Test Booklet Code

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JEE Main – 2018
Answers & Explanations

Maths				Physics				Chemistry			
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5	1	**20**	4	**35**	4	**50**	4	**65**	4	**80**	1
6	2	**21**	3	**36**	2	**51**	2	**66**	1	**81**	2
7	3	**22**	3	**37**	3	**52**	2	**67**	4	**82**	4
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11	4	**26**	3	**41**	3	**56**	3	**71**	4	**86**	3
12	1	**27**	4	**42**	4	**57**	1	**72**	4	**87**	4
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PART A – MATHS

1. 1 $y^2 = 6x,\ 9x^2 + by^2 = 16$

Let curves intersect at (α, β), Slopes of tangents at (α, β) be m_1, m_2

$$m_1 = \frac{3}{\beta},\ m_2 = -\frac{9\alpha}{b\beta},$$

$m_1 m_2 = -1 \Rightarrow 27\alpha = b\beta^2$ given $\beta^2 = 6\alpha$

$$b = \frac{27}{6} = \frac{9}{2}$$

2. 2 $\vec{u} = \alpha\vec{a}\times(\vec{a}\times\vec{b}) = \alpha\left[(\vec{a}.\vec{b})\vec{a} - (\vec{a}.\vec{a})\vec{b}\right]$

$= \alpha\left[2(2\hat{i}+3\hat{j}-\hat{k}) - 14(\hat{j}+\hat{k})\right]$

$= \alpha\left[4\hat{i}-8\hat{j}-16\hat{k}\right] = 4\alpha\left[\hat{i}-2\hat{j}-4\hat{k}\right]$

$\vec{u}.\vec{b} = 4\alpha.(-b) = -24\alpha \Rightarrow \alpha = -1$

$\therefore\ \vec{u} = -4\hat{i}+3\hat{j}+16\hat{k}$

$|\vec{u}|^2 = 336$

3. 4 $[x] \le x$ and $[x] = x$ if $x \in I$

$$\lim_{x\to 0^+} x\left(\left[\frac{1}{x}\right] + \ldots\ldots + \left[\frac{15}{x}\right]\right)$$

$$= \lim_{x\to 0^+} x\left(\frac{1}{x} + \frac{2}{x} + \ldots\ldots\frac{15}{x}\right)$$

$$- \lim_{x\to 0^+} x\left\{\frac{1}{x}\right\} + \left\{\frac{2}{x}\right\} + \ldots\ldots\left\{\frac{15}{x}\right\}$$

$= 120 - 0$

4. 3 Normal to plane is $(\vec{a}+\vec{b})+(\vec{c}+\vec{d})$

$= (\vec{a}\ \vec{b}\ \vec{d})\vec{c} - (\vec{a}\ \vec{b}\ \vec{c})\vec{d}$

$= 2(\hat{i}+2\hat{j}-\hat{k}) - 3(3\hat{i}-\hat{j}+2\hat{k})$

$= -7\hat{i}+7\hat{j}-8\hat{k}$

Solving the 2 planes one of the point of intersection is (0, 5, 4)

Equation of required plane is $7x - 7y + 8t + 3 = 0$

Distance of plane from origin =

$$\frac{3}{\sqrt{162}} = \frac{1}{\sqrt{18}}$$

5. 1 $I = \int_{-\pi/2}^{\pi/2} \frac{\sin^2 x}{1+2^x}dx$

$$= \int_{-\pi/2}^{\pi/2}\left(\frac{\sin^2 x}{1+2^x} + \frac{\sin^2(-x)}{1+2^{-x}}\right)dx$$

$$= \int_0^{\pi/2}\sin^2 x\,dx = \frac{\pi}{4}$$

6. 2 Solving We get

$\alpha = \frac{\pi}{6},\ \beta = \frac{\pi}{3}$

$gof(x) = \cos x$

$$\text{Area} = \int_{\pi/6}^{\pi/3}\cos x\,dx = \frac{\sqrt{3}-1}{2}$$

7. 3 $8\cos x[\cos^2\frac{\pi}{6} - \sin^2 x - \frac{1}{2}] = 1$

$8\cos x(\frac{1}{4} - \sin^2 x) = 1$

$2\cos x\,(4\cos^2 x - 3) = 1$

$\cos 3x = \frac{1}{2} \Rightarrow 3x = 2x\pi \pm \frac{\pi}{3}$

$x = \frac{2x\pi}{3} \pm \frac{\pi}{9}$; Sum $= \frac{13\pi}{9}$

8. 1 $h(x) = \dfrac{f(x)}{g(x)} = \dfrac{x^2 + \frac{1}{x^2}}{x - \frac{1}{x}} = \dfrac{\left(x - \frac{1}{x}\right)^2 + 2}{\left(x - \frac{1}{x}\right)}$

$= \left(x - \frac{1}{x}\right) + \dfrac{2}{x - \frac{1}{x}}$

Let $x - \frac{1}{x} = t$

$f(t) = t + \frac{2}{t} \Rightarrow F'(t) = 1 - \frac{2}{t^2} = \frac{t^2 - 2}{t^2}$

which is minimum at $t = \sqrt{2}$

$\therefore$ Local minimum $= 2\sqrt{2}$

9. 3 Divide numerator & denominator with $\cos^{10} x$

$$\int \frac{\tan^2 x.\sec^6 x}{\left(\tan^5 x + \tan^2 x + \tan^3 x + 1\right)^2} dx$$

Let $\tan x = t$

$$\int \frac{t^2.\left(1+t^2\right)^2}{\left[\left(1+t^3\right).\left(1+t^2\right)\right]^2} dt = \int \frac{t^2}{\left(1+t^3\right)^2} dt$$

$$= \frac{-1}{3\left(1+t^3\right)} + c = \frac{-1}{3\left(1+\tan^3 n\right)} + c$$

10. 3 P(Ball in red) = $P(R_1).P(R_2/R_1) + P(B_1).P(R_2/B_1)$

$= \frac{4}{10}.\frac{6}{12} + \frac{6}{10}.\frac{4}{12} = \frac{2}{5}$

11. 4 $B = \dfrac{2C + A}{3} \Rightarrow C = \dfrac{3B - A}{2}$

$= (6, 2)$

$r = \frac{1}{2}AC$

$= \frac{1}{2}\sqrt{90} = 3\sqrt{\frac{5}{2}}$

12. 1 Tangent at (1, 7) is

$2x - y + 5 = 0$

Centre (–8, –6),

radius (r) = $\sqrt{64 + 36 - c} = \sqrt{100 - c}$

Perpendicular distance of center from tangent

$\left|\dfrac{-16 + 6 + 5}{\sqrt{5}}\right| = \sqrt{100 - c}$

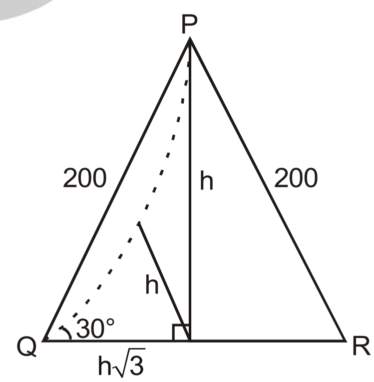
$c = 95$

13. 4 $\alpha = -w$, $\beta = -w^2$

$\alpha^{101} + \beta^{107} = -[w^{101} + w^{214}]$

$= -(w^2 + w) = -(-1) = 1$

14. 2 PQ = 2h = 200



$\Rightarrow h = 100$

15. 4 $\sum_{i=1}^{9}(xi - 5) = 9$

$\Rightarrow \sum_{i=1}^{9} xi = 54 \Rightarrow \frac{1}{9}\sum_{i=1}^{9} xi = 6 = \overline{x}$

$\sum_{i=1}^{9}(xi - 5)^2 = 45$

$$\Rightarrow \sum_{i=1}^{9} xi^2 - 10(54) + 25(9) = 45$$

$$\Rightarrow \frac{1}{9}\sum_{i=1}^{9} xi^2 = 40$$

Standard Deviation = $\sqrt{\left(\frac{1}{9}\sum xi^2 - \bar{x}^2\right)} = 2$

16. 1 $(a + b)^5 + (a - b)^5$
$= 2[{}^5C_0 a^5 + {}^5C_2\, a^3b^2 + {}^5C_4\, ab^2]$

$$\left(x + \sqrt{x^3 - 1}\right)^5 + \left(x - \sqrt{x^3 - 1}\right)^5$$

$= 2[x^3 + 10x^3(x^3 - 1) + 5\,(x^3 - 1)^2]$
$= 2[x^3 + (10x^6 - 10x^3) + 5x(x^6 - 2x^3 + 1)]$

17. 2 For point T(0, 3) Chord of contact is
PQ: $0 - 3y = 36$
$\Rightarrow y = -12$, Solving with hyperbola
We get $P\left(-\sqrt{45}, -12\right)$ & $Q\left(\sqrt{45}, -12\right)$

Area = $\frac{1}{2}.2\sqrt{45}.15 = 45\sqrt{5}$

18. 2 ${}^6C_4 \,.\, {}^3C_1 \,.\, 4! = 15.3.24 = 1080$

19. 3 $\begin{vmatrix} 1 & K & 3 \\ 3 & K & -2 \\ 2 & 4 & -3 \end{vmatrix} = 0 \quad \Rightarrow K = 11$

Now solving equation we get

$x = \frac{5z}{2}, y = -\frac{z}{2}$

$\frac{xz}{y^2} = 10$

20. 4 Put x = 0, $\begin{vmatrix} -4 & 0 & 0 \\ 0 & -4 & 0 \\ 0 & 0 & -4 \end{vmatrix} = A^3 \Rightarrow A = -4$

Put x = 4, $\begin{vmatrix} 0 & 8 & 8 \\ 8 & 0 & 8 \\ 8 & 8 & 0 \end{vmatrix} = (-4 + 4B)\,(4 + 4)^2$

B = 5

21. 3 $A = \{(a, b) \in R \times R, 4 < a < 6, 4 < b < 6\}$
$B = \{(a, b) \in R \times R, 3 \le a \le 9, 3 \le b \le 5\}$

22. 3 Tangent $2y = x + 16$
Normal $y - 16 = -2(x - 16)$
A(–16, 0) B(24, 0)
Circle through A, B, P is $(x - 4)^2 + y^2 = 20^2$
center C is (4, 0)

$m_{PC} = \frac{4}{3}$; $m_{PB} = -2$

$\tan\theta = \left|\dfrac{\frac{4}{3} + 2}{1 - \frac{8}{3}}\right| = 2$

23. 2 Differentiable at $x \in R$

24. 2 By Truth Table

p	q	~(p v q)	(~p ^ q)	~(p v a) V (~p ^ q) = ~p
0	0	1	0	1
0	1	0	1	1
1	0	0	0	0
1	1	0	0	0

25. 4 Let line $y - 3 = m\,(x - 2)$

O(0, 0), $P(2 - \frac{3}{m}, 0)$ Q $(0, 3 - 2m)$ R(h, K)

$h = 3 - \frac{2}{m}$, $K = 3 - 2m$
Eliminating m we get $3h + 2k = hk$

26. 3 $B - 2A = \sum 40^2 + 2^2 \,.\, \sum 20^2 - 2[\sum 20^2 + 2^2 . \sum 10^2]$

$= \frac{40.41.81}{6} + \frac{2.20.21.41}{6} - \frac{8.10.11.21}{6}$

$= 24800$; $\alpha = 248$

27. 4 $\frac{dy}{dx} + (\cot x)y = 4x \operatorname{cosec} x$

If $= e^{\int \cot x\, dx} = e^{\log_e \sin x} = \sin x$

$\frac{d}{dx}(y.\sin x) = 4x$

$y \sin x = 2x^2 + K$

at $x = \frac{\pi}{2}$, $y = 0 \Rightarrow K = -\frac{\pi^2}{2}$

$y\sin x = 2x^2 - \frac{\pi^2}{2}$

$x = \frac{\pi}{6}$

$y = \left(\frac{1}{2}\right) = 2\left(\frac{\pi^2}{36}\right) - \frac{\pi^2}{2}$

$= \frac{\pi^2}{18} - \frac{\pi^2}{2} = \frac{-8\pi^2}{18}$

$y = \frac{-16\pi^2}{18}$

28. 1 P(5, –1, 4) Q(4, –1, 3)

$|\overline{P}\overline{Q}| = \sqrt{1^2 + 0^2 + 1^2} = \sqrt{2}$

Direction ratios of a vector perpendicular to plane is (1, 1, 1) and direction ratios of (PQ) = (1, 0, 1)

angle between them is θ

$\cos\theta = \left|\frac{1.1 + 1.0 + 1.1}{\sqrt{3}\sqrt{2}}\right| = \sqrt{\frac{2}{3}}$

Projection $|\overline{P}\overline{Q}| \sin\theta = \sqrt{2}\sqrt{1 - \frac{2}{3}} = \sqrt{\frac{2}{3}}$

29. 4 $\sqrt{x} = t (t \geq 0)$

$2|t - 3| + t(t - 6) + 6 = 0$

If $t \geq 3$ $2(t - 3) + (t^2 - 6t) + 6 = 0$

$t^2 - 4t = 0 \Rightarrow t = 4$

If $0 \leq t \leq 3$

$2(3 - t) + (t^2 - 6t) + 6 = 0$

$t^2 - 8t + 12 = 0 \Rightarrow t = 2$

30. 4 Let C.D = d

$\frac{13}{2}[2a_1 + 12.4d] = 416$

$= 13a_1 + 312d = 416$

$a_9 + a_{43} = 66$

$\Rightarrow 2a_1 + 50d = 66$

$\Rightarrow a_1 = 8$ & $d = 1$

$a_1^2 + a_2^2 + \ldots\ldots a_{17}^2 = 8^2 + 9^2 + \ldots\ldots + 24^2$

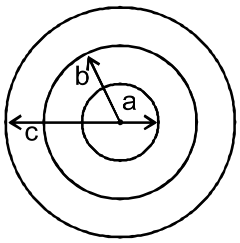
$= 4900 - 140$

$140\, M = 4760$

$\Rightarrow M = 34$

PART B – PHYSICS

31. 3



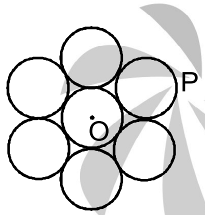
$a_A = 4\pi a^2\sigma$
$a_B = -4\pi b^2\sigma$
$a_C = 4\pi c^2\sigma$

$$V_B = \frac{1}{4\pi \in_0}\left[\frac{a_A}{b} + \frac{a_B}{b} + \frac{a_C}{c}\right]$$

$$= \frac{1}{4\pi \in_0}\left[\frac{4\pi a^2\sigma - 4\pi b^2 r}{b} + \frac{4\pi C^2\sigma}{c}\right]$$

$$= \frac{\sigma}{\in_0}\left[\frac{a^2 - b^2}{b} + c\right]$$

32. 1



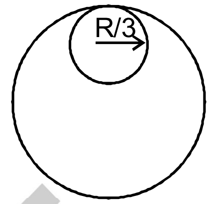
COM is at O.
$I_P = I_O + 7M(3R)^2 = I_O + 63MR^2$

$$\text{Now } I_O = \frac{MR^2}{2} + 6\left[\frac{MR^2}{2} + M(2R)^2\right]$$

$$= \frac{MR^2}{2} + 3MR^2 + 24MR^2 = \frac{55}{2}MR^2$$

$$= I_P = I_O + 63MR^2 = \frac{181}{2}MR^2$$

33. 2



$$M_r = \frac{M}{9}\text{total} = M$$

Now moment of inertia of removed part about centre of disc = $I_1 = \frac{I_1}{2}M\left(\frac{R}{3}\right)^2 + M\times\left(\frac{2}{3}R\right)^2$

$$= \frac{MR^2}{18} + \frac{4MR^2}{9} = \frac{MR^2}{2}$$

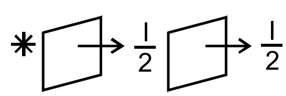
$$\therefore I_{ramain} = I_{Disc} - I_1$$

$$= \frac{9MR^2}{2} - \frac{MR^2}{2} = 4MR^2.$$

34. 4 In forward biased ΔV in diode = 0.7 V
Therefore, 3 – 0.7 – iR = 0

$$\Rightarrow i = \frac{2.3}{R} = \frac{2.3}{200} = 11.5\text{mA}$$

35. 4



Angle between B and A is 0°
Now lets assume angle between axis of A and C is θ

$$= \left(\frac{I_0}{2}\cos^2\theta\right)\cos^2\theta = \frac{I_0}{8}$$

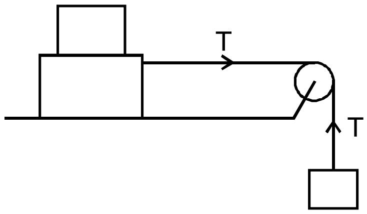
$$\Rightarrow \cos^4\theta = \frac{1}{4}$$

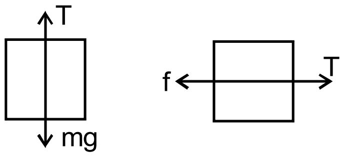
$$\Rightarrow \cos\theta = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \theta = 45°.$$

36. 2 Qualify factor, $Q = \frac{\omega_0 L}{R}$

37. 3





None of the blocks more

$\Rightarrow T - m_1 g = 0$

$\Rightarrow T = m_1 g = 5g$

Now, $f = \mu(m_2 + m)g = 0.15(10 + m)g$

$f = T$

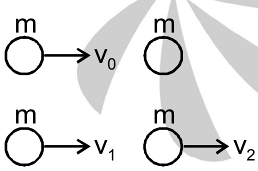
$\Rightarrow 0.15(10 + m)g = 5g$

$10 + m = \frac{5}{0.15} = \frac{100}{3}$

$m = 23.33$

Therefore minimum mass of third block is 27.3 kg.

38. 3



$mv_0 = mv_1 + mv_2$

$v_0 = v_1 + v_2$ … (i)

Also, $1.5 \times \frac{1}{2}mv_0^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2$

$1.5v_0^2 = v_1^2 + v_2^2$ … (ii)

Solving $v_1 - v_2 = \sqrt{2}v_0$.

39. 4 $\frac{m\nu^2}{r} = F = \frac{k}{r^n}$

$\Rightarrow \nu = \left[\frac{k}{m}r^{n} - 1\right]^{\frac{1}{2}}$

$\Rightarrow T = \frac{2\pi r}{\nu} = 2\pi\sqrt{\frac{m}{k}}\, r\frac{n-1}{2} = 2\pi\sqrt{\frac{m}{k}}\, r\frac{n+1}{2}$

$T \alpha r^{\frac{n+1}{2}}$

40. 3 $12 - 10(i_1 + i_2) - i_1 = 0$

$\Rightarrow 10(i_1 + i_2) - i_1 = 12$ … (i)

$\Rightarrow 10(i_1 + i_2) - 2i_2 = 13$ … (ii)

(i) × 2 + (ii)

$30\,(i_1 + i_2) = \frac{37}{32}$

Voltage across load $= 10(i_1 + i_2) = \frac{370}{32} = 11.56$

41. 3 $P_{av} = e_{rms} \times I_{rms} \sin\phi$

$= \frac{100}{\sqrt{2}} \times \frac{20}{\sqrt{2}} \times \sin\frac{\pi}{4} = \frac{1000}{\sqrt{2}}$

Wattles corrent $= I_{rms} \times \sin\phi$

$= \frac{20}{\sqrt{2}}\sin\frac{\pi}{4} = 10$

42. 4 $\nu_1 = c$

$\nu_2 = \frac{c}{2}$

$\nu_1 = \frac{1}{\sqrt{\epsilon_1}}$

$\nu_2 = \frac{1}{\sqrt{\epsilon_2}}$

$$\frac{\nu_1}{\nu_2} = \sqrt{\frac{\epsilon_2}{\epsilon_1}} = \sqrt{\frac{\epsilon_{r_2}}{\epsilon_{r_1}}} = \frac{C}{\frac{C}{2}} = 2$$

$$\Rightarrow \frac{\epsilon_{r_2}}{\epsilon_{r_1}} = 4 \Rightarrow \frac{\epsilon_{r_1}}{\epsilon_{r_2}} = \frac{1}{4}$$

43. 4 Available spectrum = 10% of 10 GHz
= 1 GHz
Therefore, number of channel

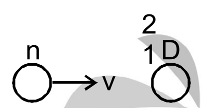
$$\frac{\text{Available band}}{\text{band width}} = \frac{10^9\text{Hz}}{5\times10^3\text{Hz}} = 2\times10^5$$

44. 2 $f = \frac{v}{2L} = \frac{1}{2L}\sqrt{\frac{r}{\rho}}$

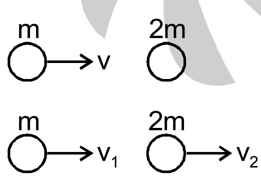
$$= \frac{1}{2\times0.6}\sqrt{\frac{9.27\times10^{10}}{2.7\times10^3}} = \frac{5.85\times10^3}{1.2}$$

= 4.88 Khz = 5kHz.

45. 2



mass of neutron = m
mass of deuterium = 2m
mass of carbon = 12m



$mv = mv_1 + 2mv_2$
or $v = v1 + 2v_2$ … (i)

$\frac{v_2 - v_1}{v} = 1$ or $v_2 - v_1 = v$ … (ii)

$\therefore 3v_2 = 2v$ or $v_2 = \frac{2v}{3}$

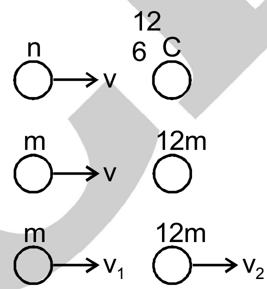
and $v_1 = v_2 - v = \frac{2v}{3} - v = \frac{-v}{3}$

$\therefore KE_f$ of 'm' $= \frac{1}{2}mV_1^2 = \frac{1}{2}\frac{mV^2}{9} = \frac{KE_i}{9}$

loss $= \frac{8KE_i}{9}$

% loss $= \frac{8}{9}\times100 = Pd$

Fractional loss $= \frac{8}{9} = 0.89$



$\therefore v = v_1 + 12v_2$ … (i)

$\frac{v_2 - v_1}{v} = 1$ or $v_2 - v_1 = v$ … (ii)

$\therefore 13v_2 = 2v$ or $v_2 = \frac{2v}{13}$

$\therefore v_1 = v_2 - v = \frac{2v}{13} - v = \frac{11v}{13}$

$\therefore KE_f$ of 'm' $= \frac{1}{2}mV_1^2 = \frac{1}{2}m\left(\frac{11}{13}V\right)^2$

$\therefore KE_f = \frac{121}{169}KE_i$

loss $= \frac{48}{169}KE_i$

% loss $= \frac{48}{169}\times100 = Pc$

Fractional loss $= \frac{48}{169} = 0.28.$

46. 4 $P = \frac{m}{V} = \frac{m}{l^3}$

$$\Rightarrow \frac{\Delta P}{P} = \frac{\Delta m}{m} + \frac{3\Delta l}{l}$$

$$= \frac{\Delta P}{P} \times 100 = \frac{\Delta m}{m} \times 100 + \frac{3\Delta l}{l} \times 100$$

$$= 1.5 + 3 = 4.5\%.$$

47. 4 $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

$$300\left(\frac{V}{2V}\right)^{\frac{2}{3}} = T_2$$

$$T_2 = 300\left(\frac{1}{2}\right)^{\frac{2}{3}} \simeq 189K$$

$$\Delta U = nC_V\Delta T = -2 \times \frac{3R}{2} \times 111 = -2.7kJ.$$

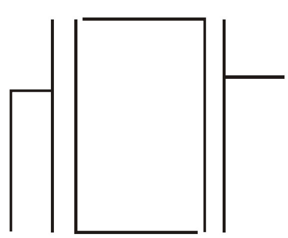
48. 4 $k = -\frac{dP}{dV/V}$

$$\frac{dV}{V} = \frac{dP}{K}$$

$$\frac{4\pi r^2 dr}{\frac{4}{3}\pi r^3} = -\frac{mg/a}{K}$$

$$\Rightarrow \frac{3dr}{r} = -\frac{mg}{aK} \text{ or } \frac{dr}{r} = -\frac{mg}{3Ka}.$$

49. 2 Q ind = CV(K – 1)



$= 20 \times 90 \times 10^{-12} \times (\frac{5}{3} - 1)$

= 1200 pc

= 1.2 nc

50. 4 m = IA

$$\therefore \frac{m_2}{m_1} = 2 = \frac{IA_2}{IA_1} = \frac{A_2}{A_1} = \frac{r_2^2}{r_1^2}$$

$$\Rightarrow \frac{r_2}{r_1} = \sqrt{2}$$

$$\therefore \frac{B_1}{B_2} = \frac{\mu_0 I}{2r_1} / \frac{\mu_0 I}{2r_2} = \frac{r_2}{r_1} = \sqrt{2}$$

51. 2 $\Lambda_n = \frac{h_c}{E_n - e_1} = \frac{h_c}{13.6Z^2\left(1 - \frac{1}{n^2}\right)}$

$$= \frac{h_c}{13.6Z^2}\left(1 - \frac{1}{n^2}\right)^{-1}$$

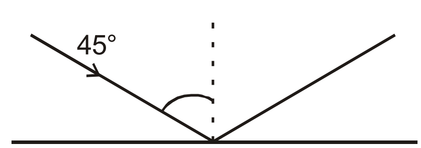
$$\simeq \frac{h_c}{13.6Z^2}\left(1 + \frac{1}{n^2}\right)$$

Also, $\lambda_n = \frac{h}{mV_n} = \frac{h2 \in_0 nh}{m \cdot Ze^2}$

$\therefore \lambda_n \, \alpha \, n$

Hence, $\Lambda_n \simeq A + \frac{B}{\lambda_n^2}.$

52. 2 F = n × 2 mu cos 45°



$= 10^{23} \times 2 \times 3.32 \times 10^{-27} \times 10^{3}$

$$\times \frac{1}{\sqrt{2}} = \frac{2\times 3.32}{\sqrt{2}} \times 10^{-1}\text{N}$$

$$\therefore P = \frac{F}{A} = \frac{2\times 3.32\times 10^{-1}}{\sqrt{2}\times 2\times 10^{-4}}$$

$= 2.35 \times 10^{3}$ N/m^2

53. 3 a –ve
i.e. speed is decreasing
therefore incorrect option is 3

54. 3 $\frac{mv^2}{r} = qvB$

$p^2 = k$

$p = \sqrt{2mk}$

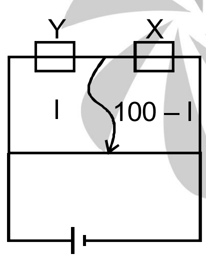
$= mv = qBr$

$= r \propto \frac{mv}{q}$

$= r \propto \frac{p}{q}$

$= r_e < r_p = r_a$

55. 4



$$\frac{X}{Y} = \frac{l}{100 - l}$$

$$\frac{X+Y}{Y} = \frac{100}{100 - l}$$

$$\frac{Y}{1K\Omega} = \frac{100 - l}{100}$$

$$Y = \frac{100 - l}{100} \times 1K\Omega$$

$$\text{Now, } \frac{Y}{X} = \frac{l - 10}{110 - l}$$

$$\frac{X+Y}{X} = \frac{100}{110 - l}$$

$$\Rightarrow X = \frac{110 - l}{100} \times 1K\Omega$$

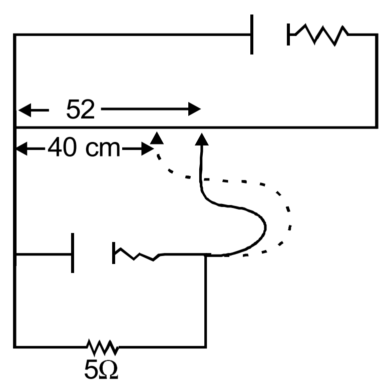
$$\therefore X + Y = \frac{210 - 2l}{100} \times 1K\Omega$$

$$\Rightarrow 1K\Omega = \frac{210 - 2l}{100} \times 1K\Omega$$

$$\Rightarrow 210 - 2l = 100 \Rightarrow l = 55$$

$$\therefore X = \frac{55}{100} \times 1K\Omega = 550\Omega.$$

56. 3 In first case $\frac{\varepsilon_0}{V} = \frac{52}{l}$



In 2nd case

Current in the circuit = $\frac{\varepsilon_0}{r+R}$

$$\frac{R\varepsilon}{r+R} = \frac{40}{l} \times V$$

$$\frac{\varepsilon_0}{V} = \frac{40}{I} \times \frac{r+R}{R} = \frac{52}{I}$$

$$\Rightarrow 40 \times \frac{(r+5)}{5} = 52$$

$$\Rightarrow r = \frac{52}{40} \times 5 - 5$$

$$= 5\left[\frac{52}{40} - 1\right] = 5 \times \frac{12}{40} = 1.5\ \Omega$$

57. 1 $h\upsilon_L = E_0 Z^2 \left(\frac{1}{12} - 0\right) = E_0 z^2$

$$\Rightarrow \upsilon_L = \frac{E_0 z^2}{h}$$

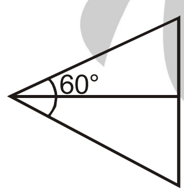
$$h\upsilon_p = E_0 z^2 \left(\frac{1}{5^2} - 0\right) = E_0 z^2$$

$$\Rightarrow \upsilon_p = \frac{E_0 z^2}{h25} = \frac{\upsilon_L}{25}$$

58. 2 $\theta = 30°$

$d \sin\theta = \lambda$

$$\Rightarrow \lambda = \frac{d}{2} = 0.5 \text{ Nm}$$



In DSE, triangle width

$$\beta = \frac{\lambda D}{d_1}$$

$$d_1 = \frac{\alpha D}{\beta} = \frac{0.5 \times 10^{-6} \times 50}{1} = 25\ \mu\text{m}$$

59. 4 $U = -\frac{k}{2r^2}$

$$F = -\frac{k}{r^3}$$

$$\Rightarrow \frac{m\nu^2}{r} = \frac{k}{r^3} \Rightarrow m\nu^2 = \frac{k}{r^2}$$

$$\Rightarrow KE = \frac{1}{2} m\nu^2 = \frac{k}{2r^2}$$

$\therefore$ TE = U + KE = 0

60. 3 $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

$$\Rightarrow k = 4\pi^2 \times f^2 m = 4 \times 3.14^2 \times 10^{24} \times \frac{108 \times 10^{-3}}{6.02 \times 10^{23}}$$

= 7.1 N/m.

PART C – CHEMISTRY

61. 1 $\Delta T_f = T° - T_S = iK_f m$
Now $T_S = T° - iK_f m$
So, i factor should be lowest, which is in case of (1).

62. 4 In alkaline medium,
$K_3(Fe(CN)_6) + KOH + H_2O_2$
$\rightarrow K_4[Fe(CN)_6] + O_2 + H_2O$
In acidic Medium,
$2K_4[Fe(CN)_6] + H_2SO_4 + H_2O_2$
$\rightarrow 2K_3[Fe(CN)_6] + K_2SO_4 + 2H_2O$

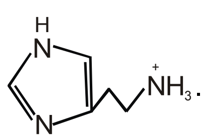
63. 3 Aniline can be used for estimation of nitrogen by kjeldahl's method as this method is not applicable for nitro compounds, Pyridine and diazo compounds.

64. 2 D-glucose on heating with HI for a long time, n-hexane is obtained.

$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} \xrightarrow[(excess)]{HI} CH_3(CH_2)_4CH_3$$

65. 4 Methyl orange shows red colour in acidic medium and yellow colour in basic medium. So if weak base is titrated with strong acid, the colour changes from yellow to pinkish red.

66. 1 Predominant form of histamine present in human blood in weakly acidic medium is



67. 4 (c) is most basic due to negative charge on nitrogen because of resonance and (b) is least basic because hybridisation of N is sp^2.

68. 2

69. 4 $B_2H_6 + 3O_2 \rightarrow B_2O_3 + 3H_2O$

$$\frac{27.66}{27.66} = 1\,\text{mole}$$

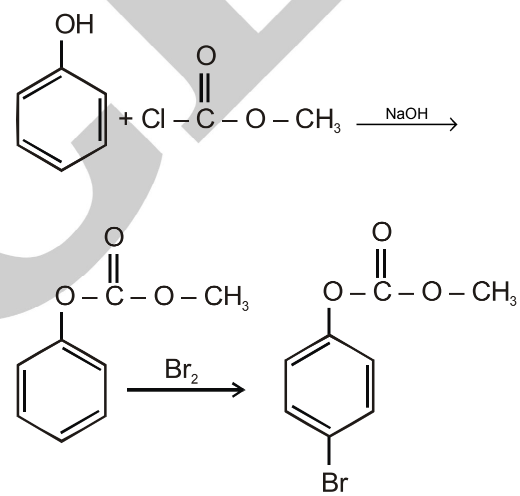
Oxygen required = 3 moles

Now $\frac{w}{M} = \frac{It}{96500\,n}$; $6 = \frac{100 \times t}{96500 \times 2}$

t = 11580 sec. = $\frac{11580}{3600}$ = 3.2 hours

70. 3 I and III are correct.

71. 4



72. 4 $[SO_4^{2-}] = \frac{50}{450} = 0.11\,M$

$K_{SP} = [Ba^{2+}][SO_4^{2-}]$
$10^{-10} = [Ba^{2+}]\,[0.11]$

$[Ba^{2+}] = \frac{10^{-10}}{0.11} = 1.1 \times 10^{-9}$ M

73. 2

	$CH_3CHO(g) \rightarrow$	$CH_4(g)$ +	$CO(g)$
Initially	363	0	0
When 5% reacted	363 – 5% of 363 363 – 18.15 = 344.75	18.15	18.15
when 33% reacted	363 – 33% of 363 363 – 119.79 = 243.21	119.79	119.79

Now Rate = $K[CH_3CHO]^x$

$$\frac{Rate_{5\%}}{Rate_{33\%}} = \frac{K[344.75]^x}{K[243.21]^x}$$

or $\frac{1}{0.5} = \left(\frac{344.75}{243.21}\right)^x$; $2 = (1.41)^x$

or $2 = \left(\sqrt{2}\right)^x$; $2 = 2^{\frac{x}{2}}$

Now $\frac{x}{2} = 1$; $x = 2$

74. 1 $C_6H_6(l) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$

$\Delta ng = 6 - \frac{15}{2} = -\frac{3}{2}$

Now $\Delta H = \Delta E + \Delta ngRT$

$\Delta H = -3263.9 - \frac{3}{2} \times \frac{8.314 \times 298}{1000}$

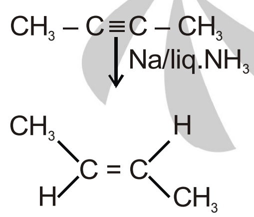
$= -3263.9 - 3.716 = -3267.6$ KJ/mol

75. 1 $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

$(C_2H_4O_Y)$ where y = 3

Hence, $C_2H_4O_3$.

76. 4 Trans alkene are formed by using Na/liq.NH_3 on alkynes.



Trans-but-2-ene

77. 1, 3

BCl_3 and $AlCl_3$ are lewis acids due to present of a vacant orbitals in Boron family halides. Also, $SiCl_4$ is lewis acid due to presence of vacant orbitals.

78. 4 $\underset{(M)}{Al} + (aq.)\,NaOH \longrightarrow$

$\underset{\text{Gelatinous White (x)}}{Al(OH)_3} \xrightarrow{NaOH} \underset{\text{Sodium Meta Aluminate}}{NaAlO_2}$

$\downarrow \Delta$

$H_2O + Al_2O_3$ (used as adsorbent in column chromatography)

79. 1 Bond order of $H_2^{2-} = \frac{2-2}{2} = 0$

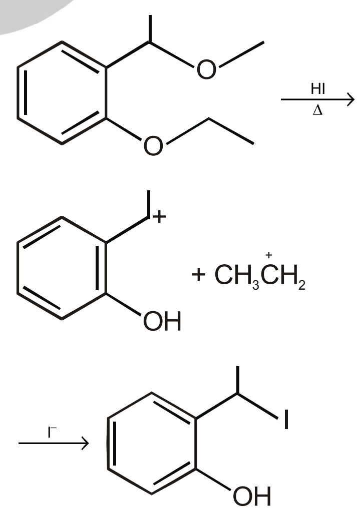
Bond order of $H_2^{2+} = \frac{2-0}{2} = 1$

Bond order of $He_2^{+} = \frac{2-1}{2} = 0.5$

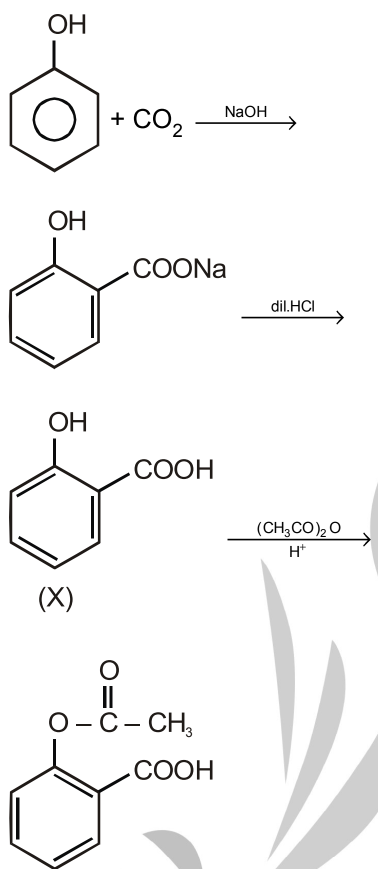
Bond order of $H_2^{-} = \frac{2-1}{2} = 0.5$

Hence (1) is not viable.

80. 1



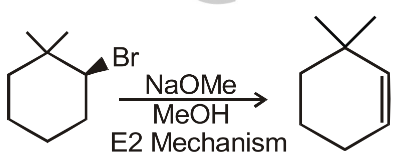
81. 2



82. 4 KCl contains only ionic bond.

83. 4 In frenkel defect, cations being small in size occupies nearby interstitial voids.

84. 3



85. 1 $(NH_4)_2SO_4 \xrightarrow{\Delta} (NH_4)_2S_2O_7 + 2NH_3 + H_2O$

$Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$

$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} Cr_2O_3 + N_2 + 4H_2O$

$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

86. 3 $H_2S \rightleftharpoons H^+ + HS^-$ $\quad K_{a_1} = 10^7$

$HS^- \rightleftharpoons H^+ + S^{2-}$ $\quad K_{a_2} = 1.2 \times 10^{-13}$

$H_2S \rightleftharpoons 2H^+ + S^{2-}$ $\quad K = K_{a_1} \times K_{a_2} = 1.2 \times 10^{-20}$

$$K = \frac{[H^+]^2[S^{2-}]}{[H_2S]}$$

or $1.2 \times 10^{-20} = \dfrac{(0.2)^2[S^{2-}]}{0.1}$

or $[S^{2-}] = \dfrac{1.2 \times 10^{-20} \times 0.1}{0.2 \times 0.2} = 3 \times 10^{-20}$

87. 4 $[Cr(H_2O)_6]Cl_3$, Oxi.No. of Cr = 0
$Cr(C_6H_6)_2$, Oxi.No. of Cr = 0
$K_2[Cr(CN)_2(O)_2NH_3]$, Oxi.No. of Cr = +6

88. 4 $[3Ca_3(PO_4)_2.Ca(OH)_2] + 2F^-$
$\downarrow$
$[3Ca_3(PO_4)_2.CaF_2] + 2OH^-$

89. 3 $CH_3COOK \rightarrow$ As KOH is strong base and CH_3COOH is weak acid.

90. 4 In structure of I_3^-, a total of 9 lone pairs.