JEE (MAIN) KASAUTI – 2017

ANSWERS WITH SOLUTIONS

For

JEE (MAIN) - 2017

(PHYSICS, CHEMISTRY & MATHEMATICS)

For
Deeper Students
(Only Private Circulation)

PHYSICS (Q.1 – Q.30)

Version – 11	Version – 22	Version – 33	Version - 44
Q.1	Q.24	Q.16	Q.8

Q.1 **Ans.:** (4) ν^6

Explanation:

$m \alpha \nu^a \rho^b g^c$

$M \alpha \left[LT^{-1}\right]^a \left[ML^{-3}\right]^b \left[LT^{-2}\right]^c$

$M\alpha \left[L^{a-3b+c} M^b T^{-a-2c}\right]$

Comparing the powers of M, L & T and solving we get b = 1, c = -3, a = 6

$\therefore$ $m \alpha \nu^6$

Version – 11	Version – 22	Version – 33	Version - 44
Q.2	Q.25	Q.17	Q.9

Q.2 **Ans.:** (4) 3.75 m

Explanation:

By the time fifth water drop starts falling the first water drop reaches the ground u = 0, $h = \frac{1}{2}gt^2$

$5 = \frac{1}{2} x10 (t)^2$ $\therefore$ t = 1 s

Hence the interval of falling of each water drop is $\frac{1}{4}s = 0.25s$

When the fifth drop starts its journey towards ground, the third drop travels in air for 0.25 + 0.25 = 0.5

Therefore height (distance) covered by third drop in air is $h_1 = \frac{1}{2}gt^2 = \frac{1}{2} x10x (0.5)^2 = 1.25$ m

The third drop will be at a height of

5 – 1.25 = 3.75 m

Version – 11	Version – 22	Version – 33	Version - 44
Q.3	Q.26	Q.18	Q.10

Q.3 **Ans.:** (1) $V_0 = \sqrt{\frac{2gH}{5}}$

Explanation: In direction along the inclined plane,

$0 = V_0 \cos 30 - g \sin 30\, t$

$\therefore$ $t = \frac{\sqrt{3}V_0}{g}$

In a direction perpendicular to incline

$-H \cos 30 = -(V \sin 30°)t - \frac{1}{2} g \cos 30° t^2$

putting value of t and solving, we get $V_0 = \sqrt{\frac{2gH}{5}}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.4	Q.27	Q.19	Q.11

Q.4 **Ans.:** (2) $\frac{\pi}{2}$

Explanation: $x_1 = a \sin(\omega t + \phi_1)$

$$x_2 = a\sin(\omega t + \phi_2)$$

$$|x_1 - x_2| = 2a\sin\left(\omega t + \frac{\phi_1 + \phi_2}{2}\right)\cos\left(\frac{\phi_1 - \phi_2}{2}\right)$$

To maximize $|x_1 - x_2|$

$$\sin\left(\omega t + \frac{\phi_1 + \phi_2}{2}\right) = 1$$

$$a\sqrt{2} = 2a \times 1 \times \cos\left(\frac{\phi_1 - \phi_2}{2}\right)$$

$$\frac{1}{\sqrt{2}} = \cos\left(\frac{\phi_1 - \phi_2}{2}\right)$$

$$\frac{\pi}{4} = \frac{\phi_1 - \phi_2}{2}$$

$$\therefore \quad \phi_1 - \phi_2 = \frac{\pi}{2}$$

Version – 11	Version – 22	Version – 33	Version - 44
Q.5	Q.28	Q.20	Q.12

Q.5 **Ans.:** (3) 150°C

Explanation: Since specific heat of lead is given in Joules, hence use W = Q instead of W = JQ.

Also W = change in KE = $\frac{1}{2}mv^2 - 0 = \frac{1}{2}mv^2$

50 % is absorbed.

$$\therefore \ \frac{1}{2}\left(\frac{1}{2}mv^2\right) = mc\Delta\theta$$

$$\therefore \ \Delta\theta = \frac{v^2}{4c} = \frac{(300)^2}{4x150} = 150°C$$

Version – 11	Version – 22	Version – 33	Version - 44
Q.6	Q.29	Q.21	Q.13

Q.6 **Ans.:** (3) $\sqrt{n}:1$

Explanation: Velocity of longitudinal waves.

$$v_1 = \sqrt{\frac{Y}{\rho}}$$

and velocity of transverse waves

$$V_2 = \sqrt{\frac{T}{m}} = \sqrt{\frac{T}{\rho A}}$$

$\therefore \quad \frac{V_1}{V_2} = \sqrt{\frac{Y}{T/A}} \qquad \left(\text{But } Y = \frac{T/A}{\Delta\ell/\ell}\right)$

$\therefore \quad \frac{V_1}{V_2} = \sqrt{\frac{Y}{Y\left(\frac{\Delta\ell}{\ell}\right)}} = \sqrt{\frac{\ell}{\Delta\ell}} \qquad \left(\text{But } \Delta\ell = \frac{1}{n}(\ell)\right)$

$\therefore \frac{V_1}{V_2} = \sqrt{n}$

Now frequency $f \alpha V$

$\therefore \frac{f_1}{f_2} = \frac{V_1}{V_2} = \sqrt{n}$

Q.7 **Ans.:** (4) $PV^{-2/3}$ = constant

Version – 11	Version – 22	Version – 33	Version - 44
Q.7	Q.30	Q.22	Q.14

Explanation: $P \alpha D^2$

$\therefore \quad \frac{P_2}{P_1} = \frac{D_2^2}{D_1^2}$ _____(1)

When $V_2 = 2V_1$ then $D_2^3 = 2D_1^3$

$\therefore \frac{D_2}{D_1} = \left(\frac{V_2}{V_1}\right)^{1/3}$ _____(2)

From (1) and (2)

$\frac{P_2}{P_1} = \left(\frac{V_2}{V_1}\right)^{2/3}$

$\therefore \quad PV^{-2/3} = \text{constant}$

Q.8 **Ans.:** (2) $\frac{11}{12}MR^2$

Version – 11	Version – 22	Version – 33	Version - 44
Q.8	Q.1	Q.23	Q.15

Explanation: Mass of incomplete ring = $M - \frac{M}{2\pi} \times \frac{\pi}{6} = M - \frac{M}{12} = \frac{11M}{12}$

$\therefore$ M. I. of incomplete ring = $\left(\frac{11M}{12}\right)R^2 = \frac{11}{12}MR^2$

Q.9 **Ans.:** (2) will be half of that for smaller droplet

Version – 11	Version – 22	Version – 33	Version - 44
Q.9	Q.2	Q.24	Q.16

Explanation: suppose R = radius of water drop

r = radius of droplets

$\frac{4}{3}\pi R^3 = 8\times\frac{4}{3}\pi r^3$ (since volume remains constant)

$\therefore\ r = \frac{R}{2}$

Since excess pressure inside drop = $\frac{2T}{R}$

(T – surface tension and R – radius)

Pressure diff. is inversely proportional to radius. Also radius of bigger drop is twice that of smaller drop

$\therefore$ the pressure difference in big drop will be half that of smaller drop.

Version – 11	Version – 22	Version – 33	Version - 44
Q.10	Q.3	Q.25	Q.17

Q.10 **Ans.:** (3) $V = \frac{1}{2}\sqrt{\left(\frac{GM}{R}\right)}$

Explanation: $F_G = \frac{GM^2}{4R^2}$

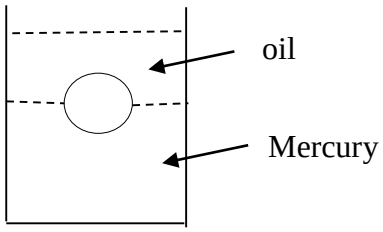
$\therefore\ \frac{MV^2}{R} = \frac{GM}{4R^2}$

$\therefore\ V = \frac{1}{2}\sqrt{\frac{GM}{R}}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.11	Q.4	Q.26	Q.18

Q.11 **Ans.:** (3) 7.2

Explanation:



Weight = buoyant force

$V\rho g = \frac{V}{2}\rho_{Hg}g + \frac{V}{2}\rho_{oil}g$

$\rho = \frac{\rho_{Hg}+\rho_{oil}}{2}$ $\therefore\ \rho = \frac{13.0+0.8}{2} = 7.2$

Version – 11	Version – 22	Version – 33	Version - 44
Q.12	Q.5	Q.27	Q.19

Q.12 **Ans.:** (4) $6\sqrt{2}$Ns

Explanation: $\vec{P}_1 = 2\times 3\hat{i} = 6\hat{i}$

$\vec{P}_2 = 6\hat{j}$ $\therefore\ \vec{I} = \vec{P}_2 - \vec{P}_1 = 6\hat{j} - 6\hat{i}$

$I = \sqrt{6^2+6^2} = 6\sqrt{2}$Ns

Q.13 **Ans.:** (2) 2qE / k

Version – 11	Version – 22	Version – 33	Version - 44
Q.13	Q.6	Q.28	Q.20

Explanation:

Force on the block F = qE toward left

Let spring be compressed maximum by x

Then $Fx = \frac{1}{2}kx^2$

$qEx = \frac{1}{2}kx^2$

$x = \frac{2qE}{k}$

Q.14 **Ans.:** (2) 0.72 J

Version – 11	Version – 22	Version – 33	Version - 44
Q.14	Q.7	Q.29	Q.21

Explanation: $V_1 = \frac{k\times 2\times 10^{-6}}{0.1} + \frac{k\times 4\times 10^{-6}}{\sqrt{(0.1)^2+(0.5)^2}}$

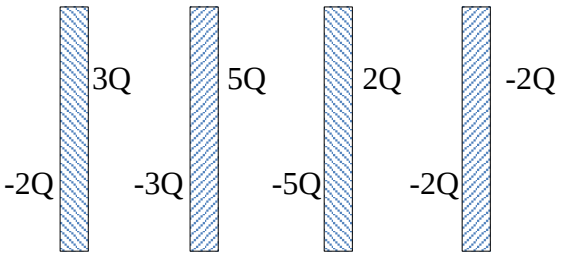
$V_2 = \frac{k\times 4\times 10^{-6}}{0.1} + \frac{k\times 2\times 10^{-6}}{\sqrt{(0.1)^2+(0.5)^2}}$

Work done is $q(V_2 - V_1) = 0.72$ J

Q.15 **Ans.:** (1) 5Q from A to B

Version – 11	Version – 22	Version – 33	Version - 44
Q.15	Q.8	Q.30	Q.22

Explanation:



Distribution of charge before the wire is connected is shown in fig. On connecting with the wire 5Q and -5Q will get neutralized. Hence, 5Q charge will flow from A to B.

Q.16 **Ans.:** (1) 25μF

Version – 11	Version – 22	Version – 33	Version - 44
Q.16	Q.9	Q.1	Q.23

Explanation: Given $\frac{\epsilon_0 A}{d} = 10$

$C^1 = \frac{\epsilon_0 A/2}{d} + \frac{4\epsilon_0 (A/2)}{d} = \frac{1}{2}\frac{\epsilon_0 A}{d} + \frac{2\epsilon_0 A}{d}$

$= 10\left(\frac{1}{2}+2\right)$

= 25 μF

Version – 11	Version – 22	Version – 33	Version - 44
Q.17	Q.10	Q.2	Q.24

Q.17 **Ans.:** (2) $E_1r_2 > E_2(R + r_1)$

Explanation: Current through R before short circuiting second cell

$$I = \frac{E_1 + E_2}{R + (r_1 + r_2)}$$

Current through R after short circuiting second cell

$$I' = \frac{E_1}{R + r_1}$$

Here I' > I or $E_1r_1 > E_2(R + r_1)$

Version – 11	Version – 22	Version – 33	Version - 44
Q.18	Q.11	Q.3	Q.25

Q.18 **Ans.:** (4) 3 : 2

Explanation: $E_1 \alpha 300$, $E_1 - E_2 \alpha 100$

$$\frac{E_1}{E_1 - E_2} = 3 \quad \text{or} \quad E_1 = 3E_1 - 3E_2$$

$3E_2 = 2E_1$

$$\therefore \frac{E_1}{E_2} = \frac{3}{2}$$

Version – 11	Version – 22	Version – 33	Version - 44
Q.19	Q.12	Q.4	Q.26

Q.19 **Ans.:** (3) $(R_1/R_2)^2$

Explanation:

$$\frac{1}{2}mv^2 = qV \quad \text{or} \quad v = \sqrt{\frac{2qV}{m}}$$

Centripetal force, $\frac{mv^2}{R} = qvB$

$$\therefore v = \left(\frac{qB}{m}\right)R$$

Hence $\sqrt{\frac{2qV}{m}} = \left(\frac{qB}{m}\right)R$

or $R = \left(\frac{2mV}{q}\right)^{1/2} \times \frac{1}{B}$

As V, q and B are constant. Hence $m \alpha R^2$

So $\frac{m_1}{m_2} = \left(\frac{R_1}{R_2}\right)^2$

Version – 11	Version – 22	Version – 33	Version - 44
Q.20	Q.13	Q.5	Q.27

Q.20 **Ans.:** (1) 3.125×10^{-3} J

Explanation:

Speed of the loop should be

$$V = \frac{\ell}{t} = \frac{0.5}{2} = 0.25 \text{ m/s}$$

Induced emf $e = Bv\ell = 1 \times 0.25 \times 0.5 = 0.125$ V

$\therefore$ current in the loop, $i = \frac{e}{R} = \frac{0.125}{10} = 1.25 \times 10^{-2}$ A

The magnetic force on the left arm due to the magnetic field is

$F_m = i\ell B = 1.25 \times 10^{-2} \times 0.5 \times 1$

$= 6.25 \times 10^{-3}$ N

To pull the loop uniformly an external force of 6.25×10^{-3} N towards right must be applied.

$W = 6.25 \times 10^{-3}$ N $\times$ 0.5 m

$= 3.125 \times 10^{-3}$ J

Version – 11	Version – 22	Version – 33	Version - 44
Q.21	Q.14	Q.6	Q.28

Q.21 **Ans.:** (1) $\frac{\mu_0 i a^2 \pi}{2Rb}$

Explanation:

$$\Delta q = \frac{\Delta\phi}{R}$$

$$\phi_i = 0$$

$$\phi_f = \left(\frac{\mu_0 i}{2b}\right)\pi a^2 = \frac{\mu_0 i a^2 \pi}{2b}$$

$$\Delta\phi = \phi_f - \phi_i = \frac{\mu_0 i a^2 \pi}{2b}$$

so $\Delta q = \frac{\mu_0 i a^2 \pi}{2Rb}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.22	Q.15	Q.7	Q.29

Q.22 **Ans.:** (3) $\sqrt{\frac{I_1^2 + I_2^2}{2}}$

Explanation: $I = I_1 \cos\omega t + I_2 \sin\omega t$

$$\left(I^2\right)_{mean} = I_1^2 \cos^2\omega t + I_2^2 \sin^2\omega t + 2I_1 I_2 \cos\omega t \sin\omega t$$

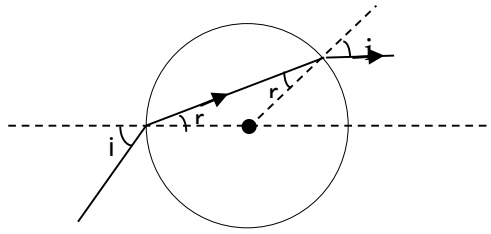
$$= I_1^2\left(\frac{1}{2}\right) + I_2^2\left(\frac{1}{2}\right) + 2I_1 I_2 (0)$$

$$I_{rms} = \sqrt{\left(I^2\right)_{mean}} = \sqrt{\frac{I_1^2 + I_2^2}{2}}$$

Version – 11	Version – 22	Version – 33	Version - 44
Q.23	Q.16	Q.8	Q.30

Q.23 Ans.: (2) $\sqrt{3}$

Explanation:



Deviation by the sphere is 2(i – r)

Here deviation

$\delta = 60° = 2(i - r)$

or $i - r = 30°$

$r = i - 30° = 60° - 30° = 30°$

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin 60°}{\sin 30°} = \sqrt{3}$$

Version – 11	Version – 22	Version – 33	Version - 44
Q.24	Q.17	Q.9	Q.1

Q.24 Ans.: (3) $\frac{\lambda}{2(\mu-1)}$

Explanation: Intensity at the centre will be zero if path difference is $\frac{\lambda}{2}$. That is,

$$(\mu-1)t = \frac{\lambda}{2} \quad \text{or} \quad t = \frac{\lambda}{2(\mu-1)}$$

Version – 11	Version – 22	Version – 33	Version - 44
Q.25	Q.18	Q.10	Q.2

Q.25 Ans.: (1) hc/λ

Explanation:

$$E = \frac{hc}{\lambda/2} - \phi_0$$

$$2E = \frac{hc}{\lambda/3} - \phi_0$$

$$2\left(\frac{2hc}{\lambda} - \phi_0\right) = \frac{3hc}{\lambda} - \phi_0$$

or $$\frac{4hc}{\lambda} - 2\phi_0 = \frac{3hc}{\lambda} - \phi_0$$

or $$\phi_0 = \frac{hc}{\lambda}$$

Q.26 **Ans.:** (4)

Version – 11	Version – 22	Version – 33	Version - 44
Q.26	Q.19	Q.11	Q.3

Explanation: BC is isochoric

$V_B > V_A$, $V_B = V_C$, $V_D > V_C$

Q.27 **Ans.:** (1) $\frac{3q^2}{2\epsilon_0 h}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.27	Q.20	Q.12	Q.4

Explanation:

$$\frac{mv^2}{r} = \frac{3q^2}{4\pi\epsilon_0 r^2}$$

$$mvr = \frac{3q^2}{4\pi\epsilon_0 v} \quad \text{_____(1)}$$

$$\& \quad mvr = \frac{nh}{2\pi} \quad \text{____(2)}$$

Using (1) & (2) and putting n = 1

$$\frac{h}{2\pi} = \frac{3q^2}{4\pi\epsilon_0 v} \qquad \therefore v = \frac{3q^2}{2\epsilon_0 h}$$

Q.28 **Ans.:** (4) $\frac{\sqrt{2}-1}{\sqrt{2}}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.28	Q.21	Q.13	Q.5

Explanation: After n half lives, the radio active nuclei remaining is $\frac{N_0}{2^n}$. So number of nuclei disintegrated in n half lives is $N_0 - \frac{N_0}{2^n}$. For $n = \frac{1}{2}$, the fraction disintegrated is $1 - \frac{1}{\sqrt{2}}$

Q.29 **Ans.:** (1) 1.5 s

Version – 11	Version – 22	Version – 33	Version - 44
Q.29	Q.22	Q.14	Q.6

Explanation:

First case $\frac{1}{2}mv^2 = Fs$ _____(1)

Second case $\frac{1}{2}\left(m + \frac{m}{2}\right)v^2 = F\,s^1$ _____(2)

Dividing (2) by (1)

$$\frac{S^1}{S} = \frac{3}{2} \qquad \text{or} \qquad s^1 = 1.5s$$

Version – 11	Version – 22	Version – 33	Version - 44
Q.30	Q.23	Q.15	Q.7

Q.30 **Ans.:** (3) 320 Hz

Explanation:

$$n = \frac{V}{4\ell} = \frac{320}{4} = 80 \text{ Hz}$$

Since even harmonics cannot be present therefore 320 Hz (= 4 x 80) is ruled out.

CHEMISTRY (Q.31 – Q.60)

Version – 11	Version – 22	Version – 33	Version - 44
Q.31	Q.53	Q.46	Q.38

Q.31 **Ans.:** (3) 26% and 32%

Explanation: The packing efficiency in a ccp structure = 74%

$\therefore$ Percentage free space = 100 – 74

= 26%

Packing efficiency in body centred structure = 68%

$\therefore$ Percentage free space = 100 – 68

= 32%

Version – 11	Version – 22	Version – 33	Version - 44
Q.32	Q.54	Q.47	Q.39

Q.32 **Ans.:** (4) The concentration of H^+ and HCO_3^- are approximately same.

Explanation:

$$H_2CO_3 \rightleftharpoons H^+ + HCO_3^- \qquad k_1 = 4.2x10^{-7}$$

$$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-} \qquad k_2 = 4.8x10^{-11}$$

Since $k_1 >> k_2$ so H_2CO_3 ionises more than HCO_3^- and hence contribution of H^+ is mostly due to ionization of carbonic acid. Thus the concentrations of H^+ and HCO_3^- are approximately equal.

Version – 11	Version – 22	Version – 33	Version - 44
Q.33	Q.55	Q.48	Q.40

Q.33 **Ans.:** (1) A only

Explanation: The rate equation depends upon the rate determining step. The given rate equation is only consistent with the mechanism 'A'.

Version – 11	Version – 22	Version – 33	Version - 44
Q.34	Q.56	Q.49	Q.41

Q.34 **Ans.:** (2) 2-Butene

Explanation:

$$R - CH = CH - R \xrightarrow[ii)\ Zn, H_2O]{i)\ O_3} 2RCHO$$

Molar mass of RCHO = 44

$\rightarrow$ R + 12 + 1 + 16 = 44

$\therefore$ Molar mass of R = 44 – 29

= 15

This is possible only when R is $-CH_3$ group

$\therefore$ The aldehyde is CH_3CHO and the symmetrical alkene is $CH_3\text{-}CH = CH\text{-}CH_3$

Q.35 **Ans.:** (3) 0.086

Version – 11	Version – 22	Version – 33	Version - 44
Q.35	Q.57	Q.50	Q.42

Explanation:

$$\text{Mole fraction of solute} = \frac{n}{N+n}$$

Where, n = Number of moles of solute

N = Number of moles of solvent

Here solute is methylalcohol and solvent is water

$$\text{Given} - n = 5.2,\ N = \frac{1000}{18}$$

$$\therefore \text{ Mole fraction} = \frac{5.2}{5.2+\frac{1000}{18}}$$

$$= \frac{5.2x18}{93.6+1000}$$

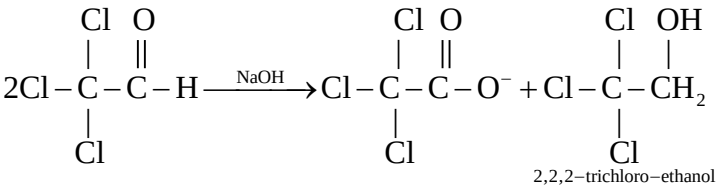
$$= \frac{93.6}{1093.6} = 0.0855 \approx 0.086$$

Q.36 **Ans.:** (1) 2, 2, 2 – trichloroethanol

Version – 11	Version – 22	Version – 33	Version - 44
Q.36	Q.58	Q.51	Q.43

Explanation:

In cannizzaro's reaction, one molecule is oxidized to carboxylate ion and other is reduced to alcohol.



Q.37 **Ans.:** (2) 38.3 J mol^{-1} K^{-1}

Version – 11	Version – 22	Version – 33	Version - 44
Q.37	Q.59	Q.52	Q.44

Explanation: Entropy change for isothermal process is –

$$\Delta S = 2.303nR\log_{10}\left(\frac{V_2}{V_1}\right)$$

$$= 2.303 \times 2 \times 8.314 \log_{10}\left(\frac{100}{10}\right)$$

$= 38.294 \text{ J mol}^{-1} \text{ K}^{-1}$

$\approx 38.3 \text{ J mol}^{-1}\text{K}^{-1}$

Q.38 **Ans.:** (2) PF_5 and BrF_5

Version – 11	Version – 22	Version – 33	Version - 44
Q.38	Q.60	Q.53	Q.45

Explanation:

PCl_4^+ and $SiCl_4$ = Both are tetrahedral

AlF_6^{3-} and SF_6 = Both are octahedral

CO_3^{2-} and NO_3^- = Both are trigonal planar

PF_5 = Trigonal bipyramidal

BrF_5 = Square pyramidal. Hence not isostructural.

Q.39 **Ans.:** (3) X = Zn, Y = Ni

Version – 11	Version – 22	Version – 33	Version - 44
Q.39	Q.31	Q.54	Q.46

Explanation:

The elements with high negative value of standard reduction potential are good reducing agents and can be easily oxidized.

Thus X should have high negative value than Y so that it will be oxidized to X^{2+} by reducing Y^{2+} to Y.

X = Zn Y = Ni

$\therefore$ $Zn + Ni^{2+} \rightarrow Zn^{2+} + Ni$

Alternatively, for a spontaneous reaction, E^0 must be positive.

$\therefore$ $E^0 = E^0_{\text{reduced species}} - E^0_{\text{oxidised species}}$

$= - 0.23 - (- 0.76)$

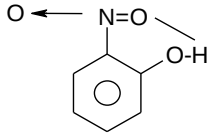
$E^0 = +0.53$ V

Q.40 **Ans.:** (1) O-nitrophenol shows intramolecular H-bonding.

Version – 11	Version – 22	Version – 33	Version - 44
Q.40	Q.32	Q.55	Q.47

Explanation:

O – nitrophenol is stable due to intramolecular hydrogen bonding.



It is difficult to break the H – bonding when dissolved in water and hence less soluble.

Q.41 **Ans.:** (3) Isobutyl alcohol

Version – 11	Version – 22	Version – 33	Version - 44
Q.41	Q.33	Q.56	Q.48

Explanation: The compounds with $CH_3-\underset{\underset{O}{\|}}{C}-$ or $CH_3-\underset{\underset{OH}{|}}{CH}-$ group form iodoform.

(1) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$

(2) $CH_3-\underset{\underset{CH_3}{|}}{CH}-\overset{\overset{O}{\|}}{C}-CH_3$

(3) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-OH$

(4) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

Thus all compounds except Isobutyl alcohol will form iodoform.

Q.42 **Ans.:** (3) Ferrous compounds are more easily hydrolysed than the corresponding ferric compounds.

Explanation: Ferrous oxide is more basic more ionic, less volatile and less easily hydrolysed than ferric oxide.

Version – 11	Version – 22	Version – 33	Version - 44
Q.42	Q.34	Q.57	Q.49

Q.43 **Ans.:** (2) CH_3CH_2COOH

Version – 11	Version – 22	Version – 33	Version - 44
Q.43	Q.35	Q.58	Q.50

Explanation:

$$\underset{\text{'P'}}{CH_3-CH_2-\overset{\overset{O}{\|}}{C}-OH} \xrightarrow{NH_3} \underset{\text{'R'}}{CH_3-CH_2-\overset{\overset{O}{\|}}{C}-O^-NH_4^+} \xrightarrow{\Delta} \underset{\text{(S)}}{CH_3-CH_2-\overset{\overset{O}{\|}}{C}-NH_2} \xrightarrow{Br_2/KOH} CH_3CH_2NH_2$$

Q.44 **Ans.:** (4) 0.875 M

Version – 11	Version – 22	Version – 33	Version - 44
Q.44	Q.36	Q.59	Q.51

Explanation:

$$M_{mix}\ V_{mix} = M_1V_1 + M_2V_2$$

$$\therefore \quad M_{mix} = \frac{M_1V_1 + M_2V_2}{V_{mix}}$$

$$= \frac{(0.5\times 750)+(2\times 250)}{1000}$$

$$\therefore \quad M_{mix} = 0.875\ M$$

Q.45 **Ans.:** (4) The oxidation state of sulphur is never less than +4 in its compounds.

Version – 11	Version – 22	Version – 33	Version - 44
Q.45	Q.37	Q.60	Q.52

Explanation:

Sulphur exhibits -2, +2, +4, +6 oxidation states but +4 and +6 are more common.

Q.46 **Ans.:** (3) 743 nm

Version – 11	Version – 22	Version – 33	Version - 44
Q.46	Q.38	Q.31	Q.53

Explanation: We know that,

$$E = h\nu = \frac{hc}{\lambda}$$

$$E = E_1 + E_2 \text{ or } \frac{hc}{\lambda} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$

$$= \frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$$

$$= \frac{1}{355} = \frac{1}{680} + \frac{1}{\lambda_2}$$

$$\therefore \quad \lambda_2 = \frac{355 \times 680}{680 - 355}$$

$$= 742.769 \text{ nm}$$

$$\approx 743 \text{ nm}$$

Q.47 **Ans.:** (3) It contains Cs+ and I_3^- ions.

Version – 11	Version – 22	Version – 33	Version - 44
Q.47	Q.39	Q.32	Q.54

Explanation:

Cs cannot show +3 oxidation state so CsI3 is formulated as Cs+ and I_3^- ions. It is a typical ionic compound.

Q.48 **Ans.:** (2) $(CH_3)_2NH$

Version – 11	Version – 22	Version – 33	Version - 44
Q.48	Q.40	Q.33	Q.55

Explanation: The order of decreasing basic strength of amines in aqueous solution is _

$$\underset{2^\circ}{(CH_3)_2NH} > \underset{1^\circ}{CH_3NH_2} > \underset{3^\circ}{(CH_3)_3N} > \underset{\text{Aniline}}{C_6H_5NH_2}$$

Basic strength α k_b α $\frac{1}{p_{k_b}}$

Hence $(CH_3)_2NH$ has the smallest p_kb value.

Q.49 **Ans.:** (1)

Version – 11	Version – 22	Version – 33	Version - 44
Q.49	Q.41	Q.34	Q.56

$$Fe \xrightarrow[heat]{O_2} Fe_3O_4 \xrightarrow[600°C]{CO} FeO \xrightarrow[700°C]{CO} Fe$$

Explanation: Formation of Fe_3O_4 through Fe, corresponds to the combustion of Fe and rest part of the reactions correspond to the production of Fe by reduction of Fe_3O_4 in blast furnace.

Q.50 **Ans.:** (4) $K_3[Cu(CN)_4]$

Version – 11	Version – 22	Version – 33	Version - 44
Q.50	Q.42	Q.35	Q.57

Explanation:

$$CuSO_4 + 2KCN \longrightarrow Cu(CN)_2 + K_2SO_4$$

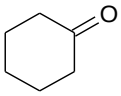
$$2Cu(CN)_2 \longrightarrow Cu_2(CN)_2 + C_2N_2 \ (\text{Cyanogen})$$

$$Cu_2(CN)_2 + 6KCN \longrightarrow 2K_3[Cu(CN)_4]$$

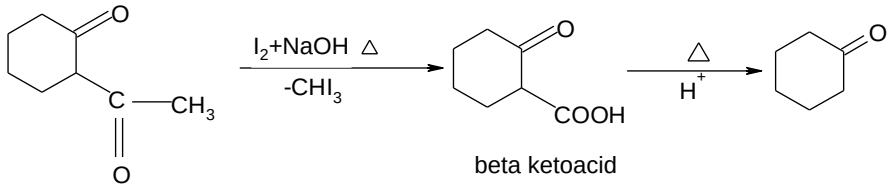
Q.51

Version – 11	Version – 22	Version – 33	Version - 44
Q.51	Q.43	Q.36	Q.58

Ans.: (3) Yellow ppt of CHI_3,



Explanation:



beta ketoacid

β - keto acid gets decarboxylated by simple heating.

Q.52 **Ans.:** (4) Zymase

Version – 11	Version – 22	Version – 33	Version - 44
Q.52	Q.44	Q.37	Q.59

Explanation:

$$\underset{\text{Glucose or Fructose}}{C_6H_{12}O_6} \xrightarrow{\text{Zymase}} \underset{\text{Ethylalcohol}}{2C_2H_5OH} + 2CO_2$$

Q.53 **Ans.:** (2) 2.5 moles of oxalic acid.

Version – 11	Version – 22	Version – 33	Version - 44
Q.53	Q.45	Q.38	Q.60

Explanation:

$$2KMnO_4 + 3H_2SO_4 + 5\begin{vmatrix} COOH \\ COOH \end{vmatrix}.2H_2O \longrightarrow K_2SO_4 + 2MnSO_4 + 18H_2O + 10CO_2$$

It is clear from the equation that two moles of $KMnO_4$ react with five moles of oxalic acid. Thus one mole of $KMnO_4$ will react with 2.5 moles of oxalic acid.

Q.54 **Ans.:** (1) In chlorine gas, the ratio of ^{35}Cl and ^{37}Cl is 1:3.

Explanation: The ratio of ^{35}Cl and ^{37}Cl is 3:1 in chlorine gas, as the average atomic mass of Cl is 35.5.

Version – 11	Version – 22	Version – 33	Version - 44
Q.54	Q.46	Q.39	Q.31

Q.55 **Ans.:** (4) A – 4, B – 3, C – 2, D – 1

Explanation:

Version – 11	Version – 22	Version – 33	Version - 44
Q.55	Q.47	Q.40	Q.32

List – I		List - II	
A.	Coagulation	1.	Electrolyte
B.	Lyophilization	2.	Purification of colloids
C.	Peptization	3.	Washing of precipitates
D.	Tyndall effect	4.	Scattering

Q.56 **Ans.:** (2) O_2

Explanation:

Version – 11	Version – 22	Version – 33	Version - 44
Q.56	Q.48	Q.41	Q.33

$$2NaNO_3 \xrightarrow{>800^\circ C} 2NaNO_2 + O_2$$

Q.57 **Ans.:** (1) 95% ethyl alcohol + 5% water

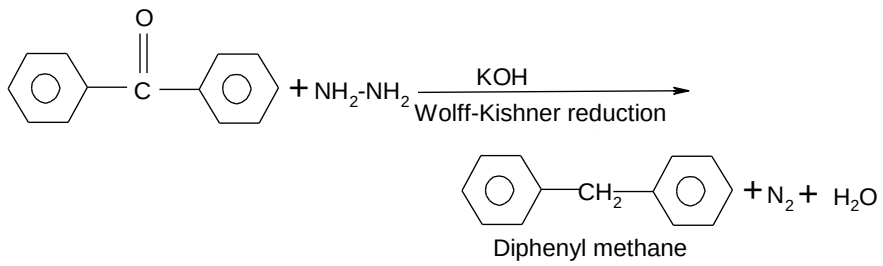
Explanation: Rectified spirit is 95.87% aqueous solution of ethyl alcohol.

Version – 11	Version – 22	Version – 33	Version - 44
Q.57	Q.49	Q.42	Q.34

Q.58 **Ans.:** (4) Benzophenone into Diphenylmethane

Explanation: By Wolff-Kishner reduction, >C = O group is reduced to $>CH_2$ group.

Version – 11	Version – 22	Version – 33	Version - 44
Q.58	Q.50	Q.43	Q.35



Version – 11	Version – 22	Version – 33	Version - 44
Q.59	Q.51	Q.44	Q.36

Q.59 **Ans.:** (1) – 7.43

Explanation:

$$2C_6H_{6(\ell)} + 15O_{2(g)} \longrightarrow 12CO_{2(g)} + 6H_2O_{(\ell)}$$

We know that,

$q_p = q_v + \Delta n_{(g)} RT$

$\Delta n_{(g)} = n_{(g)}$ product $- n_{(g)}$ reactant

$= 12 - 15$

$= -3$

$R = 8.314 \text{ J } k^{-1} \text{ mol}^{-1}$

$T = 298$ K

$\therefore \quad q_p - q_v = \Delta n_{(g)} RT$

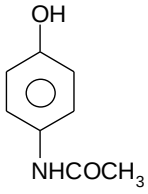
$= -3 \times 8.314 \times 298$

$= -7432.7$ J

$= -7.43$ kJ

Version – 11	Version – 22	Version – 33	Version - 44
Q.60	Q.52	Q.45	Q.37

Q.60 **Ans.:** (2)



Explanation: N-acetyl-para-aminophenol is paracetamol.

MATHEMATICS (Q.61 – Q.90)

Version – 11	Version – 22	Version – 33	Version - 44
Q.61	Q.84	Q.76	Q.68

Q.61 **Ans.:** (4) equivalent to $p \leftrightarrow q$

Explanation:

p	q	~q	$p \leftrightarrow \sim q$	~(q)	$p \leftrightarrow q$
T	T	F	F	T	T
T	F	T	T	F	F
F	T	F	T	F	F
F	F	T	F	T	T

Option (4) is required option.

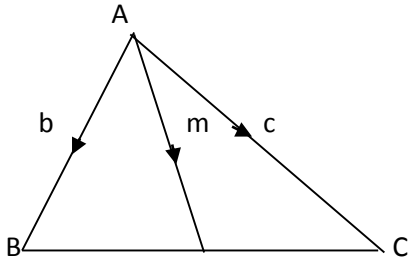
Q.62 **Ans.:** (3) 6

Version – 11	Version – 22	Version – 33	Version - 44
Q.62	Q.85	Q.77	Q.69

Explanation:

Take all P.V^s. w.r.t. vertex A.

$\therefore\ \overline{AB} = \bar{b},\ \overline{AC} = \bar{c},\ \overline{AM} = \bar{m}$



By mid. Pt. formula,

$$\bar{m} = \frac{\bar{b} + \bar{c}}{2} = \frac{\left(3\bar{i} + 5\bar{j} - 2\bar{k}\right) + \left(\bar{i} + 3\bar{j} - 6\bar{k}\right)}{2}$$

$$\overline{AM} = \bar{m} = 2\bar{i} + 4\bar{j} - 4\bar{k}$$

$\therefore\ \ell(AM) = \left|\overline{AM}\right| = \sqrt{36} = 6$ units

$\therefore$ Option (3)

Q.63 **Ans.:** (3) $-\frac{1}{4}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.63	Q.86	Q.78	Q.70

Explanation:

$$3f(x) + 5f\left(\frac{1}{x}\right) = x + 1 \qquad .....(1)$$

Replacing x by $\frac{1}{x}$

$$3f\left(\frac{1}{x}\right) + 5f(x) = \frac{1}{x} + 1 \qquad \text{_____}(2)$$

Solving

$3(1) - 5(2) \Rightarrow -16f(x) = 3x + 3 - \frac{5}{x} - 5$

$$f(x) = \frac{-1}{16}\left[3x - \frac{5}{x} - 2\right]$$

$$f(x) = \frac{1}{16}\left[\frac{5}{x} + 2 - 3x\right]$$

$y = x.f(x) = \frac{1}{16}\left[5 + 2x - 3x^2\right]$

$\therefore \frac{dy}{dx} = \frac{1}{16}\left[2 - 6x\right]$

$\left.\frac{dy}{dx}\right|_{at \quad x=1} = \frac{1}{16}\left[2-6\right] = -\frac{1}{4}$

Option (3)

Version – 11	Version – 22	Version – 33	Version - 44
Q.64	Q.87	Q.79	Q.71

Q.64 **Ans.:** (1) x – axis

Explanation:

$\left|\frac{z+3i}{z-3i}\right| = 1$ sub z = x + iy

$\therefore \quad \left|\frac{x+iy+3i}{x+iy-3i}\right| = 1$

$\therefore \quad \left|x+(y+3)i\right|^2 = \left|x+(y-3)i\right|^2$

$\therefore \quad x^2 + (y+3)^2 = x^2 + (y-3)^2$

$\therefore \quad y^2 + 6y + 9 = y^2 - 6y + 9$

$\therefore$ y = 0 which is equation of x – axis. option (1)

Q.65 **Ans.:** (1) $\frac{1}{1944}\left[3\tan^{-1}\left(\frac{x+2}{3}\right) + \frac{15(x+2)}{x^2+4x+13} - \frac{6(x+2)^3}{\left(x^2+4x+13\right)^2}\right] + C$

Version – 11	Version – 22	Version – 33	Version - 44
Q.65	Q.88	Q.80	Q.72

Explanation:

$I = \int \frac{1}{\left(x^2+4x+13\right)^3} dx = \int \frac{dx}{\left[(x+2)^2+3^2\right]^3}$

Sub x + 2 = t $\quad \therefore$ dx = dt

Let t : 3 tan θ

$I = \int \frac{dt}{\left(t^2+3^2\right)^3}$ $\quad \therefore$ dt = 3 sec² = dθ

$= \frac{3}{3^6}\int \frac{\sec^2\theta d\theta}{\left(\tan^2\theta+1\right)^3} = \frac{1}{3^5}\int \frac{\sec^2\theta d\theta}{\sec^6\theta} = \frac{1}{243}\int \cos^4\theta d\theta$

$= \frac{1}{243}\int\left(\frac{1+\cos 2\theta}{2}\right)^2 d\theta = \frac{1}{972}\int\left[1+2\cos 2\theta+\cos^2 2\theta\right]d\theta$

$$= \frac{1}{972}\int\left[1+2\cos 2\theta+\frac{1+\cos 4\theta}{2}\right]d\theta$$

$$= \frac{1}{1944}\left[2\int 1d\theta+4\int\cos 2\theta+\int 1d\theta+\int\cos 4\theta d\theta\right]$$

$$= \frac{1}{1944}\left[3\tan^{-1}\left(\frac{x+2}{3}\right)+\frac{12(x+2)}{(x^2+4x+13)}+\frac{3(x+2)}{(x^2+4x+13)}\left[1-\frac{2(x+2)^2}{x^2+4x+13}\right]\right]+c$$

$$= \frac{1}{1944}\left[3\tan^{-1}\left(\frac{x+2}{3}\right)+\frac{15(x+2)}{(x^2+4x+13)}-\frac{6(x+2)^3}{(x^2+4x+13)^2}\right]+c$$

Option (1)

Version – 11	Version – 22	Version – 33	Version - 44
Q.66	Q.89	Q.81	Q.73

Q.66 **Ans.:** (1) Both (1) and (2) are true

Explanation: In statement (2)

Line $\perp^r$ plane $\perp$ normal

$\therefore$ line is parallel to normal

$\therefore$ Drs of line are same as drs of plane

$\therefore$ Drs of line are 2, 2, 1

and it passes through P(1, 2, 3)

$\therefore$ Its equation is $\frac{x-1}{2}=\frac{y-2}{2}=\frac{z-3}{1}$

$\sqrt{2^2+2^2+1^2}=9$

$\therefore$ $\frac{x-1}{\left(\frac{2}{3}\right)}=\frac{y-2}{\left(\frac{2}{3}\right)}=\frac{z-2}{\left(\frac{2}{3}\right)}=\lambda=3$

$\therefore$ x = 3, y = 4, z = 4

$\therefore$ Pt. on this line at a distance of 3 units is A(3, 4, 4)

$\therefore$ statement (1) is true.

This pt. A(3, 4, 4) lies on the plane 2x + 2y + z = a

$\therefore$ 6 + 8 + 4 = a a = 18

$\therefore$ Statement (2) is true.

$\therefore$ Both the statements (1) and (2) are true

Option (1)

Q.67 Ans.: (3) 5

Version – 11	Version – 22	Version – 33	Version - 44
Q.67	Q.90	Q.82	Q.74

Explanation: Let R: event that a red face appears in each of the first n throws

E_1: event that die A is used when already head has appeared

E_2: event that die B is used when already tail has appeared.

$P(E_1) = P(E_2) = \frac{1}{2}$

$P(R/E_1) = \left(\frac{4}{6}\right)^n = \left(\frac{2}{3}\right)^n$ and $P(R/E_2) = \left(\frac{2}{6}\right)^n = \left(\frac{1}{3}\right)^n$

$P(E_1/R) = 32/33$

$$\therefore \quad \frac{32}{33} = P(E_1/R) = \frac{P(E_1).P(R/E_1)}{P(E_1).P(R/E_1) + P(E_2).P(R/E_2)}$$

$$\frac{32}{33} = \frac{\frac{1}{2}.\left(\frac{2}{3}\right)^n}{\frac{1}{2}\left(\frac{2}{3}\right)^n + \frac{1}{2}\left(\frac{1}{3}\right)^n} = \frac{2^n}{2^n+1} \qquad \text{Let } 2^n = \alpha$$

$$\frac{32}{33} = \frac{\alpha}{\alpha+1} \qquad \therefore\ 32\,\alpha + 32 = 33\alpha$$

$\therefore\ \alpha = 2^n = 32 = 2^5 \quad \therefore\ n = 5$ Option (3)

Q.68 **Ans.:** (2) 5005

Version – 11	Version – 22	Version – 33	Version - 44
Q.68	Q.61	Q.83	Q.75

Explanation: $\left[\frac{x+1}{x^{\frac{2}{3}} - x^{\frac{1}{3}} + 1} - \frac{x-1}{x - x^{\frac{1}{2}}}\right]^{15}$

$$= \left[\frac{\left(x^{\frac{1}{3}}+1\right)(x+1)}{\left(x^{\frac{1}{3}}+1\right)\left[\left(x^{\frac{1}{3}}\right)^2 - x^{\frac{1}{3}} + 1\right]} - \frac{\left(x^{\frac{1}{2}}+1\right)(x-1)}{x^{\frac{1}{2}}\left(x^{\frac{1}{2}}-1\right)\left(x^{\frac{1}{2}}+1\right)}\right]^{15}$$

$$= \left[\frac{\left(x^{\frac{1}{3}}+1\right)(x+1)}{(x+1)} - \frac{\left(x^{\frac{1}{2}}+1\right)(x-1)}{x^{\frac{1}{2}}(x-1)}\right]^{15}$$

$$= \left[x^{\frac{1}{3}} + 1 - 1 - x^{-\frac{1}{2}}\right]^{15} = \left(x^{\frac{1}{3}} - x^{-\frac{1}{2}}\right)^{15}$$

Let $(r + 1)^{th}$ term be independent of x

$\therefore\ T_{r+1} = {}^{n}C_r . a^{n-r} b^r$

$= {}^{15}C_r \left(x^{\frac{1}{3}} \right)^{15-r} \left(x^{-\frac{1}{2}} \right)^{r}$

$= {}^{15}C_r . x^{\left(5-\frac{r}{3}-\frac{r}{2}\right)}$

$\therefore\ 5-\frac{r}{3}-\frac{r}{2}=0 \qquad \therefore r = 6$

$\therefore$ Term indep. of x is $T_7 = {}^{15}C_6\, x^0$

$= 5005$

Option (2)

Q.69 **Ans.:** (3) $I_1 = I_2$

Version – 11	Version – 22	Version – 33	Version - 44
Q.69	Q.62	Q.84	Q.76

Explanation:

Consider $I_2 = \int_1^2 \frac{e^x}{x} dx$ Let $e^x = t$ $\therefore\ e^x\, dx = dt$

$= \int_e^{e^2} \frac{dt}{\log t} = \int_e^{e} \frac{dx}{\log x} = I_1$ $e^x = t$ gives $x = \log t$

x	1	2
t	e	e^2

As variable does not matter in definite integrals

$\therefore\ I_1 = I_2$ option (3)

Q.70 **Ans.:** (3) 4050

Version – 11	Version – 22	Version – 33	Version - 44
Q.70	Q.63	Q.85	Q.77

Explanation:

$2\sin^2 2° + 4 \sin^2 4° + 6\sin^2 6° + \ldots + 88 \sin^2 88° + 90 \sin^2 90° + 92 \sin^2 92° + \ldots + 174 \sin^2 176° + 176 \sin^2 17c° + 178 \sin^2 178°$

$= 2\sin^2 2° + 4 \sin^2 4° + 6\sin^2 6° + \ldots + 88 \sin^2 88° + 90 \sin^2 90° + 92 \sin^2 (180°-88°) + \ldots + 174 \sin^2 (180°-6°) + 176 \sin^2 (180°- 4°) + 178 \sin^2 (180°-2°)$

$= 2\sin^2 2° + 4 \sin^2 4° + 6\sin^2 6° + \ldots + 88 \sin^2 88° + 90 \sin^2 90° + 92 \sin^2 88° + \ldots + 174 \sin 6° + 176 \sin^2 4° + 178 \sin^2 2°$

$= 180 [\sin^2 2° + \sin^2 4° + \sin^2 6° + \ldots + \sin^2 88°] + 90 \sin^2 90$

$= 180 [\sin^2 2° + \sin^2 4° + \sin^2 6° + \ldots + \sin^2 (90° - 6°) + \sin^2(90° - 4°) + \sin^2 (90° - 2°) + 90 \sin^2 90°$

$= 180 [\sin^2 2° + \sin^2 4° + \sin^2 6° + \ldots + \cos^2 6° + \cos^2 4° + \cos^2 2°] + 90 (1)^2$

$= 180 [1 + 1 + 1 + 1 + \ldots \text{ 22 times}] + 90$

$= 180 [22] + 90° = 4050$ option (3)

Version – 11	Version – 22	Version – 33	Version - 44
Q.71	Q.64	Q.86	Q.78

Q.71 Ans.: (4) $x^2 - 7x + 6 = 0$

Explanation:

$$f(0) = \lim_{x\to 0} \quad = \lim_{x\to 0}\left(\frac{2^x + 3^x}{2}\right)^{\frac{2}{x}}$$

$$= \lim_{x\to 0}\left[\frac{2^x\left(1+\left(\frac{3}{2}\right)^x\right)}{2}\right]^{\frac{2}{x}}$$

$$= 4\lim_{x\to 0}\left[\frac{1+\left(\frac{3}{2}\right)^x}{2}\right]^{\frac{2}{x}}$$

$$= 4\lim_{x\to 0}\left[1+\frac{1+\left(\frac{3}{2}\right)^x}{2}-1\right]^{\frac{2}{x}}$$

$$= 4\lim_{x\to 0}\left\{\left[1+\frac{\left(\frac{3}{2}\right)^x-1}{2}\right]^{\frac{2}{\left(\frac{3}{2}\right)^x-1}}\right\}^{\left[\frac{\left(\frac{3}{2}\right)^x-1}{2}\right]^{\frac{2}{x}}}$$

$$= 4\left\{\lim_{x\to 0}\left[1+\frac{\left(\frac{3}{2}\right)^x-1}{2}\right]^{\frac{2}{\left(\frac{3}{2}\right)^x-1}}\right\}^{\left[\lim_{x\to 0}\frac{\left(\frac{3}{2}\right)^x-1}{x}\right]}$$

$$= 4\{e\}^{\log_e(3/2)} = 4\left(\frac{3}{2}\right) = 6$$

6 is the root of the equation $x^2 - 7x + 6 = 0$

$$(x - 6)(x - 1) = 0$$

$\therefore$ option (4)

Version – 11	Version – 22	Version – 33	Version - 44
Q.72	Q.65	Q.87	Q.79

Q.72 Ans.: (4) f_4

Explanation: Option (1)

$f_1(x) = x|x| \quad = x^2$ of $x \geq 0$

$= -x^2$ of $x < 0$

st. line parallel to x – axis cuts the graph only at one point

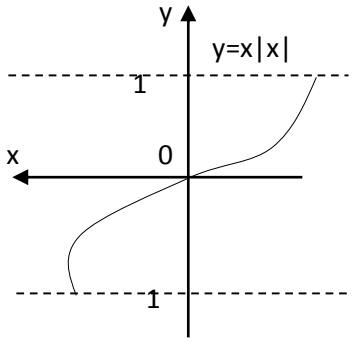
$\therefore$ f_1 is one to one f^n

Also range = co domain = [-1, 1]

$\therefore$ f_1 is onto function

$\therefore$ f1is both one to one & onto function

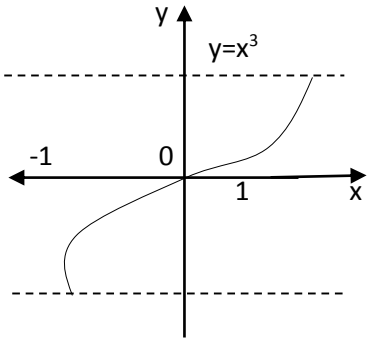
$\therefore$ (1) is not reqd. option



Option (2)

$f_2 = x^3$ for same reason as in option (1)

above f_2 is also one to one and onto function.



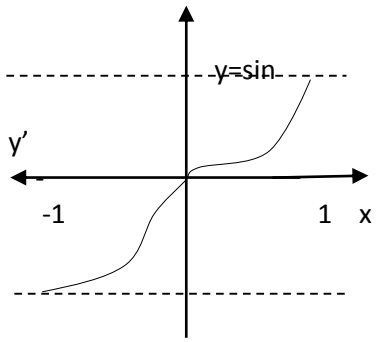
Option (3)

For same reason as in (1)

function f_3 is one to one and onto

(3) is not reqd. option

Hence option (4) is reqd. option



Option (4)

St. line parallel to x-axis cuts the graph as many points

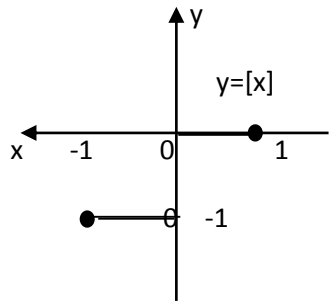
$\therefore$ f_4 is many to one function

Range = $\{-1, 0, 1\} \subset [-1, 1]$

$\therefore$ f_4 is into function

$\therefore$ f_4 is not one to one and onto function

$\therefore$ option (4) is reqd. option.



Q.73 **Ans.:** (1) 2(x + 1)

Version – 11	Version – 22	Version – 33	Version - 44
Q.73	Q.66	Q.88	Q.80

Explanation:

Given $f(0) = 1 = 1^2$ _____(1)

$f(x + y + 1) - f(x) - f(y) = 2\sqrt{f(x)f(y)}$ _____(2)

sub. y = 0

$f(x + 1) - f(x) - f(0) = 2\sqrt{f(0).f(y)}$

sub f(0) = 1

$f(x + 1) - f(x) - 1 = 2\sqrt{f(x)}$ _____(3)

sub x = 0

$f(1) - f(0) - 1 = 2\sqrt{f(0)}$

sub f(0) = 1

$f(1) - 1 - 1 = 2$

$f(1) = 4 = 2^2$

sub x = 1 in (3)

$f(2) - f(1) - 1 = 2\sqrt{f(1)}$

sub f(1) = 4

$f(2) - 4 - 1 = 4$ $\therefore f(2) = 3^2$

continuing in this manner $f(x) = (x + 1)^2$

$\therefore f'(x) = 2(x + 1)$ Option (1)

Q.74 **Ans.:** (4) $\frac{x-1}{3} = \frac{y-2}{2} = \frac{z-4}{1}$ and $\frac{x-2}{1} = \frac{y+3}{2} = \frac{z-4}{3}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.74	Q.67	Q.89	Q.81

Explanation: we test options obviously options (1) & (2) are not reqd. options as drs of lines are in proportion

$\therefore$ Lines are parallel

Option (3) Let $\frac{x-1}{3} = \frac{y-2}{2} = \frac{z-4}{1} = \lambda$

$\therefore (3\lambda + 1, 2\lambda + 2, \lambda + 4)$ is any pt. on l_1

$\frac{x-3}{2} = \frac{y-3}{1} = \frac{z-7}{3} = \mu$

$\therefore (2\mu + 3, \mu + 3, 3\mu + 7)$ is any pt. on l_2. For lines to intersect,

$3\lambda + 1 = 2\mu + 3 \Rightarrow 3\lambda - 2\mu = 2$

$2\lambda + 2 = \mu + 3 \Rightarrow 2\lambda - \mu = 1$

$\lambda + 4 = 3\mu + 7 \Rightarrow \lambda - 3\mu = 3$

If these 3 equations in λ and μ are consistent, then lines will be intersecting i.e. of $\begin{vmatrix} 3 & -2 & 2 \\ 2 & -1 & 1 \\ 1 & -3 & 3 \end{vmatrix} = 0$

LHS = 3(0) + 2(5) + 2(-5) = 0 = RHS

$\therefore$ lines are intersecting

$\therefore$ not skew lines

$\therefore$ Remaining, option (4) must be reqd. option

OR pt. (1, 2, 4) lies on both the lines $\frac{x-1}{3} = \frac{y-2}{2} = \frac{z-4}{1}$ and $\frac{x-3}{2} = \frac{y-3}{1} = \frac{z-7}{3}$

$\therefore$ lines in option (3) are not skew

$\therefore$ option (4) is reqd. option

Q.75 **Ans.:** (1) $\tan x \log\left(1+\sin^2 x\right) - 2x + \sqrt{2}\tan^{-1}\left(\sqrt{2}\tan x\right) + c$

Explanation:

Version – 11	Version – 22	Version – 33	Version - 44
Q.75	Q.68	Q.90	Q.82

$$I = \int \frac{\cot^2 x + 1}{\cot^2 x}.\log\left(\frac{1+2\tan^2 x}{1+\tan^2 x}\right)dx$$

$$= \int \frac{\operatorname{cosec}^2 x}{\cot^2 x}.\log\left(\frac{1+2\tan^2 x}{1+\tan^2 x}\right)dx$$

$$= \int \sec^2 x \log\left(\frac{1+2\tan^2 x}{1+\tan^2 x}\right)dx$$

$$= \int \log\left(\frac{1+2\tan^2 x}{1+\tan^2 x}\right).\sec^2 x\,dx$$

$$= \int \log\left(\cos^2 x + 2\sin^2 x\right).\sec^2 x\,dx$$

$$= \int \log\left(1+\sin^2 x\right).\sec^2 x\,dx$$

I II

using integration by parts,

$$= \log\left(1+\sin^2 x\right).\tan x - \int \tan x.\frac{2\sin x\cos x}{1+\sin^2 x}dx$$

$$= \tan x.\log\left(1+\sin^2 x\right) - 2\int \frac{\left[\left(1+\sin^2 x\right)-1\right]dx}{1+\sin^2 x}$$

$$= \tan x.\log\left(1+\sin^2 x\right) - 2\int 1dx + 2\int \frac{1}{1+\sin^2 x}dx$$

$\div$N & D of last integral by $\cos^2 x$

$$= \tan x.\log\left(1+\sin^2 x\right) - 2\int 1dx + 2\int \frac{\sec^2 x dx}{\left(1+\tan^2 x\right)+\tan^2 x}$$

Sub tanx : t

$\therefore \sec^2 x\, dx = dt$

$$= \tan x.\log\left(1+\sin^2 x\right) - 2\int 1dx + 2\int \frac{dt}{1^2+\left(\sqrt{2}t\right)^2}$$

$$= \tan x.\log\left(1+\sin^2 x\right) - 2x + \frac{2}{\sqrt{2}}\tan^{-1}\left(\sqrt{2}\tan x\right) + c$$

Option (1)

Q.76 **Ans.:** (2) 1000

Version – 11	Version – 22	Version – 33	Version - 44
Q.76	Q.69	Q.61	Q.83

Explanation: Using the property sum of the terms of an A.P. equidistant from beginning and end is constant which equals sum of the first and last term

$\therefore$ $t_1 + t_7 + t_{10} + t_{39} + t_{42} + t_{48} = 125$

$\therefore$ $(t_1 + t_{48}) + (t_7 + t_{42}) + (t_{10} + t_{39}) = 125$

$\therefore$ $3(t_1 + t_{48}) = 125$ mult. by 8

$\therefore$ $24(t_1 + t_{48}) = 1000$

$\therefore$ $S_{48} = 1000$ Option (2)

Q.77 **Ans.:** (1) $\begin{bmatrix} 1 & 0 \\ 2017 & 1 \end{bmatrix}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.77	Q.70	Q.62	Q.84

Explanation: $B = \begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix}$

$$B^2 = \begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix}.\begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$\therefore$ $B^3, B^4, ..., B^{2017} = 0$

$$(I+B)^{2017} = {}^{2017}C_0 I^{2017} + {}^{2017}C_1 I^{2016} B + {}^{2017}C_2 I^{2015} B^2 + ... + {}^{2017}C_{2017}.I^0.B^{2017}$$

$$= I + 2017\begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 2017 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 2017 & 1 \end{bmatrix}$$ option (1)

Q.78 **Ans.:** (3) $\frac{\pi}{4}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.78	Q.71	Q.63	Q.85

Explanation: $a + b + c = 3\sqrt{2}\frac{[\sin A + \sin B + \sin C]}{3}$

$a + b + c = \sqrt{2}[ak + bk + ck]$

$a + b + c = k\sqrt{2}(a + b + c)$

$\therefore\ k\sqrt{2} = 1$

$\therefore\ k = \frac{1}{\sqrt{2}}$

$\sin A = ak = (1)\ \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}}$

$\therefore\ A = \frac{\pi}{4}$ Option (3)

Q.79 **Ans.:** (2) $\frac{7}{12}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.79	Q.72	Q.64	Q.86

Explanation: whenever it is impossible to find point of intersection of the curves especially when equation of curve contains e^x or log x try x = 0 or x = 1 to get their point of intersection.

x = 0 and x = 1 gives y = x log x $\therefore$ y = 0

and $y = 2x - 2x^2$ also given for x = y = 0

O(0, 0) is point of intersection of curve

Also for x = 1 both give y = 0

$\therefore$ A(1, 0) is also point of intersection

$\therefore$ reqd. area $= \left|\int_0^1 x\log x\,dx - \int_0^1 (2x - 2x^2)\,dx\right|$

II I

$$= \left|\left\{\left[\log x.\left(\frac{x^2}{2}\right) - \int \frac{x^2}{2}\frac{1}{x}dx\right]_0^1 - \left(2\frac{x^2}{2} - \frac{2x^3}{3}\right)_0^1\right\}\right|$$

$$= \left|0 - \frac{1}{2}\left[\frac{x^2}{2}\right]_0^1 - \left(1 - \frac{2}{3}\right) + 0\right|$$

$$= \left|-\frac{1}{4}(1) - \frac{1}{3}\right| = \frac{7}{12}$$ option(b)

Q.80 **Ans.:** (1) 0

Version – 11	Version – 22	Version – 33	Version - 44
Q.80	Q.73	Q.65	Q.87

Explanation:

$x^2 + 4x + 4 + 4 = 2 \sin x$

$(x + 2)^2 + 4 = 2 \sin x$

For any real x, $(x + 2)^2 \geq 0$

$\therefore (x + 2)^2 + 4 \geq 4$

$\therefore$ LHS ≥ 4 _____(1)

For any $x \in R$,

$-1 \leq \sin x \leq 1$ mult. By 2,

$-2 \leq 2 \sin x \leq 2$

$\therefore$ RHS $\in [-2, 2]$ _____(2)

Form (1) and (2) LHS ≥ 4, RHS $\in [-2, 2]$ } No solution

$\therefore$ No. of solutions = 0

Q.81 **Ans.:** (4) $\frac{3}{\sqrt{9-x^2}}$

Version – 11	Version – 22	Version – 33	Version - 44
Q.81	Q.74	Q.66	Q.88

Explanation: $y = \sin^{-1}\left(x - \frac{4x^3}{27}\right)$

Mult. and divide first term in bracket by 3

$= \sin^{-1}\left[3\left(\frac{x}{3}\right) - 4\left(\frac{x}{3}\right)^3\right]$ sub. $\frac{x}{3} = \sin\theta$

$= \sin^{-1}\left[3\sin\theta - 4\sin^3\theta\right]$

$= \sin^{-1}\left[\sin 3\theta\right]$

$= 3\theta$

$y = 3 \sin^{-1}\left(\frac{x}{3}\right)$

$\therefore \frac{dy}{dx} = \frac{3}{\sqrt{1-\left(\frac{x}{3}\right)^2}} \cdot \left(\frac{1}{3}\right) = \frac{3}{\sqrt{9-x^2}}$

Option (4)

Q.82 **Ans.:** (2) Line is parallel to the plane

Version – 11	Version – 22	Version – 33	Version - 44
Q.82	Q.75	Q.67	Q.89

Explanation:

D r s of normal to the plane 2x + 3y – 4z = 7 are 2, 3, -4

D r s of the line $\frac{x}{1}=\frac{y}{2}=\frac{z}{2}$ are 1, 2, 2

$\therefore$ (2) (1) + (3) (2) + (-4) (2) = 0

$\therefore$ Line $\perp$ normal $\perp$ plane

$\therefore$ Line is parallel to the plane

Line, $\frac{x-0}{1}=\frac{y-0}{2}=\frac{z-0}{2}$ passess through the origin c(0, 0, 0)

For line to lie in the plane pt (0, 0, 0) must lie in plane

For that 2(0) + 3(0) – 4(0) = 7 must be true i.e. 0 = 7 must be true

Which obviously is not true

$\therefore$ Line does not lie in the plane

$\therefore$ Line is only parallel to the plane without lying in the plane

$\therefore$ option (2)

Q.83 **Ans.:** (1) $\sin^2\theta + \cos^2\theta$ for any real θ

Version – 11	Version – 22	Version – 33	Version - 44
Q.83	Q.76	Q.68	Q.90

Explanation: Given $q^2 = p^2 + r^2$

$\therefore\ q^2 - r^2 = p^2$ _____(1)

$$\frac{\log p_{q+r}+\log p_{q-r}}{2\left[\log_p (q+r)\right]\cdot\left[\log_p (q-r)\right]}=\frac{\frac{\log p}{\log(q+r)}+\frac{\log q}{\log(q-r)}}{2\left[\frac{\log p}{\log(q+r)}\right]\left[\frac{\log p}{\log(q-r)}\right]}$$

$$=\frac{(\log p)\left[\log(q-r)+\log(q+r)\right]}{2(\log p)^2}=\frac{\log\left(q^2-r^2\right)}{2(\log p)}$$

$$=\frac{\log\left(p^2\right)}{\log\left(p^2\right)}=1=\sin^2\theta+\cos^2\theta$$

Option (1)

Q.84 **Ans.:** (1) 7

Version – 11	Version – 22	Version – 33	Version - 44
Q.84	Q.77	Q.69	Q.61

Explanation:

Let the common multiple be x

Let tan A = 2x, tan B = 3x, tan C = 4x

$\therefore$ A = $\tan^{-1}(2x)$, B = $\tan^{-1}(3x)$, C = $\tan^{-1}(4x)$

π = A + B + C

= $\tan^{-1}(2x) + \tan^{-1}(3x) + \tan^{-1}(4x)$

$$= \tan^{-1}\left(\frac{2x+3x}{1-6x^2}\right) + \tan^{-1} 4x$$

$$= \tan -1\left(\frac{\frac{2x+3x}{1-6x^2}+4x}{1-\frac{20x^2}{1-6x^2}}\right)$$

$$\tan\pi = \left(\frac{5x+4x-24x^3}{1-6x^2-20x^2}\right)$$

$$\therefore \ \frac{9x-24x^3}{1-6x^2-20x^2}=0$$

$\therefore$ 3x $(3 - 8x^2) = 0$

$$\therefore \ x = 0 \text{ or } x^2 = \frac{3}{8}$$

$$\therefore \ x = \frac{\sqrt{3}}{\sqrt{8}}$$

$$\therefore \ \tan^2 C = (4x)^2 = 16\left(\frac{\sqrt{3}}{\sqrt{8}}\right)^2 = 6$$

$\sec^2C = 1 + \tan^2C = 1 + 6 = 7$ option (1)

Q.85 **Ans.:** (3)

Version – 11	Version – 22	Version – 33	Version - 44
Q.85	Q.78	Q.70	Q.62

Explanation:

Box 1	Box 2	Box 3
1	1	3
1	2	2
1	3	1
2	1	2
2	2	1
3	1	1

3 boxes among themselves can be arranged in 3! ways.

$\therefore$ There are only 2 ways we can distribute the balls

(i) 1, 1, 3 and (ii) 1, 2, 2

No. of ways = $\left[{}^5C_1.{}^4C_1.{}^3C_3 + {}^5C_1{}^4C_2{}^2C_2\right]\frac{3!}{2!}$

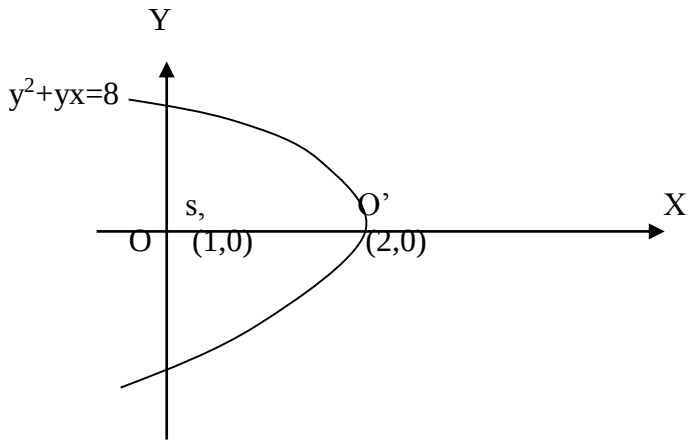
$= \left[(5)(4)(1)+(5)(6)(1)\right]3$

= 150 option (3)

Q.86 **Ans.:** (2) 90° on x – 3 = 0

Version – 11	Version – 22	Version – 33	Version - 44
Q.86	Q.79	Q.71	Q.63

Explanation:



$y^2 + 4x = 8$

$(y - 0)^2 = -4(x - 2)$

Shifting the origin at (2, 0) and sul

y – 0 = Y, x – 2 = X

given equation becomes $Y^2 = - X$

$\therefore$ a = 1

$\therefore$ focus (-a, 0) ≡ (-1, 0) ≡ (X , Y)

X = -1 = x -2 Y = y = 0

x = 1 y = 0

S(1, 0)

$\therefore$ Given chord is a focal chord.

By the property that tangents at the end of focal chord meet at right angles on directrix end direction is x = a = 1

$\therefore$ x – 2 = 1

x = 3

$\therefore$ Tangent meet at right angle on x – 3 = 0 Option (2)

Q.87 **Ans.:** (1) $|c| > \sqrt{2}|b|$

Version – 11	Version – 22	Version – 33	Version - 44
Q.87	Q.80	Q.72	Q.64

Explanation:

$f(x) = x^2 + 2bx + 2c^2$

$\therefore \quad f^{11}(x) = 2x + 2b = 0$

$x = -b$

$f^{11}(x) = 2$

$\therefore \quad f^{11}(-b) = 2 > 0$

$f(x) = x^2 + 2bx + 2c^2$

put $x = -b$

$f_{min} = f(-b) = b^2 - 2b^2 + 2c^2$

$\therefore \quad f_{min} = 2c^2 - b^2$

$g(x) = -x^2 - 2cx + b^2$

$\therefore \quad g^{11}(x) = -2x - 2c = 0$

$\therefore \quad x = -c$

$g^{11}(x) = -2$

$g^{11}(-c) = -2 < 0$

$\therefore$ g has max. at $x = -c$

$g(x) = -x^2 - 2cx + b^2$

put $x = -c$

$g_{max} = g(-c) = -c^2 + 2c^2 + b^2$

$g_{max} = b^2 + c^2$

Given that min f(x) > max. g(x)

$2c^2 - b^2 > b^2 + c^2$

$\therefore \quad c^2 > 2b^2$

$\therefore \quad |c| > \sqrt{2}|b|$ option (1)

Q.88 **Ans.:** (4) 582

Version – 11	Version – 22	Version – 33	Version - 44
Q.88	Q.81	Q.73	Q.65

Explanation:

Let $\bar{x}$ be mean

$$\bar{x} = \frac{1+3+5+7+....+2017}{1009} = \frac{(1009)^2}{1009} = 1009$$

Various of $x = \sigma^2 = \frac{1}{1009}\left(1^2 + 3^2 + 5^2 + ... + 2017^2\right) - (1009)^2$

$= 1^2 + 3^2 + 5^2 + ... + 2017^2$

$= \sum_{r=1}^{1009} (2r-1)^2$

$\therefore \quad 4\sum r^2 - 4\sum r + \sum 1$

$= \frac{4(1009)(1010)(2019)}{6} - \frac{4(1009)(1010)}{2} + 1009$

$= 1371695140 - 2038180 + 1009$

$= 139657969$

$= \frac{139657969}{1900} - 1018081$

$\therefore \quad 1357441 - 1018081$

$\sigma^2 = 339360$

$\therefore \quad \sigma = 582.5461$

$\therefore \quad [\sigma] = 582$

Option (4)

Q.89 **Ans.:** (3) 2

Version – 11	Version – 22	Version – 33	Version - 44
Q.89	Q.82	Q.74	Q.66

Explanation: Given differential equation is $(x\log x)\frac{dy}{dx}+y=2x\log x$

$$\frac{dy}{dx}+\left(\frac{1}{x\log x}\right)y=2$$

Which is linear differential equation of the form $\frac{dy}{dx}+py=Q$

$\therefore$ I.F. $= e^{\int pdx}=e^{\int\frac{1}{x\log x}dx}=e^{\int\frac{(1/x)dx}{\log x}}$ $\quad\therefore\ e^{\log_e(\log x)}=\log x$

$\therefore$ solution is

$$y.\log x=2\int \log x dx=2\int \log x.1dx$$

I II

Using integration by parts

$y \log x = 2[(\log x)(x) - x] + c$

$y \log x = 2(x \log x - x) + c$

given $x \geq 1$ $\quad\therefore$ sub $x = 1, c = 2$

$\therefore\ y \log x = 2(x \log x - x) + 2$

Put $x = e$

$y(e) = 2(e - e) + 2$

$\therefore\ y(e) = 2$ Option (3)

Q.90 **Ans.:** (3) $\frac{x^{1000}}{1000}+c$

Version – 11	Version – 22	Version – 33	Version - 44
Q.90	Q.83	Q.75	Q.67

Explanation:

$$I=\int x^{1000x}\left(1+\log x\right)dx$$

$$=\int x^{999x}\left[x^{x}\left(1+\log x\right)\right]dx$$

$$=\int\left(x^{x}\right)^{999}\left[x^{x}\left(1+\log x\right)\right]dx$$

$$=\int t^{999}dt$$ Let $x^x = t$

$\therefore\ x^x (1 + \log x)dx = dt$

$$=\frac{t^{1000}}{1000}+c$$

$$=\frac{\left(x^{x}\right)^{1000}}{1000}+c$$

$$=\frac{x^{1000x}}{1000}+c$$ Option (3)