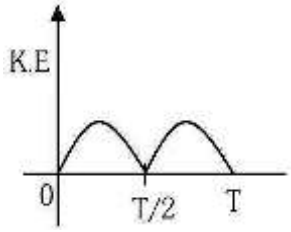
PHYSICS

1. **(d)** $\text{K.E} = \frac{1}{2}\,m\omega^2\,A^2\cos^2\omega t$

oscillation starts from extreme position



2. **(c)** Given that

Printed voltage $= 220$ V

Printed Power $= 400$ W

Supply voltage $= 200$ V

Resistance of heater $R_H = \frac{(220)^2}{400}$

So Actual power gained

$$P' = \frac{V_s^2}{R_H} = \frac{(200)^2}{(220)^2}(400)$$

$= 330.57$ W

$\simeq 331$ W

3. **(d)** $\omega_i = 600\text{rpm} = 20\pi\text{rad/sec}$

$\omega_f = 1200\text{rpm} = 40\pi\text{rad/sec}$

$t = 10\text{sec}$

$$\theta = \left(\frac{\omega_i + \omega_f}{2}\right)t$$

$$\theta = \left(\frac{40\pi + 20\pi}{2}\right)10$$

$$\theta = 300\pi$$

number of revolution $= \frac{300\pi}{2\pi} = 150$ rotation

4. **(d)** Total energy $\Rightarrow \frac{1}{2}KA^2 = 0.02$ J

$$\frac{1}{2}m\omega^2A^2 = 0.02 \text{ J}$$

$$\frac{1}{2}mV_{max}^2 = 0.02 \text{ J}$$

$$V_{max}^2 = \frac{0.04}{20 \times 10^{-3}} = 2$$

$V_{max} = 1.41$ m/s

5. **(c)** $B = \frac{\mu_0 NI}{2R} \Rightarrow I = \frac{2BR}{\mu_0 N}$

Current $I = \frac{2\times3.14\times10^{-3}\times5\times10^{-2}}{4\pi\times10^{-7}\times100}$

Current $I = 2.5$ A

Magnetic moment $M = NIA$

$= 100 \times 2.5 \times \pi r^2$

$= 100 \times 2.5 \times 3.14 \times 25 \times 10^{-4}$

$= 1.96$

$\simeq 2\text{ A} \times \text{m}^2$

6. **(b)** Absolute pressure at depth h in water

$P = P_0 + h\rho\,g$ $P_0 =$ atmospheric pressure

$P - P_0 = h\rho\,g$

$$h = \frac{P - P_0}{\rho g}$$
$$= \frac{(100 - 1) \times 10^5}{10^3 \times 10}$$
$$h = 990 \text{ m}$$

7. **(b)** A. $E = h\nu$ is the energy of a photon

B. Diffraction and interference are the characteristics of wave

C. $\lambda = \frac{h}{p}$ is the wavelength proposed by de-Broglie

D. Compton's effect can be explained only by using quantum/ particle nature of light.

so correct choice is

A -IV, B-III, C-I, D -II

8. **(b)** Young's Modulus $Y = \frac{FL}{A(\Delta L)}$ so A → II

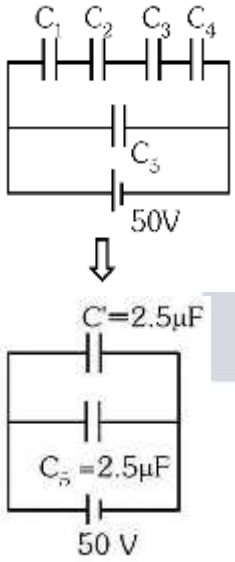
Compressibility $= \frac{1}{\text{Bulk modules}}$ so B → III

Bulk Modulus $= -P\left(\frac{V}{\Delta V}\right)$ So C → IV

Poisson's ratio $= \frac{\frac{\Delta d}{d}}{\frac{\Delta L}{L}} = \frac{\Delta d}{\Delta L}\left(\frac{L}{d}\right)$ So D → I

9. **(d)** Given $C_1 = C_2 = C_3 = C_4 = 10\mu$ F

$C_5 = 2.5\mu$ F



$C_{eq} = C' + C_5 = 5\mu$ F

$q_{C_1} = q_{C_2} = q_{C_3} = q_{C_4} = 50 \times 2.5 = 125\mu C$

$q_{C_5} = 50 \times 2.5 = 125\mu C$

10. **(a)** $W = \frac{mgh}{1+\frac{h}{R}} = \frac{mgR}{1+\frac{R}{R}} = \frac{mgR}{2}$

11. **(d)** Distance travelled by Ruler :

$\because d = \frac{1}{2}gt^2$

$\therefore d \propto t^2$

Order of distance travelled for person is

B > E > A > D > C

12. **(a)** Power of crane $= \frac{mgh}{t}$

$$= \frac{1000 \times 9.8 \times 20}{10}$$
$$= 19.6 \times 1000$$

$= 19.6\text{Kw}$

13. **(c)** Heat loss $(\Delta H) = \frac{1}{2}\frac{C_1C_2}{C_1+C_2}(V_1 - V_2)^2$

$= \frac{1}{2}\left(\frac{200\times 200}{200+200}\right)(100-0)^2 \times 10^{-12}\ \text{J}$

$= 50 \times 10^4 \times 10^{-12}\ \text{J}$

$= 5 \times 10^{-7}\ \text{J} = 0.5 \times 10^{-6}\ \text{J}$

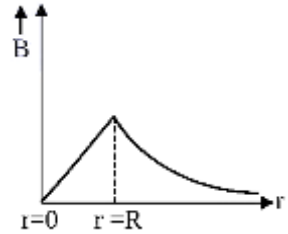
14. **(a)** $f_r = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10^{-3}\times 0.1\times 10^{-6}}}$

$= \frac{100}{6.28} \times 10^3$

$f_r = 15.9\text{kHz}$

15. **(c)** $B_{in} = \frac{\mu_0 Ir}{2\pi R^2} \propto r$

$B_{out} = \frac{\mu_0 I}{2\pi r} \propto \frac{1}{r}$



16. **(b)** From first law of thermodynamics

$\frac{dQ}{dt} = \frac{dU}{dt} + \frac{dW}{dt}$

$100 = \frac{dU}{dt} + 75$

$\frac{dU}{dt} = 100 - 75 = 25\ \text{Watt}$

17. **(b)** $I = I_0 \sin \omega t$

$I = I_0$, when $\omega t = \frac{\pi}{2}$

$\Rightarrow (2\pi f)t = \frac{\pi}{2} \Rightarrow 2\pi \times 60 \times t = \frac{\pi}{2}$

$t = \frac{1}{240}\text{sec}$

18. **(d)** $K = 4I$

$I_R = K\cos^2\frac{\Delta\phi}{2}$

$= K\cos^2\left(\frac{120^\circ}{2}\right)$

$= K\cos^2 60^\circ = \frac{K}{4}$

19. **(b)** A. False, because $V \propto A\left[R \propto A^{1/3}\right]$

B. True, because $V \propto A$

C. False, because

(Mass of atom - Mass of nucleus)

$\approx$ total mass of electrons

D. True, because

Δm = (Total mass of constituents - Mass of a nucleus)

$\Rightarrow -\Delta m$ = Mass of nucleus - Total mass of constituents)

20. **(b)** Statement A is true but B is false.

Statement A : In interference and diffraction, energy remains conserved, only redistribution takes place.

Statement B : These phenomenas are exhibited by all types of waves.

21. **(d)** Given that

$\text{EMF} = 12\ \text{V}$

$\text{r} = 2\Omega$

$\text{I} = 0.6\ \text{A}$

So terminal voltage

$\text{V} = \text{E} - \text{Ir}$

$= 12 - (.6)^2$

$\text{V} = 10.8$ volt

22. **(d)** In the given circuit, it is not mentioned whether the meter bridge is balanced or not,

So on interchanging the positions of battery and galvanometer, deflection may or may not be zero.

In case of unbalanced condition, deflection may be left or right sided in galvanometer.

23. **(b)** Time period is 2 sec

$$\text{T} = 2\pi\sqrt{\frac{\ell}{g}}$$

$$2 = 2\pi\sqrt{\frac{\ell}{\pi^2}}$$

$\ell \approx 1$ m

24. **(a)** (A) Inside conductor, electrostatic field $= 0$

(B) E.F at the surface of the conductor $E = \frac{\sigma}{\epsilon_0}$ depends on ' σ '

(C) $\text{E}_{\text{interior}}$ excess charge $= 0$

(D) At surface of the conductor

E is $\perp$ to surface

(E) $\text{E}_{\text{in}} = 0$

So V_{in} = constant not zero

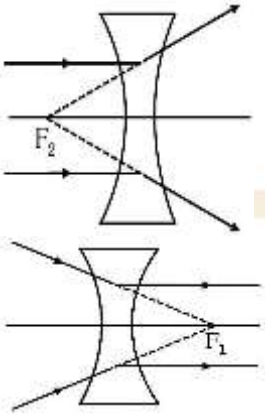
25. **(c)** Statement A : True

In forward biased, after threshold voltage current significantly increase

Statement B : False

Reverse saturation current is found in reverse biased not in forward biased.

26. **(b)**



When incident light is parallel to principal axis, after refraction image will be at focus. This focus will be second principal focus (F_2).

In this question as lens is concave (diverging) after refraction light will diverge and appears to be coming from second principal focus (F_2).

The definition of first and second focus given in NCERT book is not correct. "The focus on the side of the original source of light is called first focal point (F_1), whereas the other is called the second focal point (F_2).

27. **(c)** Mass = Volume × Density

$$\text{M} = \left(\frac{4}{3}\pi\text{R}^3\right)\rho \left[\because \text{R} = \text{R}_0\ \text{A}^{1/3}\right]$$

$$A = \left(\frac{4}{3}\pi R_0^3\, A\right)\rho$$

$$\Rightarrow A = \frac{3M}{4\pi R_0^3 \rho}$$

$$\Rightarrow A = \frac{3 \times 19.926 \times 10^{-27}}{12.56 \times (1.2 \times 10^{-15})^3 \times 2.29 \times 10^{17}} = 12$$

28. (d) Given that

$R_g = 100\Omega$

$I_g = 1\ mA$

$I = 10\ A$

$$S = \frac{I_g R_g}{(I - I_g)} = \frac{10^{-3}(100)}{(10 - 10^{-3})}$$

Since $I_g \ll I$ so $I - I_g \simeq I$

$S = 10^{-2} = 0.01\Omega$

29. (c) Let mass of wire is M

length $= L$

given m = Linear mass density

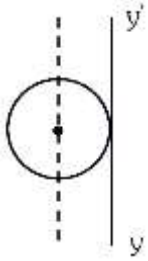
$$m = \frac{M}{L}$$

$L = 2\pi R$

$M = mL$

$$R = \frac{L}{2\pi}$$

$$I_{yy'} = \frac{MR^2}{2} + MR^2$$



$$= \frac{3}{2}MR^2 = \frac{3}{2}(mL)\left(\frac{L^2}{4\pi^2}\right)$$

$$I_{yy'} = \frac{3}{8}\frac{mL^3}{\pi^2}$$

30. (c) Given $k = 2\pi \times 0.008 rad/cm$

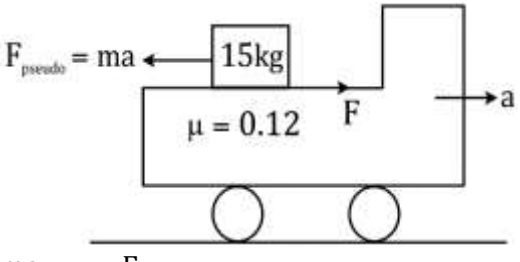
$\Delta\phi = k\Delta x$

$= 2\pi \times 0.008 \times 50$

$[\Delta x = 50\ cm]$

$\Delta\phi = 0.8\pi rad$

31. (b)



$ma_{max} = F_{lim}$

$ma_{max} = \mu, mg$

$a_{max} = \mu g = 1.2\ m/s^2$

32. (d) In $+1/2$ cycle diode is reverse biased so diode replaced by open circuit and input voltage obtained across diode.

In $-1/2$ cycle diode is forward biased so diode replaced by wire and input voltage obtained across R.

33. (c) As $V_{RMS} = \sqrt{\frac{3RT}{Mw}}$

Given temperature $\rightarrow$ constant

Then $V_{RMS} \propto \frac{1}{\sqrt{Mw}}$

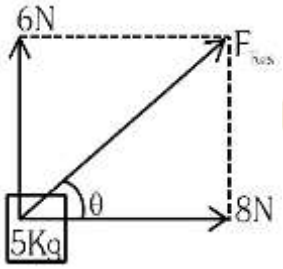
$$\Rightarrow \frac{V_{RMS}^{Ar}}{V_{RMs}^{Cl}} = \sqrt{\frac{M_{wCl}}{M_{wAr}}} = \sqrt{\frac{70}{40}} = \frac{\sqrt{7}}{2}$$

34. (d)

List I(Electromagnetic wave)		**List II (Production)**	
(A)	Microwave	(IV)	Klystron valve or magnetron valve
(B)	Visible light	(I)	Electrons in atoms emit light when they move from a higher energy level to a lower energy level
(C)	Gamma rays	(II)	Radioactive decay of nucleus
(D)	Infra-red rays	(II)	Vibration of atoms and molecules

$A \rightarrow IV; B \rightarrow I; C \rightarrow II; D \rightarrow III$

35. (a)



$F_{Res} = \sqrt{6^2 + 8^2}$

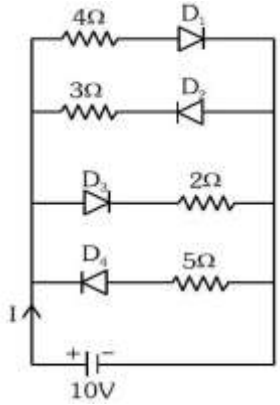
$F_{Res} = 10\ N$

$a = \frac{F_{Res}}{m} = \frac{10}{5} = 2\ m/s^2$

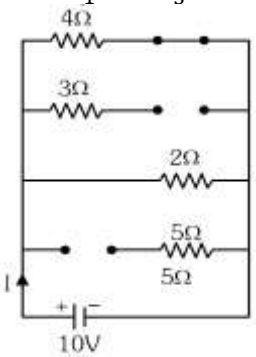
$\tan\theta = \frac{6}{8} = \frac{3}{4}$

$a = 2\ m/s^2 \tan^{-1}\left(\frac{3}{4}\right)$ with 8 N force

36. (b)



Here D_1 and D_3 are F.B and D_2 and D_4 are R.B. then equivalent circuit



$$R_{eq} = \frac{4 \times 2}{4+2} = \frac{4}{3}\Omega$$

$$I = \frac{V}{R_{eq}} = \frac{10}{4/3} = \frac{15}{2} \text{ A}$$

37. (a) $\phi = 6.6\text{eV}$

$$\frac{hc}{\lambda} = 6.6\text{eV}$$

$$\lambda_0 = \frac{12400}{6.6}$$

$$\lambda_0 = 1878.7\text{Å}$$

$$= 187.87 \text{ nm}$$

For photo electric effect

$\lambda \leq \lambda_0$

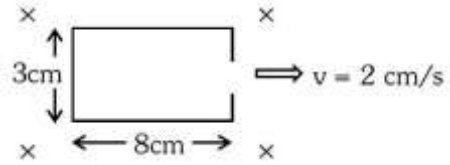
$\therefore$ The wavelength of radiation does not give rise to photoelectric effect is 200 nm .

38. (d) Distance $=$ (speed)(time)

$= 1(400 \text{ s})$

$= 400$ units

39. (a)

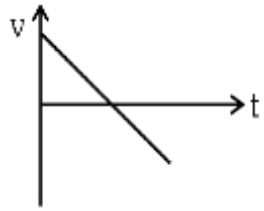


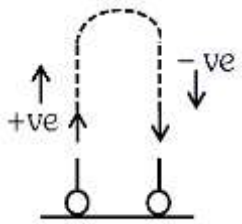
$e = \ell BV$

$= 3 \times 10^{-2} \times 0.3 \times 2 \times 10^{-2}$

$= 1.8 \times 10^{-4}$ volt

40. (c) Taking upward direction as positive





- Initially velocity decreases in upward direction then speed increases in downward direction.
- Best suitable answer is option (c).

41. (c) $20\text{VSD} = 16\text{MSD}$

$\text{VSD} = \frac{16}{20}(1\text{ mm})$

$= 0.8\text{ mm}$

$\text{LC} = \text{MSD} - \text{VSD}$

$= 1 - 0.8$

$= 0.2\text{ mm}$

$= 0.02\text{ cm}$

42. (b) $\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{5.580\text{ kg}}{(9.0\times10^{-2})^3}$

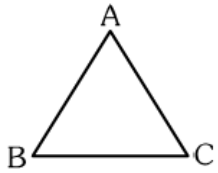
$= 7.654 \times 10^3\text{ kg/m}^3$

Rounding off to 2 significant digits

Result $= 7.7 \times 10^3$

$\Rightarrow x = 7.7$

43. (d)



For an equilateral prism $\underline{A} = 60$

since refracted ray is parallel to base so it is condition of minimum deviation.

$r = \frac{A}{2} = \frac{60}{2} = 30°$

and $i = e = 50°$

$\delta = i + e - A$

But $= 50 + 50 - 60$

$= 40°$

44. (b) $E = \frac{kq_1q_2}{2r}$

$3.4 = \frac{9 \times 10^9 \times (1.6 \times 10^{-19})^2}{2 \times r}$

$r = 2.1 \times 10^{-10}\text{ m}$

45. (d) Resistance of each wire of

W.S.B. $= \frac{4}{4} = 1\Omega$

This is balance W.S.B.
So, $R_{Net} = 1\Omega$
So, current
$I = \frac{E}{R_{Net}} = \frac{2}{1} = 2\ A$

46. (c) (A) $[Pt(Cl_2)(NH_3)_2)]$
C.N. $= 4$
$Pt^{+2} - 5\ d^8$, all ligands considered as S.F.L. So hybridisation will be dsp^2
So, Geometry is sq. planar
(B) $[Co(NH_3)_6]Cl_3$
C.N. $= 6$, hybridisation $= d^2sp^3$
So, octahedral
(C) $[NiCl_4]^{2-}$
C.N. $= 4$
Ni^{+2}, Cl^-act as WFL, No pairing, hence hybridisation is sp^3
So, Tetrahedral
(D) $[Fe(CO)_5]$
C.N. $= 5$, hybridisation is dsp^3
So geometry is trigonal bipyramidal.

47. (b) Cell reaction
$H_{2(g)} \longrightarrow 2H^+_{(aq)} + 2e^-$
$2\ atm 2 \times 10^{-2} M$
$E_{OP} = 0 - \frac{0.059}{2}\log\frac{(2\times10^{-2})^2}{2}$
$= -\frac{0.059}{2}[\log(2\times10^{-4})]$
$= -\frac{0.059}{2}[0.3 - 4]$
$= -\frac{0.059}{2}[-3.7]$
$= +0.109\ V$

48. (b) $pH = pK_a + \log\frac{[X^-]}{[HX]}$ $\left\{\begin{matrix} K_a \times K_b = 10^{-14} \\ K_a(HX) = 10^{-4} \end{matrix}\right\}$
$= 4 + \log 1$
$= 4$

49. (c) $K_p = K_c(RT)^{\Delta n_g}$
(a) $\Delta n_g = 0$ (b) $\Delta n_g = 0$
(c) $\Delta n_g = -2$ (d) $\Delta n_g = 0$

50. (d) [Reactant] v/s time graph is linear for zero order
$\therefore$ order $= 0$

51. (a) $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$
and $\Delta H^\circ = \Delta U^\circ + \Delta n_g RT$
$= -10 + \left[\frac{(-1)(8.3)(298)}{1000}\right]$
$= -10 - 2.4734$
$= -12.4734\ kJ\ mol^{-1}$
Now $\Delta G^\circ = -12.4734 - \frac{(298)(-44)}{1000}$
$= -12.4734 + 13.112$
$= +0.6386\ kJ\ mol^{-1}$, Non spontaneous

52. (d) $\ln k = 14.34 - \frac{1.25\times10^4}{T}$

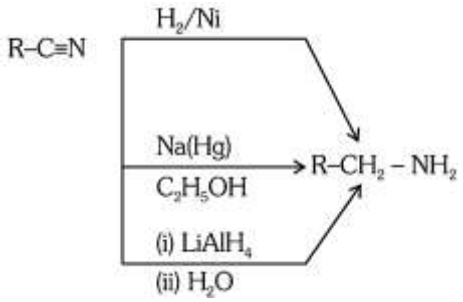
$\ln k = \ln A - \frac{E_a}{RT}$

So $\frac{E_a}{R} = 1.25 \times 10^4$

$E_a = 1.25 \times 10^4 \times \frac{1.987}{1000}$ KCal mol

$E_a = 24.84$KCal/mol

53. (c)



54. (a) DNA possesses double strand helix structure and contains thymine as one of the four bases.

55. (b) During Lasagna's test, the elements present in an organic compound are converted from covalent form to ionic form.

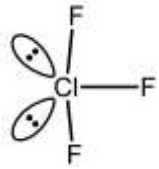
56. (b) $CHCl_3 + CH_3COCH_3$

Due to H-bonding bewteen chloroform $(CHCl_3)$ + acetone (CH_3COCH_3)

57. (c) Acetate + dil. $H_2SO_4 \rightarrow CH_3COOH$

Vinegar smell

58. (b)



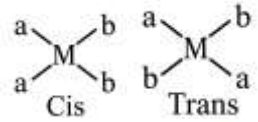
sp^2d, T-shape

Two lone pair on central atom (chlorine)

59. (c) (A) $[Pt(NH_3)_2Cl_2]$

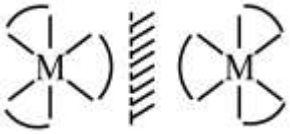
Geometry is square planar

Square planar $[Ma_2\ b_2]$ shows G.I.



(B) $[Co(en)_3]^{3+} \rightarrow [M(AA)_3]$

Due to presence of Bidented ligand, shows optical isomerism.



(C) $[Co(NH_3)_5(NO_2)]Cl_2$

Due to presence of NO_2 (Ambidented ligand) (ONO) complex shows linkage isomerism.

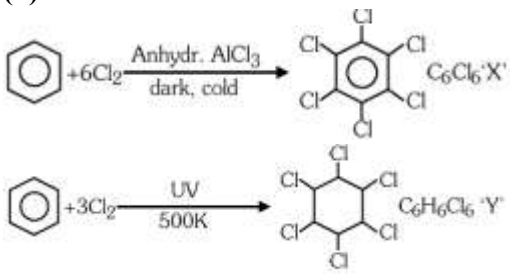
(D) $[Cr(H_2O)_6]Cl_3$

Due to presence of H_2O ligand shows hydrated isomerism.

$[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

$[Cr(H_2O)_4Cl_2]Cl.\ 2H_2O$

60. (b)



Number of chlorine atoms in ' X ' and ' Y ' are 6 & 6 respectively.

61. (c) Both N and O are 2^{nd} period element so they form only $p\pi - p\pi$ bond but not $p\pi - d\pi$ due to absence of d-orbital.

62. (c) $q = +500\ J$

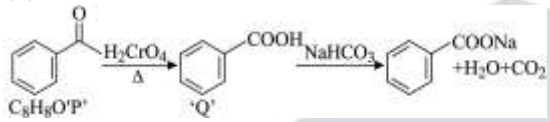
$w = -200\ J$

$\Delta U = q + w$

$= 500 - 200$

$= 300\ J$

63. (b)

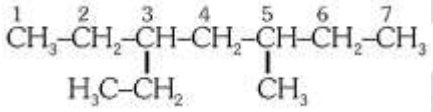


(P) Gives red orange ppt with 2,4-DNP

(P) Does not reduce Fehling's reagent

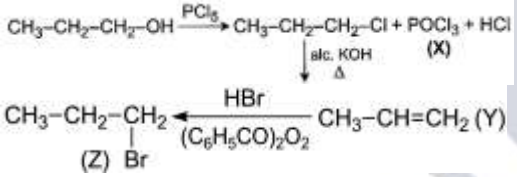
(P) On drastic oxidation, produces benzoic acid.

64. (a)



3-ethyl-5-methyl heptane

65. (b)



66. (d) $CO_2(g) + C(s) \rightarrow 2CO(g)$

Initial $t = 0$ 1 L 0

After reaction $1 - x$ $2x$

$V_{Total} = (1 - x) + 2x$

$1.4 = 1 - x + 2x$

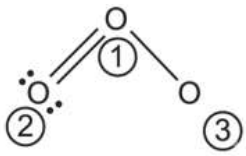
$x = 0.4$

So $V_{CO} = 0.8 dm^3$

And $V_{CO_2} = 1 - x$

$= 0.6 dm^3$

67. (d)



F.C. (formal charge) = (Total No. of valence electron in the free atom) - (Total no. of non bonding e (lone pair) $-\frac{1}{2}$ (Total number of bonding

(shared) electron)

(2) atom $\Rightarrow 6-4-\frac{1}{2}(4)=0$

(1) atom $\Rightarrow 6-2-\frac{1}{2}(6)=+1$

(3) atom $\Rightarrow 6-6-\frac{1}{2}(2)=-1$

68. (b) Unit of K $= \text{mol}^{1-n}\text{L}^{n-1}$ time e^{-1}

(A) Zero order (n = 0): $\text{mol}^1\ \text{L}^{-1}\ \text{s}^{-1}$

(B) First order (n = 1) : Unit of K $= \text{s}^{-1}$

(C) Second order (n = 2): Unit of K $= \text{mol}^{-1}\ \text{L}^1\ \text{s}^{-1}$

(D) Third order (n = 3) : Unit of K $= \text{mol}^{-2}\ \text{L}^2\ \text{s}^{-1}$

69. (c) Metallic character $\alpha \frac{1}{\text{Ionisation Energy}}$

Na > Mg > Be > Si > P

70. (b) Molecular formula of urea $= NH_2CONH_2$

Atomicity w.r.t. H = 4

Moles of urea $= \frac{5.4}{60}$

Moles of $H = \frac{5.4}{60} \times 4$

No. of H-atoms $= \frac{5.4}{60} \times 4 \times 6.02 \times 10^{23}$

$= 2.168 \times 10^{23}$

71. (d) $BiO(OH)(s) \rightleftharpoons BiO^+(aq) + .OH^-(aq).\{S = \text{solubility}\}$

At eq. - S S

$K = 4 \times 10^{-10} = K_{sp}\{\text{for AB type; } K_{sp} = S^2\}$

$S^2 = 4 \times 10^{-10}$

$S = 2 \times 10^{-5}M$

So, $[OH^-] = S$

$= 2 \times 10^{-5}$

$pOH = 5 - \log 2$

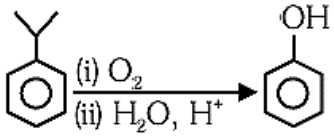
$= 5 - 0.3010$

$= 4.699$

$pH = 14 - 4.699$

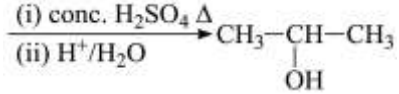
$= 9.301$

72. (c) (A)

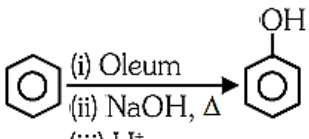


(B) $CH_3COOH \xrightarrow[\text{(ii) } H_2\text{, catalyst}]{\text{(i) } CH_3OH, H^+} CH_3CH_2 - OH$

(C) $CH_3 - CH_2 - CH_2 - OH$



(D)



73. **(d)** Power rating of bulb $= 150$ watt

Energy converted into light $= 150 \times \frac{8}{100} = 12$ J

Number of photons emitted per second

$= \frac{\text{Total energy}}{\text{Energy of one photon}}$

$= \frac{12 \text{ J}}{4.42 \times 10^{-19} \text{ J}}$

$= 2.71 \times 10^{19}$

74. **(a)** Metamers

$CH_3OCH_2CH_2CH_3$ and $CH_3CH_2OCH_2CH_3$

75. **(a)** (A) $m = \frac{n_{solute}}{w_{solvent\ (in\ gram)}} \times 1000$

$= \frac{2.5}{60 \times 75} \times 1000$

$= 0.555(T)$

(B) $M = \frac{n_{solute}}{v_{solution(inmL)}} \times 1000$

$= \frac{5}{40 \times 450} \times 1000$

$= 0.277(T)$

(C) Due to increased solubility of oxygen with decrease of temperature, aquatic species are more comfortable in cold water.

(D) Solubility increases with increase in pressure (F)

(E) $X_B = \frac{n_B}{n_A + n_B}$ (F)

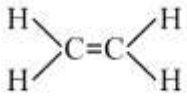
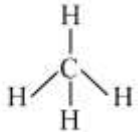
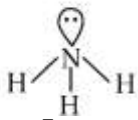
76. **(c)** Ambidentate → having more than one donor atom but at a time only one can form coordinate bond with C.M.T.

← SCN^-

← NCS^-

77. **(d)** Phthalein dye test is used for identification of phenolic group.

78. **(a)**

C_2H_4		5σ, 1π
C_2H_2	H-C≡C-H	3σ, 2π
CH_4		4σ
NH_3		3σ, 1LP

79. **(a)** $w = \frac{E}{96500} \times I \times t$

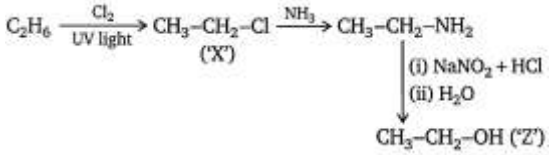
$w = \frac{63}{2 \times 96500} \times 1.5 \times 10 \times 60$

$w = 0.293$ g

80. **(a)**

	Orbital
(A) $n = 2, \ell = 1$	$2p$
(B) $n = 4, \ell = 0$	4 s
(C) $n = 5, \ell = 3$	5f
(D) $n = 3, \ell = 2$	3 d

81. (b)



82. (c) $Ce \rightarrow (_{54}Xe)6\ S^2 5\ d' 4f$

$Ce^{+4} \rightarrow (_{54}Xe)4f^{\circ}$

83. (a) $CH_4 + H_2O \underset{1273\ K}{\overset{Ni}{\rightarrow}} CO + 3H_2$

84. (a) Oxygen can show variable 0.5

Compound	Ion	
H_2O	O^{-2}	$0.5./-2$
H_2O_2	O_2^{-2}	-1
KO_2	O_2^{-1}	$-1/2$
O_2	O_2^0	o
OF_2	O^{+2}	+2
$O_2\ F_2$	O^{+1}	+1

85. (c) $\underset{\text{(colourless)}}{HPh} \rightleftharpoons H^+ + \underset{\text{(pink)}}{Ph^-}$

In acidic medium due to common ion effect equilibrium lies to the left so solution will be colourless.

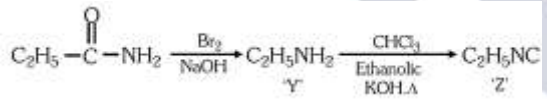
In alkaline medium, the ionisation of HPh increases due to odd ion effect so the concentration of Ph^- ions increases which imparts pink colour to solution.

86. (a) Size order $Mg > Al > Mg^{+2} > Al^{+3}$

Largest → Mg

Smallest → Al^{+3}

87. (b) $CH_3 - CH_2 - Cl \underset{'X'}{\overset{AgCN}{\rightarrow}} CH_3 - \underset{'Z'}{CH_2} - NC$



88. (c) $_{22}Ti \rightarrow (Ar)4\ s23\ d2$

$Ti^{+2} \rightarrow (Ar)3\ d^2$

1	1			

n = 2

spin only magnetc moment $(\mu) = \sqrt{n(n+2)}$

$\sqrt{2(2+2)}$

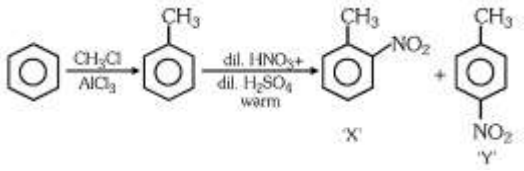
$= 2.84$ B. M.

89. (b) Catalyst

V_2O_5	Preparation of H_2SO_4 from SO_2
Fe	$N_2 + 3H_2 \rightarrow 2NH_3$
$PdCl_2$	Oxidation of ethyne to ethanol

Ni complex	Polymerisation of alkynes

90. (d)



' X ' & ' Y ' can be separated using fractional distillation.

91. (b)(A) GMO: Bt cotton (Genetically engineered crop)
(B) Thermostable DNA polymerase: Thermus aquaticus (Source of Taq polymerase)
(C) Ti plasmid: Agrobacterium tumefaciens (Natural genetic engineer)
(D) pBR 322: Escherichia coli (Commonly used cloning vector)

92. (a) (a) Bioprospecting: The systematic exploration of natural sources (molecular, genetic, and species levels) to find compounds, genes, or organisms for products of economic value, such as drugs or agrichemicals.
(b) Biofortification: The process of increasing the nutritional quality of food crops (e.g., more vitamins or minerals) through breeding or biotechnology.
(c) Biomagnification: The phenomenon where the concentration of toxins (like DDT) increases at each successive level of the food chain.
(d) Bioremediation: The use of organisms, such as microbes or plants, to clean up pollutants or contaminants from the environment.

93. (a) (A) Fertilized egg = Female (Queen/Worker).
(B) Unfertilized egg = Male (via Parthenogenesis).
(C) Females are diploid (32); Males are haploid (16).
(D) Males produce sperm by Mitosis (not Meiosis) because they are already haploid.
(E) This system is called Haplodiploid.

94. (d) (A) 2,4-D: Herbicide
(B) GA3: Brewing industry
(C) Kinetin: Nutrient mobilization
(D) ABA: Stomatal closure

95. (c) Racemose: The main axis continues to grow; flowers are arranged acropetally (youngest at top, oldest at base).
Cymose: The main axis terminates in a flower (limited growth); flowers are arranged basipetally (oldest at top).

96. (b) (b) 100 to 1000 times faster: Current extinction rates are estimated to be this much higher than pre-human (natural background) levels.
Key Difference: Unlike previous extinctions caused by natural disasters, the Sixth Extinction is driven by human activities (anthropogenic factors).
(a) & (d): Incorrect; the current rate is much faster, not lower or just 10 times faster.
(c): Incorrect; many species are currently vanishing.

97. (a) Secondary: Local folding into alpha-helices or beta-pleated sheets, held by hydrogen bonds.
Primary: Linear sequence of amino acids.
Tertiary: Overall 3D shape of one chain.
Quaternary: Assembly of multiple chains.

98. (b) (b) RuBP carboxylase-oxygenase (RuBisCO): The primary enzyme that fixes CO_2 into RuBP during the Calvin cycle (C_3 cycle).
(a) PEP carboxylase: Used in C_4 and CAM plants for initial CO_2 fixation.
(c) Carboxypeptidase: A digestive enzyme that breaks down proteins.
(d) Hexokinase: An enzyme used in Glycolysis to phosphorylate glucose.

99. (d) (B) Sporogenous tissue: The initial mass of diploid cells in the anther.
(D) Pollen mother cells: Cells that differentiate from sporogenous tissue to undergo meiosis.
(A) Microspore tetrads: The resulting cluster of four haploid cells after meiosis.
(C) Pollen grains: Mature, dehydrated microspores ready for pollination.
Sequence: Tissue → Mother Cell → Tetrad → Pollen Grain.

100. (a) (C) False: They usually cut slightly away from the center of the palindrome to create sticky ends.

(D) False: Removing nucleotides from the ends is the job of exonucleases; endonucleases cut within the DNA.
(A), (B), (E): These are True (molecular scissors, phage defense, and palindrome recognition).

101. **(d)** z gene: Codes for beta-galactosidase (breaks lactose into glucose and galactose).
y gene: Codes for permease (increases cell permeability to lactose).
a gene: Codes for transacetylase.
i gene: Codes for the repressor protein.

102. **(d)** (A) G_1 phase: (II) Growth and metabolism; no DNA replication.
(B) S phase: (III) DNA synthesis/replication (DNA amount doubles).
(C) G_2 phase: (IV) Protein synthesis for mitosis.
(D) M phase: (I) Actual cell division.

103. **(d)** Between 0.5 and 0.95.
Formula: $RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ consumed}}$
Calculation: $RQ = \frac{102}{145} \approx 0.7$
Conclusion: This value (≈ 0.7) falls in the range of 0.5 to 0.95 .

104. **(c)** (c) Large conspicuous nuclei: This is a trait of meristematic cells (cells that are actively dividing).
(a), (b), & (d): These are the core features of the elongation phase, where cells grow in size by increasing vacuolation, depositing new cell wall material, and physical enlargement.

105. **(d)** (D) First, isolate single cells from two different plant varieties.
(A) Use enzymes (cellulase/pectinase) for the digestion of cell walls.
(B) This results in the isolation of naked protoplasts (cells without walls).
(C) Perform fusion of protoplasts to create a hybrid cell.
(E) Finally, the hybrid protoplast is grown (using tissue culture) to form a new plant.

106. **(b)** (A) Conjunctive tissue: (III) Tissue located between xylem and phloem.
(B) Casparian strips: (IV) Suberin deposition in endodermal cells.
(C) Subsidiary cells: (I) Specialized cells next to guard cells.
(D) Starch sheath: (II) Endodermis of dicot stems rich in starch.

107. **(c)** Region of maturation: This is where cells differentiate; epidermal cells produce root hairs for absorption.
Elongation: Cells lengthen; no hairs.
Meristematic: Cells divide; no differentiation. Root cap: Protects the tip; no hairs.

108. **(c)** : Actinomorphic (Radial symmetry).
: Bisexual.
• $K_{(5)}$: 5 fused sepals.
• $\widehat{C_{(5)}A_5}$: 5 fused petals with epipetalous stamens (stamens attached to petals).
• $\underline{G}_{(2)}$: Superior ovary with 2 fused carpels.

109. **(b)** (b) Primary endosperm cell ($3n$) : Formed by triple fusion (1 male gamete +2 polar nuclei).
(a) Synergid (n): Haploid.
(c) Central cell ($2n$): Diploid (contains two polar nuclei before fusion).
(d) Zygote ($2n$): Diploid (1 male gamete +1 egg cell).

110. **(d)** (A) Decomposition: (III) Breakdown of complex organic matter into inorganic substances.
(B) Detritus: (IV) Raw material for decomposition (dead remains and fecal matter).
(C) Mineralization: (II) Release of inorganic nutrients by microbes into the soil.
(D) Humification: (I) Formation of humus (dark, amorphous colloidal substance).

111. **(d)** Whittaker's 1969 classification used five primary criteria:
(A) Cell structure
(B) Body organization
(D) Reproduction
(E) Phylogenetic relationships

112. **(c)** The "Evil Quartet" consists of:
Habitat loss and fragmentation (Main cause)
Over-exploitation
Alien species invasions
Co-extinctions

113. **(d)**(A) Isolation & Digestion: Extract DNA and cut it with enzymes.
(E) Electrophoresis: Separate DNA fragments by size.
(C) Blotting: Transfer fragments to a synthetic membrane.
(B) Hybridisation: Bind fragments with a labelled VNTR probe.
(D) Detection: Use autoradiography to see the final pattern.
Sequence: Digestion → Separation → Transfer → Hybridisation → Detection.

114. **(b)** (A): Standard transcription units include a promoter, structural gene, and terminator.
(B): The promoter is at the 5'-end (upstream).
(C) : The promoter is the binding site for RNA polymerase.
(D): The promoter's position determines which strand is the template $(3' \rightarrow 5')$ and which is coding $(5' \rightarrow 3')$.
(E): The terminator is at the 3'-end (downstream) and stops transcription.

115. **(b)** (b) Xenogamy: Transfer of pollen between flowers of two different plants. It is the only type that ensures genetically different pollen reaches the stigma.
(a) Geitonogamy: Transfer between flowers of the same plant; it is genetically equivalent to self-pollination.
(c) Cleistogamy: Pollination in flowers that never open (obligate self-pollination).
(d) Autogamy: Pollination within the same flower.

116. **(b)** (b) Sacred Groves: In-situ (On-site) conservation where species are protected in their natural habitat.
$(a), (c), \&(d)$: These are Ex-situ (Off-site) methods where species are protected in man-made environments (Seed Banks, Gardens, Safari Parks).

117. **(d)** (d) Plasticity: The ability of plants to follow different developmental pathways in response to their environment or life phases (e.g., Buttercup leaves looking different in air vs. water).
(a) Redifferentiation: When a cell matures again after being in a dividing state.
(b) Dedifferentiation: When a mature cell regains the ability to divide.
(c) Elasticity: A physical property, not a developmental biological phenomenon.

118. **(c)** (A) Productivity: (III) Rate of biomass production (The basic definition).
(B) Net primary productivity: (1) GPP minus respiration losses (The actual biomass available to consumers).
(C) Gross primary productivity: (IV) Rate of production during photosynthesis (Total energy captured by plants).
(D) Secondary productivity: (II) Rate of formation by consumers (Biomass produced by herbivores/carnivores).

119. **(d)** (A) Substituted methanes: Amino acids have a central α-carbon bonded to four groups, like a modified methane molecule.
(B) Serine: It is an alcoholic amino acid (contains -OH), not aromatic.
(C) Valine: It is a neutral amino acid (no charge on the side chain).
(D) Lysine: It is a basic amino acid (contains an extra $-NH_2$ group), not acidic.

120. **(a)** (a) Pinus: It is a Gymnosperm. The term "Gymnosperm" literally means "naked seeds," as the ovules are not enclosed by an ovary wall and remain exposed.
(b) Wolffia: An Angiosperm (flowering plant); ovules are enclosed within an ovary.
(c) Funaria: A Bryophyte (moss); it produces spores, not ovules or seeds.
(d) Selaginella: A Pteridophyte; it produces spores and does not form seeds.

121. **(d)** (A) Histones form an eight-molecule unit called a histone octamer.
(B) Histones are positively charged (not negative).
(C) Histones are rich in basic amino acids lysine and arginine.
(D) Negatively charged DNA (not positive) wraps around the histone octamer.
(E) Higher-level packaging requires Non-Histone Chromosomal (NHC) proteins.

122. **(a)** (A) Productivity: (III) Rate of biomass production.
(B) Net Primary Productivity: (1) GPP minus respiration losses (NPP = GPP - R).
(C) Gross Primary Productivity: (IV) Total organic matter produced during photosynthesis.
(D) Secondary Productivity: (II) Rate of biomass formation by consumers.

123. **(a)** (a) Nucleolus: Often called the "ribosome factory," it is the specific site where ribosomal RNA (rRNA) is actively synthesised and assembled.
(b) Kinetochore: Protein structure on chromosomes for spindle fibre attachment.
(c) Centrosome: Organelle involved in cell division (spindle formation).
(d) Chromatin: The relaxed form of DNA and protein; it contains the genetic code but isn't the specialized synthesis site.

124. **(b)** (b) Minimize water loss: When water is scarce, bulliform cells lose water and become flaccid, causing the leaves to roll or curl inwards. This reduces the surface area exposed to sunlight and decreases transpiration.
(a) Photosynthesis: Performed by mesophyll cells.
(c) Fungal defense: Primarily a function of the cuticle and epidermis.
(d) Water transport: Handled by xylem vessels.

125. **(a)** (A) Habitat loss: Clearing the Amazon for soyabeans is a classic example.
(B) Over-exploitation: Steller's sea cow and passenger pigeons were hunted to extinction by humans.
(C) False: The Nile perch caused the extinction of over 200 species of cichlid fish; it did not help them grow.
(D) Invasive species: Water hyacinth is an alien invasive species (often called "Terror of Bengal").
(E) False: This ignores co-extinction; when a species dies out, its dependent partners (like parasites or pollinators) are also affected.

126. **(a)** (a) Incorrect: The first word represents the Genus, and the second word represents the Specific Epithet. The statement swaps these.
(b) Correct: Specific epithets must start with a small letter (e.g., indica in Mangifera indica).
(c) Correct: Names are italics when printed and separately underlined when handwritten.
(d) Correct: Names are derived from Latin because it is a dead and stable language.

127. **(c)** Sickle-cell anaemia: Glutamic acid → Valine at 6 th position of β-globin chain.
Phenylketonuria: Enzyme deficiency (Phenylalanine hydroxylase).
Haemophilia: Blood clotting defect.
Thalassemia: Quantitative defect (less globin produced).

128. **(d)** (A) False: Water splitting is associated with PS-II, not PS-I.
(D) False: 'Kranz' anatomy is a feature of $\boldsymbol{C_4}$ plants, not $\boldsymbol{C_3}$ plants.
(B), (C), & (E): These are True (The Calvin cycle is the main biosynthetic pathway for all plants, C_4 plants lack photorespiration, and ATP is made via chemiosmosis).

129. **(a)** (A) Trypsin: (III) Enzyme (A proteolytic digestive enzyme).
(B) Morphine: (IV) Alkaloid (A secondary metabolite).
(C) Concanavalin A: (II) Lectin (Carbohydrate-binding protein).
(D) Collagen: (I) Intercellular ground substance (Abundant structural protein).

130. **(c)** (A) False: Lipids are water-insoluble (hydrophobic).
(B) True: Proteins are chains of amino acids (polypeptides).
(C) True: Polysaccharides are polymers of monosaccharides (sugars).
(D) False: Adenine and Guanine are Purines, not pyrimidines.
(E) True: Almost all enzymes are proteins (except ribozymes).

131. **(c)** (A) Incomplete Dominance: (II) Antirrhinum sp. (Snapdragon flower colour).
(B) Co-dominance: (IV) ABO blood group (specifically AB type).
(C) Pleiotropy: (III) Phenylketonuria (one gene affects multiple traits).
(D) Polygenic inheritance: (I) Human skin colour (controlled by multiple genes).

132. **(b)** (i) Denaturation: High heat separates the DNA double helix into single strands.
(ii) Annealing: Primers bind to the complementary sequences on the single strands.
(iii) Extension: Taq polymerase adds nucleotides to the primers to build new DNA strands.

133. **(b)** For each molecule of CO_2 fixed in the Calvin cycle, 3 ATP and 2 NADPH are consumed.
Since one molecule of glucose contains 6 carbon atoms, the cycle must run 6 times:
• ATP: $6 \times 3 = 18$ ATP
• NADPH: $6 \times 2 = 12$NADPH

134. **(d)** (A) Glycolysis: (III) Cytoplasm
(B) ETS: (I) Inner mitochondrial membrane
(C) Proton accumulation: (IV) Intermembrane space
(D) Krebs' cycle: (II) Mitochondrial matrix

135. **(a)** (A) Correct: Restriction endonucleases are called molecular scissors as they cut DNA.
(B) Correct: Fragments separate by size in agarose gel; smaller ones move farther.
(C) False: DNA is invisible to the naked eye/UV light without staining.
(D) False: Stained DNA (with Ethidium bromide) must be exposed to UV light (not visible light) to appear as bright orange bands.

136. **(c)** Genotypes: Parents are heterozygous I^Ai and I^Bi.

Cross: $I^Ai \times I^Bi$ produces four possibilities: I^AI^B(AB), I^Ai(A), I^Bi(B), and ii(O).
Probability: Only ii is blood group O , which is $1/4$ or 25%.

137. **(d)** (A) Mollusks: (II) Branchial (Respiration through gills).
(B) Reptiles: (I) Pulmonary only (Respiration through lungs).
(C) Adult amphibians: (IV) Pulmonary and Cutaneous (Breathe via lungs and moist skin).
(D) Amoeba: (III) Cellular (Simple diffusion across the cell membrane).

138. **(c)** Tetracycline: The BamHI site is located specifically within the tetracycline resistance gene (tet ^{R}) in pBR322.
• Insertional Inactivation: Inserting foreign DNA here disrupts the gene, causing the cell to lose its resistance to tetracycline.
• Ampicillin: The amp^R gene remains functional because its restriction sites are different (Pstl and Pvul).
Gentamycin: pBR322 does not carry a resistance gene for this antibiotic.

139. **(c)** (c) Propionibacterium shermanit. Produces large amounts of $\mathbf{CO_2}$ gas during fermentation, which creates the holes.
(a) Trichoderma polysporum. Produces Cyclosporin A.
(b) Lactobacillus: Converts milk to curd.
(d) Clostridium butylicum: Produces butyric acid.

140. **(a)** Divergent Evolution (Homology): Whales and bats share the same skeletal structure (pentadactyl limb) from a common ancestor, modified for different tasks.
(b), (c), & (d) Convergent Evolution (Analogy): These involve unrelated species developing similar functions (swimming, seeing, flying) from different anatomical origins due to similar environments.

141. **(d)** (d) Ribosomes: These are non-membrane bound organelles present in both prokaryotic and eukaryotic cells for protein synthesis.
(a) Lysosomes: Found only in eukaryotes; have a single membrane.
(b) Centrosomes: Non-membrane bound, but found only in animal (eukaryotic) cells.
(c) Mitochondria: Found only in eukaryotes; have a double membrane.

142. **(d)** (d) Biomass in sea: Inverted. The standing crop (biomass) of phytoplankton is much lower than the fish that eat them due to their rapid turnover.
(a) & (c) Grassland: Both are upright (Plants > Herbivores > Carnivores).
(b) Energy: Always upright. Energy is lost at every step (10% law); it can never be inverted.

143. **(d)** (C) Trigger: Blood pressure and GFR fall.
(E) Renin: Renin converts Angiotensinogen → Angiotensin I → Angiotensin II.
(D) Action: Angiotensin II causes vasoconstriction and Aldosterone release.
(B) Reabsorption: Aldosterone increases $\mathbf{Na^+}$and water reabsorption.
(A) Result: Blood pressure and GFR increase back to normal.

144. **(c)** (B) Mutualism (+, +): Both species benefit (e.g., lichen).
(D) Parasitism (+, -): One benefits, one is harmed (e.g., liver fluke).
(E) Amensalism (-, 0): One is harmed, the other is unaffected (e.g., Penicillium).

145. **(a)** Male honeybees (Drones): They are haploid (n) because they develop from unfertilized eggs. To produce gametes, their cells divide via mitosis (since they cannot reduce their chromosome number further).
(b), (c), & (d): These are diploid ($2n$) animals; they produce gametes via meiosis to halve the chromosome number.

146. **(c)** (C) Breathing: Air moves into the lungs and CO_2 moves out.
(B) Alveolar Exchange: Gases diffuse across the lung membrane into/out of blood.
(E) Transport: Blood carries the O_2 to the rest of the body.
(A) Tissue Exchange: Gases diffuse between the blood and the body tissues.
(D) Cellular Respiration: Cells use O_2 for energy and produce CO_2.
Sequence: Ventilation → Alveolar Diffusion → Transport → Tissue Diffusion → Cellular Use.

147. **(d)** (d) Lyases: These enzymes catalyse the removal of groups from substrates (without hydrolysis), which typically results in the formation of a double bond ($C = C$).
(a) Isomerases: Rearrange atoms within a molecule.
(b) Ligases: Link two molecules together using ATP.
(c) Transferases: Move a functional group from one molecule to another.

148. **(c)** (A) Streptokinase: (II) Clot buster (removes blood clots).
(B) Statins: (III) Lowers blood cholesterol.
(C) Lipases: (IV) Detergent formulations (removes oil stains).
(D) Cyclosporin A: (I) Immunosuppressive agent

149. **(a)** N: Population density.
r: Intrinsic rate of natural increase.
K: Carrying capacity.
$\frac{K-N}{K}$: The fraction of resources still available for population growth.

150. **(d)** The layers of the ovum from outer to inner are:
(C) Corona radiata: The outermost layer of follicular cells.
(A) Zona pellucida: The thick glycoprotein layer.
(B) Perivitelline space: The fluid-filled space between the zona and the membrane.
(D) Plasma membrane: The innermost boundary of the ovum.
Sequence: Corona radiata → Zona pellucida → Perivitelline space → Plasma membrane.

151. **(b)** (b) Ophrys (Orchid): Uses sexual deceit by mimicking a female bee's appearance. Male bees attempt to mate with the flower (pseudocopulation), resulting in pollination.
(a) Sea anemone/Clown fish: Commensalism.
(c) Fig/Wasp: Mutualism.
(d) Cuckoo/Crow: Brood parasitism.

152. **(b)** (A) Tetany: (III) Muscle spasms due to low Ca^{++}.
(B) Arthritis: (I) Inflammation of joints.
(C) Myasthenia gravis: (II) Autoimmune disorder (Note: Item II in your list has a typo from Q148; it should be "Autoimmune disorder").
(D) Muscular dystrophy: (IV) Progressive degeneration of muscle.

153. **(c)** (A) Human RBC membranes contain 52% protein and 40% lipids.
(B) Phospholipids are arranged in a bilayer.
(C) Mesosomes are extensions found in prokaryotes, not eukaryotes.
(D) Hydrophobic tails face inward to stay protected from the aqueous phase.
(E) The Glycocalyx is the outermost layer of prokaryotic (bacterial) cells.

154. **(d)** (A) False: Mitochondria and chloroplasts are not part of the endomembrane system.
(B) True: Rough ER has ribosomes attached to its surface for protein synthesis.
(C) True: Mitochondria and plastids are semi-autonomous and have circular DNA.
(D) True: Microtubules, microfilaments, and intermediate filaments form the cytoskeleton.
(E) False: Mitochondria are double membrane-bound organelles.

155. **(c)** cry l Ac and cry l Ab.
• Cotton Bollworms: Controlled by cry l Ac and cry ll Ab.
• Corn Borer: Controlled by cry I Ab.
Following the order in the question (Bollworm then Corn Borer), the correct pair is cry l Ac and cry l Ab.

156. **(c)** The Juxta Glomerular Apparatus (JGA) is formed by the close contact of:
• The Distal Convoluted Tubule (DCT) cells (specifically the macula densa).
• The Afferent renal arteriole cells (specifically the juxtaglomerular cells).
This region acts as a sensor for blood pressure and sodium levels to regulate the Glomerular Filtration Rate (GFR).

157. **(d)** (A) True: The hepatic portal system connects the intestine and liver.
(B) False: Frogs have 10 pairs of cranial nerves (not 12).
(C) True: In female frogs, ureters and oviducts open separately into the cloaca.
(D) False: Optic lobes are part of the mid-brain, not the hind-brain.
(E) True: The sinus venosus opens into the right atrium.

158. **(a)** (A) Cortisol: (II) Anti-inflammatory reactions and immune suppression.
(B) Aldosterone: (III) Reabsorption of $Na^+$and water in kidneys.
(C) Cholecystokinin: (IV) Secretion of pancreatic enzymes and bile juice.
(D) Progesterone: (I) Formation of alveoli in mammary glands.

159. **(c)** • Normal Condition: The DNA codon is GAG, which codes for Glutamic acid.

• Mutant Condition: A point mutation changes the DNA codon to GUG, which codes for Valine.
• Result: This single amino acid substitution at the sixth position of the β-globin chain causes hemoglobin molecules to polymerise under low oxygen, turning RBCs into a sickle shape.

160. **(c)** (B) Vocal sacs: Present only in males to produce loud croaking sounds to attract mates.
(D) Copulatory pad: Also known as nuptial pads, these are found on the first digit of the forelimbs in males to help them grip females during mating.
$(A), (C), \&(E)$: Features like bulging eyes, webbed feet, and skin colour are common to both male and female frogs.

161. **(c)** (c) Emphysema: α-1-antitrypsin is a human protein produced by transgenic animals and used specifically to treat this lung condition.
(a), (b), & (d): These diseases are treated using different medical or biotechnological approaches (e.g., cystic fibrosis is often linked to research involving the CFTRgene).

162. **(d)** (A) Nicotine: (II) Stimulates adrenal glands to release catecholamines.
(B) Morphine: (III) Effective sedative and painkiller.
(C) Heroin: (IV) Depressant; slows down body functions.
(D) Cocaine: (I) Causes euphoria and increased energy.

163. **(d)** (A) Cocaine: (II) Interferes with dopamine transport.
(B) Heroin: (IV) Slows down body functions.
(C) Morphine: (I) Effective sedative and painkiller.
(D) Marijuana: (III) Affects the cardiovascular system.

164. **(c)** (A) About 65 mya: (II) Dinosaurs suddenly disappeared from the earth.
(B) About 500 mya: (IV) Invertebrates were formed and became active.
(C) About 350 mya: (I) Jawless fish probably evolved.
(D) About 320 mya: (III) Seaweeds and few plants probably existed.

165. **(d)** (A) Progestasert: (III) Hormone releasing IUD.
(B) Multiload 375: (IV) Copper releasing IUD.
(C) Diaphragm: (I) Barrier made of rubber used by females.
(D) Saheli: (II) Oral contraceptive (non-steroidal "once-a-week" pill).

166. **(d)** (E) Mosquito bite: Sporozoites are injected into the human.
(D) To Liver: Sporozoites travel through blood to the liver.
(B) Liver Stage: Parasites multiply asexually in liver cells and burst them.
(A) RBC Stage: Parasites enter RBCs, multiply asexually, and burst them (causing fever).
(C) Sexual Stage: Gametocytes develop in the RBCs for the next mosquito to pick up.

167. **(b)** Month 1: Heart forms and starts beating.
Month 2: Limbs and digits develop.
Month 3: Major organ systems and external genitals form.
Month 5: First movements felt; hair appears on head.
Month 6: Eyelids separate, eyelashes form, and body covered in fine hair.
Month 9: Fetus is fully developed for birth.

168. **(b)** These are penguins, which use their paddle-like forelimbs (flippers) to swim. In contrast, Struthio (ostrich) is a flightless bird adapted for running, not swimming.

169. **(b)** (B) Adult Echinoderms have radial symmetry (not bilateral). Only their larvae are bilaterally symmetrical.
(E) Reptiles are poikilotherms (cold-blooded), meaning they cannot maintain a constant body temperature and depend on the environment.

170. **(c)** These characters identify it as a member of the class Cyclostomata:
• Circular sucking mouth: Used for its ectoparasitic lifestyle.
• No scales or paired fins: Distinguishes it from true fishes.
• 7 pairs of gill slits: Typical for respiratory exchange in lampreys.
• Cartilaginous endoskeleton: Common to this primitive group.
Scoliodon (Shark) has jaws and scales, while Exocoetus (Flying fish) has a bony skeleton and scales.

171. **(d)** (A) & (B): A CNS signal travels via a motor neuron to trigger an action potential, releasing Ca^{++}into the sarcoplasm.

(C) is incorrect: Ca^{++}actually activates actin by removing the troponin mask; it doesn't inactivate it.
(D) & (E): Myosin heads bind to actin to form cross bridges, pulling actin filaments toward the centre to shorten the sarcomere

172. **(d)** • Transfer: Moving a donor ovum (not an embryo) into the fallopian tube.
• Purpose: For females who cannot produce eggs but can provide a healthy environment for natural fertilization and development within their own body.
Key Distinction: Options (b) and (c) refer to ZIFT or IUT, which involve transferring already-formed embryos, whereas GIFT transfers the raw gamete.

173. **(b)** (B): Adjacent vertebrae are connected by cartilaginous joints (intervertebral discs).
(C): Humans have exactly 7 cervical vertebrae.
(E): The skull connects to the first vertebra (atlas) via the occipital bone.

174. **(d)** Here is the breakdown:
(C): Secondary spermatocytes undergo the second meiotic division to produce four haploid spermatids.
(E): Spermiogenesis is the specific process where non-motile spermatids transform into mature, motile spermatozoa (sperms).

175. **(c)** (A): Erythroblastosis foetalis occurs when the mother is $\mathbf{Rh}^{-ve}$ and the foetus is Rh^{+ve}. The statement incorrectly swaps these roles.
(E) : To prevent the condition, anti-Rh antibodies must be administered immediately after the delivery of the first $\boldsymbol{R}^{+ve}$ child (and any subsequent Rh^{+ve} pregnancies) to prevent the mother from producing her own antibodies. Waiting until after the second child is too late.

176. **(d)** These are all bony fishes (Osteichthyes):
• Flying fish: Exocoetus
• Angel fish: Pterophyllum
• Fighting fish: Betta

177. **(b)** This is due to the XX-XO sex determination system:
• Males (XO): Have only one X chromosome, resulting in an odd number (23).
• Females (XX): Have two X chromosomes, resulting in an even number (24).

178. **(a)** The chronological sequence of human evolution is:
• Ramapithecus: Early human-like primate (~15 mya).
• Homo habilis: First toolmaker; brain size 650-800 cc.
• Homo erectus: Upright man; brain size 900 cc.
• Neanderthal: Advanced features and burials; brain size 1400 cc.
• Homo sapiens: Modern humans (-75,000 years ago).

179. **(b)** Neurotransmitters are released from the pre-synaptic side, cross the synaptic cleft, and bind to receptors on the post-synaptic side to pass the signal along.

180. **(a)** Here is the breakdown of respiratory volumes:
• TV (Tidal Volume): 500 mL (Normal breath).
• ERV (Expiratory Reserve Volume): $1000 - 1100$ mL (Extra air you can breathe out).
• RV (Residual Volume): $1100 - 1200$ mL (Air left in lungs after forceful exhale).
• IRV (Inspiratory Reserve Volume): $2500 - 3000$ mL (Extra air you can breathe in).