10/04/2026

Code-B Phase-1

Aakash
Medical | IIT-JEE | Foundations

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MM : 720 Final Test Series(P1)_NEET2026_Test-08B **Time : 180 Min.**

PHYSICS

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CHEMISTRY

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ZOOLOGY

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177. (1)
178. (1)
179. (2)

157. (4)

158. (1)

180. (3)

Hints and Solutions

PHYSICS

(1) **Answer :** (1)
Solution:
$P = \frac{h}{\lambda}$
$P = \frac{6.6\times10^{-34}}{6000\times10^{-10}}$
$P = \frac{6.6}{6} \times 10^{-27}$
$P = 1.1 \times 10^{-27}$ kg m/s.

(2) **Answer :** (1)
Solution:
Second excited state means $n = 3$.
Therefore, energy needed to ionize = $\frac{13.6}{3^2}$eV
= 1.51 eV

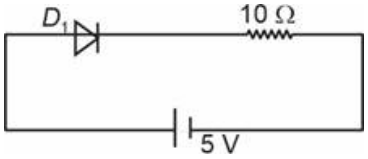
(3) **Answer :** (4)
Hint:
Energy of infrared radiation is less than the visible radiation.
Solution:
In transition $n = 6$ to $n = 4$, radiation energy will be less than the transition from $n = 5$ to $n = 3$.

(4) **Answer :** (2)
Hint:
de Broglie wavelength
$\lambda = \frac{h}{p}$
Solution:
$\lambda_p = 3\lambda$ and $\lambda_\alpha = \lambda$

$\frac{\lambda_p}{\lambda_\alpha} = \frac{\frac{h}{mv_p}}{\frac{h}{4mv_\alpha}} \Rightarrow \frac{\lambda_p}{\lambda_\alpha} = \frac{v_\alpha}{v_p} \times 4$

$\frac{3\lambda}{4\lambda} = \frac{v_\alpha}{v_p} \Rightarrow \frac{v_p}{v_\alpha} = \frac{4}{3}$

(5) **Answer :** (1)
Solution:
D_1 is in forward bias and D_2 is in reverse bias.



$I = \frac{5}{10} = 0.5$ A

(6) **Answer :** (2)
Solution:
${}_0n^1 \rightarrow {}_1p^1 + {}_{-1}e^0 + \bar{\nu}$
Neutron changes to proton along with two particles which come out of nucleus.

(7) **Answer :** (2)
Solution:
Searle's apparatus is used for the measurement of Young's modulus.

(8) **Answer :** (3)
Hint:
First resonating length $l_1 = \frac{\lambda}{4} + e$
and second resonating length $l_2 = \frac{3\lambda}{4} + e$

Solution:

$l_2 - l_1 = \left(\frac{3\lambda}{4} + e\right) - \left(\frac{\lambda}{4} + e\right)$

$l_2 - l_1 = \frac{\lambda}{2}$

$\Rightarrow \lambda = 2(l_2 - l_1)$

$= 2(47 - 15)$

$= 2 \times 32$

$= 64$ cm

(9) **Answer :** (4)
Solution:
Adding fifteen group element to germanium makes it an *n* type semiconductor. $n_e >> n_h$

(10) **Answer :** (3)
Hint:

Refractive index of the prism, $\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

Solution:

$\mu = \frac{\sin\left(\frac{60^\circ}{2} + \frac{\delta_m}{2}\right)}{\sin\left(\frac{60^\circ}{2}\right)} = \frac{\sin\left(30^\circ + \frac{\delta_m}{2}\right)}{\frac{1}{2}}$

$= 2\sin\left(30^\circ + \frac{\delta_m}{2}\right)$

(11) **Answer :** (3)
Solution:
A good diode offers low resistance in forward bias while high resistance in reverse bias.

(12) **Answer :** (2)
Solution:
Photo-diode in reverse bias is used to detect intensity of light.

(13) **Answer :** (2)
Solution:
When p-side of diode is connected to higher potential, then diode is in forward biasing.

(14) **Answer :** (2)
Solution:
'*A*' has more $\frac{BE}{A}$ than *B*.

(15) **Answer :** (3)
Solution:
Statement based on Thomson's and Rutherford's models.

(16) **Answer :** (3)
Solution:
$\nu_{output} = 2\nu_{input}$ for full wave rectifier

(17) **Answer :** (2)
Hint:

$R = R_0 A^{\frac{1}{3}}$
Solution:

$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{\frac{1}{3}}$

$\frac{R}{R_2} = \left(\frac{2}{16}\right)^{\frac{1}{3}}$

$\frac{R}{R_2} = \frac{1}{2}$

$R_2 = 2R$

(18) **Answer :** (2)
Solution:
The nuclear density is independent of mass number.

(19) **Answer :** (4)
Solution:
$N = \frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$

(20) **Answer :** (1)
Hint:
$\text{Least count} = \frac{\text{Pitch}}{\text{Number of divisions on circular scale}}$
Solution:
$\text{Pitch} = \frac{2 \text{ mm}}{2 \text{rotations}} = 1 \text{ mm}$
$\text{L.C} = \frac{1\text{mm}}{100} = 0.01 \text{ mm}$
= 0.001 cm

(21) **Answer :** (1)
Solution:
$A = A_0 e^{\frac{-bt}{2m}}$
$A^2 = A_0^2 e^{\frac{-bt}{m}}$

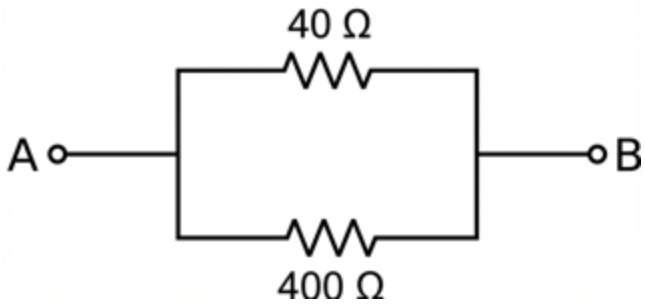
(22) **Answer :** (1)
Hint:
Use, $eV_0 = h\nu - \phi_0$
Solution:
$V_0 = \frac{h}{e}\nu - \frac{\varphi_0}{e}$
$\therefore$ slope $m = \frac{h}{e}$

(23) **Answer :** (2)
Hint:
For point source, intensity $\propto \frac{1}{r^2}$
Solution:
Since saturation photocurrent $\propto$ Intensity $\propto \frac{1}{(distance)^2}$
Hence curve *B* may represent the best relation between saturation photocurrent and distance.

(24) **Answer :** (1)
Solution:
The 4 bonding electrons of C, Si and Ge lie, respectively, in second, third and fourth orbit. Hence $(E_g)_c > (E_g)_{si} > (E_g)_{Ge}$

(25) **Answer :** (4)
Solution:
$n_h n_e = n_i^2$
$n_h = \frac{n_i^2}{n_e}$
$= \frac{3\times10^{13}\times3\times10^{13}}{5\times10^{17}}$
$= \frac{9}{5} \times 10^9$
$= 1.8 \times 10^9 \text{ cm}^{-3}$
$= 1.8 \times 10^{15} m^{-3}$

(26) **Answer :** (2)
Solution:
When *A* is at higher potential, then D_1 is in forward bias and D_2 is in reverse bias. Therefore, the circuit can be redrawn as



$R_{AB} = \frac{400\times 40}{400+40}$

= $\frac{400\times 40}{440}$

$= \frac{400}{11}\Omega$

(27) Answer : (4)
Solution:
Correct Boolean expression as,
$\bar{0}\ .\ \bar{0} = 1$

(28) Answer : (3)
Solution:
Energy released, $\Delta \mathrm{E} = (\mathrm{B.E.})_{\text{product}} - (\mathrm{BE})_{\text{reactant}}$
$= (100\times 7.2 + 120\times 8) - 220\times 6$
$= 720 + 960 - 1320$
$= 1680 - 1320$
$= 360\ \mathrm{MeV}$

(29) Answer : (2)
Solution:
In nuclear decays reaction, momentum is conserve.
$\therefore\ \left(\vec{P}_i\right)_{\text{system}} = \left(\vec{P}_f\right)_{\text{system}}$
$0 = \vec{P}_1 + \vec{P}_2$
$\Rightarrow\ \left|\vec{P}_1\right| = \left|\vec{P}_2\right|$
$m_1v_1 = m_2v_2$
$\frac{m_2}{m_1} = \frac{v_1}{v_2} = \frac{27}{64}$
$\because\ m = V\rho = \frac{4}{3}\pi R^3\rho$
$\therefore\ \frac{m_2}{m_1} = \left(\frac{R_2}{R_1}\right)^3 = \frac{v_1}{v_2} = \frac{27}{64}$
$\frac{R_2}{R_1} = \frac{3}{4}$

(30) Answer : (3)
Solution:
$\phi = \frac{hc}{\lambda_{th}}$
$\because\ \phi_x < \phi_y < \phi_z$
$\therefore\ \lambda_x > \lambda_y > \lambda_z$

(31) Answer : (1)
Solution:
$L = \frac{nh}{2\pi}$
On comparing, we get $n = 2$
$T.E. = \frac{-13.6}{4} = -3.4\ \mathrm{eV}$
$K.E. = |T.E.| = 3.4\ \mathrm{eV}$

(32) Answer : (4)
Solution:
β^+ decay → ${}_1P^1 \to {}_0n^1 + e^{+1} + \nu \Rightarrow \frac{N}{Z}$ ratio increases
β^- decay → ${}_0n^1 \to {}_1P^1 + e^{-1} + \bar{\nu} \Rightarrow \frac{N}{Z}$ ratio decreases
γ – decay → ${}^A_ZX^* \to {}^A_ZX + \gamma\text{–decay} \Rightarrow \frac{N}{Z}$ ratio remains same
α – decay → ${}_{92}U^{235} \to Th^{231}_{90} + He^4_2 \Rightarrow \frac{N}{Z}$ ratio increases

(33) Answer : (3)
Solution:
$R = \frac{\Delta V}{\Delta I}$

$= \frac{2}{0.5\times10^{-6}} = 4\times10^{6}\ \Omega$

(34) Answer : (1)
Solution:
For hydrogen atom use,

$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

For shortest wavelength of lymen series, $n_1 = 1$ and $n_2 = \infty$

$\frac{1}{\lambda_1} = R\left(1 - \frac{1}{\infty}\right) = R$ ...(1)

For longest wavelength of Balmer series, $n_1 = 2$ and $n_2 = 3$

$\frac{1}{\lambda_2} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = R\left[\frac{1}{4} - \frac{1}{9}\right] = \frac{5R}{36}$ ....(2)

Divide equation (1) by equation (2)

$\frac{\lambda_2}{\lambda_1} = \frac{R(36)}{5R} = \frac{36}{5}$

$\frac{\lambda_1}{\lambda_2} = \frac{5}{36}$

(35) Answer : (1)
Solution:
Assume no diode is connected,

$i = \frac{10}{10} = 1\ \text{mA}$

$V_{3\ k\Omega} = 3\text{V}$ and $\text{V}_{7\ k\Omega} = 7\ \text{V}$

Since $\text{V}_{3\ \text{k}\Omega} < \text{V}_{\text{z}}$

$\therefore$ Zener diode will act as normal reverse bias diode.

$\therefore i_z = 0$

(36) Answer : (2)
Solution:

$F = -\frac{dU}{dr}$

$F = -\frac{3}{2}kr^2$

$\Rightarrow \frac{mv^2}{r} = \frac{3}{2}kr^2$

$\Rightarrow v \propto r^{3/2} - (i)$

and $mvr = \frac{nh}{2\pi} - (ii)$

On solving, we get

$r^{5/2} \propto n \Rightarrow r \propto n^{2/5}$

and $v \propto r^{3/2}$

$v^2 \propto r^3 \propto n^{6/5}$

(37) Answer : (3)
Solution:
According to de-Broglie,

$2\pi r_1 = n\lambda$

$\Rightarrow r_1 = \frac{\lambda_0}{2\pi}$ [n = 1, for ground state]

In 4$^{\text{th}}$ exited state, $n = 5$

$r \propto n^2$

$r_5 = 25r_1$

$r_5 = 25 \times \frac{\lambda_0}{2\pi}$

$= \frac{25\lambda_0}{2\pi}$

(38) Answer : (3)
Solution:
Rutherford conclude that almost all the space of atom is empty & almost all the majority of its mass is concentrate at centre called nucleus.

(39) Answer : (2)
Solution:

$v = f\lambda$

$\Rightarrow \lambda = \frac{320}{640} = 50\,\text{cm}$

Let maximum length of air column at which resonance is possible is *l*.

$\therefore\ l = \frac{\lambda}{4} + \frac{n\lambda}{2}$

$l = \frac{50}{4} + n \times 25$

$\therefore l_{\max}$ is for $n = 4$

$l_{\max} = 112.5\,\text{cm}$

$\therefore$minimum height of water required for resonance $= L - l_{\max}$

$= 120 - 112.5$

$= 7.5\,\text{cm}$

(40) Answer : (3)

Solution:

In photoelectric effect experiment, stopping potential and maximum kinetic energy of ejected photoelectrons is independent of intensity.

work function is a property of material.

(41) Answer : (2)

Solution:

$E_1 = \frac{hc}{\lambda_1} = \frac{12400}{2480} = 5\,\text{eV}$

$E_2 = \frac{hc}{\lambda_2} = \frac{12400}{3100} = 4\,\text{eV}$

Therefore, stopping potential for $1,\ V_1 = 5 - 2.5 = 2.5\ \text{V}$

Stopping potential for $2,\ V_2 = 4 - 2.5 = 1.5\ \text{V}$

$\frac{V_1}{V_2} = \frac{5\times2}{2\times3} = \frac{5}{3}$

(42) Answer : (4)

Solution:

By einstein's photoelectric equation,

$\frac{hc}{\lambda} = 7eV_0 + \phi$ ...(1)

$\frac{hc}{3\lambda} = 2eV_0 + \phi$ ...(2)

On solving equation (1) and (2)

$\frac{2}{3}\frac{hc}{\lambda} = 5eV_0 \Rightarrow eV_0 = \frac{2}{15}\frac{hc}{\lambda}$

⇒ By equation (1),

$\frac{hc}{\lambda} = 7 \times \left(\frac{2}{15}\frac{hc}{\lambda}\right) + \phi$

$\Rightarrow \phi = \frac{hc}{\lambda}\left(\frac{1-14}{15}\right) = \frac{hc}{15\lambda}$

(43) Answer : (1)

Solution:

Light emitted during the de-excitation of electrons from $n = 3$ to $n = 2$ is lower as compared to $n = 4$ to $n = 2$. Therefore photoelectric effect is not possible for this transition.

(44) Answer : (3)

Solution:

$n_0^1 + X^A \rightarrow Y^{A+1} + photon(1) + photon(2)$

Let B.E per nucleon for $Y$is x

$\Rightarrow (A+1)\,x - 7A = 1$

$\Rightarrow\ x = \frac{1+7A}{A+1}$

(45) Answer : (3)

Solution:

Apply charge and mass number conservation,

${}_0^1\delta \rightarrow$dentoes neutron.

CHEMISTRY

(46) Answer : (1)

Solution:

$Molality = \frac{n}{W_{(kg)}} = \frac{6.022\times10^{22}\times1000}{6.022\times10^{23}\times500}$

= 0.2 m

(47) Answer : (3)

Solution:

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

2 mmol of of $HCl = 1\,mmol$ of $CaCO_3$

10 mmol of $HCl = \frac{1}{2}\times10 \Rightarrow 5\,mmol$ of $CaCO_3$

Weight of $CaCO_3 = \frac{5}{1000}\times100 = 0.5$ g of $CaCO_3$

$\frac{90}{100} = \frac{0.5}{x}$

$x = \frac{0.5\times100}{90}$

= 0.55 g

(48) Answer : (4)

Hint:

Total number of electrons = $\frac{\text{Weight of substance}}{\text{Molar mass of substance}}$ × N_A × Number of e^- in one molecule

Solution:

4 g CH_4 contains; $\frac{4}{16} = \frac{x}{10\times N_A}$

x = 2.5 N_A e^-

2 g SO_2 contains; $\frac{2}{64} = \frac{x}{32\,N_A}$

x = N_A e^-

4 g CO_2 contains; $\frac{4}{44} = \frac{x}{22\,N_A}$

x = 2 N_A e^-

8 g NO_2 contains; $\frac{8}{46} = \frac{x}{23\,N_A}$

x = 4 N_A e^-

(49) Answer : (3)

Hint:

Mole = $\frac{\text{Weight}}{\text{Molar mass}}$

Solution:

	% of element	Mole	Simplest ratio
C	37.5%	$\frac{37.5}{12} = 3.125$	1
H	12.5%	$\frac{12.5}{1} = 12.5$	4
O	50%	$\frac{50}{16} = 3.125$	1

The correct empirical formula is CH_4O

(50) Answer : (4)

Solution:

H_2 is limiting reactant

30 ml of H_2 will react with 15 ml of O_2

as $2H_2 + O_2 \rightarrow 2H_2O$

So V_{o_2} left unreacted = 20 – 15 = 5 ml

(51) Answer : (4)

Hint:

Zeroes at the end or right of a number are significant provided they are on the right of the decimal point.

Solution:

0.0052 has 2 significant figures

2300 has 2 significant figures

2.5 × 5.25 = 13.125

It can be written as 13

Counting numbers have infinite significant figures
2.008 has 4 significant figures
2.080 has 4 significant figures

(52) Answer : (3)
Solution:

$$\underset{1\text{ mole}}{CH_4} + \underset{}{2O_2} \rightarrow \underset{1\text{ mole}}{CO_2} + \underset{2\text{ moles}}{2H_2O}$$
$$\qquad\qquad\qquad\quad 44\text{ g} \qquad\quad 36\text{ g}$$

(53) Answer : (4)
Solution:
H_2S and H_2O are not the compounds of same elements. Hence law of multiple proportions is not applicable here.

(54) Answer : (3)
Solution:
For 10^{-6}, prefix used is micro

(55) Answer : (1)
Solution:
mass of Fe = 100 × $\frac{0.33}{100}$ = 0.33 g
∴ moles of Fe = $\frac{0.33}{56}$ = 5.89 × 10^{-3} mole
∴ Number of atom of Fe = 5.89 × 10^{-3} × 6.022 × 10^{23} = 0.035 × 10^{23} atoms

(56) Answer : (1)
Solution:

$$\text{Molality}\left(\text{m}\right) = \frac{\text{Number of moles of solute}}{\text{Weight of solvent}\left(\text{in kg}\right)}$$

(57) Answer : (1)
Hint:
The SI system allows the use of prefixes to indicate the multiplies or submultiples of a unit.
Solution:
SI unit of amount of substance is mole

(58) Answer : (1)
Hint:
Average atomic mass =

$$\frac{(\text{Isotope 1} \times \text{its abundante ratio}) + \text{Isotope 2} \times \text{its abundante ratio}}{\text{Sum of proportions of abundance}}$$

Solution:
Average atomic mass

$$= \frac{(20\times5)+(21\times2)+(22\times1)}{5+2+1}$$

$$= \frac{100+42+22}{8} = \frac{164}{8} = 20.5\text{ u}$$

(59) Answer : (2)
Hint:

$$\text{density} = \frac{\text{Mass of solution}}{\text{Volume of solution}}$$

Solution:
Mass of 1 L of solution = 1.2 g
In 49% (w/w) aqueous H_2SO_4
Mass of solution = 100 g
Mass of solute = 49 g
Mass of solvent = 51 g
Volume of solution = $\frac{100}{1.2}$

$$\text{Molality} = \frac{49/98}{51/1000} \approx 9.8\text{ m}$$

$$\text{Molarity} = \frac{{}^{49}/_{98}}{100/1.2} \times 1000 = 6\text{ m}$$

Mole fraction of solute = $\frac{0.5}{0.5+2.83} \approx 0.15$

Ratio of moles of solute to moles of solvent = 0.5 : 2.83

(60) Answer : (4)

Hint:

Number of mole(s) $= \frac{Number\ of\ molecules}{N_A}$

Solution:

Mole of sugar $= \frac{3.01\times10^{23}}{6.02\times10^{23}} = 0.5$

Mole fraction of sugar $= \frac{0.5}{0.5+24.5} = 0.02$

(61) Answer : (1)

Solution:

Atomic Number	IUPAC official Name
102	Nobelium
104	Rutherfordium
106	Seaborgium
108	Hassium

(62) Answer : (2)

Hint:

On moving left to right in a period, ionisation enthalpy generally increases.

Solution:

• Be has more ionisation enthalpy than B due to more penetrating effect.

• N has more ionisation enthalpy than O due to half filled stable configuration.

(63) Answer : (4)

Solution:

Na^+, Mg^{2+} and Al^{3+} all are positive isoelectronic species. So, greater is the charge, smaller will be the size.

(64) Answer : (1)

Solution:

Ca : (Z = 20) ⇒ 2, 8, 8, 2; It belongs to 2nd group of periodic table.

(65) Answer : (2)

Hint:

Group 15 elements belongs to *p*-block

Solution:

The outer electronic configuration of group 15 elements is ns^2np^3.

(66) Answer : (3)

Hint:

Electronic configuration of element having atomic number 50 is [Kr] $4d^{10}5s^25p^2$

Solution:

Valence shell is five hence it belongs to fifth period.

The group number will be 10 + 2 + 2 = 14

(67) Answer : (1)

Solution:

2^{nd} ionization enthalpy is always greater than 1^{st} ionization enthalpy due to increase in effective nuclear charge.

(68) Answer : (4)

Solution:

The *d*-block has 10 columns, because a maximum of 10 electrons can occupy all the orbitals in a *d*-subshell.

(69) Answer : (3)

Solution:

$\Delta V = \frac{h}{4\pi\ \Delta x\, m}$

$= \frac{6.626\times10^{-34}}{4\times3.14\times0.2\times10^{-10}\times9.1\times10^{-31}}$

= 0.289 × 10^7 m/s

= 2.9 × 10^6 m/s

(70) **Answer :** (1)
Solution:

a.	4s	P = n – l –1 = 4 – 0 – 1 = 3	Q = l =0
b.	3d	P = 3 – 2 – 1 = 0	Q = 2
c.	2p	P = 2 – 1 – 1 P = 0	Q = 1
d.	5f	P = 5 – 3 – 1 = 1	Q = 3

(71) **Answer :** (1)
Solution:
Number of neutrons $= A - Z$
$^{13}_{6}C$ number of neutrons $= 13 - 6 = 7$
$^{14}_{7}N$ number of neutrons $= 14 - 7 = 7$

(72) **Answer :** (4)
Solution:
$\mathrm{Ca}(Z = 20)\, 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
12 electrons would have $m_l = 0$

(73) **Answer :** (1)
Solution:
The work function of Na is $2.3\ \mathrm{eV}$ and that of Mg is $3.7\ \mathrm{eV}$.

(74) **Answer :** (4)
Solution:
Number of spectral lines $= \frac{\Delta n(\Delta n+1)}{2}$
a. $\Delta n = 4 \Rightarrow \frac{4\times5}{2} = 10$
b. $\Delta n = 1 \Rightarrow \frac{1\times2}{2} = 1$
c. $\Delta n = 2 \Rightarrow \frac{2\times3}{2} = 3$
d. $\Delta n = 5 \Rightarrow \frac{5\times6}{2} = 15$

(75) **Answer :** (2)
Solution:
$v = \frac{C}{\lambda}$
$v = \frac{3\times10^8}{500\times10^{-9}}$
$= \frac{3\times10^8}{5\times10^{-7}}$
$= 0.6 \times 10^{15}$
$= 6 \times 10^{14}\ \mathrm{Hz}$

(76) **Answer :** (4)
Solution:
Splitting of spectral lines in the presence of magnetic field is called Zeeman effect.

(77) **Answer :** (3)
Solution:
$\Delta \mathrm{E} \propto \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$, where $n_2 > n_1$, n = 6 to n = 5 will give least energetic photon.

(78) **Answer :** (4)
Solution:
$E = \frac{-13.6\times Z^2}{n^2}\mathrm{eV}/\mathrm{atom}$
$= \frac{-13.6\times9}{4}\mathrm{eV}/\mathrm{atom}$

$= -30.6\,\text{eV / atom}$

$r = \frac{52.9 \times n^2}{Z}\text{pm}$

$= 52.9 \times 4\ \text{pm} = 211.6\ \text{pm}$

longest wavelength transition is $n_1 = 1$ to $n_2 = 2$

$\tilde{\nu} = \text{R}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)\text{cm}^{-1}$

$\tilde{\nu} = \text{R}\left(\frac{1}{1} - \frac{1}{4}\right)cm^{-1}$

$\tilde{\nu} = \frac{3\text{R}}{4}cm^{-1}$

(79) **Answer :** (1)
Solution:
$2\pi r = n\lambda$
$\frac{2\pi a_0 n^2}{z} = n1.5\pi a_0$
$\frac{n}{z} = \frac{1.5}{2}$
$\frac{n}{z} = 0.75$

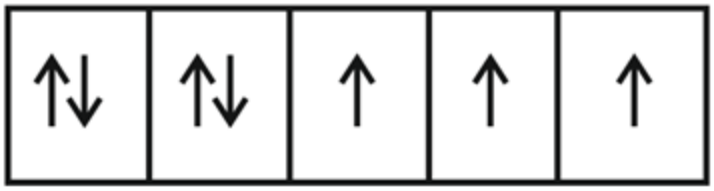
(80) **Answer :** (1)
Solution:
- $(2l+1)$ represents the number of orbitals in each subshell.
- m_l designates the orientation of the orbital

(81) **Answer :** (1)

(82) **Answer :** (3)
Solution:
For $l = 1$, possible values for m_l are $-1,\ 0$and $+1$.

(83) **Answer :** (2)
Solution:
For single electron species, energy only depends upon principal quantum number.

(84) **Answer :** (4)
Solution:
The valence electronic configuration of Co^{2+}ion is $3d^7$.



So, the number of unpaired electrons is 3.

(85) **Answer :** (2)
Solution:
The value of l cannot be equal to n. For $n = 3$, possible values of l are 0, 1 and 2.

(86) **Answer :** (2)
Solution:
$\text{H},\ \text{He}^+,\ \text{Li}^{2+}$and $\text{Be}^{3+}$are single electron species

(87) **Answer :** (2)
Solution:
Orbital angular momentum = $\sqrt{l(l+1)}\frac{h}{2\pi}$
$= \sqrt{3(3+1)}\frac{h}{2\pi}$
$= \sqrt{12}\frac{h}{2\pi}$

(88) **Answer :** (2)
Solution:

Elements	Electron gain enthalpy $[\text{KJ / mol}]$

Elements	Electron gain enthalpy $[\mathrm{KJ/mol}]$
O	-141
S	-200
Se	-195
Te	-190

(89) **Answer :** (4)
Solution:
Li and Mg have 1.0 and 1.2 electronegativity on Pauling scale respectively.

(90) **Answer :** (4)
Solution:
$\mathrm{Al_2}\,O_3$ and $\mathrm{As_2}\,O_3$ are amphoteric oxides.
$\mathrm{Cl_2}\,O_7$ is an acidic oxide.
N_2O is a neutral oxide.

BOTANY

(91) **Answer :** (2)
Solution:
Systematics includes characterisation, identification, nomenclature, classification of organisms along with their evolutionary study.

(92) **Answer :** (3)
Solution:
As we go higher from species to kingdom, the number of common characteristics goes on decreasing.

(93) **Answer :** (4)
Solution:
Local names of various plants and animals are non-universal.

(94) **Answer :** (2)
Solution:
Convolvulaceae and Solanaceae are included in the order Polymoniales, mainly based on the floral characters.

(95) **Answer :** (1)
Solution:
Both Diptera and Sapindales are orders and share equivalent rank.

(96) **Answer :** (1)
Solution:
Fragmentation occurs is algae and fungi.

(97) **Answer :** (3)
Solution:
Solanum, *Datura* and *Petunia* belong to the same family Solanaceae, whereas *Triticum* belongs to the family Poaceae.

(98) **Answer :** (3)
Hint:
Kingdom is the highest category in taxonomic hierarchy and it comes next to division/phylum.
Solution:
The correct sequence of taxonomic categories in descending order is:
Kingdom → Phylum/Division → Class → Order → Family → Genus → Species

(99) **Answer :** (2)
Solution:
Yeast (*Saccharomyces*) belongs to the class, Ascomycetes.

(100) **Answer :** (1)
Solution:
Mustard is a member of Brassicaceae.
Albugo is a member of phycomycetes and it is a parasitic fungus on mustard.

(101) **Answer :** (3)
Solution:

Claviceps belongs to the class ascomycetes and shows dikaryotic phase.

(102) Answer : (2)
Solution:
Cr–Jacob disease (CJD) in humans is caused by prions, the infectious proteins.

(103) Answer : (3)
Solution:
Cyanobacteria perform photosynthesis, similar to higher plants. They have chlorophyll *a* and phycobilins.

(104) Answer : (2)
Solution:
In slime moulds, during unfavourable conditions, plasmodium differentiates and forms fruiting bodies bearing spores at their tips.

(105) Answer : (2)
Solution:
Claviceps belong to the class Ascomycetes.

(106) Answer : (2)
Solution:
Halophiles live in extreme saline environment.

(107) Answer : (2)
Solution:
Phycoerythrin is the major pigment in red algae.

(108) Answer : (4)
Solution:
Phylogenetic classification systems are based on evolutionary relationship between the various organisms.

(109) Answer : (3)
Solution:
– In members of chlorophyceae, chlorophyll 'a' and 'b' are found and they appear grass green in colour.
– Members of rhodophyceae (red algae) have complex post-fertilisation developments.

(110) Answer : (4)
Solution:
Funaria (common moss) is a monoecious moss, meaning both male and female sex organs are found on the same gametophyte plant. The sporophyte is dependent on the gametophyte. *Funaria* has a monoecious gametophyte, and its sporophyte is not described as dioecious or monoecious in the same way as the gametophyte, as it is a single structure developing on the gametophyte. Therefore, this statement is **incorrect**.

(111) Answer : (1)
Solution:
Marchantia does not have seed and vascular tissue.

(112) Answer : (3)
Solution:
Lax is aggregation of sporophylls in gymnosperms like *Cycas* .

(113) Answer : (2)
Hint:
Stems are usually branched in orders Coniferales and Gnetales of gymnosperms.
Solution:
Cedrus – branched stem
Cycas – unbranched stem

(114) Answer : (4)
Solution:
Biodiversity is the number and type of organisms present on earth. 'Systema' is a latin word. The number of species that are known and described ranges between 1.7–1.8 million.

(115) Answer : (3)
Solution:

Canidae		Represents the family to which dog belongs
Polymoniales		Represents the order to which potato belongs
Mammalia		Represents the class to which human belongs
Panthera		Represents the genus to which leopard belongs

(116) Answer : (2)
Solution:
Bacteria was included in kingdom plantae, as per two kingdom classification system.

(117) Answer : (3)
Solution:
Dmitri Ivanowsky recognised a microbe as a causal organism of mosaic disease of tobacco and that microbe is smaller than bacteria.

(118) Answer : (3)
Solution:
Under suitable conditions, slime moulds form an aggregation called plasmodium

(119) Answer : (1)
Solution:
All the features are shown by *Paramoecium.*

(120) Answer : (2)
Solution:
Chemosynthetic autotrophic bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. *Rhizobium* is symbiotic N_2-fixing bacteria associated with the roots of leguminous plants.

(121) Answer : (3)
Solution:
The structure represents TMV, which is smaller than eubacteria and has ssRNA as genetic material, enclosed within proteinaceous capsid.

(122) Answer : (4)
Solution:
Basidiomycetes - Sex organ is absent and asexual spores are not found.
Ascomycetes - Conidia is formed on conidiophores and ascospores are formed endogenously.

(123) Answer : (3)
Solution:
Claviceps belong to Ascomycetes. Basidiospores are produced after meiosis, so they are genetically dissimilar. *Ustilago* is a smut fungus.

(124) Answer : (1)
Solution:
Sphagnum, a moss, is used as fuel, and as packing material for trans-shipment of living material because of their capacity to hold water.

(125) Answer : (2)
Solution:
Ectocarpus is a brown alga and *Porphyra* is a red alga. Red algae lack motile male gametes.

(126) Answer : (3)
Solution:
The predominant stage of life cycle of moss is gametophyte, which consists of two stages-protonema and leafy stage.

(127) Answer : (3)
Solution:
The first organism is *Selaginella* (heterosporous species) and the other organism is *Equisetum* (homosporous species).
Selaginella belongs to lycopsida, while *Equisetum* belongs to sphenopsida.

(128) Answer : (3)
Solution:
Marchantia is a liverwort and its body is thalloid and thallus is dorsiventral and closely appressed to the substratum.
Sphagnum provides peat that has long been used as fuel.
Marsilea is a heterosporous pteridophyte and it shows events, precursor to seed habit.

(129) Answer : (2)
Solution:
Prevention of soil erosion is ecological importance of bryophytes. The sporophyte in mosses is more elaborate than that in liverworts, as in former, sporophyte has foot, seta and capsule while latter typically has a simpler sporophyte, i.e, thalloid.

(130) Answer : (1)
Solution:

Male and female gametophytes do not have an independent free living existence, as they remain within the sporangia retained on the sporophytes.

(131) Answer : (1)
Hint:
Gymnosperms are archegoniate phanerogams, while angiosperms are non-archegoniate phanerogams.
Solution:
Pinus and *Cycas* – Produce seeds and have archegonia.
Funaria, *Selaginella* – Have archegonia but lack seeds.
Mustard – Have seeds but lack archegonia.

(132) Answer : (4)
Solution:
The female gametophyte is haploid, found within the megasporangium (diploid) plant body of gymnosperm.

(133) Answer : (1)
Solution:
Green algae do not have heterocyst. The second stage is the leafy stage, which develops from the secondary protonema as a lateral bud. They consist of upright, slender axes bearing spirally arranged leaves. *Lycopodium* is homosporous

(134) Answer : (3)
Solution:
Cytotaxonomy is based on cytological information like chromosome number, structure and behaviour.

(135) Answer : (4)
Solution:
Diatomaceous earth is accumulated cell wall of dead diatoms.

ZOOLOGY

(136) Answer : (1)
Solution:
In PCR, during the denaturation step, hydrogen bonds break. During the annealing step, new hydrogen bonds are formed; and in the extension step, new phosphodiester bonds are formed.

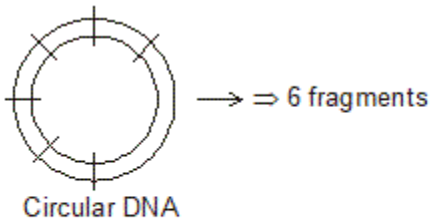
(137) Answer : (3)
Hint:
Product has to be subjected through many processes before marketing.
Solution:
Downstream processes include separation and purification of the product which is then formulated with suitable preservatives. Such formulations have to undergo clinical trials as in the case of drugs.

(138) Answer : (4)
Solution:
In order to force bacteria to take up the plasmid, the bacterial cells must first be made 'competent' to take up DNA. This is done by treating them with a specific concentration of a divalent cation, such as Ca^{++}, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. Recombinant DNA can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42ºC (heat shock), and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.

(139) Answer : (4)
Solution:
*Eco*RI produces sticky ends by cutting the strand of DNA a little away from the centre of the palindromic sites but between the same two bases on opposite strands.

(140) Answer : (2)
Solution:
The sticky ends facilitate the ligation of DNA fragments from different sources by forming hydrogen bonds between complementary sequences.
Sticky ends are essential for facilitating specific and efficient ligation of DNA fragments.

(141) Answer : (1)
Hint:
A single cut in closed circular DNA produces linear DNA.
Solution:



Total : 13 fragments generated

(142) Answer : (4)

Solution:

The source of the complementary RNA required during RNAi could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate *via* an RNA intermediate.

(143) Answer : (2)

Hint:

Tetracycline resistance would not be lost

Solution:

In the above-mentioned condition, non-transformants would be sensitive to both ampicillin and tetracycline as naturally *E.coli* does not contain any antibiotic resistance gene.

Recombinant transformants would be sensitive to tetracycline but resistant to ampicillin whereas non-recombinant transformants would be resistant to both ampicillin and tetracycline.

(144) Answer : (1)

Solution:

In the given figure, *Bam* HI should be used to cut and isolate the gene 'B' from the given DNA fragment.

(145) Answer : (1)

Solution:

The restriction endonucleases have usually 4-8 nucleotide sequences (bp) in their recognition sequences. Both *Eco*RI and *Hind*II have 6 bp in their recognition sequences.

(146) Answer : (3)

Solution:

In 1983, Eli Lilly, an American company, prepared the recombinant form of human insulin.

(147) Answer : (2)

Hint:

Prevents early exhaustion of fertility of soil

Solution:

Genetic modification increases efficiency of mineral usage by plants (it prevents early exhaustion of fertility of soil) and also reduces reliance on chemical pesticides (pest-resistant crops).

(148) Answer : (2)

Solution:

95 per cent of all the existing transgenic animals are mice.

(149) Answer : (4)

Solution:

As a first step towards gene therapy, lymphocytes from the blood of the patient are grown in a culture outside the body. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient.

(150) Answer : (4)

Solution:

Auto-immune diseases are due to activation of the immune response against our own body tissues.

(151) Answer : (4)

Solution:

Neem: In 1996, Vandana Shiva challenged the patent granted to the firm of W.R. Grace & Co. by the European Patent Office, Munich, for 'fungicidal uses of neem oil'.

Turmeric: In May, 1995, the US Patent Office granted to the University of Mississippi Medical Center a patent for "Use of Turmeric in Wound Healing".

Tobacco is native to North and South America

(152) Answer : (2)

Solution:

Some strains of *Bacillus thuringiensis* produce proteins that kill certain insects such as lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes).

(153) Answer : (4)

Solution:

The cells having rDNA can be multiplied in a continuous culture system wherein the used medium is drained out from one side while the fresh medium is added from the other to maintain the cells in their physiologically most active log/exponential phase. This type of culturing method produces a larger biomass leading to higher yields of desired protein.

(154) Answer : (3)

Solution:

Bt toxins create pores in the epithelium of midgut which leads to cell swelling and death.

(155) Answer : (4)

Solution:

Gene therapy can be performed during the early embryonic stage. It can be used to treat blood cancers.

(156) Answer : (2)

Solution:

Transgenic animals are used as bioreactors to produce complex human therapeutic proteins in large quantities.
The protein obtained from transgenic animals is not necessarily in its pure form. Thus, downstream processing is still essential to purify the recombinant protein from milk.

(157) Answer : (4)

Solution:

Some options that can be thought for increasing food production are:
(i) Agro-chemical based agriculture
(ii) Organic agriculture
(iii) Genetically engineered crop-based agriculture

(158) Answer : (1)

Solution:

It is possible to achieve propagation of a large number of plants in very short duration. This method of producing thousands of plants through tissue culture is called micro-propagation.
Somatic hybridisation by protoplast fusion produces hybrids.
Agrobacterium-mediated genetic transformation is used for introducing new genes, not mass cloning.
Conventional cross-pollination followed by field selection is time-consuming and unsuitable for rapid multiplication.

(159) Answer : (3)

Solution:

Specific Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton. The choice of genes depends upon the crop and the targeted pest, as most Bt toxins are insect-group specific. The toxin is coded by a gene named *cry*. There are a number of them, for example, the proteins encoded by the genes *cryIAc* and *cryIIAb* control the cotton bollworms, that of *cryIAb* controls corn borer.

(160) Answer : (4)

Solution:

PCR detects very low amounts of DNA through exponential amplification, repeatedly copying a specific DNA segment millions to billions of times in cycles of heating and cooling, making it visible and detectable even from a single starting molecule, using primers and *Taq* polymerase to target and build new strands. This massive increase in copies from a few original molecules allows for the analysis of trace DNA in forensics, diagnostics, and ancient sample research.
Taq polymerase is a thermostable DNA polymerase.

(161) Answer : (1)

Solution:

In insulin, chain A and B are produced separately extracted and combined by creating disulfide bonds to form human insulin.
One intrachain disulphide bond in chain A and two interchain disulphide bonds are present between A chain and B chain

(162) Answer : (3)

Solution:

The Indian Government has set up organisations such as GEAC (Genetic Engineering Approval Committee), which makes decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services.
Economic, legal, and consumer preference issues are not biosafety parameters.

(163) Answer : (2)

Solution:

In 1997, an American company (RiceTec) got patent rights on Basmati rice through the US Patent and Trademark Office. This allowed the company to sell a 'new' variety of Basmati, in the US and abroad. This 'new' variety of Basmati had actually been

derived from Indian varieties. Indian Basmati was crossed with semi-dwarf varieties and claimed as an invention or a novelty.
The choice of genes depends upon the crop and the targeted pest, as most Bt toxins are insect-group specific.

(164) Answer : (2)
Solution:
RNAi involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).
Strychnine is a secondary metabolite; a potent organic compound plants produce primarily for defense.

(165) Answer : (2)
Solution:
Recombinant human insulin produced in bacteria is structurally identical to the natural human insulin molecule because the bacteria are given the exact human gene sequence that codes for the insulin.
Any bacterium does not naturally synthesize insulin.

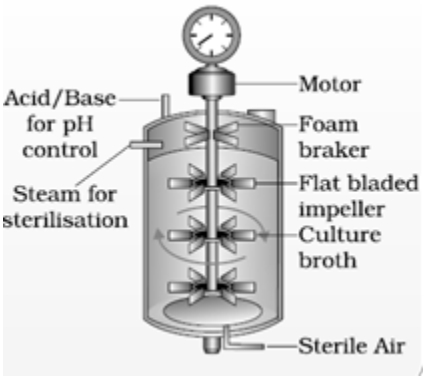
(166) Answer : (2)
Solution:
Autoradiography detects radioactively labelled molecules (like P^{32}-labelled DNA) by placing the gel against X-ray/photographic film so emissions from the isotope expose the film exactly where the labelled DNA bands are present.
Western blotting is used to detect proteins using antibody probes after electrophoresis.
ELISA is an antibody-based assay mainly used for detecting/quantifying antigens or antibodies in solution.
Centrifugation separates components by size/density.

(167) Answer : (1)
Solution:
At present, about 30 recombinant therapeutics have been approved for human-use the world over. In India, 12 of these are presently being marketed.

(168) Answer : (1)
Solution:
The concentration of the gel matrix directly determines the average pore size of the gel and significantly affects the rate of migration.
DNA is negatively charged due to its phosphate moiety and thus migrates towards the positively charged electrode (anode).
To allow the DNA to travel through the gel, the samples are loaded into wells near the cathode (the negative electrode).
The 'Lane 4' contains the smallest DNA fragment as compared to the other lanes, as the DNA fragments have travelled more closer to the anode.

(169) Answer : (1)
Solution:
The European Federation of Biotechnology (EFB) has given a definition of biotechnology that encompasses both the traditional view and modern molecular biotechnology.
ori is a specific DNA site responsible for initiating DNA replication and also controlling the copy number of linked DNA**.**
Exonucleases remove nucleotides from the ends of the DNA, whereas endonucleases make cuts at specific positions within the DNA.

(170) Answer : (2)
Solution:
The simple stirred-tank bioreactor also possesses an agitator system and sampling ports.



(171) Answer : (4)
Solution:
The cutting of DNA at specific locations became possible with the discovery of the so-called 'molecular scissors'– restriction enzymes.
The linking of antibiotic resistance gene with the plasmid vector became possible with the enzyme DNA ligase, which acts on

cut DNA molecules and joins their ends.
Taq polymerase is a type of DNA polymerase, which is used in PCR.
Staining dye and agarose gel is required for performing gel electrophoresis.

(172) Answer : (1)
Solution:
Diphtheria is caused by the bacteria, *Corynebacterium diphtheriae* ; its genetic material is DNA.
During DNA isolation, DNases must not be used, as it would degrade the DNA itself. The correct sets of enzymes required for purification of the genetic material of bacteria are RNases (to remove RNA), lysozyme (breaks bacterial cell wall) and proteases (to remove proteins). Mechanical grinding disrupts the cell to release its contents.

(173) Answer : (2)
Solution:
Insertional inactivation cannot be used to select recombinants when the *Eco*RI site of pBR322 is used. This is because this site does not lie in either the ampicillin or the tetracycline resistance genes of this plasmid.
In nature, *A. tumefaciens* (Gram-negative bacteria) infect only dicotyledonous plants; monocots are outside of the normal host range.

(174) Answer : (4)
Solution:
Today, we know more than 900 restriction enzymes that have been isolated from over 230 strains of bacteria, each of which recognises different recognition sequences.

(175) Answer : (4)
Solution:
Disarmed retroviruses are used as vectors for gene transfer in animal cells. Rhino viruses cause common cold.
Meloidogyne incognita is a nematode.

(176) Answer : (1)
Solution:
Ethidium bromide is a fluorescent dye that binds between nitrogenous bases of DNA (intercalation). When exposed to UV light, it emits orange fluorescence, allowing DNA bands to be visualized in agarose gel electrophoresis.

(177) Answer : (1)
Solution:
Plasmids and bacteriophages have the ability to replicate within bacterial cells independent of the control of chromosomal DNA. Bacteriophages because of their high number per cell, have very high copy numbers of their genome within the bacterial cells.

(178) Answer : (1)
Solution:
1972 - First artificial recombinant DNA molecule made
1990 - First recipient of clinical gene therapy for ADA deficiency
1983 - First successful humulin made

(179) Answer : (2)
Solution:
Cells of plants are bombarded with high velocity micro-particles of gold or tungsten coated with DNA in a method known as biolistics or gene gun.
Disarmed pathogens are not used to transform a bacterial cell.
Heat-shock method is typically used to transform bacterial cells.

(180) Answer : (3)
Solution:
The *rop* gene encodes a protein that regulates plasmid replication.
pBR322 is an artificial plasmid.