FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
CONCEPT RECAPITULATION TEST – I
PAPER –2
TEST DATE: 24-04-2025

ANSWERS, HINTS & SOLUTIONS

Physics

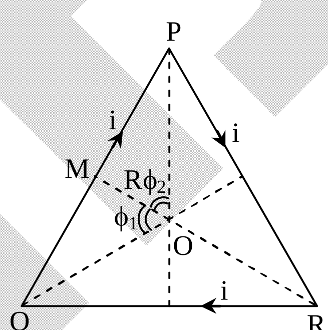
PART – I

SECTION – A

1. B

Sol. The magnitude of the magnetic field produced by one of the sides QP of triangle at the centroid O is given by

$$B = \frac{\mu_0 i}{4\pi R}(\sin\phi_1 + \sin\phi_2)$$



Where ϕ_1 and ϕ_2 are the positive values of angles made by lines QO and PO with respect to $\perp$ distance OM and R represents the $\perp$ distance of side QP from centre O. Because both the magnitudes and directions (according to RHPR, it is $\otimes$) of magnetic fields, produced by all the three sides, are same, hence magnitude of resultant field at the centre is given by

$$B_{total} = 3B = 3\frac{\mu_0 i}{4\pi R}(\sin\phi_1 + \sin\phi_2)$$

Given that

$i = 1$ amp; $\phi_1 = \phi_2 = 60^o$,

$$R = \frac{\ell}{2}\cot 60^o = \frac{\ell}{2\sqrt{3}}$$

and $\ell = 4.5 \times 10^{-2}$ meter

$$\therefore B_{total} = 3 \times 10^{-7} \times \frac{1.0}{\frac{4.5\times10^{-2}}{2\sqrt{3}}} \times \left(\frac{\sqrt{3}}{2} + \frac{\sqrt{3}}{2}\right)$$

$= \dfrac{3\times10^{-7}\times2\times3}{4.5\times10^{-2}}$ = 4 × 10^{-5} Tesla.

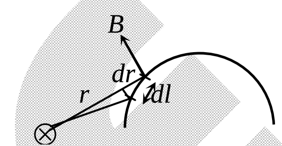
2. A

Sol. W_{Net} = – 1200 J, $W_{AB} = nR\Delta T$ = 3320 J,

W_{CA} = 0, $W_{Net} = W_{AB} + W_{BC} + W_{CA} \Rightarrow W_{BC}$ = – 4520 J

3. A

Sol. Magnetic field at a distance *r* from the wire will be



$$B = \frac{\mu_0}{2\pi}\frac{i_1}{r}$$

force on the small element of length *dl* on semicircular wire is

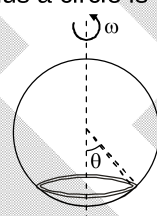
$$dF = i_2\ d\vec{l}\times\vec{B} = i_2(dl_\perp)B \quad = i_2 B\ dr \qquad (\because dl_\perp = dr)$$

$$F = \int_R^{3R} i_2\ B\,dr = \frac{\mu_0}{2\pi} i_1 i_2 \ln 3$$

4. A

Sol. When the shell rotates, current is induced due to motion of charge. To calculate magnetic induction at centre of the shell, rotating shell can be assumed to be composed of thin circular current carrying rings. Such a ring can be assumed as follows:

Consider a radius of the shell inclined at angle 'θ' with the axis of rotation. This radius is rotated about the axis keeping θ constant. Thus a circle is traced as shown in fig.



Its radius, $r = R\sin\theta$

Distance of its centre from centre of the shell, $x = R\cos\theta$.

Now consider another radius inclined at angle (θ + dθ). It is also rotated in the same way and another circle is traced. The portion between two circles forms a circular ring.

Area of this ring = $2\pi r\,R\,d\theta = 2\pi R^2 \sin\theta\,d\theta$

Charge on this ring, $dq = \sigma \cdot 2\pi R^2 \sin\theta\,d\theta$

Since, angular velocity of the shell is ω, therefore, it completes $\dfrac{\omega}{2\pi}$ revolutions per second.

Hence, current associated with the ring considered,

$i = \dfrac{\omega}{2\pi}dq = \sigma\,\omega R^2 \sin\theta\,d\theta$

Since, centre of the shell is a point lying on the axis of a circular coil of radius r, carrying current i at a distance x from centre of the coil, therefore, magnetic induction at centre of the shell due to this coil is

$$dB = \frac{\mu_0 i r^2}{2(r^2+x^2)^{3/2}}$$

$$= \frac{1}{2}\mu_0\,\sigma\,\omega R \sin^3\theta\,d\theta$$

Hence, resultant magnetic induction at centre of the shell

$$B = \int dB = \frac{1}{2}\mu_0 \sigma \omega R \int_0^{\pi} \sin^3\theta \, d\theta$$
$$= \frac{2}{3}\mu_0 \sigma \omega R \text{ Ans.}$$

5. A, C, D

Sol. $\vec{F}_m = q\left(\vec{v} \times \vec{B}\right)$ and apply Newton's second law of motion.

6. A, C, D

Sol. $V_A = E - \frac{q}{C},\ q = \frac{3CE}{4}$

$V_B = E - \frac{q'}{2C},\ q' = \frac{8CE}{6}$

$V_A - V_B = +\frac{E}{12}$

C_{eq} of circuit is $= \frac{3C}{4} + \frac{4C}{3} = \frac{9+16}{12}$

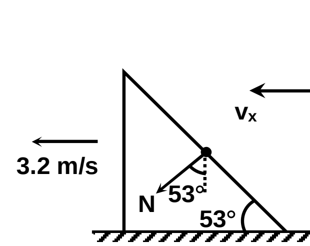
$= \frac{25C}{12}$

$\Delta H = \frac{1}{2}C_{eq}E^2 = \frac{25CE^2}{24}$

$V_{2C} = \frac{q'}{2C} = \frac{2E}{3}$

7. A, B

Sol. Let the average force exerted by the ball on the wedge during collision is N and horizontal and vertical components of velocity of ball just after collision are v_x and v_y respectively.



For the wedge, N Δt sin 53° = 5 × 3.2

$\Rightarrow$ NΔt = 20 N-s

From conservation of momentum along horizontal direction

2 × 10 = $2v_x$ + 5 × 3.2

$\Rightarrow v_x$ = 2 m/s

NΔt cos53° = $2v_y$

$\Rightarrow v_y$ = 6 m/s

Speed of ball after collision = $\sqrt{v_x^2 + v_y^2}$ = 2√10 m/s

$$e = \frac{V_{2n} - V_{1n}}{u_{1n} - u_{2n}} = \frac{3.2\sin 53° - (2\sin 53° - 6\cos 53°)}{10\sin 53° - 0} = 0.57$$

SECTION – B

8. 300

Sol. Power absorbed by earth = power emitted by earth.

$$\Rightarrow \quad \frac{e\sigma\left(4\pi R_s^2\right)T_s^4}{4\pi r^2} \times \pi R_e^2 = e\sigma\left(4\pi R_e^2\right)T_e^4$$

$$\Rightarrow \quad T_e = T_s\sqrt{\frac{R_s}{2r}} = T_s\sqrt{\frac{R_s}{2 \times 200R_s}} \quad \Rightarrow \quad T_c = \frac{T_s}{20} = 300 \text{ K}$$

9. 30

Sol. $\lambda_{C_1} = \frac{hc}{eV} = \frac{12375}{10\times10^3} A° = 1.2375\ A°$ … (1)

$\lambda_{C_2} = 0.61875\ A°$ … (2)

$$\frac{1}{\lambda_{K_\alpha}} = (Z-1)^2 \left\{\frac{1}{1} - \frac{1}{4}\right\}\times10^7 \quad \ldots (3)$$

It is given

$3 \times (\lambda_{k\alpha} - 1.2375) = \lambda_{k\alpha} - 0.61875$

$\therefore \quad \lambda_{k\alpha} = 1.54338\ A°$ … (4)

Putting this value in (3)

$Z - 1 = 29$

$Z = 30$

10. 1

Sol. $B\int_0^R \frac{\omega}{2\pi} Q \frac{2\pi r}{\pi R^2} dr\, \pi r^2 = \frac{T_0 D}{2}$

$\Rightarrow \quad \omega = \frac{T_0 D}{QR^2 B}$.

11. 2

Sol. $x = 2t,\ v_x = 2$

$y = 2t^2 \quad v_y = 4t$

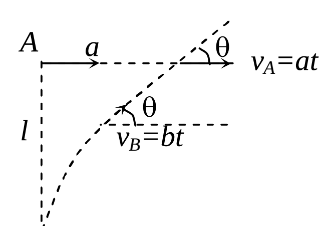
$\tan\theta = \frac{v_y}{v_x} = \frac{4t}{2} = 2t$

$\sec^2\theta \frac{d\theta}{dt} = 2 \Rightarrow \left(1+\tan^2\theta\right)\frac{d\theta}{dt} = 2 \qquad \frac{d\theta}{dt} = \frac{2}{1+4t^2}$

$\left.\frac{d\theta}{dt}\right|_{t=2} = \frac{2}{17} rad/\sec$

12. 9

Sol. Let after time t, the velocity B is directed at angle θ with the horizontal.



$-\frac{ds}{dt} = bt - at\cos\theta$

$\Rightarrow \quad -\int_l^0 ds = b\int_0^t tdt - a\int_0^t t\cos\theta\, dt$

$\frac{1}{2}at^2 = b\int_0^t t\cos\theta\, dt$

$\therefore \quad l = \frac{bt^2}{2} - \frac{a^2t^2}{2b}, \qquad t = \sqrt{\frac{2bl}{b^2-a^2}}$

$S = \frac{1}{2}bt^2 = \frac{1}{2}b\frac{2bl}{b^2-a^2} = \frac{b^2 l}{b^2-a^2} = 9$ m

13. 3

Sol. $\frac{2u\sin\theta}{g} = \frac{\pi\times 20}{31.4}$

or $u\sin\theta = g$ ...(i)

$\frac{2u\sin\theta\times u\cos\theta}{g} = 20\sqrt{3}$

$\therefore$ $u\cos\theta = g\sqrt{3}$ ...(ii)

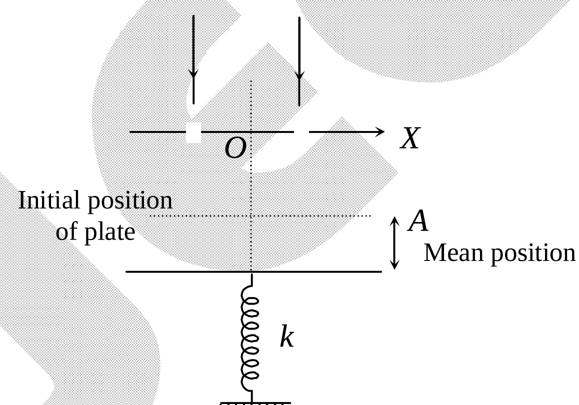
On solving (i) and (ii)

$\theta_{min} = 30^0$, u =20 m/s

SECTION – C

14. 1.00

Sol. $\beta = \frac{(D+y)\lambda}{d}$



$\frac{d\beta}{dt} = \frac{\lambda}{d}\frac{dy}{dt} = \frac{\lambda}{d}v$

At mean position

$v = A\omega = \frac{mg}{k}\sqrt{\frac{k}{m}} = g\sqrt{\frac{m}{k}}$

$\frac{d\beta}{dt} = \frac{\lambda g}{d}\sqrt{\frac{m}{k}}$

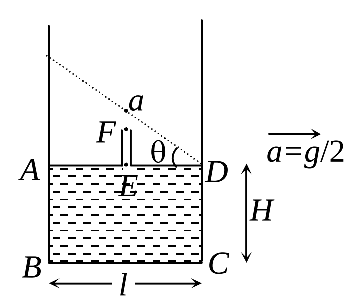
15. 2.00

Sol. $\beta_1 = \frac{(D+2A)\lambda}{d}$, $\beta_2 = \frac{D\lambda}{d}$

$\beta_1 - \beta_2 = \frac{2\lambda}{d}\frac{mg}{k}$

16. 4.00

Sol. Bernoulli's theorem at point *E* and *F*



$P_0 + \rho g\frac{l}{4} + \frac{1}{2}P(0)^2 = P_0 + \rho gh + \frac{1}{2}\rho v^2$

$\rho g\left(\frac{l}{4} - h\right) = \frac{1}{2}\rho v^2$

$v = \sqrt{2g\left(\frac{l}{4} - h\right)}$

17. 4.00

Sol. $\frac{1}{2}\left[P_0 + H\rho g + P_0 + \rho g\left(H + \frac{l}{2}\right)\right]l^2 = \left[P_0 + \rho g\left(\frac{l}{4} + H\right)\right]l^2$

Chemistry

PART – II

SECTION – A

18. A
Sol. NCERT Factual

19. A
Sol. NCERT Factual

20. A
Sol. from 3 to 2 total nodes present in wave function ψ for a hydrogen atom is

$$E_n = \left|\frac{me^4}{32(n\pi \in_0 \hbar)^2}\right|$$

total nodes = n–1

level n_i => $n_i - 1 = 4 \Rightarrow \quad n_i = 5$

level n_f $\quad n_f - 1 = 5 \Rightarrow \quad n_f = 6$

$$\Delta E = \frac{me^4}{32(\pi \in_0 \hbar)^2}\left\{\frac{1}{25} - \frac{1}{36}\right\}$$

$$= \frac{me^4}{32(\pi \in_0 \hbar)^2}\ \frac{11}{36 \times 25}$$

$$= \frac{1}{25} \times \left|\frac{me^4}{32 \times (\pi \in_0 \hbar)^2} \times \frac{11}{36}\right|$$

$$= \frac{1}{25} \times \left|\frac{me^4}{(\pi \in_0 \hbar)^2} \times \frac{11}{1152}\right|$$

= 0.04

21. A
Sol. NCERT Factual

22. A, B, C, D
Sol. Heat released in reaction = Heat gained by calorimeter system = 1.5 $\times$ 1.4 = 2.1 kJ

$$n_{eq}(H_2SO_4) = \frac{100 \times 0.5}{1000} = 0.05$$

$$n_{eq}(NH_4OH) = \frac{200 \times 0.2}{1000} = 0.04 \text{ (Limiting reagent)}$$

$\Delta_{neut}H_{NH_4OH}$ (By strong acid) = - $\frac{2.1}{0.04} = -52.5\,kJ/eq$

= – 52.5 kJ/mole

$$\Delta_{diss}H_{NH_4OH} = (-52.5) - (-57) = 4.5\ kJ/mol$$

$$\Delta_{diss}H_{CH_3COOH} = (57 - 48.1) - 4.5 = 4.4\,kJ/mol$$

23. A, B
Sol. Factual

24. A, B, C

Sol. Process BC : $\frac{P_B}{T_B} = \frac{P_C}{T_C} \Rightarrow \frac{P_B}{500} = \frac{1}{250} \Rightarrow P_B = 2\,\text{bar}$

and $\Delta U_{BC} = n.C_{V,m}(T_C - T_B)$

$= 2 \times 1.5R \times (250 - 500)$

$= -750\ R$

Process CD : $\Delta U = w$

$\Rightarrow n.C_{V,m}(T_D - T_C)$

$= -P_{ext}(V_D - V_C)$

or, $n \times 1.5R \times (T_D - T_C)$

$= -P_D\left(\frac{nRT_D}{P_D} - \frac{nRT_C}{P_C}\right)$

$\Rightarrow T_D = 450\,K$

and $\Delta H_{CD} = n.C_{P,m}.(T_D - T_C)$

$= 2 \times 2.5R \times (450 - 250)$

$= 1000\ R$

SECTION – B

25. 8

Sol.

$A_2 \rightleftharpoons 2A;\ K_1 = x\,\text{atm}$

Initial partial pressure	1 atm	0
Equ. Partial pressure	1–(x + z)	0

$B_2 \rightleftharpoons 2B;\ K_2 = y\,\text{atm}$

Initial partial pressure	1 atm	0
Eq. partial pressure	$1-(y+z)$	2y

	A_2	$+$	B_2	$\rightleftharpoons$	$2AB;$	$K_3 = 2$
Initial partial pressure	1		1		0	
Equ.partial pressure	$1-(x+z)$		$1-(y+z)$		$(2z = 0.5)$	(1)

$\therefore x + y = 0.75$ (2)

Now, $K_3 = \frac{(0.5)^2}{(0.75-x)(0.75-y)} = 2$

$\Rightarrow x = 0.25$ or 0.50

y = 0.50 or 0.25

$$\therefore \frac{K_2}{K_1} = \frac{\frac{(2y)^2}{1-(y+z)}}{\frac{(2x)^2}{1-(x+z)}} = \frac{(2y)^2 \times (0.75-x)}{(2x)^2 \times (0.75-y)} = \frac{1}{8} \text{ or } \frac{8}{1}$$

26. 2

Sol. 112 ml of H_2 is obtained from 0.45 g

22400 ml of H_2 is obtained from $\frac{0.45 \times 22400}{112} = 90\,g$

90 g compound gives one mole H_2 gas
i.e. 2H obtained from 1 mole of compound.

27. 11

Sol. $3K_2MnO_4 + 2H_2O + 4CO_2 \rightarrow 2K\overset{+7}{Mn}O_4 + \overset{+4}{Mn}O_2 + 4KHCO_3$

$n_1 = 7, n_2 = 4$

$n_1 = n_2 = 11$

28. 6

Sol. Using cross aldol reaction and self aldol reaction

29. 5

Sol. Using No alpha hydrogen condition for cannizaro reaction.

30. 6

Sol. Primary amines give Isocyanide (carbylamine) test.
(a), (b), (d), (e), (f) and (h) give this test.

SECTION – C

31. 4.33

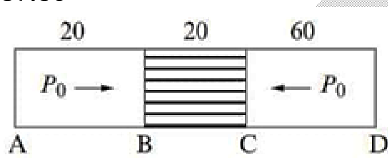
Sol. $\sqrt{3}a = 4r$
r=4.33 Å

32. 1.33

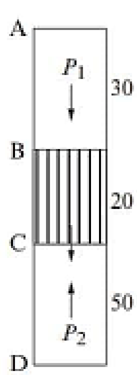
Sol. Nearest neighbours present at a distance, Y= 8

33. 37.50

Sol.



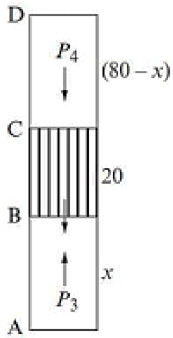
For AB column:
$P_0 \times 20 = P_1 \times 30$
For CD column:
$P_0 \times 60 = P_2 \times 50$
As P_1 + 20 cm Hg = P_2



or $\frac{20P_0}{30} + 20\,\text{cm Hg} = \frac{60P_0}{50} \Rightarrow P_0 = 37.5\,\text{cm Hg}$

34 13.88

Sol.



P_4 + 20 cm Hg = P_3

or, $\frac{60P_0}{(80-x)} + 20 = \frac{20P_0}{x} \Rightarrow x = 13.88$

Mathematics PART – III

SECTION – A

35. B
Sol. For k = 1 there is one solution

36. B
Sol. $t_n = \cot^{-1}\left(2+\frac{n(n+1)}{2}\right)$

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

$$\Rightarrow S_\infty = \frac{\pi}{2} - \tan^{-1}\frac{1}{2} = \cot^{-1}\frac{1}{2} = \tan^{-1}2$$

37. B
Sol. $100! = N.10^n = 2^{97}.3^{48}.5^{24}.7^{16}.11.13.17.19.23.29.31.37.41.43.47.53.59.61.67.71.73.79.83.89.97$
$\therefore n = 24$ and $d = 4.$
$\Rightarrow n + d = 28$

38. A
Sol. Let, then we have points (0, 0) (a, ma), (ma, a) area $\frac{1}{2}\begin{vmatrix} 0 & 0 & 1 \\ a & ma & 1 \\ ma & a & 1 \end{vmatrix} = 1000$

$\Rightarrow a^2(m^2-1) = 2000 = 25.80$
So a = 5, $m^2 - 1 = 80$
M = 9

39. A, C
Sol. The critical prints are x = -2, 0, $\frac{2}{3}$, 2, 6

$f_{min} = f\left(\frac{2}{3}\right) = \frac{1}{3}$. Also the graph is horizontal in the interval (2, 6)

40. B, C, D
Sol. HCF can be used to find the common roots of given equations

41. A, C
Sol. $f^{-1}(x) = t \Rightarrow x = f(t) \Rightarrow dx = f'(t)dt$

SECTION – B

42. 4
Sol. adj (adj A) = $|A|^{n-2}$ A where n = 3 (here)
= $= |A|A$
det (adj (adj A)) = $|A|^3$det A

$= |A|^4 = 23^4$

$\Rightarrow |A| = 23$

Now |A| = 3u + 11 = 23 ⇒ u = 4.

43. 9

Sol. $D_c = D^2 = 9$

$$D_c = \begin{vmatrix} x^3-1 & 0 & x-x^4 \\ 0 & x-x^4 & x^3-1 \\ x-x^4 & x^3-1 & 0 \end{vmatrix}$$

44. 3

Sol. Let, centre be (p, q, r)

Now distance of centre from boundary planes is same

$$\Rightarrow \frac{p}{1} = \frac{q}{1} = \frac{r}{1} = \frac{6-(p+q+r)}{\sqrt{3}} = \frac{6-(p+q+r)+(p+q+r)}{\sqrt{3}+1+1+1}$$

$$\Rightarrow p = q = r = \frac{6}{3+\sqrt{3}}$$

$\therefore$ k = 3

45. 0

Sol. Since $\vec{x}.\vec{a} = \vec{x}.\vec{b} = \vec{x}.\vec{c} = 0$

⇒ ($\vec{a}, \vec{b}, \vec{c}$ are coplanar) $\vec{X}$ is perpendicular to $\vec{a}, \vec{b}, \vec{c}$

$$\therefore \vec{a}(\vec{b}\times\vec{c}) = 0$$

46. 2

Sol. $$x^2y^2\left(\frac{dy}{y^2} - \frac{dx}{x^2}\right) + x^2y^2\left(\frac{1}{y} - \frac{1}{x}\right)dy = 0$$

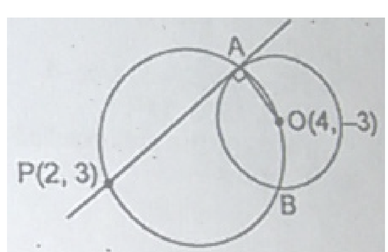
$$\Rightarrow d\left(\frac{1}{x} - \frac{1}{y}\right) + y\left(\frac{1}{y} - \frac{1}{x}\right)dy = 0 \Rightarrow \frac{d\left(\frac{1}{x} - \frac{1}{y}\right)}{\frac{1}{x} - \frac{1}{y}} = ydy$$

$$\Rightarrow \ln\left|\frac{1}{x} - \frac{1}{y}\right| = \frac{y^2}{2} + c \Rightarrow k = 2.$$

47. 6

Sol. Centre of the given circle is O(4, –3)

The circumcircle of ΔPAB will circumscribe the quadrilateral PBOA also, hence one of the diameter must be OP



$\therefore$ Equation of circumcircle of ΔPAB will be

(x – 2)(x – 4) + (y – 3)(y + 3) = 0

$\Rightarrow x^2 + y^2 - 6x - 1 = 0$ ...(1)

Director circle of given ellipse will be

$(x+5)^2 + (y-3)^2 = 9 + b^2$

$\Rightarrow x^2 + y^2 + 10x - 6y + 25 - b^2 = 0$ ....(2)

$\therefore$ From (1) and (2) by applying condition of orthogonally, we get

$2[-3(5) + 0(-3)] = -1 + 25 - b^2$

$\Rightarrow -30 = 24 - b^2$.

$b^2 = 54$

$\left(\frac{b^2}{9}\right)$ is 6

SECTION – C

48. 2.00

Sol. $x_{n+1} = x_3 \Rightarrow n = 2.$

49. 1.37

Sol. Required area $= \int_0^1 \sin^4 \pi x \, dx - = \int_0^1 \ln x \, dx = \frac{11}{8}.$

50. 3.00

Sol. For x < 0

$f(x) = \lim_{n\to\infty} \sum_{r=1}^{n} \frac{e^x}{r(r+1)} = e^x$

For x > 0

$f(x) = px \lim_{n\to\infty} \frac{1}{n}\left(n - \left(1 - \frac{1}{n+1}\right)\right) + \lambda = px + \lambda$

Now $f(x) = \begin{cases} e^x & , \quad x < 0 \\ q & , \quad x = 0 \\ px + \lambda & , \quad x > 0 \end{cases}$

Since f(x) is differentiable in R

$\therefore$ p + q + λ = 3

51. 4.00

Sol. $f'(x) = \begin{Bmatrix} e^x & , & x < 0 \\ 1 & , & x = 0 \\ 1 & , & x > 0 \end{Bmatrix}$

$\Rightarrow S = f'(\ln 2) + f'\left(\ln\frac{1}{2}\right) + f'\left(\ln\frac{3}{2^2}\right) + ...\infty$

$\Rightarrow S = 1 + \frac{1}{2} + \frac{3}{2^2} + \frac{5}{2^3} + ...\infty$

$\Rightarrow$ S = 4