AIPMT - 2014
(Physics, Chemistry and Biology)
Code - P
Answer Key and Solution

Answers

1	(4)	2	(1)	3	(4)	4	(3)	5	(3)	6	(1)	7	(2)	8	(3)	9	(4)	10	(1)
11	(3)	12	(1)	13	(2)	14	(3)	15	(4)	16	(1)	17	(3)	18	(4)	19	(2)	20	(1)
21	(4)	22	(3)	23	(3)	24	(2)	25	(4)	26	(2)	27	(2)	28	(3)	29	(3)	30	(3)
31	(4)	32	(4)	33	(2)	34	(2)	35	(4)	36	(3)	37	(4)	38	(2)	39	(2)	40	(2)
41	(3)	42	(4)	43	(3)	44	(1)	45	(4)	46	(3)	47	(4)	48	(3)	49	(4)	50	(4)
51	(3)	52	(3)	53	(1)	54	(3)	55	(2)	56	(4)	57	(2)	58	(4)	59	(2)	60	(1)
61	(Bonus)	62	(1)	63	(3)	64	(2)	65	(3)	66	(2)	67	(1)	68	(1)	69	(3)	70	(3)
71	(2)	72	(2)	73	(2)	74	(2)	75	(1)	76	(4)	77	(2)	78	(4)	79	(3)	80	(4)
81	(3)	82	(4)	83	(1)	84	(3)	85	(Bonus)	86	(2)	87	(3)	88	(4)	89	(1)	90	(2)
91	(4)	92	(1)	93	(2)	94	(1)	95	(3)	96	(4)	97	(3)	98	(2)	99	(3)	100	(3)
101	(2)	102	(4)	103	(4)	104	(2)	105	(2)	106	(3)	107	(1)	108	(1)	109	(1)	110	(4)
111	(1)	112	(3)	113	(1)	114	(1)	115	(3)	116	(2)	117	(3)	118	(4)	119	(4)	120	(2)
121	(1)	122	(3)	123	(2)	124	(1)	125	(1)	126	(4)	127	(1)	128	(2)	129	(3)	130	(2)
131	(4)	132	(4)	133	(3)	134	(3)	135	(2)	136	(4)	137	(2)	138	(2)	139	(2)	140	(3)
141	(3)	142	(1)	143	(2)	144	(2)	145	(2)	146	(1)	147	(3)	148	(2)	149	(1)	150	(1)
151	(1)	152	(1)	153	(4)	154	(1)	155	(4)	156	(3)	157	(2)	158	(3)	159	(1)	160	(2)
161	(3)	162	(1)	163	(2)	164	(2)	165	(3)	166	(3)	167	(1)	168	(1)	169	(2)	170	(3)
171	(2)	172	(1)	173	(3)	174	(3)	175	(2)	176	(4)	177	(3)	178	(4)	179	(1)	180	(1)

Physics

1. Let force (F), velocity (V) and time (T) be taken as fundamental units

$$F = M \times \frac{L}{T^2} = \frac{LM}{T^2}$$

$$F = \frac{MV}{T}$$

$$\Rightarrow M = FTV^{-1}$$

2. Velocity of projectile fired from the surface of the Earth $v_e = 5\ ms^{-1}$.
Velocity of projectile fired from the surface of another planet $v_p = 3\ ms^{-1}$.
The horizontal range of the projectile is

$$R = \frac{v^2}{g}$$

The trajectory of the projectile fired from the surface of another planet is identical with the trajectory of the projectile fired from the Earth. Hence,

$$\frac{v_e^2}{g} = \frac{v_a^2}{a}$$ (a is the acceleration due gravity of other planet)

$$\frac{5^2}{g} = \frac{3^2}{a}$$

$$a = 9.8 \times \frac{9}{25} = 3.5\ m/s^2$$

3. $\vec{r}_1 = 2\hat{i} + 2\hat{j}$

$\vec{r}_s = 13\hat{i} + 14\hat{j}$

$\vec{S} = 11\hat{i} + 11\hat{j}$

Average velocity vector, $\vec{v}_{av} = \dfrac{11\hat{i} + 11\hat{j}}{5}$

4. A system consists of three masses—m_1, m_2 and m_3—connected by a string passing over a pulley P.
According to Newton's 2nd law,

$$3am = mg - 2\mu mg$$

$$a = \frac{g - 2\mu mg}{3m}$$

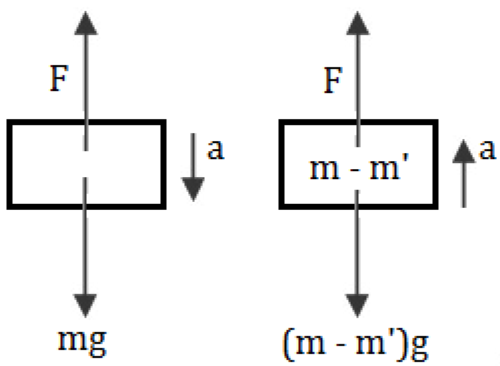
$$a = \frac{g - 2\mu g}{3} = g\left(\frac{1 - 2\mu}{3}\right)$$

5. The force 'F' acting on a particle of mass 'm' is indicated by the force–time graph.
The change in momentum of the particle over the time interval from zero to 8 s is

$$\Delta P = \left(\frac{1}{2}\right) \times 2 \times 6 - (3 \times 2) + (4^2 \times 3)$$

$$\Delta P = 6 - 6 + 12 = 12$$

6. A balloon with mass 'm' is descending with an acceleration 'a' (where a < g). From the figure, we have



mg – F = ma (i)
When a mass is removed from it, it starts moving up with an acceleration 'a', then we have
$F - (m - m')g = (m - m')a$
From (1), we get,
$F - mg + m'g = ma - m'a$
$mg - ma - mg + m'g = ma - m'a$
$m'(g + a) = 2ma$

$$m' = \frac{2ma}{g + a}$$

7. From the law of conservation of linear momentum,
Total momentum before the collision (P_i) = Total momentum after the collision (P_f)

$$0 = mv\,\hat{i} + mv\,\hat{j} + 2m\vec{v}$$

$$\vec{v} = -\frac{v}{2}\hat{i} - \frac{v}{2}\hat{j}$$

$$|\vec{v}| = \frac{v}{\sqrt{2}}$$

$$\text{Kineticn energy, } E = \frac{v}{2}mv^2 + \frac{v}{2}mv^2 + \frac{v}{2}m\left(\frac{v}{\sqrt{2}}\right)^2$$

$$E = mv^2 + \frac{mv^2}{2} = \frac{3}{2}mv^2$$

8. The oscillation of a body on a smooth horizontal surface is represented by the equation,
$X = A \cos \omega t$
Velocity is given as $v = A\omega \sin \omega t$
Acceleration is given as $a = -A\omega \cos^2 \omega t$
From the above three equations, we can say that the correct graph is 3.

9. A solid cylinder of mass 50 kg and radius 0.5 m is free to rotate about the horizontal axis.
Let a massless string be wound round the cylinder with one end attached to it and the other end hanging freely.

Hence, $T \times R = \left(\frac{MR^2}{2}\right) \times \alpha$ (α is angular acceleration)

$$T = \left(\frac{MR}{2}\right) \times \alpha = \left(\frac{50 \times 0.5}{2}\right) \times (2 \times 2\pi)$$

$$T = 157 \text{ N}$$

10. For slipping motion on an inclined plane, the acceleration for a solid sphere making an angle θ is given by

$a_{slipping} = g \sin\theta$

For rolling motion of a sphere without slipping:
The acceleration of a sphere of mass m, radius r and moment of inertia I is

$$a_{rolling} = \frac{g \sin\theta}{1 + \frac{I}{mr^2}}$$

For a uniform sphere, we know that $\frac{I}{mr^2} = \frac{2}{5}$

$$\frac{a_{rolling}}{a_{slipping}} = \frac{\frac{g \sin\theta}{g \sin\theta}}{1 + \frac{I}{mr^2}} = \frac{\frac{g \sin\theta}{g \sin\theta}}{1 + \frac{2}{5}} = \frac{5}{7}$$

Hence, we get the ratio 5:7.

11. Escape velocity is

$$v_e = \sqrt{\frac{2GM}{R}} = c$$

$$\Rightarrow R = \frac{2GM}{c^2} = \frac{2 \times 6.67 \times 10^{-11} \times 5.98 \times 10^{24}}{9 \times 10^{16}}$$

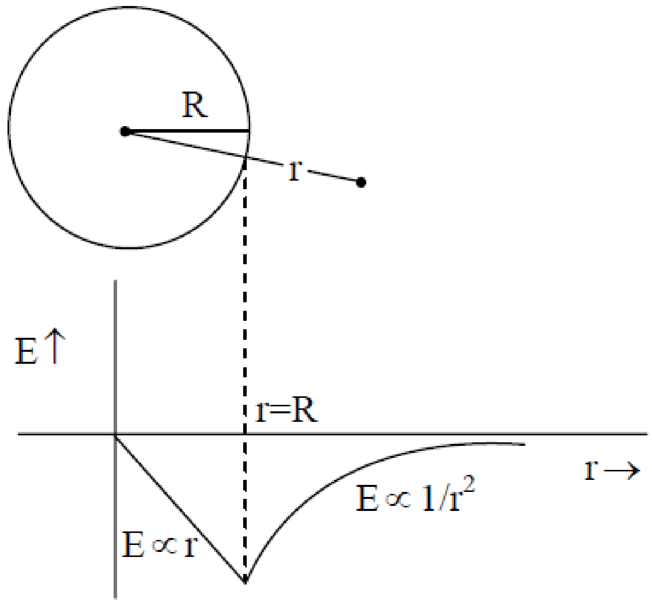
$$\therefore R = 8.8 \times 10^{-3} \approx 10^{-2} \text{ m}$$

12. The gravitational intensity for a solid sphere is

$$E = -\frac{GM}{R^3}r \quad (\text{for } R > r)$$

$$E = -\frac{GM}{R^2} \quad (\text{for } r = R)$$

$$E = -\frac{GM}{r^2} \quad (\text{for } r > R)$$



From the figure, the correct option is (1).

13. Volume V = Al

Young's modulus, $Y = \dfrac{F/A}{\frac{\Delta l}{l}}$

$$\frac{Y\Delta l}{l} = \frac{F}{A}$$

$$\Delta l = \frac{\Delta l l}{YA} = \frac{F}{Y} \cdot \frac{l^2}{V}$$

$$\Delta l = \frac{\Delta l}{YV} \times l^2$$

$$\Delta l \propto l^2$$

14. Energy evolved = surface tension × decrease in area

$\Delta U = ST \times \Delta A$

Surface area of a spherical drops = $4\pi r^2 n$

Surface area of a big drop = $4\pi R^2$

Decrease in surface area, $\Delta A = 4\pi r^2 n - 4\pi R^2$

Volume of big drop = Volume of spherical drops

$$\frac{4}{3}\pi R^3 = n \times \frac{4}{3}\pi r^3$$

$$\Rightarrow n = \frac{R^3}{r^3}$$

$$\Delta A = 4\pi\left[\frac{R^3}{r^3} \times r^2 - R^2\right] = 4\pi\left[\frac{R^3}{r^3} - \frac{R^3}{R}\right]$$

$$\Delta A = \left(\frac{4\pi R^3}{r}\right)3\left[\frac{1}{r} - \frac{1}{R}\right]$$

$$\Rightarrow \Delta A = 3V\left[\frac{1}{r} - \frac{1}{R}\right]$$

$$\therefore \Delta U = 3VT\left[\frac{1}{r} - \frac{1}{R}\right]$$

15. $\Delta Q_{gain} = 20 \times 1 \times (70) = 1400$ cal

$\Delta Q_{loss} = mLv + m \times 1 \times (20) = m(540 + 20) = 560$ m

560 m = 1400 cal

$$m = \frac{1400}{560} = \frac{10}{4} = 2.5 \text{ gm}$$

$$\Rightarrow m_w = 20 + m = 22.5 \text{ gm}$$

16. The average temperature of 70°C to 60°C,

$$T = \frac{70° + 60°}{2} = 65°$$

From netwon's law of cooling

$$\frac{dT}{dt} = -K(T - T_0)$$

For the first condition

$$\frac{(60 - 70)}{5} = -K(65 - T_0) \quad \text{(i)}$$

For the second condition

$$\frac{(54 - 60)}{5} = -K(57 - T_0) \quad \text{(ii)}$$

From (i) and (ii)

$$\frac{-10}{6} = \frac{65 - T_0}{57 - T_0}$$

$$285 - 5T_0 = 195 - 3T_0$$

$$90 = 2T_0$$

$$T_0 = 45°$$

17. Consider a monatomic gas at a pressure P and volume V.

When volume V expands isothermally to volume 2V,

$PV = P_1 2V$

$$P_1 = \frac{P}{2}$$

When volume V then expands adiabatically to volume 16V,

$P_1 (2V)^{\gamma} = P_2 2V$

$$P_2 = \frac{P}{2}\left(\frac{1}{2^3}\right)^{\frac{5}{3}}$$

$$P_2 = \frac{P}{2}\left(\frac{1}{2^3}\right)^{\frac{5}{3}} = \frac{P}{2 \times 2^5}$$

$$P_2 = \frac{P}{64}$$

18. From the figure, work done in ODA = $\frac{1}{2} \times P_0 \times V_0$

Work done in OBC = $-\frac{1}{2} \times P_0 \times V_0$

Work done in the system = Work done in ODA − Work done in OBC = 0

19. The mean free path of molecules of a gas,

$$\ell = \frac{1}{\sqrt{2}nd^2}$$

i.e. $\ell \propto \frac{1}{d^2}$

$$\Rightarrow \ell \propto \frac{1}{r^2}$$

20. Let n_1, n_2 and n_3 be the fundamental frequencies of three segments.

$$n_1 = \frac{1}{2l_1}\sqrt{\frac{T}{\mu}}$$

$$n_2 = \frac{1}{2l_2}\sqrt{\frac{T}{\mu}}$$

$$n_3 = \frac{1}{2l_3}\sqrt{\frac{T}{\mu}}$$

and $n = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

$$l = l_1 + l_2 + l_3$$

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

21. Given length l = 85 cm

Velocity of sound = 340 ms^{-1}

Fundamental frequency of a closed organ pipe is $f_1 = f_1 = \frac{V}{4\ell} = \frac{340}{4 \times 0.85} = 100$ Hz

The natural frequencies of the organ pipe will be f = 100 Hz, 300 Hz, 500 Hz, 700 Hz, 900 Hz and 1100 Hz which are below 1250 Hz.

22. As a motorcyclist slows down to 36 km/hour, he finds the traffic has eased and a car moving ahead of him.

Apparent frequency heard by the observer is

$$f' = f_0\left(\frac{V - V_0}{V - V_s}\right)$$

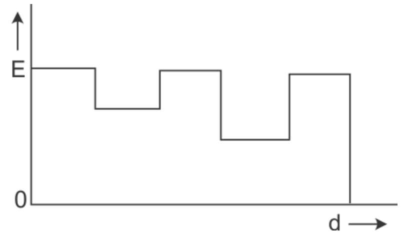
$$f' = 1392 \times \left(\frac{343 - (-10)}{343 - (-5)}\right) = 1412 \text{ Hz}$$

23. We know that $E_V = E_0$

$$E_k = \frac{E_0}{k}$$

$$k_2 > k_1$$

$$E_2 < E_1$$



24. A conducting sphere of radius R is given a charge Q.

For a conducting sphere

Electric field at centre = 0

The electric potential at the centre of the sphere = $\frac{KQ}{R} = \frac{Q}{4\pi\varepsilon_0 R}$

25. In a region, the potential is represented by V(x, y, z) = 6x − 8xy − 8y + 6yz, where V is in volts and x, y, z are in metres.

$V(x, y, z) = 6x- 8xy -8y + 6yz$

$E_x = -\frac{\partial V}{\partial x} = -6 + 8y$

$E_y = -\frac{\partial V}{\partial y} = 8x + 8 - 6z$

$E_z = -\frac{\partial V}{\partial z} = -6y$

$\vec{E} = (-6 + 8Y)$

$\vec{E} = (-6 + 8y), \hat{i} + (8x + 8- 6z)\,\hat{j} - 6y\,k$

$\vec{E} = 2\hat{i} + 10\vec{j} - 6\vec{k}$

$\left|\vec{E}\right| = 2\sqrt{35}\ NC^{-1}$

$F = qE = 2 \times \sqrt{35} = 4\sqrt{35}\ N$

26. Given:

Total resistance of wire R = 0.5 × 150 = 75Ω

Total voltage drop = 150 × 8 = 1200 V

Power loss = $\frac{V^2}{R} = \frac{(1200)2}{75} = 19.2$ KW

27. From the first condition, we have

$\frac{5}{R} = \frac{l_1}{100 - l_1}$ (i)

From the second condition, we have

$\frac{5}{R/2} = \frac{1.6\,l_1}{100 - 1.6l_1}$

$\frac{10}{R} = \frac{1.6\,l_1}{100 - 1.6l_1}$ (ii)

Comparing equations (i) and (ii),

$$\frac{5(100 - l_1)}{l_1} = \frac{10(100 - 1.6l_1)}{1.6l_1}$$

$$= 1.6(100 - l_1) = 2(100 - 1.6l_1)$$

$$\Rightarrow 80 - 0.8l_1 = 100 - 1.6l_1$$

$$\Rightarrow 0.8l_1 = 20$$

$$\therefore l_1 = 25 \text{ cm}$$

Substituting l_1 in equation (i)

$$\frac{5}{R} = \frac{25}{100 - 25}$$

$$R = \frac{75}{5} = 15\ \Omega$$

28. Given:

$l_1 = 3$ m

$l_2 = 2.85$

$R = 9.5\Omega$

Internal resistance of the unknown cell is

$$r = \left(\frac{l_1}{l_2} - 1\right)R$$

$$r = \left(\frac{3}{2.85} - 1\right)9.5$$

$$\therefore\ r = 0.5\ \Omega$$

29.

(a) The magnets are at right angles to each other. Hence, the net magnetic moment

$$M_{net} = \sqrt{m^2 + m^2 + 2mm\cos 90^\circ} = \sqrt{2}m$$

(b) The magnets are parallel to each other. Hence, the net magnetic moment

$$M_{net} = m - m = 0$$

(c) Magnets are at 30° to each other. Hence, the net magnetic moment

$$M_{net} = \sqrt{m^2 + m^2 + 2mm\cos 30^\circ} = m\sqrt{2+\sqrt{3}}$$

(d) Magnets are at 60° to each other. Hence, the net magnetic moment

$$M_{net} = \sqrt{m^2 + m^2 + 2mm\cos 60^\circ} = \sqrt{3}m$$

In configuration (c), θ is the least, so M_{net} is maximum.

30. As (G) and the shunt are in parallel combination:

$$i_g R_g = i_s R_s$$

$$\Rightarrow \left(\frac{i}{500}\right)(G) = \left(\frac{499}{500}\right)(S)$$

$$\Rightarrow S = \frac{G}{499}$$

Hence, equivalent resistance of the ammeter

$$\frac{1}{R_{eq}} = \frac{1}{G} + \frac{1}{\frac{G}{499}}$$

$$\Rightarrow R_{eq} = \frac{G}{500}$$

31. Two identical long conducting wires AOB and COD are placed at right angles to each other. Let the wires carry I_1 and I_2 currents, respectively.

$\vec{B}$ due to wire (1) $\vec{B}_1 = \left(\frac{\mu_0 i_1}{2\pi d}\right)\hat{i}$

$\vec{B}$ due to wire (2) $\vec{B}_2 = \left(\frac{\mu_0 i_2}{2\pi d}\right) - \hat{j}$

$$|B_{net}| = \frac{\mu_0}{2\pi d}\sqrt{i_1^2 + i_2^2}$$

32. When a thin semicircular conducting ring (PQR) of radius 'r' is falling with its plane vertical in a horizontal magnetic field B,

Motional emf e = Bυl

Here, effective length l = 2r

e = B$\nu \times$ 2r, whereas R is at a higher potential and P is at a lower potential.

33. Given:

V = 200 V

P = 3 kW = 3000 W

i_2 = 6 A

Efficiency of transformer = 90%

Current in primary coil $= \frac{P}{V} = \frac{3000}{200} = 15$ A

$$\frac{P_{out}}{P_{in}} = \frac{90}{100}$$

$$V_2 i_2 = \frac{90}{100} \times (3000)$$

$$V_2 \times 6 = 2700$$

$$V_2 = 450 \text{ V}$$

34. Given:

$$\phi = 25 \times 10^4 \ \frac{W}{m^2}$$

$$A = 15 \times 10^{-4} \ m^2$$

$$F = \frac{-\frac{E}{C} - \frac{E}{C}}{t} = \frac{2E}{Ct}$$

$$F = \frac{2}{Ct}(\phi \cdot At)$$

$$F = \frac{2\phi A}{C} = \frac{2 \times 25 \times 10^4 \times 15 \times 10^{-4}}{3 \times 10^8}$$

$$F = 2.5 \times 10^{-6} \ N$$

35. Angular width of 1st maxima

$$2\theta = \frac{2\lambda}{a}$$

Linear width of 1st maxima = (D) (2θ) = $\frac{2\lambda D}{a} = \frac{2 \times 600 \times 10^{-9} \times 2}{1 \times 10^{-3}}$ = 2.4 mm

36. When a path difference = $\lambda \Rightarrow$ phase difference = 2π

When a path difference = $\lambda/4 \Rightarrow$ phase difference = $\pi/2$

$$K = I + I + 2\sqrt{I}\sqrt{I}\ \cos 2\pi = 4I$$

$$K' = I + I + 2\sqrt{I}\sqrt{I}\ \cos\frac{\pi}{2} = 2I = \frac{K}{2}$$

37.

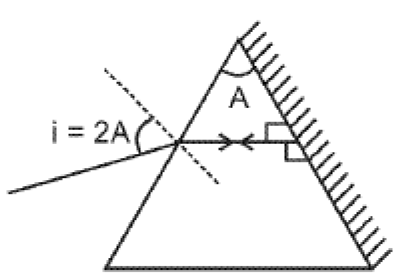
M.P. of microscope = $\left(-\frac{l}{f_0}\right)\left(1 + \frac{D}{f_e}\right)$

If f_0 increases, then MP of the microscope will decrease.

MP of telescope = $\left(\frac{f_0}{f_e}\right)$

If f_0 increases, then MP of the telescope will increase.

38.



Applying Snell's rule between the incident ray and the refracted ray, we get

$$\mu = \frac{\sin 2A}{\sin A}$$

$$\mu = \frac{2\sin A \cos A}{\sin A}$$

$$\Rightarrow \mu = 2\cos A$$

39. The work function of the metal is

$KE = h\upsilon - \phi$

$0.5\text{ eV} = h\upsilon - \phi \quad \text{(i)}$

$0.8\text{ eV} = 1.2h\upsilon - \phi \quad \text{(ii)}$

solving (i) and (ii)

$\phi = 1\text{ eV}$

40. de Broglie wavelength of the particle is

$$\lambda_1 = \frac{h}{\sqrt{2mk}}$$

If the kinetic energy of the particle is increased to 16 times its previous value, then

$$\lambda_2 = \frac{h}{\sqrt{2m16k}} = \frac{\lambda_1}{4}$$

$$\text{Percentage change} = \frac{\lambda_2 - \lambda_1}{\lambda_1} \times 100\%$$

$$= \frac{\left(-\frac{3\lambda_1}{4}\right)}{\lambda_1} \times 100\% = -75\%$$

41. Given:

$A = 975$ Å

$$\text{Energy of the photon, } E = \frac{hC}{\lambda} = \frac{1240}{97.5} = 12.75\text{ eV}$$

This energy is equal to the energy gap between n = 1 (−13.6) and n = 4(−0.85). So, by this energy, the electron will excite from n = 1 to n = 4.

When the electron will fall back, the number of spectral lines emitted =

$$\frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$$

42. ${}^7_3Li + {}^1_1H \rightarrow {}^4_2He + {}^4_2He + Q$

$Q = -BE_4 + 2BE_{He} = -7 \times 5.60 + 2 \times 7.06 \times 4$

$Q = -39.20 + 14.12 \times 4$

$\Rightarrow Q = -39.20 + 56.48 = 17.28$

43. X:Y = 1:7

X:(X + Y) = 1:8 = $1:2^3$

$\Rightarrow$ 3 half-life

$\therefore \Delta = 3 \times 1.4 \times 10^9$ yrs $= 4.2 \times 10^9$ yrs

44. The given graph is a V–I characteristic curve for a solar cell, where A represents the open circuit voltage of solar cell and B represent short circuit current.

45. The barrier potential depends on the type of semiconductor (for Si V_b = 0.7 volt and for Ge V_b = 0.3 volt), the amount of doping and on the temperature.

Chemistry

46. 3p orbital can have n = 3, l = 1 and m_l = 0

47. $E=\frac{hc}{\lambda}=\frac{6.6\times10^{-34}\times3\times10^{8}}{45\times10^{-9}}=0.44\times10^{-17}=4.4\times10^{-18}$ Joule

48.

$$V_{H_2}:V_{O_2}:V_{CH_4}=n_{H_2}:n_{O_2}:n_{CH_4}=\frac{1}{2}:\frac{1}{32}:\frac{1}{16}=16:1:2$$

49. The distance between the body-centred atom and one corner atom in the cube = $\frac{\sqrt{3}a}{2}$

50. Tyndall effect is not dependent on the charge on colloidal particles because it is an optical phenomenon.

51. Sodium carbonate is a salt of a weak acid and a strong base.

52. $\Delta T = iK_f m$
van't Hoff factor is the highest for $Al_2(SO_4)_3$.

53.

$$\underset{22.4\ \text{litre}}{H_2} + \underset{11.2\ \text{litre}}{Cl_2} \rightarrow 2HCl$$

1 mole ½ mole

Chlorine is a limiting reagent. Hence, 1 mole HCl is formed.

54.

$$\underset{0.1\ \text{mole}}{MnO_4^{2-}} \rightarrow \underset{0.1\ \text{mole}}{MnO_4^{-}} + e^-$$

Hence, for 1 mole = 0.1 × 96500 = 9650 C

55. We know

$$\Delta G^o = -2.303RT\log K_{sp}$$

$$63.3\times10^3 = -2.303\times8.314\times298\log K_{sp}$$

$$\log K_{sp} = -11.09$$

$$K_{sp} = 8\times10^{-12}$$

56.

$$n_{O_2} = \frac{5600}{22400} = \frac{1}{4}$$

$$\frac{W_{Ag}}{108} \times 1 = \frac{W_{O_2}}{M_{O_2}} \times 4$$

$$\frac{W_{Ag}}{108} = \frac{1}{4} \times 4 = 108g$$

57. For spontaneous adsorption of a gas, $\Delta S = -ve$, $\Delta H = -ve$.

58. According to the Le Chatelier's principle, the equilibrium shifts in the forward direction by increasing pressure and decreasing temperature.

59. Given:

$\Delta U = 2.1$ kcal

$\Delta S = 20$ cal K^{-1}

$T = 300$ K

$$\Delta H = \Delta U + \Delta n_g RT$$

$$\Delta H = 2.1 + \frac{2 \times 2 \times 300}{1000} = 3.3\text{kcal}$$

$$\Delta G = \Delta H - T\Delta S = 3.3 - 300 \times \frac{20}{1000} = 3.3 - 6 = -2.7\text{kcal}$$

60. Assuming $T_2 > T_1$, So, $K_p < K_p'$

61. The given options are not correct.

62. The reaction can be represented as

$$Mg \;+\; \tfrac{1}{2}O_2 \rightarrow MgO$$

$$\frac{1.0}{24} \qquad \frac{0.56}{32}$$

$$\frac{0.5}{12} \qquad \frac{0.07}{4}$$

$$\frac{0.5}{12} - x \qquad \frac{0.07}{4} - \frac{x}{2}$$

The limiting agent is oxygen.

$$\frac{0.07}{4} - \frac{x}{2} = 0$$

$$x = \frac{0.07}{2}$$

$$\text{Excess of Mg} = \frac{0.5}{12} - \frac{0.07}{2}\ \text{mole}$$

$$\text{Mass of Mg} = 1 - 0.7x12$$

$$= 0.16\ \text{gm}$$

63. $FeCl_2$ and $SnCl_2$. They are reducing agents and have lower oxidation states.

64. $Li^{+} = Be^{2+} = 1s^2$

65. NH_3 (μ = 1.47D) has the maximum dipole moment.

66. NO_3^- has triangular planar geometry.

67. $H_2O < H_2S < H_2Se < H_2Te$

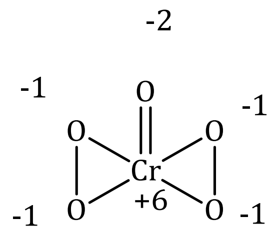
68. H_2O_2 acts as a reducing agent in both reactions.

$H_2O_2 + O_3 \rightarrow H_2O + 2O_2$

$H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$

69. The artificial sweetener which is stable under cold conditions only is aspartame.

70. Oxidation state of Cr is +6.



71. $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

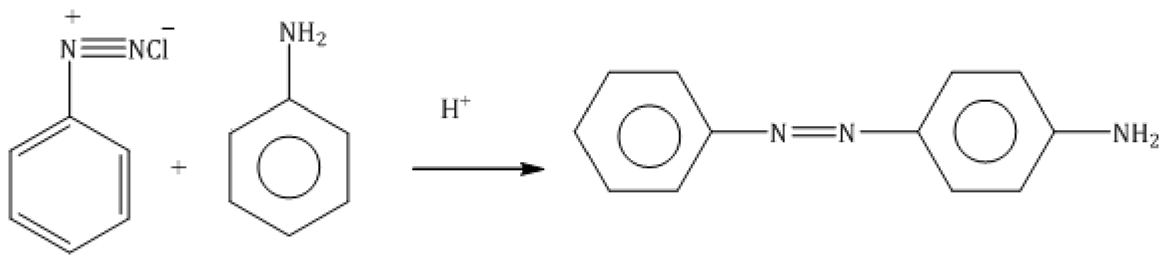
72. $[Fe(H_2O)_6]^{3+}$
$Fe^{2+} = 3d^5(t_{2g}^3, e_g^2)$
Hence, CFSE = 0

73. Since $\mu = 2.83$, n = 2
Hence, $Ni^{2+} = 3d^8$

74. Cis-$[PtCl_2(NH_3)_2]$ is used as an anticancer agent.

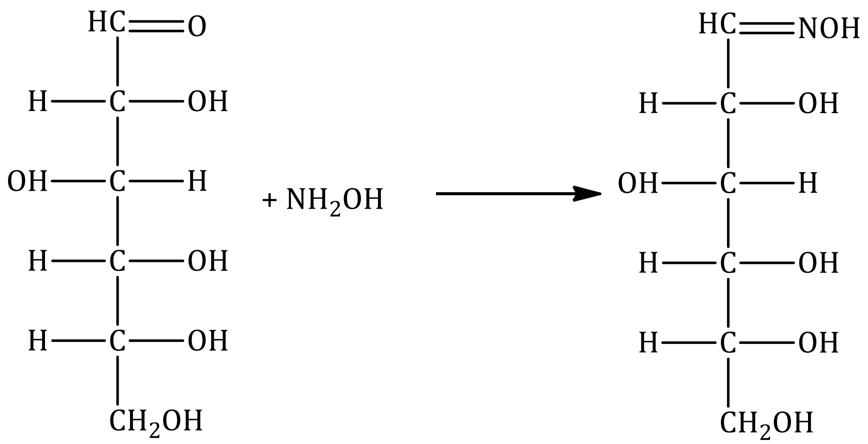
75. Lanthanoid contraction is due to negligible screening of 'f' orbitals.

76.



77. Because of conjugation, benzene diazonium chloride is stable.

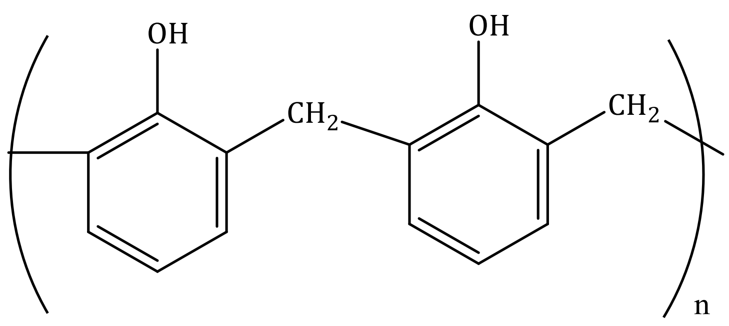
78.



D(+)glucose Oxime

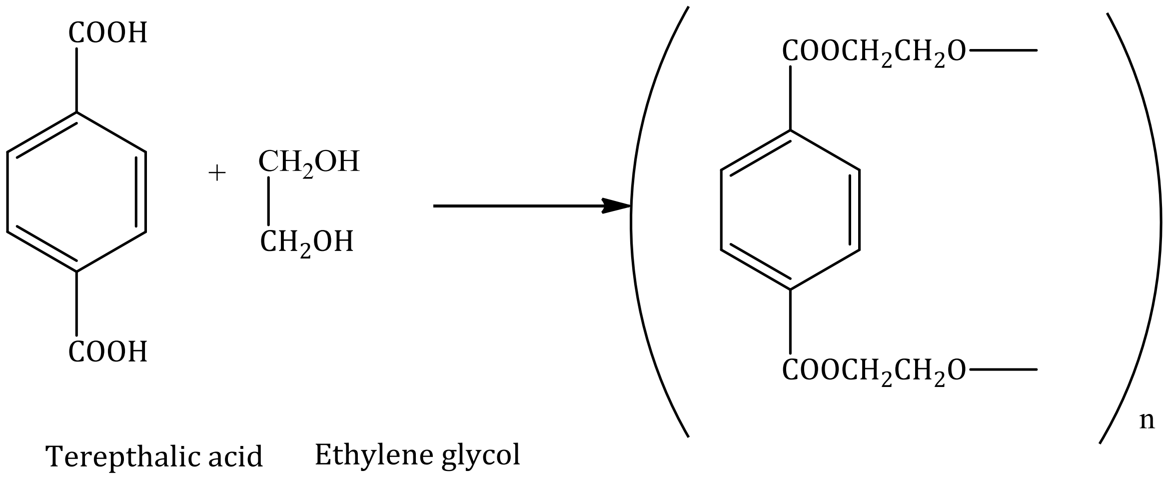
79. Adrenaline hormone is produced under the condition of stress which stimulates glycogenolysis.

80.



Bakelite is an example of thermosetting polymer.

81.

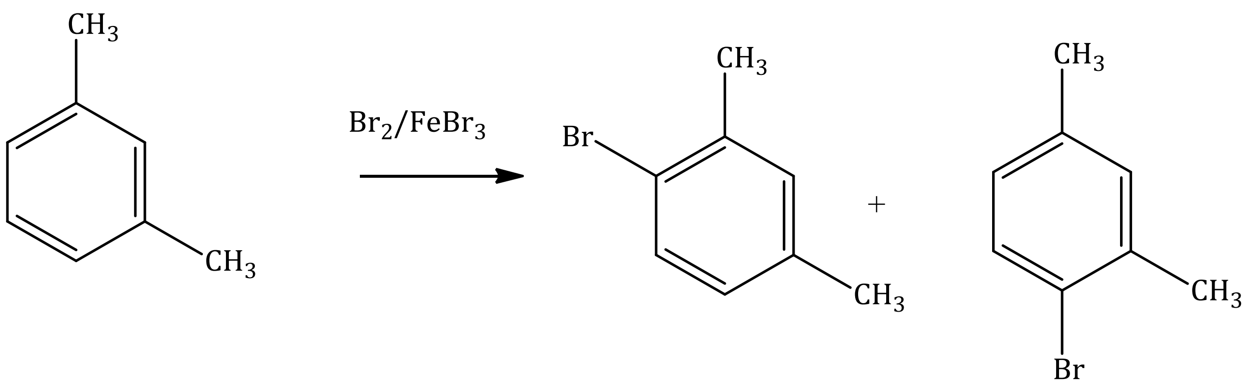


Terepthalic acid Ethylene glycol

82. Chlorofluorocarbon is not a common component of photochemical smog.

83. % of Nitrogen $= \dfrac{1.4 \times 2 \times 10}{0.75} = 37.33\%$

84.



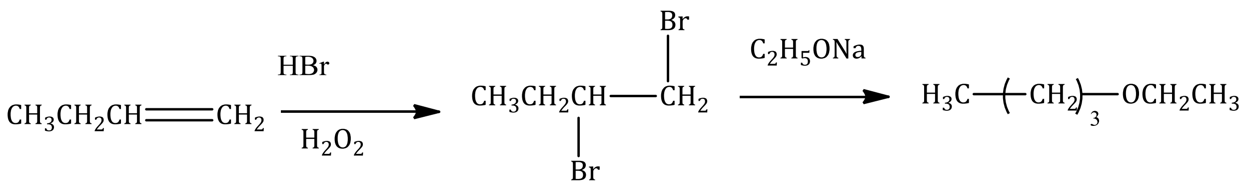
85. The options provided are not correct.

86. $C_6H_5OH + NaOH \rightarrow C_6H_5ONa \xrightarrow[S_N2]{CH_3I} C_6H_5 - OCH_3$

87. o-nitrophenol will not be soluble in sodium hydrogen carbonate. This is because it is a weaker acid than carbonic acid.

88. The nitro group is an electron-withdrawing group and favours nucleophilic attack.

89.



90. Ethyne and CO_2 both have sp-hybridised carbon.

Biology

91. *Spirogyra* shows isogamy and possesses non-flagellated gametes.

92. The main criteria for the five kingdom classification by Whittaker are based on cell type, thallus organisation, nutrition, reproduction and phylogenetic relationship. It does not take into account the presence or absence of a well-defined nucleus.

93. *Amanita muscaria* produces the psychoactive compound muscimol, which is a hallucinogen.

94. The cell membrane of eubacteria is made of peptidoglycan, while that of archaebacteria is made of pseudomurein.

95. In *Chara*, sex organs are developed on the adaxial surface of the lateral branches on almost each node, and the female sex organ is present above the male sex organ.

96. *Sphagnum* (moss) is a source of peat which is used as a fuel.

97. The entire tomato fruit which includes both placenta and pericarp is edible.

98. In imbricate aestivation, the margins of the sepals and petals overlap with one another but not in any particular direction. Example: Gulmohar

99. In the stems of dicot plants, the protoxylem lies towards the centre and the metaxylem lies towards the periphery. This arrangement of the primary xylem is called endarch. While in the roots of dicot plants, the protoxylem lies towards the periphery and the metaxylem lies towards the centre. This arrangement of the primary xylem is called exarch.

100. Mango is a seed-bearing fruit. Sterile stamens are called staminodes. Seeds in grasses are endospermic.

101. The ends of tracheids are not perforated, while the tracheary elements are.

102. Potato is an example of an underground edible stem.

103. Mesosomes help in respiration in bacteria and are thus analogous to mitochondria.

104. Microfilaments are long, cylindrical rods or protein filaments of approximately 6 nm in diameter and made of actin protein.

105. Vacuoles maintain the osmotic expansion of a cell kept in water.

106. During the S phase, the amount of DNA per cell doubles. Thus, at the G_2 phase, the amount of DNA is 4C if the initial amount of DNA in the cell is 2C.

107. The centriole and basal body of cilia or flagella are similar. Chlorophyll pigments are present in thylakoids. Cristae are the infoldings in mitochondria. Ribozyme enzyme is not a protein but a chemzyme having an RNA origin.

108. F. Went isolated auxin from the *Avena* coleoptile tip.

109. The deficiency symptoms of nitrogen, potassium and magnesium are visible first in the senescent leaves, as these are mobile elements in the plant.

110. During lactate fermentation, pyruvic acid is reduced to lactic acid by lactate dehydrogenase. The reducing agent is NADH + H^+ which is oxidised to NAD^+. During this fermentation, CO_2 is not released.

111. In *Rhodospirillum*, photosynthesis is not associated with the release of oxygen as the plant lacks PSII.

112. Etiolation is the process by which seedlings turn pale in the absence of light.

113. Abscisic acid stimulates the stomata to close under various kinds of stresses. Hence, it is called a stress hormone.

114. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called geitonogamy. Functionally, it is cross-pollination, but genetically, it is self-pollination.

115. In angiosperms like *Lilium*, the male gametophyte is highly reduced and is called pollen grain which is a 3-celled structure.

116. When many small fruits, called fruitlets, develop from a single flower, they are called an etaerio of fruitlets, and such fruitlets develop from a multicarpellary, apocarpous ovary.

117. Pollen grains are rich in nutrients and are used as food supplements in the form of pollen tablets.

118. The filiform apparatus present at the micropylar part of the synergids guides the entry of the pollen tube.

119. Non-albuminous seeds have no residual endosperms because of their complete use during embryo development.

120. RNA serves as the genetic material in tobacco mosaic virus which is enclosed in a protein coat, called capsid, made of capsomeres.

121. Transcription is the process of writing information from DNA to mRNA.

122. F. Griffith, a British medical officer, discovered transformation in 1928 in the microorganism *Streptococcus pneumoniae*.

123. Fruit colour in summer squash is an example of dominant epistasis.

124. Viruses consist of DNA or RNA as the genetic material enclosed within a protein coat.

125. Human insulin was the first human hormone to be synthesised using hybridoma technology.

126. PCR is used for DNA amplification, which is not done in the Southern hybridisation technique.

127. PCR and RAPD technique are used for the characterisation of *in vitro* clonal propagation in plants.

128. Chlorella is rich in protein and is used as a food supplement.

129. Plasmid can clone only a small fragment of DNA, while BACs, YACs and cosmids are used for cloning larger fragments of DNA.

130. Seed bank is a common example of *ex situ* conservation.

131. Lichens are good indicators of pollution; they do not grow well in polluted areas.

132. Earthworms are detritivores. The invading species in a new area in succession are called pioneer species. Pollination is a form of ecosystem service, while natality (birth rate) is related to population growth.

133. A species facing an extremely high risk of extinction in the immediate future is called critically endangered.

134. The ozone layer helps trap harmful ultraviolet radiation from the Sun. It is located in the stratosphere about 10–50 km above the Earth's surface.

135. The International Union of Conservation of Nature and Natural Resources maintains the Red Data Books of threatened species.

136. Cnidaria represents a group of both marine and freshwater organisms.

137. *Gorgonia* belongs to Anthozoa; thus, it is an animal and lacks a cell wall.

138. *Planaria* has the maximum capacity for regeneration.

139. *Torpedo* – or electric ray is an electric fish.

140. Areolar and adipose tissues are loose connective tissues, while cartilage is a specialised connective tissue and tendon is a dense connective tissue.

141. The cells lining the tubular part of the nephron are cuboidal epithelial cells; they increase the surface area for reabsorption in nephron greatly.

142. During the S phase, the DNA replicates and its amount in the cell doubles.

143. Flagella are the locomotory organs in bacteria.

144. Malonate is a competitive inhibitor of succinate for the enzyme succinic dehydrogenase. Increased concentration of succinate removes the inhibitory effect of malonate.

145. Sucrose cannot donate electrons and hence is a non-reducing sugar.

146. Recombination occurs during pachytene, and thus, recombinase is needed during this phase.

147. In humans, the initial step in the digestion of milk is carried out by rennin.

148. Fructose is absorbed with the help of carrier ions such as Na^+. This mechanism is called facilitated transport.

149. Carbon dioxide is mainly transported in the form of bicarbonate dissolved in the plasma.

150. A person with AB blood group has both A and B antigens on RBC but do not possess any antibodies in the plasma.

151. The parasympathetic nervous system secretes acetylcholine which decreases both heart rate and cardiac output.

152. Increased levels of aldosterone help in reabsorption of sodium from the distal convoluted tubules.

153. The joint between carpals is the gliding joint.

154. The neuromuscular junction is the junction between the motor neuron and muscle fibre, where stimulation of muscle fibre takes place by the motor neuron.

155. Hypothalamus is involved in thermoregulation of the body.

156. Retinal is an aldehyde derivative of vitamin A.

157. The pineal gland secretes melatonin and acts as the biological clock of the body. Oxytocin is synthesised by the hypothalamus, atrial natriuretic factor is secreted by the atrial wall of the heart and progesterone maintains pregnancy.

158. In fight or flight mode, the emergency hormones (epinephrine and norepinephrine) are secreted by the adrenal medulla.

159. In human males, the urethra is the common urinogenital duct which carries both urine and sperm.

160. The chief function of the corpus luteum is to secrete progesterone which helps maintain pregnancy.

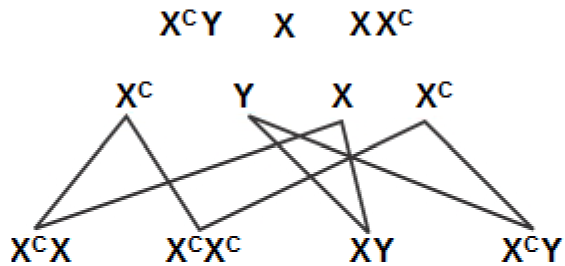
161. In pregnant females, hCG maintains the corpus luteum which secretes oestrogen and progesterone.

162. Tubectomy is a surgical method wherein a small part of the fallopian tube is removed or tied up.

163. LNG-20 is a hormone-releasing IUD which releases progesterone and prevents oogenesis and ovulation.

164. In IVF, the embryo up to the 8-celled stage or the zygote is transferred into the fallopian tube.

165. Of the two male offspring, one is colourblind; thus, 50% of the male children are colourblind.



166. According to the Hardy–Weinberg principle,
$(p + q)^2 = 1$
AA – p^2 = 360 out of 1000 individuals
Therefore, p^2 = 36 out of 100 individuals and q^2 = 16 out of 100 individuals
Hence, $q = \sqrt{0.16} = 0.4$
Since $p + q = 1$; therefore, $p = (1 - 0.4) = 0.6$

167. Turner's syndrome is caused by the absence of one of the X chromosomes in females.

168. RNA polymers catalyse polymerisation in one direction, i.e. the $5' \rightarrow 3'$ direction, and the template strand is read in the $3' \rightarrow 5'$ direction.

169. BAC and YAC are the commonly used vectors for the human genome sequence as they support larger DNA fragments.

170. Forelimbs of cat, lizard, whale and bat are examples of homologous organs as they have the same bone structure but perform different functions.

171. Gills of prawn and the lungs of man are analogous organs as they perform the same function but are structurally different.

172. The plant in the diagram is *Datura* which has hallucinogenic properties.

173. AIDS symptoms appear only in the late stages when large amounts of helper T cells are destroyed.

174. Even in a virus-infected plant, the meristem (apical and axillary tissues) is free of virus.

175. Bacteria in anaerobic sludge digesters produce a mixture of gases which contain methane, hydrogen sulphide and carbon dioxide.

176. Every winter, thousands of migratory birds coming from Siberia and other cold northern regions visit the Keoladeo National Park in Rajasthan.

177. A – Detritus
B – Rock minerals
C – Producer
D – Litter fall

178. The dominant group of invertebrates is insects, followed by molluscs, crustaceans and finally the other animal groups.

179. A scrubber in the exhaust system of a chemical industrial plant can remove gases such as SO_2 in which the exhaust is passed through a spray of water or lime.

180. 0.02 J of energy will be passed to peacock in the given food chain as only 10% of the total energy is transferred to successive tropic levels.