RITS-18
JEE MAINS-2020
ANSWER KEY
Code:

MATHEMATICS		PHYSICS		CHEMISTRY	
1	3	1	2	1	4
2	4	2	4	2	1
3	3	3	1	3	2
4	4	4	3	4	4
5	1	5	4	5	2
6	1	6	1	6	2
7	3	7	3	7	3
8	4	8	4	8	2
9	3	9	3	9	2
10	1	10	4	10	3
11	3	11	3	11	3
12	1	12	4	12	1
13	2	13	2	13	3
14	3	14	4	14	1
15	4	15	2	15	3
16	4	16	4	16	2
17	3	17	1	17	4
18	1	18	3	18	2
19	3	19	3	19	3
20	2	20	3	20	2
1	6	1	2	1	4
2	7	2	2	2	8
3	4	3	3	3	4
4	1	4	0	4	2
5	2	5	3	5	5

HINTS & SOLUTIONS

1. Ans. (3)

$$0 < |z-1| - \frac{1}{2} \le 1$$

$$\frac{1}{2} < |z-1| \le \frac{3}{2}$$

2. Ans. (4)

(4) is incorrect as $\arg\left(\frac{z_2 - z}{z_1 - z}\right)$ can be 0 or π

3. Ans. (3)

$\cos x = 2a^2 - 1$

$2a^2 - 1 = 1$ or $2a^2 - 1 = -1$ or $2a^2 - 1 = 0$

$a = \pm 1$ or $a = 0$ or $a = \pm\frac{1}{\sqrt{2}}$

4. Ans. (4)

$P(H) = \frac{5}{13}$ $\quad$ $P(W) = \frac{3}{7}$

$P(\text{at least}) = 1 - \frac{8}{13} \times \frac{4}{7} = \frac{59}{91}$

5. Ans. (1)

$$P\left(A \cup \left(\bar{A} \cap B\right)\right) = P\left(\left(A \cup \bar{A}\right) \cap \left(A \cup B\right)\right)$$

$= P(A \cup B) = \alpha + \beta - \gamma$

6. Ans. (1)

Sum of coefficient expression

$= [2 + \sin(\sin^{-1} {}^nC_r)]^{n-r}$

$= (2 + {}^nC_r)^{n-r}$ $\quad$ ${}^nC_r = 1$

$= 3^n$ or 1 $\quad$ $r = 0$ or n

7. Ans. (3)

A,B and C can enter the queue at eight positions in the order A,B & C

$\therefore {}^8C_3 = 56$

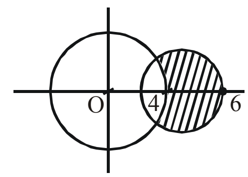
8. Ans. (4)

All throws are independent

$\therefore P = \frac{1}{6}$

9. Ans. (3)

$M - m = 6 - 4 = 2$



10. Ans. (1)

T_{r+1} in $(1 - 2x^2)^6 = {}^6C_r(-2)^r x^{2r}$

$\therefore$ coeff. of $x^4 = 1 \times {}^6C_2(-2)^2 - {}^6C_1(-2) - {}^6C_0$

$= 60 + 12 - 1 = 72 - 1 = 71$

11. Ans. (3)

$4b^2 = ac$ ....(i)

$b = -a + 2c$ ....(ii)

(i)/(ii)

$4b = \frac{ac}{-a+2c} \Rightarrow -16b = \frac{2(-a)(2c)}{-a+2c}$

$\Rightarrow$ $-a, -16b$ & $2c$ are in H.P.

12. Ans. (1)

PRILITY OBAB

$$P = \frac{\frac{8!}{2!}}{\frac{11!}{2!2!}} = \frac{1}{495}$$

13. Ans. (2)

$$(1 + x)^{10} = \sum_{r=0}^{10} {}^{10}C_r x^r \Rightarrow 10(1 + x)^9$$

$$= \sum_{r=0}^{10} {}^{10}C_r\, r.x^{r-1} = 10.2^9$$

$\therefore$ Reqd. value $= 2^{10} - 2.10.2^9$

$= 2^{10} - 10.2^{10} = -9.2^{10} = -3^2.4^5$

14. Ans. (3)

$(z + 6)^3 = 3^3 \Rightarrow z + 6 = 3$ or 3ω or $3\omega^2$

$z_1 = -3$; $z_2 = -6 + 3\omega$; $z_3 = -3 + 3\omega^2$

are vertices of an equilateral Δ.

15. Ans. (4)

Since $B \cap C$ and A are independent events

$P\left(B \cap C / A\right) = P\left(B \cap C\right)$

16. Ans. (4)

$\angle C = 90^\circ$

$\therefore\ \Delta = \frac{1}{2}ab$

$\therefore\ \sqrt{s(s-a)(s-b)(s-c)} = \frac{1}{2}ab$

$4s(s-a)(s-b)(s-c) = a^2b^2$

17. Ans. (3)

The vertices can be treated as roots of

$z^{72} = 1\ \ \&\ \ z^{108} = 1$

$\therefore$ Number of common vertices

= Number of common roots

= G.C.D (72,108) = 36

18. Ans. (1)

$$P = \frac{6\times5\times4\times3}{6^4} = \frac{5}{18}$$

19. Ans. (3)

$a^2 - (b-c)^2 = \Delta$

$\Rightarrow (a+c-b)(a+b-c) = \Delta$

$\Rightarrow 2(s-b)\,2(s-c) = \sqrt{s(s-c)(s-b)(s-c)}$

$\Rightarrow 16(s-b)^2(s-c)^2 = s(s-a)(s-b)(s-c)$

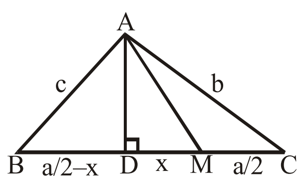
$$16 = \frac{s(s-a)}{(s-b)(s-c)} \Rightarrow \cot\frac{A}{2} = 4 \Rightarrow \tan\frac{A}{2} = \frac{1}{4}$$

$$\therefore\ \tan A = \frac{8}{15}$$

20. Ans. (2)

$$AD^2 = c^2 - \left(\frac{a}{2} - x\right)^2$$

$$= b^2 - \left(\frac{a}{2} + x\right)^2$$



$$\Rightarrow\quad c^2 + ax = b^2 - ax \quad\Rightarrow\quad x = \frac{b^2 - c^2}{2a}$$

1. (6)

$$y = ax^2 + bx + \frac{7}{2} \Rightarrow \frac{dy}{dx} = 2ax + b$$

(1, 2) lies on the curve

$$\Rightarrow \quad 2 = a + b + \frac{7}{2}$$

$$\Rightarrow \quad a + b = -\frac{3}{2} \qquad \text{...(i)}$$

Now, $\left.\frac{dy}{dx}\right|_{(1,\,2)} = 2a + b$ (slope of tangent)

For $y = x^2 + 6x + 10$,

$$\frac{dy}{dx} = 2x + 6$$

$$\Rightarrow \left.\frac{dy}{dx}\right|_{(-2,\,2)} = 2$$

$\therefore$ Slope of normal = $-\frac{1}{2}$ ....(ii)

Then 2a + b = $-\frac{1}{2}$

Solving (i) and (ii), a = 1 and $b = -\frac{5}{2}$.

$\therefore$ a – 2b = 6

2. 7

Let equation of secant be

$$\frac{x-2}{\cos\theta} = \frac{y-2}{\sin\theta} = r \quad \text{(Parametric form)}$$

Solving it with ellipse, we get $\frac{(r\cos\theta + 2)^2}{25} + \frac{(r\sin\theta + 2)^2}{16} = 1$

$$r^2\left(16\cos^2\theta + 25\sin^2\theta\right) + r\left(64\cos\theta + 100\sin\theta\right) - 236 = 0$$

$$|r_1r_2| = PA.PB = \left|\frac{-236}{16\cos^2\theta + 25\sin^2\theta}\right| = \left|-\frac{236}{16 + 9\sin^2\theta}\right|$$

Max. PA.PB = $\frac{236}{16} = \frac{59}{4}$

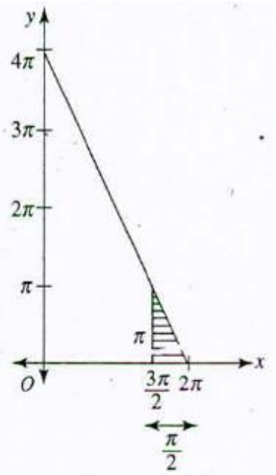
3. 4

y = |cos^{-1} (sin x) | – |sin^{-1} (cos x)|

$$= \left|\frac{\pi}{2} - \sin^{-1}(\sin x)\right| - \left|\frac{\pi}{2} - \cos^{-1}(\cos x)\right|$$

$$= \left|\frac{\pi}{2} - (x - 2\pi)\right| - \left|\frac{\pi}{2} - (2\pi - x)\right|$$

$$= \left|\frac{5\pi}{2} - x\right| - \left|x - \frac{3\pi}{2}\right| = \left(\frac{5\pi}{2} - x\right) - \left(x - \frac{3\pi}{2}\right) = 4\pi - 2x$$



Required area = Area of shaded triangle in figure $=\frac{1}{2}\times\left(\frac{\pi}{2}\right)\times\pi=\frac{\pi^2}{4}$

Hence, k = 4.

4. 1

Any normal to ellipse $\frac{x^2}{36}+\frac{y^2}{25}=1$ is :

$6x \sec\theta - 5y \operatorname{cosec}\theta - 11 = 0$

Its distance from origin is :

$$L=\frac{11}{\sqrt{36\sec^2\theta+25\operatorname{cosec}^2\theta}}$$

$$=\frac{11}{\sqrt{36\left(1+\tan^2\theta\right)+25\left(1+\cot^2\theta\right)}}$$

$$=\frac{11}{\sqrt{36\tan^2\theta+25\cot^2\theta+61}}$$

Using A.M. ≥ G.M.

$\Rightarrow \quad \frac{36\tan^2+25\cot^2\theta}{2}\geq 30$

$\Rightarrow \quad 36\tan^2\theta+25\cot^2\theta+61\geq 121$

$\therefore$ Maximum value of L = 1.

5. 2

Substituting $\left(\frac{a}{e},0\right)$ in y = – 2x + 1, we get $0=-\frac{2a}{e}+1$

$\Rightarrow \quad \frac{2a}{e}=1 \quad \Rightarrow \quad a=\frac{e}{2}$

Also, $1=\sqrt{a^2m^2-b^2}$

$\Rightarrow \quad 1=a^2m^2-b^2$

$\Rightarrow \quad 1=4a^2-b^2$

$\Rightarrow \quad 1=\frac{4e^2}{4}-b^2$

$\Rightarrow \quad b^2=e^2-1$

Also, $b^2=a^2\left(e^2-1\right)\ \therefore\ a=1,\ e=2$

31. Ans. (2)

Sol. Some of the characteristics of an optical fibre are as follows

(i) This works on the principle of total internal reflection.

(ii) It consists of core made up of glass/silica/plastic with refractive index n_1, which is surrounded by a glass or plastic cladding with refractive index n_2 ($n_2 > n_1$). The refractive index of cladding can be either changing abruptly or gradually changing (graded index fibre).

(iii) There is a very little transmission loss through optical fibres.

(iv) There is no interference from stray electric and magnetic field to the signals through optical fibres.

32. Ans. (4)

Sol. Few advantages of optical fibres are that the number of signals carried by optical fibres is much more than that carried by the Cu wire or radio waves. Optical fibres are practically free from electromagnetic interference and problem of cross talks whereas ordinary cables and microwaves links suffer a lot from it.

33. Ans. (1)

Sol. For efficient radiation and reception the height of the transmitting and receiving antennas should be comparable to a quarter wavelength of the signal used.

Therefore FM has shorter antenna and AM has longer antenna.

34. Ans. (3)

Sol. In ground wave propagation, radio waves travel along the surface of the earth (following the curvature of earth). Ground wave propagation can be sustained only at low frequencies (~500 kH to 1500 kHz) or for radio broadcast at long wavelengths.

Satellite communication is useful for the frequencies above 30 MHz which takes place through tropospheric space. The phenomenon involved in the sky wave propagation is total internal reflection.

35. Ans. (4)

Sol. Given R = 1 kΩ

or $R = 1 \times 10^3$

$C = 1\ \mu F$

$C = 1 \times 10^{-6}$ F

In this condition frequency of carrier signal

$$\frac{1}{RC} << f_c$$

$$\frac{1}{1\times10^3\times10^{-6}} << f_c$$

$\therefore$ $f_c >> 1$ kHz

Because frequency grater than 1

so $f_c = 10$ kHz

36. Ans. (1)

Sol. Ground wave propagation is for low frequency transmission

37. Ans. (3)

Sol. As shown, we conclude that A and C are analogue signals but B is digital signal.

38. Ans. (4)

Sol. Number density of atoms in silicon specimen $= 5 \times 10^{28}$ atoms-m^{-3} $= 5 \times 10^{22}$ atoms cm^{-3}.

Since, 1 atom of indium is doped in 5×10^7 silicon atoms, so total number of indium atoms doped per cm^3 of silicon will be

$$n = \frac{5\times10^{22}}{5\times10^{7}} = 10^{15}\ \text{atoms-cm}^{-3}$$

39. Ans. (3.)

Sol. If the voltage of the DC source is increased then both conductor and semiconductor registers same current ie, semiconductor is in forward biased condition and it conducts. So, ammeters connected to both semiconductor and conductor will register the same current.

40. Ans. (4)

Sol. The collector current

$$I_C = \beta I_b = \frac{2}{2\times10^3}\ A$$

$$I_C = 1 \times 10^{-3}\ A$$

The base current

$$I_b = \frac{10^{-3}}{200}\ A$$

$$I_b = 5 \times 10^{-6}\ A$$

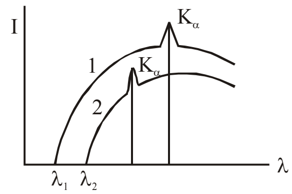
$$I_B = 5\ \mu A$$

41. Ans. (3)

Sol. The reverse current is identical in two diodes if the identical reverse bias is applied across the diodes.

42. Ans. (4)

Sol. $\lambda_{min} = \frac{hc}{eV}$



$\Rightarrow \quad \lambda \propto \frac{1}{V}$

$\because \quad \lambda_2 > \lambda_1$

$\Rightarrow \quad V_1 > V_2$

$\sqrt{v} = a(Z - b)$ Moseley's law

$v \propto (Z-1)^2$

$\Rightarrow \quad \lambda \propto \frac{1}{(Z-1)^2} \quad \left(\because v \propto \frac{1}{\lambda}\right)$

$\lambda_1 > \lambda_2$ (see graph for characteristic lines)

$\Rightarrow Z_2 > Z_1$

43. Ans. (2)

Sol. The graph between stopping potential and frequency is a straight line, so stopping potential and hence, maximum kinetic energy of photoelectrons depends linearly on the frequency.

44. Ans. (4)

Sol. The cut-off voltage or stopping potential measures maximum kinetic energy of the electron. It depends on the frequency of incident light where as the current depends on the number of photons incident. Hence, cutoff voltage will be 0.5 V. Now by inverse square law,

$$12 \propto \frac{1}{(0.2)^2} \text{ or } I \propto \frac{1}{(0.4)^2}$$

$$\therefore \quad \frac{I}{12} = \frac{(0.2)^2}{(0.4)^2} = \frac{1}{4}$$

or $\quad I = \frac{12}{4} = 3\text{mA}$

45. Ans. (2)

Sol. $mvr = \frac{nh}{2\pi}$, according to Bohr's theory

$\Rightarrow 2\pi r = n\left(\frac{h}{mv}\right) = n\lambda$ for $n = 2$, $\lambda = \pi r$

46. Ans. (4)

Sol. $qE = mg \quad \text{...(i)}$

$6\pi\eta r v = mg$

$\frac{4}{3}\pi r^3 \rho g = mg \quad \text{...(ii)}$

$\therefore \; r = \left(\frac{3mg}{4\pi\rho g}\right)^{1/3} \quad \text{...(iii)}$

Substituting the value of r in Eq. (ii), we get

$$6\pi\eta\nu = \left(\frac{3mg}{4\pi\rho g}\right)^{1/3} = mg$$

or $$(6\pi\eta\nu)^3 = \left(\frac{3mg}{4\pi\rho g}\right) = (mg)^3$$

Again substituting mg = qE, we get

$$(qE)^3 = \left(\frac{3}{4\pi\rho g}\right)(6\pi\eta\nu)^3$$

or $$qE = \left(\frac{3}{4\pi\rho g}\right)^{1/3}(6\pi\eta\nu)^{3/2}$$

$$\therefore \quad q = \frac{1}{E}\left(\frac{3}{4\pi\rho g}\right)^{1/2}(6\pi\eta\nu)^{3/2}$$

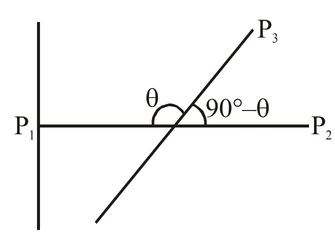
Substituting the values, we get

$$q = \frac{7}{81\pi \times 10^5}\sqrt{\frac{3}{4\pi \times 900 \times 9.8} \times 216\pi^3}$$

$$\times \sqrt{\left(1.8 \times 10^{-5} \times 2 \times 10^{-3}\right)^3} = 8.0 \times 10^{-19} \text{ C}$$

47. Ans. (1)

Sol. Let initial intensity of light is I_0. So intensity of light after transmission from first polaroid $= \frac{I_0}{2}$.



Intensity of light emitted from P_3

$$I_1 = \frac{I_0}{2}\cos^2\theta$$

Intensity of light transmitted from last polaroid

$$P_2 = I_1 \cos^2(90° - \theta)$$

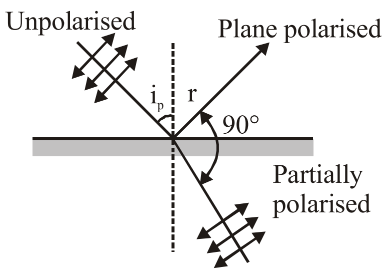
$$P_2 = \frac{I_0}{2}\cos^2\theta \sin^2\theta$$

$$P_2 = \frac{I_0}{8}(2\sin\theta\cos\theta)^2$$

$$P_2 = \frac{I_0}{8}\sin^2 2\theta$$

48. Ans. (3)

Sol. From Brewster's law reflected ray is perpendicular to refracted ray.



The reflected ray os obtained is plane polarized having is electric vector in the plane of incidence.

49. Ans. (3)

Sol. The equation of nth principal maximum for wavelength λ is given by

$$(a + b)\sin\theta = n\lambda$$

where a is the width of transparent portion and b is that of opaque portion. The width (a + b) is called the grating element.

The spectral lines will overlap, ie, the will have the same angle of diffraction of

$$n_2\lambda_2 = n_1\lambda_1$$

or $$\frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$$

50. Ans. (3)

Sol. Angular fringe width is the ratio of fringe width to distance (D) of screen from the source ie.

$$\theta = \frac{\beta}{D}$$

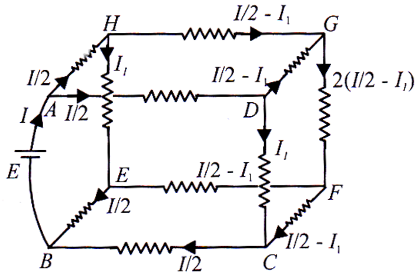
As D is taken large, hence angular fringe width of the central maximum will decrease.

1. 2

Capacitor will get optened and R_1 is shorted.

2. 2

3. 3



Let a battery of e.m.f. E is applied between points A and B. Let a current I enter through point A. The current distribution is shown in the figure.

If R_{AB} is a equivalent resistance between points A and B, then from Ohm's law

$R_{AB}\, I = E$ ......(i)

Applying Kirchhoff's second law to mesh DGFC, we get

$$\left(\frac{1}{2}-I_1\right)R+(I-2I_1)R+\left(\frac{1}{2}-I_1\right)R-I_1R=0 \Rightarrow I_1=\frac{2}{5}I$$

......(ii)

Applying Kirchooff's second law to external circuit AHEBA, we get

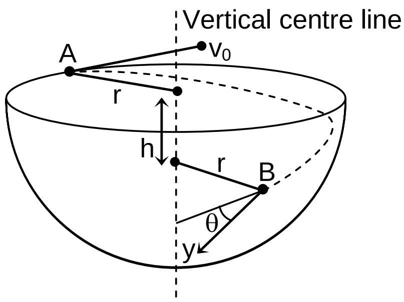
$$E = \frac{I}{2}R+I_1R+\frac{I}{2}R \quad ......(iii)$$

Solving Eqs. (i), (ii) and (iii), we get R_{AB} =

$$\frac{7}{5}R=\frac{7}{5}\times\frac{15}{7}=3\Omega$$

4. 0

5. 3



Angular momentum of the particle is conserved about the vertical centre line

$mv_0r_0 = mvr\cos\theta$

where conservation of mechanical energy gives,

$$\frac{1}{2}mv_0^2+mgh=\frac{1}{2}mv^2$$

$$r^2=r_0^2-h^2$$

$$\cos\theta=\frac{1}{\sqrt{1+\frac{2gh}{v_0^2}}\sqrt{1-\frac{h^2}{r_0^2}}}$$

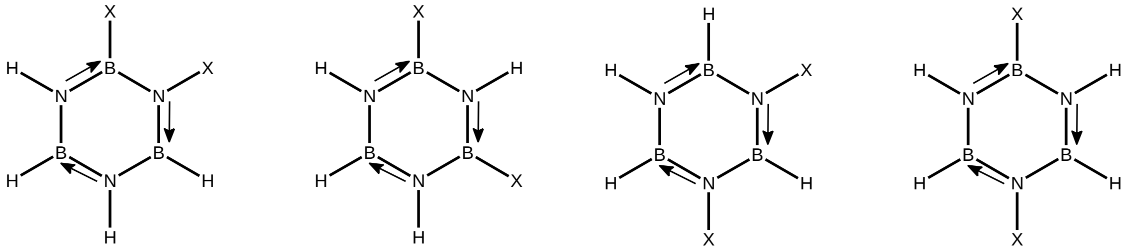
PART C - CHEMISTRY

60. **Ans. (1)**
61. **Ans. (4)**
62. **Ans. (1)**
63. **Ans. (2)**
64. **Ans. (4)**
65. **Ans. (2)**
66. **Ans. (2)**
67. **Ans. (3)**
68. **Ans. (2)**
69. **Ans. (2)**
70. **Ans. (3)**
71. **Ans. (3)**
72. **Ans. (1)**
73. **Ans. (3)**
74. **Ans. (1)**
75. **Ans. (3)**
76. **Ans. (2)**
77. **Ans. (4)**
78. **Ans. (2)**
79. **Ans. (3)**
80. **Ans. (2)**

1. 4

2. 8

3. 4



4. 2

It is EAS–OH is O & p directing group

5. 5

$\frac{3+7}{2}=5$, Claisen rearrangement