

MOCK TEST 2

PART I: MATHEMATICS

- The solution of the inequality $\frac{2x + 5}{x + 3} > -1$ is
 (1) $(2, \infty)$ (2) $\left(\frac{8}{3}, \infty\right)$
 (3) $(3, \infty)$ (4) $(2, 3)$
- If $\frac{7x + 11}{(x + B)(1 + x)} \equiv \frac{A}{x + 2} + \frac{B}{x + 1}$, then $A - B =$
 (1) 7 (2) -1 (3) 12 (4) 1
- The number of integral solutions of $x^2 - 10x + 21 \leq 0$ and $x^2 - 4x > 0$ is
 (1) 3 (2) 4
 (3) 2 (4) infinite
- The sum of the integers from 1 to 100 that are divisible by 2 or 5 is
 (1) 3000 (2) 3050 (3) 3500 (4) 3650
- If the coefficient of the r th and $(2r + 5)$ th terms of the expansion of $(1 + x)^{15}$ are equal, $r =$
 (1) 4 (2) 6 (3) 7 (4) 3
- Let $E = 2 \sin^2 x - \cos 2x$. Then for all values of x
 (1) $-1 \leq E \leq 3$ (2) $0 \leq E \leq 2$
 (3) $-1 \leq E \leq 1$ (4) None of these
- The number of ways in which 20 mangoes may be distributed among 5 children, so that each child gets at least one mango is
 (1) ${}^{20}C_4$ (2) ${}^{19}C_4$ (3) ${}^{24}C_3$ (4) ${}^{19}C_5$
- The number of divisors of $N = 38808$ can have (excluding 1 and N) is
 (1) 70 (2) 72 (3) 71 (4) 12
- If $\cos x - i \sin 2x$ and $\sin x - i \cos 2x$ are conjugates of each other, then
 (1) $x = n\pi$
 (2) $x = 0$
 (3) $x = (2n + 1)\frac{\pi}{2}$
 (4) no value of x exists

SPACE FOR ROUGH WORK

- 10.** The equation of the lines joining the origin to the points of intersection of the line $3x + y = 12$ intercepted between the axes of coordinates are

(1) $y = \frac{1}{2}x$ and $y = x$

(2) $y = x$ and $y = -x$

(3) $y = \frac{3}{2}x$ and $y = 6x$

(4) none of these

- 11.** The point $(4, -3)$ with respect to the ellipse $4x^2 + 5y^2 = 1$

(1) lies on the curve

(2) lies outside the curve

(3) lies inside the curve

(4) is the focus

- 12.** The coordinates of the point where the line joining $A(3, 4, 1)$ and $B(5, 1, 6)$ crosses the xy -plane are

(1) $\left(\frac{13}{5}, \frac{23}{5}, 0\right)$ (2) $\left(\frac{13}{5}, \frac{23}{5}, 0\right)$

(3) $\left(\frac{13}{5}, \frac{23}{5}, 0\right)$ (4) none of these

13. $\lim_{x \rightarrow \infty} \left(x - \sqrt{x^2 + x} \right) =$

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

- 14.** If $f(x) = 1 + 2\sin x + 2\cos 2x$, $0 \leq x \leq \frac{\pi}{2}$, then $f(x)$ is

(1) least at $x = \frac{\pi}{2}$

(2) greatest at $x = \frac{\pi}{2}$

(3) least at $x = \frac{\pi}{3}$

(4) greatest at $x = \frac{\pi}{3}$

- 15.** The solution of the differential equation

$\frac{dy}{dx} + \frac{y}{x} = x^2$ is

(1) $4xy = x^4 + c$ (2) $xy = x^4 + c$

(3) $4xy + x^4 = c$ (4) $xy + x^4 = c$

SPACE FOR ROUGH WORK

16. A solution of $\sqrt{x^2 + 9} + x$ is $\sqrt{9^2 = 4 + 34}$ is
- (1) 4 (2) 5 (3) 25 (4) $\sqrt{5}$
17. The value of a for which the roots α, β of the equation $2x^2 + 6x + a = 0$ satisfies the condition $\frac{\alpha}{\beta} + \frac{\beta}{\alpha} < 2$ is
- (1) $a > \frac{9}{2}$ (2) $a < 0$
- (3) $a > 0$ (4) none of these
18. If a, b, c are in G.P., then $\log_a x, \log_b x, \log_c x$ are in
- (1) A.P. (2) H.P.
- (3) G.P. (4) none of these
19. If R and R' are symmetric relation (not disjoint) on a set A , then the relation $R \cap R'$ is (1) reflexive (3) transitive
- (2) symmetric
- (4) none of these
20. If $A = \{1, 2, 3\}$, $B = \{3, 8\}$, then $(A \cup B) \times (A \cap B) =$
- (1) $\{(3, 1), (3, 2), (3, 3), (3, 8)\}$
- (2) $\{(1, 3), (2, 3), (3, 3), (8, 3)\}$
- (3) $\{(1, 2), (2, 2), (3, 3), (8, 8)\}$
- (4) $\{(8, 3), (8, 2), (8, 1), (8, 8)\}$
21. The mean deviation of the numbers 3, 4, 5, 6, 7 is
- (1) 0 (2) 25 (3) 5 (4) 1.2
22. For $2 \leq r \leq n$, $nC_r + {}^{2n}C_{r-1} + {}^nC_{r-2} =$
- (1) $(n+1)C_{r-1}$ (2) $2 \cdot (n+1)C_{r+1}$
- (3) $2 \cdot (n+2)C_r$ (4) $(n+2)C_r$
23. The coefficient of x^k , ($0 \leq k \leq n$) in the expansion of $E = 1 + (1+x) + (1+x)^2 + \dots + (1+x)^n$ is equal to
- (1) $(n+1)C_{k+1}$ (2) nC_k
- (3) ${}^{(n+1)}C_{n+k}$ (4) C_{n-k-1}

SPACE FOR ROUGH WORK

24. If $\begin{vmatrix} 6i & B & 3 & 1 \\ 4 & & i & B & 1 \\ 20 & & 3 & & i \end{vmatrix} = x + iy$, then

(1) $x = 3, y = 1$ (2) $x = 1, y = 3$

(3) $x = 0, y = 3$ (4) $x = 0, y = 0$

25. The inverse of a symmetric matrix is

(1) skew-symmetric

(2) symmetric

(3) diagonal matrix

(4) unit matrix

26. The value of

$\tan 20^\circ + \tan 40^\circ + \sqrt{3} \tan 20^\circ \tan 40^\circ =$

(1) $\sqrt{3}$

(2) $\frac{\sqrt{3}}{2}$

(3) $\frac{\sqrt{3}}{4}$

(4) none of these

27. The value of $\cos^{-1} \left(B \cos \frac{2\pi}{3} \right)$ is equal to

(1) $\frac{\pi}{4}$

(2) $\frac{\pi}{2}$

(3) $\frac{\pi}{3}$

(4) $-\frac{\pi}{4}$

28. The general solution of the equation

$3 \cos^2 x - 10 \cos x + 3 = 0$ is

(1) $2n\pi + \cos^{-1} \frac{1}{3}$

(2) $n\pi + \cos^{-1} \left(\frac{1}{3} \right)$

(3) $2n\pi \pm \cos^{-1} \left(\frac{1}{3} \right)$

(4) $n\pi \pm \cos^{-1} \left(\frac{1}{3} \right)$

29. If $|z| = 2$, then $\frac{4+z}{1+\bar{z}}$ is equal to

(1) z

(2) \bar{z}

(3) $2z$

(4) $z + \bar{z}$

30. The angle between the tangents from

the origin to the circle $(x-7)^2 + (y+1)^2 = 2$ is

(1) $\frac{\pi}{3}$

(2) $\frac{\pi}{4}$

(3) $\frac{\pi}{2}$

(4) $\frac{\pi}{6}$

31. The directrix of the parabola $4x = y^2 - 2y$ has the equation

(1) $4x - 1 = 0$

(2) $4x + 5 = 0$

(3) $4x - 5 = 0$

(4) $4y + 5 = 0$

SPACE FOR ROUGH WORK

32. Let $\vec{OA} = \hat{i} + 3\hat{j} + 2\hat{k}$ and $\vec{OB} = 3\hat{i} + \hat{j} + 2\hat{k}$. The vector bisecting the angle AOB, where C lies on AB is

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

33. If $y = \sin^{-1} \sqrt{1 - Bx} + \cos^{-1} \sqrt{x}$, then $\frac{dy}{dx} =$

- (1) $\frac{B-1}{\sqrt{x(1-Bx)}}$ (2) $\frac{1}{\sqrt{x(1-Bx)}}$
 (3) $\frac{1}{x(1-Bx)}$ (4) $\frac{1}{x(1+x)}$

34. The curve $y + x = e^{xy}$ has a vertical tangent at the point

- (1) (1, 1) (2) (1, 0)
 (3) (0, 1) (4) at no point

35. $\int_0^{\pi/2} \frac{\cos x}{(1 + \sin^2 x) \sin x} dx =$

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

36. The product of 11, 101, 10001 is

- (1) 1000001 (2) $\frac{10^6 - 1}{9}$
 (3) $\frac{10^8 - 1}{9}$ (4) $\frac{10^5 - 1}{9}$

37. The sum of n terms of two A.P. series are in the ratio $(n+1) : (n+3)$. Then the ratio of their 4th terms is

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

38. The expression $a^{\frac{\log \log a}{\log a}}$ where all the logarithms are to the base b is equal to

- (1) $\log_b (ab)$ (2) $\log_b (ab)$
 (3) \log

39. ${}^nC_n + {}^{(n+1)}C_n + {}^{(n+2)}C_n + \dots + {}^{(n+m)}C_n + (n+m+1)C_n =$

- (1) $(n+m+1)C_n$ (2) $(n+m+1)C_{n+1}$
 (3) $(n+m+2)C_{n+1}$ (4) $(n+m+2)C_{n+1}$

SPACE FOR ROUGH WORK

40. If $f(x, y) = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix}$, then $f(x, y)$ is

(1) divisible by x

(2) not divisible by x

(3) not divisible by y

(4) divisible by $(1+x)$

41. If in $\triangle ABC$, $a^2 + b^2 + c^2 = ca + ab + 3$, then the triangle

(1) is equilateral

(2) is right-angled isosceles

(3) has angles 30° , 60° and 90°

(4) none of these

42. At most n books are to be selected from $(2n+1)$ books. If a student can select at least one book in 1023 ways, then $n =$

(1) 3

(2) 6

(3) 5

(4) 7

43. Among the complex numbers, z satisfies the condition $|z+1-i| \leq 1$. Then the number having the least positive argument is

(1) $1-i$ (2) $-1+i$ (3) $-i$ (4) i

44. Four persons are chosen at random from a group containing 3 men, 2 women and 4 children. The probability that the group contain exactly 2 children is

(1) $\frac{1}{21}$ (2) $\frac{2}{7}$ (3) $\frac{1}{10}$ (4) $\frac{5}{21}$

45. The values of x for which the angle between $\vec{a} = 2\hat{i} + 4\hat{j} + k$ and $\vec{b} = 7\hat{i} + 2\hat{j} + x\hat{k}$ is obtuse and the angle between \vec{b} and the x -axis is acute and less than $\frac{\pi}{6}$ are

(1) $x < 0$ or $x > \frac{1}{2}$ (2) $0 < x < \frac{1}{2}$

(3) $\frac{1}{2} < x < 15$ (4) $x < \sqrt{\frac{37}{3}}$

SPACE FOR ROUGH WORK

PART II: PHYSICS

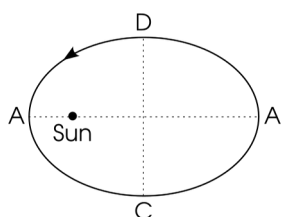
- | | |
|---|--|
| <p>46. Which of the following is optically active?</p> <p>(1) stretched polymer sheet</p> <p>(2) silvered glass</p> <p>(3) calcite</p> <p>(4) quartz</p> <p>47. In the He-Ne laser the role of the He-atom is</p> <p>(1) to emit the red light</p> <p>(2) to control the output</p> <p>(3) to control the wavelength</p> <p>(4) to effect population inversion between the Ne levels</p> <p>48. The part of a transistor, which is heavily doped to produce a large number of majority carriers, is</p> <p>(1) base (2) emitter</p> <p>(3) collector (4) none of these</p> <p>49. The double-slit electron interference pattern appears when a large number</p> | <p>of electrons are accumulated at the screen. According to the quantum theory, the interference pattern appears</p> <p>(1) only if a beam of electrons are in transit so that one part of the beam goes through one slit and another part through the other</p> <p>(2) even if one electron at a time is in transit, but an electron goes through one of the two slits only</p> <p>(3) even if one electron at a time is in transit, but an electron goes through both the slits at once</p> <p>(4) the consideration of an electron at a time in transit is not physically possible</p> <p>50. With what aspects of radiation is the equation $\log \lambda = \log R + B$ associated?</p> <p>(1) characteristic X-rays</p> <p>(2) black body radiation</p> <p>(3) α-emission</p> <p>(4) Compton effect</p> |
|---|--|

SPACE FOR ROUGH WORK

51. End of glass tube becomes round on heating due to

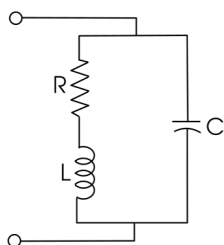
(1) surface tension (2) viscosity
(3) gravity (4) friction

52. The earth revolves round the sun in an elliptical orbit with sun at one of the foci as shown in **Figure**. The orbital speed of the earth is maximum near the point



(1) C (2) D (3) A (4) B

53. At resonance, the parallel circuit of **Figure** constituted by an iron cored coil and a capacitor behaves like



- (1) an open circuit
(2) a short circuit
(3) a pure resistance of value R
(4) a pure resistor of value much higher than R

54. Fundamental forces are thought to arise due to exchange of some mediating particles. The range of force R_o depends on mass m of mediating particle in the following way

(1) $R_o \propto m$ (2) $R_o \propto \sqrt{m}$

(3) $R_o \propto \frac{1}{\sqrt{m}}$ (4) $R_o \propto \frac{1}{m}$

55. In a p-n-junction photo cell, the value of the photoelectromotive force produced by monochromatic light is proportional to

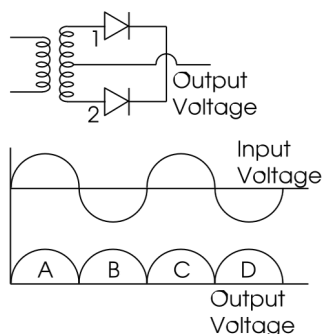
- (1) the barrier voltage at the p-n junction
(2) the intensity of the light falling on the cell
(3) the frequency of light falling on the cell
(4) the voltage applied at the p-n junction

SPACE FOR ROUGH WORK

56. When an alpha particle approaches a nucleus, the trajectory of the scattered alpha particle is

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

57. A full wave rectifier circuit along with the input and output voltages is shown in the **Figure**. The contribution to output voltage from diode-2 is



- (1) A, C (2) B, D (3) B, C (4) A, D

58. If $E_c = 20 \sin 106\pi t$ and $E_m = 12 \sin 500\pi t$ are carrier and modulating signal, then the modulation index is

- (1) 60% (2) 40% (3) 50% (4) 56%

59. When the two frequencies are identical in small oscillations, the system is known as

- (1) resonance (2) oscillator
(3) degenerate (4) linear

60. For detecting light intensity, we use

- (1) photodiode in reverse bias
(2) photodiode in forward bias (3) LED in reverse bias (4) LED in forward bias

If elements of principal quantum number $n > 4$ were not allowed in nature, the number of possible elements will be

- (1) 4 (2) 32 (3) 60 (4) 64

62. Modulation is the process of changing some characteristics of high frequency carrier wave in accordance with the audio frequency signal. The characteristic most commonly changed is

- (1) amplitude (2) velocity
(3) intensity (4) all of these

63. In Compton effect experiment, photons of energy $h\nu$ are incident on a target material of atomic number Z . The change in wavelength can be seen more easily if

SPACE FOR ROUGH WORK

- | | |
|--|---|
| <p>(1) ν is in visible region and Z is</p> <p>(2) ν_{small} is in X-ray region and Z is</p> <p>(3) ν_{small} is in X-ray region and Z is</p> <p>(4) ν_{large} is in visible region and Z is large</p> <p>64. A semiconductor is cooled from T_1 K to T_2 K. Its resistance</p> <p>(1) will decrease</p> <p>(2) will increase</p> <p>(3) will first decrease and then increase</p> <p>(4) will not change</p> <p>65. The probable energy of electrons at absolute zero is called</p> <p>(1) fermi energy (2) emission energy</p> <p>(3) work function (4) potential energy</p> <p>66. Plasma is a cloud of</p> <p>(1) α-particle</p> <p>(2) neutrino</p> <p>(3) completely ionized matter</p> <p>(4) uncharged particles</p> <p>67. Why is an ammonia maser not useful in communication?</p> | <p>(1) Because it has low power (2) Because its frequency is not convenient</p> <p>(3) Because the frequency is not stable</p> <p>(4) Because it is not continuous</p> <p>In an n-p-n transistor the collector current is 24 mA. If 80% of electrons reach collector its base current in mA is</p> <p>(1) 36 mA (2) 26 mA</p> <p>(3) 16 mA (4) 6 mA</p> <p>69. The total power content of an AM wave is 2.64 kW at a modulation factor 80%. The power contents of</p> <p>(i) carrier, and</p> <p>(ii) each sideband are respectively</p> <p>(1) 2000 W, 2000 W</p> <p>(2) 2000 W, 320 W</p> <p>(3) 320 W, 320 W</p> <p>(4) 640 W, 320 W</p> <p>70. If we dip in water, capillary tubes of different radii r, then height h to which water will rise is such that</p> <p>(1) $\frac{h}{r} = \text{constant}$ (2) $hr = \text{constant}$</p> <p>(3) $\frac{h}{r^2} = \text{constant}$ (4) $hr^2 = \text{constant}$</p> |
|--|---|

SPACE FOR ROUGH WORK

71. The modulation index of an FM carrier having a carrier swing (S) of 100 kHz and a modulating signal of 5 kHz is

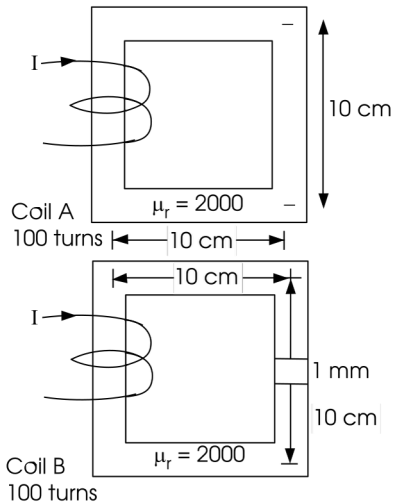
(4) 4 (2) 10 (3) 2

72. Two equal resistances each of $100 \Omega \pm 1\%$

(standard deviation) are connected in parallel. The standard deviation of the parallel combination will be

(1) 0.5% (2) $\frac{1}{\sqrt{2}}\%$ (3) $2\sqrt{2}\%$ (4) 2%

73.



- (1) coil A is greater than in B (2) both the coils are same (3) coil A is less than in B (4) coils A and B are uniform throughout

74. Match list I with list II and select the correct answer from the codes given below the lists:

List I

List II

- | | |
|-----------------|------------------------------------|
| (a) Hartley | (p) Low frequency oscillator |
| (b) Wien-Bridge | (q) High frequency oscillator |
| (c) Crystal | (r) Stable frequency oscillator |
| | (s) Relaxation oscillator |
| | (t) Negative resistance oscillator |

Codes

- (1) (a - q) (b - p) (c - r)
 (2) (a - p) (b - r) (c - s)
 (3) (a - p) (b - t) (c - q)
 (4) (a - r) (b - s) (c - p)

SPACE FOR ROUGH WORK

- | | |
|--|--|
| <p>75. In a certain 2-input logic gate, when $A = 0$, $B = 0$, then $C = 1$ and when $A = 0$, $B = 1$ then again $C = 1$. It must be gate.</p> <p>(1) XOR (2) AND
(3) NAND (4) NOR</p> <p>76. In the frame of reference of a rotating turntable, an insect of mass m is moving radially outwards (+ x direction) with a speed v. If the turntable is rotating with a constant angular velocity ω in the vertically upward direction, the net pseudo force on the insect, when it is at a distance from the axis of the turntable is given by</p> <p>(1) $m\omega^2 r + 2jm\omega v$
(2) $m\omega^2 r - 2jm\omega v$
(3) $-m\omega^2 r + 2jm\omega v$
(4) $m\omega^2 r$</p> <p>77. Adiabatic demagnetization of a substance</p> <p>(1) decrease the temperature
(2) increase the temperature
(3) increase the volume
(4) decrease the volume</p> | <p>78. A p-n junction diode cannot be used</p> <p>(1) as a rectifier.
(2) for converting light energy to electrical energy.
(3) for getting light radiation.
(4) for increasing the amplitude of an AC signal.</p> <p>79. If two meters X and Y require 40 mA and 50 mA respectively to give full scale deflection, then</p> <p>(1) X is more sensitive Y is more sensitive
(2) sensitive both X and Y are equally sensitive
(3) sensitive it would not be possible to assess
(4) the sensitivity on the basis of given data</p> <p>80. In regard to a p-type semiconductor, consider the following statements.
(i) Holes are the majority carriers.
(ii) At room temperature, electron concentration equals the donor concentration.</p> |
|--|--|

SPACE FOR ROUGH WORK

(iii) Electron density changes with temperature.

(iv) Electron concentration is greater than the carrier concentration in the intrinsic semiconductor at the same temperature.

Of these, the only true statements are

(1) (i), (ii) **(2)** (i), (iii)

(3) (ii), (iv) **(4)** (iii), (iv)

81. Zener diode is used in regulated power supply for providing

(1) reference voltage

(2) load

(3) control of output voltage

(4) control of output current

82. Match List I with List II and select the correct answer from the codes given below the lists:

List I

- (a) VLF communication
- (b) HF communication
- (c) Microwave communication
- (d) mm wave communication

List II

- (p) Stratosphere scattering
- (q) Reflection in ionosphere
- (r) Ground wave
- (s) Line of sight propagation

Codes

(1) (a - p) (b - q) (c - r) (d - s)

(2) (a - s) (b - p) (c - r) (d - q)

(3) (a - r) (b - q) (c - s) (d - p)

(4) (a - q) (b - s) (c - r) (d - p)

83. Bandwidth of colour television transmission channel in India is of

(1) 100 kHz

(2) 1 MHz

(3) 7 MHz

(4) 10 MHz

84. Efficiency of a HW rectifier is nearly

(1) 80%

(2) 60%

(3) 40%

(4) 20%

85. A frequency modulator has a sensitivity of 20 kHz/V. If the rated system deviation is 75 kHz, what is the maximum allowable modulating signal voltage?

(1) 5 V

(2) 7.5 V

(3) 3.75 V

(4) none of the above

SPACE FOR ROUGH WORK

PART III: CHEMISTRY

- 86.** The radius ratio of I, II and III orbit of He^+ , $r_1 : r_2 : r_3$ is respectively
 (1) 1 : 2 : 3 (2) 1 : 4 : 9
 (3) 9 : 4 : 1 (4) 3 : 2 : 1
- 87.** The quantum numbers of valence electron of 19K is
 (1) 3, 0, 0, + $\frac{1}{2}$ (2) 3, 1, +1, - $\frac{1}{2}$
 (3) 3, 2, +2, + $\frac{1}{2}$ (4) 4, 0, 0, - $\frac{1}{2}$
- 88.** Correct order of ionic character of silver halides is
 (1) $\text{AgCl} > \text{AgF} > \text{AgBr} > \text{AgI}$
 (2) $\text{AgF} > \text{AgCl} > \text{AgBr} > \text{AgI}$
 (3) $\text{AgI} > \text{AgBr} > \text{AgCl} > \text{AgF}$
 (4) $\text{AgF} > \text{AgI} > \text{AgBr} > \text{AgCl}$
- 89.** Which is the correct statement among the following?
 (1) Peroxide ion has a bond order 2 while O_2 has a bond order 1.
 (2) Peroxide ion has a longer and weaker bond than O_2 .
 (3) Peroxide ion and O_2 are paramagnetic.
 (4) Bond length of peroxide ion is stronger than O_2 .
- 90.** Correct order of hydrolysis is
 (1) $\text{CCl}_4 < \text{AlCl}_3 < \text{SiCl}_4 < \text{PCl}_5$
 (2) PCl
 (3) $\text{AlCl}_3 < \text{PCl}_5 < \text{CCl}_4 < \text{SiCl}_4$
 (4) CCl
- 91.** Correct IUPAC name of the complex $[\text{Cr}(\text{H}_2\text{O})_4\text{Br}_2]\text{Br} \cdot 2\text{H}_2\text{O}$ is
 (1) Dibromotetraaquachromium(II) bromide diaqua
 (2) Tetraaquadibromochromium(III) bromide dihydrate
 (3) Tetraaquadibromochromium(III) hydrate bromide
 (4) Tetraaquadibromochromium(III) bromide

SPACE FOR ROUGH WORK

- 92.** Match the List I with List II and select the correct answer using the codes given below the list:

List I	List II
(A) Peroxide	(P) Fe_2O_3
(B) Superoxide	(Q) CO_2
(C) Mixed oxide	(R) KO_2
(D) Superoxide	(S) BaO_2
	(T) MnO_2

Codes

	A	B	C	D
(1)	R	Q	T	S
(2)	S	R	P	Q
(3)	P	Q	R	S
(4)	S	Q	P	R

- 93.** A substance will be deliquescent, if its vapour pressure is

(1) equal to the atmospheric pressure.

(2) equal to that of water vapour in air.

(3) lesser than that of water vapour in air.

(4) greater than that of water vapour in air.

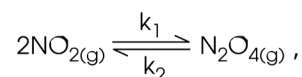
- 94.** In Arrhenius equation, $k = Ae^{-E_a/RT}$, the factor $e^{-E_a/RT}$ is known as

(1) frequency factor

(2) activation factor (3) pre-exponential factor

(4) Boltzmann factor For

- 95.** the reaction,



the rate of reaction is equal to

(1) $\frac{k_1}{k_2}[\text{NO}_2]^2$

(2) $2k_1[\text{NO}_2]^2 - k_2[\text{N}_2\text{O}_4]$

(3) $k_1[\text{NO}_2]^2 - k_2[\text{N}_2\text{O}_4]$

(4) $[2k_1 - k_2][\text{NO}_2]$

SPACE FOR ROUGH WORK

96. Which of the following statement/s is/are correct?

(1) Faraday is defined as the charge carried by 1 mole of electron.

(2) $1 \text{ F} = 6.023 \times 10^{23} \times 1.602 \times 10^{-19} \text{ C}$

(3) Faraday is the quantity of electricity required to decompose or to liberate 1 gram equivalent of a substance.

(4) All statements are correct.

97. Under what conditions ΔH is equal to ΔU , when

(1) the reaction does not involve any gaseous substance.

(2) the reaction does not involve any change in volume of reactant and product ($\Delta V = 0$).

(3) there is no change in the number of moles of products and reactants ($\Delta n = 0$).

(4) all of these

98. Match the List I with List II and select the correct answer using the codes given below the list:

List I	List II
(A) P^{ξ}	(P) $3b$
(B) V	(Q) $\frac{8a}{27Rb}$
(C) T^{ζ}	(R) $\frac{a}{27b^2}$
	(S) $\frac{a}{bR}$

Codes

	A	B	C
(1)	P	R	S
(2)	R	Q	P
(3)	R	P	Q
(4)	S	R	Q

99. The temperature to which a gas must be cooled for liquefaction by applying pressure is known as

(1) Boyle's temperature

(2) critical temperature

(3) transition temperature

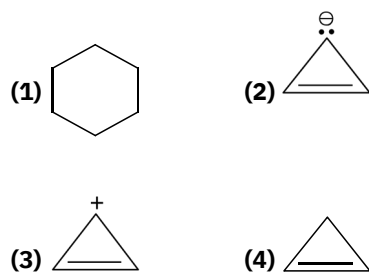
(4) inversion temperature

SPACE FOR ROUGH WORK

- 100.** A certain quantity of current on passing through electrolytic baths containing AgNO_3 , FeSO_4 and CrCl_3 in series, and x moles of chromium metal is deposited. The ratio of moles of Ag and Fe is deposited in the ratio of

- (1) $x, 2x$ (2) $3x, 2x$
 (3) $3x, \frac{3x}{2}$ (4) x, x

- 101.** The aromatic species among the following is



- 102.** The correct energy gradation of different conformers is

- (1) skew > staggered > eclipsed
 (2) skew > eclipsed > staggered

(3) eclipsed > skew > staggered

(4) staggered > skew > eclipsed

- 103.** Correct order of nucleophilicity is

(1) $\text{CH}_3^- > \text{NH}_2^- > \text{OH}^- > \text{F}^-$

(2) $\text{CH}_3^- > \text{OH}^- > \text{F}^- > \text{NH}_2^-$

(3) $\text{F}^- > \text{NH}_2^- > \text{OH}^- > \text{CH}_3^-$

(4) $\text{F}^- > \text{OH}^- > \text{NH}_2^- > \text{CH}_3^-$

- 104.** Which of the following reactions does not yield an alkyl halide?

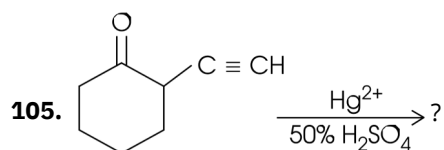
(1) $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + \text{PCl}_5 \rightarrow$

(2) $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + \text{HI} \rightarrow$

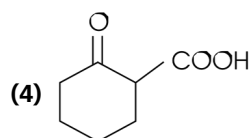
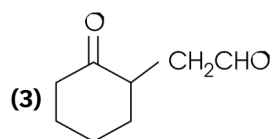
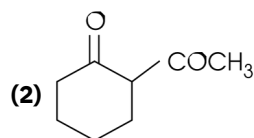
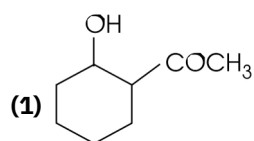
(3) $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + \text{Cl}_2 \rightarrow$

(4) $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5 \xrightarrow[\text{Red P}]{\text{SOCl}_2}$

SPACE FOR ROUGH WORK



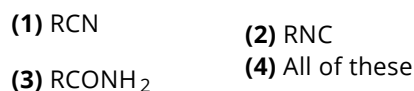
Product is



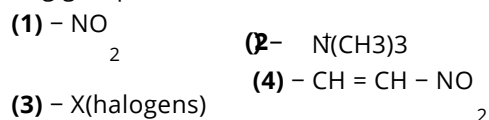
106. Which acid on heating gives a mixture of CO and CO₂ gases?



107. On reduction with LiAlH₄, amines can be prepared by



108. Which is ortho, para orienting but deactivating group?



109. Which is not true about aniline?

- (1) It undergoes bromination at ortho and para positions.
(2) It will undergo Friedel-Crafts acylation and alkylation in presence of anhydrous AlCl₃.
(3) It undergoes bromination at meta position in presence of strong acid.
(4) It forms picric acid with nitrating mixture.

SPACE FOR ROUGH WORK

- 110.** Chromatography is efficient in separating complex mixture of substances. It is based on
- (1) absorption of solute (2) adsorption of solute (3) hydration of solute (4) adsorption of solvent
- Characteristics of s-block elements are: (A) They are prepared by the electrolysis
- 111.**
- of their fused salts.
- (B) Their cations are diamagnetic.
- (C) Elements have low density, good conductor of heat and electricity.
- (D) Their oxides are basic in property.
- (1) Only D (2) A and B (3) B and C (4) A and C
- Zeolites are
- (1) double salts of Al and Si (2) double
- 112.** sulphates of alkali metals with
- Cr⁺³, Al⁺³, Fe⁺³.
- (3) double halides of K and Mg.
- (4) double silicates of Al and Na.
- 113.** Decreasing order of oxidising power of perhalate ion XO_4^{B} is
- (1) $\text{IO}_4^{\text{B}} > \text{BrO}_4^{\text{B}} > \text{ClO}_4^{\text{B}}$
- (2) $\text{ClO}_4^{\text{B}} > \text{BrO}_4^{\text{B}} > \text{IO}_4^{\text{B}}$
- (3) $\text{BrO}_4^{\text{B}} > \text{IO}_4^{\text{B}} > \text{ClO}_4^{\text{B}}$
- (4) $\text{BrO}_4^{\text{B}} > \text{ClO}_4^{\text{B}} > \text{IO}_4^{\text{B}}$
- 114.** Transition metals and their compounds are used as catalysts because
- (1) in the powder form, they have large surface area
- (2) of presence of free valence electrons
- (3) of presence of unpaired d-electrons
- (4) all of these
- 115.** Which of the following metals do not form peroxide?
- (1) Na (2) K (3) Ba (4) Pb

SPACE FOR ROUGH WORK

- 116.** Match the List I compound of silver with List II with colour and select the correct answer using the codes given below the list:

List I	List II
(A) Ag_2S	(P) White
(B) Ag_3PO_4	(Q) Yellow
(C) AgCNS	(R) Black
(D)	(S) Red
	(T) Chocolate brown

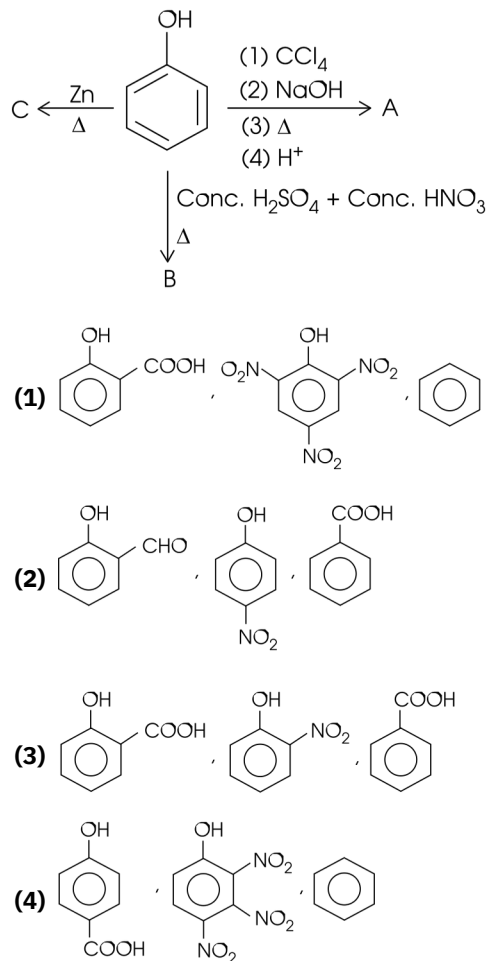
Codes

A	B	C	D
(1) P	Q	R	S
(2) S	R	Q	T
(3) R	T	Q	S
(4) R	S	Q	P

- 117.** Reducing property of formic acid is due to _____ group.

(1) COOH	(2) OH
(3) CHO	(4) H^+

- 118.** The products A, B and C of the following reaction are respectively



SPACE FOR ROUGH WORK

- 119.** Fluorine does not form any interhalogen compound as other halogens because it has
- (1) low F – F bond energy
 - (2) maximum electronegativity
 - (3) no d-orbitals
 - (4) low electron gain enthalpy
- 120.** Consider the following metallurgical process:
- (A) Heating the sulphide ore in blast furnace so that a part of it is converted to oxide and then on further heating in the absence of air, it undergoes reduction to get the metal.
- (B) Electrolysing the molten electrolyte with CaCl_2 and the metal is got by electrolytic reduction.
- (C) The sulphide ore is mixed with aqueous NaCN in presence of air, the aqueous metal complex formed is precipitated by adding zinc powder.
- The process used for obtaining sodium, silver and copper respectively are
- (1) A, B and C (2) B, C and A
and A The solubility, A and C
- 121.** Ag_2S , CuS , Ag_2S and HgS respectively are 10^{-31} , 10^{-44} and 10^{-54} . The order of their solubility in water will be
- (1) $\text{Ag}_2\text{S} > \text{CuS} > \text{HgS}$
 - (2) $\text{Ag}_2\text{S} > \text{HgS} > \text{CuS}$
 - (3) $\text{HgS} > \text{Ag}_2\text{S} > \text{CuS}$
 - (4) $\text{CuS} > \text{Ag}_2\text{S} > \text{HgS}$
- 122.** The aqueous solution with the lowest freezing point is
- (1) 0.01 m glucose
 - (2) 0.01 m KCl
 - (3) 0.01 m BaCl_2
 - (4) 0.01 m $\text{K}_4[\text{Fe}(\text{CN})_6]$
- 123.** Match the List I with List II and select the correct answer using the codes given below the list:

SPACE FOR ROUGH WORK

List I	List II
(A) Anomer	(P) Non superimposable mirror images
(B) Enantiomer	(Q) Stereoisomer that are not mirror images
(C) Diastereomer	(R) Stereoisomer that differ at C-1 configuration
(D) Mesomer	(S) Cis-trans isomerism
	(T) Optically inactive chiral compound due to internal compensation

Codes

	A	B	C	D
(1)		S	P	T
R		Q	S	T
(2)		P	Q	S
R		P	Q	T

124. Match the List I with List II and select the correct answer using the codes given below the list:

(4)

R

List I	List II
(A) Fibrous protein	(P) Polypeptide
(B) Globular protein	(Q) Peptone
(C) Conjugated protein	(R) Keratin
(D) Derived protein	(S) Nucleoprotein
	(T) Albumin

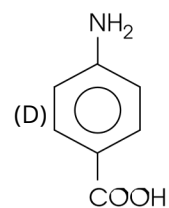
Codes

	A	B	C	D
(1)	R	S	T	Q
(2)	S	R	Q	T
(3)	P	Q	S	T
(4)	R	T	S	Q

125. Zwitter ion is possible in

(A) protein (B) sulphanilic acid

(C) oxalic acid



(1) A and B

(2) B and C

(3) C only

(4) A and D

SPACE FOR ROUGH WORK

PART IV: ENGLISH PROFICIENCY AND LOGICAL REASONING

(a) ENGLISH PROFICIENCY

Directions for questions 126 to 128: Each question below has a word capitalised followed by four words numbered 1 to 4. Choose the word that is most opposite to the meaning of the capitalised word and mark your answer in the appropriate place in your answer sheet.

126. SCINTILLA

- (1) Unscientific
- (2) Huge quantity
- (3) Mealy-mouthed
- (4) Unpromising

127. KNAVE

- (1) Honest (2) Ignorant
- (3) Timid (4) Belligerent

128. APOCRYPHAL

- (1) Confusing (2) Modern
- (3) True (4) Unsophisticated

Directions for questions 129 to 133: Each question below has a word capitalised followed by four words or phrases numbered 1 to 4. Choose the word that has nearly the same meaning as the capitalised word.

129. ENSCONCE

- (1) to surround
- (2) to promote
- (3) to honour
- (4) to settle comfortably

130. INGRATIATE

- (1) to regret
- (2) to provoke
- (3) to place oneself in a favourable position
- (4) to feel delighted

131. AUGURY

- (1) Dispute
- (2) Altar
- (3) Place of refuge
- (4) Omen

132. TRANSGRESS

- (1) to take loan
- (2) to go beyond the limit
- (3) to discuss at length
- (4) to show a clean pair of heels

SPACE FOR ROUGH WORK

133. FERRET OUT

- (1) to search (2) to trap
(3) to hide (4) to flee

Directions for questions 134 to 136: Each of the following sentence has a mistake in grammar usage or idiom. Each sentence is broken up into four parts sequentially 1, 2, 3 and 4. Choose the part that has an error and mark accordingly.

- 134. (1)** It is stupid to go
(2) to the expense of taking
(3) music lessons
(4) if you never practice
- 135. (1)** You will find
(2) if difficult
(3) to explain of your use
(4) of such offensive language
- 136. (1)** Because of the
(2) extenuating circumstances
(3) the court acquitted him
(4) out of the crime

Directions for questions 137 and 138: Each sentence below has a blank space indicating

that something has been left out. Following each sentence four words are given. Choose the word that makes the sentence meaningful.

137. John was so good at mathematics that his friends considered him to be a _____.

- (1) Profligate (2) Prodigy
(3) Prodigious (4) Primeval

138. His _____ of the topic was so good that students had few doubts to raise at the end.

- (1) exposition (2) picturisation
(3) clarity (4) exposure

Directions for questions 139 and 140: Choose from among the alternatives given, the word which will substitute the underlined expression in each of the following questions and mark the same in your answer sheet.

139. Though badly wounded he clung to his life with firm determination.

- (1) tendency (2) tenacity
(3) sustenance (4) abstinence

SPACE FOR ROUGH WORK

140. He started the fight without being incited by anger.

- (1) abjected (2) improvised
(3) provoked (4) poverished

(b) LOGICAL REASONING

Directions for questions 141 to 144: Each of the following questions a pair of words with certain relationship between them is given followed by four pairs numbered 1 to 4. Select the pair wherein the words have closest relationship to the original pair.

141. DRIVER : DRIVING ::

- (1) Carpenter : Wood
(2) Garden : Plants
(3) Counsellor : Counselling
(4) Psychologist : Teaching

142. WATER : SWIM ::

- (1) Graze : Grass
(2) Plan : Implement
(3) Ground : Play
(4) Knot : Tie

143. CANVAS : PAINTER ::

- (1) Leather : Shoe
(2) Chisel : Wood
(3) Hammer : Carpenter
(4) Marble : Sculptor

144. ELEVATED : EXALTED ::

- (1) Promoted : Excellence
(2) Purified : Hygienic
(3) Dirty : Filthy
(4) Disorderly : Unfaithful

Directions for questions 145 to 147: In each question you find a set of sentences arranged in a haphazard way. Choose the correct arrangement of sentences as indicated by the number to make a coherent paragraph.

145. A. Galileo saw, too, that all the planets, including the earth, travel round the sun.

B. On the sun he saw dark spots that moved slowly across its surface; and this proved that the sun, like the earth, spins round itself.

SPACE FOR ROUGH WORK

C. Galileo's scientific discoveries, and from the year 1609 onwards, he was the maker of the first telescope.

D. With these he studied the heavens, and there he saw many wonderful things that men had never seen before.

E. He studied at Pisa University and became a professor of Mathematics there, and afterwards at Padua.

F. The man who is described as the first truly modern scientist was an Italian astronomer Galileo Galilei, who was born in Pisa, in the year 1564

(1) BDEAFC (2) FEDCBA

(3) BEDCAF (4) BEACDF

146. A. To be able to integrate socially and excel in great Indian marketplace, it makes good sense to be conversant with regional languages other than just ones mother tongue.

B. A willingness to adopt and adapt to another language will enrich the individual.

C. Indeed, most urban Indians are bilingual and speak a smattering of at least a third language.

D. Opportunity to where beckons is the order of the day and Indians are constantly shifting base within the country.

E. In the 21st century marketplace, languages are the new bargaining chips.

F. While English must be actively promoted, it would be foolhardy to let regional languages fall off the radar.

(1) FBADCE

(2) EFBCAD

(3) DEAFBC

(4) DBCEAF

147. A. The other two south Asian contenders for the world's most coveted literary prize were Indira Sinha for *Animals People* and Mohsin Hamid for *The Reluctant Fundamentalist*.

B. Nobody was more surprised than the 45 year old another herself.

C. The choice raised eyebrows and prompted praise for the jury's bold move though there was a lack of happy unanimity.

SPACE FOR ROUGH WORK

D. The judges hailed it as a powerful and unflinching study of a grieving dysfunctional family.

E. She won an award of £ 50,000 for her novel The gathering .

F. Irish writer Anne Enright was declared the surprise winner of the Man Booker Prize .

(1) ABCEFD (2) FBECAD

(3) FEDCBA (4) DACFBE

Directions for question 148:

The question contains six statements followed by four sets of combinations of three. Choose the set in which the statements are logically related.

148. A. All cups are saucers

B. All pots are cups.

C. All pots are saucers.

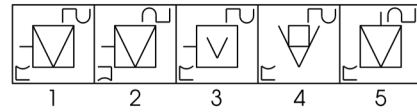
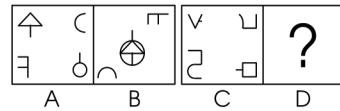
D. All saucers are cups.

E. Some cups are pots.

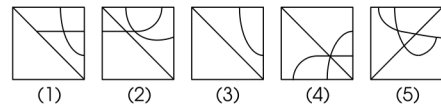
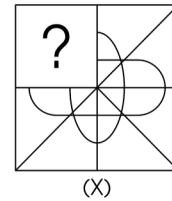
F. Some saucers are pots.

(1)CEA (2) CEF (3) ADE (4) BAE

149. Complete the following series by choosing the right alternative.



150. Choose the figure from the five alternatives 1, 2, 3, 4 and 5 will fit into the box? of the figure marked X



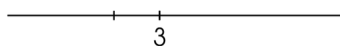
SPACE FOR ROUGH WORK

MOCK TEST 2

SOLUTIONS

PART I: MATHEMATICS

- 1. (1)** $2x - 5 > -|x - 3|$,
 $\Rightarrow 2x - 5 > 3 - x$, when $x > 3$ and
 $2x - 5 > x - 3$, when $x < 3$.
 $\Rightarrow x > \frac{3}{3}$, when $x > 3$ and
 $x > 2$, when $x < 3$.

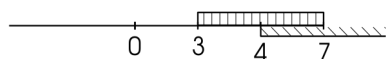


$$\therefore x \in (2, 3] \cup [3, \infty) = (2, \infty)$$

- 2. (4)** $\frac{7x + 11}{(x+1)(x+2)} \equiv \frac{4}{x+1} + \frac{3}{x+2}$

Using short cut, hence $A - B = 4 - 3$
 $= 1$

- 3. (1)** $(x - 3)(x - 7) \leq 0$
 $\Rightarrow 3 \leq x \leq 7$ and $x(x - 4) > 0$
 \Rightarrow either $x < 0$ or $x > 4$



The integers satisfying both the conditions are 5, 6, 7 and hence 3 solutions.

- 4. (2)** The numbers are even numbers or multiples of 5.
 These are 2, 4, 6, ..., 100 and
 5, 15, 25, ..., 95.

$$S = \frac{50}{2} (2 + 100) + 5(1 + 3 + 5 + \dots + 19)$$

$$= (50 \times 51) + 5 \times \frac{10}{2} (1 + 19) = 3050$$

- 5. (1)** $T_{r+1} = nC_r a^n - r b^r$, ${}^{15}C_{r-1} = {}^{15}C_{2r+4}$
 \Rightarrow either $2r + 4 = r - 1$

or $(2r + 4) + (r - 1) = 15$
 $\Rightarrow r = -5$ or $r = 4$, (r cannot be negative)

- 6. (1)** $E = 2 \sin^2 x - \cos 2x$
 $= (1 - \cos 2x) - \cos 2x$
 $= 1 - 2 \cos 2x \geq 1 - 2(1) = -1$
 and $\leq 1 - 2(-1) = 3$
 $\therefore -1 \leq E \leq 3$

- 7. (2)** The number of ways = The number of positive integral solutions of $x+y+z+t+u=20=19C_4$ (by partition method)

- 8. (1)** $N = 38808 = 23 \cdot 32 \cdot 72 \cdot 111$

Total number of factors

$$= (1+3)(1+2)(1+2)(1+1)$$

$$= 72$$

\therefore number of factors excluding 1 and $N = 70$

- 9. (4)** Since $\cos x - i \sin 2x$ and $\sin x - i \cos 2x$ are conjugates,
 $\cos x + i \sin 2x \equiv \sin x - i \cos 2x$

$$\cos x = \sin x \text{ and } \sin 2x = -\cos 2x.$$

The first $\Rightarrow x = n\pi + \pi$ and the

$$\frac{\pi}{4}$$

$$\text{second } \Rightarrow 2x = m\pi - \frac{\pi}{4}$$

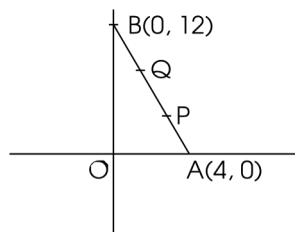
$$\text{or } x = m\pi - \frac{\pi}{8}$$

No value of x satisfies both conditions.

- 10. (3)** $\frac{BP}{PA} = \frac{2}{1}$

$$\Rightarrow P = \left(\frac{8}{3}, 4 \right) \text{ and } Q = \left(\frac{4}{3}, 8 \right),$$

since Q is the midpoint of BP .



Equation of OP is $y = \frac{3}{2}x$ and of OQ is $y = 6x$

$$E \equiv f(x, y) \equiv 4x^2 + 5y^2 - 1$$

- 11. (2)**

$$f(4, -3) = 108 \text{ is positive. } \therefore (4, -3)$$

lies outside the ellipse. On the xy -

plane, z coordinate is

- 12. (1)**

zero.

If the line AB crosses the xy plane

λ , then z coordi-

$$\text{at } P, \text{ and if } \frac{AP}{PB} = -\frac{1}{\lambda + 1}$$

$$\text{rate of } P = \frac{(\quad)}{1} \text{ should be zero.}$$

$$\text{Therefore } \lambda = -\frac{6}{5}$$

$$\text{and } x_p = \frac{(B-1)\frac{5}{6} + 6\frac{3}{5}}{1 + \frac{6}{5}} = \frac{13}{5},$$

$$y_p = \frac{(B-1)\frac{1}{6} + 6\frac{4}{5}}{1 + \frac{6}{5}} = \frac{23}{5}$$

$$\therefore P = \left(\frac{13}{5}, \frac{23}{5}, 0 \right)$$

- 13. (3)**

$$\lim_{x \rightarrow \infty} \frac{B \sqrt{x^2 + x}}{\sqrt{x^2 + x}} = \lim_{x \rightarrow \infty} \frac{B(x^2 + x)}{\sqrt{x^2 + x}}$$

$$= \lim_{x \rightarrow \infty} \frac{B}{4 \sqrt{1 + \frac{1}{x}}}$$

$$= B \frac{1}{2}$$

- 14. (1)**

$$f(x) = 1 + 2 \sin x + 2 \cos 2x$$

$$f'(x) = 2 \cos x (1 - 2 \sin x) \text{ and}$$

$$f''(x) = -2 \sin x - 4 \cos 2x$$

$$f'(x) = 0, \text{ when } x = \frac{\pi}{2} \text{ or } x = \frac{\pi}{6}$$

$$f''\left(\frac{\pi}{2}\right) = 2, \text{ positive and}$$

$$f''\left(\frac{\pi}{6}\right) = -5$$

\therefore

$$f(x) \text{ is least, when } x = \frac{\pi}{2}$$

15. (1) $x dy + y dx = x^3 dx$

$$\Rightarrow d(xy) = d\left(\frac{x^4}{4}\right)$$

$$\Rightarrow xy = \frac{x^4}{4} + \frac{c}{4}$$

$$\Rightarrow 4xy = x^4 + c$$

16. (2) $\sqrt{x^2 + 9} + x \sqrt{9^2 + 34}, \quad \sqrt{\quad}$

Multiply numerator and denominator by the conjugate,

$$\frac{(x^2 + 9) \sqrt{9^2 + 34} + (x^2 - 9) \sqrt{x^2 + 9}}{\sqrt{x^2 + 9} \sqrt{x^2 - 9}} = \frac{4^2 + 34}{4 \sqrt{34}}$$

$$\Rightarrow \frac{18}{\sqrt{x^2 + 9} \sqrt{x^2 - 9}} = \frac{18}{4 \sqrt{34}}$$

$$\Rightarrow \left\{ \frac{\sqrt{x^2 + 9} \sqrt{x^2 - 9}}{\sqrt{x^2 + 9} \sqrt{x^2 - 9}} = \frac{\sqrt{3} \sqrt{4}}{\sqrt{4} + 4} \right\}$$

$$\Rightarrow \sqrt{x^2 + 9} = \sqrt{34} \cdot \frac{3}{4}$$

$$\text{Hence } x = \pm 5$$

\therefore the solution is 5.

17. (1) $\frac{a}{\beta} - \frac{\beta}{a} < 2 \Rightarrow \frac{a^2 + \beta^2 - 2a\beta}{a\beta} < 0$

$$\Rightarrow \frac{(a - \beta)^2 - 4a\beta}{a\beta} < 0$$

$$\Rightarrow \frac{9 - 4\left(\frac{a}{2}\right)}{-2} < 0$$

$$\Rightarrow \frac{9B2a}{a} < 0$$

$$\Rightarrow a(2a - 9) > 0$$

$$\Rightarrow a < 0 \text{ or } a > \frac{9}{2}$$

Now if a and β are real, $\frac{a}{\beta} + \frac{\beta}{a} \geq 2$.

Hence the roots must be complex.

Therefore, the discriminant $36 - 8a < 0$.

$\therefore a > \frac{9}{2}; a < 0$ is disqualified.

18. (2) $b^2 - ac \Rightarrow 2 \log x b = \log x a + \log x c$

$$\Rightarrow \frac{2}{\log x b} = \frac{1}{\log_a x} + \frac{1}{\log_c x}$$

$\therefore \log_a x, \log_b x, \log_c x$ are in H.P.

19. (2) $(x, y) \in R \cap R'$

$$\Rightarrow (x, y) \in R \text{ and } (x, y) \in R'$$

$$\Rightarrow (y, x) \in R \text{ and } (y, x) \in R',$$

since R and R' are symmetric.

$$\Rightarrow (y, x) \in R \cap R'$$

$$\Rightarrow R \cap R' \text{ is symmetric.}$$

20. (2) $A \cup B = \{1, 2, 3, 8\}$ and $A \cap B = \{3\}$

$$(A \cup B) \times (A \cap B) = \{(1, 3), (2, 3), (3, 3), (8, 3)\}$$

$$21. (4) \text{ Mean deviation} = \frac{1}{5} \sum_{i=1}^5 |x_i - \bar{x}|$$

$$\text{Here } \bar{x} = 5$$

$$= \frac{1}{5} \{ |3-5| + |4-5| + |5-5| + |6-5| + |7-5| \}$$

$$= \frac{6}{5} = 1.2$$

$$\begin{aligned} 22. (4) \quad {}^nC_r + 2{}^nC_{r-1} + {}^nC_{r-2} &= {}^nC_r + {}^nC_{r-1} \\ &+ ({}^nC_{r-1} + {}^nC_{r-2}) \\ &= (n+1)C_r + (n+1)C_{r-1} \\ &= (n+2)C_r \end{aligned}$$

$$\begin{aligned} 23. (1) \quad E &= a \left(\frac{{}^{n+1}C_0}{{}^{n+1}C_1} \right) \\ &= 1 \cdot \frac{(1+x)^{n+1} - 1}{x} \end{aligned}$$

since there are $(n+1)$ terms.

$$= 1 + \frac{(1+x)^{n+1} - 1}{x}$$

Coefficient of x^k in E = Coefficient of x^{k+1} in the numerator

$$= (n+1)C_{k+1}$$

$$\begin{aligned} 24. (4) \quad x + iy &= \begin{vmatrix} 6i & 3i & 1 \\ 4 & 3i & 1 \\ 20 & 3 & i \end{vmatrix} \\ &= \begin{vmatrix} 4+6i & 0 & 0 \\ 4 & 3i & 1 \\ 20 & 3 & i \end{vmatrix} \begin{matrix} R_1 \rightarrow R_1 + R_2 \end{matrix} \end{aligned}$$

$$= (4+6i)(3+3i2)$$

$$= (4+6i)(3-3)$$

$$= 0$$

$$\therefore x = 0 \text{ and } y = 0$$

$$25. (2) \quad A \text{ is symmetric} \Rightarrow A^t = A$$

$$\text{Hence } A^{-1} = (A^t)^{-1}$$

$$= (A^{-1})^t$$

$$\Rightarrow A^{-1} \text{ is symmetric.}$$

$$26. (1) \quad \tan 60^\circ = \tan (40^\circ + 20^\circ)$$

$$= \frac{\tan 40^\circ + \tan 20^\circ}{1 - \tan 40^\circ \tan 20^\circ}$$

$$= \sqrt{3}$$

$$\therefore \tan 40^\circ + \tan 20^\circ = \sqrt{3} \tan 20^\circ$$

$$\begin{aligned} 27. (3) \quad \cos^{-1} \left(\cos \frac{2\pi}{3} \right) &= \cos^{-1} \left(\cos \left(\cos^{-1} \left(\cos \frac{2\pi}{3} \right) \right) \right) \\ &= \cos^{-1} \left(\cos \frac{\pi}{3} \right) \\ &= \frac{\pi}{3} \end{aligned}$$

$$\text{since } 0 \leq \cos^{-1} x \leq \pi$$

$$\begin{aligned} 28. (3) \quad (3 \cos x - 1)(\cos x - 3) &= 0 \text{ gives only} \\ \text{one solution } \cos x &= \frac{1}{3} \text{ and the} \\ \text{general solution is } 2n\pi \pm \cos^{-1} \left(\frac{1}{3} \right) \end{aligned}$$

29. (1) $z\bar{z} = |z|^2 = 4,$

$$\frac{4+z}{1+\frac{z}{4}} = \frac{4+z}{1+\frac{z}{4}} = \frac{z(4+z)}{z+4} = z$$

30. (3) $(x-7)^2 + (y+1)^2 = 52.$

The equation of the director circle is $(x-7)^2 + (y+1)^2 = 2 \times 52$

$(0, 0)$ satisfies this equation; origin lies on the director circle. Angle

between the tangents is 90° or $\frac{\pi}{2}$.

31. (2) $(y-1)^2 = 4\left(x + \frac{1}{4}\right)$

Vertex = $\left(-\frac{1}{4}, 1\right)$

Equation of the directrix is

$$x = 1 - \frac{1}{4} \text{ or } 4x + \frac{5}{4} = 0$$

32. (2) $|\overline{OA}| = \sqrt{14} = |\overline{OB}|$

$\Rightarrow \triangle AOB$ is isosceles.

The bisector of $\angle AOB$ is also the median OC ; $C = (2, 2, -2)$;

$$\therefore \vec{OC} = 2\hat{i} + 2\hat{j} - 2\hat{k}$$

33. (1) $y = 2 \cos^{-1} \sqrt{x},$

$$\text{since } \sin^{-1} \sqrt{1-x} = \cos^{-1} \sqrt{x}$$

$$\frac{dy}{dx} = \frac{B}{\sqrt{1-B}} \times \frac{1}{2\sqrt{x}} \times \frac{B}{\sqrt{x(1-Bx)}}$$

34. (2) $y + x = e^{xy}$

Differentiating with respect to y , we get

$$1 + \frac{dx}{dy} = e^{xy} \left(y \frac{dx}{dy} + x \right)$$

For vertical tangent (parallel to

$$y\text{-axis}), \frac{dx}{dy} = 0$$

$xxy = 1$, which is satisfied by the point $(1, 0)$.

Putting $y = \sin x$,

35. (3)

$$I = \int_{y=0}^1 \frac{dy}{(1+y)(2+y)}$$

$$= \int_0^1 \left(\frac{1}{1+y} - \frac{1}{2+y} \right) dy$$

$$= \left[\ln \left(\frac{1+y}{2+y} \right) \right]_0^1$$

$$= \ln \frac{2}{3} - \ln \frac{1}{2} = \ln \frac{4}{3}$$

36. (3) $11 \times 101 \times 10001 = (10+1)(102+1)(104+1)$

Multiplying and dividing by $10-1$, we get

$$N = \frac{1}{9} (10-1)(10+1)(102+1)(104+1)$$

$$= \frac{1}{9} (102-1)(102+1)(104+1)$$

$$= \frac{1}{9} (108-1)$$

37. (3) $\frac{\frac{n}{2} [2a_1 + (n-1)d_1]}{\frac{n}{2} [2a_2 + (n-1)d_2]} = \frac{n+1}{n+3}$ for

all values of n . To get the 4th term $(a+3d)$, put $n=7$,

$$\frac{2a+6d}{2a+6d} = \frac{8}{10} = \frac{4}{5}$$

38. (3) Let $\log_b a = N$.

$$\therefore \frac{\log_b ()}{\log_b a} = \frac{\log_b N}{\log_b a}$$

$$= \log_a N$$

$$\therefore a^{\log_a N} = N = \log_b a$$

39. (3) Write nC_n as ${}^{(n+1)}C_n + 1$, since both are equal to 1

Expression

$$= \{(n+1)C_n + 1 + {}^{(n+1)}C_n\} + \dots$$

$$= (n+2)C_n + 1 + {}^{(n+2)}C_n + \dots$$

$$= (n+3)C_n$$

$$= (n+m+2)C_{n+1}$$

40. (1) $f(0, y) = \begin{vmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1+y \\ 1 & 1 \end{vmatrix} = 0$

$\Rightarrow f(x, y)$ is divisible by x .

Similarly, $f(y) = 0$

$\Rightarrow f(x, y)$ is divisible by y .

41. (3) $a^2 + b^2 + c^2 - ca - ab - \sqrt{3} = 0$

Regrouping,

$$\left(b - \frac{a\sqrt{3}}{2}\right)^2 + \left(c - \frac{a}{2}\right)^2 = 0$$

$$\therefore a : b : c = 2 : \sqrt{3} : 1.$$

Hence the triangle has angles 30° , 60° and 90° .

42. (3) ${}^{(2n+1)}C_1 + {}^{(2n+1)}C_2 + \dots + {}^{(2n+1)}C_n$

$$= 1023$$

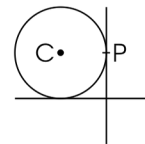
$$\therefore {}^{(2n+1)}C_0 + {}^{(2n+1)}C_1 + \dots + {}^{(2n+1)}C_n$$

$$= 1024$$

$$\text{(i.e.,)} \quad \frac{1}{2} \times 2^{2n+1} = 1024 = 2^{10}$$

$$\Rightarrow n = 5$$

43. (4) $|z - (-1 + i)| \leq 1$ represents a region of a circle with centre $(-1 + i)$ and radius 1. The point on this circle with least amplitude is $P(0, 1)$ and corresponds to i .



44. (3) Number of ways of selecting exactly two children and two others

$$= \frac{{}^4C_2 \times {}^5C_2}{4} = \frac{6}{4}$$

45. (2) $\bar{a} \cdot \bar{b} = 14x^2 - 8x + x < 0$ and

$$\frac{7}{\sqrt{x^2 + 49}} + 4 > \frac{\sqrt{3}}{2} \theta < \frac{8}{\sqrt{3}}$$

$$\Rightarrow \cos \theta > \frac{\sqrt{3}}{2}$$

$$7x(2x - 1) < 0 \text{ and } x^2 < \frac{37}{3}$$

Both these conditions are valid in $\left(0, \frac{1}{2}\right)$.

PART II: PHYSICS

46. (2)

47. (4)

48. (2)

49. (3)

50. (3)

51. (1)

. (3)

52. (4)

. (4)

53. (2)

. (2)

54. (2)

$$\begin{aligned} 58. (1) \quad m_a &= \frac{E_m}{E_c} \times 100 = \frac{1}{2} \times 100 \\ 55 \quad &= 60\% \end{aligned}$$

56. (3)

: (1)

58. (3)

. (1)

61. (3)

. (3)

62. (1)

. (3)

63. (2)

.

64

.

65

.

66

$$68. (4) \quad i_e = \frac{100}{80} \times 24 = 30 \text{ mA}$$

$$i_b = i_e - i_c$$

$$= 30 - 24 = 6 \text{ mA}$$

$$\begin{aligned} 69. (2) \quad (i) P_c &= P_T \left(\frac{2}{2 + m^2} \right) \\ &= 2.64 \times 10^3 \left(\frac{2}{2 + (0.8)^2} \right) \end{aligned}$$

$$= 2000 \text{ W}$$

$$(ii) P_{USB} = P_{LSB} = \frac{m^2}{4} P_c$$

$$P_c = \frac{(0.8)^2}{4} \times 2000 = 320 \text{ W}$$

70. (2)

$$71. (2) \quad CS = 2 \times \Delta f$$

$$\Delta f = \frac{CS}{2} = \frac{100}{2} = 50 \text{ kHz}$$

$$\therefore m_f = \frac{\Delta f}{f_m} = \frac{50}{5} = 10$$

72. (2) 73. (1) 74. (1) 75. (3) 76. (4)

77. (1) 78. (4) 79. (1) 80. (2) 81. (1)

82. (3) 83. (3) 84. (3) 85. (3)

PART III: CHEMISTRY

86. (2) Radius of hydrogen like species,

$$r_n = \frac{0.53 \text{ \AA} \times n^2}{Z}$$

Radius of He⁺ electronic orbits

(Z for He⁺ = 2, n = 1, 2, 3)

$$= \frac{0.53 \times n^2}{2}$$

$$r_1 = r_2 = r_3 = 1 : 4 : 9$$

87. (4) ${}_{19}\text{K} = 2, 8, 8, 1$

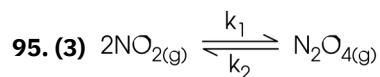
$$4s^1 = n = 4, l = 0, m = 0, s = \pm \frac{1}{2}$$

88. (2) Cation being the same, ionic character decreases with larger size anion.

89. (2)	O^2	$\begin{array}{c} \text{O}^{\text{B2}} \\ 2 \\ \text{B1} \quad \text{B1} \\ (\text{B} \quad \text{O} \quad \text{B} \quad \text{O} \quad \text{B}) \end{array}$
Total number of electrons	16	18
Bond order	2	1
Magnetic property	Para-magnetic	Dia-magnetic
Bond length	Small	Large
Bond strength	High	Low

90. (1) CCl₄ does not hydrolyse with water as carbon has no d-electrons.

91. (2) 92. (4) 93. (3) 94. (4)



The rate of reaction

$$= -k_1[\text{NO}_2]^2 - k_2[\text{N}_2\text{O}_4]$$

96. (4) 97. (4) 98. (3) 99. (2)

100. (3) Mass of element electrodeposited is proportional to equivalent mass of element.

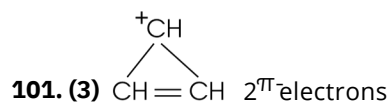
Equivalent masses of Ag : Fe : Cr in terms of molar mass M

$$= M : \frac{M}{2} : \frac{M}{3}$$

$$= 1 : 0.5 : 0.33$$

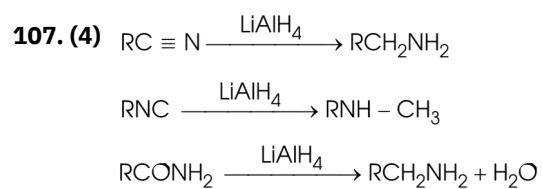
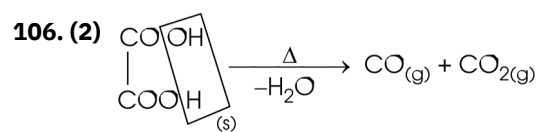
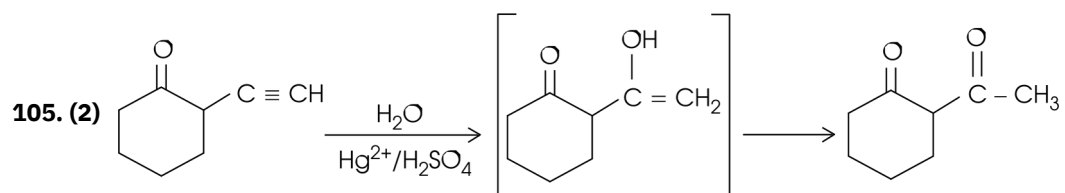
Ratio of moles of electro deposited

$$3x : 1.5x = x$$



$$4 \times 0 + 2\pi = 2\pi \text{ electrons, Huckel rule.}$$

102. (3) 103. (2) 104. (3)



108. (3) 109. (4) 110. (2) 111. (4) 112. (4)

113. (3) 114. (4) 115. (4) 116. (4) 117. (3)

118. (1) 119. (3) 120. (2) 121. (1) 122. (4)

123. (4) 124. (3) 125. (1)

PART IV: ENGLISH PROFICIENCY AND LOGICAL REASONING

(a) ENGLISH PROFICIENCY

126. (2) 127. (1) 128. (3) 129. (4) 130. (3)
131. (4) 132. (2) 133. (1) 134. (2) 135. (3)
136. (4) 137. (2) 138. (1) 139. (2) 140. (3)

(b) LOGICAL REASONING

141. (3) 142. (3) 143. (4) 144. (3) 145. (2)
146. (1) 147. (3) 148. (2)

149. (1) The element at the NW is placed inside the element at the SE and then the whole thing is placed in the centre (3, 4, 5 are ruled out). The element at the SW is rotated 90° and then is shifted to the NE (2 is ruled out)

150. (4)