EAMCET MODEL PAPER

ENGINEERING

No. of Questions: 160 **Maximum Marks: 160** **Time: 3 hours**

MATHEMATICS

1. The number of arrangements that can be formed by taking all the letters {T, U, E, S, D, A,Y}.

1) 720 2) 5040 3) 120 4) 40320

2. If all permutations of the letters of the word AGAIN are arranged as in dictionary then fiftieth word is

1) NAAGI 2) NAGAI 3) NAAIG 4) NAIAG

3. In how many ways can 4 scholarships be distributed among 6 M.P.C., 5 Bi.P.C., 4 C.E.C., students so as not exclude any group?

1) 6! 2) 360 3) 120 4) 240

4. The sum of the rational terms in the expansion of $\left(\sqrt{2} + 3^{1/5}\right)^{10}$ is

1) 41 2) 230 3) 520 4) none

5. $1 + \frac{1}{4} + \frac{1.3}{4.8} + \frac{1.3.5}{4.8.12} + \ldots\ldots\ldots\ldots$

1) $\sqrt{2}$ 2) $\frac{1}{\sqrt{2}}$ 3) $\sqrt{3}$ 4) $\frac{1}{\sqrt{3}}$

6. $\frac{1}{2} - \frac{1}{2} \cdot \frac{1}{2^2} + \frac{1}{3} \cdot \frac{1}{2^3} - \frac{1}{4} \cdot \frac{1}{2^4} + \ldots\ldots\ldots =$

1) $\log_e 2$ 2) $\log_e 3$ 3) $\log_e 5$ 4) $\log_e \left(\frac{3}{2}\right)$

7. If α, β are the roots of $ax^2 + bx + c = 0$ then $\frac{\alpha^3 + \beta^3}{\alpha^{-3} + \beta^{-3}} =$

1) $\frac{c^2}{a^2}$ 2) $\frac{c^3}{a^3}$ 3) $\frac{3abc - b^3}{c^3}$ 4) $\frac{b^2 - 2ac}{ac}$

8. The real values of x for which $y = \sqrt{\frac{(x + 1)(x - 3)}{x - 2}}$ takes real values are

1) $-1 \le x < 2$ or $x \ge 3$ 2) $1 < x < 2$ or $x > 2$

3) $x < 2$ or $x > 3$ 4) $x > 2$

9. If $A = [\,1\ 2\ 3\ 4\,]$, $B = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}$ then AB =

1) [5 3] 2) [30] 3) $\begin{bmatrix} -1 & 3 & 2 \\ -2 & 6 & 4 \\ -3 & 9 & 6 \end{bmatrix}$ 4) $\begin{bmatrix} 10 \\ -4 \end{bmatrix}$

10. If n is positive integer, $A = \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$ then A^n is

1) $\begin{bmatrix} a^n & 0 & 0 \\ 0 & b^n & 0 \\ 0 & 0 & c^n \end{bmatrix}$ 2) $\begin{bmatrix} 0 & 0 & 0 \\ 0 & b^n & 0 \\ a^n & 0 & c^n \end{bmatrix}$ 3) $\begin{bmatrix} a^n & 0 & c^n \\ 0 & b^n & 0 \\ 0 & 0 & 0 \end{bmatrix}$ 4) $\begin{bmatrix} 0 & 0 & c^n \\ 0 & b^n & 0 \\ a^n & 0 & 0 \end{bmatrix}$

11. $\begin{bmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{bmatrix} =$

1) 0 2) 1 3) ω 4) ω^2

12. A is a square matrix satisfying the equation $A^2 - 4A - 5I = O$ then $A^{-1} =$

1) $A - 4I$ 2) $\frac{1}{3}(A - 4I)$ 3) $\frac{1}{4}(A - 4I)$ 4) $\frac{1}{5}(A - 4I)$

13. If θ is the real then the modulus of $\frac{1}{1 + \cos\theta + i\sin\theta}$ is

1) $\frac{1}{2}\sec\frac{\theta}{2}$ 2) $\frac{1}{2}\cos\frac{\theta}{2}$ 3) $\sec\frac{\theta}{2}$ 4) $\cos\frac{\theta}{2}$

14. The value of $(i)i$ is

1) ω 2) $-\omega^2$ 3) $\frac{\pi}{3}$ 4) none

15. $\frac{\tan\alpha + \sec\alpha - 1}{\tan\alpha - \sec\alpha + 1} =$

1) $\frac{1 - \sin\alpha}{\cos\alpha}$ 2) $\frac{1 + \sin\alpha}{\cos\alpha}$ 3) $\frac{1 - \cos\alpha}{\sin\alpha}$ 4) $\frac{1 + \cos\alpha}{\sin\alpha}$

16. If $p = \tan 8A$, $q = \tan 5A$, $r = \tan 3A$ then $\frac{p - q - r}{pqr} =$

1) 1 2) 2 3) -1 4) -2

17. The minimum and maximum values of $\cos\theta + 2\sqrt{2}\sin\theta$ are

1) $-3, 3$ 2) $3, -3$ 3) $[-3, 3]$ 4) $[0, 3]$

18. The general solution of $\tan 5x = \cot 3x$ is x =

1) $(2n + 1)\frac{\pi}{4}$ 2) $(2n + 1)\frac{\pi}{8}$ 3) $(2n + 1)\frac{\pi}{16}$ 4) $(2n + 1)\frac{\pi}{32}$

19. $\tan\theta\tan(120° - \theta)\tan(120° + \theta) = \frac{1}{\sqrt{3}}$, $\theta =$

1) $\frac{n\pi}{3} + \frac{\pi}{18}, n \in Z$ 2) $\frac{n\pi}{3} + \frac{\pi}{12}, n \in Z$

3) $\frac{n\pi}{12} + \frac{\pi}{12}, n \in Z$ 4) $\frac{n\pi}{3} + \frac{\pi}{6}, n \in Z$

20. $\cos\left[\cos^{-1}\left(\frac{-1}{7}\right) + \sin^{-1}\left(\frac{-1}{7}\right)\right] =$

1) $\frac{-1}{3}$ 2) 0 3) $\frac{1}{3}$ 4) $\frac{4}{9}$

21. The solution of $\sin^{-1}\frac{2a}{1+a^2} - \cos^{-1}\frac{1-b^2}{1+b^2} = \tan^{-1}\frac{2x}{1-x^2}$ is

1) $\frac{a+b}{1-ab}$ 2) $\frac{a-b}{1+ab}$ 3) $\frac{ab-1}{a+b}$ 4) $\frac{ab+1}{a-b}$

22. $\dfrac{1+\tan h\,\frac{x}{2}}{1-\tan h\,\frac{x}{2}} =$

1) e^{-x} 2) e^{x} 3) $2e^{x/2}$ 4) $2e^{-x/2}$

23. $\tan h^{-1}\left(\frac{1}{2}\right) + \cot h^{-1}(2) =$

1) $\frac{1}{2}\log 3$ 2) $\frac{1}{2}\log 6$ 3) $\frac{1}{2}\log 12$ 4) $\log 3$

24. In Δ ABC, $\frac{a}{\cos A} = \frac{b}{\cos B} = \frac{c}{\cos C}$ if b = 2, then the area of the triangle is

1) $\sqrt{2}$ 2) $\sqrt{3}$ 3) 2 4) 3

25. $\cos A + \cos B + \cos C =$

1) $1+\frac{r}{R}$ 2) $1-\frac{r}{R}$ 3) $1-\frac{R}{r}$ 4) $1+\frac{R}{r}$

26. If the angle of elevation of the top of a tower of height 100 mt from a point to its foot is $\tan^{-1}\left(\frac{4}{5}\right)$ then the distance from the point to its foot is

1) 125 mt 2) 150 mt 3) 200 mt 4) 360 mt

27. O is the orthocenter, G is the centroid, S is circumcentre of Δ ABC then $\overline{SA}+\overline{SB}+\overline{SC} =$

1) $\overline{SO}$ 2) $\overline{OS}$ 3) $\overline{SG}$ 4) $\overline{OG}$

28. Let ABCDEF be a regular hexagon and $\overline{AB} = \overline{a}$, $\overline{BC} = \overline{b}$, $\overline{CD} = \overline{c}$ then $\overline{AE}$ is equal to

1) $\overline{a}+\overline{b}+\overline{c}$ 2) $\overline{b}+\overline{c}$ 3) $\overline{a}+\overline{b}$ 4) $\overline{a}+\overline{c}$

29. If the number of distinct real values of λ for which the vectors $-\lambda^2\overline{i}+\overline{j}+\overline{k}$, $\overline{i}-\lambda^2\overline{j}+\overline{k}$ and $\overline{i}+\overline{j}-\lambda^2\overline{k}$ are coplanar is n then $n^2-2=$

1) 0 2) 2 3) 1 4) 3

30. If $\overline{a}.\overline{i} = \overline{a}.(\overline{i}+\overline{j}) = \overline{a}.(\overline{i}+\overline{j}+\overline{k}) = 1$ then $\overline{a} =$

1) $\overline{i}$ 2) $\overline{j}$ 3) $\overline{k}$ 4) $\overline{i}+\overline{j}+\overline{k}$

31. If $\bar{a} = \bar{i} + \bar{j} + \bar{k}$, $\bar{b} = 2\bar{i} - 3\bar{j} + \bar{k}$ then $\bar{a} \times \bar{b} =$

1) $4\bar{i} + \bar{j} - 5\bar{k}$ 2) $4\bar{i} - \bar{j} + 5\bar{k}$ 3) $4\bar{i} + \bar{j} + \bar{k}$ 4) $4\bar{i} - \bar{j} - 5\bar{k}$

32. If $\bar{r} \times \bar{b} = \bar{c} \times \bar{b}$, $\bar{r} . \bar{a} = 0$, $\bar{a} = 2\bar{i} + 3\bar{j} - \bar{k}$, $\bar{b} = 3\bar{i} - \bar{j} + \bar{k}$, $\bar{c} = \bar{i} + \bar{j} + 3\bar{k}$ then $\bar{r} =$

1) $\frac{1}{2}(\bar{i} + \bar{j} + \bar{k})$ 2) $2(\bar{i} + \bar{j} + \bar{k})$ 3) $2(-\bar{i} + \bar{j} + \bar{k})$ 4) $\frac{1}{2}(\bar{i} - \bar{j} + \bar{k})$

33. $[\bar{a}\ \bar{b}\ \bar{c}][\bar{a}\ \bar{b}\ \bar{c}] =$

1) 0 2) 1 3) 2 4) 3

34. If $(\bar{a} \times \bar{b}) \times (\bar{c} \times \bar{d}) = l\,\bar{c} + m\bar{d}$, then $\bar{m}$ is

1) $[\bar{a}\ \bar{c}\ \bar{d}]$ 2) $[\bar{c}\ \bar{b}\ \bar{d}]$ 3) $[\bar{b}\ \bar{c}\ \bar{d}]$ 4) $-[\bar{a}\ \bar{b}\ \bar{c}]$

35. If $\bar{a}, \bar{b}, \bar{c}$ are three non-coplanar and non- zero vectors such that

$[\bar{a} \times \bar{b}\ \ \bar{b} \times \bar{c}\ \ \bar{c} \times \bar{a}] = [\bar{a} + \bar{b}\ \ \bar{b} + \bar{c}\ \ \bar{c} + \bar{a}]$ then $[\bar{a}\ \bar{b}\ \bar{c}] =$

1) 0 2) 2 3) 1 4) −1

36. The domain of $f(x) = \frac{2x + 2-x}{2x - 2-x}$ is

1) R −[0, 1] 2) $(0, \infty)$ 3) R− {0} 4) $(-\infty, 0)$

37. If $f(x) = \log\left(\frac{1+x}{1-x}\right)$ then $f(x_1) + f(x_2) =$

1) $f\left(\frac{x_1 + x_2}{1 + x_1x_2}\right)$ 2) $f\left(\frac{x_1 + x_2}{1 - x_1x_2}\right)$ 3) $f\left(\frac{x_1 - x_2}{1 + x_1x_2}\right)$ 4) $f(x_1) - f(x_2)$

38. Six coins are tossed simultaneously. The probability of getting atleast 4 heads is

1) $\frac{11}{64}$ 2) $\frac{11}{32}$ 3) $\frac{15}{44}$ 4) $\frac{21}{32}$

39. The probability that a leap year have 53 Sundays is

1) $\frac{1}{7}$ 2) $\frac{2}{7}$ 3) $\frac{5}{7}$ 4) $\frac{6}{7}$

40. In a poison variate X, if p (X = 0) = 0.2 then the variance of the distribution is

1) 2 2) 1 3) e 4) $\log_e^5$

41. A circle and a square have the same perimeter then

1) Their areas are equal

2) The area of the circle is larger

3) The area of the square is larger

4) Area of the circle = π (Area of square)

42. The locus of a point whose distance from the x-axis is one-third of its distance from the origin is

1) $x^2 = 8y^2$ 2) $y^2 = 8x^2$ 3) $x^2 = 9y^2$ 4) $y^2 = 9x^2$

43. When (0, 0) shifted to (3, –3), the co-ordinates of P, Q, R are (5, 5), (–2, 4) and (7, –7) in the new system are A, B, C then area of the triangle ABC in sq units is

1) 43 2) 23 3) 45 4) 50

44. Perpendicular distance from the origin to the line joining the points

$(a \cos \theta, a \sin \theta), (a \cos \phi, a \sin \phi)$ is

1) $2a \cos (\theta - \phi)$ 2) $a \cos\left(\frac{\theta - \phi}{2}\right)$ 3) $4a \cos\left(\frac{\theta - \phi}{2}\right)$ 4) $a \cos\left(\frac{\theta + \phi}{2}\right)$

45. The area of the triangle formed by the axes and the line $(\cos h\alpha - \sin h\alpha)\, x + (\cos h\alpha + \sin h\alpha)\, y = 2$ in square units is

1) 4 2) 3 3) 2 4) 1

46. The difference of the slopes of the lines $x^2(\sec^2 \theta - \sin^2 \theta) - (2 \tan \theta)xy + y^2 \sin^2 \theta = 0$ is

1) 1 2) 2 3) 3 4) 4

47. If the points (5, 4, 2), (8, k, – 7) and (6, 2, –1) are collinear then k =

1) –2 2) 2 3) 10 4) 1

48. If the equation of line is x = ay + b, z = cy + d. Then its symmetric form is

1) $\frac{x - a}{b} = \frac{y}{1} = \frac{z - c}{d}$ 2) $\frac{x - b}{a} = \frac{y}{1} = \frac{z - d}{c}$

3) $\frac{x + a}{b} = \frac{y}{1} = \frac{z + c}{d}$ 4) $\frac{x + b}{a} = \frac{y}{1} = \frac{z + d}{c}$

49. The product of the dc's of the line which makes equal angles with ox, oy, oz axes is

1) 1 2) $\sqrt{3}$ 3) $\frac{1}{3\sqrt{3}}$ 4) $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$

50. The area of the triangle formed by plane 2x + 3y + 6z + 9 = 0 with y-axis, z-axis is (in sq units)

1) 9 2) $\frac{9}{2}$ 3) $\frac{9}{4}$ 4) $\frac{9}{8}$

51. Let $f(x) = \frac{x + x^2 + ... + x^n - n}{x - 1}$, $x \neq 1$ the value of $f(1)$ so that f is continuous is

1) n 2) $\frac{n + 1}{2}$ 3) $\frac{n(n + 1)}{2}$ 4) $\frac{n(n - 1)}{2}$

52. Let $f(x) = \begin{cases} 0 & \forall\, x < 0 \\ x^2 & \forall\, x \geq 0 \end{cases}$ then $\forall x \in R$

1) f is differentiable 2) f, f^1 both are continuous

3) f^1 is differentiable 4) All of these

53. If $y = x^{x^{x^{\cdots\infty}}}$ then $\frac{dy}{dx} =$

1) $\frac{y^2}{x(1 + y \log x)}$ 2) $\frac{y^2}{x(1 - \log x)}$

3) $\frac{y^2}{x(1 - y \log x)}$ 4) $\frac{y^2}{x(1 + x \log x)}$

54. $y = \cos^{-1}\left[\frac{a^2 - x^2}{a^2 + x^2}\right] + \sin^{-1}\left[\frac{2ax}{a^2 + x^2}\right] \Rightarrow \frac{dy}{dx} =$

1) $\frac{a}{x^2 + a^2}$ 2) $\frac{2a}{x^2 + a^2}$ 3) $\frac{4a}{x^2 + a^2}$ 4) $\frac{a^2}{x^2 + a^2}$

55. If $1° = \alpha$ radians then the approximate value of $\cos(60°1^1)$ is

1) $\frac{1}{2} + \frac{\alpha\sqrt{3}}{120}$ 2) $\frac{1}{2} - \frac{\alpha}{120}$ 3) $\frac{1}{2} - \frac{\alpha\sqrt{3}}{120}$ 4) $\frac{1}{2} + \frac{\alpha}{120}$

56. Rolle's theorem cannot be applicable for

1) $f(x) = \sqrt{4 - x^2}$ is $[-2, 2]$ 2) $f(x) = [x]$ in $[-1, 1]$

3) $f(x) = x^2 + 3x - 4$ in $[-4, 1]$ 4) $f(x) = \cos 2x$ in $[0, \pi]$

57. The total number of parallel tangents of $f_1(x) = x^2 - x + 1$ and $f_2(x) = x^3 - x^2 - 2x + 1$ are

1) 2 2) 0 3) 1 4) infinite

58. The equation of motion of a particle p(x, y) on a plane are given by $x = 4 + b \cos t$, $y = 5 + b \sin t$, its velocity at time 't' is

1) 4 2) 5 3) b 4) tant

59. $f(x) = \log_a^x$ $(x > 0)$ is decreasing function is

1) $a > 1$ 2) $0 < a < 1$ 3) $a \neq 1$ 4) $a \neq 0$

60. $f(x) = (\sin^{-1}x)^2 + (\cos^{-1} x)^2$ is stationary at

1) $x = \frac{1}{\sqrt{2}}$ 2) $x = \frac{\pi}{4}$ 3) $x = 1$ 4) $x = 0$

61. The locus of the centre of the circles which touch the lines $6x - 8y + 5 = 0$ and $6x - 8y + 13 = 0$ is $6x - 8y + k = 0$. Then k =

1) 18 2) 10 3) 12 4) 9

62. The radius of the circle passing through the vertices of the triangle formed by the lines $x + y = 2$, $3x - 4y = 6$, $x - y = 0$ is

1) 10 2) 5 3) 20 4) 100

63. If (6, 8), (k, 2) are inverse points with respect to the circle $x^2 + y^2 = 25$, then 2k =

1) 1 2) 3 3) 5 4) 7

64. Two circles of equal radius r cut orthogonally. If the centres are (2, 3) and (5, 6), then r =

1) 1 2) 2 3) 3 4) 4

65. If (3, 6) is the vertex and (4, 5) is the focus of a parabola, then the equation of its directrix is

1) $x + y + 5 = 0$ 2) $x + y - 5 = 0$

3) $x - y - 5 = 0$ 4) $x - y + 5 = 0$

66. The line $4x + 6y + 9 = 0$ touches the parabola $y^2 = 4x$ at the point

1) $\left(-3, \frac{9}{4}\right)$ 2) $\left(3, \frac{9}{4}\right)$ 3) $\left(\frac{9}{4}, -3\right)$ 4) $\left(-\frac{9}{4}, -3\right)$

67. The eccentricity of the ellipse $9x^2 + 5y^2 - 18x - 20y - 16 = 0$ is

1) $\frac{1}{2}$ 2) $\frac{2}{3}$ 3) $\frac{1}{3}$ 4) $\frac{3}{4}$

68. If tangents are drawn from any point on the circle $x^2 + y^2 = 25$ to the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$, then the angle between tangents is

1) $\frac{\pi}{4}$ 2) $\frac{\pi}{3}$ 3) $\frac{\pi}{2}$ 4) $2\frac{\pi}{3}$

69. The angle between the asymptotes of the hyperbola $x^2 - 3y^2 = 3$ is

1) $\frac{\pi}{6}$ 2) $\frac{\pi}{4}$ 3) $\frac{\pi}{3}$ 4) $\frac{\pi}{2}$

70. If the foci of the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$ and the hyperbola $\frac{x^2}{4} - \frac{y^2}{b^2} = 1$ coincide, then $b^2 =$

1) 4 2) 5 3) 8 4) 9

71. $\int \frac{4 \sec^2 x \tan x}{\sec^2 x + \tan^2 x} dx =$

1) $2 \log (\sec^2 x + \tan^2 x) + c$ 2) $\log (2x + \tan^2 x) + c$

3) $2 \tan^2 x + c$ 4) $\log (\sec^2 x + \tan^2 x) + c$

72. $\int \frac{x + \sin x}{1 + \cos x} dx =$

1) $x \tan \frac{x}{2} + c$ 2) $x \cot \frac{x}{2} + c$ 3) $x \sin \frac{x}{2} + c$ 4) $x \cos \frac{x}{2} + c$

73. $\int e^x \left[\frac{x + 4}{(x + 6)^3} \right] dx =$

1) $\frac{e^x}{(x + 6)^2} + c$ 2) $\frac{e^x}{(x + 4)^2} + c$ 3) $\frac{xe^x}{x + 6} + c$ 4) $\frac{4e^x}{(x + 6)^2} + c$

74. $\int_0^{\frac{\pi}{2}} \frac{200 \sin x + 100 \cos x}{\sin x + \cos x} dx =$

1) 50π 2) 25π 3) 75π 4) 150π

75. $\lim_{x \to 3} \left[\frac{1}{x - 3} \int_3^x et\, dt \right]$

1) e^3 2) $\frac{1}{e}$ 3) e^2 4) e

76. The area enclosed between the parabolas $5x^2 - y = 0$ and $2x^2 - y + 9 = 0$ is

1) $6\sqrt{3}$ 2) $12\sqrt{3}$ 3) $8\sqrt{2}$ 4) $12\sqrt{2}$

77. The degree and order of $x^2 \frac{d^2y}{dx^2} + 3x \frac{dy}{dx} + 2y = e^x$ are

1) 2, 1 2) 1, 1 3) 1, 2 4) 2, 2

78. The solution of $\frac{dy}{dx} = \frac{x^2 + 4x - 9}{x + 2}$ is

1) $y = (x + 2)^2 - 13 \log|x + 2| + c$
2) $y = (x + 2)^2 - 5 \log|x + 2| + c$
3) $y = \frac{x^2}{2} + 2x + 13 \log|x + 2| + c$
4) $y = \frac{x^2}{2} + 2x - 13 \log|x + 2| + c$

79. The equation of the curve having the portion of the tangent included between the coordinate axes is bisected at the point of contact is

1) a parabola 2) an ellipse 3) a circle 4) a hyperbola

80. For $y = y(x)$, *if* $\frac{dy}{dx} = y + 3 > 0$, $y(0) = 2$, then $y(\log 2) =$

1) −2 2) 7 3) 5 4) 13

PHYSICS

81. The measured mass and volume of a body are 5 gm and 10 cm3 respectively with possible errors 0.01 gm and 0.1 c.c. Then the maximum error in density is

1) 12% 2) 1.2% 3) −8% 4) −0.8%

82. A rifle bullet loses $\left(\frac{1}{20}\right)^{th}$ of its velocity in passing through a plank. The least number of such planks required to just stop the bullet.

1) 8 2) 9 3) 10 4) 11

83. A particle (projectile) is projected from origin in x−y plane. Acceleration of particle in Y direction is 'α'. If equation of path of particle is $y = ax - bx^2$, then initial velocity of the particle is

1) $\sqrt{\frac{\alpha}{2b\cos^2\theta}}$ 2) $\sqrt{\frac{\alpha}{2\cos^2\theta}}$ 3) $\sqrt{\frac{2\alpha}{b\cos^2\theta}}$ 4) $\sqrt{\frac{2\alpha}{\cos^2\theta}}$

84. Fuel is consumed at the rate of 50 KgS^{-1} in a rocket. Then the thurst on the rocket. If the velocity of exhaust gasses is 2 $Km.S^{-1}$

1) 100 N
2) 1×10^8 N
3) 1×10^5 N
4) 1×10^6 N

85. When a car of mass 1000 kg is moving with a velocity of 20 m/s on a rough horizontal road, its engine is switched off. How far does a car move before it comes to rest, if the coefficient of kinetic friction between the road and tyres of the car is 0.75 is (acceleration due to gravity g = 10 m/s^2)

1) 2.667 m
2) 26.67 m
3) 266.7 m
4) 2667m.

86. A ball of mass 50 gm falls from rest vertically down wards through a distance of 20 m and hits the ground. Then final velocity of the ball before it hits the ground. ($g = 10\ ms^{-2}$)

1) 10 ms^{-1} 2) 20 ms^{-1} 3) 30 ms^{-1} 4) 40 ms^{-1}

87 If a uniform rod of length 'L' is bent at the midpoint, so that the two halves are inclined by an angle 'θ 'with each other then the shift in center of mass is

1) $\frac{L}{4}\cos\left(\frac{\theta}{2}\right)$ 2) $\frac{L}{2}\cos\left(\frac{\theta}{2}\right)$ 3) $L\cos\frac{\theta}{2}$ 4) $2L\cos\frac{\theta}{2}$

88. The radius of gyration of a uniform disc about a line perpendicular to the disc is equal to its radius. Then the distance of the line from the centre of the disc is

1) $\sqrt{2}\,R$ 2) $\frac{R}{2}$ 3) $\frac{R}{\sqrt{2}}$ 4) $\frac{R}{2\sqrt{2}}$

89. The potential energy of a harmonic oscillator of mass 2 kg about its mean position is 5 J. If its total energy is 9 J and its amplitude is 0.01 m, then its time period is

1) 100π sec 2) π sec 3) $\frac{100}{\pi}$ sec 4) $\frac{\pi}{100}$ sec

90. An infinite number of particles each of mass 'm' are placed on the positive x-axis at 1 m, 2 m,4 m, 8 m, ... from the origin. The magnitude of the resultant gravitational force on mass 'm' kept at the origin is

1) $\frac{4}{3}Gm^2$ 2) $\frac{4}{5}Gm^2$ 3) $\frac{7}{3}Gm^2$ 4) $\frac{9}{5}Gm^2$

91. A copper wire and a steel wire of radii in the ratio 1 : 2, lengths in the ratio 2 : 1 are stretched by the same force. If the young's modulus of copper and steel are 1.1×10^{11} Nm^{-2} and 2×10^{11} Nm^{-2} respectively, then the ratio of their extension is

1) 16 : 11 2) 11 : 16 3) 160 : 11 4) 11 : 160

92. An insect trapped in a circular groove of radius 12 cm, moves along the groove steadily and completes 7 revolutions in 100 sec. Then its angular speed is.....

1) 0.44 rad/s
2) 0.0628 rad/s
3) 4.4 rad/s
4) 6.28 rad/s

93. When water flows from a narrow pipe in to a broader pipe

1) pressure decreases, rate of flow increases

2) pressure increases, velocity increases

3) rate of flow does not change but velocity increases

4) pressure increases, velocity decreases and rate of flow remains same

94. The radius of mercury drop at 20°C is 3 mm. If the surface tension of mercury at this temperature is 4.65×10^{-1} Nm^{-1}. Then the excess pressure inside the liquid drop is

1) 300 Nm^{-2} 2) 620 Nm^{-2} 3) 600 Nm^{-2} 4) 310 Nm^{-2}

95. A constant power 'p' is applied to a particle of mass m. Then the displacement of the particle when its velocity increases from V_1 to V_2 is (ignore friction)

1) $\frac{m}{3p}\left(V_2^2 - V_1^2\right)$ 2) $\frac{m}{3p}\left(V_2^3 - V_1^3\right)$ 3) $\frac{m}{3p}\left(V_2^2 - V_1^2\right)$ 4) $\frac{m}{p}\left(V_2^3 - V_1^3\right)$

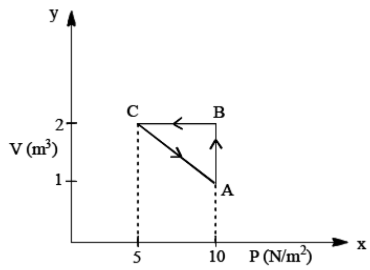
96. The pressure of a gas in a vessel is 80 cm of Hg. Now 25% of the same gas is also introduced in to the same vessel. If the process is done at the same temperature, then the final pressure of the gas is

1) 10 cm of Hg
2) 20 cm of Hg
3) 100 cm of Hg
4) 60 cm of Hg

97. How much steam at 100°C is to be passed in to water of mass 100 gm at 20°C to raise its temperature by 5°C? (Latent heat of steam is 540 cal/gm and specific heat of water 1 cal/g°C)

1) 0.0813 gm 2) 0.813 gm 3) 8.13 gm 4) 100 gm

98. An ideal gas is taken through the cycle A → B → C → A, as shown in the figure. If the net heat supplied to the gas in the cycle is 5 J. Then the work done by the gas in the process C → A is



1) –5 J 2) 5 J 3) 10 J 4) –10 J

99. Match List – I with List – II (the terms have their usual meanings).

List – I	**List – II**
a) Isobaric process	e) $dQ = dW$
b) Isochoric process	f) $dQ = dU + dW$
c) Isothermal process	g) $dU = -dW$
d) Adiabatic process	h) $dQ = dU$

1) a-e, b-f, c-h, d-g 2) a-f, b-h, c-e, d-g

3) a-f, b-e, c-h, d-g 4) a-g, b-f, c-e, d-h

100. If the density of hydrogen at STP is 0.09 kgm^{-3}, then the rms velocity of its molecules at 0°C is

1) $1.84 \times 10^4\ ms^{-1}$

2) $1.84 \times 10^2\ ms^{-1}$

3) $1.84 \times 10^3\ ms^{-1}$

4) $1.84 \times 10^6\ ms^{-1}$

101. A railway engine moving with a speed of 60 m/s passes infront of a stationary listener. The real frequency of the whistle is 400 Hz. Then the apparent frequency heard by the listener, when the engine is moving away from listener. (velocity of sound = 340 m/s).

1) 340 HZ 2) 486 HZ 3) 470 HZ 4) 330 HZ

102. In a tank, a 4 cm thick layer of water $\left(\mu = \frac{4}{3}\right)$ floats on a 6 cm thick layer of an organic liquid .

($\mu = 1.5$) Viewing at normal incidence, how far below the water surface does the bottom of tank appear to be?

1) 1 cm 2) 5 cm 3) 6 cm 4) 7 cm

103. The refractive index of material of a plano-convex lens, if the radius of curvature of the convex surface is 10 cm and focal length of lens is 30 cm.

1) $\frac{1}{3}$ 2) $\frac{-2}{3}$ 3) $\frac{4}{3}$ 4) $\frac{3}{4}$

104. Two coherent sources are 0.15 mm apart and fringes are observed 1 m away with monochromatic light of wavelength 6000 A°. Then the fringe width in a liquid of refractive index $\frac{5}{2}$ is

1) 4 mm 2) 1.6 mm 3) 10 mm 4) 2.4 mm

105. An electric dipole is placed at an angle of 30° to a non−uniform electric field. The dipole will experience

1) A translational force only in the direction of the field

2) A translational force only in a direction normal to the direction of the field

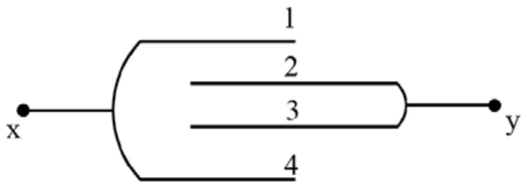
3) A torque as well as a translational force

4) A torque only

106. Two metal spheres of radii in the ratio 4 : 3 are kept in contact and a charge is given to them. Next they are separated wide apart so that there is no electric influence of one on another. Then the ratio of charges on them is

1) 1 : 1 2) 4 : 3 3) 3 : 4 4) 9 : 16

107. The equivalent capacity between X and Y



1) $\frac{4\,\varepsilon_0 A}{d}$ 2) $\frac{3\varepsilon_0 A}{d}$ 3) $\frac{2\varepsilon_0 A}{d}$ 4) $\frac{\varepsilon_0 A}{d}$

108. The length of a potentiometer wire is 1 m and its resistance is 4 Ω. A current of 5 mA is flowing in it. An unknown source of emf is balanced on 40 cm length of this wire, then the e.m.f of the source is

1) 8 mV 2) 20 V 3) 20 mV 4) 8 V

109. A 2 A current is flowing through a circular coil of radius 10 cm containing 100 turns. Then the magnetic flux density at the centre of the coil is

1) 1.26×10^{-5} Wb / m^2 2) 1.26×10^{-4} Wb / m^2

3) 1.26×10^{-3} Wb / m^2 4) Zero

110. A galvanometer has a resistance of 98 Ω. If 2% of the main current is to be passed through the galvanometer, then the value of the shunt be

1) 1 Ω 2) 2 Ω 3) 3 Ω 4) 4 Ω

111. Two small magnets each of magnetic moment 10 Am2 are placed in axial position 0.1 m apart from their centres. The force acting between them is

1) 10^{-1} N 2) 10^{-2} N 3) 10^{-3} N 4) 0.6 N

112. The mutual inductance between two coils, when a current of 2 A changes to 6 A in 2 sec and induces an emf of 20 mV in the secondary coil is

1) 10 mH 2) 1 mH 3) 100 mH 4) 100 H

113. The maximum value of current, when a coil of inductance 2 H is connected to 150 V and 50 cycles/sec supply.

1) 3.39 A 2) 3.39 mA 3) 0.339 A 4) 0.339 mA

114. Relation between the stopping potential V_0 of a metal and the maximum velocity 'v' of the photo electrons is

1) $V_0 \propto \frac{1}{v^2}$ 2) $V_0 \propto v^2$ 3) $V_0 \propto v$ 4) $V_0 \propto \frac{1}{v}$

115. A hydrogen atom in a state of binding energy 0.85 ev makes a transition to a state of excitation energy of 10.2 ev. Then the initial state of hydrogen atom is

1) 3 2) 2 3) 4 4) 1

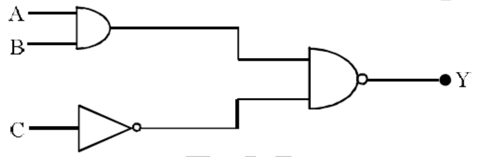
116. The half life of 58Co is 72 days. Then its average life is

1) 0.9 days 2) 0.009 days 3) 10.39 days 4) 103.9 days

117. A full wave rectifier uses two diodes with a load resistance of 100 Ω. Each diode is having negligible forward resistance. Then the efficiency of this full wave rectifier is (in percentage)

1) 81.2% 2) 40.6% 3) 20.3% 4) 0.406%

118. In the following circuit, the output 'Y' becomes zero for these inputs



1) A = 0, B = 1, C = 1 2) A = B = C = 0

3) A = 1, B = 1, C = 0 4) A = 1, B = 0, C = 0

119. T.V. transmission tower at a particular station has a height of 80 m. Then its coverage range is

1) 8 km 2) 32 km 3) 16 km 4) 64 km

120. Which one of the following electromagnetic radiations have the smallest wavelength.

1) ultra violet rays 2) x – rays 3) ϒ – rays 4) microwaves

CHEMISTRY

121. In ground state the radius of hydrogen atom is 0.53 A°.The radius of Li^{+2} ion (z = 3) in the same state is

1) 0.176 A° 2) 1.06 A° 3) 0.53 A° 4) 0.265 A°

122. A mixture contains 56 gr of nitrogen, 44 gr of CO_2 and 16 gr of methane. The total pressure of the mixture is 720 mm of Hg. The partial pressure of methane is

1) 180 mm 2) 360 mm 3) 540 mm 4) 720 mm

123. Calculate the work done when 1 mole of an ideal gas is compressed reversibly from 1 bar to 4 bar at constant temperature of 300 k.

1) –7.5 KJ 2) 3.5 KJ 3) 18.02 KJ 4) –14.0 KJ

124. The value of ΔH^0 for the reaction $Cu^+_{(g)} + I^-_{(g)} \rightarrow CuI_{(g)}$; $\Delta H = -446$ KJ/mole

If ionization energy of $Cu_{(g)}$ is 745 KJ/mole and electron affinity of $I_{(g)}$ is –295 KJ/mole, then the value of ΔH^0 for the

$Cu_{(g)} + I_{(g)} \rightarrow CuI_{(g)}$ is

1) – 446 KJ 2) 450 KJ 3) 594 KJ 4) 4 KJ

125. For the reaction $2\,NO_{2(g)} \rightleftharpoons 2\,NO_{(g)} + O_{2(g)}$; $K_c = 1.8 \times 10^{-6}$ at 185°C. The value of K_c at 185°C for the reaction $NO_{(g)} + \frac{1}{2}\,O^2_{(g)} \rightleftharpoons NO_{2(g)}$ is

1) 0.9×10^6 2) 1.95×10^{-3} 3) 1.95×10^3 4) 7.5×10^2

126. The correct expression for the solubility product of $Ca_3(PO_4)_2$ is

1) $16\ S^4$ 2) $27\ S^5$ 3) $81\ S^4$ 4) $108\ S^5$

127. Number of moles of MnO_4^- required to oxidise one mole of ferrous oxalate completely in acidic medium will be

1) 0.2 moles 2) 0.4 moles 3) 0.6 moles 4) 7.5 moles

128. 56 gr of nitrogen and 8 gr of hydrogen are heated in a closed vessel. At equilibrium 34 gr of ammonia are present. The equilibrium number of moles of nitrogen, hydrogen and ammonia are respectively.

1) 1, 2, 2 2) 2, 2, 1 3) 1, 1, 2 4) 2, 1, 2

129. The electron affinity values (in KJ $mole^{-1}$) of three halogens x, y and z are respectively –349, –333 and –325. Then x, y and z are respectively

1) F_2, Cl_2 and Br_2 2) Cl_2, F_2 and Br_2
3) Cl_2, Br_2 and F_2 4) Br_2, Cl_2 and F_2

130. In which of the following pairs the two species are iso structural

1) SO_3^{-2} and NO_3^- 2) BF_3 and NF_3
3) BrO_3^- and XeO_3 4) SF_4 and XeF_4

131. The value of ..... is less for D_2O as compared to H_2O

1) density (g mL^{-1}) at 20°C 2) boiling point
3) dielectric constant at 20°C 4) latent heat of vaporization

132. Though air pollutant, this gas acts as umbrella of life on earth

1) SO_2 2) CO 3) CO_2 4) O_3

133. Which of the following gives propyne on hydrolysis

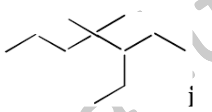
1) Al_4C_3 2) La_4C_3 3) B_4C_3 4) Mg_2C_3

134. Boric acid on heating at 150°C gives

1) B_2O_3 2) $H_2B_4O_7$ 3) HBO_2 4) H_2BO_3

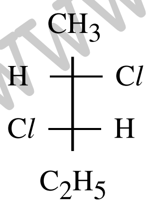
135. Silica is reacted with Na_2CO_3. Which is the gas liberated?

1) CO 2) O_2 3) O_3 4) CO_2

136. The IUPAC name of  is

1) 3 – ethyl – 4, 4 – di methyl heptane 2) 1, 1 – diethyl – 2, 2 – dimethyl pentane
3) 4, 4 – dimethyl – 5, 5 – diethyl pentane 4) 5, 5 – diethyl – 4, 4 – dimethyl pentane

137. The absolute configuration of the following



1) 2S, 3R 2) 2S, 3S 3) 2R, 3S 4) 2R, 3R

138. A molecule (X) has (i) four sigma bonds formed by the overlap of sp^2 and S orbital (ii) one sigma bond formed by sp^2 and sp^2 orbitals and (iii) one π – bond formed by p_z and p_z orbitals. Which of the following is X?

1) C_2H_6 2) C_2H_3Cl 3) $C_2H_2Cl_2$ 4) C_2H_4

139. Which of the following arrangement shows alignment of magnetic moments of Anti ferromagnetic substances?

1) ↑↑↑↑↑↑ 2) ↓↓↓↓↓↓ 3) ↓↓↑↓↓↑ 4) ↓↑↓↑↓↑

140. If the elevation in boiling point of a solution of 18 gm of solute (moleculer weight = 180) in 100 gm of water is, ΔT_b the molal elevation constant of the liquid is....

1) 10 2) ΔT_b 3) $10\Delta T_b$ 4) $\frac{\Delta T_b}{10}$

141. The values $\wedge^{\infty}_{eq}$ for NH4Cl, NaOH and NaCl respectively 142.5, 242.350 and 123.42 Ohm^{-1} Cm^2 $equi^{-1}$, the value of $\wedge^{\infty}_{eq}$ of NH_4OH is

1) 261.43 2) 23.57 3) 223.27 4) 215.27

142. Which of the following reaction is used to make a fuel cell?

1) $2\,H_{2\,(g)} + O_{2\,(g)} \rightarrow 2\,H_2O_{\,(l)}$

2) $2\,Fe_{\,(s)} + O_{2\,(g)} + 4\,H^+_{(aq)} \rightarrow 2\,Fe^{+2}_{(aq)} + 2\,H_2O_{\,(l)}$

3) $Pb_{(s)} + PbO_{2\,(s)} + H_2SO_{4\,(aq)} \rightarrow PbSO_{4\,(s)} + H2O\,(l)$

4) $2\,H2O2\,(l) \rightarrow 2\,H2O\,(g) + O2\,(g)$

143. Gold numbers of protective colloids X, Y, and Z are 0.01, 0.10 and 0.005 respectively, the correct order of their protective powers is ....

1) Y < X < Z 2) Y < Z < X 3) Y > Z > X 4) Z < Y < X

144. Weak tyndall effect can be observed with

1) Gold sol 2) Sulphur sol 3) Smoke 4) Starch sol

145. Ammonia is obtained by the action of H_2O on

1) $CaCN_2$ 2) Mg_3N_2 3) BN 4) All

146. SO_3 is dissolved in heavy water to form a compound 'X'. The hybridization state of sulphur in 'X' is

1) sp^2 2) sp^3 3) sp 4) dsp^2

147. Give the no. of lone pairs in the central atoms of the following inter halogen compounds XX^1, XX^1_3, XX^1_5, XX^1_7

1) 3, 2, 1, 0 2) 3, 2, 2, 0 3) 3, 1, 2, 0 4) 3, 2, 1, 1

148. Kr – 85 is used for

1) Respiration by asthma person

2) filling inflating tyres

3) Measurement of thickness of a metal sheet

4) all

149. Natural rubber is

1) P.V.C 2) Cis–polyisoprene

3) Trans–polyisoprene 4) Polychloroprene

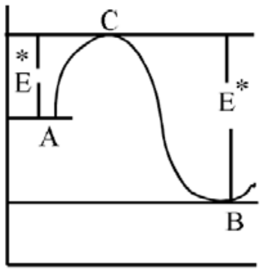
150. From the graph, pick out the correct one

1) E* for the forward reaction is $E_A - E_B$

2) E* for the backward reaction is $E_C - E_A$

3) E* for reverse reaction > E* for forward reaction

4) E* for forward reaction > E* for back ward reaction



151. Which one of the following pairs of ions have the same electronic configuration

1) Cr^{+3}, Fe^{+3} 2) Fe^{+3}, Mn^{+2} 3) Fe^{+3}, Co^{+3} 4) Sc^{+3}, Cr^{+3}

152. An excess of $AgNO_3$ is added to 200 ml of 0.2 M solution of dichlorotetra aquachromium (III) chloride. The number of moles of Ag*Cl* precipitated would be

1) 0.02 2) 0.01 3) 0.04 4) 0.001

153. The important oxide ore of iron is

1) siderite 2) haematite 3) pyrites 4) bauxite

154. Which of the following is a food antioxidant

1) butylated hydroxy toulene (BHT) 2) Saccharin

3) Aspartame 4) Alitame

155. The pace setter of the endocrine system in the human body is the endocrine gland called

1) Thyroid 2) Insulin 3) Secretine 4) Adrenaline

156. Which of the following reaction show nucleo-phillic substitution of Alkyl halide?

1) $R - X + H_2 \rightarrow RH + HX$

2) $R - X + KCN \rightarrow RCN + KX$

3) $2\ R - X + 2\ Na \xrightarrow{\text{ether}} R - R + 2\ NaX$

4) $R - X + Mg \xrightarrow{\text{ether}} RMgX$

157. $C_2H_4 \xrightarrow[AlCl_3]{HCl} A \xrightarrow[(aq)]{KOH} B \xrightarrow[170°C]{Con.H_2SO_4} C$. What is 'C' ?

1) C_2H_4 2) $C_2H_5 - O - C_2H_5$ 3) C_2H_5OH 4) C_2H_6

158. $CH_3COCl + H_2 \xrightarrow[\text{catalyst}]{\text{Lindlar's}} CH_3CHO + HCl$

The above reaction is known as

1) Aldol condensation 2) Clemmenson's reduction

3) Rosenmund's reduction 4) Carbyl amine reaction

159. $(CH_3)_2C = O \xrightarrow{Zn-Hg/Con-HCl} X$, here 'X' is

1) $CH_3 - CH_2 - CH_2 - OH$ 2) $CH_3 - CH\,(OH) - CH_3$

3) $CH_3 - CH_2 - CHO$ 4) $CH_3 - CH_2 - CH_3$

160. $C_6H_5Cl \xrightarrow[Cu_2O]{NH_3} A \xrightarrow[AlC.KOH]{CHCl} B$. In this reaction 'B' is

1) C_6H_5CN 2) $C_6H_5CH_2CN$

3) $C_6H_5CH_2NC$ 4) C_6H_5NC

KEY

1-2; 2-3; 3-1; 4-1; 5-1; 6-4; 7-2; 8-1; 9-2; 10-1; 11-1; 12-4; 13-1; 14-4; 15-2; 16-1; 17-1; 18-3; 19-1; 20-2; 21-2; 22-2; 23-4; 24-2; 25-1; 26-1; 27-1; 28-2; 29-2; 30-1; 31-1; 32-3; 33-2; 34-4; 35-2; 36-3; 37-1; 38-2; 39-2; 40-4; 41-2; 42-1; 43-1; 44-2; 45-3; 46-2; 47-1; 48-2; 49-3; 50-351-3; 52-4; 53-3; 54-3; 55-3; 56-2; 57-4; 58-3; 59-2; 60-1; 61-4; 62-2; 63-2; 64-3; 65-4; 66-3; 67-2; 68-3; 69-3; 70-2; 71-4; 72-1; 73-1; 74-3; 75-1; 76-2; 77-3; 78-4; 79-4; 80-2; 81-2; 82-4; 83-1; 84-3; 85-2; 86-2; 87-1; 88-3; 89-4; 90-1; 91-3; 92-1; 93-4; 94-4; 95-2; 96-3; 97-2; 98-1; 99-2; 100-3; 101-1; 102-4; 103-3; 104-2; 105-3; 106-2; 107-3; 108-1; 109-3; 110-2; 111-4; 112-1; 113-3; 114-2; 115-3; 116-4; 117-1; 118-3; 119-2; 120-3; 121-1; 122-1; 123-2; 124-4; 125-4; 126-4; 127-3; 128-3; 129-2; 130-3; 131-3; 132-4; 133-4; 134-2; 135-4; 136-1; 137-2; 138-4; 139-4; 140-2; 141-1; 142-1; 143-1; 144-4; 145-4; 146-2; 147-1; 148-3; 149-2; 150-3; 151-2; 152-3; 153-2; 154-1; 155-1; 156-2; 157-1; 158-3; 159-4; 160-4

EXPLANATIONS

1. Number of arrangements = 7! = 5040

2. Alphabetical order of the letters in given words A, A, G, I, N

Number of words that are begin with A is 4! = 24

Number of words that are begin with G is $\frac{4!}{2!} = 12$

Number of words that are begin with I is $\frac{4!}{2!} = 12$

The next words are NAAGI, NAAIG Fiftieth word is NAAIG

3. The numbers of scholarships among the groups in the distribution may be of the following types

Type 1 : 2 MPC, 1 BiPC, 1 CEC

Type 2 : 1 MPC, 2; BiPC, 1 CEC

Type 3 : 1 MPC, 1 BiPC, 2 CEC

Required number of ways $= 6C_2 \times 5C_1 \times 4C_1 + 6C_1 \times 5C_2 \times 4C_1 + 6C_1 \times 5C_1 \times 4C_2$

$= 15 \times 5 \times 4 + 6 \times 10 \times 4 + 6 \times 5 \times 6$

$= 300 + 240 + 180 = 720 = 6!$

4. In $\left(\sqrt{2} + 3^{1/5}\right)^{10}$

$T_{r+1} = {}^{10}C_r \left(\sqrt{2}\right)^{10-r} \left(3^{1/5}\right)^r$

$\Rightarrow {}^{10}C_r\, 2^{5-\frac{r}{2}},\ 3^{\frac{r}{5}}$

$\Rightarrow r = 0, 10$

$T + T_{11}$

$= {}^{10}C_0 \left(\sqrt{2}\right)^0 \left(3^{1/5}\right)^{10} + {}^{10}C_{10}\left(\sqrt{2}\right)^{10}$

$= 9 + 32 = 41$

5. $1 + \frac{1}{4} + \frac{1.3}{4.8} + \frac{1.3.5}{4.8.12} + \ldots\ldots\ldots.$

$= 1 + \frac{1}{2} \cdot \frac{1}{2} + \ldots\ldots\ldots.$

$= \left(1 - \frac{1}{2}\right)^{-1/2} = \sqrt{2}$

6. $\log_c (1 + x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \ldots\ldots\ldots\ldots$

Put $x = \frac{1}{2}$, then

$\log_e \left(1 + \frac{1}{2}\right)$

$= \frac{1}{2} - \frac{1}{2} \cdot \frac{1}{2^2} + \frac{1}{3} \cdot \frac{1}{2^3} - \frac{1}{4} \cdot \frac{1}{2^4} + \ldots\ldots\ldots$

$= \log_e \left(\frac{3}{2}\right)$

7. $\frac{\alpha^3 + \beta^3}{\alpha^{-3} + \beta^{-3}} = \frac{\alpha^3 + \beta^3}{\frac{1}{\alpha^3} + \frac{1}{\beta^3}} = \frac{\alpha^3 + \beta^3}{\left(\frac{\beta^3 + \alpha^3}{\alpha^3\beta^3}\right)} = (\alpha\beta)^3$

$= \frac{c^3}{a^3}$

8. y is real $\Rightarrow \frac{(x + 1)(x - 3)}{(x - 2)} \geq 0$

$(x + 1)(x - 3)$ and $(x - 2)$ have the same sign and $(x - 2) \neq 0$

$\Rightarrow (x + 1)(x - 2)(x - 3) > 0, x \neq 2$

If $x < -1$ then

$x + 1 < 0, x - 2 < 0, x - 3 < 0$ and Hence $(x + 1)(x - 2)(x - 3) < 0$

If $-1 < x < 2$ then

$x + 1 > 0, x - 2 < 0, x - 3 < 0$ and Hence $(x + 1)(x - 2)(x - 3) > 0$

If $2 < x < 3$ then

$(x + 1) > 0, (x - 2) > 0, (x - 3) < 0$ and Hence $(x + 1)(x - 2)(x - 3) < 0$

If $x > 3$ then

$(x + 1) > 0, (x - 2) > 0, (x - 3) > 0$ and Hence $(x + 1)(x - 2)(x - 3) > 0$

$\therefore -1 \leq x < 2$ or $x \geq 3$

9. $AB = [1\ 2\ 3\ 4]\begin{bmatrix}1\\2\\3\\4\end{bmatrix} = [1+4+9+16] = [30]$

10. $A = \begin{bmatrix}a & 0 & 0\\0 & b & 0\\0 & 0 & c\end{bmatrix}$ then $A^2 = \begin{bmatrix}a & 0 & 0\\0 & b & 0\\0 & 0 & c\end{bmatrix}\begin{bmatrix}a & 0 & 0\\0 & b & 0\\0 & 0 & c\end{bmatrix}$

$A^2 = \begin{bmatrix}a^2 & 0 & 0\\0 & b^2 & 0\\0 & 0 & c^2\end{bmatrix}$ similarly

$A^n = \begin{bmatrix}a^n & 0 & 0\\0 & b^n & 0\\0 & 0 & c^n\end{bmatrix}$

11. $\begin{vmatrix}1 & \omega & \omega^2\\\omega & \omega^2 & 1\\\omega^2 & 1 & \omega\end{vmatrix} = c_1 + c_2 + c_3$

$= \begin{vmatrix}1+\omega+\omega^2 & \omega & \omega^2\\1+\omega+\omega^2 & \omega^2 & 1\\1+\omega+\omega^2 & 1 & \omega\end{vmatrix}$

$= \begin{vmatrix}0 & \omega & \omega^2\\0 & \omega^2 & 1\\0 & 1 & \omega\end{vmatrix} = 0$

12. $A^2 - 4A - 5I = O$

$\Rightarrow A(A - 4I) = 5I$

$A^{-1} = \frac{1}{5}(A - 4I)$

13. $\left|\frac{1}{1 + \cos\theta + i\sin\theta}\right| = \frac{1}{2\cos\frac{\theta}{2}}\left|\frac{1}{\cos\frac{\theta}{2} + i\sin\frac{\theta}{2}}\right|$

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

$= \frac{1}{2}\sec\frac{\theta}{2}$

14. Let $y = (i)^i \Rightarrow \log y = i \log i$

$i\left(i\dfrac{\pi}{2}\right) = \dfrac{-\pi}{2}$

$\log y = \dfrac{-\pi}{2} \Rightarrow y = e^{\frac{-\pi}{2}}$

$\because\ i = \cos\dfrac{\pi}{2} + i\sin\dfrac{\pi}{2} = e^{i\frac{\pi}{2}}$

$\therefore\ i \log i = i\left(\log_e e^{i\frac{\pi}{2}}\right) = i\left(i\dfrac{\pi}{2}\right)$

15. $\dfrac{\tan\alpha + \sec\alpha - 1}{\tan\alpha - \sec\alpha + 1}$

$= \dfrac{\tan\alpha + \sec\alpha - (\sec\alpha - \tan\alpha) \times (\sec\alpha + \tan\alpha)}{\tan\alpha - \sec\alpha + 1}$

$= \dfrac{(\sec\alpha + \tan\alpha)(\tan\alpha - \sec\alpha + 1)}{(\tan\alpha - \sec\alpha + 1)}$

$= \sec\alpha + \tan\alpha$

$= \dfrac{1}{\cos\alpha} + \dfrac{\sin\alpha}{\cos\alpha} = \dfrac{1 + \sin\alpha}{\cos\alpha}$

16. $8A - 5A = 3A$

$\tan(8A - 5A) = \tan 3A$

$\dfrac{\tan 8A - \tan 5A}{1 + \tan 8A \tan 5A} = \tan 3A$

$\Rightarrow \dfrac{p - q}{1 + pq} = r$

$\Rightarrow p - q = r + pqr \quad \Rightarrow p - q - r = pqr$

$\Rightarrow \dfrac{p - q - r}{pqr} = 1$

17. Minimum value $= c - \sqrt{a^2 + b^2} = 0 - \sqrt{1 + 8} = -3$

Max. value $= c + \sqrt{a^2 + b^2} = 0 + \sqrt{1 + 8} = 3$

18. $\tan 5x = \tan\left(\dfrac{\pi}{2} - 3x\right)$

$\Rightarrow 5x = n\pi + \dfrac{\pi}{2} - 3x$

$\Rightarrow x = \dfrac{2n\pi + \pi}{16}$

$x = \frac{(2n+1)\pi}{16} \Rightarrow x = (2n+1)\frac{\pi}{16}$

19. $\tan 3\theta = \frac{1}{\sqrt{3}}$

$3\theta = n\pi + \frac{\pi}{6}$

$\theta = \frac{n\pi}{3} + \frac{\pi}{18}, n \in Z$

20. $\cos\left[\cos^{-1}\left(\frac{-1}{7}\right) + \sin^{-1}\left(\frac{-1}{7}\right)\right] = \cos\left(\frac{\pi}{2}\right) = 0$

21. $\sin^{-1}\left(\frac{2a}{1+a^2}\right) - \cos^{-1}\left(\frac{1-b^2}{1+b^2}\right)$

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

$\Rightarrow 2\tan^{-1} a - 2\tan^{-1} b = 2\tan^{-1} x$

$\Rightarrow \tan^{-1} a - \tan^{-1} b = \tan^{-1} x$

$\Rightarrow \tan^{-1}\left(\frac{a-b}{1+ab}\right) = \tan^{-1} x$

$\Rightarrow x = \frac{a-b}{1+ab}$

22. $\tan h\ \frac{x}{2} = \frac{e^{x/2} - e^{-x/2}}{e^{x/2} + e^{-x/2}}$

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

$$= \frac{e^{x/2} + e^{-x/2} + e^{x/2} - e^{-x/2}}{e^{x/2} + e^{-x/2} - e^{x/2} + e^{-x/2}}$$

$$= \frac{2e^{x/2}}{2e^{-x/2}} = e^x$$

23. $\tan h^{-1} x = \frac{1}{2}\log\left(\frac{1+x}{1-x}\right)$,

$\cot h^{-1} x = \frac{1}{2}\log\left(\frac{x+1}{x-1}\right)$

$\tan h^{-1}\left(\frac{1}{2}\right) + \cot h^{-1}(2)$

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

$= \frac{1}{2} \log\left(\frac{3}{1}\right) + \frac{1}{2} \log\left(\frac{3}{1}\right)$

$= \frac{1}{2} \times 2 \log 3$

$= \log 3$

24. $\frac{a}{\cos A} = \frac{b}{\cos B} = \frac{c}{\cos C}$

$\Rightarrow \frac{\sin A}{\cos A} = \frac{\sin B}{\cos B} = \frac{\sin C}{\cos C}$

$\Rightarrow \tan A = \tan B = \tan C$

$\Rightarrow A = B = C = 60°$

Area $= \frac{\sqrt{3}}{4} a^2$

$= \frac{\sqrt{3}}{4} (2)^2$

Area $= \sqrt{3}$

25. $\cos A + \cos B + \cos C$

$= 1 + 4 \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2}$

$= \frac{1 + 4 R \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2}}{R}$

$= 1 + \frac{r}{R}$

26. $h = 100, \theta = \tan^{-1}\left(\frac{4}{5}\right)$

$\Rightarrow \tan \theta = \frac{4}{5}$

$h = d \tan \theta$

$\Rightarrow d = h.\cot \theta$

$d = 100 \times \frac{5}{4}$

$\Rightarrow d = 125$ mt

27. D is mid point of BC

$\overline{BD} = \overline{DC} \Rightarrow \overline{DB} + \overline{DC} = \overline{O}$

$\Rightarrow 2\,\overline{SD} = \overline{AO}$

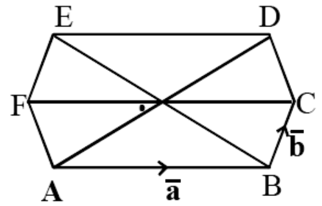
$\overline{SA} + \overline{SB} + \overline{SC} = \overline{SA} + \overline{SD} + \overline{DB} + \overline{SD} + \overline{DC}$

$= \overline{SA} + \overline{SD} + \overline{SD} + (\overline{DB} + \overline{DC})$

$= \overline{SA} + 2\,\overline{SD} + \overline{O}$

$= \overline{SA} + \overline{AO} = \overline{SO}$

28.



$\overline{AF} = \overline{CD}$ and $\overline{FE} = \overline{BC}$

$\overline{AE} = \overline{AF} + \overline{FE}$

$= \overline{CD} + \overline{BC}$

$\overline{AE} = \overline{b} + \overline{c}$

29. $\begin{vmatrix} -\lambda^2 & 1 & 1 \\ 1 & -\lambda^2 & 1 \\ 1 & 1 & -\lambda^2 \end{vmatrix} = 0$

$\Rightarrow -\lambda^6 + 3\lambda^2 + 2 = 0$

$\Rightarrow \lambda^6 - 3\lambda^2 - 2 = 0$

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

$\Rightarrow \lambda^2 = 2 \Rightarrow \lambda = \pm\sqrt{2}$

30. If $\overline{a} = x\,\overline{i} + y\overline{j} + z\,\overline{k}$, then $\overline{a}\,.\overline{i} = x$

$\therefore\ \overline{a}\,.\overline{i} = 1$

$\Rightarrow x = 1$

$\overline{a}.\left(\overline{i} + \overline{j}\right) = 1 \Rightarrow x + y = 1 \Rightarrow y = 0.\ (\because x = 1)$

$\overline{a}.\left(\overline{i} + \overline{j} + \overline{k}\right) = 1 \Rightarrow x + y + z = 1$

$\Rightarrow z = 0$

$\therefore \overline{a} = 1\,(\overline{i}) + 0\,(\overline{j}) + 0\,(\overline{k})$

$\therefore\ \overline{a} = \overline{i}$

31. If $\overline{a} = \overline{i} + \overline{j} + \overline{k}, \overline{b} - \overline{2i} - \overline{3j} + \overline{k}$ then

$\overline{a} \times \overline{b} = \begin{vmatrix} \overline{i} & \overline{j} & \overline{k} \\ 1 & 1 & 1 \\ 2 & -3 & 1 \end{vmatrix}$

$= \overline{i}\ (1 + 3) - \overline{j}\ (1 - 2) + \overline{k}\ (-3 - 2)$

$= 4\,\overline{i} + \overline{j} - 5\,\overline{k}$

32. Given that $\overline{r} \times \overline{b} = \overline{c} \times \overline{b}$

$\Rightarrow \overline{r} \times \overline{b} - \overline{c} \times \overline{b} = \overline{0}$

$\Rightarrow (\overline{r} - \overline{c}) \times \overline{b} = \overline{0}$

$\Rightarrow \overline{r} - \overline{c}$ is parallel to $\overline{b}$

$\Rightarrow \overline{r} - c = t\,\overline{b} \Rightarrow \overline{r} = \overline{c} + t\,\overline{b}$

$\overline{r}\,.\,\overline{a} = \overline{a}\,.\,\overline{c} + t\overline{a}.\overline{b}$

$\Rightarrow 0 = 2 + t\,(2)$

$\Rightarrow t = -1$

$\Rightarrow \overline{r} = \overline{c} - \overline{b}$

$\Rightarrow -2\overline{i} + 2\overline{j} + 2\overline{k}$

$\overline{r} = 2(-\overline{i} + \overline{j} + \overline{k})$

33. $\because \left[\overline{a}'\ \overline{b}'\ \overline{c}'\right] = \overline{a}'.(\overline{b}' \times \overline{c}')$

$$= \frac{\overline{b} \times \overline{c}}{\left[\overline{a}\ \overline{b}\ \overline{c}\right]} . \left(\frac{\overline{c} \times \overline{a}}{\left[\overline{a}\ \overline{b}\ \overline{c}\right]} \times \frac{\overline{a} \times \overline{b}}{\left[\overline{a}\ \overline{b}\ \overline{c}\right]} \right)$$

$$= \frac{1}{\left[\overline{a}\ \overline{b}\ \overline{c}\right]^3} \left((\overline{b} \times \overline{c}).(\overline{c} \times \overline{a}) \times (\overline{a} \times \overline{b}) \right)$$

$$= \frac{1}{\left[\overline{a}\ \overline{b}\ \overline{c}\right]^3} \left[\overline{b} \times \overline{c}\ \ \overline{c} \times \overline{a}\ \ \overline{a} \times \overline{b} \right]$$

$$= \frac{1}{\left[\overline{a}\ \overline{b}\ \overline{c}\right]^3} \left[\overline{a}\ \overline{b}\ \overline{c}\right]^2$$

$$= \frac{1}{\left[\overline{a}\ \overline{b}\ \overline{c}\right]}$$

$\left[\overline{a}\ \overline{b}\ \overline{c}\right]\left[\overline{a}'\ \overline{b}'\ \overline{c}'\right]$

$$= \left[\overline{a}\ \overline{b}\ \overline{c}\right] \frac{1}{\left[\overline{a}\ \overline{b}\ \overline{c}\right]} = 1$$

34. $(\overline{a} \times \overline{b}) \times (\overline{c} \times \overline{d}) = \left[\overline{a}\ \overline{b}\ \overline{d}\right]\overline{c} - \left[\overline{a}\ \overline{b}\ \overline{c}\right]\overline{d}$

$= l\overline{c} + m\overline{d}$

Where $l = \left[\overline{a}\ \overline{b}\ \overline{d}\right]$

$m = -\left[\overline{a}\ \overline{b}\ \overline{c}\right]$

35. $\left[\overline{a} \times \overline{b}\ \ \overline{b} \times \overline{c}\ \ \overline{c} \times \overline{a}\right] = \left[\overline{a}\ \overline{b}\ \overline{c}\right]^2$

$\left[\overline{a} + \overline{b}\ \ \overline{b} + \overline{c}\ \ \overline{c} + \overline{a}\right] = 2\left[\overline{a}\ \overline{b}\ \overline{c}\right]$

$\left[\overline{a}\ \overline{b}\ \overline{c}\right]^2 = 2\left[\overline{a}\ \overline{b}\ \overline{c}\right]$

$\Rightarrow \left[\overline{a}\ \overline{b}\ \overline{c}\right] = 2$

36. $f(x)$ is defined when $2x - 2-x \neq 0$

$\Rightarrow x \neq 0$

Domain of f is $R - \{0\}$

37. $f(x_1) + f(x_2) = \log\left(\frac{1 + x_1}{1 - x_1}\right) + \log\left(\frac{1 + x_2}{1 - x_2}\right)$

$= \log\left(\frac{1 + x_1 + x_2 + x_1x_2}{1 - x_1 - x_2 + x_1x_2}\right)$

$= \log\left(\frac{1 + \left(\frac{x_1 + x_2}{1 + x_1x_2}\right)}{1 - \left(\frac{x_1 + x_2}{1 + x_1x_2}\right)}\right)$

$= f\left(\frac{x_1 + x_2}{1 + x_1x_2}\right)$

38. Required probability is

$= \frac{{}^6C_4 + {}^6C_5 + {}^6C_6}{2^6} = \frac{15 + 6 + 1}{64} = \frac{22}{64} = \frac{11}{32}$

39. Let A be the event of containing 52 Sundays in leap year and S be the sample space.

A leap year contains 366 days i.e. 52 weeks and 2 days extra. The extra two days may be (sun, mon) or (mon, tue), or (tue, wed) or (wed, thurs) or (thurs, fri) or (fri, sat) or (sat, sun)

$n(S) = 7$, $n(A) = 2$

$P(A) = \frac{2}{7}$

40. $P(X = 0) = 0.2 \Rightarrow \frac{e^{-\lambda}. \lambda^0}{0!} = 0.2$

$\Rightarrow e^{-\lambda} = 0.2$

$\Rightarrow -\lambda = \log(0.2)$

$\Rightarrow \lambda = \log_e^5$

Variance $= \log_e^5$

41. Let 'a' be the side of a square, r be the radius of the circle.

Given that $4a = 2\pi r$

42. Given that $|y| = \frac{1}{3}\sqrt{x^2 + y^2}$

$9y^2 = x^2 + y^2$

$8y^2 = x^2$

43. On translation or rotation there is no change in area

Area of triangle ABC = area of triangle PQR

44. Let $A = (a\cos\theta, a\sin\theta)$,

$B = (a\cos\phi, a\sin\phi)$,

$O = (0, 0)$

$OA = OB \Rightarrow$ Foot of the $\perp^r$ (Q) = midpoint of AB

$Q = \left[\frac{a(\cos\theta + \cos\phi)}{2}, \frac{a(\sin\theta + \sin\phi)}{2}\right]$

$OQ = a \cos\left(\frac{\theta - \phi}{2}\right)$

45. Use area $\frac{c^2}{2\,|ab|}$

46. Use $|m_1 - m_2| = \frac{\sqrt{b^2 - 4ac}}{|a|}$

47. Use $\begin{vmatrix} 5 & 4 & 2 \\ 8 & k & -7 \\ 6 & 2 & -1 \end{vmatrix} = 0 \Rightarrow k = -2$

48. $x = ay + b,\ z = cy + d$

$\Rightarrow \frac{x-b}{a} = y,\ \frac{z-d}{c} = y$

$\Rightarrow \frac{x-b}{a} = \frac{y}{1} = \frac{z-d}{c}$

49. DC's are $(l, m, n) = \left(\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right)$

$lmn = \frac{1}{3\sqrt{3}}$

50. Use area $= \frac{1}{2}|bc|$

51. $\lim_{x \to 1} \frac{x + x^2 + \ldots\ldots + x^n - n}{x - 1} = f(1)$

52. $f(x) = \begin{cases} 0 & \forall\, x < 0 \\ x^2 & \forall\, x \geq 0 \end{cases} \Rightarrow f^1(x) = \begin{cases} 0 & \forall\, x < 0 \\ 2x & \forall\, x \geq 0 \end{cases}$

Clearly both f & f^1 are continuous & differentiable

53. $y = x^{x^{x^{\cdots\cdots\infty}}}$

$\Rightarrow y = x^y \Rightarrow \log y = y.\log x$

$\Rightarrow \frac{dy}{dx} = \frac{y^2}{x(1 - y\log x)}$

54. $y = \cos^{-1}\left[\frac{a^2 - x^2}{a^2 + x^2}\right] + \sin^{-1}\left[\frac{2ax}{a^2 + x^2}\right]$

Let $\frac{x}{a} \tan\theta \Rightarrow \theta = \tan^{-1}\left(\frac{x}{a}\right)$

$y = 4\tan^{-1}\left(\frac{x}{a}\right) \Rightarrow \frac{dy}{dx} = \frac{4a}{x^2 + a^2}$

55. Use $f(x + \Delta x) = f1(x)\,\Delta x + f(x)$

56. $f(x) = [x]$ is discontinuous on $[-1, 1]$

57. $f_1(x) = x^2 - x + 1,\ f_2(x) = x^3 - x^2 - 2x + 1$

$\Rightarrow f_{11}(x) = 2x - 1,\ f_{21}(x) = 3x2 - 2x - 2$

Let the tangents drawn to the curve

$y = f_1(x)$ & $y = f_2(x)$

At (x_1, y_1) & (x_2, y_2) are parallel

$\Rightarrow 2x_1 - 1 = 3x_2^2 - 2x_2 - 2$

$\Rightarrow 2x_1 = 3x_2^2 - 2x_2 - 1$

Which is possible for infinite numbers of ordered pairs

$\Rightarrow$ Infinite solutions

58. $V = \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}$

59. $f(x) = \log_a^x$

$\Rightarrow f(x) = \frac{\log x}{\log a}$

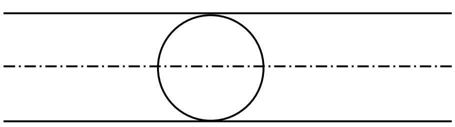
$f^1(x) = \frac{1}{x \log a} < 0$ when $0 < a < 1$

60. $f(x) = (\sin^{-1} x)^2 + (\cos^{-1} x)^2$

$f^1(x) = \frac{2 \sin^{-1}x}{\sqrt{1 - x^2}} - \frac{2 \cos^{-1}x}{\sqrt{1 - x^2}} \Rightarrow f^1(x) = 0$

$\Rightarrow x = \frac{1}{\sqrt{2}}$

61. $6x - 8y + 5 = 0$



$6x - 8y + 13 = 0$

The given lines are parallel lines

The locus of the centre is

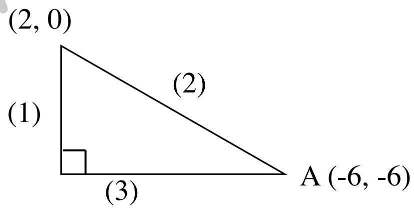
$6x - 8y + \left(\frac{5 + 13}{2}\right) = 0$

(or) $6x - 8y + 9 = 0$

62. $x + y = 2$ .... (1)

$3x - 4y = 6$ ...... (2)

$x - y = 0$ .... (3)



(1) and (3) are perpendicular lines.

Radius $= \dfrac{AB}{2} = 5$

63. (6, 8) and (k, 2) are inverse points $\Rightarrow$ they are conjugate points $\Rightarrow$

$S_{12} = O \Rightarrow 6k + 16 = 25 \Rightarrow k = \dfrac{3}{2} \Rightarrow 2k = 3$

64. $d = C_1C_2 = \sqrt{18}$

Now, $d^2 = {r_1}^2 + {r_2}^2$

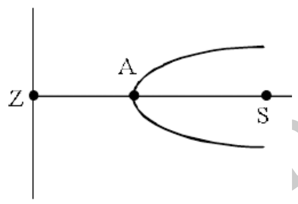
$\Rightarrow 18 = r^2 + r^2$

$\Rightarrow 2r^2 = 18$

$\Rightarrow r^2 = 9$

$\Rightarrow r = 3$

65.



$A = (3, 6)$

$S = (4, 5)$

$\Rightarrow Z = 2A - S = (2, 7)$

Equation of the directrix is

$(y - 7) = 1(x - 2)$

$\Rightarrow x - y + 5 = 0$

66. Verifying the options $\left(\dfrac{9}{4}, -3\right)$ satisfies both the line and parabola

67. Converting into standard form

$9(x^2 - 2x) + 5(y^2 - 4y) = 16$

$\Rightarrow 9(x - 1)^2 + 5(y - 2)^2 = 45$

$\Rightarrow \dfrac{(x - 1)}{5} + \dfrac{(y - 2)^2}{9} = 1$

$a = \sqrt{5}$, $b = 3$ and $a < b$

$e = \sqrt{\dfrac{b^2 - a^2}{b^2}} = \sqrt{\dfrac{9 - 5}{9}} = \dfrac{2}{3}$

68. The given ellipse is $\dfrac{x^2}{16} + \dfrac{y^2}{9} = 1$..... (1)

$a = 4$, $b = 3$ and $a > b$

The given circle is $x^2 + y^2 = 25$

$\Rightarrow x^2 + y^2 = 16 + 9$

$\Rightarrow$ this is the director circle of the ellipse

$\Rightarrow$ angle between the tangents $= \dfrac{\pi}{2}$

69. $\dfrac{x^2}{3} - \dfrac{y^2}{1} = 1$

$a = \sqrt{3}$, $b = 1$

$\theta = 2\tan^{-1}\dfrac{b}{a} = 2\left(\dfrac{\pi}{6}\right) = \dfrac{\pi}{3}$

70. For the ellipse a = 5, b = 4

$a > b \Rightarrow e = \sqrt{\dfrac{a^2 - b^2}{a^2}} = \dfrac{3}{5}$

foci = (ae, 0) = (3, 0)

For the hyperbola, a = 2, b = b

$\Rightarrow e = \sqrt{\dfrac{4 + b^2}{4}} = \sqrt{\dfrac{4 + b^2}{2}}$

Foci = (ae, 0) = $\left(\sqrt{4 + b^2}, 0\right)$

Equating $3\sqrt{4 + b^2} \Rightarrow 9 = 4 + b^2 \Rightarrow b^2 = 5$

71. Put $\sec^2 x + \tan^2 x = t$

$\Rightarrow (2\sec x(\sec x \tan x) + 2\tan x(\sec^2 x))dx$

$= dt$

$\Rightarrow 4\sec^2 x \tan x\, dx = dt$

$\displaystyle\int \frac{4\sec^2 x \tan x}{\sec^2 + \tan x}\, dx$

$= \log(\sec^2 x + \tan^2 x) + c$

72. $\displaystyle\int \frac{x + \sin x}{1 + \cos x}\, dx = \int \frac{x + \sin x}{2\cos^2 x/2}\, dx$

$= \displaystyle\int x\left(\frac{1}{2}\sec^2 x/2\right) dx + \frac{2\sin x/2 \cos x/2}{2\cos 2\, x/2}\, dx$

$= (x\tan x/2 - \int \tan x/2\,(1)\, dx) + \int \tan x/2 + c$

$= x\tan x/2 + c$

73. $\displaystyle\int e^x\left[\frac{x + 4}{(x + 6)^3}\right] dx = \int e^x \left[\frac{(x + 6) - 2}{(x + 6)^3}\right] dx$

$= \displaystyle\int e^x\left[(x + 6)^{-2} - 2(x + 6)^{-3}\right] dx$

$= e^x (x + 6)^{-2} + c$

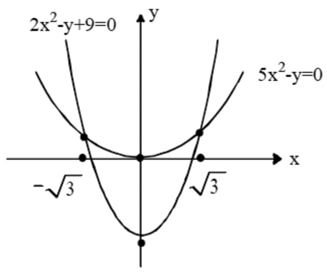
$(\because \displaystyle\int e^x\left[f(x) + f'(x)\right] dx = e^x f(x) + c)$

74. $\int_0^{\pi/2} \frac{a \sin x + b \cos x}{\sin x + \cos x} dx = \frac{\pi}{4}(a + b)$

$= \frac{\pi}{4}$ (200 + 100) = 75π

75. $\lim_{x \to 3} \frac{\int_3^x e^t\, dt}{x - 3} = \lim_{x \to 3} \frac{e^x - e^3}{x - 3} = e^3$

76.



Solving the curves, $x = \pm\sqrt{3}$

Area $= \int_{-\sqrt{3}}^{\sqrt{3}} \left[5x^2 - (2x^2 + 9)\right] dx$

$= 2 \int_0^{\sqrt{3}} (3x^2 - 9)\, dx$

$= 2(x^2 - 9x)\Big|_0^{\sqrt{3}}$

$= 2\left(3\sqrt{3} - 9\sqrt{3}\right) = 2\left|-6\sqrt{3}\right| = 12\sqrt{3}$

77. order = 2, degree = 1

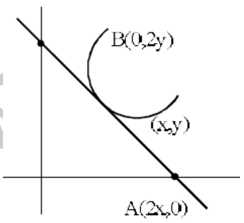
78. $\frac{dy}{dx} = \frac{x^2 + 4x - 9}{x + 2} \Rightarrow dy$

$= \frac{x^2 + 4x - 9}{x + 2}\, dx \Rightarrow \int dy = \int \frac{(x + 2)^2 - 13}{(x + 2)}\, dx$

$\Rightarrow y = \int \left[(x + 2) - \frac{13}{x + 2}\right] dx$

$\Rightarrow y = \frac{x^2}{2} + 2x - 13 \log |x + 2| + c$

79.



Let the point of contact be (x, y)

The slope of the line is

$m = \frac{2y}{2x} = -\frac{y}{x}$

$\Rightarrow \frac{dy}{dx} = -\frac{y}{x}$

$\Rightarrow \int \frac{dy}{y} = -\int \frac{dx}{x}$

$\Rightarrow \log y + \log x = \log c$

$\Rightarrow xy = c$, Which is a hyperbola

80. $\frac{dy}{dx} = y + 3 \Rightarrow \frac{dy}{y+3}$

$= dx \Rightarrow$ on integrating,

$\log (y + 3) = x + c$

$y(0) = 2 \Rightarrow \log 5 = c$

$\Rightarrow \log (y + 3) = x + \log 5$

$\Rightarrow \log \left(\frac{y+3}{5}\right) = x$

$\Rightarrow y = 5e^x - 3$

$\Rightarrow y (\log 2)$

$= 5(2) - 3 = 7$

PHYSICS

81. Density (d) $= \frac{\text{Mass (m)}}{\text{Volume V}}$

Max. error in density,

$\frac{\Delta d}{d} \times 100 = \frac{\Delta m}{m} \times 100 + \frac{\Delta V}{V} \times 100$

$\frac{\Delta d}{d} \times 100 = \frac{0.01}{10} \times 100 + \frac{0.1}{10} \times 100$

$= \frac{1}{5} + 1$

$= 1.2\%$

82. From $V^2 - u^2$

$= 2as \Rightarrow \left(\frac{19V}{20}\right)^2 - V^2 = 2ax$ ..... (1) and

$O^2 - V^2 = 2anx$ ..... (2)

$(2)/(1) \Rightarrow n = \frac{-V^2}{\left(\frac{19V}{20}\right)^2 - V^2} = \frac{1}{1 - \left(\frac{19}{20}\right)^2}$

$= \frac{400}{39} = 10.3$

So, the no.of planks required to just stop bullet = 11

83. $y = ax - bx^2 \Rightarrow y$

$$= (\tan\ \theta).\ x - \left(\frac{\alpha}{2u^2 \cos^2 \theta}\right)\ x^2$$

$$b = \frac{\alpha}{2u^2 \cos^2 \theta} \Rightarrow u = \sqrt{\frac{\alpha}{2\ b \cos^2 \theta}}$$

84. Thurst. $F = u\ \frac{dm}{dt} = 2 \times 10^3 \times 50$

$$= 1 \times 10^5\ N$$

85. $S = \frac{V^2}{2\mu_x g} = \frac{20 \times 20}{2 \times 0.75 \times 10} = \frac{40 \times 4}{6}$

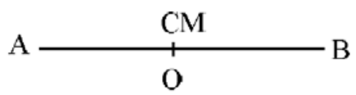
$= 26.67$ m.

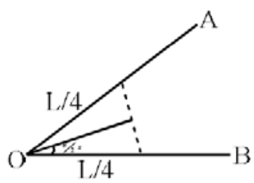
86. From Law of conservation of energy,

$$mgh = \frac{1}{2}\ mV^2$$

$$V = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20\ ms^{-1}$$

87.





$$\cos \theta/2 = \frac{x}{(L/4)}$$

Shift in c.m, $x = \frac{L}{4} \cos \theta/2$

88. $I = IG + Md^2 \Rightarrow Mk^2 = \frac{Mr^2}{2} + Md^2$

$$\Rightarrow K^2 = \frac{R^2}{2} + d^2$$

$$R^2 = \frac{R^2}{2} + d^2 \quad (\therefore K = R)$$

$$d^2 = \frac{R^2}{2} \Rightarrow d = \frac{R}{\sqrt{2}}$$

89. $T.E = P.E + K.E \Rightarrow 9$

$$= 5 + \frac{1}{2}\ KA^2 \Rightarrow \frac{1}{2}\ KA^2 = 4$$

$$K = \frac{8}{A^2} = \frac{8}{(0.01)^2} = 8 \times 10^4\ N/m$$

$$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{2}{8 \times 10^4}} = \frac{\pi}{100} \text{ sec}$$

90. The resultant Gravitational force,

$$F = \frac{Gm^2}{1} + \frac{Gm^2}{4} + \frac{Gm^2}{16} + \ldots\ldots\ldots\ldots$$

$$F = Gm^2\left(\frac{1}{1} + \frac{1}{4} + \frac{1}{16} + \ldots\ldots\ldots\ldots\right)$$

$$= Gm^2\left(\frac{1}{1 - \frac{1}{4}}\right) = \frac{4}{3}Gm^2$$

$\left(\because \text{ sum of the infinite terms in G.P is } S_\infty = \frac{a}{1 - r}\right)$

91. $e = \frac{FL}{\pi r^2 y} \Rightarrow e \alpha \frac{L}{r^2 y}$

92. $\omega = \frac{2\pi}{T} = \frac{2\pi \times 7}{100}$

$= 0.44\ rad/\text{ sec}$

93. Conceptual

94. $P = \frac{2T}{r} = \frac{2 \times 4.65 \times 10^{-1}}{3 \times 10^{-3}}$

$= 310 \text{ Nm}-2$

95. Power $P = F.V = ma.V \Rightarrow a = \frac{P}{mV}$

$\Rightarrow V.\frac{dV}{dS} = \frac{P}{mV} = V^2 dV \Rightarrow \frac{P}{m} ds$

$\frac{P}{m}\int_0^S ds = \int_{V}^{V_2} dV \Rightarrow \frac{P}{m}. S = \frac{1}{3}\left(V_2^3 - V_1^3\right)$

$S = \frac{m}{3P}\left(V_2^3 - V_1^3\right)$

96. At const. volume and temp., according to ideal gas equation

$\frac{P_1}{m_1} = \frac{P_2}{m_2} \Rightarrow P_2 = \frac{m_2}{m_1}P_1$

but $m_2 = m + \frac{m}{4} = \frac{5m}{4}$

$P_2 = \frac{5m/4}{m} \times 80 = 100$ cm of Hg.

97. Heat lost by steam = heat gained by water

$m_s L_s + m_s S\,(100 - \theta) = m_w S\,(\theta - 20)$

ms (540) + ms × 1 × (100 − 25)

= 100 × 1 (25 − 20)

$\text{ms} \times 615 = 500 \Rightarrow \text{ms} = \dfrac{500}{615} = 0.813\ gm$

98. $\Delta WAB = P\Delta V = 10(2-1) = 10\ J$

$\Delta WBC = o$ (as V = const.)

From fist law of thermodynamics,

$\Delta Q = \Delta U + \Delta W$

But $\Delta V = 0$ (Process ABCA is cyclic)

$\Delta Q = \Delta WAB + \Delta WBC + \Delta WCA$

$\Delta WCA = \Delta Q - \Delta WAB - \Delta WBC$

$= 5 - 10 - 0 = -5J$

100. $P = \dfrac{1}{3}\rho V^2_{rms} \Rightarrow V_{rms} = \sqrt{\dfrac{3P}{\rho}}$

$V_{rms} = \sqrt{\dfrac{3 \times 1.013 \times 105}{0.09}} = 1.84 \times 103\ \text{ms}^{-1}$

101. $n^1 = \left[\dfrac{V}{V + Vs}\right] n = \left[\dfrac{340}{340 + 60}\right] 400 = 340\ HZ$

102. $\text{dapp} = \dfrac{h_1}{\mu_1} + \dfrac{h_2}{\mu_2} = \dfrac{6}{1.5} + \dfrac{4}{4/3} = 7$ Cm.

103. According to lens makers formula,

$\dfrac{1}{f} = (\mu - 1)\left[\dfrac{1}{R_1} - \dfrac{1}{R_2}\right]$

$\dfrac{1}{30} = (\mu - 1)\left[\dfrac{1}{10} - \dfrac{1}{\infty}\right] \Rightarrow \mu = \dfrac{4}{3}$

104. Fringe width in air,

$\beta = \dfrac{\lambda D}{d} = \dfrac{6000 \times 10^{-10} \times 1}{0.15 \times 10^{-3}} = 4$ mm

Fringe width in a liquid is

$\beta^1 = \dfrac{\beta}{\mu} = \dfrac{4}{5/2} = \dfrac{8}{5} = 1.6$ mm

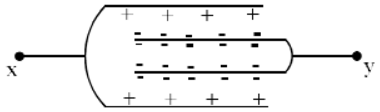
105. Conceptual

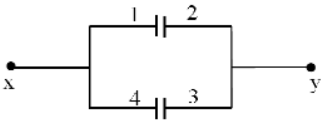
106. $q = cV = (4\pi\varepsilon_0 R)V$

Since they are in contact, potential 'V' same.

$q \propto R \Rightarrow q_1 : q_2 = R_1 : R_2 = 4 : 3$

107. The arrangement can be represented as the grouping of two identical capacitors each of capacity $\frac{\varepsilon_0 A}{d}$





$\Rightarrow$ equivalent capacitance

$$C_{XY} = C + C = 2C = \frac{2\,\varepsilon_0 A}{d}$$

108. Potential gradient,

$$x = i\rho = \frac{iR}{L} = \frac{5 \times 4}{1} = 20 \text{ mV}$$

$$\text{e.m. f} = l \times x = 0.4 \times 20 = 8 \text{ mV}$$

109. $B = N\,\frac{\mu_0 i}{2r} = \frac{100 \times 2\pi \times 10^{-7} \times 2}{10 \times 10^{-2}}$

$$= 1.26 \times 10^{-3} \text{ wb/ m}^2$$

110. $S = \frac{G}{\left(\frac{i}{i_g} - 1\right)} = \frac{98}{\left(\frac{1}{2\%} - 1\right)} = \frac{98}{\left(\frac{100}{2} - 1\right)}$

$$= \frac{98}{(50 - 1)} = 2\ \Omega$$

$$\left(\frac{i_g}{i} = 2\%\right)$$

111. $F = \frac{\mu_0}{4\pi}\ \frac{6\ M_1 M_2}{r^4} = 10^{-7} \times \frac{6 \times 10 \times 10}{(0.1)^4}$

$$= 0.6 \text{ N}$$

112. $e = M\,\frac{dI}{dt} \Rightarrow 20 \times 10^{-3} = M\left(\frac{6-2}{2}\right)$

$$\Rightarrow M = 10 \text{ mH}$$

113. $\text{Irms} = \frac{E\text{rms}}{XL} = \frac{E\text{rms}}{L\omega} = \frac{E\text{rms}}{L(2\pi v)}$

$$\frac{150}{2 \times 2 \times 3.14 \times 50} = \frac{150}{628} = 0.24 \text{ A}$$

$$I_0 = \sqrt{2} \times \text{Irms} = 1.414 \times 0.24 = 0.339 \text{ A}$$

114. Conceptual

115. $E_1 = \frac{-13.6}{n_1^2}$ e.v

($n_1 \rightarrow$ initial state of electron)

$$-0.85 = \frac{-13.6}{n_1^2} \Rightarrow n_1 = 4$$

$(E_1 = -0.85 \text{ ev})$

116. $\tau = \frac{T}{0.693} = \frac{72}{0.693} = 103.9$ days

117. Efficiency of full wave rectifier,

$$\eta = \frac{0.812\, R_L}{r_f + R_L}$$

$$\eta = \frac{0.812 \times 100}{100} = 0.812$$

The percentage efficiency of the full wave rectifier = 81.2%

119. Coverage range

$$d = \sqrt{2R_e h} = \sqrt{2 \times 6400 \times 10^3 \times 80} = 32 \text{ km}$$

CHEMISTRY

121. $r_n = 0.53 \times \frac{n^2}{z}\ A^0$

$$r_1 \text{ of } Li^{+2} = \frac{0.53 \times (1)^2}{3} = 0.176\, A^0$$

122. Number of moles $n_N2 = \frac{56}{28} = 2$

$$n_{CO_2} = \frac{44}{44} = 1,\ n_{CH_4} = \frac{16}{16} = 1$$

Mole fraction of methane

$$(x_{CH_4}) = \frac{nCH_4}{nH_2 + nCO_2 + nCH_4}$$

$$= \frac{1}{2+1+1} = \frac{1}{4}$$

Partial pressure of methane

$$P_{CH_4} = P_{total} \times x_{CH_4}$$

$$= 720 \times \frac{1}{4} = 180 \text{ mm}$$

123. $w = 2.303\ nRT \log\left(\frac{P_2}{P_1}\right)$

$$= 2.303 \times 1 \times 8.314 \times 300 \times \log \frac{4}{1}$$

$$= 2.303 \times 1 \times 8.314 \times 300 \times 0.6$$

$$= 3446.48 \text{ J} = 3.446 \text{ KJ}$$

124. $Cu_{(g)} \rightarrow Cu^{+1}_{(g)} + 1e^- ; \Delta H_1 = 745\ KJ\ mole^{-1}$

$I_{(g)} + 1e^- \rightarrow I^-_{(g)}\ \Delta H_{EA} = -295\ KJ\ mole^{-1}$

$Cu^{+1}_{(g)} + I^-_{(g)} \rightarrow CuI_{(g)},\ \Delta H_f = -446\ KJ\ mole^{-1}$

$Cu_{(g)} + I_{(g)} \rightarrow CuI_{(g)};\ \Delta H = x$

$\Delta H = 745 + (-295) + (-446) = +4\ KJ/mole$

125. $2\ NO_2 \qquad 2\ NO + O_2,\ K_c = 1.8 \times 10^{-6}$

$$K_c = \frac{[NO]^2\ [O_2]^1}{[NO_2]^2} \quad \frac{1}{K_c} = \frac{[NO_2]^2}{[NO]^2\,[O_2]}$$

$$NO_{(g)} + \frac{1}{2}(O_2)_{(g)} \qquad NO_{2(g)}$$

$$K_c = \frac{[NO_2]}{[NO]\,[O_2]^{1/2}}\ ;\ (K_c)^2 = \frac{(NO_2)^2}{[NO]^2\,[O_2]}$$

Then $(K_c)^2 = \dfrac{1}{K_C}$

$$K_C^2 = \frac{1}{1.8 \times 10^{-6}} = \frac{1 \times 106}{1.8}$$

$K_C^2 = 5.5 \times 105$

$K_C = \sqrt{55 \times 104}$

$= 7.5 \times 10^2$

127. $6\ KMnO_4 + 10\ FeC_2O_4 + 24\ H_2SO_4 \rightarrow 3\ K_2SO_4 + 5\ Fe_2\ (SO_4)_3\ 6\ MnSO_4 + 20\ CO_2 + 24\ H_2O$

$6\ KMnO_4 = 10\ FeC_2O_4$

10 Moles of

FeC_2O_4 req .... 6 moles of $KMnO_4$

1 mole of FeC_2O_4 ......?

$= \dfrac{1 \times 6}{10} = 0.6$

129. EA order $Cl_2 > F_2 > Br_2$

130. BrO_3^-, XeO_3, SO_3^{-2}, NF_3 are pyramidal (sp^3)

NO_3^-, BF_3 – Planar triangle (sp^2)

SF_4 sea saw (sp^3d^1)

XeF_4 Sq. planer (sp^3d^2)

131.

Property value	D_2O	H_2O
Dielectric constant	78.06	78.39
Surface tension	67.8	72
Refractive index	1.328	1.33

132. O_3 (Ozone) in the form of ozone layer prevent in coming U.V. rays.

133. $Mg_2C_3 + 4\ H_2O \rightarrow 2\ Mg(OH)_2 + CH \equiv C - CH_3$

propyne

134. $H_3BO_3 \xrightarrow{1000^\circ} HBO_2 + H_2O$

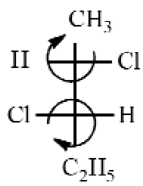
$4\ HBO_2 \xrightarrow[\Delta]{150 - 160C^\circ} H_2B_4O_7 + H_2O$

$H_2B_4O_3 \xrightarrow[\text{High.temp}]{} 2\ B_2O_3 + H_2O$

135. $SiO_2 + Na_2CO_3 \rightarrow Na_2SiO_3 + CO_2$

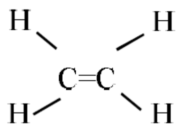
136. 3−ethyl − 4, 4 − dimethyl heptane

137. 2s, 3s



H − is on horizontal

138.



One $sp^2 - sp^2\ \sigma$ bond

Four $sp^2 - s\ \sigma$ bonds

One $p - p\ \pi$ bond

139. In anti − ferromagnetism the net moment is 0.

140. $\Delta Tb = Kb.m$

$Kb = \dfrac{\Delta Tb}{m}$; but $m = \dfrac{18 \times 1000}{18 \times 100} = 1$

$Kb = \dfrac{\Delta Tb}{1} = \Delta Tb$

141. $NH_4OH = \Lambda^{\infty}_{eq}(NH_4Cl) + \Lambda^{\infty}_{eq}(NaOH) - \Lambda^{\infty}_{eq}(NaCl)$

$= 142.5 + 242.350 - 123.42$

$= 261.43$

142. In a fuel cell,

$2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(l)$

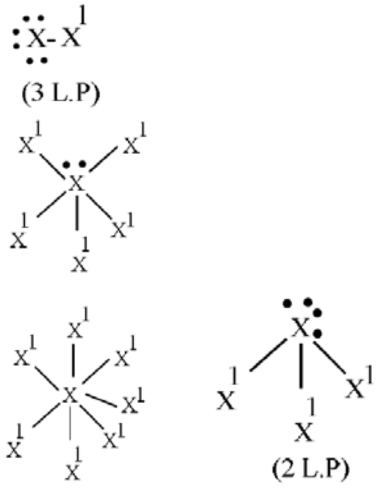
143. Gold number decreases protective power increases so, y < x < z

144. Tyndall effect is observed in starch sol

145. $CaCN_2$, Mg_3N_2, BN Reaction with H_2O it can form ammonia

146. sp^3, $SO_3 + D_2O \rightarrow D_2SO_4$

147.



148. Kr – 85 used in

1) Electric tubes for voltage regulation

2) Measurement of the thickness of the metal sheets and joints.

149. rubber is cis – 1, 4 – polyisoprene

150. From graph, activation energy for backward reaction is greater than forward reaction

151. They have same no. of electrons

152. $M = \dfrac{n \times 1000}{V\,(ml)}$

$$n = \frac{M \times V\,(ml)}{1000} = \frac{0.2 \times 200}{1000} = 0.04 \text{ mol}$$

153. Important oxide ore is haematite

154. BHT, BHA are food antioxidant

155. The human body is the endocrine gland is called thyroid

156. $R - X + KCN \rightarrow RCN + KX$ show nucleophillic substitution of alkyl halide

157. $C_2H_4 + HCl \xrightarrow{AlCl_3} C_2H_5Cl\ (A)$

$C_2H_5Cl + KOH(aq) \longrightarrow C_2H_5OH + KCl$

$C_2H_5OH \xrightarrow[170°C]{Con.H_2SO_4} C_2H_4 + H_2O$

158. Pd / $BaSO_4$ with H_2 is called Lindlars catalyst this is a Rosenmunds reaction

159. $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_3 \xrightarrow[Zn-Hg\,/\,Con.HCl]{Reduction}$

$CH_3 - CH_2 - CH_3$

160. $C_6H_5Cl + NH_3 \xrightarrow{Cu_2O} C_6H_5NH_2 + HCl$

$C_6H_5NH_2 + CHCl_3 + 3\ KOH(alco) \longrightarrow C_6H_5NC + 3\ KCl + 3\ H_2O$

(ఈ నమూనా ప్రశ్నపత్రాన్ని శ్రీగాయత్రి విద్యాసంస్థలకు చెందిన నిపుణులు రూపొందించారు)