shape, its genotype would be Rr.

Parents : Rr × Rr

↓ (selfing)

Progeny : RR Rr Rr rr

Phenotypically, the ratio will be 3 : 1, *i.e.*, only rr seedlings will show wrinkled seed phenotype, rest will show round seed shape.

1200 → Round shape (RR, Rr)

400 → Wrinkled (rr)

(ii) (c): 'A' represents the dominant gene and 'a' represents its recessive allele. The most likely result in the first generation offspring when Aa is crossed with aa is :

Parents : Aa × aa

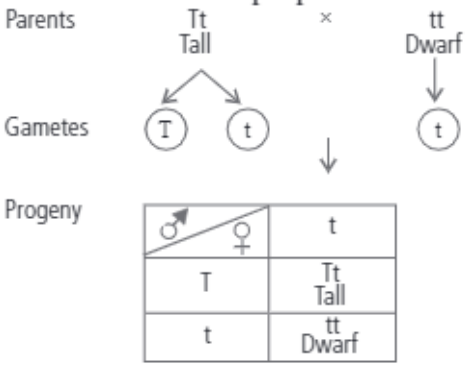
Gametes : (A) (a) (a) (a)

F_1 : Aa Aa aa aa

Hence, Aa : aa

1 : 1

(iii) (b): This is an example of a test cross in which a cross is made between heterozygous tall and homozygous dwarf individuals and tall and dwarf plants are obtained in same proportion.

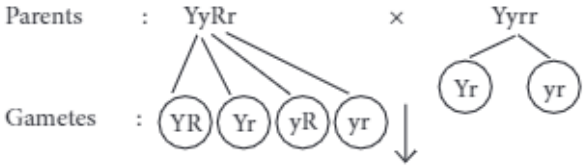


Phenotypic ratio = 1 Tall : 1 Dwarf

(iv) (c): Self pollination of homozygous tall F_2 plant (TT) will give rise to all individuals of genotype TT.

(v) (d)

4. (i) (a): A cross between yellow round seeds (YyRr) and yellow wrinkled seeds (Yyrr) will be:



Progenies :

♀ / ♂	Yr	yr
YR	YYRr Yellow round	Yy Rr Yellow round
Yr	YYrr Yellow wrinkled	Yy rr Yellow wrinkled
yR	Yy Rr Yellow round	yy Rr Green round
yr	Yy rr Yellow wrinkled	yyrr Green wrinkled

Phenotypic ratio is :

Yellow round seeds : Yellow wrinkled seeds : Green round seeds : Green wrinkled seeds

: : 3 : 3 : 1 : 1 or 3/8, 3/8, 1/8, 1/8

(ii) (a)

(iii) (b)

(iv) (c): Round yellow heterozygous pea plant may be represented by genotype RrYy. On selfing such plants following results will be obtained.

Parents: ♂ RrYy (Round Yellow) × ♀ RrYy (Round Yellow)

Gametes : (RY) (Ry) (rY) (ry) (RY) (Ry) (rY) (ry)

Offsprings:

♀ \ ♂	(RY)	(Ry)	(rY)	(ry)
(RY)	RRYY	RRYy	RrYY	RrYy
(Ry)	RRYy	RRyy	RrYy	Rryy
(rY)	RrYY	RrYy	rrYY	rrYy
(ry)	RrYy	Rryy	rrYy	rryy

Hence, total 16 genotypes will be obtained in the next generation out of which the frequency of occurrence of RrYY genotype is 2, as illustrated by the given Punnett square chart.

(v) (a): Gametes produced by YyRr parent would be 25% YR, 25% yR, 25% Yr and 25% yr.

5. (i) (c)

(ii) (b): According to the given passage some children show recessive trait, *i.e.*, homozygous. So, the woman must be heterozygous.

(iii) (c): Human ova are haploid, hence they only contain one copy of each gene. Since the woman has a Bb genotype her ova would contain either B or b allele.

(iv) (d): According to the given passage, within a single family, the sample size of offspring in each generation is very small. Hence, the actual phenotypic and genotypic ratios often deviate from expected ratios. It is only when sample sizes of offspring is large that actual ratios approach theoretical or expected ratios more closely.

(v) (c): Human sperm is haploid, hence they only contain one copy of each gene. Since the man has a bb genotype, his sperm would contain allele b only.

6. (i) (d)

(ii) (b)

(iii) (b): Factors representing the alternate or same form of a character are called alleles. In heterozygous individuals or hybrids, a character is represented by two contrasting alleles. Out of the two contrasting alleles, only one is able to express its effect in the individual. It is called dominant allele. The other allele which does not show its effect in the heterozygous individual is called recessive allele, *e.g.*, in case of hybrid tall pea plants (Tt). 'T' is dominant allele whereas 't' is recessive allele.

(iv) (d): *Refer to answer 6 (iii).*

(v) (c): In given case, genotypic ratio of F_2 progeny will be 1 : 2 : 1 where, one is homozygous dominant, two are heterozygous dominant and one is homozygous recessive.

7. (i) (d)

(ii) (a)

(iii) (a): 25% of the total number of eggs will not hatch (genotype cc). 50% of the offspring will be curly-winged (Cc) and 25% of the offspring are straight-winged (CC).

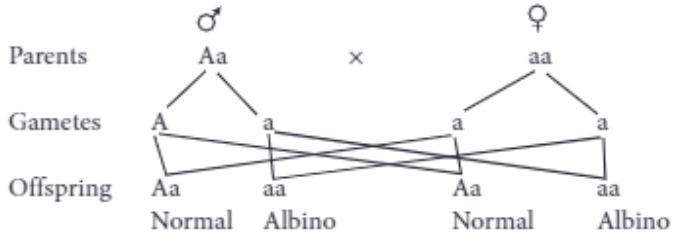
(iv) (c)

(v) (b)

8. (i) (c) X and Y parents must have 'a' allele (recessive) that is respective for albinism, the genotype of both X and Y individuals would be Aa and Aa as they are normal and 3rd generation, normal and albino male and female is formed in 3 : 1 ratio.

(ii) (b): Albinism is caused by the recessive allele. The children of generation-1, male and female all are normal (Aa). So, in generation-1, the genotype of female must be AA as she is normal and genotype of male is aa as he is albino male.

(iii) (d): Albinism is caused by the recessive allele and father of X is albino male so, the genotype of X is Aa and genotype of albino female is aa. So, the probability that their children would be albino is 50%.



(iv) (a)

(v) (a)

9. (i) (a)

(ii) (a)

(iii) (d): Plant with wrinkled and green coloured seeds (S) (genotype rryy) is crossed with plant with wrinkled and yellow coloured seeds (R) (genotype rrYY or rrYr). If plant with wrinkled and green coloured seeds (rryy) is crossed with plant having wrinkled and

yellow coloured seeds of genotype rrYY then all plants produced with wrinkled and yellow coloured seeds whereas if plant with wrinkled and green coloured seeds (rryy) is crossed with plant having wrinkled and yellow coloured seeds that has genotype rrYy then 50% plants with wrinkled and yellow coloured seeds and 50% plants with wrinkled and green coloured seeds are produced.

(iv) (a): When plant YyRr is self pollinated, 9 : 3 : 3 : 1 ratio of phenotypes will be observed. This can be explained as follows:

Parents : YyRr × YyRr

Progenies :

♀ / ♂	YR	Yr	yR	yr
YR	YYRR Yellow round	YYRr Yellow round	YyRR Yellow round	YyRr Yellow round
Yr	YYRr Yellow round	YYrr Yellow Wrinkled	YyRr Yellow round	Yyrr Yellow Wrinkled
yR	YyRR Yellow round	YyRr Yellow round	yyRR Green round	yyRr Green round
yr	YyRr Yellow round	Yyrr Yellow Wrinkled	yyRr Green round	yyrr Green Wrinkled

Phenotypic ratio = 9 yellow and round : 3 yellow and wrinkled : 3 green and round : 1 green and wrinkled.

(v) (b): Gametes produced by YyRR parent would be 50% YR and 50% yR.

10. (i) (c)

(ii) (b)

(iii) (d)

(iv) (a): The crossing between two heterozygous smooth seeded (Rr) plants would give phenotypic ratio of 3 smooth seeded plant : 1 wrinkled seeded plant.
If plants obtained were 1000, then the number of smooth and wrinkled plants will be closed to 750 and 250 respectively.

(v) (b)

11. (b) **12. (b)**

13. (c): Traits like tallness and dwarfness in pea plant are inherited independently and when a homozygous tall pea plant is crossed with a dwarf pea plant, only tall pea plants are obtained in F_1 generation.

14. (a): Mendel chose pea plants for studying inheritance because of number of reasons. Pea plants are self pollinating which enables them to produce next generation of plants easily, also purelines could be easily obtained. Due to short life cycle, many generations of pea plants can be produced in a comparatively short span of time. Also pea plant shows a number of clear cut visible contrasting traits like tall and dwarf height, round and wrinkled seeds, etc.

15. (b): In monohybrid cross we study the inheritance of one pair of contrasting characters of organism by their first generation and second generation progeny. In dihybrid cross we study the inheritance of two pairs of contrasting characters of organisms.

16. (d): When pureline pea plants having round yellow seeds are crossed with that of wrinkled green seeds then plant obtained in F_1 are all with round yellow seeds as round yellow seeds are dominant to wrinkled green seeds.

17. (b): The blood group system in humans is determined by a gene which has 3 different alleles *viz.* I^A, I^B and I^O. I^A and I^B are dominant to I^O but codominant to each other. Blood group A is indicated by genotype I^AI^A or I^AI^O, Blood group B → I^BI^B or I^BI^O, Blood group AB → I^AI^B and blood group O → I^OI^O

When ♀ I^OI^O × I^O I^O ♂

The gametes : I^O × I^O

F_1 : I^OI^O

Blood group O

18. (b)

19. (a): In humans, sex is determined by sex chromosomes. A male has one X and one Y chromosome (XY). A female has two X chromosomes (XX). Male produces two types of sperms, one with X and one with Y whereas female produces only one type of egg with X chromosome.
When sperm with X chromosome fertilises egg then zygote has both XX chromosomes and develops into female progeny. If sperm with Y chromosome fertilises egg then zygote has XY chromosomes and develops into male progeny.

20. (c): Gene for black hair colour is dominant to gene for red hair colour in humans. Mother has black hair and can be represented by (BB) whereas father can be represented by (bb).

(i) Parents : ♀ BB × bb ♂

Gametes : (B) (b)

Progeny : Bb

Heterozygous black

So, the child will be heterozygous for black hair colour.

21. **(c) :** Pure breeding plants are homozygous for many traits, *i.e.*, they will have either both dominant genes or both recessive genes for a particular trait.

22. **(d):** A tall plant which always produces tall offspring is homozygous dominant with genotype (TT). It will always produce only one type of gamete (T).

23. **(b):** The given cross can be illustrated as follows:

Tt × tt

Parents : Heterozygous tall × Homozygous tall

Gametes : (T) (t) (t)

Progenies : (Tt) (tt)

Tall : Dwarf

1 : 1

24. **(d):** A heterozygous tall plant when crossed with dwarf plant will give following result.

Parents : Tt Tall × tt Dwarf

Gametes : (T) (t) (t)

Progeny :

♂ / ♀	t
T	Tt Tall
t	tt Dwarf

Phenotypic ratio = 1 Tall : 1 Dwarf

25. **(a)**

26. **(c) :** Father produces two types of sperms, one with X and one with Y chromosome whereas mother produces all egg with X chromosome. Zygote that inherits X chromosome from father has XX chromosomes and develops into baby girl whereas zygote which inherits Y chromosome from father has XY chromosomes and develops into baby boy.

27. **(b)**

28. **(d):** In grasshoppers, the male has only one sex chromosome (XO) whereas the female has two sex chromosomes *i.e.*, homogametic. This type of sex determination mechanism is called XX–XO mechanism.

29. **(b)**

30. **(a)**