BRILLIANT® TUTORIALS

BITSAT 2008
MTP 7/QNS

BRILLIANT'S MOCK TEST 7

FOR STUDENTS OF
OUR ONE/TWO-YEAR POSTAL COURSE
TOWARDS

BITSAT, 2008

Test Booklet Code

G

Time: 3 Hours **Maximum Marks: 450**

Read the following instructions carefully:

1. Immediately fill in the particulars on the Answer Book with Blue/Black Ball Point Pen.
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The candidate should write their Enrolment No. only in the space provided on the Test Booklet/Answer Sheet.
4. For each correct response, the candidate will get 3 marks. For each incorrect response, one mark will be deducted from the total score. No deduction from the total score, however, will be made if no response is indicated for an item in the Answer Sheet.
5. The test is of 3 hours duration.
6. The test consists of 150 questions.
7. The maximum marks are 450.
8. Use Blue/Black Ball Point Pen only for writing particulars/marking responses on Side – 1 and Side – 2 of the Answer Sheet.
9. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
10. Do not fold or make any stray marks on the Answer Sheet.
11. Use of Electronic/Manual Calculator is prohibited .

Name of the Candidate (in Capitals): .....

Enrolment Number: | | | | | | | | | | | |

PART I: MATHEMATICS

1. The roots of the equation $x^2 + 2(3a + 5)x + 2(9a^2 + 25) = 0$ are rational for

(1) $a \in R$ **(2)** $a = -\frac{4}{5}$

(3) $a = \frac{5}{3}$ **(4)** no value of a

2. If $x = \log_{(1/3)}5$, $y = \log_{1/17}25$, which one of the following is correct?

(1) $x < y$ **(2)** $x = y$

(3) $x > y$ **(4)** $x > 2y$

3. If a, b, c are in A.P., then 3^{ax+5}, 3^{bx+5}, 3^{cx+5} are in

(1) A.P.

(2) G.P, only when $x > 0$

(3) G.P, if $x < 0$

(4) G.P, $\forall\, x \neq 0$

4. a, b, c are in G.P. p, q, r form another G.P. Then $\frac{a}{p}, \frac{b}{q}, \frac{c}{r}$ are in

(1) A.P.

(2) G.P.

(3) H.P.

(4) Arithmetico Geometric

5. The number of distinct real roots if $\begin{vmatrix} \sin x & \cos x & \cos x \\ \cos x & \sin x & \cos x \\ \cos x & \cos x & \sin x \end{vmatrix} = 0$ in $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ is

(1) 0 **(2)** 1 **(3)** 2 **(4)** 3

6. The inverse of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ a & 1 & 0 \\ b & c & 1 \end{bmatrix}$ is

(1) $\begin{bmatrix} 1 & 0 & 0 \\ -a & 0 & 0 \\ b & -c & 1 \end{bmatrix}$

(2) $\begin{bmatrix} 1 & 0 & 0 \\ -a & 1 & 0 \\ a & b & 1 \end{bmatrix}$

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(3) $\begin{bmatrix} 1 & 0 & 0 \\ -a & 1 & 0 \\ a-c & b-c & 1 \end{bmatrix}$

(4) $\begin{bmatrix} 1-a & 0 & b \\ 0 & 1 & -c \\ 0 & 0 & 1 \end{bmatrix}$

7. 100 balls are numbered as 1, 2, 3, . . . 100. If the number of ways of selecting r balls with replacement out of these such that the largest number selected is 10, is 271. Then r =

(1) 4 **(2)** 5 **(3)** 3 **(4)** 6

8. The number of rational numbers of the form $\frac{p}{q}$, where $p, q \in \{3, 4, 8, 9, 12\}$ is

(1) 25 **(2)** 21 **(3)** 19 **(4)** 23

9. The probability that a leap year selected contains 53 Wednesdays or 53 Thursdays is

(1) $\frac{1}{7}$ **(2)** $\frac{2}{7}$ **(3)** $\frac{4}{7}$ **(4)** $\frac{3}{7}$

10. A natural number is chosen at random from the first 50 natural numbers. Then the probability that $x + \frac{50}{x} > 24$ is

(1) $\frac{3}{5}$ **(2)** $\frac{31}{50}$ **(3)** $\frac{29}{50}$ **(4)** $\frac{14}{25}$

11. The digit in unit place of $\sum_{r=0}^{50} \lfloor r + 2^{2^n} \rfloor$, where n is any natural number greater than 1, is

(1) 1 **(2)** 0 **(3)** 6 **(4)** 4

12. If the coefficient of x^{100} in $1 + (1 + x) + (1 + x)^2 + \ldots + (1 + x)^n$ is ${}^{201}C_{101}$, then n equals

(1) 100 **(2)** 200 **(3)** 101 **(4)** 99

13. If z is complex number, then the equation $\left|\frac{2z - i}{z + 1}\right| = a$ represents a circle when

(1) a = 1 alone

(2) a = 2 alone

(3) for all values of a except 2

(4) for no value of a

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14. If ω is an n^{th} root of unity, then $1 + 2\omega + 3\omega^2 + \ldots + n\omega^{n-1}$ is

(1) $\frac{-n}{(1-\omega)^2}$ **(2)** $\frac{-2n}{1-\omega}$

(3) $\frac{-2n}{(1-\omega)^2}$ **(4)** $\frac{-n}{1-\omega}$

15. For any vector $\overline{a}$, $|\overline{a} \times \hat{i}|^2 + |\overline{a} \times \hat{j}|^2 + |\overline{a} \times \hat{k}|^2$ is

(1) a^2 **(2)** $2a^2$ **(3)** $\overline{a}$ **(4)** $2\overline{a}$

16. If $\sin\beta$ is the G.M. between $\sin\alpha$ and $\cos\alpha$, then $\cos 2\beta$ =

(1) $2\sin^2\left(\frac{\pi}{4} + \alpha\right)$

(2) $2\cos^2\left(\frac{\pi}{4} + \alpha\right)$

(3) $2\cos^2\left(\frac{\pi}{4} - \alpha\right)$

(4) $2\sin^2\left(\frac{\pi}{4} - 2\alpha\right)$

17. If in a ΔABC, $\cos B = \frac{\sin C}{2 \sin A}$, then the triangle is

(1) right-angled

(2) equilateral

(3) isosceles

(4) right-angled isosceles

18. The minimum value of $4^{\sin x} + 4^{\cos x}$ is

(1) $2^{1 - \frac{1}{2\sqrt{2}}}$ **(2)** $2^{1-\sqrt{2}}$

(3) $4^{1-2\sqrt{2}}$ **(4)** $4^{1-\sqrt{2}}$

19. If $a + b + c = 0$, then the straight line $3ax + 2by + 6c = 0$ passes through the fixed point

(1) (3, 2) **(2)** (2, 3)

(3) (– 3, 2) **(4)** (– 2, 3)

20. The equation of the circle described on the common chord of the circles $x^2 + y^2 + 2x = 0$ and $x^2 + y^2 + 2y = 0$ as a diameter is

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(1) $x^2 + y^2 + x - y = 0$

(2) $x^2 + y^2 - x - y = 0$

(3) $x^2 + y^2 - x + y = 0$

(4) $x^2 + y^2 + x + y = 0$

21. The locus of the point of intersection of tangents to the parabolas $y^2 = 4(x + 1)$ and $y^2 = 8(x + 2)$ which are perpendicular to each other is

(1) $x + 6 = 0$ **(2)** $x + 3 = 0$

(3) $x + 7 = 0$ **(4)** $x - y = 4$

22. If the normals at (x_1, y_1) . . . . to the hyperbola $xy = 2$ meet at the point $(3, 4)$, then x_1, x_2, x_3, x_4 equals

(1) 3 **(2)** 4 **(3)** – 4 **(4)** – 3

23. If $f(x + 2y, x - 2y) = xy$, then $f(x, y)$ equals

(1) $\frac{x^2 - y^2}{8}$ **(2)** $\frac{x^2 - y^2}{4}$

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

24. $\lim\limits_{x \to 0} \left(\frac{\sin x}{x}\right)^{\frac{\sin x}{x - \sin x}} =$

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

25. The value of 'a' for which the function $\cos x - \sin x + ax + b$ is decreasing is given by

(1) $a < -\sqrt{2}$ **(2)** $a > \sqrt{2}$

(3) $a < \sqrt{2}$ **(4)** $a < 1$

26. $\int\limits_0^4 \{\sqrt{x}\}\, dx$ equals (where {x} denotes the fractional part of x)

(1) $\frac{16}{3}$ **(2)** $\frac{7}{3}$ **(3)** $\frac{4}{3}$ **(4)** $\frac{8}{3}$

27. Let $\vec{v} = 2\hat{i} + \hat{j} - \hat{k}$ and $\vec{w} = \hat{i} + 3\hat{k}$ If $\vec{u}$ is a unit vector, then the maximum value of the scalar triple product $[\vec{u}\ \vec{v}\ \vec{w}]$ is

(1) – 1 **(2)** $\sqrt{10} + \sqrt{6}$

(3) $\sqrt{58}$ **(4)** $\sqrt{59}$

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28. Foot of perpendicular of point (2, 2, 2) in the plane $x + y + z = 9$ is

(1) (1, 1, 1) **(2)** (3, 3, 3)

(3) (9, 0, 0) **(4)** (2, 6, 1)

29. The value of $\begin{vmatrix} \lfloor 1 & \lfloor 2 & \lfloor 3 \\ \lfloor 2 & \lfloor 3 & \lfloor 4 \\ \lfloor 3 & \lfloor 4 & \lfloor 5 \end{vmatrix}$ is

(1) $\lfloor 3$ **(2)** $\lfloor 4$ **(3)** $\lfloor 2$ **(4)** $\lfloor 5$

30. If $x = \text{cosec}\,\theta - \cot\theta$, $y = \sec\theta + \tan\theta$, then

(1) $xy + 1 = x + y$

(2) $xy + 1 = x - y$

(3) $xy + 1 = y - x$

(4) $xy = y - x$

31. The value of $\sin 78° + \sin 6° - \sin 66° - \sin 42°$ is

(1) $\frac{1}{2}$ **(2)** 1 **(3)** $-\frac{1}{2}$ **(4)** $\frac{1}{8}$

32. The points $(p + 1, 1)$, $(2p + 1, 3)$, $(2p + 2, 2p)$ are collinear, if

(1) $p = -1$ **(2)** $p = \frac{1}{2}$

(3) $p = -2$ **(4)** $p = -\frac{1}{2}$

33. The three lines $3x + 4y + 6 = 0$, $\sqrt{2}x + \sqrt{3}y + 2\sqrt{2} = 0$ and $4x + 7y + 8 = 0$ are

(1) the sides of a triangle

(2) parallel

(3) concurrent

(4) none of these

34. If $|z_1| = 2|z_2|$ and amp z_i – amp $z_2 = \frac{\pi}{2}$, then $iz_1 + 2z_2$ equals

(1) 1 **(2)** 0

(3) $2z_2$ **(4)** $(2i + 1)\,z_2$

35. The solution of $|z| - z = 1 + 2i$ is

(1) $\frac{3}{2} - 2i$ **(2)** $\frac{3}{2} + 2i$

(3) $2 - \frac{3}{2}i$ **(4)** none of these

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36. The set of values of p for which the roots of $3x^2 + 2x + p(p - 1) = 0$ are of opposite signs is

(1) (0, 1) **(2)** $(-\infty, 0)$

(3) $(0, \infty)$ **(4)** $(1, \infty)$

37. If α , β are the roots of $ax^2 + bx + c = 0$, then those of $ax^2 + 3bx + 9c = 0$ are

(1) $2\alpha, 2\beta$ **(2)** $3\alpha, 3\beta$

(3) $\frac{\alpha}{3}, \frac{\beta}{3}$ **(4)** $\frac{\alpha}{2}, \frac{\beta}{2}$

38. The 15^{th} term of $(3 \times 5) + (7 \times 8) + (11 \times 11) + \ldots$ is

(1) 225 **(2)** 813 **(3)** 2773 **(4)** 3473

39. The sum to 12 terms of the series $\sqrt{3} + \sqrt{6} + \sqrt{12} + \cdots$ is

(1) $123\left(\sqrt{6} + \sqrt{3}\right)$ **(2)** $63\left(\sqrt{2} + \sqrt{3}\right)$

(3) $63\left(\sqrt{6} + \sqrt{3}\right)$ **(4)** $63\left(\sqrt{6} - \sqrt{3}\right)$

40. The circles $x^2 + y^2 + px + 3y - 5 = 0$ and $x^2 + y^2 + 5x + py + 7 = 0$ intersect orthogonally. Then p is

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

41. The sum of all the numbers that can be formed with all of the digits 2, 3, 4, 5 is

(1) 94324 **(2)** 93324

(3) 92324 **(4)** 95324

42. The equation $\log_3 x + \frac{1}{\log_{(1+x)} 3} = 2$ can be written as

(1) $x^2 + x + 2 = 0$ **(2)** $x^2 - x - 2 = 0$

(3) $x^2 + x - 9 = 0$ **(4)** $x^2 - x - 9 = 0$

43. If n is an integer between 0 and 21, then the minimum value of $\lfloor n \lfloor 21 - n$ is

(1) $\lfloor 21$ **(2)** $\lfloor 20$

(3) $\lfloor 9 \lfloor 12$ **(4)** $\lfloor 10 \lfloor 11$

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44. The coefficient of x^{-1} in

$(1 + x)^n \left(1 + \frac{1}{x}\right)^m$ is

(1) $\frac{\lfloor m + n}{\lfloor m \, \lfloor n}$ **(2)** $\frac{\lfloor m + n}{\lfloor n - 1 \; m - 1}$

(3) $\frac{\lfloor m + n}{\lfloor n \, \lfloor m - 1}$ **(4)** $\frac{\lfloor m + n}{\lfloor m - 1 \, \lfloor n + 1}$

45. $\lim_{x \to 0} \frac{a^{x^2} - b^{x^2}}{x^2}$ is equal to

(1) $\log \frac{a}{b}$ **(2)** $\log \frac{b}{a}$

(3) log (ab) **(4)** none of these

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PART II: PHYSICS

46. A breeder reactor consumes

(1) more fuel than it enriches

(2) less fuel than it enriches

(3) equal fuel that it enriches

(4) no fuel

47. The integrated circuit (I.C.) used in counting circuits are called _____ .

(1) linear **(2)** hybrid

(3) digital **(4)** monolithic

48. A certain transmitter radiates 9 kW with the carrier unmodulated, and 10.125 kW when the carrier is sinusoidally modulated. If another sine wave, corresponding to 40% modulation, is transmitted simultaneously, the total radiated power is

(1) 7.3 kW **(2)** 10.84 kW

(3) 1 kW **(4)** 9 kW

49. Two vertical plates are squeezed together with a little water between them. If the plate separation is 'd' the plate area in contact with the liquid is A and the surface tension of water is T, the force normal to the plates required to pull them apart is

(1) $\frac{AT}{d}$ **(2)** $\frac{2AT}{d}$ **(3)** $\frac{4AT}{d}$ **(4)** $\frac{4T}{Ad}$

50. A small heavy metallic sphere suspended by a light inextensible string has period of oscillation T. It is immersed in a non-viscous liquid of density x relative to the material of the sphere. Its period of oscillation now is

(1) T **(2)** xT

(3) (1 – x) T **(4)** $\frac{T}{\sqrt{1-x}}$

51. A bird alights on a horizontal wire stretched between two points. The additional tension produced in the wire at the time the bird alights is

(1) zero

(2) equal to the weight of the bird

(3) greater than the weight of the bird

(4) lesser than the weight of the bird

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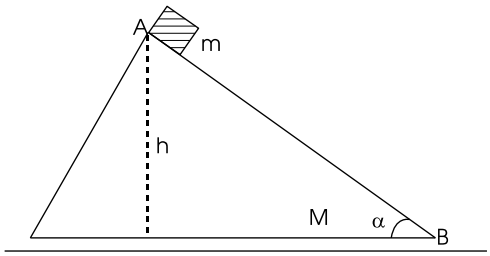
52. A small block of mass m is placed at the top on the smooth inclined face AB of a wedge of mass M free to slide on a horizontal surface as shown in the **Figure** and released from rest.



(i) the total momentum of the block and the wedge is constant during motion

(ii) the total momentum of the block and the wedge along the horizontal is constant during motion

(iii) when the block reaches B the displacement of M to the left is $\frac{mh\cot\alpha}{(M+m)}$

(iv) when the block reaches B the horizontal displacement of m to the right is $\frac{mh\cot\alpha}{(M+m)}$

(1) All are correct except (i)

(2) (ii) and (iv) only are correct

(3) (i) and (iii) are correct

(4) (i) only is correct

53. The intensity of cosmic ray is minimum at the equator. This is due to _____ of the earth.

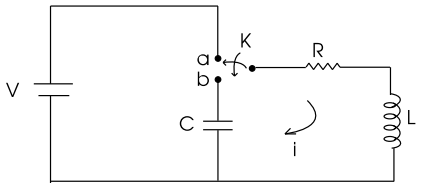
(1) atmosphere

(2) spin motion

(3) greenhouse effect

(4) magnetic field

54.



In the network of the **Figure**, it is changed from a to b at t = 0. The values of i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at t = 0 (+) if

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R = 1000 Ω, L = 1 H and C = 0.1 μF and V = 100 V are

(1) 0.1 A, -10^2 A/s, 10^5 A/s^2

(2) 0.1 A, 10^2 A/s, 10^5 A/s^2

(3) 0 A, 10^2 A/s, 10^5 A/s^2

(4) 0.1 A, -10^2 A/s, -9×10^5 A/s^2

55. Which is not true? The electronic devices are capable of performing the functions of a

(1) rectifier **(2)** generator

(3) amplifier **(4)** modulator

56. Given:

(A): If an exceedingly thin soap film is seen in reflected light, it appears dark.

(R): There is a phase difference of π from the rays reflected front and the rear faces of the film.

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**

(2) Both **A** and **R** are true but **R** is not the correct explanation of **A**

(3) **A** is true but **R** is false

(4) **A** is false but **R** is true

57. Given:

(A): A laser beam does not undergo any increase in diameter even at very large distances.

(R): It is monochromatic coherent beam.

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**

(2) Both **A** and **R** are true but **R** is not the correct explanation of **A**

(3) **A** is true but **R** is false

(4) **A** is false but **R** is true

58. The length of the string of a simple pendulum is measured with a meter scale to be 92.0 cm, the radius of the bob plus the hook is measured with the help of vernier caliper to be 2.17 cm. Mark out the correct statement(s)

(1) Least count of meter scale is 0.1 cm

(2) Least count of vernier caliper is 0.01 cm

(3) Effective length of simple pendulum is 94.2 cm

(4) All the above

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59. When the object is at a distance u_1 and u_2 from the optic centre of a lens, a real and a virtual image is formed respectively with the same magnification. The focal length of the lens is

(1) $\frac{u_1 + u_2}{2}$ **(2)** $\frac{\sqrt{u_1 u_2}}{2}$

(3) $\sqrt{u_2 u_2}$ **(4)** $\frac{(u_1 - u_2)^2}{3}$

60. A substance emits gamma rays when

(1) an orbital electron jumps from higher orbit to a lower one

(2) a nucleon inside the nucleus suffers a transition from a higher nuclear energy state to a lower one

(3) an electron and a positron annihilate inside the nucleus

(4) none of the above occurs

61. A body travels uniformly a distance of (13.8 ± 0.2) m in time (4.0 ± 0.3) m, the velocity of particle is

(1) (3.45 ± 0.31) m/s

(2) (3.4 ± 0.31) m/s

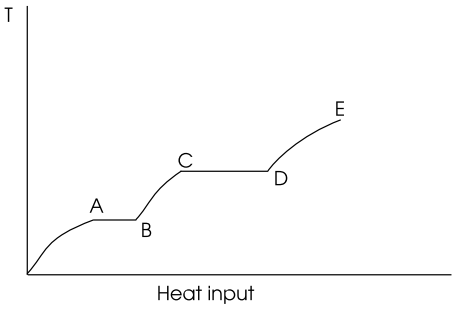
(3) (3.68 ± 0.4) m/s

(4) (3.6 ± 0.42) m/s

62. In a double slit experiment, the distance between the slits is d. The screen is at a distance D from the slits. If a bright fringe is formed opposite a slit, the order of the fringe is

(1) $\frac{d}{2D\sqrt{\lambda}}$ **(2)** $\frac{d^2}{2D\lambda}$ **(3)** $\frac{d^2}{D\lambda}$ **(4)** $\frac{2d^2}{D\lambda}$

63.



A material is supplied with heat at constant rate. The temperature of the

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material is changing with the heat as shown in the diagram. If CD = 2AB,

(1) material is an alloy of two metals

(2) material has different values of specific heat at different temperatures

(3) latent heat of vaporisation is double the latent heat of fusion

(4) At AB and CD, material disintegrates into fragments

64. When a salt is dissolved in pure water, the vapour pressure of the solution decreases. Hence in order to make the solution boil, the temperature of the solution should be increased to a value which is

(1) the boiling point of pure water

(2) below the boiling point of pure water

(3) above the boiling point of pure water

(4) infinity

65. The space between the plates of a capacitor is filled with two dielectrics of thickness d_1 and d_2 and relative permittivities ε_1 and ε_2 respectively. If a single dielectric of the total thickness $(d_1 + d_2)$ is to replace the two effectively to get the same capacitance, what should be its relative permittivity?

(1) $\varepsilon_1 + \varepsilon_2$ **(2)** $\dfrac{\varepsilon_1\varepsilon_2}{\varepsilon_1 + \varepsilon_2}$

(3) $\dfrac{(d_1 + d_2)\,\varepsilon_1\varepsilon_2}{e_1\,\varepsilon_1 + d_2\,\varepsilon_2}$ **(4)** $\dfrac{\varepsilon_1^2 + \varepsilon_2^2}{\sqrt{\varepsilon_1\varepsilon_2}}$

66. The equation for current in a diode is $I = I_s\left(e^{V_D/V_T} - 1\right)$ and is approximated as $I = I_s e^{V_D/V_T}$ for practical purposes. What is the percentage error due to approximation?

(1) 10% **(2)** 2.1% **(3)** 4.2% **(4)** 1.2%

67. The relation between current and voltage in an AC circuit is shown. What is the circuit?

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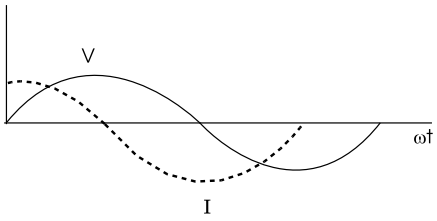

(1) LR **(2)** CR

(3) C alone **(4)** R alone

68. Given

(A): The Bohr model of the Hydrogen atom does not explain the fine structure of spectral lines.

(R): The Bohr model does not take into account the spin of the electron.

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**

(2) Both **A** and **R** are true but **R** is not the correct explanation of **A**

(3) **A** is true but **R** is false

(4) **A** is false but **R** is true

69. Given

(A): On a glass plate of refractive index 1.5 when an unpolarised beam is incident at angle of incidence 56°, the reflected beam is plane polarised.

(R): The glass absorbs the ordinary ray and reflects only the extraordinary ray.

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**

(2) Both **A** and **R** are true but **R** is not the correct explanation of **A**

(3) **A** is true but **R** is false

(4) **A** is false but **R** is true

70. From the statements given below, identify the one which is not correct.

(1) Semiconductors have high resistivity.

(2) When temperature increases, semiconductivity increases.

(3) Semiconductors do not convert to dielectrics at low temperature.

(4) Semiconductors convert electric energy to other forms of energy.

71. The inertial mass of a body is equal to its gravitational mass. This is explained by

(1) the relativistic law of gravity

(2) the principle of equivalence

(3) mass energy relation

(4) Einstein's gravitational theory

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72. A system is in normal population only when the number of atoms in the _____ .

(1) excited state is more

(2) ground state is more

(3) excited state is equal to ground state

(4) none of the above

73. Piezo electricity is produced by

(1) heating quartz crystal

(2) rotating electrostatic charge

(3) applying pressure on quartz crystal

(4) applying voltage on the quartz crystal

74. Camera lenses are often coated with transparent film in order to

(1) protect the lens from scratches

(2) avoid loss of light by reflection at the surface

(3) increase the life of the lens

(4) make the surface smooth

75. The unit of Poynting vector is

(1) watt **(2)** watt m^3

(3) watt/m^2 **(4)** watt/m^3

76. Two conductors A and B bent into circles are held with their planes perpendicular to each other so that their centres coincide. A current is flowing in coil A while there is no current in B. If the current is changed suddenly, then in coil B

(1) no current is induced

(2) smaller current than that of A is induced

(3) a larger current than that of A is induced

(4) none of the above

77. A prism is used to resolve D_1 and D_2 lines of sodium. If μ for 6563 Å is 1,6545 and μ for 5270 Å is 1.6635, the minimum thickness of the base of the prism required is

(1) 2.36 cm **(2)** 9.1 mm

(3) 1.41 cm **(4)** 1.01 cm

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78. A cyclotron operates with an alternating field of potential E and frequency f and a magnetic induction field B. The radius of the Dees is R. The maximum kinetic energy K, acquired by a particle of mass M and charge q in this cyclotron is given by

(1) $K = \frac{B^2 q^2}{2MR^2}$ **(2)** $K = 2\pi^2 R^2 f^2 M$

(3) $K = \frac{MB^2 q^2}{2R^2}$ **(4)** $K = \frac{E^2 B^2 R^2}{2M}$

79. Mark out the correct statement(s).

(1) The reading of a particular physical quantity measured from an instrument having smaller least count is more accurate than measured from an instrument having a larger least count.

(2) The last significant digit in the measurement is uncertain.

(3) In a particular measurement, the number of significant digits is more as compared to previous reading, it means 2nd reading is more accurate.

(4) All the above

80. The sensitivity of a beam balance may be increased by

(1) increasing the length of the beam

(2) lowering the centre of gravity of the beam

(3) decreasing the weight of the beam

(4) increasing the number of divisions on the scale behind the pointer

81. The wavelength of X-ray is measured by _____ .

(1) the Coolidge tube

(2) the Bragg's spectrometer

(3) the electron microscope

(4) the prism spectrometer

82. Which is applied in a RC coupled amplifier?

(1) Current **(2)** Power

(3) Voltage **(4)** None

SPACE FOR ROUGH WORK

83. Given

(A): The material of the cathode in a thermionic emitter should have a small work function.

(R): This is to facilitate electron emission only when large heat is supplied

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**

(2) Both **A** and **R** are true but **R** is not the correct explanation of **A**

(3) **A** is true but **R** is false

(4) **A** is false but **R** is true

84. A horizontal disc rotates freely about a vertical axis through its centre. A ring, having the same mass and radius as the disc, is now gently placed on the disc, after some time, the two rotate with a common angular velocity. Then which of the following is false?

(1) Some friction exists between the disc and ring

(2) The angular momentum of system viz: 'disc plus ring' is conserved

(3) The final common angular velocity is $\frac{2}{3}$ rd of the initial angular velocity of the disc

(4) $\frac{2}{3}$ rd of the initial kinetic energy changes to heat

85. The count rate from 100 cm^3 of a radioactive liquid is r. Some of this liquid is now discarded. The count rate of remaining liquid is $\frac{r}{10}$ after three half-lives. Volume of remaining liquid is (cm^3)

(1) 80 **(2)** 40 **(3)** 30 **(4)** 10

SPACE FOR ROUGH WORK

PART III: CHEMISTRY

86. Number of spectral lines of Lyman series when an electron undergoes transition from its excited (5th) state is

(1) 5 **(2)** 10 **(3)** 20 **(4)** 3

87. Mn^{+x} has the magnetic moment is equal to 4.9 Bohr magneton. The value of x is

(1) 3 **(2)** 4 **(3)** 2 **(4)** 5

88. A gaseous alkane is exploded with oxygen gas. The volume of O_2 for complete combustion to volume of CO_2 formed are in the ratio of 7 : 4. The molecular formula of alkane is

(1) CH_4 **(2)** C_2H_6

(3) C_3H_8 **(4)** C_4H_{10}

89. Diamond has FCC unit cell. It has atoms at alternate tetrahedral sites, and in all corners, and in all face centres. The total number of carbon atoms in a crystal of diamond are

(1) 2 **(2)** 4 **(3)** 6 **(4)** 8

90. When mercuric iodide is added to the aqueous solution of potassium iodide ,

(1) freezing point is raised

(2) freezing point is lowerd

(3) freezing point does not change

(4) boiling point does not change

91. If an endothermic reaction is non-spontaneous at its freezing point and becomes feasible at its boiling point, then

(1) ΔH is – ve, ΔS is + ve

(2) ΔH and ΔS both are + ve

(3) ΔH and ΔS both are – ve

(4) ΔH is + ve, ΔS is – ve

92. Ammonium carbamate decomposes as $NH_2COONH_{4(s)} \rightleftharpoons 2NH_{3(g)} + CO_{2(g)}$

K_p for the reaction is 2.9×10^{-5} atm^3. If we start with 1 mole of the compound, the total pressure at equilibrium will be

(1) 0.0766 atm **(2)** 0.0580 atm

(3) 0.0388 atm **(4)** 0.1984 atm

SPACE FOR ROUGH WORK

93. Which of the following statements or relationship is wrong?

(1) On hydrolysis, a salt of a strong acid and a weak base gives a solution with < 7.

(2) The solubility of AgCl is maximum in water, low in aqueous KCl or $AgNO_3$.

(3) In the lead storage battery, the cell reaction is represented as $\underset{\text{anode}}{Pb_{(s)}} \left| H_2SO_4 \right| \underset{\text{cathode}}{PbO_{2(s)}}$.

(4) Dry battery is a secondary cell.

94. The size and energy of an electron in the orbital are referred by

(1) principal quantum number

(2) azimuthal quantum number

(3) magnetic quantum number

(4) spin quantum number

95. The potential energy of the electrons present in the ground state of Li^{+2} is given by the expression

(1) $+\frac{3e^2}{4\pi r}$ **(2)** $\frac{-3e}{4\pi r}$

(3) $\frac{-3e^2}{4\pi r^2}$ **(4)** $\frac{-3e^2}{4\pi r}$

96. Which equilibrium can be described as acid-base reaction using the Lewis acid-base definition, but not using Bronsted and Lowry concept?

(1) $NH_3 + CH_3COOH \rightleftharpoons CH_3COONH_4$

(2) $H_2O + CH_3OOH \rightleftharpoons H_3O^+ + CH_3COO^-$

(3) $4NH_3 + Cu^{2+} \rightleftharpoons [Cu(NH_3)_4]^{2+}$

(4) $HCl + CH_3COOH \rightleftharpoons CH_3COOH_2^+ + Cl^-$

97. Phosphorus undergoes slow combustion and glows in darkness. The process is

(1) Photosensitisation

(2) Chemiluminiscence

(3) Fluorescence

(4) Phosphorescence

SPACE FOR ROUGH WORK

98. Which of the following statements regarding the molecularity of a chemical reaction is wrong?

(1) It is the number of molecules of the reactants taking part in a single step of reaction.

(2) It is calculated from the reaction mechanism.

(3) It may be either a whole number or fractional.

(4) It depends on the rate determining step of the reaction.

99. Cu^{+2} is more stable than Cu^{+1}. This is due to

(1) stable electronic configuration

(2) complexation

(3) extensive hydration of Cu^{+2} ion

(4) higher charge and smaller size of Cu^{+2} ion as compared to Cu^{+} ion and hydration of Cu^{+2} ion

100. The equivalent mass of ferrous oxalate ion when it react with acidified $KMnO_4$ is

(1) Molar mass **(2)** $\frac{\text{Molar mass}}{2}$

(3) $\frac{\text{Molar mass}}{4}$ **(4)** $\frac{\text{Molar}}{3}$

101. The equilibrium constant K_c for the cell reaction,

$Cu_{(s)} + 2Ag^{+}_{(aq)} \rightarrow Cu^{+2}_{(aq)} + 2Ag_{(s}$ will be

(E^{o} of the cell is 0.46 V)

(1) K_c = antilog 15.6

(2) K_c = antilog 2.5

(3) K_c = antilog 1.5

(4) K_c = antilog 12.2

102. Unit of rate constant for I order and zero order reactions in terms of molarity M are respectively

(1) sec^{-1}, M sec^{-1} **(2)** sec^{-1}, M

(3) M sec^{-1}, sec^{-1} **(4)** M, sec^{-1}

103. Alums help in purifying water by

(1) forming complex with clay particles

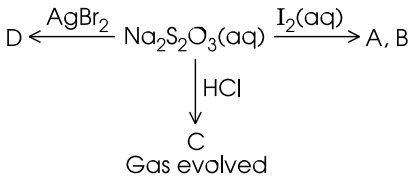
(2) sulphate ions combine with dirt and precipitate

(3) Al^{+3} ion coagulate the – ve charge muddy impurities

(4) Al^{+3} make muddy impurities, water soluble

SPACE FOR ROUGH WORK

104. The products A, B, C and D of the following reaction are respectively.



	A	B	C	D
(1)	NaI	Na_2SO_4	Cl_2	$Ag_2(S_2O_3)$
(2)	NaI	$Na_2S_4O_6$	SO_2	$Ag_2S_2O_3$
(3)	NaI	$Na_2S_4O_6$	SO_2	$Na_3[Ag(S_2O_3)_2]$
(4)	$Na_2S_4O_6$	Na_2SO_4	SO_2	$Na_3[Ag(S_2O_3)_2]$

105. Materials used in the manufacture of portland cement are

(1) Limestone, gypsum, coal, clay

(2) Na_2CO_3, silical, borax, coal

(3) Limestone, bromine, NH_3

(4) Limestone, phosporite

106. Delicate coloured silk cloth is permenanently bleached by

(1) Cl_2 **(2)** SO_2

(3) H_2O_2 **(4)** bleaching powder

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

List I	**List II**
A. Bordeaux mixture	P. $AgNO_{3(aq)}$ with excess of NH_4OH
B. Schweitzers reagent	Q $CuSO_{4(aq)}$ + NaOH and sodiumpotassium tartarate
C. Tollen's reagent	R. $CuSO_{4(aq)}$ excess of NH_4OH
D. Fehling's reagent	S. $FeSO_4$ and H_2O_2
	T. $CuSO_{4(s)}$ + $Ca(OH)_{2(s)}$

Codes

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

SPACE FOR ROUGH WORK

108. Which one of the following theories explains the magnetic nature, formation of spin free complexes etc?

(1) Valence bond theory

(2) Molecular orbital theory

(3) Effective atomic number theory and magnetic property

(4) Crystal field theory

109. The hybridisation, shape and oxidation number of Ni in the organometallic complex $Ni(CO)_4$ are respectively.

(1) dsp^2, square planar, +2, paramagnetic

(2) dsp^3 , square planar, +2, diamagnetic

(3) sp^3, tetrahedral, 0, diamagnetic

(4) sp^3, tetrahedral, +2, paramagnetic

110. Choose the wrong statement among the following properties of transition metals.

(1) They show variable oxidation states.

(2) They form complexes.

(3) They show magnetic properties.

(4) They do not form coloured compounds.

111. Lanthanide compounds are alike in chemical properties. They are separted by ion exchange method, based on

(1) size of the ions

(2) oxidation state of the ions

(3) solubility of their nitrates

(4) basicity of the hydroxides of lanthanides

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

List I		**List II**	
A.	Aluminium	P.	Reduction of oxide with coke in furnace
B.	Copper	Q.	Leaching sulphide ore with KCN and precipitating the metal on adding ironfilling.
C.	Iron	R.	Electrolytic reduction of molten halide ore

SPACE FOR ROUGH WORK

D. Silver — S. Electrolytic reduction of molten oxide ore

T. Partlly oxidising the sulphide ore in air, and its reduction to the metal by the sulphide ore

Codes

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

113. Choose the wrong statement.

(1) Alkali metals are paramagnetic but their salts are diamagnetic.

(2) Alkali metals salt produced characteristic coloured flame.

(3) Sodium metal can be used to prepare absolute alcohol.

(4) Glass surface becomes dull in presence of aq. NaOH.

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

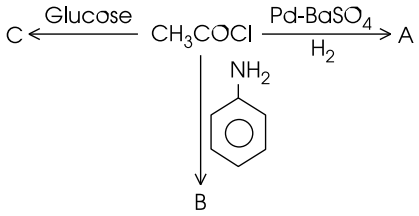
List I	**List II**
A. Lithium aluminium hydride	P. Component of Ziegler-Natta catalyst
B. Lead tetraethyl	Q. Fertilizer
C. Calcium cyanamide	R. Explosive
D. Triethyl aluminium	S. Antiknock material added to petrol
	T. Reducing agent in organic compounds

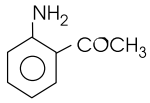
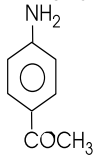
Codes

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

SPACE FOR ROUGH WORK

115. The products A, B and C of the following reaction are respectively



	A	B	C
(1)	CH_3COOH ,	 ,	glucose tetraacetate
(2)	CH_3CH_2OH ,	$CH_3\ CONHC_6H_5$,	glucose pentaacetate
(3)	CH_3CHO ,	$CH_3\ CONHC_6H_5$,	glucose pentaacetate
(4)	CH_3CHO,	 ,	glucose pentaacetate

116. On warming a mixture of solid NaCl and $K_2Cr_2O_7$ produces a gas

(1) orange coloured gas is produced.

(2) which on passing into $Pb(NO_3)_2$ solution produces yellow residue.

(3) when passed in toluene produces, benzaldehyde.

(4) all of the above.

117. Nitric acid with metals produces,

(1) H_2 gas with 1% HNO_3 with Mn or Mg

(2) nitric oxide gas with Cu

(3) produces meta stannic acid with tin

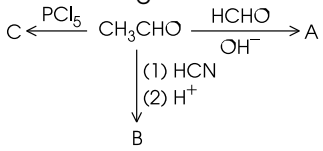
(4) All of the above

118. C_6H_4 (OH) – CH = CH – CHOHCOOH will exist in _____ different form.

(1) 2 **(2)** 4 **(3)** 5 **(4)** 6

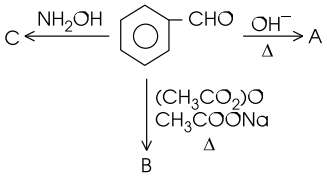
SPACE FOR ROUGH WORK

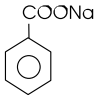
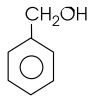
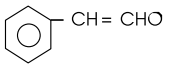
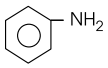
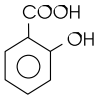
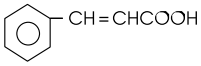
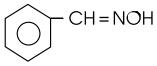
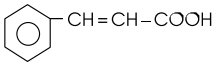
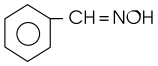
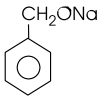
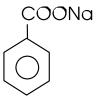
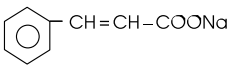
119. The products A, B and C of the following reaction are respectively



	A	B	C
(1)	CH_3COOH	$CH_3CHOHCN$	CH_3CHCl_2
(2)	$CH_3CHOHCH_2CHO$	$CH_3CHOHCOOH$	CH_3CHCl_2
(3)	CH_3CH_2OH	Racemic $CH_3CHOHCOOH$	CH_3CHCl_2
(4)	CH_2OHCH_2CHO	Racemic $CH_3CHOHCOOH$	CCl_3CHCl_2

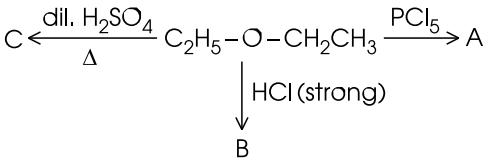
120. The products A, B and C of the following reaction are respectively



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

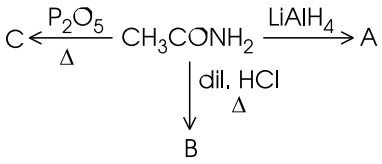
SPACE FOR ROUGH WORK

121. The products A, B and C of the following reaction are respectively



	A	B	C
(1)	C_2H_5Cl	$[(C_2H_5)_2\ OH]Cl$	C_2H_5OH
(2)	$C_2H_4Cl_2$	$C_2H_5OH\ HCl$	$C_2H_5HSO_4$
(3)	C_2H_5Cl	C_2H_5OH	C_2H_5OH
(4)	$C_2H_4Cl_2$	C_2H_5OH	C_2H_5OH

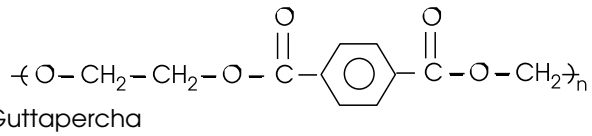
122. The products A, B and C of the following reaction are respectively



	A	B	C
(1)	CH_3COOH	CH_3COOH	$CH_3CH_2NH_2$
(2)	CH_3CH_2OH	$CH_3CH_2NH_2$	CH_3CN
(3)	$CH_3CH_2NH_2$	CH_3COOH	$CH_3C \equiv N$
(4)	CH_3CN	CH_3CH_2OH	CH_3NCO

SPACE FOR ROUGH WORK

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

List I		**List II**	
A.	Polypeptide	P.	
B.	Cis polyisoprene	Q.	Guttapercha
C.	Polysaccharide	R.	Rubber
D.	Polyester	S.	Amino acid
		T.	Cellulose

Codes

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

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

List I		**List II**	
A.	Anaesthetic	P.	Vitamin
B.	Ascorbic acid	Q.	Genetic material
C.	Nucleic acid	R.	Antigen
D.	Virial disease	S.	Nitrous oxide and oxygen
		T.	Rabies

Codes

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

SPACE FOR ROUGH WORK

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

	List I		**List II**
A.	Wax	P.	Soap
B.	Rayon	Q.	Cellulose derivative
C.	Zeolite	R.	Long chain aliphatic ester
D.	Triglyceride	S.	Explosive
		T.	Water purification

Codes

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

SPACE FOR ROUGH WORK

PART IV: ENGLISH PROFICIENCY AND LOGICAL REASONING

(a) ENGLISH PROFICIENCY

Directions for questions 126 to 128: In each of the following questions a capitalised word is 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. LETHARGIC

(1) convalescent

(2) beautiful

(3) invigorating

(4) interrogating

127. IRKSOME

(1) interesting **(2)** lazy

(3) tireless **(4)** devious

128. KINDLE

(1) dislike **(2)** quench

(3) gather **(4)** sparkle

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. CONJECTURE

(1) magic **(2)** guess

(3) position **(4)** farm

130. DECIMATE

(1) kill **(2)** disgrace

(3) collide **(4)** deride

131. TEPID

(1) boiling **(2)** lukewarm

(3) freezing **(4)** cold

132. REPLICA

(1) museum piece **(2)** famous site

(3) facsimile **(4)** replacement

SPACE FOR ROUGH WORK

133. REGAL

(1) oppressive **(2)** royal

(3) major **(4)** basic

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 which has an error and mark accordingly.

134. **(1)** One should

(2) always

(3) take care

(4) of his health

135. **(1)** I shall

(2) ring him

(3) tomorrow

(4) afternoon

136. **(1)** The clothes

(2) were neatly

(3) hanged

(4) on the cloth line

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. The Marathon is a _____ race.

(1) gruelling **(2)** gullible

(3) haggard **(4)** infernal

138. She is far too intelligent to utter such _____ remarks.

(1) fervent **(2)** fatuous

(3) illusive **(4)** hurtle

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

139. The king travelled through the town with his identity concealed and mingled with the common folks.

(1) inane **(2)** limpid

(3) incognito **(4)** histrionic

SPACE FOR ROUGH WORK

140. Her employers were greatly impressed by her persistent hard work and offered her a higher scale.

(1) diminution **(2)** impunity

(3) restitution **(4)** diligence

(b) LOGICAL REASONING

Directions for questions 141 to 144: In 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. TILE : MOSAIC : :

(1) wick : candle

(2) easel : painting

(3) hoop : embroidery

(4) knot : macrame

142. TORRENT : DROPLET : :

(1) avalanche : pebble

(2) swamp : desert

(3) hurricane : wreckage

(4) water : eddy

143. PHILATELY : STAMPS : :

(1) calligraphy : pens

(2) numismatics : coins

(3) cartography : maps

(4) chronology : events

144. EMBROIDER : FABRIC : :

(1) spin : yarn

(2) refine : ore

(3) glaze : glass

(4) fret : wood

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. Knowledge of a wide and diversified vocabulary enables you to detect subtle differences in sentence meaning.

B. A primary skill needed for good reading comprehension is the understanding of the meanings of individual words.

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C. A second reading skill to be developed is the ability to discover the central theme of the passage.

D. For this reason, it is important that you familiarize yourself with as many words as possible.

E. Although the central theme may vary from passage to passage, if can usually be found in the title or in the topic sentence.

F. By making yourself aware of what the entire passage is about, you can relate what you read to the central theme.

(1) BEACDF **(2)** BEDCAF

(3) BEDAFC **(4)** BADCFE

146. A. However there is no absolute rule.

B. Usually the topic sentence is found in the beginning of a paragraph.

C. The term "topic sentence" is used to describe the sentence that gives the key to an entire paragraph.

D. Read the whole passage first. Then try to decide which sentence comes closest to expressing the main point of the paragraph.

E. Before you try to locate the topic sentence in a paragraph, remember that this technique depends upon reading and judgement.

F. A writer may build his paragraph to a conclusion, putting the key sentence at the end.

(1) EFDABC **(2)** CBAFED

(3) DACFBE **(4)** CFDEBA

147. A. Some found work in transporting goods or selling them.

B. Trade started from person to person, but grew to involve different towns and different lands.

C. Trade encouraged specialization, which led to improvement in quality.

D. Men also realized that different men could make different products.

E. No doubt it started from a desire to have something different.

F. Trade exists for many reasons.

(1) FEDCBA **(2)** EFBCAD

(3) DEAFBC **(4)** DFEBCA

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Direction for question 148: In the question given two statements A and B are followed by four conclusions numbered C, D, E and F. Assume the two given statements to be true even if they vary from commonly known facts. Read all the conclusions and decide which of the given conclusions logically follows the two given statements.

148. Statements: A. Some chairs are windows.

B. No window is sky.

Conclusions: C. No window is chair.

D. No chair is window.

E. Some windows are skies.

F. Some chairs are skies.

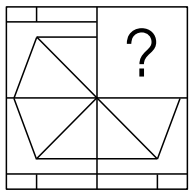
(1) Either E or F follows

(2) Either D or E follows

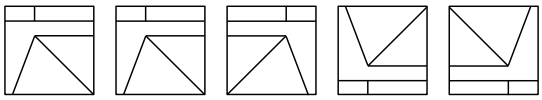
(3) Either D or F follows

(4) None follows

Direction for question 149: Choose the figure from among the five alternatives 1, 2, 3, 4 and 5, that which will fit into the box (?) of the figure (X)

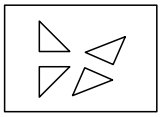


(X)

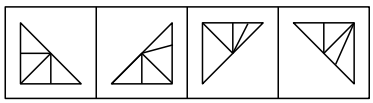


(1) (2) (3) (4) (5)

Direction for question 150: In the following question select the figure from a set of four figures 1, 2, 3, 4 that can be formed by joining the figures gives in box marked (X)



(X)



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

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

BRILLIANT'S MOCK TEST 7

FOR STUDENTS OF

OUR ONE/TWO-YEAR POSTAL COURSE

TOWARDS

BITSAT, 2008

SOLUTIONS

PART I: MATHEMATICS

1. (3) Roots are rational

$\Rightarrow$ Discriminant is a perfect square

$\Rightarrow 4(3a + 5)^2 - 8(9a^2 + 25)$ is a perfect square

$\Rightarrow -36a^2 + 12a - 100$ is a perfect square

$\Rightarrow -4(3a - 5)^2$ is a perfect square

which is true only if $a = \frac{5}{3}$

2. (3) $\frac{1}{17^y} = 25 = 5^2 = \frac{1}{3^{2x}}$

$\Rightarrow 9^x = 17^y \Rightarrow x > y$

3. (4) $(3^{bx+5})^2 = 3^{2bx+10}$

$= 3^{ax+5+cx+5}$

$= 3^{ax+5}\, 3^{cx+5}$

$\Rightarrow$ The terms are in G.P.

4. (2) $\frac{b^2}{q^2} = \frac{ac}{pr} = \frac{a}{p} \cdot \frac{c}{r}$

$\Rightarrow$ the terms are in G.P.

5. (3) The given equation becomes

$(\sin x + 2\cos x)(\sin x - \cos x)^2 = 0$

i.e., $(\sin x + 2\cos x)(1 - \sin 2x) = 0$

$1 - \sin 2x = 0 \quad \Rightarrow x = \frac{\pi}{4}$

$\sin x + 2\cos x = 0$

$\Rightarrow \tan x = -2,$

$\Rightarrow x = \tan^{-1}(-2)$

6. (3) Inverse of $A = \frac{1}{|A|}(\text{adj } A)$

$$= \frac{1}{1}\begin{bmatrix} 1 & 0 & 0 \\ -a & 1 & 0 \\ a-c & b-c & 1 \end{bmatrix}$$

7. (3) The problem is equivalent to filling r places in a line with numbers 1 to 100. This can be done in 10^r ways. This set of 10^r ways will contain two types of arrangements (i) those contain 10 and (ii) those do not

contain 10. The number of arrangements where 10 does not occur is 9^r. Hence as per the problem, $10^r - 9^r = 271 \Rightarrow r = 3$

8. (3) There are 5 numbers of the form $\frac{P}{q}$ with 3 in the numerator. Similarly for each of 4, 8, 9 and 12.

$\therefore$ total number of numbers of the form $\frac{p}{q}$ is $5 \times 5 = 25$. But the value 1 is repeated 5 times, $\frac{1}{3}$ is repeated twice and $\frac{3}{4}$ is repeated twice.

$\therefore$ the number of distinct rational numbers formed

$$= 25 - 4 - 1 - 1 = 19$$

9. (4) Leap year contains 366 days. Dividing by 7, the remainder is 2.

For 53 Wednesdays or 53 Thursdays, this year should not start with Tuesday, Wednesday or Thursday.

$\Rightarrow$ The required probability is $\frac{3}{7}$.

10. (2) $x^2 - 24x + 50 > 0$

$$\Rightarrow \left(x - \frac{24 + \sqrt{376}}{2}\right)\left(x - \frac{24 - \sqrt{376}}{2}\right) > 0$$

$$\Rightarrow x > \frac{24 + \sqrt{376}}{2} \text{ or } x < \frac{24 - \sqrt{376}}{2}$$

$\Rightarrow$ x is a positive integer $\le \frac{5}{2}$ or

x is a positive integer ≥ 21.5

i.e., x = 1, 2 or 22, 23, . . . 50

$\therefore$ the required probability = $\frac{31}{50}$.

11. (2) For any $k \ge 4$, $\sum_{r=0}^{k} \lfloor r$ ends with 4.

For any $n > 1$, $2^{2^n} = \left(2^4\right)^{\frac{2^n}{4}} = 16^k$, where k is an integer.

$\Rightarrow 2^{2^n}$ ends with 6 and

$\sum_{r=0}^{4} \lfloor r = 1 + 1 + 2 + 6 + 24$ and

$\sum_{r=0}^{n} \lfloor r$ ends with 4 for all $n \ge 4$

$\therefore \sum_{r=0}^{50} \lfloor r + 2^{2^n}$ ends with 0.

12. (2) $1 + (1 + x) + (1 + x)^2 + \ldots + (1 + x)^n$

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

Coefficient of $x^{100} = {}^{n+1}C_{101}$

$= {}^{201}C_{101}$ (given)

$\Rightarrow n + 1 = 201$

$\Rightarrow n = 200$

13. (3) $\left|z - \frac{i}{2}\right| = \frac{a}{2}|z + 1$

When a = 2, the equation is $\left|z - \frac{i}{2}\right| = |z + 1|$, which represents a line which is the perpendicular of the segment joining $\frac{i}{2}$ and -1.

When $a \ne 2$, when we substitute $z = x + iy$, the coefficient of x^2

= coefficient of $y^2 = \frac{a^2}{4}$ and xy term is absent.

$\therefore$ the given equation represents a circle when $a \ne 2$.

14. (4) If $S = 1 + 2\omega + 3\omega^2 + \ldots + n\omega^{n-1}$

$S(1 - \omega) = 1 + \omega + \omega^2 + \ldots + \omega^{n-1} - n\omega^n$

$= 0 - \omega \cdot 1$

$= -\omega$

$\Rightarrow S = \dfrac{-n}{1 - \omega}$

15. (2) If $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$,

$\vec{a} \times \hat{i} = -a_2\hat{k} + a_3\hat{j}$

$\Rightarrow |a \times \hat{i}|^2 = a_2^2 + a_3^2$

$\Rightarrow \sum |\vec{a} \times \hat{i}|^2 = 2a^2$

16. (2) $\sin^2\beta = \sin\alpha\cos\alpha$

$\Rightarrow \cos 2\beta = 1 - \sin 2\alpha$

$\Rightarrow (\sin\alpha - \cos\alpha)^2 = 2\cos^2\left(\dfrac{\pi}{4} + \alpha\right)$

17. (3) $\sin C = 2\sin A\cos B$

$= \sin(A + B) + \sin(A - B)$

$= \sin C + \sin(A - B)$

$\Rightarrow \sin(A - B) = 0 \Rightarrow A = B$

i.e., the triangle is isosceles.

18. (2) $4^{\sin x}$ and $4^{\cos x}$ are both positive. Their A.P. $\geq$ G.P.

$\therefore 4^{\sin x} + 4^{\cos x} \geq 2 \cdot 4^{\frac{1}{2}(\sin x + \cos x)}$

$= 2^1 \cdot 2^{\sqrt{2}\sin\left(\frac{\pi}{4} + x\right)}$

$\Rightarrow$ Minimum value of $4^{\sin x} + 4^{\cos x}$ is $2^{1 - \sqrt{2}}$

($\therefore$ minimum value of $\sin\left(\dfrac{\pi}{4} + x\right)$ is -1).

19. (2) Putting $x = 2$, $y = 3$ in the equation of straight line, we get $6(a + b + c) = 0$.

$\therefore$ (2) is the correct choice.

20. (1) The extremities of the common chord are O(0, 0) and A($-1, -1$). If the common chord is the diameter, the centre is $\left(-\dfrac{1}{2}, -\dfrac{1}{2}\right)$ and radius is $\dfrac{1}{\sqrt{2}}$.

$\therefore$ the required equation of the circle is $\left(x + \dfrac{1}{2}\right)^2 + \left(y + \dfrac{1}{2}\right)^2 = \dfrac{1}{2}$

21. (2) The equation of the tangent to $y^2 = 4(x + 1)$ with slope, m is

$y = m(x + 1) + \dfrac{1}{m}$ ... (1)

The equation of the tangent to $y^2 = 8(x + 2)$ with slope $-\dfrac{1}{m}$ is

$y = -\dfrac{1}{m}(x + 2) - 2m$ ... (2)

From (1) and (2)

$\left(m + \dfrac{1}{m}\right)(x + 3) = 0$

$\Rightarrow x + 3 = 0$

22. (2) $xy = 2 \Rightarrow \frac{dy}{dx} = -\frac{y}{x}$

$\Rightarrow$ slope of the normal at $(\alpha, \beta) = \frac{\alpha^2}{2}$.

Equation of the normal at (α, β) is

$y - \beta = \frac{\alpha^2}{2}(x - \alpha)$

i.e., $y - \frac{2}{\alpha} = \frac{\alpha^2}{2}(3 - \alpha)$

or $\alpha^4 - 3\alpha^3 + 8\alpha - 4 = 0$

If the four roots of this equation are x_1, x_2, x_3, x_4, then

$x_1 x_2 x_3 x_4 = -(-4) = 4$

23. (1) Putting $u = x + 2y$, $v = x - 2y$,

$x = \frac{u + v}{2}$, $y = \frac{u - v}{4}$

$\therefore f(u, v) = \left(\frac{u + v}{2}\right)\left(\frac{u - v}{4}\right)$

$= \frac{u^2 - v^2}{8}$

$\Rightarrow f(x, y) = \frac{x^2 - y^2}{8}$

24. (1) $\lim\limits_{x \to 0} \left(\frac{\sin x}{x}\right)^{\frac{\sin x}{x - \sin x}}$

$= \lim\limits_{x \to 0} \left[1 - \left(1 - \frac{\sin x}{x}\right)\right]^{\frac{\sin x}{x - \sin x}}$

Putting $y = 1 - \frac{\sin x}{x} = \frac{x - \sin x}{x}$,

the given limit becomes

$\lim\limits_{y \to 0} \left[(1 - y)^{1/y}\right]^{\lim\limits_{x \to 0} \frac{\sin x}{x}}$

$= (e^{-1})^1 = \frac{1}{e}$

25. (3) $f(x) = \cos x - \sin x + ax + b$

$\Rightarrow f'(x) = -\sin x - \cos x + a < 0$, if $f(x)$ is decreasing.

$\Rightarrow a < \sin x + \cos x$

$= \sqrt{2} \sin\left(\frac{\pi}{4} + x\right)$

$< \sqrt{2}$

26. (2) $\{\sqrt{x}\} = \sqrt{x} - [\sqrt{x}]$

$\Rightarrow \int_0^4 \{\sqrt{x}\}\, dx$

$= \int_0^4 \left(\sqrt{x} - [\sqrt{x}]\right) dx$

$= \frac{4^{\frac{3}{2}}}{\frac{3}{2}} - \left(\int_0^1 [\sqrt{x}]\, dx + \int_1^4 [\sqrt{x}]\, dx\right)$

$= \frac{16}{3} - \left(0 + \int_1^4 dt\right) = \frac{7}{3}$

27. (4) As $[\vec{u}\ \vec{v}\ \vec{w}]$ represents the volume of parallelopiped, it would be maximum if $\vec{u}$ is perpendicular to the plane of $\vec{v}$ and $\vec{w}$. So height is 1 and the area is base $\times$ height.

i.e., $|\vec{v} \times \vec{w}| \times 1 =$ volume of parallelopiped $= \sqrt{59}$.

28. (2) Equation of line perpendicular to the plane through (2, 2, 2) is

$$\frac{x-2}{1} = \frac{y-2}{1} = \frac{z-2}{1} = ;$$

$\Rightarrow (\lambda + 2, \lambda + 2, \lambda + 2)$ is a general point on it.

Now, $\lambda + 2 + \lambda + 2 + \lambda + 2 = 9$

$\Rightarrow \lambda = 1$

$\therefore$ foot of the perpendicular is (3, 3, 3).

29. (2) Given determinant is

$$\begin{vmatrix} 1 & 2 & 6 \\ 2 & 6 & 24 \\ 6 & 24 & 120 \end{vmatrix} = \begin{vmatrix} 1 & 2 & 6 \\ 0 & 2 & 12 \\ 0 & 12 & 84 \end{vmatrix}$$

by $R_2 \to R_2 - 2R_1$

$R_3 \to R_3 - 6R_1$

$= 24 = \underline{|4}$

30. (3) $xy = (\text{cosec}\,\theta - \cot\theta)(\sec\theta + \tan\theta)$

$= \text{cosec}\,\theta \sec\theta + \sec\theta - \text{cosec}\,\theta - 1$

$\therefore xy + 1 = \text{cosec}\,\theta \sec\theta + \sec\theta - \text{cosec}\,\theta$

$$= \frac{1}{\sin\theta\cos\theta} + \sec\theta - \text{cosec}\,\theta$$

$$= \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta} + \sec\theta - \text{cosec}\,\theta$$

$= \tan\theta + \cot\theta + \sec\theta - \text{cosec}\,\theta$

$= (\sec\theta + \tan\theta) - (\text{cosec}\,\theta - \cot\theta)$

$= y - x$

31. (3) $(\sin 78° - \sin 42°) + (\sin 6° - \sin 66°)$

$= 2\cos 60° \sin 18° - 2\cos 36° \sin 30°$

$= \sin 18° - \cos 36°$

$$= \frac{\sqrt{5}-1}{4} - \frac{(\sqrt{5}+1)}{4} = -\frac{1}{2}$$

32. (4) Let A, B, C be the points $(p + 1, 1), (2p + 1, 3), (2p + 2, 2)$.

A, B, C are collinear, if slope of AB = slope of BC

$$\therefore \frac{2}{p} = \frac{2p-3}{1} \Rightarrow 2p^2 - 3p - 2 = 0$$

$\Rightarrow (2p + 1)(p - 2) = 0$

$\Rightarrow p = 2 \text{ or } -\frac{1}{2}$

33. (3) Solving $3x + 4y + 6 = 0$ and $4x + 7y + 8 = 0$,

$\Rightarrow x = -2, y = 0$. These values satisfy the other equation.

$\therefore$ the lines are concurrent.

34. (2) $\left|\frac{z_1}{z_2}\right| = 2$ and $\text{amp}\left(\frac{z_1}{z_2}\right) = \frac{\pi}{2}$

$$\Rightarrow \frac{z_1}{z_2} = 2e^{\frac{i\pi}{2}}$$

$$\Rightarrow z_1 = 2z_2\left(\cos\frac{\pi}{2} + i\sin\frac{\pi}{2}\right)$$

$\Rightarrow iz_1 + 2z_2 = -2z_2 + 2z_2 = 0$

35. (1) Let $z = x + iy$. Then
$(x^2 + y^2) - (x + iy) = 1 + 2i$

$\Rightarrow y = -2$ and $\sqrt{x^2 + 4} - x = 1$

i.e., $x^2 + 4 = x^2 + 2x + 1$

$\Rightarrow x = \frac{3}{2}$

36. (1) For the roots being real,
Discriminant ≥ 0

$\therefore 4 - 12\,p(p - 1) \geq 0$

$\Rightarrow 3p^2 - 3p - 1 \leq 0$

$\Rightarrow p = \left[\frac{3 - \sqrt{13}}{2}, \frac{3 + \sqrt{13}}{2}\right]$ ... (1)

For the roots being of opposite signs,

$\frac{p(p - 1)}{3} < 0 \Rightarrow p \in (0, 1)$ ... (2)

(1) and (2) must be simultaneously true.

$\therefore p \in (0, 1)$

37. (2) $3\alpha + 3\beta = -\frac{3b}{a}$, $9\alpha\beta = \frac{9c}{a}$

$\therefore$ the equation whose roots are 3α, 3β is

$x^2 + \frac{3b}{a}x + \frac{9c}{a} = 0$

i.e., $ax^2 + 3bx + 9c = 0$

38. (3) The first factors are in A.P., so also the second factors. The fifteenth term of $3 \times 5 + 7 \times 8 + \ldots$ is
$(3 + 14 \times 4)\,(5 + 14 \times 3) = 59 \times 47$

$= 2773$

39. (3) The given series are in G.P. with the first term $a = \sqrt{3}$ and the common ratio $= \sqrt{2}$.

$\therefore S_{12} = \sqrt{3}\,\frac{\left[(\sqrt{2})^{12} - 1\right]}{\sqrt{2} - 1}$

$= \sqrt{3} \times 63 \times (\sqrt{2} + 1)$

$= 63(\sqrt{6} + \sqrt{3})$

40. (4) The required condition is

$\frac{5p}{2} + \frac{3p}{2} = -5 + 7 \Rightarrow p = \frac{1}{2}$

41. (2) Total number of digits that can be formed with 2, 3, 4, 5 $= \underline{|4} = 24$.

$2 + 3 + 4 + 5 = 14$.

Each of the four numbers occur in the unit place 6 times, in the 10^{th} place 6 times etc.

$\therefore$ the required sum
$= 6 \times 14\,(1 + 10 + 100 + 1000)$

$= 84 \times 1111 = 93324$

42. (3) $\log_3 x + \frac{1}{\log_{1+x} 3} = 2$

$\Rightarrow \log_3 x + \log_3 (1 + x) = 2$

$\Rightarrow \log_3 x(1 + x) = 2$

$\Rightarrow x^2 + x - 9 = 0$

43. (4) $\underline{|n}\,\underline{|21 - n} = \frac{\underline{|21}}{{}^{21}C_n}$

$\therefore \underline{|n}\,\underline{|2n - 1}$ is least when ${}^{21}C_n$ is the greatest
i.e., when $21 - n + 1 \geq n \Rightarrow n \leq 11$.

$\Rightarrow n \leq 10$ as 21 is odd.

44. (4) $(1+x)^n\left(1+\frac{1}{x}\right)^m = \frac{(1+x)^{m+r}}{x^m}$

$\therefore$ coefficient of $\frac{1}{x}$ in this expansion

= coefficient of x^{m-1} in $(1+x)^{m+n}$

$= {}^{m+n}C_{m-1} = \frac{\lfloor m+n}{\lfloor m-1 \lfloor n+1}$

45. (1) $\lim_{x\to 0} \frac{(a^{x^2}-1)-(b^{x^2}-1)}{x^2}$

$= \lim_{x\to 0}\left[\left(\frac{a^{x^2}-1}{x^2}\right)-\left(\frac{b^{x^2}-1}{x^2}\right)\right]$

$= \ln a - \ln b = \ln \frac{a}{b}$

PART II: PHYSICS

46. (2)

47. (3)

48. (2) $\frac{P_t}{P_c} = 1 + \frac{m^2}{2}$ or $\frac{m^2}{2} = \frac{P_t}{P_c} - 1$

$\frac{m^2}{2} = \frac{10.125}{9} - 1 = 1.125 - 1 = 0.125$

$m^2 = 2 \times 0.125 = 0.250$ or $m = 0.5$

The total modulation index will be

$m_t = \sqrt{m_1^2 + m_2^2} = \sqrt{(0.5)^2 + (0.4)^2}$

$= \sqrt{0.41} = 0.64$

$P_t = P_c\left(1 + \frac{m^2}{2}\right) = 9\left[1 + \frac{(0.64)^2}{2}\right]$

$= 10.84$ kW

49. (2)

50. (4)

51. (3)

52. (1)

53. (4)

54. (4)

55. (2)

56. (1)

57. (4)

58. (4)

59. (1)

60. (2)

61. (2) $v = \frac{s}{t} = \frac{13.8}{4.0} = 3.45 = 3.4$ m/s (upto 2 significant digits)

$\frac{dv}{v} = \pm\left(\frac{ds}{s} + \frac{dt}{t}\right) = \pm\left[\frac{0.2}{13.8} + \frac{0.3}{4.0}\right]$

$= \pm 0.0894$

$dv = 0.31$ m/s

$v = [3.4 \pm 0.31]$ m/s

62. (2)

63. (3)

64. (3)

65. (3)

66. (2)

67. (3)

68. (1)

69. (3)

70. (3)

71. (2)

72. (2)

73. (3)

74. (2)

75. (3)

76. (1)

77. (3)

78. (2)

79. (4)

80. (2)

81. (2)

82. (3)

83. (3)

84. (3) Let ω_1 = an initial angular velocity of disc

ω_2 = final common angular velocity of disc and ring

For disc $I_1 = \frac{1}{2} mr^2$

For ring $I_2 = mr^2$

By conservation

$$L = I_1 \omega_1 = (I_1 + I_2)\omega_2$$

$$\Rightarrow \omega = \frac{I_1\omega_1}{I_1 + I_2} = \frac{\omega_1}{3}$$

$$E_1 = \frac{1}{2} I_1 \omega_1^2$$

$$E = \frac{1}{2}\left(I_1 + I_2\right)\omega^2$$

Heat produced = $E_1 - E$

Ratio of heat produced to initial Kinetic Energy = $\frac{E_1 - E}{E_1}$

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

85. (1) Initial count rate for 1 cm^3 of liquid $= \frac{r}{100}$

After three half-lives, the count rate for 1 $cm^3 = \frac{1}{8} \times \frac{r}{100}$

Let volume of remaining liquid = V cm^3

Count rate of this liquid = $V \times \frac{r}{800}$

$$= \frac{r}{10}$$

$\Rightarrow V = 80$

PART III: CHEMISTRY

86. (2) Number of spectral line when an electron undergoes transition from n^{th} electronic level to lower level

$$= \frac{n(n-1)}{2} = \frac{5(5-1)}{2} = \frac{5\times 4}{2} = 1($$

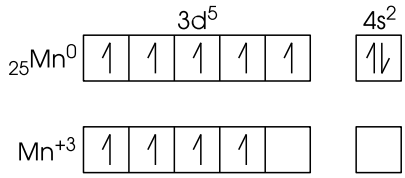
87. (2) μ resultant $= \sqrt{n(n+2)}$ Bohr magneton

n = number of unpaired/single electrons in the transition metal species

$\sqrt{n(n+2)} = 4.9$

$n(n+2) = (4.9)^2 = 24$

$n = 4$



$n = 4 = Mn^{+3}$

88. (2) $C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \longrightarrow$

$nCO_{2(g)} + (n+1)H_2O$

$\left(\frac{3n+1}{2}\right) : n = 7 : 4$

$4\left(\frac{3n+1}{2}\right) = 7n$

$6n + 2 = 7n$

$n = 2$

$C_2H_{6(g)} + 3\frac{1}{2}O_2 \rightarrow 2CO_{2(g)} + 3H_2O$

$= 1 : 3\frac{1}{2}$

89. (4) In a FCC unit, 8 cubes are present i.e., with 8 tetrahedral holes.

Number of carbon atoms at alternate tetrahedral cubes = 4
Number of carbon atoms occupying 8 corners $= 8\times\frac{1}{8} = 1$

Number of carbon atoms occupying at 6 face centres

$= 6\times\frac{1}{2} = 3$

Total number of carbon atoms in FCC unit cell = 8

90. (1) $2KI_{(aq)} + HgI_2 \longrightarrow K_2^{+1}[HgI_4]^{-1}$

Total number of ions 7 = 3

As a result, the number of ions decreases, depression of freezing point of the resultant solution is less. Freezing point is raised.

91. (2) For an endothermic reaction.
ΔH = + ve, $\Delta G = \Delta H - T\Delta S$

ΔG is + ve at low temperature, and ΔS + ve, but $T\Delta S < \Delta H$

At high temperature, $T\Delta S > \Delta H$ and ΔG becomes – ve, spontaneous.

92. (2) $NH_2COONH_{4(s)} \rightleftharpoons 2NH_{3(g)} + CO_{2(g)}$

At equilibrium, if partial pressure of CO_2 = p atms, pNH_3 = 2p atm

$K_p = p^2NH_3 \times pCO_2$

$= (2p)^2 \times p = 4p^3$

$4p^3 = 2.9 \times 10^{-5}$

$p^3 = 0.725 \times 10^{-5}$

$p = 1.935 \times 10^{-2}$

Total pressure $3p = 5.805 \times 10^{-2}$ atm

$= 0.058$ atm

93. (4) Dry battery is primary cell, one chemical energy is used as electric current, it cannot be recharged.

94. (1) If n primary quantum number,

$$E_n = \frac{-2.18 \times 10^{-18} Z^2}{n^2}$$

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

95. (4) For Li^{+2}, Z = 3

$$\text{Potential energy} = \frac{-3e^2}{4\pi r}$$

96. (3) NH_3 – electron donor, Lewis base

Cu^{2+} – electron acceptor, Lewis acid

97. (4)

98. (3) Molecularity of reaction is a positive whole number only.

99. (3)

100. (4) $FeC_2O_4 + H_2SO_4 \longrightarrow FeSO_4 +$ COOH | COOH

Both are acting as reducing agent with acid $KMnO_4$.

$Fe^{+2} \longrightarrow Fe^{+3} + 1e^- = 1e^-$

$$\overset{+3}{\underset{\text{COOH}}{\overset{|}{\underset{\text{COOH}}{}}}} + [O] \longrightarrow \overset{+4}{2CO_2} + H_2O = 3e^-$$

Total number of electrons from FeC_2O_4 molecules is 3.

Equivalent mass of FeC_2O_4

$$= \frac{\text{Molar mass}}{3}$$

101. (1) $Cu^0 + 2Ag^{+1}_{(aq)} \rightarrow Cu^{+2}_{(aq)} + 2Ag^c$

$Cu^0 \longrightarrow Cu^{+2} + 2e^-$ Anode

$2Ag^{+1} + 2e^- \longrightarrow 2Ag^0$ Cathode

n = Number of electrons involved in the redox reaction

= 2

$$E = \frac{0.059}{2} \log K_c$$

$$\log K_c = \frac{2 \times 0.46}{0.059} = 15.6$$

K_c = antilog of 15.6

102. (2)

103. (3)

104. (3)

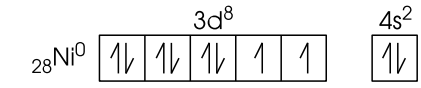
105. (1)

106. (3)

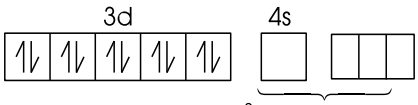
107. (4)

108. (4)

109. (3) $Ni^0 (CO)^o$



CO is strong field ligand in spectro chemical series. Hence, pairing of electrons.



sp^3 hybridisation

n = 0, diamagnetic.

110. (4)

111. (4)

112. (2)

113. (3)

114. (4)

115. (3)

116. (4)

117. (4)

118. (3) As it contains one double bond and one chiral carbon atom, two geometrical with two different configuration at chiral center. Four isomers and one racemic mixture.

119. (4)

120. (3)

121. (1)

122. (3)

123. (3)

124. (4)

125. (1)

PART IV: ENGLISH PROFICIENCY AND LOGICAL REASONING

(a) ENGLISH PROFICIENCY

126. (3) 127. (1) 128. (2) 129. (2) 130. (1)

131. (2) 132. (3) 133. (2) 134. (4) 135. (2)

136. (3) 137. (1) 138. (2) 139. (3) 140. (4)

(b) LOGICAL REASONING

141. (4) 142. (1) 143. (2) 144. (4) 145. (4)

146. (2) 147. (1) 148. (4) 149. (3) 150. (1)