MATHEMATICS – SET 3

1. The value of cos1° cos2° cos3°... cos179°is

A) $\frac{1}{\sqrt{2}}$ B) 0 C) 1 D) -1

2. For all $n \in N, 3 \cdot 5^{2n+1} + 2^{3n+1}$ is divisible by

A) 19 B) 17 C) 23 D) 25

3. The coefficient of x^n in the expansion of $(1+x)^{2n}$ and $(1+x)^{2n-1}$ are in the ratio

A) 1 : 2 B) 1 : 3 C) 3 : 1 D) 2 : 1

4. The equations of the lines which pass through the point $(3, -2)$ and are inclined at 60° to the line $\sqrt{3}x + y = 1$ is

A) $y + 2 = 0, \sqrt{3}x - y - 2 - 3\sqrt{3} = 0$ B) $x - 2 = 0, \sqrt{3}x - y + 2 + 3\sqrt{3} = 0$

C) $\sqrt{3}x - y - 2 - 3\sqrt{3} = 0$ D) None of these

5. The point $(-2, -3, -4)$ lies in the

A) First octant B) Seventh octant C) Second octant D) Eighth octant

6. The differential equation $y\frac{dy}{dx} + x = c$ represents

1) Family of hyperbolas 2) Family of parabolas
3) Family of ellipse 4) Family of circles

7. Let $f: R \to R$ be defined by $f(x) = \frac{1}{x}\ \forall\ x \in R$. Then f is

A) one-one B) onto C) bijective D) f is not defined

8. If $cos^{-1}x > sin^{-1}x$, then

A) $\frac{1}{\sqrt{2}} < x \leq 1$ B) $0 \leq x < \frac{1}{\sqrt{2}}$ C) $-1 \leq x < \frac{1}{\sqrt{2}}$ D) $x > 0$

9. If A and B are invertible matrices, then which of the following is not correct?

A) $adjA = |A| \cdot A^{-1}$ B) $\det(A)^{-1} = [\det(A)]^{-1}$

C) $(AB)^{-1} = B^{-1}A^{-1}$ D) $(A+B)^{-1} = B^{-1} + A^{-1}$

10. If x, y, z are all different from zero and $\begin{vmatrix} 1+x & 1 & 1 \\ 1 & 1+y & 1 \\ 1 & 1 & 1+z \end{vmatrix} = 0$, then value of $x^{-1} + y^{-1} + z^{-1}$ is

A) xyz B) $x^{-1}y^{-1}z^{-1}$ C) $-x - y - z$ D) -1

11. If $y = tan^{-1}\left(\frac{\log\left(\frac{e}{x^2}\right)}{\log(ex^2)}\right) + tan^{-1}\left(\frac{3+2logx}{1-6logx}\right)$, then $\frac{d^2y}{dx^2}$ is equal to

A) 2 B) 1 C) 0 D) – 1

12. If the curve $ay + x^2 = 7$ and $x^3 = y$, cut orthogonally at (1, 1), then the value of a is

A) 1 B) 0 C) – 6 D) 6

13. The maximum value of $\left(\frac{1}{x}\right)^x$ is

A) e B) e^e C) $e^{\frac{1}{e}}$ D) $\left(\frac{1}{e}\right)^{\frac{1}{e}}$

14. $\int \left(\frac{x+2}{x+4}\right)^2 e^x \, dx$ is equal to

A) $e^x \left(\frac{x}{x+4}\right) + C$ B) $e^x \left(\frac{x+2}{x+4}\right) + C$ C) $e^x \left(\frac{x-2}{x+4}\right) + C$ D) $\left(\frac{2xe^x}{x+4}\right) + C$

15. The area of the region bounded by the curve $x = 2y + 3$ and the lines $y = 1$ and $y = -1$ is

A) 4 sq. units B) $\frac{3}{2}$ sq. units C) 6 sq. units D) 8 sq. units

16. The integrating factor of the differential equation $\frac{dy}{dx} + y = \frac{1+y}{x}$ is

A) $\frac{x}{e^x}$ B) $\frac{e^x}{x}$ C) xe^x D) e^x

17. The number of vectors of unit length perpendicular to the vectors $\vec{a} = 2\hat{\imath} + \hat{\jmath} + 2\hat{k}$ and $\vec{b} = \hat{\jmath} + \hat{k}$ is

A) one B) two C) three D) infinite

18. The locus represented by $xy + yz = 0$ is

A) A pair of perpendicular lines B) A pair of parallel lines

C) A pair of parallel planes D) A pair o perpendicular planes

19. Corner points of the feasible region determined by the system of linear constraint are $(0, 3), (1, 1)$ and $(3, 0)$. Let $Z = px + qy$, where $p, q > 0$. Condition on p and q so that the minimum of Z occurs at $(3, 0)$ and $(1, 1)$ is

A) $p = 2q$ B) $p = \frac{q}{2}$ C) $p = 3q$ D) $p = q$

20. In a college, 30 % students fail in physics, 25% fail in mathematics and 10% fail in both. One student is chosen at random. The probability that she fails in physics if she failed in mathematics is

A) $\frac{1}{10}$ B) $\frac{2}{5}$ C) $\frac{9}{20}$ D) $\frac{1}{3}$

Physics set – 3 (20 Questions)

21. Two rain drops falling through air have radii in the ratio 1 : 2. They will have terminal velocity in the ratio

A) 4 : 1 B) 1 : 4 C) 2 : 1 D) 1 : 2

22. A body cools from $50^{\circ}C$ to $49.9^{\circ}C$ in 5 s. Assuming Newton's law of cooling and temperature of surroundings fixed at $30^{\circ}C$, how long will the same body take for cooling from $40^{\circ}C$ to $39.9^{\circ}C$?

A) 2.5s B) 5.0s C) 10s D) 7.5s

23. The temperature of source and sink of a Carnot engine are 400 K and 300 K respectively. Its efficiency is

A) 100% B) 75% C) 33.3% D) 25%

24. A perfect gas at 27°C is heated at constant pressure so as to double its volume. The increase in the temperature of the gas will be

A) 600°C B) 327°C C) 54°C D) 300°C

25. A simple harmonic oscillator has a period of 0.01 s and an amplitude of 0.2 m. The magnitude of the velocity in m sec^{-1} at the centre of oscillation is

A) 20 π B) 100 C) 40 π D) 100 π

26. An observer standing near the sea-coast counts 48 waves per min. If the wavelength of the wave is 10m, the velocity of the waves will be

A) 8 m/s B) 12 m/s C)16 m/s D) 20 m/s

27. Work function of potassium metal is 2.30 eV. When light of frequency $8 \times 10^{14} Hz$ is incident on the metal surface, photoemission of electrons occurs. The stopping potential of the electrons will be equal to

A) 0.1 V B) 1.0 V C) 2.3 V D) 3.3 V

28. The ratio of the de Broglie wavelength of proton and α-particle which have been accelerated through same potential difference is

A) $2\sqrt{3}$ B) $3\sqrt{2}$ C) $2\sqrt{2}$ D) $3\sqrt{3}$

29. If the electron in a hydrogen atom jumps from an orbit *with* $n_2 = 3$ to a orbit with level $n_1 = 2$, the emitted radiation has a wavelength given by

A) $\lambda = \frac{36}{5R}$ B) $\lambda = \frac{5R}{36}$ C) $\lambda = \frac{6}{5R}$ D) $\lambda = \frac{3}{5R}$

30. The electrons in hydrogen atoms are raised from ground state to third excited state. The number of emission lines will be

A) 10 B) 4 C) 6 D) 3

31. A radio isotope has half life of 5 years. The fraction of the atom of this material that would decay in 15 years will be

A) 1 B) 2/3 C)7/8 D)5/8

32. The ratio of nuclear radii of X^{27} and X^{8} are

A) 1.5 B) 3.375 C) 0.5 D) none of these

33. In the reaction represented by ${}^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y \rightarrow {}^{A-4}_{Z-2}Y \rightarrow {}^{A-4}_{Z-1}K$

the decays in the sequence are

A) α, β, γ B) β, γ, α C) γ, α, β D) α, γ, β

34. 3.2 g of matter is completely converted into energy. Energy released is

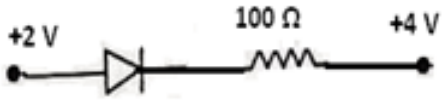
A) 2.88 x 10^{13} J B) 28.8 x 10^{13} J C) 5.6 x 10^{13} J D) 2.88 x 10^{13} J

35. If the ratio of the concentration of electrons to that of holes in a semiconductor is $\frac{7}{5}$ the ratio of currents is $\frac{7}{4}$, then the ratio of drift velocities is

A. $\frac{5}{8}$ B) $\frac{4}{5}$ C) $\frac{5}{4}$ D) $\frac{4}{7}$

36. The junction diode shown in the figure is ideal. The current in the circuit is

A. 60mA
B. 20mA
C. 40mA
D. Zero



37. For a transistor, if $\frac{I_C}{I_E} = 0.96$, then current gain for CE-mode transistor is

A) 6 B) 12 C) 24 D) 48

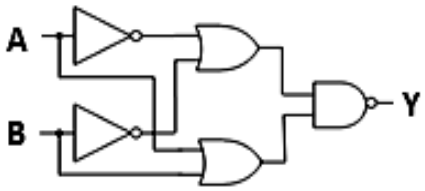
38. In the following circuit, the output Y = 1 for the inputs

A. A =0, B=1

B. A=B=0

C. A=B=1

D. Both b and c



39. A wheel with 10 metallic spokes each 0.5m long is rotated with a speed of 120 rpm in a plane normal to the earth's magnetic field at that place.

If the magnitude of that field is 0.4×10^{-4}T, what is the induced emf between the axle and the rim of the wheel?

A) 6.283×10^{-5} V B) 6.283×10^{-4} V

B) 7.283×10^{-5} V D) 7.283×10^{-4} V

40. An n-type crystal is

A) Neutral B) positively charged

B) negatively charged D) none of these

Set – 3 (chemistry)

41. *Ka* for HCN is 4×10^{-10} . What is the percentage ionisation of 1M solution?

A) 3.8×10^{-5} B) 6.2×10^{-3} C) 0.002 D) 0.20

42. The volume strength of 3% hydrogen peroxide solution is

A) 10 B) 20 C) 30 D) 3

43. Which of the following imparts violet colour to the Bunsen flame?

A) NaCl B) $BaCl_2$ C) $CaCl_2$ D) KCl

44. The type of hybridization of boron in diborane is

A) *sp* – hybridization B) sp^2 – hybridization

C) Sp^3 – hybridization D) sp^3d^2 – hybridization

45. Which of the following reagents distinguish ethylene from acetylene?

A) Ammoniacal cuprous chloride B) Br_2 water

C) Alkaline $KMnO_4$ solution D) Chlorine dissolved in CCl_4

46. In the following reaction, the final product 'R' is

$$CaC_2 \xrightarrow{H_2O} P \xrightarrow[\text{tube}]{\text{hot Iron}} Q \xrightarrow[AlCl_3]{CH_3Cl} R$$

A) benzene B) ethyl benzene C) toluene D) n-Propyl benzene

47. The earth is protected from UV-radiation of sun by

A) ozone layer B) nitrogen layer C) carbon dioxide layer D) oxygen layer

48. The correct IUPAC name of $[Pt(NH_3)_2Cl_2]$ is

A) Diamminedichloridoplatinum (II) B) Diamminedichloriplatinum (IV)

C) Diamminedichloridoplatium (0) D) Dichloridodiammineplatinum (IV)

49. Identify the octahedral complex

A) $[Co(NH_3)_6]Cl_3$ only B) $K_4[Fe(CN)_6]$ only C) $[Pt(NH_3)_6]^{4+}$ only D) all of these

50. An alkyl halide (RX) reacts with Na to form 4, 5-diethyloctane, compound RX is

A) $CH_3(CH_2)_3$ Br B) $CH_3(CH_2)_2$ $CH(Br)CH_2CH_3$

C) $CH_3(CH_2)_3CH(Br)CH_3$ D) $CH_3(CH_2)_3$ Br

51. t-butyl chloride preferably undergo hydrolysis by

A) SN^1 Mechanism B) SN^2 mechanism C) Both (a) and (b) D) None of these

52. Ketone upon treatment with Grignard reagents followed by hydrolysis gives

A) primary alcohol B) secondary alcohol C) tertiary alcohol D) aldehyde

53. The compound which gives turbidity immediately with Lucas ragent at room temperature is

A) butan – 1 – o1 B) butan -2- o1 C) 2-methyl propan -2-ol D)2-methyl-propan-1-o1

54. The most suitable reagent for the conversion of primary alcohol into aldehyde, with the same number of carbons is

A) acidified $K_2Cr_2O_7$ B) acidified $KMnO_4$ C) alkaline $KMnO_4$ D) PCC

55. The catalyst used in Rosenmund reaction is

A) Zn/Hg B) $Pd/BaSO_4$ C) Raney Ni D) Na in ethanol

56. Hoffmann bromamide reaction is used to prepare

A) 1° amine B) 2° amine C) 3° amine D) all of these

57. Which of the following is not the correct reaction of aryl diazonium salts?

(a) $C_6H_5N_2Cl + Cu_2Cl_2 \rightarrow C_6H_5Cl$

(b) $C_6H_5N_2Cl + HBF_4 \xrightarrow{\text{Heat}} C_6H_5F$

(C) $C_6H_5N_2Cl + H_3PO_2 \rightarrow C_6H_5PO_4$

(d) $C_6H_5N_2Cl$ + aniline $\rightarrow$azodye

58. Which of the following is ketohexose?

A) Glucose B) Sucrose C) Fructose D) Ribose

59. Which one of the following is a copolymer?

A) Polyethylene B) Polyvinyl chloride C) Poly tertraflurothylene D) Nylon-6,6

60. Chloramphenicol is

A) Narrow spectrum antibiotic B) broad spectrum analgesic

C) Broad spectrum antibiotic D) broad spectrum antibacterial