All India Aakash Test Series for JEE (Main)-2021

TEST -1 - Code-C

Test Date : 06/10/2019

ANSWERS

PHYSICS		CHEMISTRY		MATHEMATICS	
1.	(4)	26.	(3)	51.	(1)
2.	(1)	27.	(4)	52.	(3)
3.	(1)	28.	(2)	53.	(1)
4.	(4)	29.	(3)	54.	(4)
5.	(1)	30.	(1)	55.	(1)
6.	(2)	31.	(2)	56.	(4)
7.	(3)	32.	(3)	57.	(3)
8.	(3)	33.	(4)	58.	(4)
9.	(2)	34.	(3)	59.	(2)
10.	(2)	35.	(4)	60.	(2)
11.	(3)	36.	(4)	61.	(4)
12.	(4)	37.	(1)	62.	(1)
13.	(4)	38.	(3)	63.	(2)
14.	(3)	39.	(3)	64.	(3)
15.	(2)	40.	(3)	65.	(2)
16.	(1)	41.	(4)	66.	(4)
17.	(1)	42.	(1)	67.	(2)
18.	(2)	43.	(4)	68.	(3)
19.	(4)	44.	(4)	69.	(2)
20.	(3)	45.	(3)	70.	(4)
21.	(50)	46.	(36)	71.	(04)
22.	(21)	47.	(50)	72.	(46)
23.	(46)	48.	(10)	73.	(04)
24.	(55)	49.	(32)	74.	(10)
25.	(16)	50.	(28)	75.	(04)

HINTS & SOLUTIONS

PART - A (PHYSICS)

1. Answer (4)

Hint: $1\text{N} = \frac{1\text{kg m}}{s^2}$

Sol. : $\frac{1}{\alpha}\cdot\frac{1}{\beta}(\gamma)^2 = \frac{\gamma^2}{\alpha\beta}$

2. Answer (1)

Hint: $a = 12 - 3t = \frac{dv}{dt}$

Sol. : $\int_7^v dv = \int_1^5 (12-3t)dt$

$\Rightarrow v - 7 = \left(12t - \frac{3t^2}{2}\right)\Big|_1^5 = 12$

$\Rightarrow v = 19$ m/s

3. Answer (1)

Hint: $[a] = [\text{LT}^{-2}]$

Sol. : $(c) = [a]^{1/2} = [\text{L}^{1/2}\text{T}^{-1}]$

$[b] = \frac{[\text{L}]\,[a]}{\text{T}^3} = [\text{L}^2\ \text{T}^{-5}]$

4. Answer (4)

Hint: $[\tau] = [\rho^x f^y v^z] = \text{ML}^2\text{T}^{-2}$

Sol. : $\Rightarrow (\text{ML}^{-3})^x(\text{T}^{-1})^y(\text{LT}^{-1})^z = \text{ML}^2\text{T}^{-2}$

$\Rightarrow x = 1, -3x + z = 2 \Rightarrow z = 2 + 3 = 5$

$-y - z = -2 \Rightarrow y = 2 - 5 = -3$

$\Rightarrow [\tau] = \rho f^{-3} v^5$

5. Answer (1)

Hint: $A = 16.6 \times 4.7 = 78.02\ \text{cm}^2$

Sol. : There will be only two significant figures as 4.7 cm has only two significant figures.

6. Answer (2)

Hint: $R_P = \frac{R_1R_2}{R_1+R_2} = \frac{3\times 6}{9} = 2\ \Omega$

$R_P = 2.0\ \Omega$

Sol. : $\frac{\Delta R_P}{2^2} = \frac{0.1}{9} + \frac{0.2}{36} = \frac{0.4+0.2}{36}$

$\Delta R_P = \frac{0.6}{9} = 0.067 = 0.1\Omega$

7. Answer (3)

Hint: Mean value

$= \frac{1.49+1.50+1.52+1.54+1.48}{5}$

$= \frac{7.53}{5} = 1.506 = 1.51\,\text{cm}$

Sol. : Mean absolute error

$= \frac{0.02+0.01+0.01+0.03+0.03}{5}$

$= \frac{0.1}{5} = 0.02$

% error $= \frac{0.02}{1.51}\times 100 = 1.3\%$

8. Answer (3)

Hint: $\int_u^{u/2} v^{-1/2}dv = \int_0^t -k\,dt \Rightarrow 2v^{1/2}\Big|_u^{\frac{u}{2}} = -kt$

$\Rightarrow 2\left[\sqrt{u} - \sqrt{\frac{u}{2}}\right] = kt$

Sol. : $t = \frac{2\sqrt{u}}{k}\left[1 - \frac{1}{\sqrt{2}}\right] = \frac{\sqrt{u}}{k}[2-\sqrt{2}]$

9. Answer (2)

Hint: $0 = u - gt_1 \Rightarrow t_1 = \frac{u}{g}$

Sol. : $0 = H + ut - \frac{1}{2}gt^2$

$\Rightarrow \frac{1}{2}gt^2 - ut - H = 0$

$t = \frac{u + \sqrt{u^2 + 4Hg/2}}{g} = \frac{u+\sqrt{u^2+2Hg}}{g}$

$\frac{u+\sqrt{u^2+2Hg}}{g} = 3\cdot\frac{u}{g}$

$\Rightarrow u^2 + 2Hg = 4u^2$

$\Rightarrow 2Hg = 3u^2 \Rightarrow H = \frac{3u^2}{2g}$

10. Answer (2)

Hint: $H = ut - \frac{1}{2}gt^2$

Sol. : $\Rightarrow \frac{1}{2}gt^2 - ut + H = 0$

$$t = \frac{u \pm \sqrt{u^2 - 2gH}}{g}$$

$$\Rightarrow \quad t_1 + t_2 = \frac{2u}{g}$$

$$\Rightarrow \quad u = \frac{g(t_1 + t_2)}{2}$$

$0 = u^2 - 2gh_{max}$

$$\Rightarrow \quad h_{max} = \frac{u^2}{2g} = \frac{g(t_1 + t_2)^2}{8}$$

11. Answer (3)

Hint: $x_Q - x_P = Vt - \frac{1}{2}at^2$

Sol. : Graph is a downward parabola which initially goes up and then down.

12. Answer (4)

Hint: ΔV = Area under v-t graph

Sol. : $\Delta V = \frac{1}{2} \times 4 \times 5 - \frac{1}{2} 2 \times \frac{5}{2}$

= 10 – 2.5 = 7.5 m/s

$V = V_i + \Delta V = 17.5$ m/s

13. Answer (4)

Hint: Total time of journey

= 2 × 90 = 180 minutes

= 3 hr

Sol. : Speed of river = $\frac{12}{3} = 4$ km/h

14. Answer (3)

Hint: $V^2 = 9x$

Sol. : $2V\frac{dV}{dt} = 9V \quad \Rightarrow \quad a = \frac{9}{2}$

$$S = \frac{1}{2}\frac{9}{2} \cdot t^2 \quad \Rightarrow \quad 16 = 9t^2$$

$$\Rightarrow \quad t = \frac{4}{3} \text{ s}$$

$$V_{av} = \frac{4 \times 3}{4} = 3 \text{ m/s}$$

15. Answer (2)

Hint: $\int \frac{dx}{ax + b} = \frac{1}{a}\ln(ax + b) + c$

Sol. : $I = \frac{3}{3}\ln(3x + 4)\Big|_0^2 = \ln\frac{10}{4} = \ln\frac{5}{2}$

16. Answer (1)

Hint: Particle is instantaneously at rest at t = 5 s

Sol. : $d_1 = \left(10 \times 5 - \frac{1}{2} 2 \times 5^2\right) - \left(10 \times 4 - \frac{1}{2} 2 \times 4^2\right)$

= (50 – 25) – (40 – 16) = 1 m

$$d_2 = \frac{1}{2} 2 \times 2^2 = 4 \text{ m}$$

$\Rightarrow$ Average speed = $\frac{5}{3}$ m/s

17. Answer (1)

Hint: For critical point $y' = 0$

$x = -3$ is point of maxima

Sol. : $\frac{dy}{dx} = 6x^2 + 6x - 36 = 0$

$$\Rightarrow \quad x^2 + x - 6 = 0$$

$x = -3$ or $x = 2$

$$\frac{d^2y}{dx^2} = 2x + 1$$

$\Rightarrow$ y has a maximum at $x = -3$

$\Rightarrow$ $y_{max} = -54 + 27 + 108 + 7 = 88$

18. Answer (2)

Hint: $x_P = ut$

Sol. : $x_Q = d + \frac{1}{2}at^2$

$$0 = \frac{1}{2}a.2t - u \quad \Rightarrow \quad t = \frac{u}{a}$$

$$(x_Q - x_P)_{min} = d + \frac{1}{2}a \cdot \frac{u^2}{a^2} - \frac{u^2}{a}$$

$$= d - \frac{u^2}{2a}$$

19. Answer (4)

Hint: $125 = 5t^2 \Rightarrow t = 5$ s

Sol. : $S_{5th} = 0 + \frac{1}{2}10[9] = 45$ m

$S_{1st} = 5$ m

20. Answer (3)

Hint: Apply $s = ut + \frac{1}{2}at^2$

Sol. : $\frac{1}{2}2 \times 3^2 + \left[6(t-3) - \frac{1}{2}2 \times (t-3)^2\right] = 0$

$$\Rightarrow \quad 18 + 12t - 36 - 2(t^2 - 6t + 9) = 0$$

$$\Rightarrow \quad 6t - 9 - t^2 + 6t - 9 = 0$$

$t^2 - 12t - 18 = 0$

$t = \frac{12 \pm \sqrt{144 - 72}}{2}$

$= \frac{12 \pm 6\sqrt{2}}{2} = (6 + 3\sqrt{2})$ s

21. Answer (50)

Hint: $v = -\frac{5}{2}x + 5$

Sol. : $a = \frac{dv}{dt} = -\frac{5}{2}v = \frac{-5}{2}\left(\frac{-5}{2}x + 5\right)$

$= \frac{25x}{4} - \frac{25}{2}$

$a\ (x = 1\text{ m}) = \frac{-25}{4}$ m/s^2

22. Answer (21)

Hint: $\frac{dv}{dt} = (2t + 4) \Rightarrow \int_0^v dv = \int_0^3 (2t + 4)\, dt$

Sol. : $V = \left(\frac{2t^2}{2} + 4t\right)\Big|_0^3$ = 9 + 12 = 21 m/s

23. Answer (46)

Hint: $x_{5\text{ s}} = \frac{1}{2}\ 2 \times 5^2 = 25$ m, $V_{5\text{ s}} = 10$ m/s

Sol. : $x_{8\text{ s}} = 25 + 10 \times 3 - \frac{1}{2}\ 2 \times 3^2 = 46$ m

24. Answer (55)

Hint: $S_{n\text{th}} = u + \frac{1}{2}a\,(2n - 1)$

Sol. : $S_{4\text{th}} = u - 5\ (7) = u - 35$

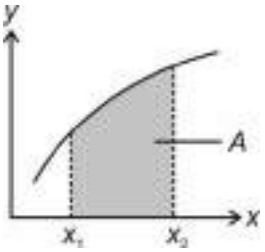
$S_{5\text{th}} = u - 5 \times 9 = u - 45$

$u - 35 = 2(u - 45)$

$\Rightarrow\ u = 90 - 35 = 55$ m/s

25. Answer (16)

Hint: $A = \int_{x_1}^{x_2} y\,dx$



Sol. : $A = 24 - \int_0^2 3x^2 dx = 24 - 8 = 16$

PART - B (CHEMISTRY)

26. Answer (3)

Hint: If a charged particle having charge qC is accelerated through a P.D. of V volts, its K.E. increase by qV J.

Sol. : de Broglie wavelength is given as :

$\lambda = \frac{h}{\sqrt{2m(K.E.)}}$

$\therefore\ \frac{\lambda_\alpha}{\lambda_p} = \sqrt{\frac{2m_p \cdot q_p \cdot 2V}{2m_\alpha \cdot q_\alpha V}}$ $[m_\alpha = 4m_p$ and $q_\alpha = 2q_p]$

$= \sqrt{\frac{2 \times 2}{2 \times 4 \times 2}} = \frac{1}{2}$

27. Answer (4)

Hint: In case of unielectronic species, energy of orbitals depends on n.

Sol. : For unielectronic species, higher the value of n, higher will be the energy level of orbital.

$\therefore$ Order of energy is : I < II = III < IV

28. Answer (2)

Hint: Transition takes from 4th excited state i.e., 5th energy level.

Sol. : Total number of different photons emitted = 10

Out of 10 different photons, 4 belong to ultraviolet region.

3 each to the visible and infrared region.

Minimum wavelength photon or maximum energy photon belongs to ultraviolet region ($5 \rightarrow 1$ transition)

29. Answer (3)

Hint: Iso-electronic species have same number of electrons.

Sol. : He^+ and Li^{++} have one electron each while H^+ has zero electron.

30. Answer (1)

Hint: For photoelectric effect to occur, the energy of incident photon should be more than work function of metal.

Sol. : Energy of incident photon

$= \frac{hc}{\lambda}$

$\approx \frac{1240}{310}$ eV $= 4$ eV

$\therefore$ Photoelectric effect is possible for metal A only.

31. Answer (2)

Hint: According to Bohr's model,

Angular momentum of an electron $\propto$ orbit number.

Sol. : $A \cdot M = mvr = \frac{nh}{2\pi}$

$\therefore \quad \frac{(A \cdot M)_{4, He^+}}{(A \cdot M)_{2, Be^{3+}}} = \frac{4}{2} = 2$

32. Answer (3)

Hint: The removed electron belongs to outermost orbital i.e., 4s

Sol. : Possible quantum numbers for 3d orbital electron is $\left(3, 2, 0, \frac{1}{2}\right)$

Possible quantum numbers for 4s orbital electron is $\left(4, 0, 0, \frac{1}{2}\right)$

33. Answer (4)

Hint: Cathode rays particles are electrons while anode rays particles are positively charged ions.

Sol. : Anode rays particles can carry a integral multiple of the fundamental unit of electric charge.

34. Answer (3)

Hint: Radial nodes of an orbital has spherical shape.

Sol. : Number of radial nodes of an orbital $= n - \ell - 1$

35. Answer (4)

Hint: Successive ionisation energy of any element always increases.

Sol. : The largest jump in I.E. is from $I.E._2$ to $I.E._3$

$\therefore$ Most probable outermost electronic configuration is ns^2.

36. Answer (4)

Hint: s-block and p-block elements are called representative elements.

Sol. : Outer electronic configuration of f-block elements is $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$

Metallic character and reactivity increase down the group among s-block elements, and due to high reactivity they are never found in pure form in nature.

37. Answer (1)

Hint& Sol. :

The given graph is for atomic radius (regular increase)

38. Answer (3)

Hint: Mg^{2+} and Al^{3+} have same number of electrons.

Sol. : Size of given species follows the order

$Mg > Al > Mg^{2+} > Al^{3+}$

39. Answer (3)

Hint: For any element : $IE_1 < IE_2$ (always)

Sol. : In periodic table He has highest ionisation energy.

Due to half filled electronic configuration IE of ns^2np^3 is more than that of ns^2np^2 and ns^2np^4 outer electronic configuration.

40. Answer (3)

Hint: Due to ns^2 configuration of Mg, addition of electron will lead to absorption of energy.

Sol. : Addition of electron to Na, Al and F leads to release of energy.

41. Answer (4)

Hint: Correct order of ionisation energy :

B > Tl > Ga > Al > In

Sol. : Screening effect follows the order : s > p > d > f

Atomic radius : B < Ga < Al < In < Tl

Ionic size : $Mg^{2+} < Na^+ < F^- < O^{2-}$

42. Answer (1)

Hint: Reactant B will act as limiting reagent.

Sol. :

	$2A$	+	$3B \rightarrow$	C
Initial moles	6		8	
			(L.R)	

$\therefore$ Moles of C formed $= \frac{8}{3} = 2.67$ moles

43. Answer (4)

Hint: Moles of $KIO_3 = \frac{64.2}{214} = 0.3$ moles

Moles of KI $= \frac{83}{166} = 0.5$ moles

Moles of HCl $= \frac{43.8}{36.5} = 1.2$ moles

Sol. : HCl will act as limiting reagent.

$\therefore$ Moles of ICl formed $= \frac{1.2}{2} = 0.6$ moles

Moles of KCl formed $= \frac{1.2}{2} = 0.6$ moles

Moles of H_2O formed $= \frac{1.2}{2} = 0.6$ moles

$\therefore$ Total moles of products formed = 1.8 moles

44. Answer (4)

Hint: 2 moles of $KMnO_4$ reacts with 5 moles of H_2O.

Sol. : m · moles of $KMnO_4$ reacted

= 50 × 0.12

= 6 m · moles

Moles of H_2O_2 reacted

= 6 × 2.5

= 15 m moles

$\therefore$ Molarity of H_2O_2 solution

$= \frac{15}{20} = 0.75$

= 0.75 mol/L

$\therefore$ % W/V $= \frac{0.75 \times 34}{10}$

= 2.55 g/mL

45. Answer (3)

Hint: M. moles of H^+ = 40 × 0.2 + 60 × 0.1 × 2

= 20 m. moles

M. moles of OH^- = 150 × 0.1 = 15 m moles

Sol. : Volume of final solution = 250 mL

$\therefore \ [H^+] = \frac{5}{250} = 0.02$ M

46. Answer (36)

Hint: At STP 1 mole of any gas occupy 22.4 L.

Sol. : Volume of H_2(g) produced $= \frac{3.136}{22.4}$

= 0.14

Assume mass of Al in 3 g sample = x

$\therefore \ \frac{3}{2} \cdot \frac{x}{27} + \frac{3-x}{24} = 0.14$

$\Rightarrow \ \frac{3x}{54} + \frac{3-x}{24} = 0.14$

$\Rightarrow$ 72x + 162 – 54x = 0.14 × 54 × 24

$\Rightarrow$ x = 1.08 g

$\therefore$ % of Al in alloy $= \frac{1.08}{3} \times 100 = 36\%$

47. Answer (50)

Hint: Moles of Fe^{3+} reacted = 2 × moles of NH_2OH (from 1st reaction)

Sol. : From reaction 1st

Moles of $NH_2OH = \frac{1}{2}$ × moles of Fe^{3+} reacted in 50 mL solution

$= 5 \times 10^{-3}$ moles

$\therefore$ Moles of NH_2OH in 10 ml original sample $= 5 \times 10^{-3}$ moles

$\therefore$ Molarity $= \frac{5 \times 10^{-3}}{10 \times 10^{-3}} = 0.5$ M

48. Answer (10)

Hint: During formation of cation, electrons are removed from outermost orbits first.

Sol. : Ground state electronic configuration of Fe^{3+} is

	$1s^2$	$2s^2$	$2p^6$	$3s^2$	$3p^6$	$3d^5$
$n+l$ =	1	2	3	3	4	5

$\therefore$ Number of electrons having $s = -\frac{1}{2}$

= 1 + 3 + 1 + 5

= 10

49. Answer (32)

Hint: % of C = 37.5

% of H = 12.5

% of O = 50

Sol. :

	C	H	O
%	37.5	12.5	50
moles	$\frac{37.5}{12} = 3.125$	$\frac{12.5}{1} = 12.5$	$\frac{50}{16} = 3.125$
ratio	$\frac{3.125}{3.125} = 1$	$\frac{12.5}{3.125} = 4$	$\frac{3.125}{3.125} = 1$

$\therefore$ Empirical formula = CH_4O

Empirical formula mass = 32

50. Answer (28)

Hint: Avg. mol. mass of air = 0.2 × 32 + 0.8 × 28

= 28.8 g/mol

$\therefore$ Moles of $N_2 = \frac{14.4}{28.8} \times 0.8$

= 0.4 mol

Sol. : For given reaction N_2 will be the limiting reagent.

$\therefore$ Moles of Li_3N formed = 0.8

$\therefore$ Amount of Li_3N formed = 35 × 0.8

= 28 g

PART - C (MATHEMATICS)

51. Answer (1)

Hint: $\frac{3^x - 2^x}{x} \geq 0$

Sol.: $f(x) = \sqrt{\frac{3^x - 2^x}{x}}$

$\frac{3^x - 2^x}{x} \geq 0$

If $x > 0$ then $3^x - 2^x \geq 0 \Rightarrow x \in (0, \infty)$

If $x < 0$ then $3^x - 2^x \leq 0 \Rightarrow x \in (-\infty, 0)$

Domain of $f(x)$ is $(-\infty,\infty) - \{0\}$

52. Answer (3)

Hint: Total number of relations from A to B = $2^{n(A).n(B)}$

Sol. : Total number of relations from A to B = $2^{n(A).n(B)}$

$n(P(\phi)) = 1$ and $n(P(P(\phi))) = 2$

So total number of relations = $2^{1\times2} = 4$

53. Answer (1)

Hint: $3^{(4\log_9 5)-1} = \frac{1}{3}\left[3^{2\log_3 5}\right]$

Sol. : $3^{(4\log_9 5)-1} = \frac{1}{3}\left[3^{2\log_3 5}\right]$

$= \frac{1}{3} \cdot 3^{\log_3 5^2}$

$= \frac{25}{3}$

54. Answer (4)

Hint: $2 - x < 0 \cap x^2 + 7x + 12 \neq 0$

Sol. : $f(x) = \frac{\log_3(2-x)}{x^2 + 7x + 12}$

$2 - x > 0 \cap x^2 + 7x + 12 \neq 0$

$\Rightarrow x < 2 \cap x \neq -3, -4$

$\Rightarrow x \in (-\infty, 2) - \{-3, -4\}$

55. Answer (1)

Hint: $n(A\Delta B) = n(A \cup B) - n(A \cap B)$

Sol. : $\because n(A - B) = n(A) - n(A \cap B)$

$n(A \cap B) = 115 - 60 = 55$

$\because n(A\Delta B) = n(A \cup B) - n(A \cap B)$

$= 200 - 55 = 145$

56. Answer (4)

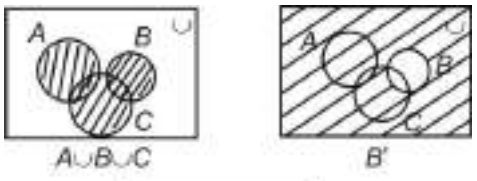
Hint: See Venn-diagram

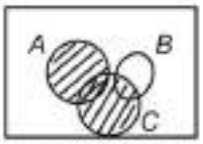
Sol. : The shaded region contains those elements of universal set which are available in set B but not available in either set A or set C, that is $B - (A \cup C)$

57. Answer (3)

Hint: Use Venn-diagram

Sol. :





$(A \cup B \cup C) \cap B' = (A \cup C) - B$

58. Answer (4)

Hint: $4^{\log_2 3} = 3^{\log_2 4} = 9$

Sol. : $\log_{\frac{1}{3}}\left(\frac{\sqrt{3^6 . \sqrt[3]{3^{-2} \cdot 3^{-4}}}}{3^{\log_2 4}}\right) = \log_{\frac{1}{3}}\left(\frac{3^2}{3^2}\right) = 0$

59. Answer (2)

Hint: $\ln 3 = \frac{\ln 2}{x}$, $\ln = y \ln 2$ and $\ln 5 = \frac{\ln 2}{zx}$

Sol. : $\because x = \log_3^2 \Rightarrow \frac{\ln 2}{\ln 3} = x \Rightarrow \ln 3 = \frac{\ln 2}{x}$

Similarly, $\ln = y \ln 2$ and $\ln 5 = \frac{\ln 3}{z} = \frac{\ln 2}{zx}$

Now, $\log_{42} 70 = \dfrac{\ln 70}{\ln 42} = \dfrac{\ln 2 + \ln 5 + \ln 7}{\ln 2 + \ln 3 + \ln 7}$

$= \dfrac{\ln 2 + \dfrac{\ln 2}{zx} + y \ln 2}{\ln 2 + \dfrac{\ln 2}{x} + y \ln 2}$

$= \dfrac{1 + \dfrac{1}{zx} + y}{1 + \dfrac{1}{x} + y}$

$= \dfrac{xyz + zx + 1}{z(x + yx + 1)}$

$= \dfrac{xyz + zx + 1}{xyz + zx + z}$

60. Answer (2)

Hint: $\dfrac{x-3}{2} \le \dfrac{1}{2} \cap x > 3$

Sol. : Domain of $\log_{\frac{1}{2}}\left(\dfrac{x-3}{2}\right)$ is $\dfrac{x-3}{2} > 0$

$\Rightarrow x \in (3, \infty)$

and, $\log_{\frac{1}{2}}\left(\dfrac{x-3}{2}\right) \ge 1 \Rightarrow \dfrac{x-3}{2} \le \dfrac{1}{2} \Rightarrow x \le 4$

$x \in (3, 4]$

61. Answer (4)

Hint: Factorise $x^2 + 2x - 3$

Sol. : $y = \dfrac{x^2 + 2x - 3}{x^2 - 1}$

$= \dfrac{(x-1)(x+3)}{(x-1)(x+1)}$

$y = \dfrac{x+3}{x+1}, (x \ne 1)$

$x = \dfrac{3-y}{y-1}$

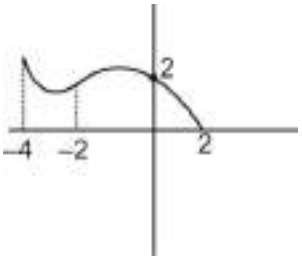
$\therefore \quad y \ne 1, 2$

$y \in R - \{1, 2\}$

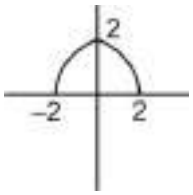
62. Answer (1)

Hint: Transformation of graphs.

Sol. : $y = f(-x)$



Now, $y = f(-|x|)$



63. Answer (2)

Hint: $a^{\log_b^c} = c^{\log_b^a}$

Sol. : $4^{\log_2(x+4)} = \left(\sqrt{5}-1\right)^{\log_{(6-2\sqrt{5})}81}$

$\Rightarrow (x+4)^{\log_{2^4}} = 81 \log_{\left(\sqrt{5}-1\right)^2}\left(\sqrt{5}-1\right)$

$\Rightarrow (x+4)^2 = 81^{\frac{1}{2}}$

$\Rightarrow x + 4 = 3$ or $x + 4 = -3$

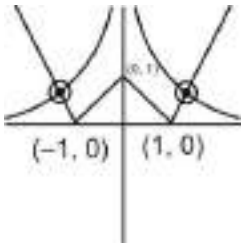
$\Rightarrow x = -1$ or -7

But $x = -7$ is not in domain

64. Answer (3)

Hint: $||x| - 1| = \dfrac{1}{x^2}$, then solve graphically.

Sol. :



$||x| - 1| = \dfrac{1}{x^2}$

$y = ||x| - 1|$ and $y = \dfrac{1}{x^2}$

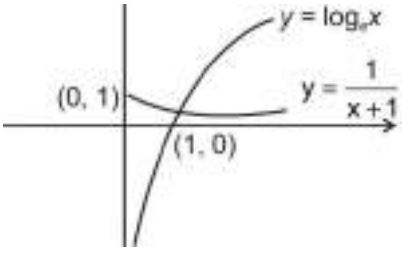
Number of solutions = 2

65. Answer (2)

Hint: As $x > 0$, so the given equation

$\log_e x = \dfrac{1}{x+1}$

Sol. :



66. Answer (4)

Hint: $f(x)+f(1-x)=\frac{1}{3}$

Sol. : $f(1-x)=\frac{3^{1-2x}}{9^{1-x}+3}=\frac{3}{9+3.9^{x}}=\frac{1}{9^{x}+3}$

$\Rightarrow \quad f(x)+f(1-x)=\frac{3^{2x-1}+1}{9^{x}+3}=\frac{1}{3}$

So, $f\left(\frac{1}{2017}\right)+f\left(\frac{2016}{2017}\right)=\frac{1}{3}$

$=f\left(\frac{2}{2017}\right)+f\left(\frac{2015}{2017}\right)$ and so on.

Then, $\sum_{r=1}^{2016} f\left(\frac{r}{2017}\right)=\frac{1}{3}\left(\frac{2016}{2}\right)=336$

67. Answer (2)

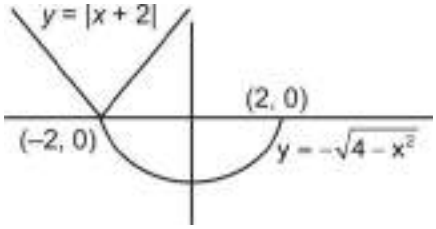
Hint: $R = \{(4, 2)\}$

Sol. : If $\frac{x}{y}$ is a prime number then only possible values of (x, y) is (4, 2).

68. Answer (3)

Hint: Draw the graphs of $y = |x + 2|$ and $y=-\sqrt{4-x^2}$

Sol. : $x = -2$ is the only solution



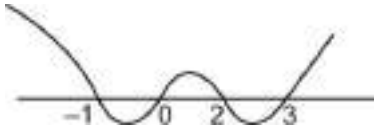
69. Answer (2)

Hint: Use wavy curve method

Sol. : $(x^2 - 2x - 1)(x^2 - 2x - 2) - 2 < 0$

$\Rightarrow \quad x^4 - 4x^3 + x^2 + 6x < 0$

$\Rightarrow \quad x(x + 1)(x - 2)(x - 3) < 0$



$x \in (-1, 0) \cup (2, 3)$

70. Answer (4)

Hint: $\log_b a=\frac{\ln a}{\ln b}$

Sol. : (1) $\log_5(200) > 3$

(2) $\frac{1}{\log_5 80}+\frac{2}{\log_4 80}=\log_{80}5+2\log_{80}4$

$= \log_{80}(5\times16) = 1$

(3) $\log_2 9 > 3$ and $\log_3 16 < 3$

(4) $\log_3 20 + \log_4 20 < \log_2 20$

$\Rightarrow \quad \frac{\ln 20}{\ln 3}+\frac{\ln 20}{\ln 4}<\frac{\ln 20}{\ln 2}$

$\Rightarrow \quad \frac{1}{\ln 3}<\frac{1}{\ln 2}-\frac{1}{2\ln 2}$

$\Rightarrow \quad \frac{1}{\ln 3}<\frac{1}{2\ln 2}$

$\Rightarrow \quad \frac{1}{\ln 3}<\frac{1}{\ln 4}$ (Incorrect)

71. Answer (04)

Hint: $f(-x) = f(x)$

Sol. : $\therefore f(-1) = f(1)$ and $f(-2) = 2$

So there will be atleast 4 elements in set B.

$B = \{f(0), f(-1), f(-2), f(-3)\}$

72. Answer (46)

Hint: Number of students reading atmost one newspaper = $70 - n(A \cap B) - n(B \cap C) - n(C \cap A) + 2n(A \cap B \cap C)$

Sol. : Number of students reading atleast two newspapers

$= n(A \cap B) + n(B \cap C) + n(C \cap A) = -2.n(A \cap B \cap C)$

$= 5 + 10 + 15 - 2^3 = 24$

So, number of students reading atmost one newspaper = 70 – 24 = 46

73. Answer (04)

Hint: Use wavy curve to solve the inequations.

Sol. : $\frac{x+1}{(x-4)(x-9)^2}\geq 0$

$x \in (-\infty, -1] \cup (4, 9) \cup (9, \infty)$

and $\frac{(x+1)^{2020}(x+3)^6(x-8)^8}{x(x-6)}\leq 0$

$x \in (0, 6] \cup \{-3, -1, 8\}$

So, $x \in (4, 6) \cup \{-3, -1, 8\}$

Integral values of x are –3, –1, 5 and 8.

74. Answer (10)

Hint: $\log_{10}\left(x^{1+\log_{10} x}\right) = 2$ then put $\log_{10} x = t$

Sol. : $x^{1+\log_{10} x} = 100$

$\Rightarrow \quad (1+\log_{10} x)\log_{10} x = 2$

Put $\log_{10} x = t$

$\Rightarrow \quad t^2 + t - 2 = 0$

$\Rightarrow \quad t = 1, -2$

$x = 10^1, 10^{-2}$

Product of roots is $\frac{1}{10}$

75. Answer (04)

Hint: $n((A \times B) \cap (B \times A)) = (n(A \cap B))^2$

Sol. : If $(x, y) \in (A \times B)$ and $(x, y) \in B \times A$

Then $x \in A$ and $x \in B$ similarly

$Y \in A$ and $y \in$ B

So $x, y \in A \cap B$

Number of ordered pairs common to $A \times B$ and $B \times A$ is $(n(A \cap B))^2$

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All India Aakash Test Series for JEE (Main)-2021

TEST -1 - Code-D

Test Date : 06/10/2019

ANSWERS

PHYSICS		CHEMISTRY		MATHEMATICS	
1.	(3)	26.	(3)	51.	(4)
2.	(4)	27.	(4)	52.	(2)
3.	(2)	28.	(4)	53.	(3)
4.	(1)	29.	(1)	54.	(2)
5.	(1)	30.	(4)	55.	(4)
6.	(2)	31.	(3)	56.	(2)
7.	(3)	32.	(3)	57.	(3)
8.	(4)	33.	(3)	58.	(2)
9.	(4)	34.	(1)	59.	(1)
10.	(3)	35.	(4)	60.	(4)
11.	(2)	36.	(4)	61.	(2)
12.	(2)	37.	(3)	62.	(2)
13.	(3)	38.	(4)	63.	(4)
14.	(3)	39.	(3)	64.	(3)
15.	(2)	40.	(2)	65.	(4)
16.	(1)	41.	(1)	66.	(1)
17.	(4)	42.	(3)	67.	(4)
18.	(1)	43.	(2)	68.	(1)
19.	(1)	44.	(4)	69.	(3)
20.	(4)	45.	(3)	70.	(1)
21.	(16)	46.	(28)	71.	(04)
22.	(55)	47.	(32)	72.	(10)
23.	(46)	48.	(10)	73.	(04)
24.	(21)	49.	(50)	74.	(46)
25.	(50)	50.	(36)	75.	(04)

HINTS & SOLUTIONS

PART - A (PHYSICS)

1. Answer (3)

Hint: Apply $s = ut + \frac{1}{2}at^2$

Sol. : $\frac{1}{2}2\times3^2 + \left[6(t-3) - \frac{1}{2}2\times(t-3)^2\right] = 0$

$\Rightarrow$ $18 + 12t - 36 - 2(t^2 - 6t + 9) = 0$

$\Rightarrow$ $6t - 9 - t^2 + 6t - 9 = 0$

$t^2 - 12t - 18 = 0$

$t = \frac{12 \pm \sqrt{144 - 72}}{2}$

$= \frac{12 \pm 6\sqrt{2}}{2} = (6 + 3\sqrt{2})$ s

2. Answer (4)

Hint: $125 = 5t^2 \Rightarrow t = 5$ s

Sol. : $S_{5th} = 0 + \frac{1}{2}10[9] = 45$ m

$S_{1st} = 5$ m

3. Answer (2)

Hint: $x_P = ut$

Sol. : $x_Q = d + \frac{1}{2}at^2$

$0 = \frac{1}{2}a.2t - u \Rightarrow t = \frac{u}{a}$

$(x_Q - x_P)_{min} = d + \frac{1}{2}a\cdot\frac{u^2}{a^2} - \frac{u^2}{a}$

$= d - \frac{u^2}{2a}$

4. Answer (1)

Hint: For critical point $y' = 0$

$x = -3$ is point of maxima

Sol. : $\frac{dy}{dx} = 6x^2 + 6x - 36 = 0$

$\Rightarrow$ $x^2 + x - 6 = 0$

$x = -3$ or $x = 2$

$\frac{d^2y}{dx^2} = 2x + 1$

$\Rightarrow$ y has a maximum at $x = -3$

$\Rightarrow$ $y_{max} = -54 + 27 + 108 + 7 = 88$

5. Answer (1)

Hint: Particle is instantaneously at rest at $t = 5$ s

Sol. : $d_1 = \left(10\times5 - \frac{1}{2}2\times5^2\right) - \left(10\times4 - \frac{1}{2}2\times4^2\right)$

$= (50 - 25) - (40 - 16) = 1$ m

$d_2 = \frac{1}{2}2\times2^2 = 4$ m

$\Rightarrow$ Average speed = $\frac{5}{3}$ m/s

6. Answer (2)

Hint: $\int\frac{dx}{ax+b} = \frac{1}{a}\ln(ax+b) + c$

Sol. : $I = \frac{3}{3}\ln(3x+4)\Big|_0^2 = \ln\frac{10}{4} = \ln\frac{5}{2}$

7. Answer (3)

Hint: $V^2 = 9x$

Sol. : $2V\frac{dV}{dt} = 9V \Rightarrow a = \frac{9}{2}$

$S = \frac{1}{2}\frac{9}{2}\cdot t^2 \Rightarrow 16 = 9t^2$

$\Rightarrow$ $t = \frac{4}{3}$ s

$V_{av} = \frac{4\times3}{4} = 3$ m/s

8. Answer (4)

Hint: Total time of journey

$= 2 \times 90 = 180$ minutes

$= 3$ hr

Sol. : Speed of river = $\frac{12}{3} = 4$ km/h

9. Answer (4)

Hint: ΔV = Area under v-t graph

Sol. : $\Delta V = \frac{1}{2}\times4\times5 - \frac{1}{2}2\times\frac{5}{2}$

$= 10 - 2.5 = 7.5$ m/s

$V = V_i + \Delta V = 17.5$ m/s

10. Answer (3)

Hint: $x_Q - x_P = Vt - \frac{1}{2}at^2$

Sol. : Graph is a downward parabola which initially goes up and then down.

11. Answer (2)

Hint: $H = ut - \frac{1}{2}gt^2$

Sol. : $\Rightarrow \frac{1}{2}gt^2 - ut + H = 0$

$t = \frac{u \pm \sqrt{u^2 - 2gH}}{g}$

$\Rightarrow t_1 + t_2 = \frac{2u}{g}$

$\Rightarrow u = \frac{g(t_1 + t_2)}{2}$

$0 = u^2 - 2gh_{max}$

$\Rightarrow h_{max} = \frac{u^2}{2g} = \frac{g(t_1 + t_2)^2}{8}$

12. Answer (2)

Hint: $0 = u - gt_1 \Rightarrow t_1 = \frac{u}{g}$

Sol. : $0 = H + ut - \frac{1}{2}gt^2$

$\Rightarrow \frac{1}{2}gt^2 - ut - H = 0$

$t = \frac{u + \sqrt{u^2 + 4Hg/2}}{g} = \frac{u + \sqrt{u^2 + 2Hg}}{g}$

$\frac{u + \sqrt{u^2 + 2Hg}}{g} = 3 \cdot \frac{u}{g}$

$\Rightarrow u^2 + 2Hg = 4u^2$

$\Rightarrow 2Hg = 3u^2 \Rightarrow H = \frac{3u^2}{2g}$

13. Answer (3)

Hint: $\int_u^{u/2} v^{-1/2}dv = \int_0^t -kdt \Rightarrow 2v^{1/2}\Big|_u^{\frac{u}{2}} = -kt$

$\Rightarrow 2\left[\sqrt{u} - \sqrt{\frac{u}{2}}\right] = kt$

Sol. : $t = \frac{2\sqrt{u}}{k}\left[1 - \frac{1}{\sqrt{2}}\right] = \frac{\sqrt{u}}{k}[2 - \sqrt{2}]$

14. Answer (3)

Hint: Mean value

$= \frac{1.49 + 1.50 + 1.52 + 1.54 + 1.48}{5}$

$= \frac{7.53}{5} = 1.506 = 1.51\,\text{cm}$

Sol. : Mean absolute error

$= \frac{0.02 + 0.01 + 0.01 + 0.03 + 0.03}{5}$

$= \frac{0.1}{5} = 0.02$

% error = $\frac{0.02}{1.51} \times 100 = 1.3\%$

15. Answer (2)

Hint: $R_P = \frac{R_1R_2}{R_1 + R_2} = \frac{3 \times 6}{9} = 2\,\Omega$

$R_P = 2.0\,\Omega$

Sol. : $\frac{\Delta R_P}{2^2} = \frac{0.1}{9} + \frac{0.2}{36} = \frac{0.4 + 0.2}{36}$

$\Delta R_P = \frac{0.6}{9} = 0.067 = 0.1\Omega$

16. Answer (1)

Hint: $A = 16.6 \times 4.7 = 78.02\ \text{cm}^2$

Sol. : There will be only two significant figures as 4.7 cm has only two significant figures.

17. Answer (4)

Hint: $[\tau] = [\rho^x f^y v^z] = ML^2T^{-2}$

Sol. : $\Rightarrow (ML^{-3})^x (T^{-1})^y (LT^{-1})^z = ML^2T^{-2}$

$\Rightarrow x = 1, -3x + z = 2 \Rightarrow z = 2 + 3 = 5$

$-y - z = -2 \Rightarrow y = 2 - 5 = -3$

$\Rightarrow [\tau] = \rho f^{-3} v^5$

18. Answer (1)

Hint: $[a] = [LT^{-2}]$

Sol. : $(c) = [a]^{1/2} = [L^{1/2}T^{-1}]$

$[b] = \frac{[L][a]}{T^3} = [L^2\,T^{-5}]$

19. Answer (1)

Hint: $a = 12 - 3t = \frac{dv}{dt}$

Sol. : $\int_7^v dv = \int_1^5 (12 - 3t)dt$

$\Rightarrow v - 7 = \left(12t - \frac{3t^2}{2}\right)\Big|_1^5 = 12$

$\Rightarrow v = 19$ m/s

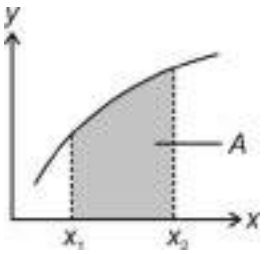
20. Answer (4)

Hint: $1\text{N} = \frac{1\text{kg m}}{s^2}$

Sol. : $\frac{1}{\alpha} \cdot \frac{1}{\beta}(\gamma)^2 = \frac{\gamma^2}{\alpha\beta}$

21. Answer (16)

Hint: $A = \int_{x_1}^{x_2} y\,dx$



Sol. : $A = 24 - \int_0^2 3x^2 dx = 24 - 8 = 16$

22. Answer (55)

Hint: $S_{nth} = u + \frac{1}{2}a\,(2n-1)$

Sol. : $S_{4th} = u - 5\,(7) = u - 35$

$S_{5th} = u - 5 \times 9 = u - 45$

$u - 35 = 2(u - 45)$

$\Rightarrow \; u = 90 - 35 = 55$ m/s

23. Answer (46)

Hint: $x_{5\,s} = \frac{1}{2}\ 2 \times 5^2 = 25$ m, $V_{5\,s} = 10$ m/s

Sol. : $x_{8\,s} = 25 + 10 \times 3 - \frac{1}{2}\ 2 \times 3^2 = 46$ m

24. Answer (21)

Hint: $\frac{dv}{dt} = (2t+4) \Rightarrow \int_0^v dv = \int_0^3 (2t+4)\,dt$

Sol. : $V = \left(\frac{2t^2}{2} + 4t\right)\Big|_0^3 = 9 + 12 = 21$ m/s

25. Answer (50)

Hint: $v = -\frac{5}{2}x + 5$

Sol. : $a = \frac{dv}{dt} = -\frac{5}{2}v = \frac{-5}{2}\left(\frac{-5}{2}x + 5\right)$

$= \frac{25x}{4} - \frac{25}{2}$

$a\,(x = 1\text{ m}) = \frac{-25}{4}$ m/s^2

PART - B (CHEMISTRY)

26. Answer (3)

Hint: M. moles of $H^+ = 40 \times 0.2 + 60 \times 0.1 \times 2$

$= 20$ m. moles

M. moles of OH^- = 150 × 0.1 = 15 m moles

Sol. : Volume of final solution = 250 mL

$\therefore \; [H^+] = \frac{5}{250} = 0.02$ M

27. Answer (4)

Hint: 2 moles of $KMnO_4$ reacts with 5 moles of H_2O.

Sol. : m · moles of $KMnO_4$ reacted

= 50 × 0.12

= 6 m · moles

Moles of H_2O_2 reacted

= 6 × 2.5

= 15 m moles

$\therefore$ Molarity of H_2O_2 solution

$= \frac{15}{20} = 0.75$

= 0.75 mol/L

$\therefore \; \%\ W/V = \frac{0.75 \times 34}{10}$

= 2.55 g/Ml

28. Answer (4)

Hint: Moles of $KIO_3 = \frac{64.2}{214} = 0.3$ moles

Moles of KI $= \frac{83}{166} = 0.5$ moles

Moles of HCl $= \frac{43.8}{36.5} = 1.2$ moles

Sol. : HCl will act as limiting reagent.

$\therefore$ Moles of ICl formed $= \frac{1.2}{2} = 0.6$ moles

Moles of KCl formed $= \frac{1.2}{2} = 0.6$ moles

Moles of H_2O formed $= \frac{1.2}{2} = 0.6$ moles

$\therefore$ Total moles of products formed = 1.8 moles

29. Answer (1)

Hint: Reactant B will act as limiting reagent.

Sol. :

	2A	+	3B	$\rightarrow$	C
Initial moles	6		8		
			(L.R)		

$\therefore$ Moles of C formed $= \frac{8}{3} = 2.67$ moles

30. Answer (4)

Hint: Correct order of ionisation energy :

B > Tl > Ga > Al > In

Sol. : Screening effect follows the order : s > p > d > f

Atomic radius : B < Ga < Al < In < Tl

Ionic size : $Mg^{2+} < Na^{+} < F^{-} < O^{2-}$

31. Answer (3)

Hint: Due to ns^2 configuration of Mg, addition of electron will lead to absorption of energy.

Sol. : Addition of electron to Na, Al and F leads to release of energy.

32. Answer (3)

Hint: For any element : $IE_1 < IE_2$ (always)

Sol. : In periodic table He has highest ionisation energy.

Due to half filled electronic configuration IE of ns^2np^3 is more than that of ns^2np^2 and ns^2np^4 outer electronic configuration.

33. Answer (3)

Hint: Mg^{2+} and Al^{3+} have same number of electrons.

Sol. : Size of given species follows the order

$Mg > Al > Mg^{2+} > Al^{3+}$

34. Answer (1)

Hint& Sol. :

The given graph is for atomic radius (regular increase)

35. Answer (4)

Hint: s-block and p-block elements are called representative elements.

Sol. : Outer electronic configuration of f-block elements is $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$

Metallic character and reactivity increase down the group among s-block elements, and due to high reactivity they are never found in pure form in nature.

36. Answer (4)

Hint: Successive ionisation energy of any element always increases.

Sol. : The largest jump in I.E. is from $I.E._2$ to $I.E._3$

$\therefore$ Most probable outermost electronic configuration is ns^2.

37. Answer (3)

Hint: Radial nodes of an orbital has spherical shape.

Sol. : Number of radial nodes of an orbital $= n - \ell - 1$

38. Answer (4)

Hint: Cathode rays particles are electrons while anode rays particles are positively charged ions.

Sol. : Anode rays particles can carry a integral multiple of the fundamental unit of electric charge.

39. Answer (3)

Hint: The removed electron belongs to outermost orbital i.e., 4s

Sol. : Possible quantum numbers for 3d orbital electron is $\left(3, 2, 0, \frac{1}{2}\right)$

Possible quantum numbers for 4s orbital electron is $\left(4, 0, 0, \frac{1}{2}\right)$

40. Answer (2)

Hint: According to Bohr's model,

Angular momentum of an electron $\propto$ orbit number.

Sol. : $A \cdot M = mvr = \frac{nh}{2\pi}$

$\therefore \quad \frac{(A \cdot M)_{4,\, He^+}}{(A \cdot M)_{2,\, Be^{3+}}} = \frac{4}{2} = 2$

41. Answer (1)

Hint: For photoelectric effect to occur, the energy of incident photon should be more than work function of metal.

Sol. : Energy of incident photon

$= \frac{hc}{\lambda}$

$\approx \frac{1240}{310}\ eV = 4\ eV$

$\therefore$ Photoelectric effect is possible for metal A only.

42. Answer (3)

Hint: Iso-electronic species have same number of electrons.

Sol. : He^+ and Li^{++} have one electron each while H^+ has zero electron.

43. Answer (2)

Hint: Transition takes from 4^{th} excited state i.e., 5^{th} energy level.

Sol. : Total number of different photons emitted = 10

Out of 10 different photons, 4 belong to ultraviolet region.

3 each to the visible and infrared region.

Minimum wavelength photon or maximum energy photon belongs to ultraviolet region ($5 \rightarrow 1$ transition)

44. Answer (4)

Hint: In case of unielectronic species, energy of orbitals depends on n.

Sol. : For unielectronic species, higher the value of n, higher will be the energy level of orbital.

$\therefore$ Order of energy is : I < II = III < IV

45. Answer (3)

Hint: If a charged particle having charge qC is accelerated through a P.D. of V volts, its K.E. increase by qV J.

Sol. : de Broglie wavelength is given as :

$$\lambda = \frac{h}{\sqrt{2m(K.E.)}}$$

$$\therefore \frac{\lambda_\alpha}{\lambda_p} = \sqrt{\frac{2m_p \cdot q_p \cdot 2V}{2m_\alpha \cdot q_\alpha V}} \; [m_\alpha = 4m_p \text{ and } q_\alpha = 2q_p]$$

$$= \sqrt{\frac{2\times 2}{2\times 4\times 2}} = \frac{1}{2}$$

46. Answer (28)

Hint: Avg. mol. mass of air = 0.2 × 32 + 0.8 × 28

= 28.8 g/mol

$\therefore$ Moles of $N_2 = \frac{14.4}{28.8} \times 0.8$

= 0.4 mol

Sol. : For given reaction N_2 will be the limiting reagent.

$\therefore$ Moles of Li_3N formed = 0.8

$\therefore$ Amount of Li_3N formed = 35 × 0.8

= 28 g

47. Answer (32)

Hint: % of C = 37.5

% of H = 12.5

% of O = 50

Sol. :

	C	H	O
%	37.5	12.5	50
moles	$\frac{37.5}{12} = 3.125$	$\frac{12.5}{1} = 12.5$	$\frac{50}{16} = 3.125$
ratio	$\frac{3.125}{3.125} = 1$	$\frac{12.5}{3.125} = 4$	$\frac{3.125}{3.125} = 1$

$\therefore$ Empirical formula = CH_4O

Empirical formula mass = 32

48. Answer (10)

Hint: During formation of cation, electrons are removed from outermost orbits first.

Sol. : Ground state electronic configuration of Fe^{3+} is

	$1s^2$	$2s^2$	$2p^6$	$3s^2$	$3p^6$	$3d^5$
$n+l$ =	1	2	3	3	4	5

$\therefore$ Number of electrons having $s = -\frac{1}{2}$

= 1 + 3 + 1 + 5

= 10

49. Answer (50)

Hint: Moles of Fe^{3+} reacted = 2 × moles of NH_2OH (from 1st reaction)

Sol. : From reaction 1st

Moles of NH_2OH = $\frac{1}{2}$ × moles of Fe^{3+} reacted in 50 mL solution

= 5×10^{-3} moles

$\therefore$ Moles of NH_2OH in 10 ml original sample = 5×10^{-3} moles

$\therefore$ Molarity $= \frac{5\times 10^{-3}}{10\times 10^{-3}} = 0.5$ M

50. Answer (36)

Hint: At STP 1 mole of any gas occupy 22.4 L.

Sol. : Volume of $H_2(g)$ produced $= \frac{3.136}{22.4}$

= 0.14

Assume mass of Al in 3 g sample = x

$\therefore \quad \frac{3}{2} \cdot \frac{x}{27} + \frac{3-x}{24} = 0.14$

$\Rightarrow \frac{3x}{54}+\frac{3-x}{24}=0.14$

$\Rightarrow$ 72x + 162 – 54x = 0.14 × 54 × 24

$\Rightarrow$ x = 1.08 g

$\therefore$ % of Al in alloy $=\frac{1.08}{3}\times 100=36\%$

PART - C (MATHEMATICS)

51. Answer (4)

Hint: $\log_{b^a}=\frac{\ln a}{\ln b}$

Sol. : (1) $\log_5(200) > 3$

(2) $\frac{1}{\log_5 80}+\frac{2}{\log_4 80}=\log_{80}5+2\log_{80}4$

$=\log_{80}(5\times 16)=1$

(3) $\log_2 9 > 3$ and $\log_3 16 < 3$

(4) $\log_3 20+\log_4 20<\log_2 20$

$\Rightarrow \frac{\ln 20}{\ln 3}+\frac{\ln 20}{\ln 4}<\frac{\ln 20}{\ln 2}$

$\Rightarrow \frac{1}{\ln 3}<\frac{1}{\ln 2}-\frac{1}{2\ln 2}$

$\Rightarrow \frac{1}{\ln 3}<\frac{1}{2\ln 2}$

$\Rightarrow \frac{1}{\ln 3}<\frac{1}{\ln 4}$ (Incorrect)

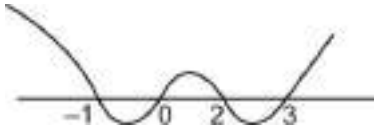
52. Answer (2)

Hint: Use wavy curve method

Sol. : $(x^2-2x-1)(x^2-2x-2)-2<0$

$\Rightarrow x^4-4x^3+x^2+6x<0$

$\Rightarrow x(x+1)(x-2)(x-3)<0$

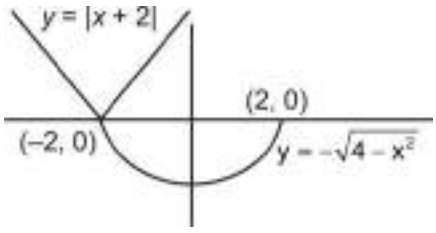


$x\in(-1, 0)\cup(2, 3)$

53. Answer (3)

Hint: Draw the graphs of $y = |x + 2|$ and $y=-\sqrt{4-x^2}$

Sol. : $x = -2$ is the only solution



54. Answer (2)

Hint: $R = \{(4, 2)\}$

Sol. : If $\frac{x}{y}$ is a prime number then only possible values of (x, y) is (4, 2).

55. Answer (4)

Hint: $f(x)+f(1-x)=\frac{1}{3}$

Sol. : $f(1-x)=\frac{3^{1-2x}}{9^{1-x}+3}=\frac{3}{9+3.9^x}=\frac{1}{9^x+3}$

$\Rightarrow f(x)+f(1-x)=\frac{3^{2x-1}+1}{9^x+3}=\frac{1}{3}$

So, $f\left(\frac{1}{2017}\right)+f\left(\frac{2016}{2017}\right)=\frac{1}{3}$

$=f\left(\frac{2}{2017}\right)+f\left(\frac{2015}{2017}\right)$ and so on.

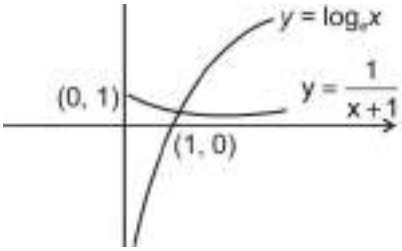
Then, $\sum_{r=1}^{2016} f\left(\frac{r}{2017}\right)=\frac{1}{3}\left(\frac{2016}{2}\right)=336$

56. Answer (2)

Hint: As $x > 0$, so the given equation

$\log_e x=\frac{1}{x+1}$

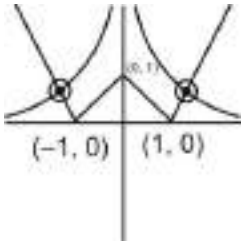
Sol. :



57. Answer (3)

Hint: $||x|-1|=\frac{1}{x^2}$, then solve graphically.

Sol. :



$||x|-1|=\frac{1}{x^2}$

$y = ||x|-1|$ and $y=\frac{1}{x^2}$

Number of solutions = 2

58. Answer (2)

Hint: $a^{\log_b^c} = c^{\log_b^a}$

Sol. : $4^{\log_2(x+4)} = \left(\sqrt{5}-1\right)^{\log_{(6-2\sqrt{5})}81}$

$\Rightarrow \left(x+4\right)^{\log_2^4} = 81 \log_{\left(\sqrt{5}-1\right)^2}\left(\sqrt{5}-1\right)$

$\Rightarrow \left(x+4\right)^2 = 81^{\frac{1}{2}}$

$\Rightarrow$ $x + 4 = 3$ or $x + 4 = -3$

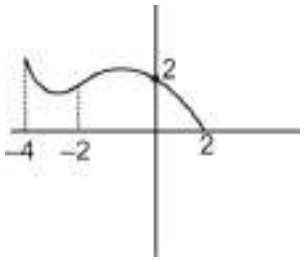
$\Rightarrow$ $x = -1$ or -7

But $x = -7$ is not in domain

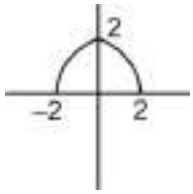
59. Answer (1)

Hint: Transformation of graphs.

Sol. : $y = f(-x)$



Now, $y = f(-|x|)$



60. Answer (4)

Hint: Factorise $x^2 + 2x - 3$

Sol. : $y = \dfrac{x^2+2x-3}{x^2-1}$

$= \dfrac{(x-1)(x+3)}{(x-1)(x+1)}$

$y = \dfrac{x+3}{x+1}, (x \neq 1)$

$x = \dfrac{3-y}{y-1}$

$\therefore$ $y \neq 1, 2$

$y \in R - \{1, 2\}$

61. Answer (2)

Hint: $\dfrac{x-3}{2} \leq \dfrac{1}{2} \cap x > 3$

Sol. : Domain of $\log_{\frac{1}{2}}\left(\dfrac{x-3}{2}\right)$ is $\dfrac{x-3}{2} > 0$

$\Rightarrow$ $x \in (3, \infty)$

and, $\log_{\frac{1}{2}}\left(\dfrac{x-3}{2}\right) \geq 1 \Rightarrow \dfrac{x-3}{2} \leq \dfrac{1}{2} \Rightarrow x \leq 4$

$x \in (3, 4]$

62. Answer (2)

Hint: $\ln 3 = \dfrac{\ln 2}{x}$, $\ln = y \ln 2$ and $\ln 5 = \dfrac{\ln 2}{zx}$

Sol. : $\because x = \log_3^2 \Rightarrow \dfrac{\ln 2}{\ln 3} = x \Rightarrow \ln 3 = \dfrac{\ln 2}{x}$

Similarly, $\ln = y \ln 2$ and $\ln 5 = \dfrac{\ln 3}{z} = \dfrac{\ln 2}{zx}$

Now, $\log_{42} 70 = \dfrac{\ln 70}{\ln 42} = \dfrac{\ln 2 + \ln 5 + \ln 7}{\ln 2 + \ln 3 + \ln 7}$

$= \dfrac{\ln 2 + \dfrac{\ln 2}{zx} + y \ln 2}{\ln 2 + \dfrac{\ln 2}{x} + y \ln 2}$

$= \dfrac{1 + \dfrac{1}{zx} + y}{1 + \dfrac{1}{x} + y}$

$= \dfrac{xyz + zx + 1}{z\left(x + yx + 1\right)}$

$= \dfrac{xyz + zx + 1}{xyz + zx + z}$

63. Answer (4)

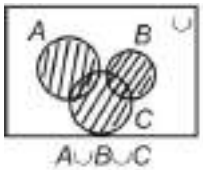
Hint: $4^{\log_2 3} = 3^{\log_2 4} = 9$

Sol. : $\log_{\frac{1}{3}}\left(\dfrac{\sqrt{3^6 . \sqrt[3]{3^{-2} \cdot 3^{-4}}}}{3^{\log_2 4}}\right) = \log_{\frac{1}{3}}\left(\dfrac{3^2}{3^2}\right) = 0$

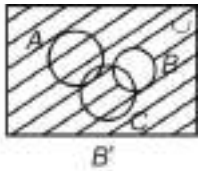
64. Answer (3)

Hint: Use Venn-diagram

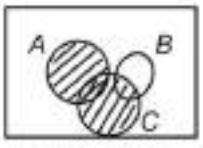
Sol. :



$A \cup B \cup C$



B'



$(A \cup B \cup C) \cap B' = (A \cup C) - B$

65. Answer (4)

Hint: See Venn-diagram

Sol. : The shaded region contains those elements of universal set which are available in set B but not available in either set A or set C, that is $B - (A \cup C)$

66. Answer (1)

Hint: $n(A\Delta B) = n(A \cup B) - n(A \cap B)$

Sol. : $\because n(A - B) = n(A) - n(A \cap B)$

$n(A \cap B) = 115 - 60 = 55$

$\because n(A\Delta B) = n(A \cup B) - n(A \cap B)$

$= 200 - 55 = 145$

67. Answer (4)

Hint: $2 - x < 0 \cap x^2 + 7x + 12 \neq 0$

Sol. : $f(x) = \dfrac{\log_3(2-x)}{x^2+7x+12}$

$2 - x > 0 \cap x^2 + 7x + 12 \neq 0$

$\Rightarrow x < 2 \cap x \neq -3, -4$

$\Rightarrow x \in (-\infty, 2) - \{-3, -4\}$

68. Answer (1)

Hint: $3^{(4\log_9 5)-1} = \dfrac{1}{3}\left[3^{2\log_3 5}\right]$

Sol. : $3^{(4\log_9 5)-1} = \dfrac{1}{3}\left[3^{2\log_3 5}\right]$

$= \dfrac{1}{3} \cdot 3^{\log_3 5^2}$

$= \dfrac{25}{3}$

69. Answer (3)

Hint: Total number of relations from A to B = $2^{n(A).n(B)}$

Sol. : Total number of relations from A to B = $2^{n(A).n(B)}$

$n(P(\phi)) = 1$ and $n(P(P(\phi))) = 2$

So total number of relations = $2^{1\times 2} = 4$

70. Answer (1)

Hint: $\dfrac{3^x - 2^x}{x} \geq 0$

Sol.: $f(x) = \sqrt{\dfrac{3^x - 2^x}{x}}$

$\dfrac{3^x - 2^x}{x} \geq 0$

If $x > 0$ then $3^x - 2^x \geq 0 \Rightarrow x \in (0, \infty)$

If $x < 0$ then $3^x - 2^x \leq 0 \Rightarrow x \in (-\infty, 0)$

Domain of $f(x)$ is $(-\infty,\infty) - \{0\}$

71. Answer (04)

Hint: $n((A \times B) \cap (B \times A)) = (n(A \cap B))^2$

Sol. : If $(x, y) \in (A \times B)$ and $(x, y) \in B \times A$

Then $x \in A$ and $x \in B$ similarly

$Y \in A$ and $y \in B$

So $x, y \in A \cap B$

Number of ordered pairs common to $A \times B$ and $B \times A$ is $(n(A \cap B))^2$

72. Answer (10)

Hint: $\log_{10}\left(x^{1+\log_{10} x}\right) = 2$ then put $\log_{10} x = t$

Sol. : $x^{1+\log_{10} x} = 100$

$\Rightarrow (1+\log_{10} x)\log_{10} x = 2$

Put $\log_{10} x = t$

$\Rightarrow t^2 + t - 2 = 0$

$\Rightarrow t = 1, -2$

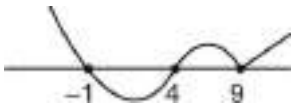
$x = 10^1, 10^{-2}$

Product of roots is $\dfrac{1}{10}$

73. Answer (04)

Hint: Use wavy curve to solve the inequations.

Sol. : $\dfrac{x+1}{(x-4)(x-9)^2} \geq 0$



$x \in (-\infty, -1] \cup (4, 9) \cup (9, \infty)$

and $\dfrac{(x+1)^{2020}(x+3)^6(x-8)^8}{x(x-6)} \leq 0$

$x \in (0, 6] \cup \{-3, -1, 8\}$

So, $x \in (4, 6) \cup \{-3, -1, 8\}$

Integral values of x are -3, -1, 5 and 8.

74. Answer (46)

Hint: Number of students reading atmost one newspaper = $70 - n(A \cap B) - n(B \cap C) - n(C \cap A) + 2n(A \cap B \cap C)$

Sol. : Number of students reading atleast two newspapers

$= n(A \cap B) + n(B \cap C) + n(C \cap A)$

$= -2.n(A \cap B \cap C)$

$= 5 + 10 + 15 - 2^3 = 24$

So, number of students reading atmost one newspaper = 70 – 24 = 46

75. Answer (04)

Hint: $f(-x) = f(x)$

Sol. : $\therefore f(-1) = f(1)$ and $f(-2) = 2$

So there will be atleast 4 elements in set B.

$B = \{f(0), f(-1), f(-2), f(-3)\}$

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