JEE EXPERT

ANSWER KEY

REGULAR TEST SERIES - (RTS-05)
Batch : 12TH (Zenith X01 & X02)
Date 21.07.2019

PHYSICS

1	(D)	2	(A)	3	(A)	4	(D)	5	(B)
6	(B)	7	(C)	8	(D)	9	(D)	10	(C)
11	(B)	12	(C)	13	(B)	14	(C)	15	(D)
16	(B)	17	(C)	18	(B)	19	(A)	20	(D)
21	(C)	22	(A)	23	(D)	24	(C)	25	(B)
26	(A)	27	(C)	28	(D)	29	(B)	30	(C)

CHEMISTRY

31	(C)	32	(C)	33	(D)	34	(C)	35	(D)
36	(C)	37	(C)	38	(D)	39	(A)	40	(B)
41	(D)	42	(D)	43	(A)	44	(D)	45	(C)
46	(B)	47	(B)	48	(A)	49	(A)	50	(D)
51	(D)	52	(C)	53	(C)	54	(B)	55	(C)
56	(A)	57	(B)	58	(A)	59	(C)	60	(B)

MATHEMATICS

61	(B)	62	(C)	63	(D)	64	(B)	65	(B)
66	(C)	67	(C)	68	(B)	69	(C)	70	(B)
71	(A)	72	(A)	73	(D)	74	(A)	75	(C)
76	(B)	77	(A)	78	(C)	79	(A)	80	(C)
81	(A)	82	(B)	83	(A)	84	(C)	85	(D)
86	(D)	87	(C)	88	(D)	89	(A)	90	(B)

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SOLUTIONS

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CHEMISTRY

31. **(C)**

32. **(C)** Let number of Fe^{+2} = N and that of Fe^{+3} is N′.

So $N + N' = 0.93$

Also $2N + 3N' = 2$

$\Rightarrow$ $N = 0.79$ $N' = 0.14$

So $\frac{N'}{N} = \frac{0.14}{0.79} = 0.177$

$$\%Fe^{+3} = \frac{N'}{N+N'} \times 100 = \frac{0.14}{0.93} \times 100 = 15.05\%$$

33. **(D)**

34. **(C)** CCP structure has got ABCABC type of packing.
HCP structure has got ABAB type of packing.

35. **(D)** $Z_{A^{+n}} = 1$ $Z_{B^{-m}} = 4 + 4 = 8$ y formula is AB_8

36. **(C)** $\frac{d_{Bcc}}{d_{ccp}} = \frac{2M}{N_{AV}\, a^3_{Bcc}} \times \frac{N_{AV} a^3_{fcc}}{4M} = \frac{3\sqrt{3}}{2 \times 2\sqrt{2}} = \frac{3}{4}\frac{\sqrt{3}}{\sqrt{2}} = 0.918$

37. **(C)** Since, $2r = \frac{a\sqrt{2}}{2}$ $\therefore$ $r = \frac{150}{2\sqrt{2}} = \frac{75}{\sqrt{2}}$ pm

38. **(D)** % Vacant space = 100 – % packing

$$= 100 - \frac{1 \times \frac{4}{3}\pi r^3}{a^3} \times 100$$

$$= 100 - \frac{1 \times \frac{4}{3}\pi r^3}{8r^3} \times 100$$

$$= 100 - \frac{\pi}{6} \times 100$$

39. **(A)** Number of atoms in a unit cell (Z) = 1 + 2 = 3

$$Z = \frac{l^3 \times \rho \times N}{M}$$

$$M = \frac{l^3 \times \rho \times N}{Z}$$

$$= \frac{24\times10^{-24} \times 7.2\times 6.023\times10^{23}}{3} = 34.69$$

$$\text{Number of atoms } = \frac{\text{Mass}}{\text{Molar mass}} \times 6.023\times10^{23}$$

$$= \frac{200}{34.69} \times 6.023\times10^{23}$$

$$= 3.47 \times 10^{24}$$

40. **(B)**

41. **(D)** $\frac{P_0 - P}{P^0} = x_2$

For solution in solvent A $\quad x_2 = \dfrac{\frac{m}{M_2}}{\frac{m}{M_2} + \frac{m'}{M_A}} \approx \dfrac{\frac{m}{M_2}}{\frac{m'}{M_A}}$

For solution in solvent B $\quad x'_2 = \dfrac{\frac{m}{M_2}}{\frac{m}{M_2} + \frac{m'}{M_B}} \approx \dfrac{\frac{m}{M_2}}{\frac{m'}{M_B}}$

$$x_2 = 2x'_2$$

$\Rightarrow \quad \frac{m'}{M_B} = \frac{2m'}{M_A}$

$\Rightarrow \quad M_A = 2M_B$

42. **(D)** $\frac{P - P_s}{P_s} = \frac{n}{N}$

$P_s = \frac{19}{20}P$; $\quad n = \frac{x}{M_{solute}}$; $\quad N = \frac{y}{M_{solvent}}$

$M_{solvent} = \frac{1}{5} M_{solute}$

$\Rightarrow \quad \frac{x}{y} = \frac{5}{19}$

43. **(A)** $\quad \Delta T_f = 9.3 = 1.86 \times \dfrac{\frac{50}{60}}{W_1(kg)}$

$\Rightarrow \quad W_1(kg) = \frac{50}{62} \times \frac{1.86}{9.3} = 0.16129$

$\Rightarrow$ Amount of ice separated = 200 – 161.29 = 38.71g

44. **(D)** $2.55 = 1.86 \times m \quad \Delta T_b = 0.52 \times \frac{2.55}{1.86} = 0.7$

45. **(C)** $\pi \, \alpha \, C \quad \left(C = \frac{\text{mole}}{\text{volume}}\right)$

46. **(B)** $P_{Theoretical} = \frac{1}{3}(150) + \frac{2}{3}(240) = 50 + 2(80) = 50 + 160 = 210$ torr $> P_{Actual}$.

47. **(B)** $0.704 = i \times 1.86 \times 0.1892 \quad \Rightarrow \quad i = 2$

48. **(A)** $\underset{1-\alpha}{AxBy} \rightleftharpoons \underset{x\alpha}{xA^{y^+}} + \underset{y\alpha}{yB^{x^-}} \qquad i = 1 + \alpha(x + y - 1) \quad \Rightarrow \quad \alpha = \frac{i-1}{x+y-1}$

49. **(A)** $\underset{1-\alpha}{Al_2(SO_4)_3} \rightleftharpoons \underset{2\alpha}{2Al^{+3}} + \underset{3\alpha}{3SO_4^{2}}$

$4.2 = 1 + (5-1)\,\alpha$

$\Rightarrow \quad 1 + 4\alpha = 4.2$

$\Rightarrow \quad 4\alpha = 3.2$

$\Rightarrow \quad \alpha = 0.8$

50. **(D)** TEL is sigma bonded complex.

51. **(D)** Being a high spin complex, Co assumes sp^3d^2 hybridization.

52. **(C)** Small magnitude of charge on the central metal atom does not help in formation of stable complexes.

53. **(C)** The spinel structure consists of an FCC arrangement of O^{2-} ions in which the divalent cation occupies one-eight of the tetrahedral voids and trivalent cation occupies one-half of the octahedral voids.

54. **(B)**

55. **(C)** Number of oxide ions $= \frac{1}{8} \times 8$ corners $+ \frac{1}{2} \times 6$ face-centres = 4

Number of A^{2+} ions present in tetrahedral void = 1

Number of B^{3+} ions = 2

$\therefore$ Formula of compound = AB_2O_4

56. **(A)** **57.** **(B)** **58.** **(A)** **59.** **(C)** **60.** **(B)**

61. **(B)** $f(x)=\int \frac{x^2(\sqrt{1+x^2}-1)}{(1+x^2)(1+x^2-1)}dx=\int \frac{\sqrt{1+x^2}-1}{1+x^2}dx=\int \frac{dx}{\sqrt{1+x^2}}-\int \frac{dx}{1+x^2}$

$=\log(x+\sqrt{1+x^2})-\tan^{-1}x+k$

$\therefore$ $f(0)=\log 1-\tan^{-1}0+k=k=0$

$\therefore$ $f(x)=\log(x+\sqrt{1+x^2})-\tan^{-1}x$

$\therefore$ $f(1)=\log(1+\sqrt{2})-\frac{\pi}{4}$

62. **(C)** $I=\int \frac{(x^2+\cos^2 x)}{(1+x^2)}\cdot \text{cosec}^2 x\,dx$

$=\int \frac{(1+x^2-\sin^2 x)}{(1+x^2)}\cdot \text{cosec}^2 x\,dx \qquad =\int \text{cosec}^2 x\,dx-\int \frac{dx}{1+x^2}=-\cot x+\tan^{-1}x+C$

63. **(D)** $I=\int \sqrt{1+2\tan x(\tan x+\sec x)\,dx}$

$=\int \sqrt{\sec^2 x-\tan^2 x+2\tan^2 x+2\tan x\cdot \sec x\,dx}$

$=\int (\sec x+\tan x)\,dx=\int \sec x\,dx+\int \tan x\,dx \;=\ln|\sec x+\tan x|+\ln|\sec x|+C$

$=\ln|\sec x(\sec x+\tan x)+C$

64. **(B)** $\int \frac{e^{2x}-2e^x}{e^{2x}+1}dx=\frac{1}{2}\int \frac{2e^{2x}}{e^{2x}+1}dx-2\int \frac{e^x dx}{(e^x)^2+1}$

$=\frac{1}{2}\log(e^{2x}+1)-2\int \frac{dz}{z^2+1}$, if z = e^x $\qquad =\frac{1}{2}\log(e^{2x}+1)-2\tan^{-1}(e^x)+c$

65. **(B)** $\int \underset{\text{II}}{\cos x}\log\left(\tan\frac{x}{2}\right)dx$

$\log\left(\tan\frac{x}{2}\right)\cdot \sin x-\int \frac{1}{\tan(x/2)}\cdot \sec^2\frac{x}{2}\cdot\frac{1}{2}\cdot \sin x\,dx+c$

$=\sin x\cdot \log\left(\tan\frac{x}{2}\right)-\int \frac{1}{2\sin(x/2)\cos(x/2)}\cdot \sin x\,dx+c$

$=\sin x\cdot \log\left(\tan\frac{x}{2}\right)-\int dx+c \;=\sin x\cdot \log\left(\tan\frac{x}{2}\right)-x+c$.

66. **(C)** $I_n-I_{n-2}=\int\left(\frac{\sin nx}{\sin x}-\frac{\sin(n-2)x}{\sin x}\right)dx$

$=\int \frac{2\cos(n-1)x\sin x}{\sin x}dx=2\sin\,(n-1)x+c$.

67. **(C)** $\int \frac{3\sin x + 2\cos x}{3\cos x + 2\sin x}\,dx = ax + b\ln|2\sin x + 3\cos x| + C$

Diff. both sides, we get

$$\frac{3\sin x + 2\cos x}{3\cos x + 2\sin x} = a + \frac{(2\cos x + 3\sin x)}{(2\sin x + 3\cos x)}$$

$$= \frac{\sin x\cdot(2a-3b) + \cos x\cdot(3a+2b)}{(3\cos x + 2\sin x)}$$

Comparing like terms on both sides, we get 3 = 2a – 3b, 2 = 3a + 2b

$\Rightarrow \quad a = \frac{12}{13}, b = -\frac{15}{39}.$

68. **(B)** $I = \int \sin x\cdot\cos x\cdot\cos 2x\cdot\cos 4x\cdot\cos 8x\,dx$

$$= \frac{1}{2}\int \sin 2x\cdot\cos 2x\cdot\cos 4x\cdot\cos 8x\,dx \qquad = \frac{1}{4}\int \sin 4x\cdot\cos 4x\cdot\cos 8x\,dx$$

$$= \frac{1}{8}\int \sin 8x\cdot\cos 8x\,dx = \frac{1}{16}\int \sin 16x\,dx = \frac{1}{256}\cos 16x + C$$

69. **(C)** Let $I = \int \frac{dx}{\cos^6 x + \sin^6 x} = \int \frac{\sec^6 x}{1+\tan^6 x}\,dx$

$$= \int \frac{(1+\tan^2 x)^2\sec^2 x\,dx}{1+\tan^6 x}$$ If tanx = p, then $\sec^2$x dx = dp

$$\Rightarrow \quad I = \int \frac{(1+p^2)^2\,dp}{1+p^6} = \int \frac{(1+p^2)}{p^4-p^2+1}\,dp = \int \frac{p^2\left(1+\frac{1}{p^2}\right)}{p^2\left(p^2+\frac{1}{p^2}-1\right)}\,dp$$

$$= \int \frac{dk}{k^2+1} = \tan^{-1}(k) + c \qquad \left(p - \frac{1}{p} = k, \left(1+\frac{1}{p^2}\right)dp = dk\right)$$

$$= \tan^{-1}\left(p - \frac{1}{p}\right) + c = \tan^{-1}(\tan x - \cot x) + c$$

70. **(B)** Let $I = \int \frac{-dx}{(x+a)^{8/7}(x-b)^{6/7}}$

$$= \int \frac{dx}{(x+a)^2\left(\frac{x-b}{x+a}\right)^{6/7}}$$ If $\left(\frac{x-b}{x+a}\right) = p$, then $\frac{a+b}{(x+a)^2}dx = dp$

$$\Rightarrow \quad I = \frac{1}{a+b}\int \frac{dp}{p^{6/7}} = \frac{7}{a+b}(p^{1/7}) = \left(\frac{7}{a+b}\right)\left(\frac{x-b}{x+a}\right)^{1/7} + c$$

71. **(A)** $I = \int \frac{6p^5\,dp}{p^3+p^2}$ $\quad [(x+1) = p^6$, then dx = $6p^5$dp]

$$= 6\int p^2 dp - 6\int p dp + 6\int dp - 6\int \frac{1}{(p+1)}\, dp \quad = \frac{6p^3}{3} - \frac{6p^2}{2} + 6p - 6\ln(p+1) + c$$

$= 2p^3 - 3p^2 + 6p - 6\ln(1+p) + c$, where $p = (x+1)^{1/6}$

72. **(A)** $I = \int p^{n+5} dp$ If $x + \frac{1}{x} = p$ then, $\left(1 - \frac{1}{x^2}\right) dx = dp$

$$\Rightarrow \quad I = \int \left(x + \frac{1}{x}\right)^{n+3} \left(\frac{x^2 - 1}{x^2}\right) dx = \int p^{n+5} dp \qquad = \frac{p^{n+6}}{n+6} + c = \frac{\left(x + \frac{1}{x}\right)^{n+6}}{n+6} + c$$

73. **(D)** Put tanx = t, where $I = 2\int \frac{\sqrt{\cot x}}{\sin 2x}\, dx = \int t^{-3/2} dt = -2\sqrt{\cot x} + c$

74. **(A)** Put logx = t $\Rightarrow$ dx = e^t dt

Hence $I = \int e^t \left(\frac{1}{t} - \frac{1}{t^2}\right) dt = \frac{e^t}{t} + c = \frac{x}{\log x} + c$

75. **(C)** $\int 3^x . e^x dx = \int (3.e)^x\, dx = \frac{(3e)^x}{\log(3e)} + c = \frac{3^x e^x}{1 + \log 3} + c$.

76. **(B)** $\cos x = t$

$d(\cos x) = dt$

$$\int \sqrt{1-t^2}\, dt = \frac{t}{2}\sqrt{1-t^2} + \frac{1}{2}\sin^{-1}(t) + c$$

$$= \frac{\cos x}{2}.\sin x + \frac{1}{2}\sin^{-1}(\cos x) + c = \frac{1}{4}\sin 2x + \frac{1}{2}\sin^{-1}\left(\sin\left(\frac{\pi}{2} - x\right)\right) + c$$

$$= \frac{1}{4}\sin 2x - \frac{x}{2} + c$$

77. **(A)** Put $x^2 = t \Rightarrow x.dx = \frac{dt}{2}$

$$\frac{1}{2}\int t f(t) dt = \frac{1}{2}\left\{t\int f(t) dt - \int\int (f(t) dt)\, dt\right\} = \frac{1}{2}\left\{tF(t) - \int F(t) dt\right\}$$

$$= \frac{1}{2}\left\{x^2 F(x^2) - \int F(x^2) d(x^2)\right\}$$

78. **(C)** $\frac{\cos 5x + \cos 4x}{1 - 2\cos 3x} = \frac{\sin 3x(\cos 5x + \cos 4x)}{\sin 3x - \sin 6x}$

$$= \frac{\sin 3x \cdot 2\cos\frac{9x}{2}\cos\frac{x}{2}}{-2\cos\frac{9x}{2}\sin\frac{3x}{2}} = \frac{2\sin\frac{3x}{2}\cos\frac{3x}{2}\cos\frac{x}{2}}{-\sin\frac{3x}{2}}$$

$$= -\left(2\cos\frac{3x}{2}\cos\frac{x}{2}\right) = -(\cos 2x + \cos x)$$

$\therefore$ given integral = $-\int(\cos 2x+\cos x)\,dx = -\dfrac{\sin 2x}{2}-\sin x + c$

79. **(a)** $\displaystyle\int \frac{e^x\left(2-x^2\right)}{(1-x)\sqrt{1-x^2}}\,dx = \int \frac{e^x\left(1-x^2+1\right)}{(1-x)\sqrt{1-x^2}}dx = \int \frac{e^x\left(1-x^2\right)}{(1-x)\sqrt{1-x^2}}dx + \int \frac{e^x}{(1-x)\sqrt{1-x^2}}\,dx$

$$= \int \underbrace{e^x\sqrt{\frac{1+x}{1-x}}}_{\text{II}\quad\text{I}}\,dx + \int \frac{e^x}{(1-x)\sqrt{1-x^2}}\,dx$$

Integrate by parts (only first part)

$$= \sqrt{\frac{1+x}{1-x}}.e^x - \int \frac{1}{2}\left(\frac{1+x}{1-x}\right)^{-1/2}.\frac{d}{dx}\left(\frac{1+x}{1-x}\right).e^x\,dx + \int \frac{e^x\,dx}{(1-x)\sqrt{1-x^2}}$$

$$= e^x.\sqrt{\frac{1+x}{1-x}} - \frac{1}{2}\int\sqrt{\frac{1-x}{1+x}}.\frac{1-x+1+x}{(1-x)^2}e^x\,dx + \int \frac{e^x}{(1-x)\sqrt{1-x^2}}\,dx$$

$$= e^x\sqrt{\frac{1+x}{1-x}} - \int \frac{e^x}{(1-x)\sqrt{1-x^2}}\,dx + \int \frac{e^x}{(1-x)\sqrt{1-x^2}}\,dx \qquad = e^x\sqrt{\frac{1+x}{1-x}} + c$$

80. **(C)** $\dfrac{dx}{dt} = f'''(t)\cos t - f''(t)\sin t + f''(t)\sin t + f'(t)\cos t \qquad = [f'''(t)+f'(t)]\cos t$

$$\frac{dy}{dt} = -f'''(t)\sin t - f''(t)\cos t + f''(t)\cos t - f'(t)\sin t \qquad = -[f'''(t)+f'(t)]\sin t$$

y $\quad\left[\left(\dfrac{dx}{dt}\right)^2+\left(\dfrac{dy}{dt}\right)^2\right]^{1/2} = \left[\left(f'''(t)+f'(t)\right)^2\left(\cos^2 t+\sin^2 t\right)\right]^{1/2} = f'''(t)+f'(t)$

y $\quad\displaystyle\int\left[\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2\right]^{1/2}dt = f''(t)+f(t)+c$

81. **(A)** $\displaystyle\int \frac{\cos x-\sin x}{\cos x+\sin x}.(2+2\sin 2x)dx = 2\int\frac{(\cos x-\sin x)(\cos x+\sin x)^2}{\cos x+\sin x}\,dx$

$= 2\int(\cos x-\sin x)(\cos x+\sin x)dx \quad = 2\int\left(\cos^2 x-\sin^2 x\right)dx = 2\int\cos 2x\,dx = \sin 2x + c$

82. **(B)** $\displaystyle I = \int \log\frac{\phi(x)}{f(x)}d\left\{\log\frac{\phi(x)}{f(x)}\right\} = \frac{1}{2}\left\{\log\frac{\phi(x)}{f(x)}\right\}^2 + k$

83. **(A)** Substituting $x = p^6$, $dx = 6p^5\,dp$, we have

$$I = \int\frac{6p^5(p^5+p^4+p)}{p^6(1+p^2)}\,dp = \int\frac{6(p^5+p^3+1)}{(p^2+1)}\,dp = \int 6p^3dp + \int\left(\frac{6}{p^2+1}\right)dp$$

$$= \frac{6p^4}{4} + 6\tan^{-1}p = \frac{3}{2}x^{2/3} + 6\tan^{-1}(x^{1/6}) + c$$

84. **(C)** Put lnx = t

$$I=\int e^t\left(\frac{t-1}{t^2+1}\right)^2 dt=\int e^t\left(\frac{1}{t^2+1}-\frac{2t}{(t^2+1)^2}\right)dt \quad =\frac{e^t}{t^2+1}+c=\frac{x}{(\ln x)^2+1}+c.$$

85. **(D)** Given equation is satisfied if cosx dx = d(f (x)) $\Rightarrow$ f (x) = sinx

86. **(D)** Let $I=\int\frac{dx}{(1+\sqrt{x})\sqrt{(x-x^2)}}$

If $\sqrt{x}$ = sinp, then $\frac{1}{2\sqrt{x}}$ dx = cosp dp

$$I=\int\frac{2\sin p\cos p\ dp}{(1+\sin p)\sin p\cos p}=2\int\frac{dp}{(1+\sin p)}=2\int\frac{(1-\sin p)\,dp}{\cos^2 p}$$

$$=2\int\sec^2 p\ dp-\int(\tan p\sec p)\ dp$$

$$=2(\tan p-\sec p)=2\left(\sqrt{\frac{x}{(1-x)}}-\frac{1}{\sqrt{(1-x)}}\right)+c=\frac{2(\sqrt{x}-1)}{\sqrt{(1-x)}}+c$$

87. **(C)** $I=\int\frac{\ell n(\tan x)}{\sin x.\cos x}dx,$ let $t=\ell n(\tan x)$

$$\Rightarrow \quad \frac{dt}{dx}=\frac{\sec^2 x}{\tan x}\ \Rightarrow\ dt=\frac{dx}{\sin x.\cos x}\ \Rightarrow\ I=\int t\ dt=\frac{1}{2}t^2+c=\frac{1}{2}(\ell n(\tan x))^2+c$$

88. **(D)** $I=\int e^{\cot x}(\cos x-\operatorname{cosec} x)dx=\int e^{\cot x}.\cos x\,dx-\int e^{\cot x}.\operatorname{cosec} x\ dx$

$$=\sin x.e^{\cot x}-\int e^{\cot x}-\operatorname{cosec}^2 x.\sin x\ dx-\int e^{\cot x}.\operatorname{cosec} x\ dx \qquad =$$

$\sin x.e^{\cot x}+c$

89. **(A)** Let $\sin x=z\ \Rightarrow\ d(\sin x)=dz$

$$\int\frac{dz}{\sqrt{1-z^2}}=\sin^{-1}z+c=\sin^{-1}(\sin x)+c=x+c$$

90. **(B)** $$\int e^x\left(\frac{1+2\sin\left(\frac{x}{2}\right)\cos\left(\frac{x}{2}\right)}{2\cos^2\frac{x}{2}}\right)dx=\int e^x\left(\tan\frac{x}{2}+\frac{1}{2}\sec^2\frac{x}{2}\right)dx=e^x\tan\frac{x}{2}+c$$