01 Genetic Basis of Inheritance

1. The four gametes produced by AaBb – AB, Ab, aB, ab. Therefore percentage of 'ab' gamete produced by 'AaBb' parent will be 25% .

3. Dwarf plants of F_2 generation of a monohybrid cross are homozygous dwarf and hence form pure line parents or breed true for dwarfness.

5. Parents: Tt × Tt

   Gametes: (T) (t) (T) (t)

	T	**t**
T	TT	Tt
t	Tt	tt

   $3/4^{th}$ of the offsprings appear dominant (TT, Tt, Tt)

6. In F_2 generation, Mendel got tall and dwarf plants in approximately 3:1 ratio (here ratio is 2.84:1)

10. Test cross is a back cross but back cross is not necessarily a test cross.

11. In pea flower, the stamens and carpels are enclosed in the innermost two petals that are appressed together forming a boat-shaped structure called Carina.

12. A dominant allele expresses itself in hybrids.

13. F_2 progeny of monohybrid cross shows two phenotypes and three genotypes, viz. homozygous dominant, heterozygous dominant and homozygous recessive. The cross between F_1 progeny obtained from homozygous tall (TT) and homozygous dwarf (tt) plant will yield (three types of genotypes) homozygous tall (TT), heterozygous tall (Tt) and homozygous dwarf (tt). The two phenotypes will be tall and dwarf.

02 Gene: It's nature, expression and regulation

1. RNA $\xrightarrow{\text{Reverse Transcription}}$ DNA

6. At the 3′ end of t-RNA, an unpaired CCA base sequence is present. It is called as amino acid attachment site.

7. Histones are absent in prokaryotes.

13. DNA contains only phosphorous (phosphate group) derived from phosphoric acid (H_3PO_4).

16. As, A = 25, hence, T = 25 (since number of adenine = number of thymine).
Similarly, C = 45, hence, G = 45 (since number of cytosine = number of guanine).
Hence, number of nucleotides in DNA segment = A+T+G+C= 25+25+45+45= 140.

17. Endonuclease enzyme cuts DNA at specific sites. DNA polymerase helps in formation of complementary strand and proof reading of bases.

19. Release of polypeptide chain takes place during termination process.

03 Biotechnology: Process and Application

2. The palindromes in DNA are base pair sequences that are the same, when it is read forward (left to right) or backward (right to left) from a central axis of symmetry. The given sequences read the same in 5′ ⟶ 3′ direction and 3′ ⟶ 5′ direction.

3. Restriction enzymes are widely found in prokaryotes and provide protection to host cell by destroying foreign DNA that makes entry into it.

5. Agarose is a polysaccharide extracted from sea weeds and is commonly used as matrix in agarose gel electrophoresis.

7. Nucleases is a class of enzymes that cleaves DNA.

9. Plasmid and Bacteriophage are cloning vectors used to transfer foreign DNA into the host cell.

10. Electrophoresis is a technique of separation of charged molecules under the influence of an electrical field through a matrix.
DNA fragments generated by restriction endonuclease are separated by gel electrophoresis.

13. In PCR, Taq polymerase is used which is obtained from *Thermus aquaticus* bacteria. It is a relatively thermostable enzyme thus used in PCR, as during this process, the step involving denaturation of DNA strands requires high temperature of about 94° C.

04 Enhancement In Food Production

1. IR–8 is an improved rice variety, while Rojo–64 A, Sonora–64 and Kalyan Sona are improved varieties of wheat.

2. The explants in tissue culture method require continuous supply of sugar, mineral salts, providing macro and microelements for normal plant growth, a few vitamins, an amino acid glycine and auxin, cytokinin in varying ratio in the culture medium. Agar is a solidifying agent which is not absolutely essential for culturing tissues.

6. ICAR : Indian Council for Agricultural Research – Evaluation of newly developed variety w.r.t. yield, quality, etc is done at ICAR.
   NSC : National Seed Corporation – The quality of seed is certified by an agency, i.e. NSC.
   IARI : Indian Agricultural Research Institute – Many biofortified crops have been developed by IARI.
   IRRI : International Rice Research Institute – IR-8 is a semidwarf variety of rice developed at IRRI.

9. Pusa shubhra is a variety of cauliflower for disease Curl blight black rot.

05 Microbes In Human Welfare

1. Vinegar (Acetic Acid) is produced by the bacteria *Acetobacter aceti*.
2. *Azotobacter* is asymbiotic, free-living bacteria.
3. *Rhizobium* is a symbiotic, non-motile, gram –ve aerobic bacterium. It harbours inside the roots of leguminous plants forming symbiotic association.
4. VAM is an endomycorrhizae and shows importance in phosphate nutrition.
6. *Agrobacterium* is a plant vector.

06 Photosynthesis

1. $6CO_2+12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \underset{\text{Glucose}}{C_6H_{12}O_6}+6H_2O+6O_2\uparrow$

2. PEP carboxylase is found in leaf mesophyll cells of C_4 plants. The mesophyll and bundle sheath cells are in close contact with one another and are connected by cytoplasmic connections. There is an exchange of metabolites between the two kinds of cells, CO_2 fixed in mesophyll cells by PEP carboxylase is converted to malic acid, which is then exported to the bundle sheath cells. Here, malic acid is decarboxylated to produce pyruvic acid and CO_2. The pyruvic acid is exported back to the mesophyll cells, where it is converted to phosphoenolpyruvic acid, the CO_2 acceptor in the C_4 pathway.

3. 6 CO_2 and 6 molecules of RuBP combine to form an unstable (6C) compound which immediately splits into two molecules of stable 3C compound, i.e. PGA.

4. Cyclic photophosphorylation produces only ATP and not $NADPH_2$.

5. In this process, water is oxidized in presence of light and chlorophyll, hydrogen is removed from water and oxygen is released.

6. Photosynthesis is a process in which carbondioxide and water combine to form carbohydrates in presence of light and oxygen is evolved.

7. Blackman's reaction is the dark reaction taking place in stroma and is independent of light.

11. Chlorophyll-a $\longrightarrow C_{55}H_{72}O_5N_4Mg$
Chlorophyll-b $\longrightarrow C_{55}H_{70}O_6N_4Mg$

15. ATP and $NADPH_2$ together are called 'Assimilatory power' as they are required for assimilation of CO_2.

17. Hill's reaction $\longrightarrow$ Light dependent reaction
Calvin's cycle $\longrightarrow$ Dark reaction

07 Respiration

3. Citric acid $\xrightarrow{-H_2O}$ Cis-aconitic acid
(6C) (6C)

4. The intermediate products formed during Kreb's cycle are used in the synthesis of organic compounds like proteins and fats.

5.

Substrate	Respiratory Quotient (R.Q.)
Carbohydrate	1
Fats	< 1
Organic acid	>1

6. During glycolysis, DHAP(Diyhdroxyacetone phosphate) undergoes isomerization reaction to form 2 molecules of 3-PGAL.

8. Alcoholic fermentation is anaerobic respiration.
$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2 + 2ATP$
Glucose Ethyl alcohol Carbon dioxide

11. In TCA cycle, 2ATPs are generated.

13. Kreb's cycle is a stage of aerobic respiration which takes place in the matrix of the mitochondria.

15.

Substrate	Respiratory Quotient
Fats	< 1
Glucose	1
Organic acid	> 1

17. Glycolysis is an enzymatic breakdown of hexose sugar (glucose) into two molecules of Pyruvate (3C) in the cytoplasm.

18. The value of Respiratory Quotient (R.Q.) is different for different substrates.

08 Reproduction In Plants

1. Integument is a diploid cell.
$\therefore$ $2n = 2 \times 14 = 28$
Antipodal cells are haploid.
$\therefore$ $n = 14$
Embryo is diploid. $\therefore$ $2n = 2 \times 14 = 28$
Endosperm is triploid. $\therefore$ $3n = 3 \times 14 = 42$
Nucellus is diploid. $\therefore$ $2n = 2 \times 14 = 28$

2. Seeds are produced by fertilized ovule which is an outcome of fusion of male gametes and egg cell.

4. The division of parental body into two nearly equal daughter individuals during favourable conditions is called Binary fission.

6. *Oxalis* is vegetatively propagated by runner.

14. *Vallisneria* shows adaptation for epihydrophily.

15. Self incompatibility is a phenomenon in which genetic mechanism of flower prevents the fusion of gametes of genetically similar plants. It is also called self-sterility.

17. The antipodal cells are the part of embryo sac and hence they are haploid (n). Zygote is formed by the fusion of male and female gamete, hence it is diploid (2n). The endosperm is formed by fusion of secondary nucleus (2n) and one male gamete (n), hence it is triploid (3n).

18. Angiosperms are flowering plants in which seeds are enclosed inside the fruit.

09 Organisms And Environment–I

1. Green plants (Producers)
   ↓
   Grasshopper (Herbivore)
   ↓
   Frog (Primary carnivore)
   ↓
   Snake (Secondary carnivore)
   ↓
   Hawk (Tertiary carnivore)

2. Lake is an example of natural ecosystem since it operates under natural conditions without any major interference of man.

6. The Montreal Protocol was a treaty signed in 1987 to control the emission of ozone depleting substances, mainly CFCs.

7. The Chipko movement was initially meant for protecting trees, but now meant for preservation of environment.

8. Green house gases are CH_4, CO_2, N_2O and CFCs.

9. At every trophic level in a food chain, only 10% of energy is available.
   Grass → Insect → Frog → Snake
   30 J 3 J 0.3 J 0.03 J
   So, energy available for Snake is 0.03 J.

11. Production and respiration rates of the community and nutrient cycles are considered as the function of the ecosystem.

12. The sequence given in Option (B) is an example of Xerarch succession, while others are examples of Hydrarch succession.

10 Origin And Evolution Of Life

1. The spark discharge glass apparatus was designed by Miller and Urey to show that simple organic compounds could be formed in nature from the inorganic molecules.
2. Nature selects the organisms which are provided with favourable variations and those are fit to survive. This is called as 'Natural selection' or 'Survival of the fittest'.
3. Upto 1845, in England, the species *Biston betularia* was a light coloured moth. However, after industrial revolution, more and more black peppered moths were observed and by 1895, they comprised 99% of the moth population.
4. Hardy-Weinberg equilibrium principle states gene (allele or genotype) frequencies remain same from generation to generation, thus maintaining the genetic equilibrium unless disturbed by factors like mutation, non-random mating, etc.
5. Darwin observed many varieties of finches (a group of small-sized and black coloured passerine birds) on Galapagos Islands.
   Many varieties of these birds were found on same island with alteration in beaks, some insectivorous and some vegetarians.
   They radiated to different geographical areas.
   They have undergone adaptive radiation especially in their type of beak.
6. Darwin gave Natural selection theory, Hugo de Vries proposed mutation theory of evolution, Lamarck proposed theory of inheritance of acquired characters and Huxley said that the birds are glorified reptiles.
8. Most of the ape fossils of human evolutionary line have been excavated from African rocks.
14. The condition in which members of the same species fail to interbreed is called geographical isolation.
15. The organs of the body which are non-functional to the possessor but were functional in ancestor and are also functional in related animals are called vestigeal organs.

11 Chromosomal Basis of Inheritance

1. The number of linkage groups in a species corresponds to its haploid number of chromosomes.
   Hence, number of linkage groups in maize are 10 (10 pairs of chromosomes) as chromosome number is 20.

2. i. The individual suffering from Klinefelter's has 47 chromosomes instead of 46 and chromosomal make up will be 44 + XXY.
   ii. When an abnormal egg with XX chromosomes is fertilized with normal Y sperm, the resulting baby gets XXY.

4. Myopia is an example of complete sex-linked inheritance.

6. Y-chromosome contains small amount of euchromatin and large amount of heterochromatin.

7. ZZ-ZW type of sex determination is seen in birds. Male has genotype (ZZ) and female has genotype (ZW).

8. The chromosomal make-up of an individual suffering from Turner's syndrome is 44 + XO.

10. Haemophilia is inherited from father to his grandson through his daughter. This is called 'Criss-cross inheritance'.

12 Genetic Engineering and Genomics

1. In somatic gene therapy, healthy genes are introduced into somatic cells like blood cells, bone marrow cells.
2. Vaccine is an antigenic preparation developed from attenuated bacteria and viruses.
3. The cutting of DNA by restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis.
4. PCR is a gene amplification technique in which multiple copies of known DNA sequence is obtained.
6. In DNA fingerprinting, the broken DNA fragments of variable size are separated on the agarose gel by electrophoresis.
9. The objective of HGP was to determine the functions of all the genes and identify the various genes that cause genetic disorders in human beings.
10. DNA fingerprinting is also known as DNA profiling, DNA typing, molecular fingerprinting.

13 Human Health and Diseases

1. Hashish and Charas are hallucinogens and products of the hemp plant *Cannabis sativa*.
2. Saliva and tears are examples of Physiological (Chemical) barriers that constitute the first line of defence.
3. Development of swelling is a local inflammatory response.
4. In malaria, classical waves of fever arise from simultaneous waves of merozoites escaping and infecting red blood cells.
7. T and B-lymphocytes develop from haemopoietic stem cells that originate in the red bone marrow. The process of their production is called haematopoiesis.
10. The O-antigen present on the cell wall of *Salmonella typhi* are responsible for its pathogenicity.
12. Suppressor T-cells suppress the activity of Killer T-cells. Antibodies are produced by B-cells.
13. B-lymphocytes (Plasma cells) produce antibodies.
14. Erythroblastosis foetalis is a disease in which Rh-ve mother produces antibodies against Rh+ve foetus. It is also called haemolytic disease of the newborn (HDN).

14 Animal Husbandry

1. Aseel is an indigenous (desi) breed of fowl, rest all are exotic breeds.
2. Ranikhet disease is a viral disease affecting poultry.
3. Rohu is a fresh water fish, while others are marine water fishes.
5. *Catla* is a fresh water fish.
7. Multiple Ovulation Embryo Transfer Technology (MOET) is an artificial breeding method for herd improvement. It is done in cattle, sheep, rabbits, etc.
8. The mating of more closely related individuals within the same breed for 4-6 generations is called Inbreeding. It increases homozygosity.

15 Circulation

1. Monocytes, Lymphocytes and Neutrophils are types of WBCs.
2. In lymphocytes, the nucleus is single, large and spherical.
4. Cardiac output is defined as the amount of blood pumped by each ventricular contraction per minute.
   Stroke volume is the amount of blood pumped out by the left ventricle at its each contraction.
   The heart (left ventricle) contracts 75 times/minute.

   $\therefore$ The stroke volume $= \dfrac{\text{Cardiac output/minute}}{\text{ventricular contraction/minute}} = \dfrac{5250\text{ml}}{75}$

   $= 70$ ml
5. P-wave indicates impulse of contraction generated by SA node which causes atria depolarization.
8. Thrombocytes are blood platelets that play an important role in blood clotting.
9. Bundle of HIS is present within the basal part of interatrial septum.
10. The inferior vena cava, radial vein and pulmonary artery carry deoxygenated blood, while the radial artery carries oxygenated blood.
12. The pH of blood varies between 7.36 and 7.45, the average is about 7.4
17. ECG (Electrocardiogram) = Apparatus which record waves of auricular and ventricular activities and cardiac cycle.
18. The two pairs of pulmonary veins bring oxygenated blood from lungs to left atrium.
19. Right auricle receives deoxygenated blood from three veins:
    i. Superior vena cava (pre-caval)
    ii Inferior vena cava (post-caval)
    iii. Coronary sinus

    The right ventricle receives deoxygenated blood from right atrium.

16 Excretion and Osmoregulation

1. Whale is a mammal, hence it is ureotelic. Other aquatic fishes and animals show ammonotelic excretion.
2. The filtrate is isotonic to blood plasma (in proximal convoluted tubule) and the filtrate becomes hypertonic to blood plasma (in descending limb of loop of Henle). The filtrate is hypotonic to blood plasma (in ascending limb at loop of Henle) in distal convoluted tubule. ADH make the filtrate isotonic to blood plasma.
3. Distal convoluted tubule is another segment of selective secretion and reabsorption. It helps in regulation of blood pH by the reabsorption of HCO_3 an important buffer. The distal tube also function in K^+ and Na^+ homeostasis.
4. Urea and Uric acid are the ultimate products of protein catabolism.
5. Uric acid is insoluble in water and can be stored for a very long time and excreted in a crystalline form and hence it requires minimum amount of water for its dispersal and also requires less energy for elimination.
8. Presence of blood or blood cells in urine is called hematuria.
9. The 'Juxtaglomerular apparatus' is responsible for production and release of Renin.
12. Kidneys are retroperitoneal (retro–behind) in position, i.e. present behind the peritoneum.
13. The yellow colour of urine is due to the presence of pigment Urochrome, which is a breakdown product of haemoglobin from worn out red blood corpuscles.
14. Bright's disease (Nephritis) is inflammation of kidney that involves glomeruli and caused by infection of streptococci bacteria. In this case, blood cells and proteins are also filtered. Such a stage is called haematuria. Glomerular filtration rate is also reduced.

17 Control and Co-ordination

3.

Name of nerve	Nature
Vagus	Mixed
Olfactory	Sensory
Trigeminal	Mixed
Abducens	Motor

4. The axon of a nerve fibre is covered with a myelin sheath made up of lipids and proteins and is white in appearance.

7. The hypothalamus located in the diencephalon acts as thermoregulatory centre of the body in warm-blooded animals.

8. Centre for pain and pressure is located in Parietal lobe.

10. ICSH is secreted by the anterior pituitary (adenohypophysis).

15. Hypothalamus – Temperature regulation.

16. Adrenaline is a stress hormone that participates in fight, fright and flight mechanism.

20. Insulin is secreted by the β-cells of Islets of Langerhans in the pancreas. It decreases the blood glucose level.

18 Human Reproduction

2. In the caput (head) epididymis, sperms undergo maturation acquiring increased motility and fertilization capacity.

4. Both Penis and Clitoris show the presence of erectile tissues called corpora cavernosa.

5. Tunica albuginea is the covering of the testis.

7. Saheli is a weekly oral contraceptive pill that checks ovulation by inhibiting the secretion of FSH and LH hormones.

9. The seminal fluid contains citric acid, fructose, fibrinogen and prostaglandins. Fructose provides energy to sperms for swimming.

10. During each menstrual cycle of 28 days, only 1 ovum from either ovary is released.
$\therefore$ On an average, 13 eggs / year.

11. In external budding, a small projection or bud is formed on the outer surface of the parental body. eg. *Hydra*

13. In mammals, the testis are located in the extra abdominal scrotal sac. Failure of the testes to descend into the scrotum is called Cryptorchidism. This leads to sterility.

17. Early child marriage is a cause of population explosion.

18. Parturition is the process of expelling fully formed young one or baby from the mother's uterus after the gestation period.

20. Clitoris present in females is homologous to the penis in males.

19 Organisms and Environment–II

1. Mycorrhizae is a mutualistic association between certain species of fungi and roots of higher plants. It is a positive inter-specific interaction.
2. Water potential is a term associated with plant water relations and not population.
3. Addition of new individuals by reproduction, i.e. natality and entry of individuals from outside, i.e. immigration contributes to population growth.
4. A population is said to be in the declining phase when,
   Mortality (Death rate) > Natality (Birth rate)
5. Sand and dust storms are caused because of various environmental factors like temperature, wind, air pressure, etc. The sand and dust storms produce natural pollution.
6. Particulate matter of polluted air can be separated by two types of devices – Arrestors and Scrubbers. Arrestors include electrostatic precipitators, cyclone separator, gravity settling chamber and filters.
   Incineration involves aerobic burning of the combustible constituents of solid wastes like garbage, rubbish and dead animals. This is an ideal method for medical waste management as it eliminates the infectious organisms.
7. Natality = 250, Immigration = 20
   Mortality = 240, Emigration = 30
   Net Increase in Population
   = [(Natality + Immigration) – (Mortality + Emigration)]
   = [(250 + 20) – (240 + 30)]
   = 0
8. A rapidly growing population has high birth rate and low death rate. Hence, the contribution of reproductive members (15 – 49 years) is the highest.
9. Fossorial adaptation is a terrestrial adaptation for digging. e.g. The fore-limbs of rat are strong and stout which are provided with claws for digging.
10. An increase in natality and decrease in mortality leads to increase in population.