

**RITS-37**  
**JEE ADVANCED-2019**  
**ANSWER KEY**  
**Code: 120313**

<b>CHEMISTRY</b>		<b>PHYSICS</b>		<b>MATHEMATICS</b>	
1	B	1	B	1	B
2	C	2	D	2	D
3	B	3	D	3	C
4	D	4	B	4	D
5	A	5	D	5	D
6	B	6	D	6	B
7	B	7	A	7	D
8	D	8	C	8	B
9	ABC	9	ABD	9	AD
10	BD	10	AD	10	CD
11	B	11	AC	11	BD
12	ABD	12	ABC	12	ABD
1	3	1	3	1	3
2	2	2	0	2	1
3	8	3	5	3	6
4	5	4	2	4	0
5	5	5	8	5	4
6	0	6	5	6	4
1	A – PQRS B – PRS C – PS D – PRS	1	A – RST B – QRST C – PQ D – QRST	1	A – QR B – RS C – PS D – PS
2	A – S B – P C – Q D – R	2	A – QRS B – PQR C – PQRS D – PS	2	A – R B – Q C – P D – S

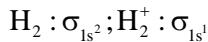
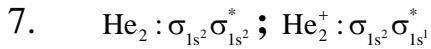
## **CHEMISTRY**

2. -I effect at dienophile favour Diels

3. Methyl orange indicator

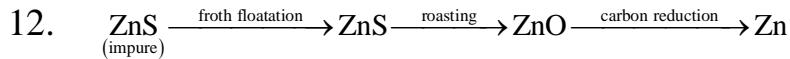
4. B

$$E_{af} - E_{ab} = \Delta h$$



8.  $\text{BeF}_2 > \text{BaF}_2 > \text{SrF}_2 > \text{CaF}_2 > \text{MgF}_2$  - solubility

9. Edmans reagent used for N-Terminal



13. Conceptual

14. PTC are used in Riemer tiemann

15. Conceptual

16. 5

At  $\frac{3}{4}$ <sup>th</sup> of the equivalence point,

$$P_{\text{OH}}^{\text{eq}} = P_{\text{Kb}} + \log \left[ \frac{5}{3} \right]$$

$$P_{\text{OH}}^{\text{eq}} = P_{\text{Kb}} + \log \left( \frac{3/4}{1/4} \right)$$

$$P_{\text{OH}}^{\text{eq}} = P_{\text{Kb}} + \log(3)$$

$$P_{\text{H}} = 14 - P_{\text{OH}}^{\text{eq}}$$

$$= 14 - P_{\text{Kb}} - \log(3)$$

$$\Rightarrow 14 - P_{\text{Kb}} = 9 \Rightarrow P_{\text{Kb}} = 5$$

$$\therefore P_{\text{Kb}} = 5$$

$$\therefore K_b = 10^{-5} \quad \therefore n = 5$$

17. Sulphides of Sn,As and Sb are soluble in YAS

18.  $[\text{CuCl}_2\text{Br}_2]^{2-}$  is a tetrahedral complex

## PHYSICS

21. Dimension of Energy is  $[ML^2T^{-2}]$

So,  $[PM] = [ML^2T^{-2}]$ , Hence  $P = [L^2T^{-2}]$

$[QM^{-1}LT^{-2}] = [ML^2T^{-2}]$ , Hence  $Q = [M^2L]$

$[RMLT^{-1}] = [ML^2T^{-2}]$ , Hence  $R = [LT^{-1}]$

Hence option (B) is correct

22. Here induced emf's are opposite of each other and capacitors connected in series

$$\text{So } Q = (\varepsilon_1 - \varepsilon_2)C_{eq}$$

$$= \pi(r_1^2 - r_2^2) \frac{C}{2} \frac{dB}{dt}$$

$$= [\pi(400 - 30) \times 10^{-4} \times 5 \times 10^{-6} \times 10] C$$

$$= 1.5\pi \mu C$$

$$= 4.7 \mu C$$

23. When switch is open

Hence, charge flown through switch is  $5\mu C$

24.  $m = \frac{f}{u+f}$

Here object is real, so we can imagine a situation like this with a converging lens say object is placed at a distance 'x' from focus towards pole in first position and at a distance y from focus away from pole is 2<sup>nd</sup> position one image is virtual and other is real.

$$\text{So, } \frac{f}{-(f-x)+f} = -\frac{f}{-(f+y)+f}$$

$$\text{Hence, } x = y$$

$$\text{And } x + y = f$$

$$\Rightarrow x = \frac{f}{2}$$

$$\text{Hence, } x = \pm 2$$

So diameter of coin is 4 cm

25. The maximum kinetic energy electrons can reach a maximum distance of d

$$\text{Hence, } \frac{hc}{\lambda} - \frac{hc}{\lambda_{th}} = eEd$$

$$\Rightarrow \lambda_{th} = \left( \frac{1}{\lambda} - \frac{eEd}{hL} \right)^{-1}$$

26. Mass of helium atom is 4 times mass of neutron (approx). If collision is perfectly in elastic the energy lost is completely utilized for excitation of  $\text{He}^+$  atom,

$$mu = 5mv \Rightarrow v = \frac{4}{5}u$$

$$\Delta E = \frac{1}{2}mu^2 - \frac{1}{2}mv^2 = \frac{2}{5}mu^2$$

$$\text{For minimum energy of neutron } \frac{2}{5}mu^2 = 40 + 8 \text{ cm}$$

$$\text{Here } u = 9.89 \times 10^4 \text{ m/sec}$$

27. Say initially concentration of U-238 & U-235 is 2No

$$\text{Then, } N_1 = N_o e^{-\lambda_1 t} \text{ and } N_2 = N_o e^{-\lambda_2 t}$$

$$\text{Hence, } \frac{N_1}{N_1 + N_2} = 9928 \text{ and } \frac{N_2}{N_1 + N_2} = 0072$$

$$\Rightarrow \frac{N_1}{N_2} = \frac{9928}{0072}$$

$$\Rightarrow \frac{e^{-\lambda_1 t}}{e^{-\lambda_2 t}} = \frac{9928}{0072}$$

$$\Rightarrow (\lambda_2 - \lambda_1) t = \ln \frac{9928}{0072}$$

$$\Rightarrow t = \ln \frac{9928}{0072} / \ln 2 \left( \frac{1}{7.1 \times 10^9} - \frac{1}{4.56 \times 10^9} \right)$$

$$= 5.98 \times 10^9 \text{ years}$$

29. P.E. of liquid column =  $\frac{mgh}{2} = \frac{\pi r^2 h g h}{2}$

$$= \frac{1}{2} \pi r^2 h^2 g$$

$$\text{As } h = \frac{2\sigma}{\rho g} = \text{ we will get P.E.} = \frac{2\pi\sigma^2}{\rho g}$$

Work done by surface tension  $\sigma \cdot 2\pi r \cdot h$

$$= \frac{4\pi\sigma^2}{\rho g}$$

Working done by gravity  $\frac{-2\pi\sigma^2}{\rho g}$

Heat liberated is  $= W_{\text{surface tension}} - \text{change in P.E.}$

$$= \frac{2\pi\sigma^2}{\pi g}$$

30. Conceptual

31. Current through RC circuit  $= I_1 = \frac{20}{100\sqrt{2}} \text{ Amp} = .141 \text{ Amp}$

Current through RL circuit  $= I_2 = \frac{20}{50\sqrt{2}} \text{ Amp} = .282 \text{ Amp}$

So current  $I = \sqrt{I_1^2 + I_2^2} = .3 \text{ Amp}$

Voltage across  $100\Omega$  resistor  $= I_1 \times 10 = 10\sqrt{2} \text{ V}$

Voltage across  $50\Omega$  resistor  $= I_2 \times 100 = 10\sqrt{2} \text{ V}$

32. Conceptual

33. At the moment of breaking of string velocity is along +ve y-axis. Hence, it will

be a projectile in YZ plane time of flight  $= \sqrt{\frac{2 \times 5}{10}} = 1 \text{ sec}$

Y co-ordinate  $= v \times t = 3 \text{ m}$

34.  $p = u + \frac{g}{2}(2x - 1)$

$q = u + \frac{g}{2}(2y - 1)$

$r = u + \frac{y}{2}(2z - 1)$

So  $q - r = g(y - z)$

Hence,  $y - z = \frac{q - r}{g}$

Similarly  $z - x = \frac{r - p}{g}$  and  $x - y = \frac{p - q}{g}$

$$\text{So, } p(y-z) + q(z-n) + r(x-y) = \frac{p(q-r) + q(r-p) + r(p-q)}{q} = 0$$

35. The string must be taut at highest position

$$\text{So, } v = \sqrt{g(\ell - \pi r)}$$

Conserving energy we will get

$$\frac{1}{2}mu^2 - \frac{1}{2}mv^2 = mg(\ell + \ell - \pi r)$$

$$\Rightarrow u^2 = v^2 + 2g(2\ell - \pi r)$$

$$\Rightarrow u^2 = g(\ell - \pi r) + 2g(2\ell - \pi r)$$

$$\Rightarrow u^2 = g(5\ell - 3\pi r)$$

$$\Rightarrow u = \sqrt{g(5\ell - 3\pi r)} = \sqrt{10 \left( 12.5 - 3 \times \pi \times \frac{\pi}{3} \right)}$$

$$= \sqrt{10 \times 2.5} = 5 \text{ m/sec}$$

36. The bubble will settle at that position where rate of change of pressure is zero

37. The equation of the process is

$$P = \frac{-P_0}{V_0} \cdot V + P_0$$

$$\Rightarrow RT = \frac{-P_0}{V_0} \cdot V^2 + P_0 V$$

$$\Rightarrow R dT = \frac{-P_0}{V_0} \cdot 2V \cdot dV + P_0 dV$$

$$\Rightarrow dV = \frac{R}{-\frac{P_0}{V_0} \cdot 2V + P_0}$$

When process changes from exothermic to exothermic rate of heat exchange become zero.

$$\text{Hence, } \frac{\Delta H}{\Delta T} = 0 \Rightarrow C = 0$$

$$\text{Again } c = C_v + \frac{PdV}{dT} = \frac{\left( -\frac{P_0}{V_0} V + P_0 \right) dV \cdot R}{\left( \frac{-P_0}{V_0} \cdot 2V + P_0 \right) dV} + C_v$$

When  $C = 0$

$$\Rightarrow \frac{R}{\gamma - 1} = C_v = \frac{-\left(-\frac{V}{V_0} + 1\right)R}{-\frac{2V}{V_0} + 1}$$

$$\Rightarrow \frac{-2V}{V_0} + 1 = (\gamma - 1) \left( \frac{V}{V_0} - 1 \right)$$

$$\Rightarrow \frac{V}{V_0} (\gamma - 1 + 2) = \gamma$$

$$\Rightarrow V = V_0 \frac{\gamma}{\gamma + 1} = \frac{5}{8} V_0$$

38. Centre of mass of the system is at rest. w.r.t. centre of mass momentum as well as energy is conserved.

$$\frac{mu^0}{2} = \frac{mu}{4} \cdot r \Rightarrow r = 2r_0$$

$$mu^2 - \frac{Kq^2}{r_0} = \frac{mu^2}{16} - \frac{Kq^2}{r}$$

Solving we will get  $m = \frac{q^2}{\pi_0 5r_0 u^2}$

39. Conceptual

40. Conceptual

### MATHS

41.  $\bar{a}, \bar{b}, \bar{c}$  are coplanar  $\Rightarrow \bar{b} \times \bar{c} \& \bar{c} \times \bar{a}$  are collinear.

42.  $\because f(x)$  is increasing in  $(-\infty, -8)$  and decreasing  $(4, \infty)$

$$\therefore f(x) = \frac{1}{x+9} + \frac{1}{5-x} \quad \forall x \in [-8, 4]$$

$$= \frac{14}{(9+x)(5-x)}, \text{ minimum of } (9+x)(5-x)$$

Occurs at  $x = -8 \& x = 4$

$$\therefore \text{Maximum of } f(x) = 1 + \frac{1}{13} = \frac{14}{13}$$

43.  $f'(px) > 0$  or  $f'(px) < 0 \quad \forall p, x \in R$

$\Rightarrow f(px)$  is monotonic

$\therefore f(x) + f(3x) + \dots + f((2m-1)x)$  is monotonic polynomial of degree  $2m-1$

44.  $|f(x) + g(x)| + |f(x) - g(x)|$

$$= 2 \max \{|f(x)|, |g(x)|\}$$

45. Ellipse equation is  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ , Area =  $\pi ab$

Let  $P = (a \cos \theta, b \sin \theta)$   $S = (ae, 0)$

$$M(h, k) \text{ mid point of PS} \Rightarrow h = \frac{ae + a \cos \theta}{2}; k = \frac{b \sin \theta}{2}$$

$$= \frac{h - ae}{a/2} + \frac{k^2}{(b^2/4)} = 1, \text{ locus of } (h, k) \text{ is ellipse} \quad \text{Area} = \pi \left(\frac{a}{2}\right) \left(\frac{b}{2}\right) = \frac{1}{4} \pi ab$$

46.  $2^p + 3^q + 5^r = 2^p + (4-1)^q + (4+1)^r$

$$= 2^p + 4m + (-1)^q + 4n + 1$$

Case (i)  $p=1, q$  is even,  $r$  can be any thing

No. of triplets =  $1 \times 5 \times 10 = 50$

Case (ii)  $p \neq 1, q$  is odd,  $r$  can be any thing

No. of triples =  $9 \times 5 \times 10 = 450$

47.  $(x-2)^5 (1+x)^5$

$$= [{}^5 C_0 x^5 - 2 \times {}^5 C_1 x^4 + \dots] [{}^5 C_0 + {}^5 C_1 x + \dots]$$

$$\Rightarrow \text{coeff. of } x^5 = -81$$

48.  $3 \sin \alpha < \sin \alpha + \sin \beta + \sin \gamma < 3 \sin \gamma$

$$3 \cos \alpha > \cos \alpha + \cos \beta + \cos \gamma > 3 \cos \gamma$$

$$\Rightarrow \frac{1}{3 \cos \alpha} < \frac{1}{\cos \alpha + \cos \beta + \cos \gamma} < \frac{1}{3 \cos \gamma}$$

$$\Rightarrow \tan \alpha < \frac{\sin \alpha + \sin \beta + \sin \gamma}{\cos \alpha + \cos \beta + \cos \gamma} < \tan \gamma$$

49. Construct a triangle ABC with sides 2, 3, 4. Then construct a circle circumscribing triangle ABC

$$\cos \frac{\alpha}{2} = \frac{7}{8} \Rightarrow \cos \alpha = \frac{17}{32}$$

(Equal chords subtend equal angle)

50.  $f(x) = x^2 + ax + b$   
 $\Rightarrow x^2 + (2c+a)x + c^2 + ac + b = f(x+c)$

$\therefore$  Roots are 0,  $d - c$

51.  $f(x) = x^5 - 10a^3x^2 + b^4x + c^5$   
 $f'(x) = 5x^4 - 20a^3x + b^4$   
 $f''(x) = 20x^3 - 20a^3$

$$f(\alpha) = f'(\alpha) = f''(\alpha) = 0 \Rightarrow \alpha = a$$

$$\text{and } 5a^4 - 20a^4 + b^4 = 0 \Rightarrow b^4 = 15a^4$$

$$\text{Also, } \alpha^5 - 10a^3\alpha^2 + b^4\alpha + c^5 = 0$$

$$\Rightarrow a^5 - 10a^5 + ab^4 + c^5 = 0$$

$$\Rightarrow 6a^5 + c^5 = 0$$

52. Given expression is  $(x-n)(y-n) = n^2$

No. of solutions =  $S(n)$  = No. of factors of  $n^2$

$$S(6) = \text{No. of factors of } 6^2 \text{ i.e., } 2^2 \cdot 3^2 = 3 \times 3 = 9$$

If  $n$  is prime i.e.,  $n = p$ , no. of factors of  $p^2$  is  $3 \cdot (1.p.p^2)$

53.  $f(x) = (x^2 + 5x + 5)^2 + 4$   
 $\therefore a = 4$ , max. of  $f(x)$  will be at  $x = 6$

$$b = (36 + 30 + 5)^2 + 4 = 71^2 + 4 = 5045$$

54.  $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h} \Rightarrow f'(0) = \lim_{h \rightarrow 0} \frac{f(h)}{h}$

$$\text{Also, } \left| \frac{f(h)}{h} \right| \leq \left| \frac{\sinh}{h} \right| \Rightarrow |f'(0)| \leq 1$$

55.  $(a\omega + b)(a\bar{\omega} + b) = 1 \Rightarrow (a-b)^2 + ab = 1$

Case (i)  $(a-b)^2 = 0$  and  $ab = 1$  then solutions are  $\{(1,1), (-1,-1)\}$

Case (ii)  $(a-b)^2 = 1$  and  $ab = 0$  then solutions are

$$\{(0,1), (1,0), (-1,0), (0,-1)\}$$

56. Let  $f(p) = p^2 - mp + 1$ , :  $f(1) < 0 \Rightarrow 2 - m < 0 \Rightarrow m > 2$

Also,  $\frac{|x|^2 + 16}{2} \geq 4|x| \Rightarrow 0 \leq \frac{4|x|}{|x|^2 + 16} \leq \frac{1}{2}$

$$\Rightarrow 0 \leq \left( \frac{4|x|}{|x|^2 + 16} \right)^m < 1$$

57.  $\because \bar{A} \times (\bar{A} \times (\bar{A} \times \bar{B})) \cdot \bar{C} = -|\bar{A}|^2 [\bar{ABC}]$

$$|\bar{A}|^2 = 49 \text{ and } [\bar{ABC}] = 7$$

58.  $(u + v + w + t)^2 = \sum u^2 + 2\sum uv \Rightarrow \sum uv = 0$  [using given condition]

So, let the quartic equation whose roots are  $u, v, w, t$  be

$$f(x) = x^4 - ax - b \text{ so, } x^{n+4} - ax^{n+1} - bx^n = 0$$

$$\Rightarrow s_{n+4} - as_{n+1} - bs_n = 0$$

Where  $s_n = u^n + v^n + w^n + t^n$

Required is  $\frac{(s_4)^2}{s_8} s_1 = 0, s_2 = 0$

59. A)  $f'(x)$  changes sign in the neighbourhood of  $x = 2, 2x - x^2 - 2 = -1 - (x-1)^2 \leq -1$

$$\Rightarrow R_f \equiv [3\pi/4, \pi)$$

B)  $-e^{ax} \leq e^{ax} \sin bx \leq e^{ax}$

C)  $f'(x) > 0 \forall x \in R^+, R_f \equiv (2, \infty)$

D) Let  $X \equiv \{x_1, x_2, \dots, x_n\}$

Let  $f(x_1) = x_2 \Rightarrow f(f(x_1)) = f(x_2) \Rightarrow f(x_2) = x_1$

60. A)  $\alpha^2 = \frac{1}{4}(2b^2 + 2c^2 - a^2), \beta^2 = \frac{1}{4}(2c^2 + 2a^2 - b^2)$

$$\gamma^2 = \frac{1}{4}(2a^2 + 2b^2 - c^2)$$

$$\Rightarrow \alpha^2 + \beta^2 + \gamma^2 = \frac{3}{4}(a^2 + b^2 + c^2)$$

$$B) \frac{1}{2}(x+y+z) \times 2 = \frac{\sqrt{3}}{4} \times 2^2$$

$$\Rightarrow x + y + z = \sqrt{3}$$

$$C) \angle B = 60^\circ \Rightarrow \angle A + \angle C = 120^\circ$$

$$b^2 = ac \Rightarrow \sin^2 B = \sin A \cdot \sin C$$

$$\Rightarrow \frac{3}{4} = \sin A \sin C$$

$$\Rightarrow \frac{3}{2} = \cos(A - C) - \cos(A + C)$$

$$\Rightarrow \cos(A - C) = 1 \Rightarrow \angle A = \angle C$$

$\Delta$  is equilateral

$$D) \frac{\sqrt{abc(a+b+c)}}{\Delta} = \frac{1}{\Delta} \sqrt{4R\Delta \cdot 2S} = \sqrt{\frac{8RS}{\Delta}}$$

$$= \sqrt{\frac{8R}{r}} \geq \sqrt{8 \times 2} = 4$$