



BIOLOGY

1. **(3)**
Offset is a vegetative part of a plant, formed by mitosis.
Meiotic divisions do not occur in somatic cells.
Parthenogenesis is the formation of embryo from ovum or egg without fertilisation.
Parthenocarpy is the fruit formed without fertilisation, (generally seedless)
2. **(3)**
Semi-conservative DNA replication was first shown in Bacterium Escherichia coli by Matthew Meselson and Franklin Stahl.
3. **(2)**
Francois Jacob and Jacques Monod proposed model of gene regulation known as operon model/lac operon.
Alec Jeffreys – DNA fingerprinting technique.
Matthew Meselson and F. Stahl – Semiconservative DNA replication in E. coli.
Alfred Hershey and Martha Chase – Proved DNA as genetic material not protein
4. **(4)**
Starch synthesis in pea is controlled by pleiotropic gene.
Other options (1, 2 & 3) are correctly matched.
5. **(3)**
Punnett square was developed by a British geneticist, Reginald C. Punnett.
Franklin Stahl proved semi-conservative mode of replication.
Transduction was discovered by Zinder and Laderberg.
Spliceosome formation is part of posttranscriptional change in Eukaryotes
6. **(2)**
Sporopollenin cannot be degraded by enzyme; strong acids and alkali, therefore it is helpful in preserving pollen as fossil.
Pollenkitt – Help in insect pollination.
Cellulosic Intine – Inner sporoderm layer of pollen grain known as intine made up cellulose & pectin.
Oil content – No role in pollen preservation.
7. **(4)**
Bamboo species are monocarpic i.e., flower generally only once in its life-time after 50100 years.
Jackfruit, papaya and mango are polycarpic i.e., produce flowers and fruits many times in their life-time.
8. **(2)**
This technique is used for making multiple copies of gene (or DNA) of interest in vitro.
Each cycle has three steps
(1) Denaturation
(2) Primer annealing
(3) Extension of primer
9. **(2)**
Indian Government has setup organisation such as GEAC (Genetic Engineering Appraisal Committee) which will make decisions regarding the validity of GM research and safety of introducing GM-organism for public services. (Direct from NCERT).
10. **(4)**
Retrovirus is commonly used as vector for introducing a DNA fragment in human lymphocyte.
Gene therapy : Lymphocyte from blood of patient are grown in culture outside the body, a functional gene is introduced by using a retroviral vector, into these lymphocyte.
11. **(3)**
Biopiracy is term used for or refer to the use of bioresources by multinational companies and other organisation without proper authorisation from the countries and people concerned with compensatory payment (definition of biopiracy given in NCERT).
12. **(2)**
In 1997, an American company got patent rights on Basmati rice through the US patent and trademark office that was actually been derived from Indian farmer's varieties.
The diversity of rice in India is one of the richest in the world, 27 documented varieties of Basmati are grown in India.
Indian basmati was crossed with semi-dwarf varieties and claimed as an invention or a novelty.
Sharbati Sonora and Lerma Rojo are varieties of wheat.
13. **(4)**
Ribozyme is a catalytic RNA, which is nucleic acid.
14. **(2)**
Nucleolus is a non membranous structure and is a site of r-RNA synthesis.
15. **(3)**
Golgi complex, after processing releases secretory vesicles from their trans-face.
16. **(3)**
ATP, NADPH and oxygen are products of light reaction, while NADH is a product of respiration process.

17. (4)
Saccharomyces i.e. yeast is an eukaryote (unicellular fungi)
Mycobacterium – a bacterium
Oscillatoria and Nostoc are cyanobacteria.

18. (1)
Light, temperature and concentration of CO₂ affect opening and closing of stomata while they are not affected by O₂ concentration.

19. (2)
Sugar is a common term used to denote carbohydrate.
Carbohydrates are polyhydroxy aldehyde, ketone or their derivatives, which means they have carbonyl and hydroxyl groups.

20. (3)
Synaptonemal complex disintegrates. Terminalisation begins at diplotene stage i.e. chiasmata start to shift towards end.

21. (4)
Grass being a monocot, has Dumb-bell shaped stomata in their leaves.

22. (4)
Polysiphonia is a genus of red algae, where asexual spores and gametes are non-motile or non-flagellated.
Other options (1, 2 & 3) are correctly matched

23. (2)

Herbarium	Dried and pressed plant specimen
Key	Identification of various taxa
Museum	Plant and animal specimen are preserved
Catalogue	Alphabetical listing of species

24. (2)
In Pinus, winged pollen grains are present. It is extended outer exine on two lateral sides to form the wings of pollen. It is the characteristic feature, only in Pinus.
Pollen grains of Mustard, Cycas & Mango are not winged shaped.

25. (1)
In Agaricus (a genus of basidiomycetes), basidiospores or meiospores are produced exogenously.
Neurospora (a genus of ascomycetes) produces ascospores as meiospores but endogenously inside the ascus.)
Alternaria (a genus of deuteromycetes) does not produce sexual spores.

Saccharomyces (Unicellular ascomycetes) produces ascospores, endogenously.

26. (4)
Green sulphur bacteria do not use H₂O as source of proton, therefore they do not evolve O₂.

27. (2)
Double fertilization is a unique phenomenon that occur in angiosperms only.
Syngamy + Triple fusion = Double fertilization

28. (1)
Potassium helps in maintaining turgidity of cells.

29. (3)
Yucca have an obligate mutualism with a species of moth i.e. Pronuba.

30. (1)
Pollen grains can be stored for several years in liquid nitrogen at –196°C (Cryopreservation)

31. (3)
In cellular respiration, NAD⁺ act as an electron carrier.

32. (4)
Iron is absorbed by plants in the form of ferric ions. (According to NCERT) Plants absorb iron in both form i.e. Fe²⁺ and Fe³⁺. (Preferably Fe²⁺)

33. (2)
Ecological niche was termed by J. Grinnel. It refers the functional role played by the organism where it lives.

34. (2)
O₃ (ozone) is a secondary pollutant. These are formed by the reaction of primary pollutant.
CO – Quantitative pollutant
CO₂ – Primary pollutant
SO₂ – Primary pollutant

35. (3)
Natality refers to birth rate.

Death rate	Mortality
Number of individual entering a habitat is	Immigration
Number of individual leaving the habitat	Emigration

36. (1)
World Ozone day is celebrated on 16th September.
5th June - World Environment Day
21st April - National Yellow Bat Day
22nd April - National Earth Day

37. (4)
The given data depicts the inverted pyramid of biomass, usually found in aquatic ecosystem. Pyramid of energy is always upright
Upright pyramid of biomass and numbers are not possible, as the data depicts primary producer is less than primary consumer and this is less than secondary consumers.
38. (3)
UV rays act on CFCs, releasing Cl atoms, chlorine reacts with ozone in sequential method converting into oxygen
Carbon, oxygen and Fe are not related to ozone layer depletion
39. (2)
Endodermis have casparian strip on radial and inner tangential wall.
It is suberin rich.
40. (4)
Grasses are monocots and monocots usually do not have secondary growth.
Palm like monocots have anomalous secondary growth.
41. (4)
Halophytes like mangroves have pneumatophores.
Apogeotropic (-vely geotropic) roots having lenticels called pneumathodes to uptake O_2 .
42. (3)
Sweet potato is a modified adventitious root for storage of food
Rhizomes are underground modified stem
Tap root is primary root directly elongated from the radicle
43. (4)
Gymnosperms have naked ovule.
Called phanerogams without womb/ovary
44. (1)
Pseudopodia are locomotory structures in sarcodines (Amoeboid)
45. (3)
Vascular cambium is partially secondary
Form secondary xylem towards its inside and secondary phloem towards outsides.
4 – 10 times more secondary xylem is produced than secondary phloem.
46. (2)
Glycosuria denotes presence of glucose in the urine. This is observed when blood glucose level rises above 180 mg/100 ml of blood, this is called renal threshold value for glucose. Gout is due to deposition of uric acid crystals in the joint.
Renal calculi are precipitates of calcium phosphate produced in the pelvis of the kidney.
Glomerular nephritis is the inflammatory condition of glomerulus characterised by proteinuria and haematuria.
47. (3)
Ultrafiltration refers to filtration of very fine particles having molecular weight less than 68,000 daltons through malpighian corpuscle.
Concentration of urine refers to water absorption from glomerular filtrate as a result of hyperosmolarity in the medulla created by counter-current mechanism in Henle's loop.
Urine is carried from kidney to bladder through ureter.
Urinary bladder is concerned with storage of urine.
48. (2)
Divergent evolution occurs in the same structure, example - forelimbs, heart, brain of vertebrates which have developed along different directions due to adaptation to different needs whereas eye of octopus, bat and man are examples of analogous organs showing convergent evolution.
49. (1)
Rheumatoid arthritis is an autoimmune disorder in which antibodies are produced against the synovial membrane and cartilage.
Vitiligo causes white patches on skin also characterised as autoimmune disorder.
Psoriasis is a skin disease that causes itchy or sore patches of thick red skin and is also autoimmune whereas Alzheimer's disease is due to deficiency of neurotransmitter acetylcholine.
50. (3)
 $I^A I^O$, $I^B I^O$ - Dominant-recessive relationship
 $I^A I^B$ - Codominance
 I^A , I^B & I^O - 3-different allelic forms of a gene (multiple allelism)
51. (1)
Curd is more nourishing than milk.
It has enriched presence of vitamins specially Vit-B₁₂.
52. (4)
In different vertebrates, bones of forelimbs are similar but their forelimbs are adapted in different way as per their adaptation, hence example of homology.

53. (4)
Elephantiasis is caused by roundworm, *Wuchereria bancrofti* and it is transmitted by *Culex* mosquito.
54. (4)
Metamorphosis refers to transformation of larva into adult.
Animal that perform metamorphosis are said to have indirect development.
In earthworm development is direct which means no larval stage and hence no metamorphosis.
55. (3)
Homeotherm are animals that maintain constant body temperature, irrespective of surrounding temperature.
Birds and mammals are homeotherm.
Chelone (Turtle) belongs to class reptilia which is Poikilotherm or cold blood
56. (3)
Males bear a pair of short, thread like anal styles which are absent in females. Anal/caudal styles arise from 9th abdominal segment in male cockroach.
57. (3)
Diatoms are chief producers of the ocean.
58. (2)
Ciliates differs from other protozoans in having two types of nuclei.
eg. *Paramecium* have two types of nuclei i.e. macronucleus & micronucleus.
59. (1)
The digestive tract of Aves has additional chambers in their digestive system as crop and Gizzard.
Crop is concerned with storage of food grains.
Gizzard is a masticatory organ in birds used to crush food grain.
60. (1)
Placenta releases human chorionic gonadotropic hormone (hCG) which stimulates the Corpus luteum during pregnancy to release estrogen and progesterone and also rescues corpus luteum from regression. Human placental lactogen (hPL) is involved in growth of body of mother and breast. Progesterone maintains pregnancy, keeps the uterus silent by increasing uterine threshold to contractile stimuli.
61. (4)
Saheli is the first non-steroidal, once a week pill. It contains centchroman and its functioning is based upon selective Estrogen Receptor modulation.
62. (4)
The extraembryonic or foetal membranes are amnion, chorion, allantois and Yolk sac.
Amnion is formed from mesoderm on outer side and ectoderm on inner side.
Chorion is formed from trophoectoderm and mesoderm whereas allantois and Yolk sac membrane have mesoderm on outside and endoderm in inner side.
63. (2)
Spermiogenesis is transformation of spermatids into spermatozoa whereas spermiation is the release of the sperms from sertoli cells into the lumen of seminiferous tubule.
64. (4)
Whenever the pre-reproductive individuals or the younger population size is larger than the reproductive group, the population will be an increasing population.
65. (3)
'Smack' also called as brown sugar/Heroin is formed by acetylation of morphine. It is obtained from the latex of unripe capsule of Poppy plant.
66. (1)
- | | | | |
|----|-------------------|------|---------------------|
| a. | Eutrophication | iii. | Nutrient enrichment |
| b. | Sanitary landfill | iv. | Waste disposal |
| c. | Snow blindness | i. | UV-B radiation |
| d. | Jhum cultivation | ii. | Deforestation |
67. (2)
Amensalism/Antibiosis (0, -)
Antibiotics are chemicals secreted by one microbial group (eg : *Penicillium*) which harm other microbes (eg : *Staphylococcus*)
It has no effect on *Penicillium* or the organism which produces it.
68. (3)
Sacred groves – in-situ conservation.
Represent pristine forest patch as protected by Tribal groups.

69. (2)
Parietal or oxyntic cell is a source of HCl and intrinsic factor. HCl converts iron present in diet from ferric to ferrous form so that it can be absorbed easily and used during erythropoiesis. Intrinsic factor is essential for the absorption of vitamin B₁₂ and its deficiency causes pernicious anaemia.
70. (2)
Fibrinogen forms fibrin strands during coagulation. These strands form a network and the meshes of which are occupied by blood cells, this structure finally forms a clot.
Antibodies are derived from γ -Globulin fraction of plasma proteins which means globulins are involved in defence mechanisms.
Albumin is a plasma protein mainly responsible for BCOP.
71. (4)
Signal for contraction increase Ca⁺⁺ level many folds in the sarcoplasm.
Ca⁺⁺ now binds with sub-unit of troponin (troponin "C") which is masking the active site on actin filament and displaces the sub-unit of troponin.
Once the active site is exposed, head of the myosin attaches and initiate contraction by sliding the actin over myosin.
72. (3)
Silicosis is due to excess inhalation of silica dust in the workers involved grinding or stone breaking industries.
Long exposure can give rise to inflammation leading to fibrosis and thus causing serious lung damage.
Anthrax is a serious infectious disease caused by Bacillus anthracis. It commonly affects domestic and wild animals. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.
Botulism is a form of food poisoning caused by Clostridium botulinum.
73. (4)
Epinephrine is derived from tyrosine amino acid by the removal of carboxyl group. It is a catecholamine.
74. (3)
Limbic system is emotional brain. It controls all emotions in our body but not movements.
75. (1)
Estrogen promotes the activity of osteoblast and inhibits osteoclast. In an ageing female osteoporosis occurs due to deficiency of estrogen. Parathormone promotes mobilisation of calcium from bone into blood. Excessive activity of parathormone causes demineralisation leading to osteoporosis.
76. (4)
Lens in the human eye is held in its place by suspensory ligaments attached to the ciliary body.
77. (4)
Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.
78. (4)
Tricuspid valves are AV valve present between right atrium and right ventricle. Bicuspid valves are AV valve present between left atrium and left ventricle. Semilunar valves are present at the openings of aortic and pulmonary aorta.
79. (3)
Tidal volume is volume of air inspired or expired during normal respiration. It is approximately 500 mL. Inspiratory reserve volume is additional volume of air a person can inspire by a forceful inspiration. It is around 2500 – 3000 mL. Expiratory reserve volume is additional volume of air a person can be expired by a forceful expiration. This averages 1000 – 1100 mL.
Residual volume is volume of air remaining in lungs even after forceful expiration. This averages 1100 – 1200 mL.
80. (2)
Nissl granules are present in the cyton and even extend into the dendrite but absent in axon and rest of the neuron.
Nissl granules are in fact composed of free ribosomes and RER. They are responsible for protein synthesis.
81. (2)
Oxidative phosphorylation takes place in inner mitochondrial membrane.
82. (4)
The phenomenon of association of many ribosomes with single m-RNA leads to formation of polyribosomes or polysomes or ergasomes.

83. (3)
In humans, dentition is
Thecodont : Teeth are present in the sockets of the jaw bone called alveoli. Diphyodont : Teeth erupts twice, temporary milk or deciduous teeth are replaced by a set of permanent or adult teeth.
Heterodont dentition : Dentition consists of different types of teeth namely incisors, canine, premolars and molars.
84. (2)
Phospholipid synthesis does not take place in RER. Smooth endoplasmic reticulum are involved in lipid synthesis.
85. (2)
Polytene chromosomes are found in salivary glands of insects of order Diptera.
86. (4)
Coding strand and mRNA has same nucleotide sequence except, 'T' – Thymine is replaced by 'U' – Uracil in mRNA.
87. (3)
As per mutation theory given by Hugo de Vries, the evolution is a discontinuous phenomenon or saltatory phenomenon/ saltation.
88. (1)
During proliferative phase, the follicles start developing, hence, called follicular phase. Secretory phase is also called as luteal phase mainly controlled by progesterone secreted by corpus luteum. Estrogen further thickens the endometrium maintained by progesterone. Menstruation occurs due to decline in progesterone level and involves breakdown of overgrown endometrial lining.
89. (1)
Enhancer sequences are present in eukaryotes. Operon concept is for prokaryotes.
90. (2)
Woman is a carrier
Both son & daughter inherit X–chromosome
Although only son be the diseased

PHYSICS

91. (3)
$$\frac{(2n+1)\lambda}{2} - \frac{n\lambda}{2} = L_2 - L_1$$

$$\lambda = \frac{v}{\nu} = 2 \times 53 \times 10^{-2}$$

$$\Rightarrow v = 1.06 \times 320 \approx 339 \text{ m/s}$$

92. (4)
$$E = \frac{\sigma}{2\epsilon_0} = \frac{q}{2A\epsilon_0}$$

$$F = qE = \frac{q^2}{2A\epsilon_0}$$
93. (4)
Force same but acceleration for \bar{e} is much higher due to less mass.
94. (3)
$$a = |w^2x| \Rightarrow w = 2 \text{ rad/sec}$$

$$T = \frac{2\pi}{w} = \pi \text{ sec}$$
95. (1)
$$i_s = \frac{NAB}{C}$$

$$V_s = \frac{NAB}{CR} = \frac{i_s}{R}$$

$$\Rightarrow R = \frac{i_s}{V_s} = \frac{5 \times 10^3}{20} = 250 \Omega$$
96. (2)
 $\lambda = 0.5 \text{ kg/m}$
 $B = 0.25 \text{ T}$
 $\theta = 30^\circ$
$$IB\ell \cos \theta = mg \sin \theta$$

$$I = \frac{mg \tan \theta}{B\ell} = \frac{\lambda g \tan \theta}{B}$$

$$I = \frac{0.5 \times 9.8 \times \frac{1}{\sqrt{3}}}{0.25} = \frac{20}{\sqrt{3}}$$

$$I = 11.32 \text{ A}$$
97. (2)
98. (4)
$$X_L = \omega L = 314 \times 20 \times 10^{-3} = 6.28 \Omega$$

$$X_C = \frac{1}{314 \times 10^{-4}} = 31.84 \Omega$$

$$Z^2 = (X_C - X_L)^2 + R^2 = (25.56)^2 + 50^2 \approx 3150$$

$$P_{av} = \frac{V_0^2 R}{Z^2} = \frac{100 \times 50}{2 \times 3150} \approx 0.79 \text{ W}$$

99. (3)

$$f = -15 \text{ cm}$$

$$v_1 = -40 \text{ cm}; v_2 = -20 \text{ cm}$$

$$v_1 = \frac{-40 \times -15}{-40 + 15} = -24 \text{ cm}$$

$$v_2 = \frac{-20 \times -15}{-20 + 15} = -60 \text{ cm}$$

∴ 36 cm away from the mirror

100. (3)

Direction of propagation in direction of $\vec{E} \times \vec{B}$

∴ Direction of \vec{B} will be +z direction

101. (2)

$$25 \times 10^{-3} = \frac{1}{2} \times L \times 3600 \times 10^{-6}$$

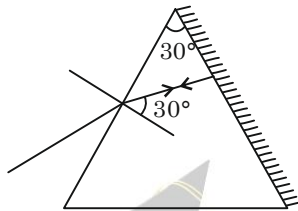
$$\Rightarrow L = \frac{25}{1.8} = 13.89 \text{ H}$$

102. (3)

$$\sin i = \sqrt{2} \sin 30^\circ$$

$$= \frac{1}{\sqrt{2}}$$

$$\Rightarrow i = 45^\circ$$



103. (3)

$$U_E = 2T_E = -2K_E$$

104. (4)

$$\lambda_0 = \frac{h}{mv_0}$$

$$\text{Velocity after time } t, V = V_0 + \frac{eE_0}{m}t$$

$$\lambda = \frac{h}{m\left(V_0 + \frac{eE_0}{m}t\right)} = \frac{\lambda^1}{\left(1 + \frac{eE_0}{mV_0}t\right)}$$

Alternative :

The increase in energy will cause decrease in wavelength.

∴ Only option (4) is correct.

105. (4)

$$\begin{aligned} \text{Left nuclei} &= 600 - 450 = 150 = \frac{600}{4} \\ &= 600 \times \frac{1}{2} \times \frac{1}{2} \end{aligned}$$

∴ Two half lives.

106. (4)

$$KE_1 = hv_0$$

$$KE_2 = 4hv_0$$

$$\therefore \frac{v_1}{v_2} = \left(\frac{KE_1}{KE_2}\right)^{1/2} = \frac{1}{2}$$

107. (2)

$$V_i = 20v$$

$$V_i = I_B R_B$$

$$20 = I_B \times 500 \times 10^3$$

$$I_B = \frac{20}{500 \times 10^3} = 40 \mu\text{A}$$

$$V_C = I_C R_C \Rightarrow 20 = I_C \times 4 \times 10^3 \Rightarrow I_C = 5 \text{ mA}$$

$$\beta = \frac{I_C}{I_B} = \frac{5 \times 10^{-3}}{40 \times 10^{-6}} = \frac{1000}{8} = 125 \text{ 108}$$

108. (2)

Due to heating, both minority and majority charge carriers will increase. This will change forward as well as reverse resistance. Therefore overall VI characteristics will change

109. (3)

$$A \cdot \vec{B} + \vec{A} \cdot B$$

110. (3)

111. (4)

$$\frac{10E}{(n+1)R} = \left(\frac{E}{R + \frac{R}{n}}\right) = \frac{E}{\frac{R}{n}[n+1]}$$

$$\Rightarrow n = 10$$

112. (4)

$$I_n = \frac{nE}{nr} = \frac{E}{r}$$

113. (4)

$$n = 1 - \frac{T_2}{T_1} = \frac{T_1 - T_2}{T_1} = \frac{100}{373} \approx 0.268 = 26.8\%$$

114. (4)

from first law of thermodynamics

$$dQ = dv + dw$$

$$1 = \frac{dv}{dQ} + \frac{dw}{dQ}$$

$$\frac{dv}{dQ} = 1 - \frac{nC_V dT}{nC_P dT}$$

$$= 1 - \frac{3}{5} = \frac{2}{5}$$

115. (4)

$$v_0 = \frac{v}{2\ell_0} = \frac{3v}{4\ell_c} \Rightarrow \ell_0 = \frac{2\ell_c}{3} = \frac{40}{3} \text{ cm}$$

116. (3)

$$\sqrt{\frac{3RT}{m}} = 1.12 \times 10^3$$

$$\frac{3 \times 1.38 \times 10^{-23} \times T}{2.76 \times 10^{-26}} = 125.44 \times 10^6$$

$$T = \frac{125.44 \times 10 \times 2.76 \times 10^{-26}}{3 \times 1.38 \times 10^{-23}} = \frac{346.2144 \times 10^3}{4.14}$$

$$T = 83.62 \times 10^3 \text{ K}$$

$$T = 8.36 \times 10^4 \text{ K}$$

117. (1)

$$\lambda m T = \text{const}$$

$$\lambda_0 T_1 = \frac{3}{4} \lambda_0 T_2$$

$$\frac{T_2}{T_1} = \frac{4}{3}$$

Power Radiated

$$P = \sigma T^4$$

$$\frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^4$$

$$\frac{nP}{P} = \left(\frac{4}{3}\right)^4$$

$$n = \frac{256}{81}$$

118. (4)

$$Y = \frac{F/A}{\Delta \ell / \ell} = \frac{F'/3A}{3\Delta \ell / \ell} \Rightarrow F = \frac{F'}{9} \Rightarrow F' = 9F$$

119. (4)

Rate of production of heat = Rate of loss of potential energy

$$= mgv = \frac{4}{3} \pi r^3 \rho g v$$

\therefore proportional to r^3

120. (3)

$$Dq = 54 \times 4.2 \text{ J}, P = 1.013 \times 10^5 \text{ Nm}^{-2}$$

$$p = \frac{mas}{\text{Vol.}} = \frac{0.1 \times 10^{-3}}{V}$$

$$V_i = \frac{0.1 \times 10^{-3}}{10^3} = 0.1 \times 10^{-6} \text{ m}^3.$$

$$V_f = 167.1 \times 10^{-6} \text{ m}^3.$$

$$W = PdV = 1.013 \times 10^5 \times (167.1 \times 10^{-6} - 0.1 \times 10^{-6})$$

$$= 1.013 \times 10^5 \times 167 \times 10^{-6}$$

$$= 16.91 \text{ J}$$

From first law of thermodynamics

$$dq = dV + dw$$

$$54 \times 4.18 = dV + 16.91 \Rightarrow dV = 208.83 \text{ J}$$

121. (3)

Distance \downarrow U \downarrow KE \uparrow

122. (3)

$$K_t : (K_t + K_r) = \frac{1}{2} mv^2 : \left(\frac{1}{2} mv^2 \left(1 + \frac{K^2}{r^2} \right) \right)$$

$$= 1 : \left(1 + \frac{2}{5} \right) = 1 : \frac{7}{5} = 5 : 7$$

123. (3)

124. (2)

Increase in G will cause increase in g.

125. (3)

By conservation of energy

$$\lambda = AB = D$$

126. (4)

$$KE = \frac{1}{2} MR^2 \left[1 + \frac{K^2}{R^2} \right]$$

$$K \uparrow \Rightarrow KE \uparrow \Rightarrow W \uparrow$$

$$K_A = \frac{2}{5} \Rightarrow K_B = \frac{1}{2}$$

$$K_C = 1$$

$$\therefore W_C > W_B > W_A$$

127. (3)

$$U_1 = V, m_1 = m$$

$$U_2 = 0, m_2 = 4m$$

$$V_1 = 0$$

$$v_1 = \frac{m_1 - em_2}{m_1 + m_2} u_1 + \frac{m_2(1+e)}{m_1 + m_2} u_2$$

$$\Rightarrow m_1 - em_2 = 0 \Rightarrow 1 - 4e = 0$$

$$\Rightarrow e = \frac{1}{4} = 0.25$$

128. (2)

129. (2)

$$\vec{r} = (2\hat{i} - 3\hat{k}) - (2\hat{i} - 2\hat{j} - 2\hat{k})$$

$$\vec{r} = 0\hat{i} - 2\hat{j} - \hat{k}$$

$$\vec{F} = 4\hat{i} + 5\hat{j} - 6\hat{k}$$

$$\vec{\tau} = (2\hat{j} - \hat{k}) \times (4\hat{i} + 5\hat{j} - 6\hat{k})$$

$$= -7\hat{i} - 4\hat{j} - 8\hat{k}$$

130. (3)

$$\text{Displacement} = \begin{matrix} 3 & - & 3 & - & 3 & = & -3 \text{ m} \\ 0 & & 3 & & 6 & & \end{matrix}$$

$$\begin{matrix} \bullet & \leftarrow & \bullet & \leftarrow & \bullet \\ -6 & & 3 & & 0 & & 3 & & 6 \end{matrix}$$

$$\langle v \rangle = \frac{|-3|}{3} = 1 \text{ m/s}$$

$$\text{Distance} = 3 + 3 + 3 = 9 \text{ m}$$

$$\langle \text{speed} \rangle = \frac{9}{3} = 3 \text{ m/s}$$

131. (2)

$$g \sin \theta = a \cos \theta \Rightarrow a = g \tan \theta$$

132. (2)

$$\text{Least count} = 0.001 \text{ cm}$$

$$\text{Main scale reading} = 5 \text{ mm.}$$

$$\text{Reading} = (.5 + 25 \times 0.001) + 0.004$$

$$= (0.5 + 0.025) + 0.004$$

$$= 0.525 + 0.004$$

$$= 0.529 \text{ cm}$$

133. (1)

134. (3)

$$P = \frac{\lambda D}{d}$$

$$\text{Angular width} = \frac{\lambda}{d}$$

$$\Rightarrow \frac{0.2}{0.21} = \frac{d'}{2} \Rightarrow d' = \frac{0.2 \times 2}{0.21} \approx 1.9 \text{ mm}$$

135. (1)

CHEMISTRY

136. (4)

$$\text{Moles of water} = \frac{0.00224}{22.4} = 10^{-4}$$

$$\text{Molecules of water} = \text{mole} \times N_A = 10^{-4} N_A$$

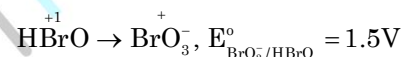
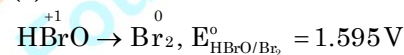
$$\text{Molecules of water} = \text{mole} \times N_A = 10^{-3} N_A$$

$$\begin{aligned} \text{Molecules of water} &= \text{mole} \times N_A = \frac{0.18}{18} N_A \\ &= 10^{-2} N_A \end{aligned}$$

$$\text{Mass of water} = 10 \times 1 = 18 \text{ G}$$

$$\text{Molecules of water} = \text{mole} \times N_A = \frac{18}{18} N_A = N_A$$

137. (2)



E_{cell}° for the disproportionation of HBrO,

$$E_{\text{cell}}^{\circ} = E_{\text{HBrO}/\text{Br}_2}^{\circ} - E_{\text{BrO}_3^-/\text{HBrO}}^{\circ}$$

$$= 1.595 - 1.5$$

$$= 0.095 \text{ V} = +ve$$

Hence, option (2) is correct answer.

138. (4)

For 2nd group hydrides, on moving down the group metallic character of metals increases so ionic character of metal hydride increases.

139. (3)

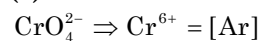
For first order reaction, $t_{1/2} = \frac{0.693}{k}$, which is independent of initial concentration of reactant.

For second order reaction, $t_{1/2} = \frac{1}{k[A_0]}$, which depends on initial concentration of reactant.

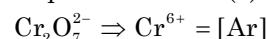
140. (4)

In $[\text{CoCl}_2(\text{en})_2]$, coordination number of Co is 6 and this compound has octahedral geometry. As per given options, type of isomerism is geometrical isomerism.

141. (2)



Unpaired electron (n) = 0; Diamagnetic



Unpaired electron (n) = 0; Diamagnetic



Unpaired electron (n) = 1; Paramagnetic



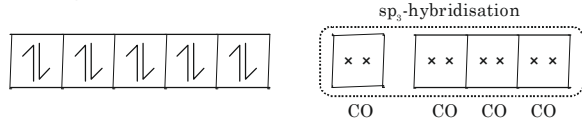
Unpaired electron (n) = 0; Diamagnetic

142. (3)

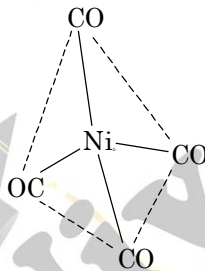


\therefore CO is a strong field ligand

Configuration would be:



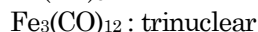
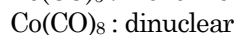
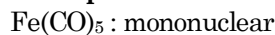
For, for 'CO'-ligands hybridisation would be sp^3 and the thus the complex would be diamagnetic and of tetrahedral geometry



143. (3)

Based on the number of metal atoms present in a complex, they are classified into mononuclear, dinuclear, trinuclear and so on.

Example:



Hence, option (3) is correct answer.

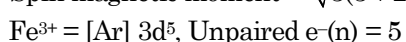
144. (4)



$$\text{Spin magnetic moment} = \sqrt{4(4+2)} = \sqrt{24} \text{ BM}$$



$$\text{Spin magnetic moment} = \sqrt{3(3+2)} = \sqrt{15} \text{ BM}$$



$$\text{Spin magnetic moment} = \sqrt{5(5+2)} = \sqrt{35} \text{ BM}$$



$$\text{Spin magnetic moment} = \sqrt{2(2+2)} = \sqrt{8} \text{ BM}$$

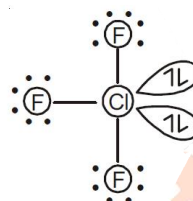
145. (1)

\therefore 'B' has no vacant d-orbitals in its valence shell, so it can't extend its covalency beyond 4. i.e. 'B' cannot form the ion like $\text{MF}_6^{3(-)}$ i.e. $\text{BF}_6^{3(-)}$

Hence, the correct option is (1).

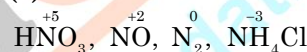
146. (3)

The structure of ClF_3 is



The number of lone pair of electrons on central Cl is 2.

147. (4)



Hence, the correct option is (4).

148. (1)

Due to high electronegativity and small size, F forms only one oxoacid, HOF known as Fluoric (I) acid. Oxidation number of F is +1 in HOF.

149. (1)

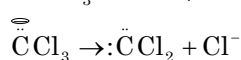
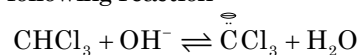
The metal which is more reactive than 'Al' can reduce alumina i.e. 'Mg' should be the correct option.

150. (2)

Elements	B	Ga	Al	In	Tl
Atomic radii (pm)	85	135	143	167	170

151. (2)

It is Reimer-Tiemann reaction. The electrophile formed is: CCl_2 (Dichlorocarbene) according to the following reaction

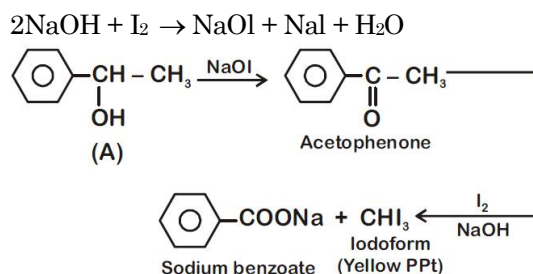


152. (2)

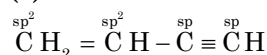
Due to formation of intermolecular H-bonding in carboxylic acid, association occurs. Hence boiling point increases and become more than the boiling point of aldehydes, ketones and alcohols of comparable molecular masses.

153. (1)

Option (1) is secondary alcohol which on oxidation gives phenylmethyl ketone (Acetophenone). This on reaction with I_2 and NaOH form iodoform and sodium benzoate.



154. (3)



Number of orbital require in hybridization = Number of σ -bonds around each carbon atom.

155. (1)

$-\text{NO}_2$ group exhibit $-I$ effect and it decreases with increase in distance. In option (1) positive charge rescent on C-atom at maximum distance so $-I$ effect reaching to it is minimum and stability is maximum.

156. (4)

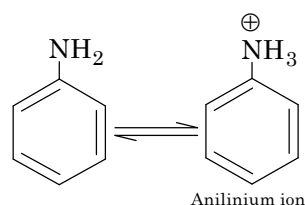
$-I$ effect increases on increasing electronegativity of atom. So, correct order of $-I$ effect is $-\text{NH}_2 < -\text{OR} < -\text{F}$.

* Most appropriate Answer is option (4), however option (3) may also be correct answer.

157. (2)

Cross linked or network polymers are formed from bi-functional and tri-functional monomers and contain strong covalent bonds between various linear polymer chains, e.g. bakelite, melamine etc. Option (2) is not related to cross-linking. So option (2) should be the correct option.

158. (2)

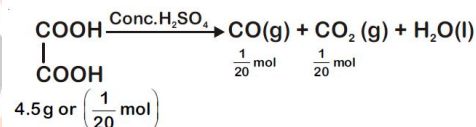
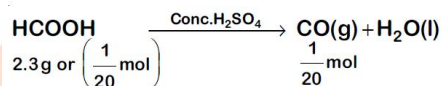


$-\text{NH}_3^+$ is m-directing, hence besides para (51%) and ortho (2%), meta product (47%) is also formed in significant yield.

159. (4)

Amylose and Amylopectin are polymers of α -D glucose, so β -link is not possible. Amylose is linear with $1 \rightarrow 6 \alpha$ -linkages. So option (4) should ;be the correct option.

160. (1)



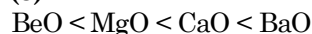
Gaseous mixture formed is CO and CO₂ when it is passed through KOH, only CO₂ is absorbed. So the remaining gas is CO.

So, weight of remaining gaseous product CO is

$$\frac{2}{20} \times 28 = 2.8\text{g}$$

So, the correct option is (1)

161. (3)

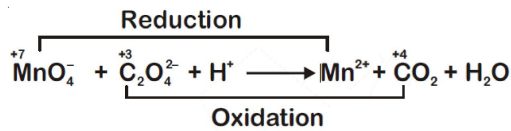


—————>

Basic character increases.

So, the most acidic should be BeO. In fact, BeO is amphoteric oxide while other given oxides are basic.

162. (3)



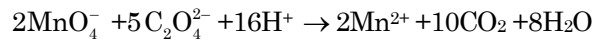
n-factor of $\text{MnO}_4^- \Rightarrow 5$

n-factor of $\text{C}_2\text{O}_4^{2-} \Rightarrow 2$

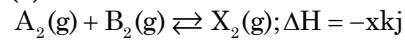
Ratio of n-factors of MnO_4^- and $\text{C}_2\text{O}_4^{2-}$ is 5 : 2

So, molar ratio in balanced reaction is 2 : 5

∴ The balanced equation is



163. (4)



On increasing pressure equilibrium shifts in a direction where pressure decreases i.e. forward direction.

On decreasing temperature, equilibrium shifts in exothermic direction i.e., forward direction.

So, high pressure and low temperature favours maximum formation of product.

164. (3)

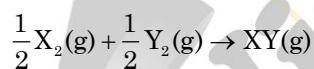
Half life of zero order

$$t_{1/2} = \frac{[A_0]}{2k}$$

$t_{1/2}$ will be doubled on doubling the initial concentration.

165. (1)

The reaction for $\Delta_f H^\circ(\text{XY})$



Bond energies of X_2 , Y_2 and XY are X , $\frac{X}{2}$, X

Respectively

$$\therefore \Delta H = \left(\frac{X}{2} + \frac{X}{4} \right) - X = -200$$

On solving, we get

$$\Rightarrow -\frac{X}{2} + \frac{X}{4} = -200$$

$$\Rightarrow X = 800 \text{ kJ/mole}$$

166. (2)

In real gas equation, $\left(P + \frac{an^2}{V^2} \right) (V-nb) = nRT$

Van der Waal's constant, 'a' signifies intermolecular forces of attraction.

167. (2)

$$\text{Meq of HCl} = 75 \times \frac{1}{5} \times 1 = 15$$

$$\text{Meq of NaOH} = 25 \times \frac{1}{5} \times 1 = 5$$

Meq of HCl in resulting solution = 10

Molarity of $[\text{H}^+]$ in resulting mixture

$$= \frac{10}{100} = \frac{1}{10}$$

$$\text{pH} = -\log[\text{H}^+] = -\log\left[\frac{1}{10}\right] = 1.0$$

168. (1)

Coagulation of colloidal solution by using an electrolyte depends on the charge present (positive or negative) on colloidal particles as well as on its size.

Coagulating power of an electrolyte depends on the magnitude of charge present on effective ion of electrolyte.

169. (4)

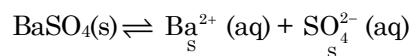
van der waal constant 'a', signifies intermolecular forces of attraction.

Higher is the value of 'a', easier will be the liquefaction of gas.

170. (4)

$$\text{Solubility of BaSO}_4, s = \frac{2.42 \times 10^{-3}}{233} (\text{mol L}^{-1})$$

$$= 1.04 \times 10^{-5} (\text{mol L}^{-1})$$

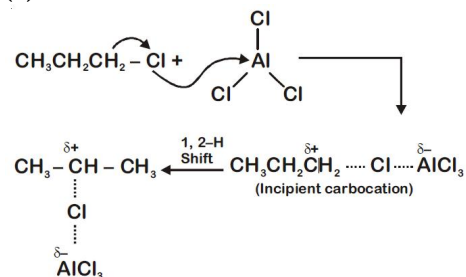


$$K_{sp} = [\text{Ba}^{2+}][\text{SO}_4^{2-}] = S^2$$

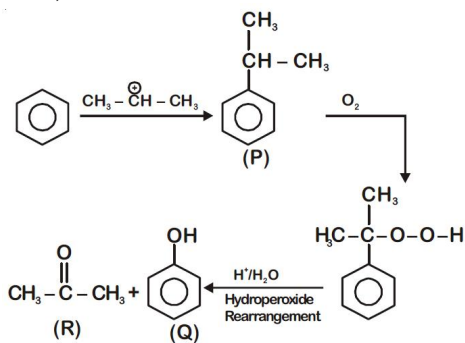
$$= (1.04 \times 10^{-5})^2$$

$$= 1.08 \times 10^{-10} \text{ mol}^2 \text{ L}^{-2}$$

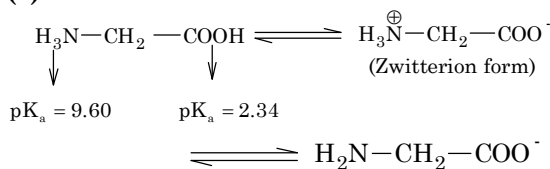
171. (2)



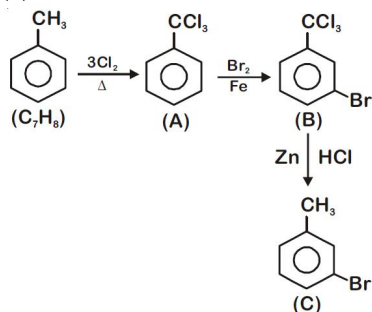
Now,



172. (2)



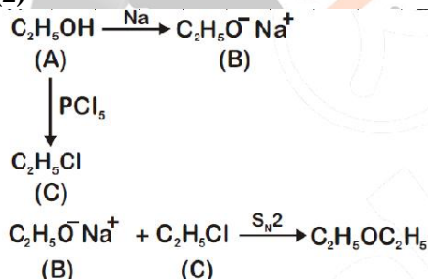
173. (4)



So, the correct option is (4)

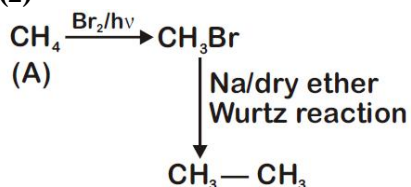
174. (4)
Fact

175. (2)



So the correct option is (2)

176. (2)



Hence the correct option is (2)

177. (3)

$$\text{No} : (\sigma 1s)^2, (\sigma^* 1s)^2, (\sigma 2s)^2, (\sigma 2s)^2, (\sigma 2p_z)^2, (\pi 2p_x)^2 = (\pi 2p_y)^2, (\pi^* 2p_x)^1 = (\pi^* 2p_y)^0$$

$$\text{BO} = \frac{10 - 5}{2} = 2.5$$

$$\text{CN} : (\sigma 1s)^2, (\sigma^* 1s)^2, (\sigma 2s)^2, (\sigma^* 2s)^2, (\pi 2p_x)^2 = (\pi 2p_y)^2, (\sigma 2p_z)^2$$

$$\text{BO} = \frac{9 - 4}{2} = 3$$

$$\text{CN} : (\sigma 1s)^2, (\sigma^* 1s)^2, (\sigma 2s)^2, (\sigma^* 2s)^2, (\pi 2p_x)^2 = (\pi 2p_y)^2, (\sigma 2p_z)^1$$

$$\text{BO} = \frac{9 - 4}{2} = 2.5$$

$$\text{CN}^+ : (\sigma 1s)^2, (\sigma^* 1s)^2, (\sigma 2s)^2, (\sigma^* 2s)^2, (\pi 2p_x)^2 = (\pi 2p_y)^2$$

$$\text{BO} = \frac{8 - 4}{2} = 2$$

Hence, option (3) should be the right answer.

178. (2)

Element (X) electronic configuration

$$1s^2 2s^2 2p^3$$

So, valency of X will be 3.

Valency of Mg is 2.

Formula of compound formed by Mg and X will be Mg_3X_2 .

179. (1)

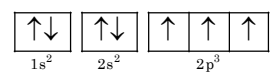
$$\text{For BCC lattice : } Z = 2, a = \frac{4r}{\sqrt{3}}$$

$$\text{For FCC lattice : } Z = 4, a = 2\sqrt{2} r$$

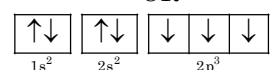
$$\begin{aligned} \therefore \frac{d_{25^\circ\text{C}}}{d_{900^\circ\text{C}}} &= \frac{\left(\frac{ZM}{N_A a^3}\right)_{\text{BCC}}}{\left(\frac{ZM}{N_A a^3}\right)_{\text{FCC}}} \\ &= \frac{2}{4} \left(\frac{2\sqrt{2}r}{\frac{4r}{\sqrt{3}}}\right)^3 = \left(\frac{3\sqrt{3}}{4\sqrt{2}}\right)^3 \end{aligned}$$

180. (1)

According to Hund's Rule of maximum multiplicity, the correct electronic configuration of N-atom is



OR



\therefore option (1) violates Hund's Rule.