Deeksha - K CET

Subject	Topic	**Mock Test – 02**	Date
C + M + P	Complete Syllabus	CET – 12 – CT	

C+M+P Key Answers:

1. c	2. b	3. c	4. c	5. d	6. d	7. b	8. c	9. b	10. a
11. a	12. c	13. b	14. b	15. b	16. a	17. d	18. b	19. b	20. c
21. b	22. d	23. b	24. d	25. b	26. c	27. b	28. c	29. b	30. a
31. a	32. d	33. a	34. a	35. c	36. a	37. a	38. b	39. a	40. a
41. c	42. d	43. d	44. c	45. d	46. b	47. c	48. b	49. d	50. d
51. a	52. a	53. b	54. a	55. b	56. c	57. b	58. c	59. c	60. b
61. a	62. c	63. d	64. b	65. d	66. c	67. d	68. d	69. c	70. a
71. a	72. a	73. c	74. b	75. a	76. b	77. c	78. b	79. b	80. b
81. a	82. c	83. a	84. b	85. d	86. d	87. b	88. d	89. d	90. a
91. c	92. b	93. b	94. a	95. b	96. b	97. d	98. b	99. c	100.b
101.b	102.b	103.d	104.a	105.a	106.a	107.d	108.a	109.d	110.d
111.d	112.d	113.a	114.b	115.d	116.b	117.a	118.a	119.b	120.b
121.a	122.c	123.c	124.a	125.c	126.c	127.b	128.c	129.d	130.d
131.a	132.a	133.c	134.b	135.b	136.b	137.c	138.a	139.b	140.b
141.d	142.c	143.d	144.a	145.b	146.d	147.c	148.c	149.a	150.c
151.b	152.b	153.c	154.c	155.c	156.c	157.b	158.b	159.d	160.a
161.d	162.a	163.b	164.b	165.d	166.b	167.b	168.d	169.c	170.a
171.b	172.a	173.d	174.c	175.c	176.a	177.c	178.d	179.b	180.d

Chemistry Solutions:

1. It causes muscular weakness
2. $CH_3Br + AgF \rightarrow CH_3F + AgBr$

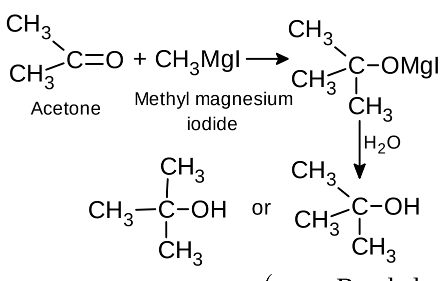
   This reaction is known as Swarts reaction.
3. H_3PO_4 is a tribasic acid as it has $3P-OH$ bonds i.e., 3 ionisable H atoms thus, can form three series of salts.
4. Suppose initially there is 1 mole of each. Hence, total moles $=3$. Total pressure of 3 moles $=$ $900\,\text{mm}$.

   After removing half of the molecules of N_2, its mole $=0.5$.

   Now total moles $=2.5$. Hence, total pressure

   $=\dfrac{2.5}{3}\times 900 = 750\,\text{mm}$
5. Oxygen can form $p\pi - p\pi$ bonding while fluorine can form only single bonds.
6. $142\,g$ of $Cl_2 = 2\,\text{mol}$ of Cl_2 or

   $=4\,\text{mol}$ of Cl atoms.
7. Sol:



$(tert - \text{Butyl alcohol})$

8. $\Delta_t = 4/9\Delta_0 = (4/9)\left(18{,}000\text{cm}^{-1}\right) = 8000\text{cm}^{-1}$

9. Electronic configuration of element with atomic number 106 should be $[Rn]5f^{14}6d^5 7s^1$

10. $4NH_{3(g)} + 5O_{2(g)} \xrightarrow[500\,K,\ 9\,\text{bar}]{Pt/Rh\ \text{gauge catalyst}} 4NO_{(g)} + 6H_2O_{(g)}$
(from air)

Thus, 2 moles of NO will be produced by the oxidation of 2 moles of NH_3.

11. $t = \dfrac{2.303}{k}\log\dfrac{a}{a-x}$

or $t = \dfrac{2.303}{15\times10^{-3}}\log\dfrac{5}{3} = 34.07\,\text{s}$

12. Work function = Energy required to just dislodge the electron $= hv = h\dfrac{c}{\lambda}$

$$= \frac{6.63\times10^{-34}\times3\times10^8}{330\times10^{-9}} = 6\times10^{-19}\,\text{J}$$

13. $E = E^\circ - \dfrac{0.0591}{n}\log Q$

$E^\circ = 0$ for all concentration cells

$$= 0 - \frac{0.0591}{1}\log\left(\frac{0.01}{0.05}\right) = 0.0413\,\text{V}$$

14. Aromatic ketones are less relative than aliphatic ketones which in turn are less reactive than aldehydes. Hence, acetophenone does not react with $NaHSO_3$.

15. According to Hardy Schulze rule, the coagulating power of an ion depends upon its valency. Higher the valency of ion, greater is its coagulating power.

16. $\pi = \dfrac{n_B RT}{V}$; $\qquad n_B = \dfrac{W_B}{M_B}$

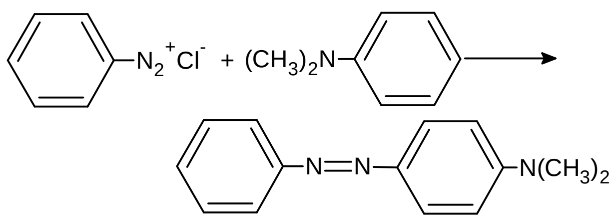
$\pi = \dfrac{W_B}{M_B}\times\dfrac{RT}{V}$

$M_B = \dfrac{W_B}{V}\times\dfrac{RT}{\pi} = \dfrac{2\times0.0821\times300\times760}{0.3\times20}$

$= 6239.6\,\text{g mol}^{-1}$

17. Glycogen is stored in the liver of animals.

18. Sol:



p −Dimethylaminoazobenzene
(Butter yellow)

19. Orthonitrophenol has lower boiling point and higher vapour pressure because of intramolecular hydrogen bonding

20. The CFSE of the ligands is in the order

$H_2O < NH_3 < CN^-$

Hence, excitation energies are in order :

$$\left[Co(H_2O)_6\right]^{3+} > \left[Co(NH_3)_6\right]^{+} > \left[Co(CN)_6\right]^{3-}$$

From the relation $E = \dfrac{hc}{\lambda} \Rightarrow E \propto \dfrac{1}{\lambda}$

The order of absorption of wavelength of light in the visible region is:

$$\left[Co(H_2O)_6\right]^{3+} > \left[Co(NH_3)_6\right]^{+} > \left[Co(CN)_6\right]^{3-}$$

21. Electrolysis of water takes place as:

$2H_2O(l) \rightarrow 2H_{2(g)} + O_{2(g)}$

Thus, 2 moles of H_2O, i.e., $2\times18 = 36\,g$ of H_2O on electrolysis produce 2 moles of H_2 gas and one mole of O_2 gas, i.e., total 3 moles of the gases

$\therefore$ $100\,g$ of water will produce gases

$= \dfrac{3}{36}\times100 = 8.33\,\text{moles}$

Volume occupied by 8.33 moles of gases at $25\,°C$ and 1atm pressure is given by

$V = \dfrac{nRT}{P}$

$$= \frac{(8.33\,\text{mole})\left(0.0821\,\text{L atm K}^{-1}\text{mol}^{-1}\right)(298\,\text{K})}{1\text{atm}}$$

$= 203.8\,\text{L}$

Taking the volume of liquid water as negligible (being $100\,m\text{L}=0.1\text{L}$), $\Delta\text{V} = 203.8\,\text{L}$

$\therefore\ w = -P_{ext}\Delta V = -1\text{atm} \times 203.8\,\text{L}$

$= -203.8\,\text{L atm} = -203.8 \times 101.3\,\text{J}$

$= -206\,\text{kJ}$

22. It is a copolymer of glycine $(H_2N - CH_2 - COOH)$ and amino caproic acid $[H_2N(CH_2)_5 COOH]$.

23. Rate $= k[A]^x[B]^y$

From exp. (1), $5\times10^{-4} = k\left[2.5\times10^{-4}\right]^x\left[3\times10^{-5}\right]^y \ldots$(i)

From exp. (2), $4\times10^{-3} = k\left[5\times10^{-4}\right]^x\left[6\times10^{-5}\right]^y \ldots$(ii)

Dividing (ii) by (i), $\dfrac{4\times10^{-3}}{5\times10^{-4}} = 2^x\cdot2^y = 8$

From exp. (3) $1.6\times10^{-2} = k\left[1\times10^{-3}\right]^x\left[6\times10^{-5}\right]^y \ldots$(iii)

Dividing (iii) by (ii), $\dfrac{1.6\times10^{-2}}{4\times10^{-3}} = 2^x = 4$ or

$x = 2,\ y = 1$

Hence, order with respect to A is 2 and with respect to B is 1.

24. Detergents containing branched hydrocarbon chains are non-biodegradable.

25. Sol:

	PCl_5	$\rightleftharpoons$ PCl_3	+ Cl_2
Initial moles	1	0	0
Moles at eqm.	0.5	0.5	0.5
			Total $=1.5$
Partial pressure	$\frac{0.5}{1.5}P$	$\frac{0.5}{1.5}P$	$\frac{0.5}{1.5}P$

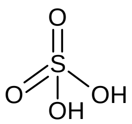
Where P is the total pressure)

$K_p = \left(\dfrac{0.5}{1.5}P\right)\left(\dfrac{0.5}{1.5}P\right)/\left(\dfrac{0.5}{1.5}P\right)$

$= \dfrac{1}{3}P = 1.6$ (Given) or $p = 4.8\,\text{atm}$.

26. Sol:

H_2SO_4 :



sp^3hybridisation, tetrahedral

27. Due to lesser energy gap between $5f$ and $6d-$ orbitals, a large number of oxidation states are shown by actinoids.

28. Greater the energy absorbed, less stable is the compound or more the energy released, more stable is the compound.

29. Though polar, alkyl halides cannot form hydrogen bonds with water hence they are insoluble in water.

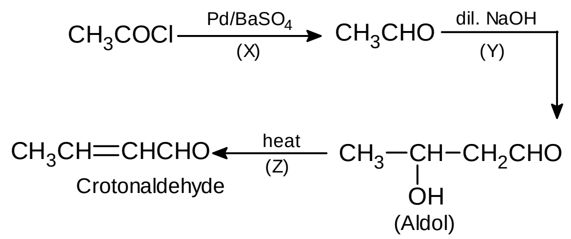
30. $KCl \rightleftharpoons K^+ + Cl^- \qquad (n=2)$

$\alpha = \dfrac{i-1}{n-1} = \dfrac{1.95-1}{2-1} = 0.95$

31. F-centres are electron trapped anion site which are responsible for colour.

32. Tertiary butyl alcohols are more reactive towards Lucas reagent (Conc HCl / Anh $ZnCl_2$)

33. Sol:



34. Due to stronger intermolecular interactions in acetone and chloroform lesser number of molecules vaporise resulting in low vapour pressure and high boiling point.

35. The trend in boiling point can be explained on the basis of intermolecular hydrogen bonding which is maximum in primary amines.

36. $K_2Cr_2O_7 + 4H_2SO_4 \rightarrow$

$K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3O$

$SO_2 + H_2O + O \rightarrow H_2SO_4] \times 3$

$\overline{K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \rightarrow}$

$K_2SO_4 + Cr_2(SO_4)_3 + H_2O$

Thus, X, Y and Z of H_2SO_4, SO_2 and H_2O respectively are 1, 3, 1.

37. $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

Given: $\left[H^+\right] = \sqrt{K_a \times C}$

$K_a = 1.75\times10^{-5}, [CH_3COOH] = 0.01\,\text{mol dm}^{-3}$

$\left[H^+\right] = \sqrt{1.74\times10^{-5}\times0.01} = \sqrt{1.74\times10^{-7}}$

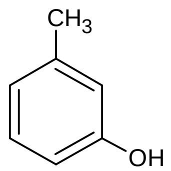
$\left[H^+\right] = 4.17\times10^{-4}$

$pH = -\log\left[H^+\right] = -\log\left(4.17\times10^{-4}\right) = 3.379 \approx 3.4$

38. $W = Z\times I\times t$

$= 4\times10^{-4}\times12\times\frac{75}{100}\times3\times3600 = 38.8\,g$

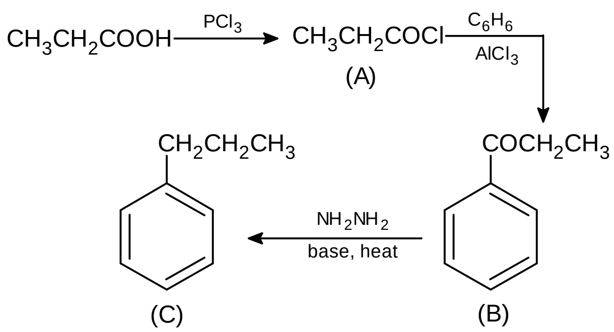
39. Sol:



$m-$Cresol
$(3-$Methylphenol$)$

40. The dihedral angle is $60°$

41. Sol:



42. Due to the absence of benzylic $H-$atom, *tert*$-$butylbenzene does not undergo oxidation easily to give benzoic acid.

43. Low temperature is favourable condition for physical adsorption.

44. Due to $-I$ effect of Cl, chloroacetic acid is a stronger acid than acetic acid. Due to stabilization of phenoxide ion by resonance, phenol is a strong acid than ethanol.

45. Number of tetrahedral voids per atom in a unit cell is 2. Hence the total number of tetrahedral voids $= 2n$.

46. $E = E° + \frac{0.059}{2}\log\left[Mg^{2+}\right]$

Hence, plot of E *vs* $\log\left[Mg^{2+}\right]$ will be linear with positive slope and intercept $= E°$.

47. Not only sufficient threshold energy of colliding atoms or molecules but also the proper orientation for the collision is required for the formation of products.

48. H_2 is not responsible for global warming.

49. $\underset{s}{PbCl_2} \rightarrow \underset{s}{Pb^{2+}} + \underset{2s}{2Cl^-}$

$K_{sp} = s(2s)^2 = 4s^3 = 4\times\left(10^{-2}\right)^3 = 4\times10^{-6}$

In $0.1\text{M}\ NaCl, \left[Cl^-\right] = 0.1 + 2\times10^{-2} = 0.1\text{M}$

$\left[Pb^{2+}\right]\left[Cl^-\right]^2 = K_{sp}$ or

$\left[Pb^{2+}\right](0.10)^2 = 4\times10^{-6}$ or

$\left[Pb^{2+}\right] = 4\times10^{-4}\text{M}$

50. Suppose one molecule of the alkaloid contains x $N-$atoms. Then % of N

$= \frac{14x}{162}\times100 = 17.28$ (Given) or

$x = 2$

51. $K_2Cr_2O_4 + 10H_2SO_4 + 6KI \longrightarrow$
$K_2SO_4 + 16KHSO_4 + Cr_2(SO_4)_3 + 3I_2 + 7H_2O$

52. Sol:

$CH_2{=}CH_2 + H_2O \longrightarrow CH_2OH{-}CH_2OH$

53. $\underset{\text{Black Powder}}{MnO_2} + \underset{\text{Conc.}}{4HCl} \rightarrow MnCl_2 + 2H_2O + \underset{\text{Greenish yellow gas}}{Cl_2}$

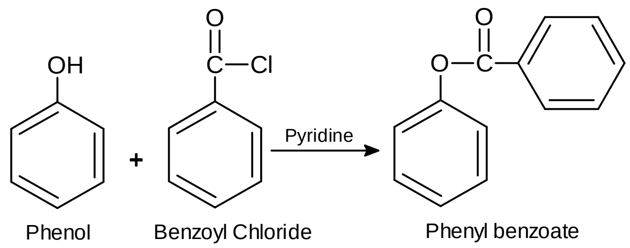
$Cl_2 + H_2O \rightarrow 2HCl + [O]$

Coloured matter $[O] \rightarrow$ Colourless matter

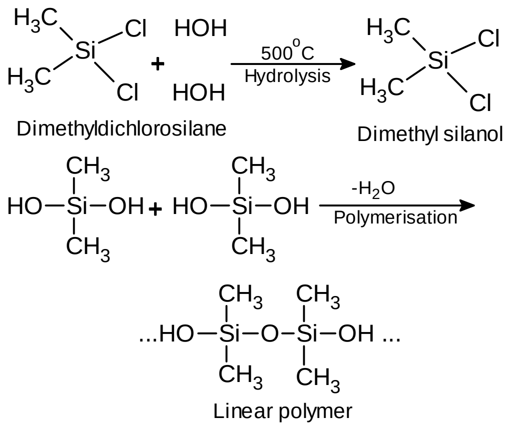
$\underset{\text{Slaked lime}}{2Ca(OH_2)} + 2Cl_2 \rightarrow \underset{\text{Bleaching powder (white)}}{Ca(OCl)_2} + CaCl_2 + 2H_2O$

54. Highly pure dilute solution of sodium in ammonia shows blue colouration which is due to solvated electrons.

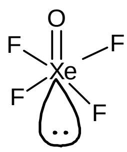
55. This reaction is known as Schotten-Baumann reaction.



56. Hydrolysis of $(CH_3)_2\,SiCl_2$ will give linear polymer on hydrolysis followed by polymerisation.



57. Sol:



58. $\underset{(A)}{P_4}+10Cl_2 \rightarrow \underset{(B)}{4PCl_5}$

59. Glycosidic bond (A) is between $C-1$ and $C-4$

Glycosidic bond (B) is between $C-1$ and $C-6$

Glycosidic bond (C) is between $C-1$ and $C-4$

60. $C_2H_5-O-C_2H_5+\underset{(\text{Excess})}{2HI}\rightarrow 2C_2H_5I+H_2O$

Mathematics Solutions:

61. $A^3-A^2=A^2.(A-I)$

$$A^2=\begin{pmatrix}-1&0\\0&2\end{pmatrix}\begin{pmatrix}-1&0\\0&2\end{pmatrix}=\begin{pmatrix}1&0\\0&4\end{pmatrix}$$

$$A^3-A=\begin{pmatrix}1&0\\0&4\end{pmatrix}\begin{pmatrix}-2&0\\0&1\end{pmatrix}$$

$$=\begin{pmatrix}-2&0\\0&4\end{pmatrix}=2\begin{pmatrix}-1&0\\0&2\end{pmatrix}=2A$$

62. We have, $(A+B)(A-B)=A^2-B^2 \Rightarrow AB=BA$

Now, $(ABA^{-1})^2=(BAA^{-1})^2 \quad (\because AB=BA)$

$=(BI)^2=B^2$

63. $$\begin{pmatrix}2&0&7\\0&1&0\\1&-2&1\end{pmatrix}\begin{pmatrix}-x&14x&7x\\0&1&0\\x&-4x&-2x\end{pmatrix}=\begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}$$

$$\Rightarrow\begin{pmatrix}5x&0&0\\0&1&0\\0&10x-2&5x\end{pmatrix}=\begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}$$

$\Rightarrow\ 5x=1$ and $10x-2=0 \Rightarrow x=\frac{1}{5}$

64. We have, $\sin^{-1}x+\sin^{-1}y=\frac{\pi}{2}\Rightarrow x^2+y^2=1$

$\therefore$ we have, $\frac{9}{x^2}+\frac{16}{x^2}=1\Rightarrow x^2-25\Rightarrow x=5$

65. $\sec^{-1}x=\operatorname{cos}ec^{-1}y\Rightarrow\cos^{-1}\frac{1}{x}+\sin^{-1}\frac{1}{y}$

Now, $\cos^{-1}\frac{1}{x}+\cos^{-1}\frac{1}{y}=\sin^{-1}\frac{1}{y}+\cos^{-1}\frac{1}{y}=\frac{\pi}{2}$

66. If x is negative,

$\sin^{-1}(x)=-\sin^{-1}(-x)=-\cos^{-1}\sqrt{1-x^2}$

67. $\tan^{-1}\left(\frac{1-x^2}{2x}\right)+\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$

$=\cot^{-1}\frac{2x}{1-x^2}+2\tan^{-1}x$

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

$=\frac{\pi}{2}-2\tan^{-1}x+2\tan^{-1}x=\frac{\pi}{2}$

$\therefore\quad \sin\left(\frac{\pi}{2}\right)=1$

68. $\cos^{-1}\sqrt{p}+\cos^{-1}\sqrt{1-p}+\cos^{-1}\sqrt{1-q}=\frac{3\pi}{4}$

$\Rightarrow\cos^{-1}\sqrt{p}+\cos^{-1}\sqrt{1-\left(\sqrt{p}\right)^2}+\cos^{-1}\sqrt{1-q}=\frac{3\pi}{4}$

$\Rightarrow\cos^{-1}\sqrt{p}+\sin^{-1}\sqrt{p}+\cos^{-1}\sqrt{1-q}=\frac{3\pi}{4}$

$$\Rightarrow \frac{\pi}{2}+\cos^{-1}\sqrt{1-q}=\frac{3\pi}{4}$$

$$\Rightarrow \cos^{-1}\sqrt{1-q}=\frac{\pi}{4}\Rightarrow\sqrt{1-q}=\frac{1}{\sqrt{2}}$$

$$\Rightarrow 1-q=\frac{1}{2}\Rightarrow q=\frac{1}{2}$$

69. Clearly R is an equivalence relation

(i) every triangle is congruent to itself

(ii) If a triangle $'a'$ is congruent to the triangle $'b'$, then clearly $'b'$ is congruent to $'a'$

(iii) If a triangle $'a'$ is congruent to the triangle $'b'$, $'b'$ is congruent to the triangle $'c'$ then, $'a'$ is congruent to $'c'$.

70. Total number of function from A into B is 2^4.

71. Out of these, two functions are not onto – i.e.,

$f(x)=1,\forall x\in A$ and $g(x)=2,\forall x\in A$.

Thus the total number of onto functions

$=2^4-2=14$

f is not one-one because

$f(3)=0$ and $f(5)=0$ but $3\neq 5$.

f is onto – for $n\in z$, we have $2n\in z$ and

$f(2n)=n$, $\because 2n$ is an even integer.

72. We have, $f(x)=(a-x^n)^{1/n}$

$$f[f(x)]=f\left[\left(a-x^n\right)^{1/n}\right]$$

$$=\left[a-\left[\left(a-x^n\right)^{1/n}\right]^n\right]^{1/n}$$

$$=\left[a-\left(a-x^n\right)\right]^{1/n}=\left(x^n\right)^{1/n}=x$$

73. Consider $C_1\to C_1+(C_2+C_3)$

$$\begin{vmatrix}1+x+y+z & 1 & y+z\\ 1+x+y+x & 1 & z+x\\ 1+x+y+z & 1 & x+y\end{vmatrix}$$

$$=(1+x+y+z)\begin{vmatrix}1 & 1 & y+z\\ 1 & 1 & z+x\\ 1 & 1 & x+y\end{vmatrix}=0$$

74. Consider L.H.S and $C_1\to C_1-(C_2+C_3)$, we get

$$\text{LHS}=\begin{vmatrix}-2a & c+a & a+b\\ -2c & b+c & c+a\\ -2b & a+b & b+c\end{vmatrix}$$

$$=-2\begin{vmatrix}a & c+a & a+b\\ c & b+c & c+a\\ b & a+b & b+c\end{vmatrix}$$

Consider, $C_1\to C_2-C_1, C_3\to C_3-C_1$

$$=-2\begin{vmatrix}a & c & b\\ c & b & a\\ b & a & c\end{vmatrix}=2\begin{vmatrix}a & b & c\\ c & a & b\\ b & c & a\end{vmatrix} C_2\leftrightarrow C_3$$

$\therefore k=2$

75. $$\Delta=\begin{vmatrix}\log e & 2\log e & 3\log e\\ 2\log e & 3\log e & 4\log e\\ 3\log e & 4\log e & 5\log e\end{vmatrix}$$

$$=\begin{vmatrix}1 & 2 & 3\\ 2 & 3 & 4\\ 3 & 4 & 5\end{vmatrix}(\log e)^3 \quad \begin{matrix}R_1\to R_1-R_2\\ R_2\to R_2-R_3\end{matrix}$$

$$=\begin{vmatrix}-1 & -1 & -1\\ -1 & -1 & -1\\ 3 & 4 & 5\end{vmatrix}(\log e)^3=0$$

76. $$\Delta=\begin{vmatrix}x! & (x+1)! & (x+2)!\\ (x+1)x! & (x+2)(x+1)! & (x+3)(x+2)!!\\ (x+2)(x+1)x! & (x+3)(x+2)(x+1)! & (x+4)(x+3)(x+2)!\end{vmatrix}$$

$=x!\ .\ (x+1)!\,(x+2)!$

$$\begin{vmatrix}1 & 1 & 1\\ x+1 & x+2 & x+3\\ (x+1)(x+2) & (x+3)(x+2) & (x+4)(x+3)\end{vmatrix}$$

$=x!\ .\ (x+1)!\,(x+2)!$

$$\begin{vmatrix}1 & 0 & 0\\ x+1 & 1 & 2\\ (x+1)(x+2) & 2(x+2) & 4x+10\end{vmatrix}$$

$=2x!\quad (x+1)!\,(x+2)!$

77. $f(x)$ is continuous at $x=0$.

$$\Rightarrow f(0)=\lim_{x\to 0}f(x)\Rightarrow \lim_{x\to 0}f(x)=-2$$

Now, $$\lim_{x\to 0}f(x)=\lim_{x\to 0}\frac{\sqrt{1+kx}-\sqrt{1-kx}}{x}$$

$$=\lim_{x\to 0}\frac{1+kx-1+kx}{x\left[\sqrt{1+kx}+\sqrt{1-kx}\right]}$$

$$= \lim_{x\to 0} \frac{2k}{\sqrt{1+kx}+\sqrt{1-kx}} = k$$

Thus, $k=-2$

78. By data, $f(x)$ is continuous at $x=0$

$$\therefore \quad f(0) = \lim_{x\to 0} f(x)$$

$$\Rightarrow \quad \lambda = \lim_{x\to 0}\left(\frac{\cos 3x - \cos x}{x^2}\right)$$

$$\Rightarrow \quad \lambda = \lim_{x\to 0} \frac{-3\sin 3x + \sin x}{2x} \text{ (by L.H. Rule)}$$

$$\Rightarrow \quad \lambda = \lim_{x\to 0} -\frac{9}{2}\left(\frac{\sin 3x}{3x}\right) + \frac{1}{2}\lim_{x\to 0}\left(\frac{\sin x}{x}\right)$$

$$\Rightarrow \quad \lambda = -\frac{9}{2}+\frac{1}{2} = -4$$

79. $y = \log\sqrt{\sin x} \Rightarrow y = \frac{1}{2}\log(\sin x)$

$$\Rightarrow \frac{dy}{dx} = \frac{1}{2}\frac{\cos x}{\sin x} = \frac{1}{2}\cot x$$

80. $y = e^{\sin(\log x)}$

$$\frac{dy}{dx} = e^{\sin(\log x)}.\cos(\log x).\frac{1}{x}$$

$$= \frac{y}{x}\cos(\log x)$$

81. $y = \log\left[\sqrt{x+\sqrt{x^2+a^2}}\right]$

$$y = \frac{1}{2}\log\left(x+\sqrt{x^2+a^2}\right)$$

$$\frac{dy}{dx} = \frac{1}{2}\frac{1}{\sqrt{x^2+a^2}}$$

82. $y = \tan^{-1}\left(\frac{\log\left(e/x^2\right)}{\log\left(ex^2\right)}\right) + \tan^{-1}\left(\frac{4+2\log x}{1-8\log x}\right)$

$$\Rightarrow y = \tan^{-1}\left(\frac{\log e - \log x^2}{\log e + \log x^2}\right) + \tan^{-1} a + \tan^{-1}(2\log x)$$

$$y = \tan^{-1}1 - \cancel{\tan^{-1}(\log x^2)} + \tan^{-1}4 + \cancel{\tan^{-1}(\log x^2)}$$

$(\because \log e = 1)$

$$y = \tan^{-1}1 + \tan^{-1}4$$

$$\Rightarrow \frac{dy}{dx} = 0 \Rightarrow \frac{d^2y}{dx^2} = 0$$

83. $y = (\sin x)^{\tan x}$

$$\Rightarrow \frac{dy}{dx} = (\sin x)^{\tan x}\left[\frac{\tan x}{\sin x}.\cos x + \log(\sin x).\sec^2 x\right]$$

$$\Rightarrow \frac{dy}{dx} = (\sin x)^{\tan x}[1+\sec^2 x.\log(\sin x)]$$

84. We have, $\sqrt{x}+\sqrt{y} = \sqrt{a}$

$$\Rightarrow \frac{1}{2\sqrt{x}} + \frac{2}{2\sqrt{y}}\frac{dy}{dx} = 0 \Rightarrow \frac{dy}{dx} = -\sqrt{\frac{y}{x}}$$

Slope of normal $= -\left(\frac{dx}{dy}\right) = \sqrt{\frac{x}{y}}$

By data, $\sqrt{\frac{x}{y}} = 0 \Rightarrow x = 0 \Rightarrow y = a$

$\therefore$ The point is $(0,a)$.

85. We have, $f(x) = e^x \sin x . x \in [0,\pi]$

Now, $f(0)=0$ and $f(\pi)=0$. $\therefore f(0) = f(\pi)$

Also, $f(x)$ is continuous on $[0,\pi]$ and differentiable on $(0,\pi)$.

$\therefore$ by Rolle's theorem, we have, $c \in [0,\pi]$ such that $f'(c) = 0$.

Now, $f'(x) = e^x\cos x + e^x \sin x = 0$

$$\Rightarrow e^x(\cos x + \sin x) = 0$$

$$\Rightarrow \tan x = -1 \Rightarrow x = \frac{3\pi}{4}$$

86. Maximum area of a rectangle that can be inscribed in a circle of radius r units is $\frac{r^2}{2}$. Here $r=4$.

$\therefore$ area $= \frac{16}{2} = 8$ sq. units

87. $y = a\log x + bx^2 + x \Rightarrow \frac{dy}{dx} = \frac{a}{x} + 2bx + 1$

For extreme, $\frac{dy}{dx} = 0$

By data $\left(\frac{dy}{dx}\right)_{x=1} = 0$ and $\left(\frac{dy}{dx}\right)_{x=2} = 0$

$$\Rightarrow a+2b+1=0 \text{ and } \frac{a}{2}+4b+1=0$$

$$\Rightarrow a+2b+1=0 \text{ and } a+8b+2=0$$

Solving, we get $a=-\dfrac{2}{3}, b=-\dfrac{1}{6}$

88. $\displaystyle\int\frac{x^3+x^2+1}{x+1}dx=\int\frac{x^2(x+1)+1}{x+1}dx$

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

$$\left[\begin{array}{ll} x+1)x^3+x^2+1(x^2; & \dfrac{x^3+x^2+1}{x+1}=x^2+\dfrac{1}{x+1} \\ \dfrac{x^3+x^{\ 2}}{1} & \end{array}\right]$$

$\displaystyle\int\frac{x^3+x^2+1}{x+1}dx=\int x^2dx+\int\frac{1}{x+1}dx$

$\displaystyle=\frac{x^3}{3}+\log(x+1)$

89. $\displaystyle\int\frac{x^2+1}{x^4+1}dx=\int\frac{\cancel{x^2}\left(1+\frac{1}{x^2}\right)1}{\cancel{x^2}\left(x^2+\frac{1}{x^2}\right)}dx$

$\displaystyle I=\int\frac{\left(1+\frac{1}{x^2}\right)dx}{\left(x-\frac{1}{x}\right)^2+2}$

$\displaystyle x-\frac{1}{x}=t\Rightarrow\left(1+\frac{1}{x^2}\right)dx=dt$

$\displaystyle I=\int\frac{dt}{t^2+\left(\sqrt{2}\right)^2}=\frac{1}{\sqrt{2}}\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$

$\displaystyle=\frac{1}{\sqrt{2}}\tan^{-1}\left(\frac{x^2-1}{\sqrt{2}x}\right)$

90. $\displaystyle\int\frac{dx}{x^2+2x+2}=\int\frac{dx}{1+(x+1)^2}$

$=\tan^{-1}(x+1)+c$

$\Rightarrow\qquad f(x)=\tan^{-1}(x+1)$

91. $\displaystyle\int\left(e^{a\log x}+e^{x\log a}\right)dx=\int\left(e^{\log x^a}+e^{\log a^x}\right)dx$

$\displaystyle=\int\left(x^a+a^x\right)dx$

$\displaystyle=\frac{x^{a+1}}{a+1}+\frac{a^x}{\log a}+c$

92. Let, $\displaystyle f(x)=\frac{\sin x}{1+\cos^2 x}$

$\displaystyle f(\pi-x)=\frac{\sin(\pi-x)}{1-\cos^2(\pi-x)}=\frac{\sin x}{1+\cos^2 x}=f(x)$

$\displaystyle\therefore\quad\int_0^\pi x.f(x)dx=\frac{\pi}{2}\int_0^\pi f(x)dt$

$\displaystyle=\frac{\pi}{2}\int_0^\pi\frac{\sin x}{1+\cos^2 x}dx$

$\displaystyle=\frac{\pi}{2}\left[-\tan^{-1}(\cos x)\right]_0^\pi$

$\displaystyle\left(\because\frac{d}{dx}(\cos x)=-\sin x\right)$

$\displaystyle=\frac{\pi}{2}\left[\frac{\pi}{4}+\frac{\pi}{4}\right]=\frac{\pi^2}{4}$

93. $\displaystyle\int_2^3\frac{dx}{x(x-1)}=\int_2^3\left(\frac{1}{x-1}-\frac{1}{x}\right)dx$

$=\log(x-1)-\log x]_2^3$

$\displaystyle=\log\left(\frac{x-1}{x}\right)\Bigg]_2^3$

$\displaystyle=\log\frac{2}{3}-\log\frac{1}{2}=\log\frac{4}{3}$

94. $\displaystyle I=\int_{-1}^1\left(ax^3+bx\right)dx$

$f(x)=ax^3+bx\Rightarrow f(-x)=-ax^3-bx=-f(x)\forall a,b$

$I=0$ for all a and b

95. $\displaystyle I=\int_0^1\sin\left(2\tan^{-1}\sqrt{\frac{1+x}{1-x}}\right)dx$

Clearly, $\displaystyle\tan^{-1}\sqrt{\frac{1+x}{1-x}}=\frac{\pi}{2}-\frac{1}{2}\cos^{-1}x$

$\displaystyle\sin\left[2\tan^{-1}\sqrt{\frac{1+x}{1-x}}\right]=\sin(\pi-\cos^{-1}x)$

$=\sin(\cos^{-1}x)=\sqrt{1-x^2}$

$\displaystyle I=\int_0^1\sqrt{1-x^2}\ dx=\frac{x}{2}\sqrt{1-x^2}+\frac{1}{2}\sin^{-1}x\Bigg]_0^1$

$\displaystyle=\frac{1}{2}.\frac{\pi}{2}=\frac{\pi}{4}$

Or Put $x=\cos\theta\Rightarrow dx=-\sin\theta d\theta$;

$\displaystyle I=\int_{\frac{\pi}{2}}^0\sin\left[2\left(\frac{\pi}{2}-\frac{\theta}{2}\right)\right].(-\sin\theta)d\theta$

$\displaystyle=\int_{\frac{\pi}{2}}^0\sin^2\theta d\theta=\frac{\pi}{4}$

96. $y=0 \Rightarrow 4x-x^2=0$

$\Rightarrow x(4-x)=0 \Rightarrow x=0, x=4$

$\therefore \quad A=\int_0^4 ydx=\int_0^4 (4x-x^2)dx$

$=2x^2-\left.\frac{x^3}{3}\right]_0^4=32-\frac{64}{3}=\frac{32}{3}$

97. Solving $x^2=8y$ and $x-2y+8=0$, we get, $x=-4,8$.

$\therefore$ required area

$=\int_{-4}^{8}\left[\left(\frac{x+8}{2}-\frac{x^2}{8}\right)\right]dx$

$=\left.\frac{x^2}{4}+4x-\frac{x^3}{24}\right]_{-4}^{8}$

$=\left(16+32-\frac{64}{3}\right)-\left(4-16+\frac{8}{3}\right)$

= 36 sq. units

98. $y=x^2$ and $y=4x-x^2 \Rightarrow x=0, x=2$

$\therefore A=\int_0^2\left[x^2-\left(4x-x^2\right)\right]dx$

$=\int_0^2\left(2x^2-4x\right)dx$

$=\left.\frac{2x^3}{3}-2x^2\right]_0^2=\frac{8}{3}$ numerically

99. The equation can be written as

$$\left(\frac{d^2y}{dx^2}\right)^5+\left(\frac{d^3y}{dx^3}\right)+4\left(\frac{d^2y}{dx^2}\right)^3+\left(\frac{d^3y}{dx^3}\right)^2=(x^2-1)\frac{d^3y}{dx^3}$$

Clearly $m=3, n=2$

100. $y=A\cos\omega t+B\sin\omega t$

$\Rightarrow y"=-A\omega\sin\omega t+B\omega\cos\omega t$

$\Rightarrow y"=-A\omega^2\cos\omega t+B\omega^2\sin\omega t$

$\Rightarrow y"=-\omega^2(A\cos\omega t+B\sin\omega t) \Rightarrow y"=-\omega^2 y$

101. We have, $ydx+(x+x^2y)dy=0$

$\Rightarrow \; ydx+xdy+x^2ydy=0$

$\Rightarrow \; \int\frac{ydx+xdy}{(xy)^2}+\int\frac{1}{y}dy-k \qquad \ldots(1)$

Clearly, $\frac{d}{dx}\left(\frac{1}{xy}\right)^2=-\frac{1}{(xy)^2}d(xy)$

$=-\frac{1}{(xy)^2}(xdy+ydx)$

$\therefore \quad \int\frac{ydx+xdy}{(xy)^2}=-\frac{1}{xy}$

$(1) \Rightarrow -\frac{1}{xy}+\log y=k$

102. We have,

$(\sin x+\cos x)dy+(\cos x-\sin x)dx=0$

$\Rightarrow \quad \int dy+\int\frac{\cos x-\sin x}{\sin x+\cos x}dx=k$

$\Rightarrow \quad y+\log(\sin x+\cos x)=\log c$

$\Rightarrow y=\log\left(\frac{c}{\sin x+\cos x}\right) \Rightarrow e^y(\sin x+\cos x)=c$

103. We have, $P(A\cup B)=P(A)+P(B)-P(A\cap B)$

$\Rightarrow \; P(A\cup B)+P(A\cap B)=1-P(\bar{A})+1-P(\bar{B})$

$\Rightarrow 0.8+0.3=2-(P(\bar{A})+P(\bar{B}))$

$\Rightarrow \; P(\bar{A})+P(\bar{B})=2-1.1=0.9$

104. UNIVERSITY has 10 letters. $\therefore \; n(S)=\frac{10!}{2!}$

Considering two I's as one letter, we have $n(E)=9!$

$\therefore$ Probability that two I's are together

$=\frac{9!}{(10!/2!)}=\frac{2!\times 9!}{10!}=\frac{1}{5}$

Required probability $=1-\frac{1}{5}=\frac{4}{5}$

105. There are three letters and three envelopes. These can be put in $3P_3=6$ ways.

Out of these 6 ways only one is correct.

$\therefore$ Required probability $=\frac{1}{6}$

106. Let E be the event that 4 appears at least once

$E=\{(1,4),(2,4),(3,4),(4,4),(5,5),(6,4),(4,6),(4,5)$
$(4,3),(4,2),(4,1)\}$

$\therefore n(E)=11$ and also $n(S)=36$

$\therefore$ required probability $=\frac{11}{36}$

107.In 22nd century three will be 25 leap years and 75 non leap years.

A be the event of selecting a non leap year

$n(A)=75$

$\therefore \quad P(A)=\frac{75}{100}=\frac{3}{4}$

$P(C)=$ probability that a non leap year to have fifty three Sundays is $\frac{1}{7}$

$\therefore \quad P(A\cap C)=P(A).P(C)=\frac{3}{4}.\frac{1}{7}=\frac{3}{28}$

B be the event of selecting a leap year $n(B)=25$

$\therefore \quad P(B)=\frac{25}{100}=\frac{1}{4}$

$P(D)=$ Probability that a leap year to have fifty three Sundays is $\frac{2}{7}$

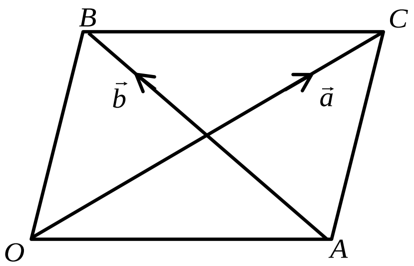
$\therefore \quad P(B\cap D)=P(B).P(D)=\frac{1}{4}.\frac{2}{7}=\frac{2}{28}$

$\therefore$ Required probability $=\frac{3}{28}+\frac{2}{28}=\frac{5}{28}$

108.Objective function is a linear function which is to be optimised.

109.Clearly, $Z_{\max}+Z_{\min}=15-32=17$

110.Mid point of $\vec{AB}$ = Mid point of $\vec{OC}$



$\Rightarrow \quad \frac{\vec{a}}{2}=\frac{\vec{OA}+\vec{OB}}{2}$

$\Rightarrow \quad \vec{a}=2\vec{OA}+\vec{OB}-\vec{OA}$

$\Rightarrow \quad \vec{a}=2\vec{OA}+\vec{AB}$

$\Rightarrow \quad \vec{a}=2\vec{OA}+\vec{b}$

$\Rightarrow \quad \vec{OA}=\frac{\vec{a}-\vec{b}}{2}$

111.We have, $\vec{GA}+\vec{GB}+\vec{GC}=\vec{0}$ (standard result)

$\Rightarrow \vec{GA}+\vec{BG}+\vec{GC}-\vec{BG}+\vec{GB}=\vec{0}$

$\Rightarrow \vec{GA}+\vec{BG}+\vec{GC}=2\vec{BG} \qquad (\because \vec{GB}=-\vec{BG})$

112.Among the four options (d) is the only a unit vector. Thus the answer must be (d).

Or

The required unit vector is along $\vec{a}\times\left(\vec{b}\times\vec{c}\right)$

113.Consider, $\vec{u}\times\vec{v}=\left(\vec{a}-\vec{b}\right)\times\left(\vec{a}+\vec{b}\right)$

$=-\vec{b}\times\vec{a}+\vec{a}\times\vec{b}$

$=2\left(\vec{a}\times\vec{b}\right)$

$\left|\vec{a}\times\vec{b}\right|^2=\left|\vec{a}\right|^2.\left|\vec{b}\right|^2-\left(\vec{a}.\vec{b}\right)^2$

$=16-\left(\vec{a}.\vec{b}\right)^2$

$\left|\vec{a}\times\vec{b}\right|^2=\sqrt{16-\left(\vec{a}.\vec{b}\right)^2}$

$\therefore \quad \left|\vec{u}\times\vec{v}\right|=2\sqrt{16-\left(\vec{a}.\vec{b}\right)^2}$

114.By data, $\left|\vec{a}\times\vec{b}\right|=20$

Now, $\left(7\vec{a}+5\vec{b}\right)\times\left(8\vec{a}+11\vec{b}\right)$

$=77\left(\vec{a}+\vec{b}\right)-40\left(\vec{a}\times\vec{b}\right)=37\left(\vec{a}\times\vec{b}\right)$

$=\left|\left(7\vec{a}+5\vec{b}\right)\times\left(8\vec{a}+11\vec{b}\right)\right|=37\left|\vec{a}\times\vec{b}\right|$

$=37\times 20$

= 740 sq. units.

115.Standard result : $\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1$.

116.Any point on, $\frac{x-1}{3}=\frac{y+2}{4}=\frac{z-3}{-2}$ is

$(3\lambda+1, 4\lambda-2, -2\lambda+3)$

This must lie on $2x-y+3z-1=0$

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

$\Rightarrow 6\lambda+2-4\lambda+2+9-6\lambda-1=0$

$\Rightarrow -4\lambda+12=0 \Rightarrow \lambda=3$

$\therefore$ the point of intersection is (10,10,-3)

Or

Verify which point lies on both the line and the plane, by actual verification.

117. Equation of the required plane is given by

$$\begin{vmatrix} x-5 & y-7 & z+3 \\ 4 & 4 & -5 \\ 7 & 1 & 3 \end{vmatrix} = 0$$

$$\Rightarrow (x-5)17 + (y-7)47 + (z+3)(-24) = 0$$

$$\Rightarrow 17x - 47y - 24z + 172 = 0$$

118. Clearly the required plane passes through the point (3, 6, 4), which lies on the line.

$\therefore$ Equation of the plane is of the form

$a(x-3) + b(y-6) + c(z-4) = 0$

As line is parallel to this plane we have,

$a + 5b + 4c = 0$

Again plane passes through (3, 2, 0)

$\Rightarrow 0 - 4b - 4c = 0$

$$\Rightarrow \frac{a}{-20+16} = \frac{-b}{-4-0} = \frac{c}{-4+0} \Rightarrow \frac{a}{1} = \frac{b}{-4} = \frac{c}{1}$$

Thus required plane is $x - y + z - 1 = 0$

119. Equation of the line passing through (1, 1, 1) is of the form,

$$\frac{x-1}{l} = \frac{y-1}{m} = \frac{z-1}{n}$$

This is parallel to the plane $2x + 3y + z + 5 = 0$

$\Rightarrow 2l + 3m + n = 0$

Clearly, the d.r's of the line in the option (b) satisfy this condition.

$\therefore$ equation of the line is $\dfrac{x-1}{-1} = \dfrac{y-1}{1} = \dfrac{z-1}{-1}$

120. Equation of the plane passing through (1, 1, 1) is given by

$a(x-1) + b(y-1) + c(z-1) = 0$

This plane is perpendicular to the plane.

$x + 2y + 3z - 7 = 0$ and $2x - 3y + 4z = 0$

$$\Rightarrow \left.\begin{matrix} a + 2b + 3c = 0 \\ 2a - 3b + 4c = 0 \end{matrix}\right]$$

$$\Rightarrow \frac{a}{8+9} = \frac{-b}{4-6} = \frac{c}{-3-4} \Rightarrow \frac{a}{17} = \frac{b}{2} = \frac{c}{-7}$$

$\therefore$ equation of the plane is,

$17(x-1) + 2(y-1) - 7(z-1) = 0$

$\Rightarrow \quad 17x + 27 - 7z = 12$

Physics Solutions:

121. All measurements are correct upto two places of decimal. However, the absolute error in (a) is 0.01mm which is least of all the four. So it is most precise.

122. Speedometer of the car measures the instantaneous speed of the car.

123. Owing to its high specific heat, water is used as a coolant in automobile radiators as well as a heater in hot water bags.

124. $Z = \dfrac{A^4 B^{1/3}}{CD^{3/2}}$

The relative error in Z is given by

$$\frac{\Delta Z}{Z} = 4\frac{\Delta A}{A} + \frac{1}{3}\frac{\Delta B}{B} + \frac{\Delta C}{C} + \frac{3}{2}\frac{\Delta D}{D}$$

125. $PV = \dfrac{m}{M}RT$ (for m grams of gas) … (i)

$P'V = \dfrac{m'}{M}RT'$ … (ii)

Dividing equation (ii) by (i) we get

$$\frac{P'}{P} = \frac{m'}{m}\frac{T'}{T}$$

$$m' = \frac{P'}{P} \times \frac{T}{T'} \times m = \left(\frac{P/2}{P}\right) \times \frac{400}{300} \times 6 = 4\,\text{g}$$

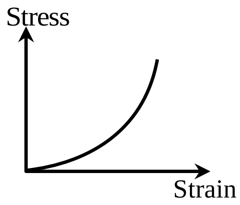
$\therefore$ Mass of oxygen leaked

$\Delta m = m - m' = 6 - 4 = 2\,\text{g}$

126. The given diagram shows that the curves move away from the origin at higher temperature.

127. The water level falls in the vessel.

128. Sol:



129. May lie within or outside the body.

130. When a disc rotates with uniform angular velocity, angular acceleration of the disc is zero. Hence, option (d) is not true.

131. Figure shows that slope of $x-t$ graph changes from positive to negative at $t=2\,s$, and it changes from negative to positive at $t=4\,s$ and so on. Thus direction of velocity is reversed aver every two seconds. Hence, the body must be receiving consecutive impulses after every two seconds.

132. As acceleration of the box is due to static friction,

$\therefore \quad ma = f_s \le \mu_s N = \mu_s mg$

$a \le \mu_s g$

$\therefore \quad a_{max} = \mu_s g = 0.2\times 10\,\text{ms}^{-2} = 2\text{ms}^{-2}$

133. The reading on the scale is a measure of the force on the floor by the person. By the Newton's third law this is equal and opposite to the normal force N on the person by the floor.

$\therefore$ When the lift is ascending upwards with a acceleration of $9\,\text{ms}^{-2}$, then

$N - 50\times 10 = 50\times 9$

or $N = 50\times 10 + 50\times 9 = 50(10+9) = 950\,\text{N}$

$\therefore$ The reading of weighing machine is $95\,\text{kg}$.

134. Here, $\upsilon = 3.2\text{ MHz} = 3.2\times 10^6\,\text{Hz} = 3.2\times 10^6\,\text{s}^{-1}$

$v = 1.6\,\text{km s}^{-1} = 1.6\times 10^3\,\text{ms}^{-1}$

Wavelength, $\lambda = \dfrac{v}{\upsilon} = \dfrac{1.6\times 10^3\,\text{ms}^{-1}}{3.2\times 10^6\,\text{s}^{-1}}$

$= 0.5\times 10^{-3}\,\text{m} = 0.5\,\text{mm}$

135. According to Kepler's third law $T^2 \propto R^3$

$\therefore \quad \dfrac{T_1}{T_2} = \left(\dfrac{R_1}{R_2}\right)^{3/2}$ or

$R_2 = (R_1)\left(\dfrac{T_2}{T_1}\right)^{2/3} = (R_1)\left(\dfrac{16}{2}\right)^{2/3}$

$= 4R_1 = 4R$ (given $R_1 = R$) $\ldots$(i)

Orbital velocity, $v_0 = \sqrt{\dfrac{GM}{R}}$

$\therefore \quad \dfrac{v_{o2}}{v_{01}} = \sqrt{\dfrac{R_1}{R_2}} = \sqrt{\dfrac{R_1}{4R_1}} = \dfrac{1}{2}$ (using (i))

or $v_{02} = \dfrac{1}{2}v_{o1} = \dfrac{1}{2}v_0$

136. G has different value in different system of units. In SI system the value of G is $6.67\times 10^{-11}\,\text{N m}^2\,\text{kg}^{-2}$ whereas in CGS its value is $6.67\times 10^{-8}\,\text{dyne cm}^2\text{g}^{-2}$. The value of G is same throughout the universe. The value of G was first experimentally determined by English scientist Henry Gavendish. G is a scalar quantity.

137. 6

138. By quantisation of charge, $q = ne$

or $n = \dfrac{q}{e} = \dfrac{-1\text{C}}{-\left(1.6\times 10^{-19}\right)} = 6\times 10^{18}$ electrons

139. $F = qE = 5\times 10^{-6}\times 2\times 10^5 = 1\,\text{N}$

Since, the particle is thrown against the field

$\therefore \quad a = -F/m = -\dfrac{1}{10^{-3}} = -10^3\,\text{ms}^{-2}$

As $v^2 - u^2 = 2as$

$\therefore \quad 0^2 - (20)^2 = 2\times\left(-10^3\right)\times s$

or $s = 0.2\,\text{m}$

140. Here, $r = 10\,\text{cm} = 0.1\,\text{m}$

$E = 5\times 10^5\ \text{N C}^{-1}$

As the angle between the plane sheet and the electric field is $60°$, angle made by the normal to the plane sheet and the electric field is $\theta = 90° - 60° = 30°$

$\phi_E = ES\cos\theta = E\times \pi r^2\cos\theta$

$= 5\times 10^5\times 3.14\times(0.1)^2\cos 30°$

$= 1.36\times 10^4\ \text{N m}^2\,\text{C}^{-1}$

141. As the capacitor is isolated after charging, charge on it remains constant. Plate separation d increases, capacitance decreases as $C = \dfrac{\varepsilon_0 A}{d}$ and hence, potential increases as $V = \dfrac{q}{C}$

142.Capacitance of a parallel plate capacitor is

$$C=\frac{\varepsilon_0 A}{d} \quad \ldots(i)$$

Potential difference between the plates is

$$V=Ed \quad \ldots(ii)$$

The energy stored in the capacitor is

$$U=\frac{1}{2}CV^2=\frac{1}{2}\left(\frac{\varepsilon_0 A}{d}\right)(Ed)^2 \quad \text{(using (i) and (ii)}$$

$$=\frac{1}{2}\varepsilon_0 E^2 Ad$$

143.The electrical resistance of a conductor is depend upon all factors size, temperature and geometry of conductor.

144.In conductors due to increase in temperature the resistivity increases and in semiconductors it decreases exponentially.

145.Between points A and B all resistances are combined in series

$$\therefore\ R_{eq}=3\Omega+4\Omega+5\Omega+6\Omega=18\Omega$$

146. $V_A-V_B=2\times 2=4\,\text{V}$

$$\therefore\ V_A-0=4\,\text{V}\Rightarrow V_A=4\text{V}$$

According to question $V_B=0$

Point D is connected to positive terminal of battery of emf $3\,\text{V}$.

147.The bridge will be balanced when the shunted resistance is of the value of 3Ω

$$\therefore\ 3=\frac{4\times R}{4+R}$$

$$12+3R=4R$$

$$\therefore\ R=12$$

148.Internal resistance of cell

$$r=R\left(\frac{l_1}{l_2}-1\right)$$

$$R=10.2\,\Omega,\ l_1=75.8\,\text{cm}$$

$$l_2=68.3\,\text{cm}$$

$$r=10.2\left(\frac{75.8}{68.3}-1\right)=1.12\,\Omega$$

149.The value of threshold frequency υ_0 for A is less than that for B, hence $\phi_A<\phi_B$.

150.Here, $eV=\frac{hc}{\lambda}-W_0$

$$0.5e=\frac{hc}{6\times10^{-7}}-W_0$$

$$\Rightarrow 0.5=\frac{h}{e}\left(\frac{c}{6\times10^{-7}}\right)-\frac{W_0}{e} \quad \ldots(i)$$

Similarly, $1.5=\frac{h}{e}\left(\frac{c}{4\times10^{-7}}\right)-\frac{W_0}{e} \quad \ldots(ii)$

From equation (i) and (ii),

$$1=\frac{h}{e}\frac{c}{10^{-7}}\left[\frac{1}{4}-\frac{1}{6}\right]\Rightarrow\frac{h}{e}=\frac{12\times10^{-7}}{3\times10^{8}}=4\times10^{-15}\,\text{V s}$$

151.The de Broglie wavelength is given by $\lambda=\frac{h}{p}=\frac{h}{mv}$

So if the velocity of the electron increases, the de Broglie wavelength decreases.

152.As Melbourne is situated in southern hemisphere where north pole of earth's magnetic field lies therefore magnetic lines of force seem to come out of the ground.

153.Ferromagnetic materials are having magnetic susceptibility $\chi>>1$, hence on the basis of this result the possible material is a ferromagnetic material.

154.Core of electromagnets are made of soft iron that is a ferromagnetic material with high permeability and low retentivity.

155.Current sensitivity of galvanometer is deflection per unit current i.e.,

$$\frac{\phi}{I}=\frac{NAB}{k} \quad \ldots(i)$$

Similarly voltage sensitivity is deflection per unit voltage i.e.

$$\frac{\phi}{V}=\left(\frac{NAB}{K}\right)\frac{I}{V}=\left(\frac{NAB}{k}\right)\frac{I}{R} \quad \ldots(ii)$$

From (i) and (ii)

Voltage sensitivity $=\text{current sensitivity}\times\frac{1}{\text{resistance}}$

Now if current sensitivity is doubled, then the resistance in the circuit will also be doubled since it is proportional to the length of the wire, then voltage sensitivity

$$=(2\times\text{current sensitivity})\times\frac{1}{(2\times\text{resistance})}$$

$$(\text{current sensitivity})\times\frac{1}{(\text{resistance})}$$

Hence, voltage sensitivity will remain unchanged.

156.From Ampere circuital law

$$\oint\vec{B}\cdot\vec{dl}=\mu_0 I_{\text{enc}}$$

$$B\times 2\pi R=\mu_0 I_{\text{enc}}$$

$$B=\frac{\mu_0 I_{\text{enc}}}{2\pi R}=2\times10^{-7}\times\frac{75}{3}=5\times10^{-6}\,\text{T}$$

The direction of field at the given point will be vertical up determined by the screw rule or right hand rule.

157. $v=3.2\times10^{7}\,\text{ms}^{-1}$

$B=5\times10^{-4}\,\text{T}$

The frequency of electron is

$$\upsilon=\frac{qB}{2\pi m}=\frac{1.6\times10^{-19}\times5\times10^{-4}}{2\times3.14\times9.1\times10^{-31}}$$

$$\upsilon=1.4\times10^{7}\,\text{Hz}=14\,\text{MHz}$$

158.Balmer series.

159.Angular momentum $=\dfrac{nh}{2\pi}$

$$\Rightarrow \text{moment of momentum }=\frac{nh}{2\pi}$$

$$\Rightarrow p\times r_n=\frac{nh}{2\pi}$$

$$\frac{h}{\lambda}r_n=\frac{nh}{2\pi}\Rightarrow\lambda=\frac{2\pi r_n}{n}$$

For 1st orbit, $n=1,\ \lambda=2\pi r_1$

$\Rightarrow \lambda=$ circumference of 1st orbit.

160. ${}_1H^2+{}_1H^2\rightarrow{}_2He^4+\Delta E$

The binding energy per nucleon of a helium nuclei $=7\,\text{MeV}$

$\therefore$ Total binding energy $=4\times7=28\,\text{MeV}$

Hence, energy released

$$\Delta E=(28-2\times2.2)=23.6\,\text{MeV}$$

161.Total linear momentum, total angular momentum and total energy will be conserved.

162.Magnetic energy, $U=\dfrac{1}{2}LI^2$

$$\therefore\ L=\frac{2U}{I^2}=\frac{2\times648}{(9)^2}=16\,\text{H}$$

Induced emf,

$$\varepsilon=-L\frac{dI}{dt}=\frac{-(16\text{H})(0-9\text{A})}{0.45\,\text{s}}=320\,\text{V}$$

163.The direction of induced emf is reversed after every half revolution of the loop.

164.Here, $l=r=5\,\text{cm}=5\times10^{-2}\,\text{m}$,

$$\omega=2\pi\left(\frac{1800}{60}\right)\text{rad s}^{-1}=60\pi\,\text{rad s}^{-1},$$

$$B=1\,\text{Wb m}^{-2}$$

$$\varepsilon=\frac{1}{2}Bl^2\omega=\frac{1}{2}\times1\times\left(5\times10^{-2}\right)^2\times60\pi=0.23\,\text{V}$$

165. $v=120\sin(100\pi t)\cos(100\pi t)\,\text{V}$

$$=60\sin(200\pi t)\qquad(\because\ \sin2\theta=2\sin\theta\cos\theta)$$

Compare it with standard equation

$V=V_0\sin\omega t$

We get

$V_0=60\,\text{V}$ and $\omega=200\pi$ or $2\pi\upsilon=200\pi$ or $\upsilon=100\,\text{Hz}$

166.In a capacitive ac circuits, the voltage lags behind the current in phase by $\pi/2$ radian.

167.At resonance frequency, the inductive and capacitive reactance are equal.

i.e., $X_L=X_C$

$\therefore$ Impedance,

$$Z=\sqrt{R^2+(X_L-X_C)^2}=\sqrt{R^2+O^2}=R$$

168.Here, Transformation ratio, $k=0.3$

$$\text{As, } k=\frac{N_s}{N_p}=\frac{V_s}{V_p}$$

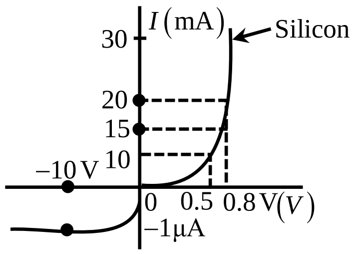
$$\therefore\ V_s=kV_p=0.3\times220=66\,\text{V}$$

169. $E_g = \frac{hc}{\lambda} = \frac{1240\,\text{eV nm}}{2480\,\text{nm}} = 0.5\,\text{eV}$

170. There the mobile charges exist.

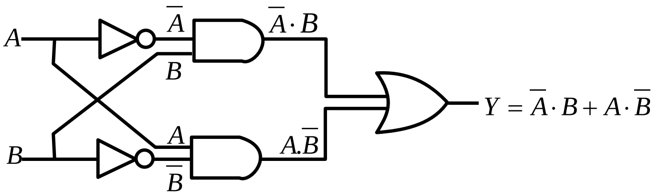
171. In diagram, At $I = 20\,\text{mA}$, $V = 0.8\,\text{V}$ and

At $I = 10\,\text{mA}, V = 0.7\,\text{V}$



$$Br_{fb} = \frac{\Delta V}{\Delta I} = \frac{0.1\,\text{V}}{10\,\text{mA}} = 10\,\Omega$$

172. $Y = \overline{A} \cdot B + A \cdot \overline{B}$



The truth table for the given logic circuit is

173. The process of changing the frequency of a carrier wave (modulated wave) in accordance with the audio frequency signal (modulating wave) is known as frequency modulation (FM).

174. Since the refractive index is less at the beam boundary, the ray at the edges of the beam move faster compared to the axis of beam. Hence, the beam converges.

175. For total internal reflection, $\sin i > \sin C$ where, $i =$ angle of incidence, $C =$ critical angle.

But, $\sin C = \frac{1}{\mu}$ $\therefore$ $\sin i > \frac{1}{\sin i}$

$\mu > \frac{1}{\sin 45^\circ}$ $\quad$ $(i = 45^\circ$ (Given))

$\mu > \sqrt{2}$

Hence, option (c) is correct.

176. Using, $\mu = \frac{\sin(A + \delta_m)/2}{\sin A/2}$

Here, $A = \frac{\pi}{3} = 60^\circ$, $\delta_m = \frac{\pi}{6} = 30^\circ$, $c = 3 \times 10^8\,\text{ms}^{-1}$

$\therefore \mu = \frac{\sin(60^\circ + 30^\circ)/2}{\sin 60^\circ/2} = \frac{0.7071}{0.50} = 1.414$

Therefore, $v = \frac{c}{\mu} = \frac{3 \times 10^8}{1.414}$

$v = 2.12 \times 10^8\,\text{ms}^{-1}$

177. Converging spherical.

178. Here, $\frac{I_{max}}{I_{min}} = \frac{25}{9}$

or $\left(\frac{A_1 + A_2}{A_1 - A_2}\right)^2 = \frac{25}{9}$

$$\frac{\frac{A_1}{A_2} + 1}{\frac{A_1}{A_2} - 1} = \frac{5}{3} \Rightarrow \frac{A_1}{A_2} = 4$$

$\therefore$ Width ratio of two slits $\frac{d_1}{d_2} = \frac{A_1^2}{A_2^2} = \frac{16}{1} = 16:1$

179. Angular position of first dark fringe

$\theta_1 = (2 \times 1 - 1)\frac{\lambda}{2d} = \frac{\lambda}{2d}$

$= \frac{5460 \times 10^{-10}}{2 \times 0.1 \times 10^{-3}} = 2730 \times 10^{-6}\,\text{rad}$

$= 2730 \times 10^{-6} \times \frac{180}{\pi} = 0.16^\circ$

180. New limit of resolution $= \frac{4800}{6000} \times 0.1\,\text{mm}$

$= 0.08\,\text{mm}$