FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2024
FULL TEST – I
PAPER –2
TEST DATE: 28-12-2023

ANSWERS, HINTS & SOLUTIONS

Physics

PART – I

SECTION – A

1. B

Sol. $\left(\frac{\in_0 klx}{d}+\frac{\in_0 (2A-lx)}{d}\right)V=Q$

$i=\left(\frac{\in_0 klx}{d}+\frac{-\in_0 l}{d}\right)\frac{dx}{dt}=\text{constant}$

As the dielectric levels $c\downarrow \Rightarrow Q\downarrow \Rightarrow i$ is $-$ ve

2. B

Sol. $F_1=F_B-(\pi a^2)\rho gh$

$F_2=F_B-(\pi a^2)\rho g(2h)$

3. A

4. A

Sol. $M_1 g\sin\theta > \frac{M_1 g\cos\theta}{5}$

M_1 will slip if $\tan\theta > \frac{1}{5}$

$M_2 g\sin\theta' + \frac{M_1 g\sin\theta'}{5} > \frac{1}{2}M_2 g\cos\theta'$

M_2 will slip if $\tan\theta' > \frac{1}{2+\frac{2}{5}\frac{M_1}{M_2}}$

So M_1 will slip first

5. ABD

6. AC

Sol. Equivalent diagram is as shown in P is moved 2 cm right them R_1=12, R_3=3

$\frac{R_1}{R_2}=\frac{R_2}{R_4}\left(\text{Hence wheat stone will be balanced}\right)$

If s is moved left $\frac{5}{3}cm$ then $R_4=\frac{20}{3}$ hence $\frac{R_1}{R_3}=\frac{R_2}{R_4}$ (hence wheat stone will be balanced)

7. BC

SECTION – B

8. 2

Sol. $P=700\times10^3\times1.6\times10^{-19}\times\frac{dn}{dt}=10\times10^{-3}$

$\frac{dN}{dt}=\frac{10^{-1}}{10^{-14}}\times\frac{1}{7\times16}=\frac{10^{12}}{11.2}=\lambda N_0$

$\lambda=\frac{\ln 2}{14\times86400}\Rightarrow N_0=\frac{14\times86400\times10^{12}}{11.2\ln 2}=154\times10^{15}$

9. 2

Sol. $\tau_1=RC$

$\tau_2=\frac{L}{R}$

$\Rightarrow LC=t_1t_2=0.1\text{sec}$

$\Rightarrow T=2\pi\sqrt{LC}=2\pi\sqrt{\frac{1}{10}}=2\text{sec}$

10. 6

Sol. By linear momentum conservation impulse (J) = mV.

By angular momentum conservation, angular impulse $=J\frac{\lambda}{2}=I\omega$

So $mv\frac{\lambda}{2}=I\omega$ or $\omega=\frac{mv\lambda}{2I}=\frac{mv\lambda}{2\left(\frac{m\lambda^2}{12}\right)}=\frac{6v}{\lambda}=6\,rad/s$

11. 9

Sol. $y=\frac{1/A}{x/\ell}.....(1)$

$y=\frac{F/3A}{x/3\ell}.....(2)\Rightarrow F=9N$

12. 3

13. 4

Sol. $y = 2x^2, \frac{dy}{dx} = 4x, \frac{d^2y}{dx^2} = 4$

$r = \frac{1+16x^2}{4} \Rightarrow at\ x = 0, r = \frac{1}{4}$

$r = \frac{mv}{qB} \Rightarrow B = \frac{mV}{qr} = 4$

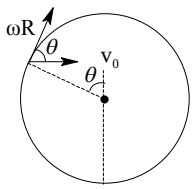
SECTION – C

14. 4.50

15. 2.25

16. 31.25

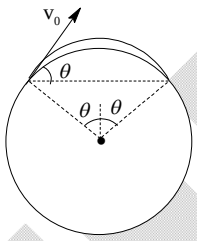
Sol. $v_y = \omega R \sin\theta = v_0 \sin\theta$



$h_{max} = \frac{(v_0 \sin\theta)^2}{2g} + R + R\cos\theta \Rightarrow \frac{dh}{d\theta} = 0$

17. 31.25

Sol. from frame of wheel



$Range = 2R\sin\theta = \frac{v_0^2 \times 2\sin\theta\cos\theta}{g} \Rightarrow \cos\theta = \frac{Rg}{v_0^2} = \frac{1}{4}$

Chemistry

PART – II

SECTION – A

18. B

Sol. Distance b/w corner and centre of tetrahedral void is $2r\left(=\frac{\sqrt{3}}{4}a\right)$

19. D

Sol. Alcohols are less acidic than H_2CO_3

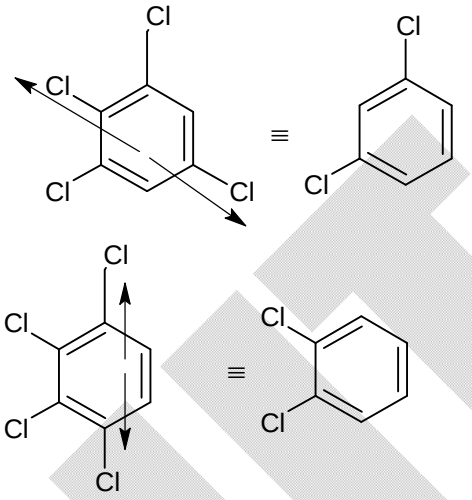
20. A

Sol. $\frac{hc}{\lambda}=w_0+eV_1$

$\frac{2hc}{\lambda}=w_0+eV_2$

21. C

Sol.



22. ABCD

23. AD

Sol. Chiral molecules do not have plane of symmetry.

24. AD

Sol. BaO_2 and Na_2O_2 are peroxides.

SECTION – B

25. 4

Sol. $pKa\,of\ HX=14-10=4$

$pH=pK_a+\log\frac{1}{1}=4$

26. 8

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

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

$\Rightarrow 28+x=36$

$x=8$

27. 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$=5\times12\times\frac{10F}{3}$

$=Rs.200$

28. 5

Sol. $K_{In}=\frac{\left[H^{+}\right]\left[I_n^{-}\right]}{\left[HI_n\right]}$

$=10^{-9.18}\times\frac{0.6}{0.4}$

$=\frac{3}{2}\times10^{-9.18}$

$K_{In}=10^{-9}\frac{\left[In^{-}\right]}{\left[HI_n\right]}$

$K_{In}=\frac{3}{2}\times10^{-9.18}=10^{-9}\times\frac{\alpha}{1-\alpha}$

$\frac{3}{2}\times0.66=\frac{\alpha}{1-\alpha}$

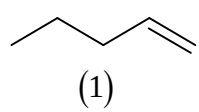
$$\frac{\alpha}{1-\alpha}=1$$
$$2\alpha=1$$
$$\alpha=0.5$$

29. 4

Sol. d, e, f, g are correct and Colloid is +ve.

30. 9

Sol.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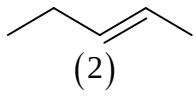
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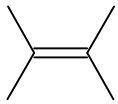
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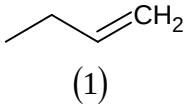

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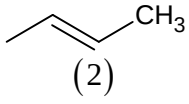

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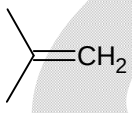

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SECTION – C

31. 73.20

Sol. $(P)(V)=\left(n_{H_2O-Vap}\right)(R)(T)$

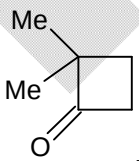
$$n_{H_2O-Vap}=\frac{\frac{32}{760}\times 76}{0.0821\times 320}=0.122 \text{ mole}$$

$$\%\text{ of water vaporized}=\frac{0.122\times 18}{3}\times 100=73\%$$

32. 103.80 - 104.0

Sol. $$V=\frac{(n)(R)(T)}{(P)}=\frac{\left(\frac{3}{18}\right)(0.0821)(320)}{\left(\frac{32}{760}\right)}=104\,L$$

33. 17.00

Sol. Compound B is 

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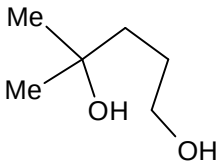
$C_6H_{10}O_1$

34. 118.00

Sol. The compound (D) is 

$C_6H_{14}O_2$

Mathematics

PART – III

SECTION – A

35. A

Sol. E_1 "No card is king from removed cards"
E_2 "1 card is king from removed cards"
E_3 "2 card is king from removed cards"
E_3 "3 card is king from removed cards"
E_4 "4 card is king from removed cards"
E_5 "5 card is king from removed cards"
F = 3 cards are drawn from pack those are kings.

$$P(F) = \sum_{i=1}^{S} P(E_i).P\left(\frac{F}{E_i}\right) = \frac{1}{(13)(17)(25)}$$

36. A

Sol. $f(f(x)) = x$

$$f_{2008}(x) + f_{2009}(x) = x + f(x) = x + \frac{3x+5}{2x-3} = \frac{2x^2+5}{2x-3}$$

37. C

Sol. $\frac{\text{Total} - \text{Row1} - \text{Row2}}{\lfloor 2} \{\lfloor 2 \text{ for N}\}$

$$\frac{{}^8C_5 \lfloor 6 - \lfloor 6 - \lfloor 6}{\lfloor 2}$$

38. B

Sol. $f(b) = \left|\sin x + \frac{2}{3+\sin x} + b\right| \forall\, x \in R$

$\sin x = t$

$g(t) = t + \frac{3}{3+t}$ $\quad t \in [-1, 1]$

$g'(t) = 1 - \frac{2}{(3+t)^2} > 0$

$(3 + t)^2 - 2 > 0$

$g(t) = t + \frac{2}{3+1}$ increasing $\forall \in [-1, 1]$

$g(t)_{max} = 3/2$

$g(t)_{min} = 0$

$$f(b) = \begin{vmatrix} \frac{3}{2} + b \\ -b \end{vmatrix} \quad \text{if } b \geq -\frac{3}{4}$$

$$b < -\frac{3}{4}$$

$$\text{min of } f(b) = -\left(\frac{-3}{4}\right) = \frac{3}{4}$$

39. AB

Sol. $T_n = \sum_{r=2n}^{3n-1} \frac{(r/n)}{1+(r/n)^2},\ S_n = \sum_{r=2n+1}^{3n} \frac{(r/n)}{r^2+(r/n)^2}$

Let $f(x) = x/(1+x^2)$

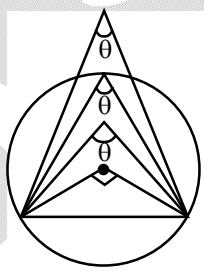
$f'(x) = \frac{(1+x^2)-2x^2}{(1+x^2)^2} = \frac{1-x^2}{(1+x^2)^2}$

$\therefore$ f(x) is decreasing in (2, 3)

$T_n > \int_2^3 f(x)dx,\ S_n < \int_2^3 f(x)dx$

40. BCD

Sol. (A) If $\arg\left(\frac{z_1}{z_2}\right) = \frac{\pi}{2}$ then z_1 and z_2 subtend right-angle at circumcentre origin.



$\therefore$ The chord joining z_1 and z_2 subtend right-angle at circumcentre origin.

$$\begin{cases} \theta = \pi/4 & \text{if} \quad |z| = 1 \\ \theta = \pi/4 & \text{if} \quad |z| > 1 \\ \theta = \pi/4 & \text{if} \quad |z| < 1 \end{cases}$$

(B) $|z_1z_2 + z_2z_3 + z_3z_1| = |z_1+z_2+z_3| = |z_1|.|z_2|.|z_3|\left|\frac{1}{z_1}+\frac{1}{z_2}+\frac{1}{z_3}\right| = \overline{|z_1+z_2+z_3|}$

(C) $\left(\frac{(z_1+z_2)(z_2+z_3)(z_3+z_1)}{z_1\cdot z_2\cdot z_3}\right) = \left(\overline{\frac{(z_1+z_2)(z_2+z_3)(z_3+z_1)}{z_1z_2z_3}}\right)$

(D) The triangle formed by joining z_1, z_2 and z_3 is isosceles and right angled at z_3.

41. BC

Sol. Let $\sqrt{x} = \cos 2\theta$

$dx = -\sin 4\theta\, d\theta$

$I = \int_0^{\pi/4} \cot\theta \sin 4\theta d\theta$ and $J = \int_0^{\pi/4} \tan\theta \sin 4\theta d\theta$

SECTION – B

42. 1

Sol. $\lim_{t\to x+1} \frac{t^2 f(x+1) - (x+1)^2 f(t)}{f(t) - f(x+1)} = 1$

$\Rightarrow \lim_{t\to x+1} \frac{2tf(x+1) - (x+1)^2 f(t)}{f'(t)} = 1$

$\Rightarrow$ $[x + 1][2f(x + 1) - (x + 1) f'(x + 1)] = f'(x + 1)$

$\Rightarrow$ $f'(x) = \frac{2xf(x)}{x^2+1}$

$\Rightarrow$ $f(x) = x^2 + 1$

$$\lim_{x\to1}\frac{\ln(f(x))-\ln 2}{x-1} = \lim_{x\to1}\frac{f'(f(x))}{f(x)} = 1$$

43. 182

Sol. $2x^2+5x+7=0$ has non-real roots $\frac{a}{2}=\frac{b}{5}=\frac{c}{7}$

Min. value of a + b + c = 2 + 5 + 7 = 14
Max. value of a + b + c = 28 + 70 + 98 = 196
(Max. – Min) = 196-14 = 182

44. 6

Sol. $15^2 + (15 + d)^2 + (15+ 2d)^2 + \ldots + (15 + 9d)^2 = 1185$

$\Rightarrow 19d^2 + 90d + 71 = 0$

$\Rightarrow S_n \geq S_{n-1}$

$$\frac{n}{2}(31-n)\geq\left(\frac{n-1}{2}\right)(32-n)\Rightarrow n\leq 16$$

45. 8

Sol. $2\sin^2 x + \sin^2 2x = 2$

$2\sin^4 x - 3\sin^2 x + 1 = 0 \Rightarrow (3\sin^2 x - 1)(\sin^2 x - 1) = 0$

$\sin 2x + \cos 2x = \tan x$

$2\tan x + 1 + 2\tan^2 x = \tan x(1 + \tan^2 x)$

$\Rightarrow 2\cos^2 x + \sin x \leq 2$

$\Rightarrow 2\sin^2 x - \sin x \geq 0$

$\Rightarrow \sin x (2\sin x - 1) \geq 0$

46. 5

Sol. Line L is the shortest distance line of given lines.

47. 8

Sol. $f(2 - x) = f(2 + x)$, it means it symmetric about $x = 2 \Rightarrow \int_0^2 f(x)dx = \int_2^4 f(x)dx = 5$

Let $2 - x = t$; $f(t) = f(4 - t)$ i.e., $f(x) = f(4 - x) = f(4 + x)$

$$\int_0^{50} f(x)dx = 25\left(\int_0^2 f(x)dx\right) = 25\times 5 = 125$$

SECTION – C

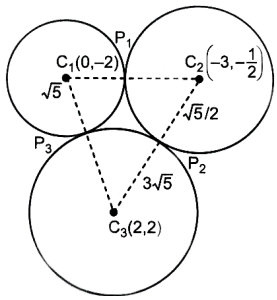
48. 0.63

49. 7.75

Sol. (Q.48-49):

$P_2\left(-\frac{16}{7}, -\frac{1}{7}\right)$

$P_3\left(\frac{1}{2}, -1\right)$



50. 0.75

51. 0.75

Sol. (Q.50-51)

$f'(x) = x^2 + xg'(1)$

$f''(x) = 2$

$f'(1) = 2 - 3 = -1$

$f(x) = x^2 - 3x$

$g'(1) = -2x^2 + x(2x - 3) + 2$

$= -3x + 2$

$f(1) + g(-1) = -2 + (3 + 2) = 3$

$g'(1) = 2f(1) + 2 + f'(1)$

$\Rightarrow f(1) = -2$

$\Rightarrow g''(2) = 2(-2) + 2(2) = 0$

$-2 = 1 + g'(1)$

$g'(1) = -3$