FIITJEE

ALL INDIA TEST SERIES

FULL TEST – II

JEE (Advanced)-2019

PAPER – 2

ANSWERS, HINTS & SOLUTIONS

Physics PART – I

SECTION – A

1. B

Sol. F_1 should be greater than F_2 therefore friction is towards right.
To balance torque about centre of mass normal shifted towards the right wall.

2. B

Sol. Tension in the string T = mg
Torque on the cylinder about the point of contact = 0

$$Mgr\sin\theta = mgr\left(1-\sin\theta\right)$$

$$m = \frac{M\sin\theta}{1-\sin\theta}$$

3. C

Sol. Work done by force = change in gravitational potential energy

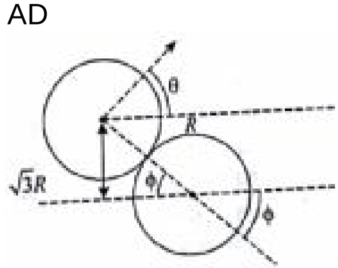
W = $m_0 \times \Delta V$

W = $GMm_0\left[\frac{1}{\sqrt{2}}-\frac{1}{\sqrt{5}}\right]$

4. AC

5. AD

Sol.



For elastic collision $\theta + \phi = 90^\circ$ and form figure we use

$\sin\theta = \sqrt{3}/2 \Rightarrow \theta = 60^\circ \text{ hence } \phi = 30^\circ$

6. ABCD

Sol. $a_t = \frac{dv}{dt} \Rightarrow a_r = v^2/R$ & $\vec{a}_{net} = \sqrt{a_t^2 + a_r^2}$

7. BC

Sol. $\text{e} = \text{B}_0 v_0 (2y) = 4B_0 v_0^{3/2}\sqrt{t}$

$$i = \frac{e}{\lambda(2y)} = \frac{Bv_0}{\lambda} \qquad where \Rightarrow y = \sqrt{4v_0 t}$$

$$F = \left(\frac{B_0 v_0}{\lambda}\right)(2y)B_0 = \frac{2B_0^2 v_0 y}{\lambda} = \frac{4B_0^2 v_0^{3/2}}{\lambda}\sqrt{t}$$

$$p = \vec{F}.\vec{v} = \frac{2B_0^2 v_0^2 y}{\lambda} = \frac{4B_0^2 v_0^{5/2}}{\lambda}\sqrt{t}$$

8. CD

Sol. Take torque of tension about IAOR it will first clockwise and then anticlockwise torque so it will come to rest after covering certain distance. When spool at rest at extreme right block will also be remain at rest but at same initial position (according to energy conservation)

9. A

Sol. $dQ = -dU$

$dQ = -nC_v dt$

$$\frac{dQ}{n \times dt} = -C_v = -5/2R$$

10. B

Sol. $dQ = dU + dW$

$-dU = dU + dW$

$-2dU = dW$

$-2n \times \frac{5}{2} RdT = pdV$

$-5nRdT = pdV$

$nRT = pV$

Dividing these equation we get $\int \frac{dV}{V} = \int -5\frac{dT}{T}$

Solving we get $TV^{1/5} = \text{constant}$

SECTION – C

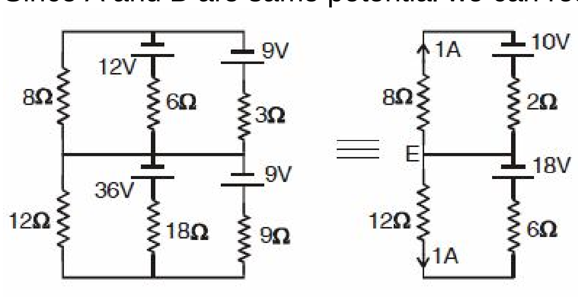
11. 1

Sol. $$W_{NA}+W_{NG}+W_G=\frac{1}{2}m_B V^2-0$$

$$W_{NA}+0+0=\frac{1}{2}(2)(1)^2-0=1$$

12. 1

Sol. Since A and B are same potential we can redraw the circuit as



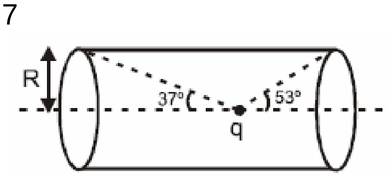
Hence current through 8Ω is 1A and

$$V_B-V_D=(V_B-V_E)+(V_E-V_D)=-8+12=4V$$

$$x+y=1+0=1$$

13. 7

Sol.



$$\phi=\frac{q}{\epsilon_0}\left(\frac{2\pi\left(1-\cos 37^o\right)}{4\pi}\right)-\frac{q}{\epsilon_0}\left(\frac{2\pi\left(1-\cos 53^o\right)}{4\pi}\right)$$

$$\phi=\frac{q}{\epsilon_0}\left[1-\frac{1}{2}\left(1-\frac{4}{5}\right)-\frac{1}{2}\left(1-\frac{3}{5}\right)\right]$$

$$\phi=\frac{q}{\epsilon_0}\left(1-\frac{1}{10}-\frac{2}{10}\right)=\frac{7q}{10\epsilon_0}$$

14. 6

Sol. $$X_{BF}=\mu\ell_1+\ell_2$$

$$\frac{dx_{BF}}{dt}=\frac{\mu d\ell_1}{dt}+\frac{d\ell_2}{dt}$$

$$V_{BF}=\frac{4}{3}(-8+2)+(4-2)$$

$$=\frac{4}{3}\times(-6)+2=-8+2=-6ms^{-1}$$

15. 5

Sol. The plate is free to rotate about vertical axis yy'.
Let v, v_{cm} *and* ω be the velocity of particle, velocity of centre of mass of plate and angular velocity of plate just after collision.
∴ From conservation of angular momentum about vertical axis passing through O is

$$mu\frac{a}{2}+\frac{ma^2}{3}\omega------(1)$$

Since the collision is elastic, the equation of coefficient of restitution is

$$e=\frac{v_{cm}-v}{u}=1--------(2)$$

But $v_{cm}=\frac{a\omega}{2}-----(3)$

Solving, equation (1), (2) and (3) we get

$$\omega=\frac{12}{7}\frac{u}{a}=5\,\text{rad/s}$$

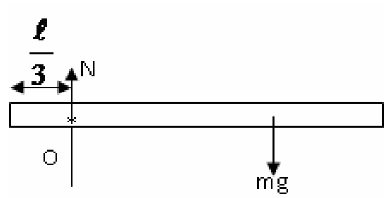
16. 4

Sol. $F=\frac{\sigma^2}{2\in_0}\times(\text{Projected area})$

$$F=\frac{\sigma^2}{2\in_0}\times\pi\left(\frac{R}{\sqrt{2}}\right)^2\Rightarrow\frac{\pi\sigma^2R^2}{4\in_0}$$

17. 3

Sol.



Taking torques about 'O'

$$\text{Mg}\times\frac{\ell}{6}=\left[\frac{1}{12}ml^2+\frac{Ml^2}{36}\right]\alpha$$

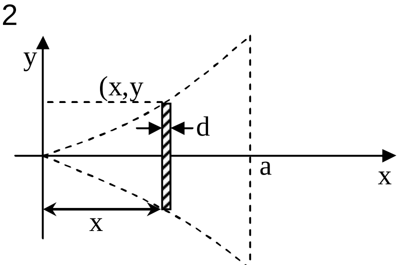
$$g=\left(\frac{1}{2}+\frac{1}{6}\right)l.\alpha\Rightarrow\alpha.l\Rightarrow\frac{3}{2}g$$

$$a_{cm}\Rightarrow\alpha\times\frac{\ell}{6}\Rightarrow\frac{g}{4}$$

$$\therefore N=mg-\frac{mg}{4}\Rightarrow\frac{3mg}{4},x=3$$

18. 2

Sol.



$$dI = \frac{1}{12} dm \times (2y)^2$$

$$dI = \frac{1}{12} (2y)^3 \, dx\rho$$

$$I = \frac{1}{12} \times 8\rho \times \int_0^a x^6 dx \Rightarrow I = \frac{2}{3} \times \frac{a^7 \rho}{7} = \frac{2a^7 \rho}{21}, N = 2$$

19. 4

Sol. $\frac{M}{L} = \frac{q}{2m}$

$\therefore M \Rightarrow \frac{e.L}{2m} \& L = \frac{nh}{2\pi}$

$\therefore M \Rightarrow \frac{nhe}{4\pi m}, k = 4$

20. 3

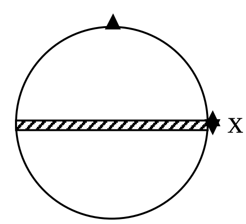
Sol. $F \Rightarrow \pi R^2 x.\rho g$

$\therefore \frac{d^2x}{dt^2} = -\frac{\pi R^2 x \rho g}{m}$

$m = \frac{2}{3}\pi R^3 \rho$

$\therefore \frac{d^2x}{dt^2} \Rightarrow \frac{-\pi R^2 x \rho}{2\pi R^3 \rho} \times 3g \Rightarrow \frac{-3xg}{2R}$

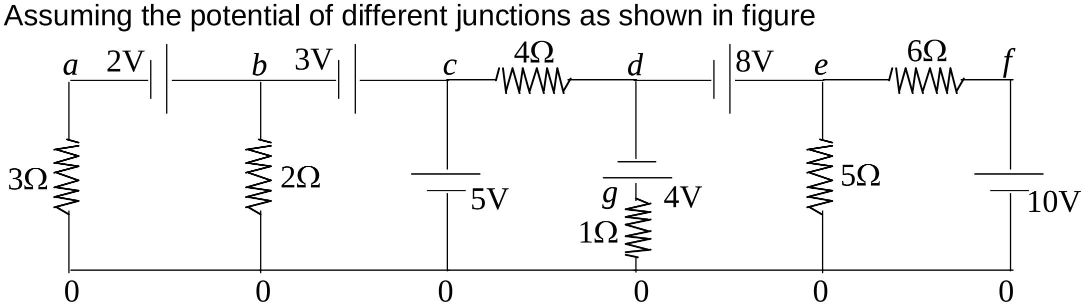
$\therefore x = \frac{1}{2\pi}\sqrt{\frac{3g}{2R}} \qquad , N = 3$



SECTION – D

21. 00001.52

Sol. Assuming the potential of different junctions as shown in figure



Using junction rule:

$\frac{x-5}{4} + \frac{4+x}{1} + i = 0 - - - (1)$

$i - \frac{(8+x)}{5} + \frac{(2-x)}{6} = 0 - - - (2)$

From (1) and (2)

$x = \frac{-482}{194}$

So current through $1\Omega = 4 - \frac{482}{194} = 1.52\,\text{ampere}$

22. 00001.12

Sol. $\mathrm{k_{eq}} = \frac{16k}{5} \Rightarrow T = 2\pi\sqrt{\frac{m}{k_{eq}}} = 1.12\,\text{seconds}$

23. 00019.20

Sol. $v + u = 120 --- (1)$

$\frac{v^2}{u^2} = \frac{1}{16} \Rightarrow \frac{v}{u} = \frac{1}{4} --- (2)$

$\Rightarrow v = 24 \; and \; u = 96$

$\Rightarrow \frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{24} + \frac{1}{96}$

$\Rightarrow f = 19.2\,\text{cm}$

Chemistry PART – II

SECTION – A

24. A

Sol. In option (A) all methyl groups are equatorial

25. A

Sol. Due to back bonding (A) is a weaker base.

26. B

Sol. $Fe(CO)_x$

$26-0+2x=36(EAN)$

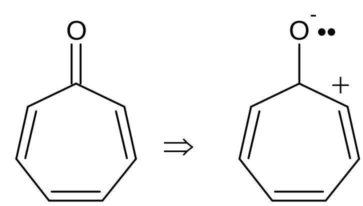
$x=5$

27. BC

Sol.

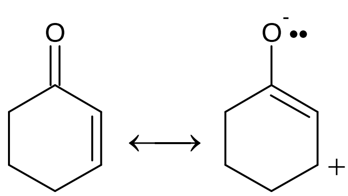
(A)

(B)

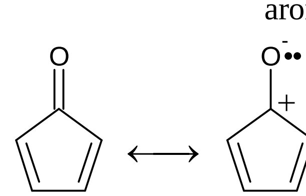


aromatic

(C)



(D)



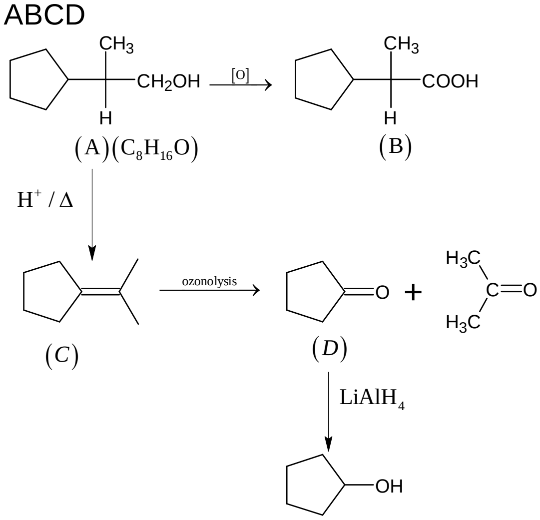
anti aromatic

28. ABCD

29. ABC

30. ABCD

Sol.



31. AD
Sol. Chiral molecules do not have plane of symmetry

32. B
Sol. $P_4(s) \longrightarrow P_4(g) \quad \Delta H = 59 KJ$ b

$P_4(s) \longrightarrow 4P(g) \quad \Delta H = 1265 KJ$

$P_4(g) \longrightarrow 4P(g) \quad \Delta H = 1206 KJ$

Average P-P bond enthalpy $= \frac{1206}{6} = 201 KJ$

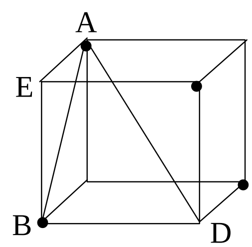
33. C
Sol. On an average, one $P-P$ bond of tetrahedral is broken and one new $P-P$ bond joining the two tetrahedral units is formed.

$201 - x = -104$

$\therefore x = 305\, KJ\, mol^{-1}$

SECTION – C

34. 6
Sol.



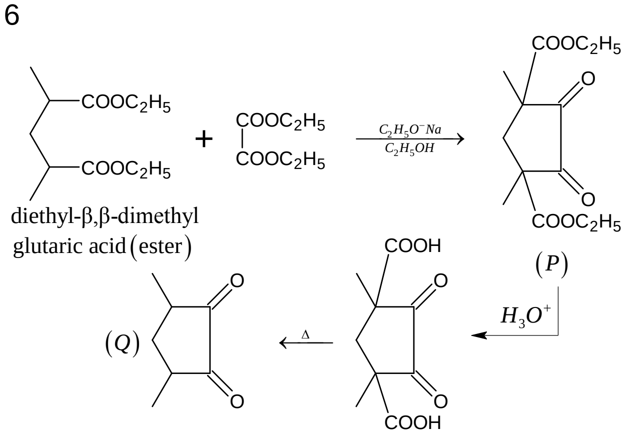
Face diagonal of cube $(AB) = 2R$

Edge length of cube $(BE) = \frac{2R}{\sqrt{2}}$

Body diagonal of cube $(AD) = \sqrt{3} \times \frac{2R}{\sqrt{2}} \Rightarrow \sqrt{6} \times R$

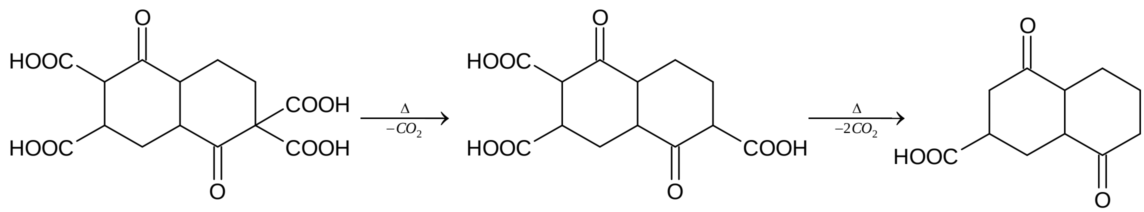
35. 7
Sol. It will be neutral solution.

36. 6
Sol.



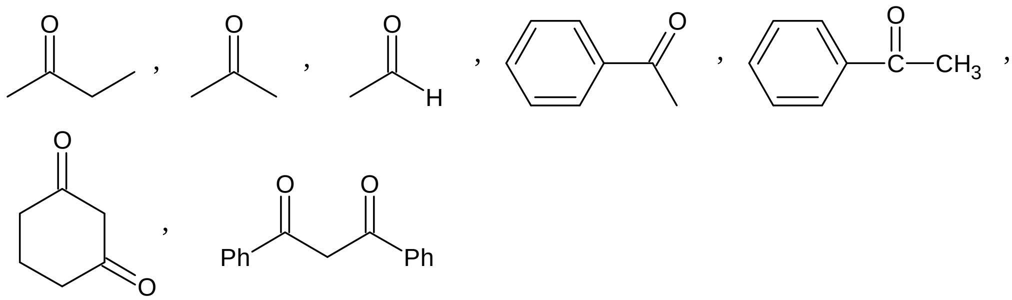
37. 3

Sol.



38. 6

Sol. These compounds will give iodoform test



39. 5

Sol. $Mg^{2+} + 2e^- \longrightarrow Mg\left(E_{Mg} = \frac{24}{2} = 12g\right)$

Charge required for the deposition of $12g\,Mg=1F$

Charge required for the deposition of $1g\,Mg=\frac{1}{12}F$

$\therefore$ cost for $\frac{F}{12}$charge=Rs.5

$Al^{3+} + 3e^- \longrightarrow Al\left(E_{Al} = \frac{27}{3} = 9g\right)$

Charge required for $9g = 1F$

Charge required for $30g = \frac{30}{9}F = \frac{10F}{3}$

Cost for $\frac{10F}{3}$charge$=5\times12\times\frac{10F}{3} \Rightarrow Rs.200$

40. 8

Sol. $(CO)_{x/2}\,Co\text{-}Co(CO)_{x/2}$

$EAN(=36)=27+1+2\times\frac{x}{2}$

$\Rightarrow 28 + x = 36 \Rightarrow x = 8$

41. 1

Sol. The unit cell which is formed in this arrangement will be SCC.

42. 7

Sol. $64g\ \ CaC_2$ gives $28g$ polythene

43. 3

Sol. Balanced equation is

$$3M^{x+} + Cr_2O_7^{2-} \longrightarrow 3MO_3^- + 2Cr^{3+} + 4H^+ \Rightarrow x = 3$$

SECTION – D

44. 00004.90

Sol. $2K_2Cr_2O_7 + 6H_2C_2O_4 \longrightarrow 4Cr^{3+} + 12CO_2$

$n = 6 \qquad n = 2 \qquad\qquad \downarrow$

$n_{K_2Cr_2O_7} = 0.1/6 \qquad\qquad n_{CO_2} = 4.4/44 = 0.1\,\text{mole}$

$$mass\,of\ K_2Cr_2O_7 = \frac{1}{60} \times 294 \Rightarrow 4.9g$$

45. 00000.60

46. 00000.50

Sol. $$d = \frac{1 \times 1000}{2 \times 10^{24} \times \left(a \times 10^{-8}\right)^3} = 4$$

$$\left(a \times 10^{-8}\right)^3 = \frac{10^{-21}}{8}$$

$$a \times 10^{-8} = \frac{10^{-7}}{2} \Rightarrow a = 5\mathring{A}$$

Mathematics PART – III

SECTION – A

47. A

Sol. $\frac{3f''(x)}{f'(x)} = \frac{f'''(x)}{f''(x)}$

$\Rightarrow 3\ln f'(x) = \ln f''(x) + k$

$\Rightarrow \frac{d^2x}{dy^2} = c$

48. D

Sol. Let $I=\int_0^3 \frac{f(x)dx}{(x^2-3x+1)}$.............(1)

$I=\int_0^3 \frac{f(3-x)}{(x^2-3x+1)}$.............(2)

$(1)+(2) \Rightarrow 2I=3$

$I=\frac{3}{2}$

49. C

Sol. $V_n=2a_{n+2}+S_n$

$=2[-4+(n+1)]+\frac{n}{2}[-8+(n-1)]$

$=\frac{n^2-5n-12}{2}$

V_n is minimum at n=2 or n=3

$\Rightarrow$ Minimum value of V_n is -9

50. BD
51. D

52. BCD

Sol. $p(n) =$ Probability that child stops after drawing exactly n marbles

$p(n) = \frac{1}{2}.\frac{2}{3}.\frac{3}{4}.......\left(\frac{n-1}{n}\right)\left(\frac{1}{n+1}\right) = \frac{1}{n(n+1)}$

53. ABCD

Sol. $x^3+2x^2-3x+1=0\begin{cases}\alpha\\ \beta\\ \gamma\end{cases}$

$$x^3-3x^2-2x+1=0\begin{cases}1/\alpha\\1/\beta\\1/\gamma\end{cases}$$

Given expression $\dfrac{1}{3-\frac{1}{\alpha}}+\dfrac{1}{3-\frac{1}{\beta}}+\dfrac{1}{3-\frac{1}{\gamma}}$

$$=\frac{\sum\left(3-\frac{1}{\alpha}\right)\left(3-\frac{1}{\beta}\right)}{\left(3-\frac{1}{\alpha}\right)\left(3-\frac{1}{\beta}\right)\left(3-\frac{1}{\gamma}\right)}=\frac{27-6\sum\left[\frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma}\right]+\frac{1}{\alpha\beta}+\frac{1}{\beta\gamma}+\frac{1}{\gamma\alpha}}{\left(3-\frac{1}{\alpha}\right)\left(3-\frac{1}{\beta}\right)\left(3-\frac{1}{\gamma}\right)}=\frac{11}{7}$$

54. ABC

Sol. $3x^2\dfrac{dx}{dy}=\dfrac{x^3}{x^3-y}$ $\quad x^3=t$

$\Rightarrow \dfrac{dt}{dy}=\dfrac{t}{t-y}$ $\quad\Rightarrow (t-y)dt=t\,dy$

$\Rightarrow t\,dt=y\,dt+t\,dt\Rightarrow \dfrac{t^2}{2}=t.y+\dfrac{c}{2}$

$\Rightarrow x^6=2x^3y+c$

55. A

Sol. For $\lambda=10\Rightarrow t_1=2,\ t_2>2$ and if $x+1/x=2\Rightarrow x=1$ and $x+1/x=t_2$ so there will be two distinct values of x

56. B

Sol. Since domain of $f(t)=2t^3-9t^2+30,\ t=x+1/x,\ |t|\geq 2\, f(-2)=-22,\ f(2)=10,$ critical points at $t=0\,\&\,3;\ f(3)=3$

SECTION – C

57. 2
58. 0
59. 6
60. 3
61. 4
62. 8

Sol. The triangle has circumcentre at origin and its orthocentre laying on the circumcircle.

63. 5

Sol. $\displaystyle\lim_{y\to 1}\frac{100y^{100}}{y^{100}-1}-\frac{50.y^{50}}{y^{50}-1}$

$$\lim_{y\to 1} 100-50-\left(\frac{100}{1-y^{100}}-\frac{50}{1-y^{50}}\right)$$

L=50-L $\therefore$ L=$\frac{50}{2}=25$

64. 1

Sol. $T_n=\frac{H_{n+1}\text{-}H_n}{H_nH_{n+1}}$

As $H_{n+1}\text{-}H_n=\frac{1}{n+1}$

$\Rightarrow T_n=\frac{1}{H_n}-\frac{1}{H_{n+1}}$

$\Rightarrow T_1=\frac{1}{H_1}-\frac{1}{H_2}$

$T_2=\frac{1}{H_2}-\frac{1}{H_3}$

$\vdots \quad \vdots \quad \vdots$

$T_n=\frac{1}{H_n}-\frac{1}{H_{n+1}}$

$T_1+T_2+...+T_n=\frac{1}{H_1}-\frac{1}{H_{n+1}}$

As $n\to\infty$, $T_1+T_2+...+0=1$

65. 7

Sol. Clearly a team of 4 with two batsman and two bowler can be formed as

Case-I: 2 bowler+2batsman

Number of ways=${}^4C_2\times{}^4C_2=36$

Case-II: 2 bowler+1 batsman +1 all-rounder

${}^4C_2\times{}^4C_1\times{}^1C_1=24$

Case-III: 1bowler +2 batsman +1 all-rounder

${}^4C_1\times{}^4C_2\times{}^1C_1=24$

$\therefore$ Probability that all-rounder is selected=$\frac{24+24}{36+24+24}=\frac{4}{7}$

$\therefore$ $p=7$

66. 5

SECTION – D

67. 00000.32

68. 00031.00

Sol. $\dfrac{(x-3)^{\frac{-|x|}{x}}\sqrt{(x-4)^2}\,(17-x)}{\sqrt{-x}\,(-x^2+x-1)(|x|-32)}<0$

For $\sqrt{-x}$ to be defined $x<0$

$\Rightarrow \dfrac{-|x|}{x}=1$

Since $\sqrt{(x-4)^2}, \sqrt{-x}$ are positive & $-x^2+x-1$ is always negative

$\dfrac{(x-3)(x-17)}{x+32}>0$

$x<0$

$\Rightarrow \dfrac{1}{x+32}>0 \Rightarrow x=31$

69. 00833.33

Sol. $\because \int_a^x e^{f(t)}dt=\int_0^x g(x-t)dt+2x+3$

$\Rightarrow \int_a^x e^{f(t)}dt=\int_0^x g(t)dt+2x+3$ (Using King Property)

Differential both sides, we get

$e^{f(x)}=g(x)+2$

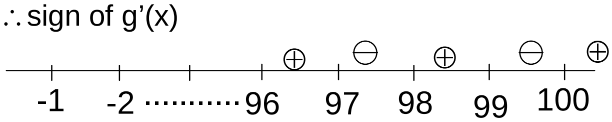
$\Rightarrow g(x)=e^{f(x)}-2$

$\Rightarrow g'(x)=e^{f(x)}.f'(x)$

$\because e^{f(x)}$ is always greater than zero.

$\therefore$ sign of g'(x) is same as sign of $f'(x)$.

$\therefore$ sign of g'(x)



Clearly, local extremum (maximum or minimum) will occur at x=99,97,95,….,3,1

$\therefore$ Sum of all the values=1+3+5+…+99=$\dfrac{50}{2}[2\times1+(50-1)\times2]=2500$