ANSWER KEY

Physics

1.	(b)	14.	(a)	27.	(a)	40.	(b)
2.	(c)	15.	(b)	28.	(d)	41.	(d)
3.	(c)	16.	(b)	29.	(d)	42.	(b)
4.	(a)	17.	(b)	30.	(a)	43.	(a)
5.	(a)	18.	(d)	31.	(a)	44.	(d)
6.	(c)	19.	(c)	32.	(a)	45.	(c)
7.	(a)	20.	(d)	33.	(b)	46.	(c)
8.	(d)	21.	(a)	34.	(c)	47.	(d)
9.	(d)	22.	(b)	35.	(b)	48.	(c)
10.	(c)	23.	(d)	36.	(a)	49.	(d)
11.	(c)	24.	(d)	37.	(a)	50.	(b)
12.	(c)	25.	(d)	38.	(d)		
13.	(a)	26.	(a)	39.	(b)		

Botany

101.	(c)	114.	(b)	127.	(a)	140.	(a)
102.	(a)	115.	(a)	128.	(d)	141.	(c)
103.	(c)	116.	(a)	129.	(b)	142.	(b)
104.	(b)	117.	(c)	130.	(d)	143.	(c)
105.	(d)	118.	(d)	131.	(b)	144.	(b)
106.	(d)	119.	(c)	132.	(b)	145.	(c)
107.	(a)	120.	(c)	133.	(a)	146.	(c)
108.	(d)	121.	(d)	134.	(d)	147.	(a)
109.	(b)	122.	(d)	135.	(c)	148.	(a)
110.	(c)	123.	(a)	136.	(c)	149.	(b)
111.	(a)	124.	(c)	137.	(b)	150.	(d)
112.	(a)	125.	(c)	138.	(c)		
113.	(b)	126.	(c)	139.	(b)		

Chemistry

51.	(a)	64.	(b)	77.	(a)	90.	(d)
52.	(d)	65.	(c)	78.	(c)	91.	(c)
53.	(a)	66.	(a)	79.	(d)	92.	(b)
54.	(b)	67.	(b)	80.	(a)	93.	(a)
55.	(d)	68.	(d)	81.	(d)	94.	(b)
56.	(c)	69.	(a)	82.	(a)	95.	(a)
57.	(d)	70.	(b)	83.	(d)	96.	(d)
58.	(a)	71.	(a)	84.	(a)	97.	(a)
59.	(c)	72.	(a)	85.	(d)	98.	(c)
60.	(b)	73.	(a)	86.	(d)	99.	(b)
61.	(a)	74.	(a)	87.	(d)	100.	(b)
62.	(b)	75.	(c)	88.	(d)		
63.	(d)	76.	(c)	89.	(a)		

Zoology

151.	(b)	164.	(b)	177.	(b)	190.	(b)
152.	(c)	165.	(b)	178.	(b)	191.	(b)
153.	(b)	166.	(c)	179.	(b)	192.	(b)
154.	(c)	167.	(b)	180.	(b)	193.	(c)
155.	(c)	168.	(c)	181.	(b)	194.	(b)
156.	(d)	169.	(b)	182.	(b)	195.	(b)
157.	(b)	170.	(b)	183.	(d)	196.	(c)
158.	(a)	171.	(b)	184.	(a)	197.	(a)
159.	(a)	172.	(c)	185.	(c)	198.	(a)
160.	(b)	173.	(d)	186.	(b)	199.	(c)
161.	(b)	174.	(a)	187.	(a)	200.	(d)
162.	(a)	175.	(d)	188.	(c)		
163.	(d)	176.	(a)	189.	(d)		

❍❍❍

ANSWERS WITH EXPLANATION

PHYSICS

Section A

1. Option (b) is correct.

Since angular momentum:

$$mvr = \frac{nh}{2\pi} \text{ or, } I\omega = \frac{nh}{2\pi}$$

$$h = \frac{2\pi I\omega}{n}$$

Here, I = moment of inertia

$$\frac{h}{I} = \frac{\left(\frac{2\pi I\omega}{n}\right)}{I}$$

$$\frac{h}{I} = \frac{2\pi\omega}{n} = \frac{2\pi(2\pi f)}{n}$$

$$\left[\frac{h}{I}\right] = [T^{-1}]$$

2. Option (c) is correct.

In an unbiased *p-n* junction, the diffusion of charge carriers across the junction takes place from higher concentration to lower concentration.

3. Option (c) is correct.

When the collector is positive and the emitter is negative w.r.t. base, it causes forward biasing for each junction, which causes the conduction of current.

4. Option (a) is correct.

$W = \mu mgS = 0.2 \times 50 \times 9.8 \times 1\ J = 98\ J$

5. Option (a) is correct.

Let the total length of the string be l. Then for the three segments:

$$l = l_1 + l_2 + l_3$$

$$n_{string} = n = \left(\frac{1}{2l}\right) \times \sqrt{\frac{T}{m}}$$

T is the tension in the string and m is the string's the linear mass density.

So, $$n \propto \frac{1}{l}$$

Hence, $$\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$$

6. Option (c) is correct.

From the question,

$$n_1\lambda_1 = n_2\lambda_2 \qquad \text{(Condition for maxima)}$$

So, $$\frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1}$$

$$= \frac{10000}{12000} = \frac{5}{6}$$

Hence, minimum values for n_1 and n_2 are 5 and 6.

Distance of the maxima corresponding to n_1 and n_2 from the center of the screen:

$$X_{min} = n_1\lambda_1\frac{D}{d}$$

$$= \frac{5(12000 \times 10^{-10})^2}{2 \times 10^{-3}}$$

$$= 6 \times 10^{-3}\ m = 6\ mm$$

7. Option (a) is correct.

Let v be the final velocity of m. Then the conservation of angular momentum, we see that:

$$mv_0R_0 = mv \times \frac{R_0}{2}$$

or, $$v = 2v_0$$

Now, $$\text{Final KE} = \frac{1}{2} \times m(2v_0)^2 = 2mv_0^2$$

8. Option (d) is correct.

$$y = a \sin \omega t + b \cos \omega t$$

Let $a = A \cos \theta$; $b = A \sin \theta$

$\Rightarrow$ $$a^2 + b^2 = A^2(\cos^2\theta + \sin^2\theta) = A^2$$

or $$A = \sqrt{a^2 + b^2}$$

Hence,

$$Y = A \cos \theta \sin \omega t + A \sin \theta \cos \omega t$$

$$A \sin(\omega t + \theta)$$

$$= \sqrt{a^2 + b^2} \cdot \sin(\omega t + \theta)$$

It is SHM with amplitude $A = \sqrt{a^2 + b^2}$

9. Option (d) is correct.

Given: $\lambda = 600 \times 10^{-9}$ m

$D = 2$ m

and $d = 1$ mm $= 10^{-3}$ m

Now width of central maxima is given as:

$$W_0 = \frac{2\lambda D}{d}$$

$$= 2 \times 600 \times 10^{-9} \times \frac{2}{10^{-3}}$$

$$= 2.4 \times 10^{-3}\ m = 2.4\ mm$$

10. Option (c) is correct.

As $P \propto V$

$\therefore$ $PV^{-1} = \text{constant} \Rightarrow x = -1$

Also for diatomic gas,

$$C_V = \frac{5}{2}R$$

$$C = C_V - \frac{R}{x-1} = \frac{5}{2}R - \frac{R}{-1-1} = 3R$$

But as rms speed is doubled therefore temperature becomes four times.

Hence, $$Q = nC\Delta T$$

$$= n \times 3R \times 3T_i = 9\,nRT_i = 9\,P_1V_1$$

11. Option (c) is correct.

M.I. of the uniform circular disc about its diameter = I

M.I. of the disc about its axis = $\frac{1}{2}mr^2$

According to the Theorem of perpendicular axes

$$I_z = I_x + I_y$$

M.I. of the disc about its axis,

$$I_z = I + I = 2I$$

Thus, $$2I = \frac{1}{2}mr^2$$

$\therefore$ $$mr^2 = 4I$$

As per the parallel axes theorem,

Moment of inertia of disc about the perpendicular axis passing through its rim:

$$= \frac{1}{2}mr^2 + mr^2$$

$$= 2I + 4I = 6I$$

12. Option (c) is correct.

Distance traveled by the particle in the nth second

$$S_{nth} = u + \frac{1}{2}a(2n-1)$$

where u = initial speed, a = acceleration of particle

Here,

$n = 3$, $u = 0$, $a = \frac{4}{3}\text{m/s}^2$

So, $$S_{3rd} = \frac{1}{2} \times \frac{4}{3}(2 \times 3 - 1)$$

$$= \frac{10}{3}\text{m}$$

13. Option (a) is correct.

The difference in frequencies of closed pipe

$$\frac{2v}{4l} = 260 - 220 = 40\ \text{Hz}$$

So, the fundamental frequency, $f' = \frac{v}{4l} = 20\ \text{Hz}$

14. Option (a) is correct.

Wavelength,

$$\lambda = \frac{h}{p}$$

$$\lambda = \frac{h}{\sqrt{2mE}}$$

$$\lambda = \frac{h}{\sqrt{2m \times 3/2\ kT}}$$

or, $$\lambda = \frac{h}{\sqrt{2m \times (3/2)kT}} = \frac{h}{(3mkT)^{1/2}}$$

15. Option (b) is correct.

Torque is given by $\tau = pE \sin \theta$

$$\tau = pE \sin \theta = qlE \sin \theta$$

or, $$q = \frac{\tau}{E \sin \theta} = \frac{4}{(2 \times 10^{-2} \times 0.5 \times 2 \times 10^5)} = 2\ \text{mC}$$

16. Option (b) is correct.

Since, $h = 2 \times T \cos \theta / r\rho g$

As T, h, g and r are constants

$$\rho\uparrow \Rightarrow \theta\downarrow$$

$$\theta_1 < \theta_2 < \theta_3 \qquad [\text{as } \rho_1 > \rho_2 > \rho_3]$$

It shows $0 \le \theta_1 < \theta_2 < \theta_3 < \pi/2$

17. Option (b) is correct.

As the period for which the particle moves with velocities v_1, v_2 and v_3 is same (t = 20 s), the

Time average velocity = $\frac{v_1+v_2+v_3}{3} = \frac{3+4+5}{3} = 4$ m/s

18. Option (d) is correct.

$$f \propto \sqrt{k}$$

If the spring is divided in equal parts then the force constant of each part gets double

$$f_2/f_1 = \sqrt{k_2/k_1} = \sqrt{2}$$

$$f_2 = \sqrt{2} f_1$$

19. Option (c) is correct.

Time = $\frac{\text{distance}}{\text{speed}} = \frac{t}{\frac{c}{n}} = \frac{nt}{c}$

20. Option (d) is correct.

The de Broglie wavelength is given as:

$$\lambda = \frac{h}{p}$$

⇒ Wavelength is inversely proportional to momentum,

$$\lambda \propto \frac{1}{p}$$

21. Option (a) is correct.

We know that potential gradient

$$\frac{dV}{dr} = 10 \text{ V/m}$$

$$dr = 0.6 - 0.3 = 0.3 \text{ m}$$

So, $dV = V_B - V_C = \left(\frac{dV}{dr}\right) \times dr$

$= 10 \times 0.3$ V

$= 3.0$ V

22. Option (b) is correct.

Magnetic Field $B = \mu_0 N i/2r$

$= 4\pi \times 10^{-7} \times 50 \times 2/(2 \times 0.5)$

$= 1.26 \times 10^{-4}$ T

23. Option (d) is correct.

$$i_0 = \frac{v_0}{Z}$$

$$Z = \sqrt{R^2 + (\omega L)^2}$$

$$= \sqrt{4^2 + (1000 \times 3 \times 10^{-3})^2} = 5\ \Omega$$

$$i_0 = \frac{4}{5}$$

$$i_0 = 0.8 \text{ A}$$

24. Option (d) is correct.

$S = t^3 - 6t^2 + 3t + 4$

$v = \frac{ds}{dt} = 3t^2 - 12t + 3$

$a = \frac{dv}{dt} = 6t - 12$

$a = 0$ when $t = 2$

⇒ $v_{a=0} = 3 \times 4 - 12 \times 2 + 3 = -9 \text{ ms}^{-1}$

⇒ $|v| = 9 \text{ ms}^{-1}$

25. Option (d) is correct.

Apply Newton's second law.

Change in momentum is equal to Impulse.

$$I = m(v_2 - v_1)$$

26. Option (a) is correct.

It is noted that the color of light is found from its frequency, so when the frequency remains the same, color will also remain the same, so it will remain green.

27. Option (a) is correct.

Work done by the gas $= P\Delta V$

$= -50\ (10 - 4) = -300$ J

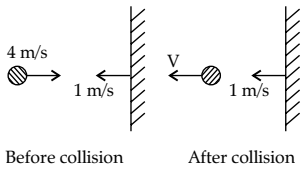
Using, $dQ = dU + dW$

⇒ $dU = dQ - dW$

$= 300 + 100 = 400$ J

So, the internal energy is increased by 400 J.

28. Option (d) is correct.



Let v be the velocity of ball after collision. For elastic collision coefficient of restitution,

$$e = 1$$

or relative velocity after collision = relative velocity before collision

$\therefore$ $v - 1 = 4 + 1$

or $v = 6$ m/s (away from the wall)

29. Option (d) is correct.

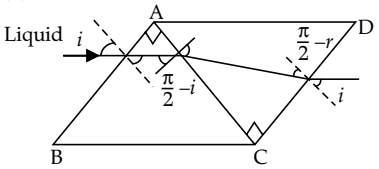
Intensity cannot affect the cut-off frequency or stopping potential. High intensity means more number of photons, so the chances of hitting the electron by them increases and hence more photoelectrons are emitted i.e., photocurrent increases.

30. Option (a) is correct.

The temperature of land rises rapidly as compared to sea, because of specific heat of land is five times less than that of sea water. Thus, the air above the land become hot and light and rises up. To compensate the drop of pressure, the cooler air starts blowing towards land from sea so set-up sea breeze.

During night land as well as sea radiate heat energy. The temperature of land falls more rapidly as compared to sea water, as sea water consists of higher specific heat, capacity. The air above sea water being warm and light rises up. To take its place the cold air from land starts blowing towards sea and set-up land breeze.

31. Option (a) is correct.



By Snell's law at the surface AC

$$\sqrt{3} \sin\left(\frac{\pi}{2} - i\right) = \sqrt{2} \sin r \quad \text{...(i)}$$

By Snell's law at the surface DC,

$$\sqrt{2} \sin\left(\frac{\pi}{2} - r\right) = 1 \sin i \quad \text{...(ii)}$$

From equation **(i)** and (ii),

$$2\cos^2 i + 1 = 2$$

or, $\cos i = \frac{1}{\sqrt{2}}$

or, $i = 45°$

32. Option (a) is correct.

From statement II:

Power $P = \frac{\text{work}}{\text{time}} = \frac{n \times K}{1} = nK$

33. Option (b) is correct.
When the incident light crosses the interface the light is absorbed temporarily by the atoms in the second medium. Electrons in these atoms oscillate back and forth in the direction of the electric field vectors in the refracted ray, perpendicular to the direction, the refracted ray is traveling.
The light is remitted by the atoms to form both the reflected and refracted rays.
The electric field vector in the light match the directions the electrons were oscillating, and they must be perpendicular to the direction of prorogation of the wave. When the lights come in at the Brewster angle the reflected wave has no electric field vectors parallel to the refracted ray, because the electrons do not oscillate along that direction. The reflected wave also has no electric field vectors parallel to the reflected ray, because that's the direction of propagation of the wave. The only direction possible is perpendicular to the plane of the picture. So, the reflected rays acquire maximum plane polarization.

34. Option (c) is correct.
If a small amount of antimony is added to the germanium the crystal, crystal becomes an *n*-type semiconductor. Hence, there will be more free electrons than holes.

35. Option (b) is correct.
For copper, resistance will decrease and for silicon, it will increase. As silicon is a semiconductor its resistance will increase when the temperature reduces. The opposite is the case for copper as it is a conductor.

Section B

36. Option (a) is correct.
Let k be the spring constant of the spring, so

$$\mathbf{U} = \frac{1}{2} \times k \times (2)^2 = 2k$$

Now for $\Delta x = 10$ cm:

$$U_{final} = \frac{1}{2} \times k \times (10)^2 = 50k$$

Further, $\frac{U}{U_{final}} = \frac{2k}{50k} = \frac{1}{25}$

So, $U_{final} = 25\,U$

37. Option (a) is correct.
As the e.m. wave is propagating along $+z$ direction, the cross product of the unit vector along the electric field with the unit vector along the magnetic field associated with the e.m. wave should be along the $+z$ axis.

$\therefore\ \vec{E} = E_0\hat{i}$ and $\vec{B} = B_0\hat{j}$

38. Option (d) is correct.
The one-dimensional elastic collision of a moving massive body with a light body at rest, brings the velocity of the light body to double the velocity the massive body, but the velocity of the massive body remains unchanged.

39. Option (b) is correct.
Orbital velocity of a satellite in a circular orbit of radius 'R' is inversely proportional to the square root of radius. Thus,

$$\frac{v_2}{v_1} = \sqrt{\frac{R_1}{R_2}} \qquad \left[\text{As } v = \sqrt{\frac{GM}{R}}\right]$$

or, $\frac{v_2}{v_1} = \sqrt{\frac{4 \times R_1}{R_1}}$

or, $v_2 = v_1 \times 2$

as $v_1 = 3V$

So, $v_2 = 6V$

40. Option (b) is correct.
Resistance $R = \rho l/A$

Length and area of a cross-section of stretched wire:

$$l' = nl,\ A' = \frac{A}{n},$$

Resistance of the stretched wire:

$$R' = \frac{\rho l'}{A'}$$

$$R' = \frac{\rho nl}{A/n} = \frac{\rho l}{A} n^2$$

$$R' = Rn^2$$

41. Option (d) is correct.

$$\text{Height} = \text{Range}$$

$$\frac{u^2 \sin^2\theta}{2g} = \frac{u^2 \sin 2\theta}{g}$$

$$\frac{u^2 \sin^2\theta}{2g} = \frac{u^2 2\sin\theta\cos\theta}{g}$$

$$\frac{\sin^2\theta}{2} = 2\sin\theta\cos\theta$$

$$\sin\theta = 4\cos\theta$$

$$\tan\theta = 4$$

$$\theta = \tan^{-1}(4)$$

42. Option (b) is correct.

$$\text{Young's Modulus} = \frac{\text{stress}}{\text{strain}}$$

$$\text{stress} = Y \cdot \text{strain}$$

$$\frac{F}{A} = Y \cdot \text{strain}$$

$$F = YA\,(\text{strain})$$

$$mg = YA\,(\text{strain})$$

$$m = \frac{YA(\text{strain})}{g}$$

$$m = \frac{2 \times 10^{11} \times 3 \times 10^{-6} \times 10^{-3}}{10}$$

$$m = 60\text{ kg}$$

43. Option (a) is correct.

Excess pressure inside a soap bubble $= \frac{4s}{r}$

As temperature = constant (from Boyle's law)

$P_1V_1 = P_2V_2 = PV$

$$\frac{4s}{r_1} \cdot \frac{4}{3}\pi r_1^3 + \frac{4s}{r_2} \cdot \frac{4}{3}\pi r_2^3 = \frac{4s}{r} \cdot \frac{4}{3}\pi r^3$$

$$r_1^2 + r_2^2 = r^2$$

$$\sqrt{r_1^2 + r_2^2} = r$$

$$\sqrt{3^2 + 4^2} = r = 5\text{ mm}$$

44. Option (d) is correct.

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$V_{rms_1} = \sqrt{\frac{3RT_1}{M}}$$

$$V_{rms_2} = \sqrt{\frac{3RT_2}{M}}$$

$$\frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{V}{2V} = \sqrt{\frac{273+100}{T_2}}$$

$$\frac{1}{2} = \sqrt{\frac{373}{T_2}}$$

$$T_2 = 4 \times 373\ K = 1492\ K$$

$$T_2 = (1492 - 273)°C = 1219°C$$

45. Option (c) is correct.

$$\text{Speed of EM wave} = \frac{\text{Amplitude of Electric Field}}{\text{Amplitude of Magnetic Field}}$$

$$c = \frac{E}{B}$$

$$B = \frac{E}{c} = \frac{9.0\times10^{-4}}{3\times10^{8}} = 3 \times 10^{-12}\ T$$

$$B = 3 \times 10^{-12}\ T$$

46. Option (c) is correct.

The relative permeability of a paramagnetic substance is slightly greater than one, while that of diamagnetic substance is less than one.

For ferromagnetic substances, it is much greater than one.

47. Option (d) is correct.

For open pipe $n = \frac{V}{2L}$

For closed pipe $n^- = \frac{V}{4L}$

When the open pipe is dipped half into water it will behave like the closed pipe of a half-length

$$n^- = \frac{V}{4\left(\frac{L}{2}\right)} = \frac{V}{2L} = n$$

48. Option (c) is correct.

Case I: $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{6}$ …**(i)**

Case II: $\frac{1}{C_{s'}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{10}$ …(ii)

Subtracting (i) – (ii)

$$\frac{1}{C_3} = \frac{1}{6} - \frac{1}{10}$$

$$\frac{1}{C_3} = \frac{4}{60}$$

$$C_3 = 15\ \mu F$$

49. Option (d) is correct.

$$E_n = \frac{-13.6\ eV}{n^2}$$

For $n = 1$, $E_g = \frac{-13.6\ eV}{1^2}$

When an atom absorbs a photon of energy 10.2 eV its new energy becomes

$$-13.6\ eV + 10.2\ eV = -3.4\ eV$$

$$-3.4\ eV = \frac{-13.6}{n^2}$$

$$n^2 = \frac{-13.6\ eV}{-3.4\ eV}$$

$$n^2 = 4$$

$$n = 2$$

Electron jumps to the second orbit

$$v_n \propto \frac{1}{n}$$

$$v_1 \propto \frac{1}{1}$$

$$v_2 \propto \frac{1}{2}$$

$$\frac{v_1}{v_2} = \frac{2}{1}$$

$$v_2 = \frac{v}{2}$$

50. Option (b) is correct.

For a transformer

$$\frac{\text{number of turns in secondary coil}}{\text{number of turns in primary coil}} = \frac{\text{voltage across secondary coil}}{\text{voltage across primary coil}}$$

$$\frac{2000}{400} = \frac{1000}{V_P}$$

$$V_P = 200\ V$$

CHEMISTRY

Section A

51. Option (a) is correct.

22.4 L of H_2 gas at STP = 1 mole

11.2 L of Cl_2 gas at STP = 0.5 mole

Now, the chemical equation is represented as follows:

	H_2	+	Cl_2	→	2HCl
Initial:	1 mole		0.5 mole		0
Final:	0.5 mole		0		2 × 0.5 mole

Now, according to the balanced chemical equation, 1 mole of each of H_2 and Cl_2 reacts to give 2 moles of HCl. Here, only 0.5 mole of Cl_2 is present. Thus, it is the limiting reagent and it reacts completely to form HCl with twice the concentration of that of Cl_2.

Thus, the mole of HCl formed is 1 mole.

52. Option (d) is correct.

Among the alkali metals, the Li^+ ion is the smallest thus, the extent of hydration is maximum in Li^+ ion, *i.e.*, The Li^+ ion in water gets hydrated to form a bulky species. Thus, the smaller the size of a cation, the greater is the extent of hydration and the lesser is the ionic mobility. Thus, the order of ionic mobility is:

$$Li^+ < Na^+ < K^+ < Rb^+$$

53. Option (a) is correct.

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

54. Option (b) is correct.

For $n = 3$ and $l = 1$, the corresponding subshell is 3*p*. *p*-subshell has 3 orbitals. Each orbital of 3*p* can accommodate two electrons.

Hence, total 6 electrons can fit for $n = 3$ and $l = 1$.

55. Option (a) is correct.

$$CH_4 \xrightarrow[h\nu]{Br_2} CH_3—Br \xrightarrow[\text{dry ether}]{Na} CH_3—CH_3$$

(less than four 'C' atoms)

56. Option (c) is correct.

Both IBr_2^- and XeF_2 have linear geometry. So, they are isostructural and the number of valence electrons present in both the species is the same, *i.e.*, 22. Thus, they are also isoelectronic.

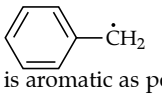
S. No.	Compounds	Number of valence electrons	Geometry
1.	$BeCl_2$	2 + 14 = 16	Linear
2.	XeF_2	8 + 14 = 22	Linear
3.	TeI_2	6 + 14 = 20	Bent or V-shaped
4.	IBr_2^-	7 + 14 + 1 = 22	Linear
5.	IF_3	7 + 21 = 28	T-shaped

57. Option (d) is correct.

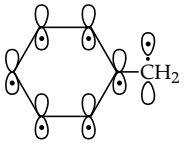
$CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

Here, the oxidation state of Ca, F, H, S, and O remains the same so, it is not a redox reaction.

58. Option (a) is correct.



Benzyl free radical is aromatic as per Huckel's rule it has 6π electrons present in *p*-orbital of carbon atoms involved in formation of benzene ring (Aromatic nature)



6-*p*-orbitals and 6 unpaired electrons

59. Option (c) is correct.

$XeOF_2$

$$x - 2 - 1 \times 2 = 0$$
$$x = +4$$

60. Option (b) is correct.

Let the solubility of AgCl be S mol L^{-1}

$$\underset{S}{AgCl} \rightarrow \underset{S}{Ag^+} + \underset{S + 0.1}{Cl^-}$$

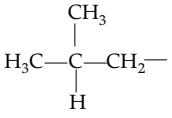
Concentration of Cl^- is (S + 0.1) mol L^{-1} because S mol L^{-1} from ionization of AgCl and 0.1 mol L^{-1} from ionization of 0.1 M NaCl.

Now, $K_{sp} = [Ag^+][Cl^-]$

$$1.6 \times 10^{-10} = S\,(S + 0.1)$$
$$1.6 \times 10^{-10} = S\,(0.1) \qquad \{\because S << 0.1\}$$
$$S = 1.6 \times 10^{-9}\ M$$

61. Option (a) is correct.

Iso means one, CH_3 group is present in the side chain (attached to 2nd carbon) and thus the structure of the isobutyl group is:



62. Option (b) is correct.

For every 10° rise in temperature the rate of reaction doubles. So, rate = 2^n

when, $n = 1$; rate $= 2^1 = 2$

when, temperature is increased from 10°C to 100°C, change in temperature = 100° – 10°

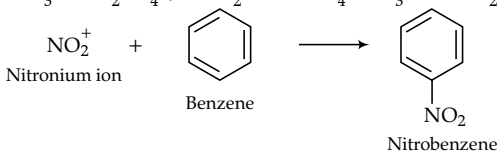
= 90°C

i.e., $n = 9$

So, rate = $2^9 = 512$ times

63. Option (d) is correct.

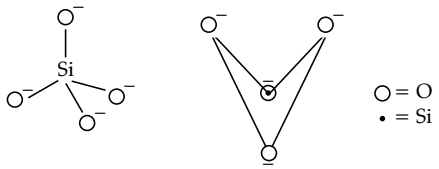
$HNO_3 + 2H_2SO_4 \rightleftharpoons NO_2^+ + 2HSO_4^- + H_3O + NO_2^+$



When $KHSO_4$ is added to this mixture then it dissociates to K^+ and HSO_4^- ions which increases HSO_4^- concentration in the mixture thus, equilibrium shifts to backward reaction, and hence the rate of nitration becomes slower.

64. Option (b) is correct.

The basic building unit of all silicates is the tetrahedral SiO_4^{4-}. It is represented as,



65. Option (c) is correct.

For a first-order reaction

$$k = \frac{2.303}{t}\log\frac{[R_0]}{[R]}$$

At $t_{1/2}$, $[R] = \frac{[R_0]}{2}$

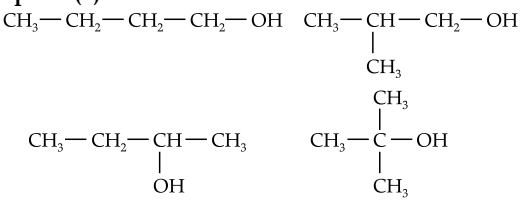
$$\therefore \quad k = \frac{2.303}{t_{1/2}}\log\frac{[R]}{[R_0]/2}$$

$$= \frac{2.303}{t_{1/2}} \times 0.3010$$

$$\Rightarrow \quad t_{1/2} = \frac{0.693}{k}$$

Hence, $t_{1/2}$ for first-order reaction is independent of initial concentration of a reactant.

66. Option (a) is correct.



67. Option (b) is correct.

Oxidation half reaction is

$$\underset{(1\ atm)}{H_2} \longrightarrow \underset{(At\ pH\ 10)}{2H^+ + 2e^-}$$

If pH = 10, $[H^+] = 10^{-10}$

From Nernst Equation

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2}\log\frac{[H^+]^2}{P_{H_2}}$$

For hydrogen electrode $E^\circ_{cell} = 0$

$$E_{cell} = -\frac{0.0591}{2}\log\frac{(10^{-10})^2}{1} = 0.0591 \log 10^{10}$$

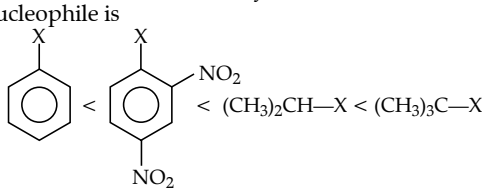
Ecell = 0.591 V

68. Option (d) is correct.
The addition of solute decreases the vapor pressure as some sites of the surface is occupied by solute particles resulting in decreased surface area. However, the addition of solvent, *i.e.*, dilution increases the surface area of the liquid surface, thus resulting in increased vapor pressure. Hence, the addition of water to the aqueous solution of (1 molal) KI results in increased vapor pressure.

69. Option (a) is correct.
$[Co(NH_3)_3Cl_3]$ does not ionize so does not give test for chloride ions.
While all other give test for chloride ions:
$[Co(NH_3)_6]Cl_3 \longrightarrow [Co(NH_3)_6]^{3+} + 3Cl^-$
$[Co(NH_3)_4Cl_2]Cl \longrightarrow [Co(NH_3)_4Cl_2]^+ + Cl^-$
$[Co(NH_3)_5Cl]Cl_2 \longrightarrow [Co(NH_3)_5Cl]^{2+} + 2Cl^-$

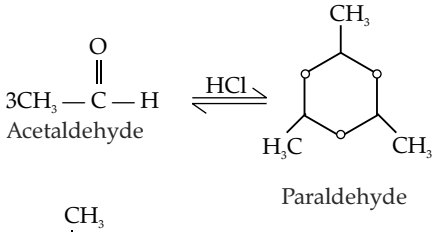
70. Option (b) is correct.
The reaction of carbonyl compounds with ammonia derivatives give an addition product followed by the elimination reaction (elimination of water). Slightly acidic medium generate a nucleophilic center for the attack of weak base like ammonia derivatives.

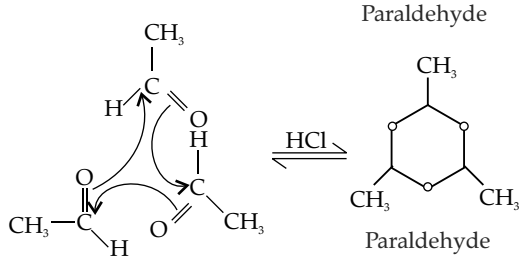
71. Option (a) is correct.
Among the given halides aryl halides (C_6H_5X) is least reactive towards nucleophile as in the C—X bond acquire some double bond character due to resonance.
→ NO_2 show –I effect hence facilitates the nucleophilic attack, 3° halides are more reactive due to the formation a more stable carbocation.
Thus the order of reactivity of the C—X bond towards nucleophile is



72. Option (a) is correct.
Biphenyl is coplanar as all carbon atoms are sp^2 hybridized.

73. Option (a) is correct.
Paraldehyde is a polymer of acetaldehyde





74. Option (a) is correct.
SnO_2 reacts with acid as well as the base.
So, SnO_2 is an amphoteric compound.

$$SnO_2 + 4HCl \longrightarrow SnCl_2 + 2H_2O$$

$$SnO_2 + 2NaOH \longrightarrow Na_2SnO_3 + H_2O$$

CaO is basic in nature while SiO_2 and CO_2 are acidic in nature.

75. Option (c) is correct.
As $\Delta H < 0$ *i.e.*, the given reaction is exothermic. According to the Le-Chatelier principle, for an exothermic reaction, a forward reaction is favored when the temperature becomes low. Also, there are 5 gaseous moles on the reactant side and 2 gaseous moles on the products side. So, the forward reaction is favored when the pressure of the reaction mixture becomes high. The reason is that at high pressure, the reaction tends to move in a direction where is are a lesser number of gaseous moles.

76. Option (c) is correct.

$$HX \rightleftharpoons H^+ + X^-$$

Initially	1	0	0
At equilibrium	$1-\alpha$	α	α

Total moles $= 1 - \alpha + \alpha + \alpha = 1 + \alpha$

$$i = \frac{1+\alpha}{1}$$

as $\alpha = 20\% = 0.2$
Thus, $i = 1 + \alpha = 1 + 0.2 = 1.2$
$\Delta T_f = ik_f m = 1.2 \times 1.86 \times 0.5 = 1.12$ K

77. Option (a) is correct.

$$\Delta G^\circ = -nFE^\circ$$

For reaction, $Cu^{2+} + 2e^- \longrightarrow Cu$
$\Delta G^\circ = -2 \times F \times 0.337$ …**(i)**
For reaction,

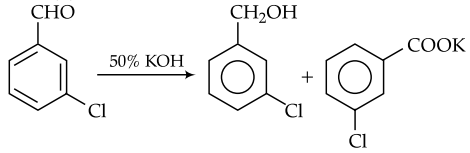
$$Cu^+ \longrightarrow Cu^{2+} + e^-$$
$$\Delta G^\circ = +1 \times F \times 0.153 \quad \text{…(ii)}$$

Adding eq. **(i)** and (ii) we get

$$Cu^+ + e^- \longrightarrow Cu,\ \Delta G^\circ = -0.521\ F$$

$\Delta G^\circ = -nFE^\circ = -0.521$
$\therefore \quad E^\circ = 0.52$ V

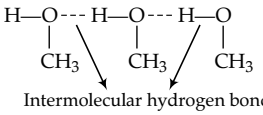
78. Option (c) is correct.



This reaction is called Cannizzaro's reaction.

79. Option (d) is correct.
The correct bond dissociation energy order of halogen molecules is $Cl_2 > Br_2 > F_2 > I_2$. The exceptionally low value of fluorine molecule is due to the small size of fluorine and hence there is large electronic repulsion that takes place which leads to lower bond dissociation energy.

80. Option (a) is correct.
CH_3OH forms intermolecular hydrogen bonding is shown as follows:



Intermolecular hydrogen bonding

This hydrogen bonding must be overcome to convert liquid CH_3OH to a gas.

81. Option (d) is correct.
From E° values of M^{2+}/M, we have

E°/V	Cr	Mn	Fe	Co
M_{2+}/M	–0.90	–1.18	–0.44	–0.28

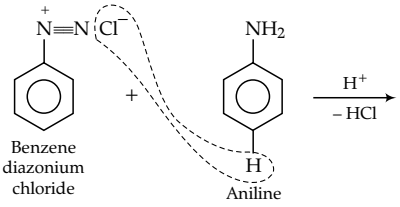
E° value for Mn is more negative than expected from general trend due to extra stability of half-filled Mn^{2+} ion.
Thus, the correct order should be

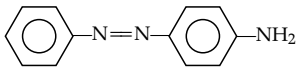
$$Mn > Cr > Fe > Co$$

But an examination of E° values for redox couple M^{3+}/M^{2+} shows that Cr^{+2} is strong reducing agent ($E^\circ_{M^{3+}/M^{2+}} = 0.41$ V) and liberates H_2 from dilute acids.
$2Cr^{+2}(aq) + 2H^+(aq) \longrightarrow 2Cr^{3+}(aq) + H_2 \uparrow (g)$
Thus, correct order is Mn > Fe > Cr > Co.

82. Option (a) is correct.
Sucrose does not show mutarotation.
Only those sugars which have a free aldehyde (—CHO) or ketone $\left(\rangle C=O\right)$ group are capable of showing mutarotation.

83. Option (d) is correct.



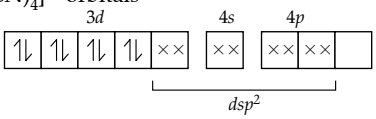


[A]
(Yellow dye)
(*p*-azo benzene compound)

84. Option (a) is correct.
For the absorption of visible light, the presence of unpaired *d*-electrons are a necessity.
In $[Ni(CN)_4]^{2-}$

$$Ni^{+2} = [Ar]\ 3d^8\ 4s^0$$

$\therefore$ $[Ni(CN)_4]^{2-}$ orbitals

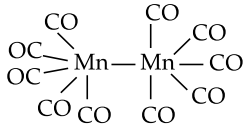


Pairing occurs because CN^- is a strong field ligand. Thus, $[Ni(CN)_4]^{2-}$ does not contain an unpaired electron it does not absorb visible light.
All other complexes in the option contain unpaired electrons thus absorbing visible light.

85. Option (d) is correct.
The standard reduction potential of halogens are positive and decrease from fluorine to iodine.
So, F_2 is the strongest oxidizing agent.

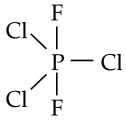
Section B

86. Option (d) is correct.
The atomic number of manganese is 25. Carbonyl is a neutral ligand so, oxidation number of manganese is zero.
EAN = No. of electrons of metal + M - L bond or co-ordination number + Electrons shared by two atoms of metal.
EAN = 25 + 1 + 10 = 36.



87. Option (d) is correct.
- In H_3PO_4, all H are bonded with O
- SO_2 and CO_2 both are acidic oxide

88. Option (d) is correct.



- $\mu = 0$ hence non polar

89. Option (a) is correct.
The Conjugate acid of water is H_3O^+.

90. Option (d) is correct.
We know that $\Delta H = \Delta U + \Delta n_g RT$
For a given reaction $\Delta n_g = n_P - n_R = 0 - 3 = -3$
$\therefore$ $\Delta H = \Delta U + (-3)RT$
$\Delta H = \Delta U - 3RT$

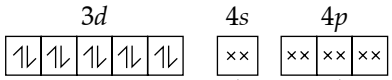
91. Option (c) is correct.
p-nitrophenol has more boiling point than *o*-nitrophenol due to the presence of intramolecular H-bonding in it which makes it slow volatile also.
Thus option **(c)** is an incorrect statement.

92. Option (b) is correct.
The electron gain enthalpy of N is almost zero but of P is –74.3 kJ mol^{-1}. This is because N has a small size as compared to P. It requires extra energy to add an electron as it is an endothermic process.

93. Option (a) is correct.
1 g-atom N = (1/2) mole N_2 =14 g N

94. Option (b) is correct.
(a)-(iii), (b)-(iv), **(c)-(i), (d)**-(ii)

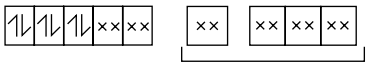
$[Ni(CO)_4]$



sp^3

It has sp^3 hybridization, thus it has a tetrahedral geometry with a dipole moment of 0 B.M.

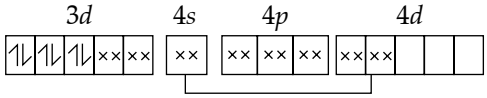
$[Co(NH)_3]^{3+}$



d^2sp^3

It has d^2sp^3 hybridization, thus will have octahedral geometry and is low spin complex a dipole moment of 0 BM.

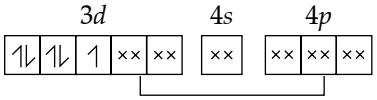
$[CoF_6]^{3-}$



sp^3d^2

It has sp^3d^2 hybridization, octahedral geometry and is a high spin complex with 4.9 BM.

$[Mn(CN)_6]^{4-}$



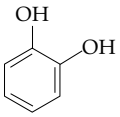
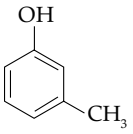
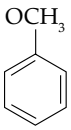
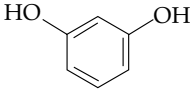
d^2sp^3

It has d^2sp^3 hybridization, octahedral geometry, low spin complex with 1.73 BM.

95. Option (a) is correct.
Phenol is more acidic than 4-methyl phenol because of stabilization of phenoxide ion through resonance. Presence of electron-withdrawing group increases the acidity of phenol whereas the electron-donating group decreases its acidity.

96. Option (d) is correct.
Among the given options OSF_2 has a pyramidal shape. It has one S=O bond and two S—F single bonds and one lone pair of electrons.

97. Option (a) is correct.

List I		List II	
(a)	Catechol	(iii)	
(b)	Cresol	(i)	
(c)	Anisole	(ii)	
(d)	Resorcinol	(iv)	

98. Option (c) is correct.

$[Co(NH_3)_3Cl_3]$ is of type MA_3B_3 which shows facial and meridional isomers.

99. Option (b) is correct.

At constant volume, $w = 0$ $[w = -P\Delta V]$

Also, $\Delta U = q + w$ $\Delta U = q = 10$ kJ

100. Option (b) is correct.

$$\Delta S^\circ = \Sigma S^\circ_P = \Sigma S^\circ_R$$
$$= 2 \times 192.3 - [191.5 + (3 \times 130.6)]$$
$$= 384.6 - 583.3 = -198.7 \text{ J/K/mol}$$

BOTANY

Section A

101. Option (c) is correct.

Cell walls of fungi are made up of chitin and polysaccharides.

102. Option (a) is correct.

Dihybrid Cross

	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

RrYy rrYy Rryy rryy

4 : 2 : 2 : 1

103. Option (c) is correct.

Starch synthesis during the daytime is coordinated with sucrose synthesis in the cytosol. Starch is a chemically non-reactive and osmotically inactive polysaccharide of much greater molecular weight.

104. Option (b) is correct.

Elongation region have meristematic cells which undergoes continuous cell division and responsible for growth of root because of enlargement of cells numbers.

105. Option (d) is correct.

In sub-metacentric chromosomes, the centromere is situated a little above the center. In the metacentric, the centromere is positioned in the center, and in a telocentric, the centromere is positioned terminally.

106. Option (d) is correct.

Palmitic acid is a saturated fatty acid that contains 16 carbon atoms including carboxyl carbon. Oleic acid is an 18 C unsaturated fatty acid.

107. Option (a) is correct.

G2–phase → 80 pg

Gametes → 20 pg (products of meiosis-II)

108. Option (d) is correct.

Isobrachial (metacentric) chromosome appears L – Shaped during anaphase.

109. Option (b) is correct.

Species is the basic and lowest category in taxonomic hierarchy.

110. Option (c) is correct.

Endosperm is triploid (3n) in most of the angiospermic plant as two polar nuclei fuse with a male gamete and three of them are haploid.

111. Option (a) is correct.

In glycolysis, glucose is phosphorylated to glucose - 6 - phosphate by using ATP in the presence of hexokinase.

112. Option (a) is correct.

When exposed to ultraviolet light, EtBr will show fluorescence with bright orange color, intensifying almost 20-fold after binding to DNA.

113. Option (b) is correct.

Prions cause mad cow disease. They form abnormal aggregates of proteins called amyloids, which accumulate in infected tissue and responsible for tissue damage and cell death.

114. Option (b) is correct.

There are three biodiversity hotspots in India.

115. Option (a) is correct.

AUG has dual functions, it codes for methionine and it also acts as an initiator codon.

116. Option (a) is correct.

Glycine is the simplest amino acid in which R is replaced by hydrogen. Cysteine and methionine are sulfur-containing amino acids.

117. Option (c) is correct.

Mycoplasma is inhibited by tetracycline but insensitive to penicillin.

118. Option (d) is correct.

Explanation: Many desert plants have a thick cuticle on their leaf surfaces and stomata in deep pits to minimize loss of water by transpiration. They also have a special photosynthetic pathway (CAM - Crassulacean acid metabolism). Some have their leaves reduced to spines and the photosynthetic function is taken over by the flattened stems. Thus option **(d)** is the answer.

119. Option (c) is correct.
The thylakoid space bounded by the thylakoid membrane is present only in the chloroplast.

120. Option (c) is correct.
NADPH reductase enzyme is located on grana lamella towards the stroma side. Break down of proton gradient releases energy.

121. Option (d) is correct.
Fungi are group of eukaryotic heteromorphic organisms with diverse forms, sizes, physiology and mode of reproduction. They exhibit more species diversity.

122. Option (d) is correct.
Polyamines.

123. Option (a) is correct.
Bacillus thuringiensis bacterium forms some protein crystals (*cry*) during a particular phase of their growth. These crystals contain a toxic insecticidal protein. This toxin does not kill the *Bacillus* because *Bt* toxin exists as inactive protoxins in them. But once an insect ingests *Bt* toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilises the crystals. The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause swelling and lysis leading to the death of an insect.

124. Option (c) is correct.
Competitive inhibition is a form of enzyme inhibition where binding of the inhibitor to the active site on the enzyme prevents binding of the substrate and vice versa. Malonate is a competitive inhibitor of the enzyme succinate dehydrogenase: malonate binds to the active site of the enzyme without reacting, and so competes with succinate, the usual substrate of the enzyme.

125. Option (c) is correct.
Ribosomes may occur singly a monosomes or in rosettes and helical groups called polysomes. The different ribosomes of a polysome are connected with a strand of *m*-RNA. Nucleosome is a basic unit of DNA packaging in eukaryotes. Plastidome are the plastids of a cell when they are referred to a functional unit. Polyhedral bodies are involved in carbon fixation are present in autotrophic bacteria.

126. Option (c) is correct.
In a majority of aquatic plants such as water hyacinth and water lily, the flowers emerge above the level of water and are pollinated by insects or wind as in most of the land plants.

127. Option (a) is correct.
Protonema is a haploid thin thread-like structure found in mosses. It represents the juvenile phase.

128. Option (d) is correct.
Each restriction endonuclease recognises a specific palindromic nucleotide sequences in the DNA. The sequences read the same on the two strands in 5′ – 3′ direction. This is also true if read in the 3′ – 5′ direction.

129. Option (b) is correct.
Nostoc is a cyanobacterial cell with a membrane bound organelles absent.

130. Option (d) is correct.
Fact.

131. Option (b) is correct.
Mannitol or laminarin is stored food in *Fucus*. On the other hand, food is stored in the form of fluoride starch in *Porphyra* and *Gracilaria and* as starch in *Chara*.

132. Option (b) is correct.
Dioecious plants bear unisexual flowers that promote only xenogamy.

133. Option (a) is correct.
Endonucleases or restriction enzymes cleave only at very specific nucleotide sequences within a polynucleotide chain.

134. Option (d) is correct.
Diatoms are unicellular algae, which have a glass-like wall made up of silicon dioxide embedded in the matrix. Their cell wall is a unique type and is known as frustule which is divided into epitheca and hypotheca.

135. Option (c) is correct.
The leaves in gymnosperms are well adapted to withstand extremes of temperature, humidity and wind. The needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata help to reduce water loss.

Section B

136. Option (c) is correct.
Explanation: Ecological diversity is the diversity at ecosystem level. India with its deserts, rainforests, mangroves, coral reefs, wetlands, estuaries and alpine meadows has a greater ecosystem diversity.

137. Option (b) is correct.
Explanation: During chemiosmosis, protons are channeled from outer chamber of mitochondria into inner chamber by F_0 part of oxysome (complex V) embeded in inner mitochondrial membrane.

138. Option (c) is correct.
Lenticels permit the exchange of gases between the outer atmosphere and the internal tissue of the stem.

139. Option (b) is correct.
Humus is a dark-colored amorphous substance.

140. Option (a) is correct.
Explanation: If a female individual is with small head, furrowed tongue, partially open mouth and broad palm with characteristic palm crease and also the physical psychomotor and mental development is retarded, the individual is suffering from Down's syndrome, an autosomal trisomy (chromosomal disorder).
The karyotype analysis of such an individual will show trisomy of chromosome number 21.

141. Option (c) is correct.
Explanation: In nondisjunction, the separation fails to occur causing both sister chromatids or homologous chromosomes to be pulled to one pole of the cell. In Down syndrome non-disjunction results in an embryo with three copies of chromosome 21 instead of the usual two.

142. Option (b) is correct.
Fact.

143. Option (c) is correct.
Insectivorous plants belong to first and third, both trophic levels of the ecosystem. They are partially heterotrophic and partially autotrophic.

144. Option (b) is correct.
Explanation: Substrate-level phosphorylation is the direct formation of ATP or GTP by transferring a phosphate group from a high energy compound to an ADP or GDP molecule. During the conversion of succinyl-CoA to succinic acid a molecule of GTP is synthesised during Krebs cycle. This is a substrate level phosphorylation.

145. Option (c) is correct.
Explanation: The variation due to space results in spatial pattern. There are two types of spatial patterns. viz. Stratification and Zonation.

146. Option (c) is correct.
Explanation: Crossing over and exchange of genetic material between homologous chromosomes occurs during pachytene stage of meiosis.
Crossing over is the exchange of genetic material between non-sister chromatids of the homologous chromosomes. It is an enzyme-mediated process and the enzyme involved is called recombinase.

147. Option (a) is correct.
Fact.

148. Option (a) is correct.
Out of the given statements, only statement B is correct. In Cycas, both sexes are present on different plants. It means these plants are considered as dioecious. Male plants bear male cone or strobilus and female plants bears megasporophylls.

149. Option (b) is correct.
The correct matching of options is as follows:

Organism	Number of nucleotides/ base pairs
Bacteriophage $\phi \times 174$	5386 nucleotides
Bacteriophage lambda	48502 bp
Escherichia coli	4.6×10^6 bp
Human DNA	3.3×10^9 bp (haploid content)

150. Option (d) is correct.
Explanation: If the seeds collected from hybrids are sown, the plants in the progeny will segregate and do not maintain hybrid characters. Production of hybrid seeds is costly and hence the cost of hybrid seeds become too expensive for the farmers
If hybrid seeds are made into apomicts, there is no segregation of characters in the hybrid progeny.
Then the farmers can keep on using the hybrid seeds to raise new crop year after year and he does not have to buy hybrid seeds every year.

ZOOLOGY

Section A

151. Option (b) is correct.
Lamprey and Hagfish are Cyclostomes which are jawless fishes.

152. Option (c) is correct.
Fact.

153. Option (b) is correct.
Explanation: Coelenterates are radially symmetrical.
Radial symmetry is found in the cnidarians such as Hydra and echinoderms such as Starfish.
Cockroach and earthworm; *Taenia and Ascaris*; Sepia and Pila exhibit bilateral symmetry.

154. Option (c) is correct.
Renin secreted by JGA regulates the glomerular filtration rate by inducing multihormonal system *i.e.*, RAAS (Renin Angiotensin-Aldosterone system). Activation of this system increases the reabsorption rate of sodium (Na^+) and water, making the urine more concentrated. Alcohol and Caffeine decreases vasopressin level which lowers reabsorption of water thus making urine more dilute. ANF causes vasodilation and acts as check on RAAS.

155. Option (c) is correct.
Pneumonia, cholera, and typhoid are bacterial diseases that can be cured using antibiotics. The common cold is caused by Rhinovirus and cannot be treated using antibiotics.

156. Option (d) is correct.
The terga, sterna, and pleura are chitinous plates that cover the cockroach body. The arthrodial membranes join these three.

157. Option (b) is correct.
After successful fertilization, the ruptured Graafian follicle gets converted into corpus luteum. It chiefly secrets progesterone.

158. Option (a) is correct.
Increase in Ca^{++} level leads to the binding of calcium with a subunit of troponin on actin filaments and thereby remove the masking of active sites for myosin.

159. Option (a) is correct.
Forceful expiration after forceful inspiration is defined as vital capacity

$$VC = TV + IRV + ERV$$
$$= [500 + 3000 + 1100]\ ml = 4600\ ml$$

160. Option (b) is correct.
A complete stoppage of heart function is called cardiac arrest. Inadequate blood supply to the body possibly due to a defect in the heart valve is called heart failure.

161. Option (b) is correct.
The body has a meshwork of cells internal cavities lined with food filtering flagellated cells and indirect development is the characteristic of the phylum Porifera.
Poriferans are commonly called sponges.
These are multicellular organisms which are sessile/ sedentary in nature.
Most of them are marine while a few are freshwater forms.
The body is cylindrical, asymmetrical, or has radial symmetry.

162. Option (a) is correct.
Amniocentesis is used to test for the presence of certain genetic disorders.

163. Option (d) is correct.
Due to mutation.

164. Option (b) is correct.
Thyroid hormones are iodothyronine.

165. Option (b) is correct.
The cornea is extremely sensitive to pain.

166. Option (c) is correct.
The eggs of the parasite are excreted along with the faeces of infected persons which contaminate soil, water, plants, etc. A healthy person acquires this infection through contaminated water, vegetables, fruits, etc.

167. Option (b) is correct.
Red muscles are skeletal muscles that are rich in capillaries, myoglobin, and mitochondria. Capillaries are very small blood vessels that deliver oxygenated blood to the muscles. This oxygen is taken up by a protein called myoglobin. The myoglobin then helps provide the oxygen to the mitochondria, the sort of power plant of the cell. They use oxygen, among other things, to produce a lot of energy.

168. Option (c) is correct.
Aldosterone regulates the homeostasis of sodium and potassium ions whereas the remaining hormones are involved in sugar metabolism.

169. Option (b) is correct.
Fact.

170. Option (b) is correct.
Periodic abstinence involves avoiding coitus 4 days before and 3 days after ovulation.

171. Option (b) is correct.
Mumps, measles, pneumonia (viral or bacterial or fungal), chickenpox, smallpox, dengue, chikungunya, and Hepatitis are viral diseases.

172. Option (c) is correct.
Both parents should be heterozygous for blood groups 'A' and 'B' to have a child with blood group 'O'.

$$[♂ \rightarrow I^{A}I^{0}, ♀ \rightarrow I^{B}I^{0}]$$

173. Option (d) is correct.
Pteropus is viviparous and *Ornithorhynchus* is oviparous. Garden lizard has three-chambered heart and crocodile has a four-chambered heart. *Ascaris* and *Ancylostoma* have pseudo segmentation. Sea horse and flying fish are cold-blooded or poikilothermic animals.

174. Option (a) is correct.
Oxytocin is called Birth Hormone as it causes the contraction of smooth muscles of the uterus leading to the birth of the child.

175. Option (d) is correct.
Parturition is triggered by oxytocin which initiates uterine contractions. Prostaglandins are produced in response to oxytocin which is effective in causing uterine contractions at times. Oestrogen, progesterone level marks the beginning of parturition. Prolactin hormone is responsible for milk secretion at the end of pregnancy.

176. Option (a) is correct.
Explanation: Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.
Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.

177. Option (b) is correct.
Maximum reabsorption of electrolytes and water occurs in PCT.

178. Option (b) is correct.
The Obturator foramen is the largest foramen of the skeleton but is closed by a fibrous membrane. It is formed by ischium and pubis.

179. Option (b) is correct.
After the production of ADH in the cell bodies of neurosecretory cells in the hypothalamus, it is transported axonally to neurohypophysis (posterior pituitary) where they are stored and released.

180. Option (b) is correct.
Explanation: Thromboplastin, helps in the formation of enzyme prothrombinase. This enzyme inactivates heparin and it also converts inactive prothrombin into its active thrombin.
Thromboplastin → Prothrombinase → Prothrombin → Thrombin

181. Option (b) is correct.
Explanation: Chargaff's law = A + G = T + C
Also, the number of adenine is equal to thymine while the number of guanine is equal to cytosine.
From Chargaff's law mentioned above: A and T has 40 nucleotides and G and C has 75 nucleotides. Thus, the total nucleotides = 75 + 40 = 115
Now these many nucleotides are on one strand. Therefore, on both the strands it will be 115 × 2 = 230 nucleotides.

182. Option (b) is correct.
The olfactory epithelium is specialized in the nose involved in smell.

183. Option (d) is correct.
In 1958, Francis Crick proposed the hypothesis of the central dogma. He proposed that genetic information flows from DNA $\xrightarrow{\text{Transcription}}$ RNA $\xrightarrow{\text{Translation}}$ Protein

184. Option (a) is correct.
NaCl is returned to the interstitium by the ascending portion of vasa recta. Similarly, small amount of urea enter the thin segment of the ascending limb of Henle's loop which is transported back to the interstitium by the collecting tubule. This transport of substances facilitated by the special arrangement of Henle's loop and vasa recta is called the counter current mechanism. This mechanism helps to maintain a concentration gradient in the medullary interstitium.

185. Option (c) is correct.
Aldosterone is mineralocorticoid hormone which is essential for sodium conservation in kidney.

Section B

186. Option (b) is correct.
Industrial melanism is the evolutionary consequence, here the population of animals living in that particular industrial region where the environment is soot-darkened causing the variation in animals by darkening of body tissues by excessive production of melanin. The melanization caused for these kind of organism result of industrialization increases and they are expected that its member will survive and reproduce. This process takes place over time and causing generations as a result of natural selection of lighter more distinct animals by predators.

187. Option (a) is correct.
Fructose is absorbed by facilitated transport and Na^+ by active transport. Absorption of Glycerol and fatty acids does not occur in the duodenum. Absorption of Cholesterol and Maltose does not occur in the large intestine. Glycine (amino acid) and glucose are actively absorbed in small intestine.

188. Option (c) is correct.
During cellular respiration, the Electron Transport Chain (ETC) is the stage where the majority of ATP (adenosine triphosphate) is produced in eukaryotic cells. The Electron Transport Chain is located in the inner mitochondrial membrane and is the final stage of aerobic respiration.

189. Option (d) is correct.
Earthworm, leech, and tapeworm are hermaphrodites/ bisexual animals.

190. Option (b) is correct.
E. coli takes 20 minutes to divide. So, after 60 minutes, there will be three generations.
At time = 0, there is only 1 light strand.
After 20 minutes, the first generation will be formed. It will have all the hybrid strands which means all the new DNA will be intermediate.
After 40 minutes, we will have a second generation. In this half of the DNA will be hybrid strand and the other half will be light strand. 50% of the DNA is ^{14}N labeled and 50% of the DNA is ^{15}N labeled.
After 60 minutes, we will have a third-generation having 75% of the DNA as ^{15}N labeled and 25% of the DNA as ^{14}N labeled. The exact number of DNA molecules that contain the ^{14}N after three replications will be 2.

191. Option (b) is correct.
Fact.

192. Option (b) is correct.
Spermatogonia are diploid germ cells of seminiferous tubules that undergo mitosis to form the primary spermatocytes. The spermatid, second polar body and secondary oocyte are haploid.

193. Option (c) is correct.
The chromosomal theory of sex determination was given by two scientists, namely Nettie Stevens and Edmund Beecher Wilson, independently in the same year. They named X and Y chromosomes sex chromosomes or

allosomes and other chromosomes which have no relation with the sex and contain genes are named autosomes. They also discovered that males have XY and females have XX sex chromosomes.

194. Option (b) is correct.

Cistron is a segment of DNA that codes for a specific polypeptide for the synthesis of RNA or protein. Cistron is an alternative term for a gene.

195. Option (b) is correct.

Industrial melanism observed in moth, *Biston bitularia* show directional selection as there is an increase in darker forms of the peppered moth (*Biston betularia*) that occurred in industrial areas. In directional selection, the population changes towards one particular direction.

196. Option (c) is correct.

According to one of the observations of the 'Theory of Natural selection', members of a population vary extensively in their characteristics, i.e., no two members of a population are exactly alike even though they look superficially similar.

197. Option (a) is correct.

Polyploidy occurs when there is failure of cytokinesis after telophase stage of cell division resulting in an increase in a whole set of chromosomes in an organism.

Other statements can be corrected as -

Autopolyploidy is the containment of multiple chromosome sets derived from same species.

Allopolyploidy is the containment of multiple chromosome sets derived from different species.

Aneuploidy is the presence of abnormal number of chromosomes in a cell.

198. Option (a) is correct.

Frederick Griffith observed that when the bacteria *Streptococcus pneumonia* were grown on a culture plate, some of them produce S-type virulent colonies, while others form R-type colonies that are non-virulent. Thus, when the mice were infected with the R-strain they did not develop pneumonia and they lived.

R-strain bacteria (non-virulent) $\rightarrow$ Injected into mice $\rightarrow$ Mice lived.

199. Option (c) is correct.

Louis Pasteur 1860 rejected the theory of spontaneous generation which states that life originated from non-living matter automatically. But Pasteur disproved this theory and demonstrated that life came from pre-existing life.

200. Option (d) is correct.

Out of the given insects, only three, i.e., ants, honeybees and wasps shows haploid-diploid method of sex-determination. In these insects, males are haploid which develop from unfertilized eggs of females. Whereas, females are diploid which develop from fertilized eggs. Therefore, in them sex-determination is referred as haploid-diploid and it is usually observed in Hymenopteran species.

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