JEE MAIN-2019

ONLINE 09-01-2019 (EVENING)

IMPORTANT INSTRUCTIONS

1. The question paper has three parts: **Physics**, **Mathematics** and **Chemistry**. Each part has three sections.
2. Section 1 contains 8 questions. The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).
   Marking Scheme: +4 for correct answer and 0 in all other cases.
3. Section 2 contains 10 multiple choice questions with one or more than one correct option.
   Marking Scheme: +4 for correct answer, 0 if not attempted and –2 in all other cases.
4. Section 3 contains 2 “match the following” type questions and you will have to match entries in Column I with the entries in Column II.
   Marking Scheme: for each entry in Column I, +2 for correct answer, 0 if not attempted and – 1 in all other cases.

PART-A-PHYSICS

1. A mass of 10 kg is suspended vertically by a rope from the roof. When a horizontal force is applied on the rope at some point, the rope deviated at an angle of 45° at the roof point. If the suspended mass is at equilibrium, the magnitude of the force applied is ($g = 10\ ms^{-2}$)

(1) 200 N (2*) 100 N (3) 70 N (4) 140 N

2. Two point charges $q_1(\sqrt{10}\,\mu C)$ and $q_2(-25\mu C)$ are placed on the x-axis at x = 1m and x = 4m respectively. The electric field (in V/m) at a point y = 3m on y-axis is [take $\frac{1}{4\pi\in_0} = 9\times10^9\ Nm^2C^{-2}$]

(1*) $(63\hat{i}-27\hat{j})\times10^2$ (2) $(-63\hat{i}+27\hat{j})\times10^2$

(3) $(81\hat{i}-81\hat{j})\times10^2$ (4) $(-81\hat{i}+81\hat{j})\times10^2$

3. At a given instant, say t = 0, two radioactive substances A and B have equal activities. The ratio $\frac{R_B}{R_A}$ of their activities after time t itself decays with time t as e^{-3t}. If the half-life of A is $\ell n2$, the half-life of B is

(1*) $\frac{\ell n2}{4}$ (2) $4\ell n2$ (3) $2\ell n2$ (4) $\frac{\ell n2}{4}$

4. A particle is executing simple harmonic motion (SHM) of amplitude A, along the x-axis, about x = 0. When its potential energy (PE) equals kinetic energy (KE), the position of the particle will be:

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

5. A musician using an open flute of length 50 cm produces second harmonic sound waves. A person runs towards the musician from another end of a hall at a speed of 10 km/h. If the wave speed is 330 m/s, the frequency heard by the running person shall be close to:

(1) 500 Hz (2) 333 Hz (3*) 666 Hz (4) 753 Hz

6. Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to:

(1) $\sqrt{\frac{Gh}{c^3}}$ (2) $\sqrt{\frac{c^3}{Gh}}$ (3*) $\sqrt{\frac{Gh}{c^5}}$ (4) $\sqrt{\frac{hc^5}{G}}$

7. A rod of mass 'M' and length '2L' is suspended at its middle by a wire. It exhibits torsional oscillations; If two masses each of 'm' are attached at distance 'L/2' from its centre on both sides, it reduces the oscillation frequency by 20%. The value of ratio m/M is close to:

(1) 0.57 (2) 0.77 (3*) 0.37 (4) 0.17

8. The top of a water tank is open to air and its water level is maintained. It is giving out 0.74 m^3 water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to:

(1) 6.0 m (2) 2.9 m (3*) 4.8 m (4) 9.6 m

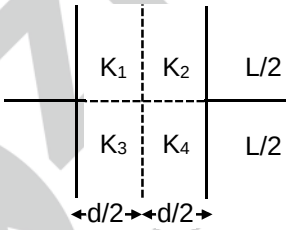
9. Two Carnot engines A and B are operated in series. The first one, A, receives heat at T_1(= 600 K) and rejects to a reservoir at temperature T_2. The second engine B receives heat rejected by the first engine and, in turn, rejects to a heat reservoir at T_3(= 400 K). Calculate the temperature T_2 if the work outputs of the two engines are equal:

(1) 300 K (2*) 500 K (3) 600 K (4) 400 K

10. In a car race on straight road, car A takes a time t less than car B at the finish and passes finishing point with a speed 'v' more than that of car B. Both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Then 'v' is equal to:

(1*) $\sqrt{a_1a_2}\,t$ (2) $\frac{2a_1a_2}{a_1+a_2}t$ (3) $\frac{a_1+a_2}{2}t$ (4) $\sqrt{2a_1a_2}\,t$

11. A parallel plate capacitor with square plates is filled with four dielectrics of dielectric constants K_1, K_2, K_3, K_4 arranged as shown in the figure. The effective dielectric constant K will be:



(1) $K=\frac{(K_1+K_2)(K_3+K_4)}{2(K_1+K_2+K_3+K_4)}$ (2) $K=\frac{(K_1+K_2)(K_3+K_4)}{K_1+K_2+K_3+K_4}$

(3) $K=\frac{(K_1+K_4)(K_2+K_3)}{2(K_1+K_2+K_3+K_4)}$ (4*) $K=\frac{(K_1+K_3)(K_2+K_4)}{K_1+K_2+K_3+K_4}$

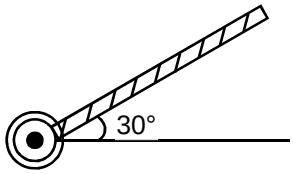
12. A particle having the same charge as of electron moves in a circular path of radius 0.5 cm under the influence of a magnetic field of 0.5T. If an electric field of 100 V/m makes it to move in a straight path, then the mass of the particle is (Given charge of electron = 1.6×10^{-19} C)

(1) 1.6×10^{-19} kg (2) 1.6×10^{-27} kg (3) 9.1×10^{-31} kg (4*) 2.0×10^{-24} kg

13. A series AC circuit containing an inductor (20 mH), a capacitor (120 μF) and a resistor (60Ω) is driven by an AC source of 24V/50Hz. The energy dissipated in the circuit in 60 s is:

(1) 3.39×10^3 J (2) 5.65×10^2 J (3*) 5.17×10^2 J (4) 2.26×10^3 J

14. A rod of length 50 cm is pivoted at one end. It is raised such that if makes an angle of 30° from the horizontal as shown and released from rest. Its angular speed when it passes through the horizontal (in rad s^{-1}) will be ($g = 10\ ms^{-2}$)



(1) $\sqrt{\frac{30}{2}}$ (2) $\frac{\sqrt{30}}{2}$ (3) $\frac{\sqrt{20}}{3}$ (4*) $\sqrt{30}$

15. In a Young's double slit experiment, the slits are placed 0.320 mm apart. Light of wavelength $\lambda = 500$ nm is incident on the slits. The total number of bright fringes that are observed in the angular range $-30° \leq \theta \leq 30°$ is:

(1) 320 (2) 640 (3) 321 (4*) 641

16. The energy required to take a satellite to a height 'h' above Earth surface (radius of Earth = 6.4×10^3 km) is E_1 and kinetic energy required for the satellite to be in a circular orbit at this height is E_2. The value of h for which E_1 and E_2 are equal, is:

(1) 6.4×10^3 km (2) 1.28×10^4 km (3) 1.6×10^3 km (4*) 3.2×10^3 km

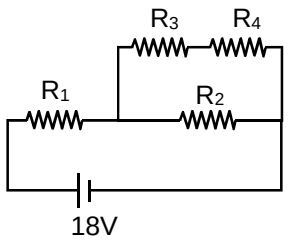
17. Two plane mirrors are inclined to each other such that a ray of light incident on the first mirror (M_1) and parallel to the second mirror (M_2) is finally reflected from the second mirror (M_2) parallel to the first mirror (M_1). The angle between the two mirrors will be:

(1) 75° (2*) 60° (3) 90° (4) 45°

18. A force acts on a 2 kg object so that its position is given as a function of time as $x = 3t^2 + 5$. What is the work done by this force in first 5 seconds?

(1) 875 J (2) 950 J (3) 850 J (4*) 900 J

19. In the given circuit the internal resistance of the 18V cell is negligible. If $R_1 = 400\ \Omega$, $R_3 = 100\Omega$ and $R_4 = 500\Omega$ and the reading of an ideal voltmeter across R_4 is 5V, then the value of R_2 will be:



(1) 550 Ω (2) 230 Ω (3*) 300 Ω (4) 450 Ω

20. The position co-ordinates of a particle moving in a 3-D coordinate system is given

by $x = a\cos\omega t$

$y = a\sin\omega t$

and $z = a\omega t$

The speed of the particle is:

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

21. A carbon resistance has a following colour code. What is the value of the resistance?

(1*) 530 kΩ ± 5% (2) 6.4 MΩ ± 5% (3) 64 kΩ ± 10% (4) 5.3 MΩ ± 5%

22. A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. The output power is delivered at 230 V by the transformer. If the current in the primary of the transformer is 5A and its efficiency is 90%, the output current would be:

(1) 25A (2*) 45A (3) 50A (4) 35A

23. One of the two identical conducting wires of length L is bent in the form of a circular loop and the other one into a circular coil of N identical turns. If the same current is passed in both, the ratio of the magnetic field at the central of the loop (B_L) to that at the centre of the coil (B_C), i.e. $\frac{B_L}{B_C}$ will be:

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

24. A 15 g mass of nitrogen gas is enclosed in a vessel at a temperature 27°C. Amount of heat transferred to the gas, so that rms velocity of molecules is doubled, is abou: [Take R = 8.3 J/K mole]

(1) 6 kJ (2*) 10 kJ (3) 14 kJ (4) 0.9 kJ

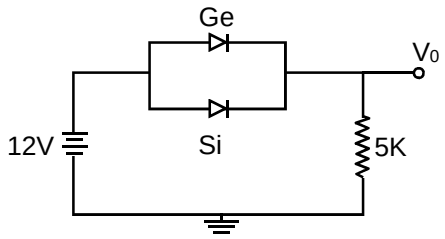
25. In a communication system operating at wavelength 800 nm, only one percent of source frequency is available as signal bandwidth. The number of channels accommodated for transmitting TV signals of band width 6 MHz are (Take velocity of light $c = 3\times10^8$ m/s, $h = 6.6\times10^{-34}$ J-s)

(1*) 6.25×10^5 (2) 3.75×10^6 (3) 3.86×10^6 (4) 4.87×10^5

26. Charge is distributed within a sphere of radius R with a volume charge density $\rho(r) = \frac{A}{r^2}e^{-2r/a}$, where A and *a* are constants. If Q is the total charge of this charge distribution, the radius R is:

(1) $\frac{a}{2}\log\left(1-\frac{Q}{2\pi aA}\right)$ (2) $a\log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$ (3) $a\log\left(1-\frac{Q}{2\pi aA}\right)$ (4*) $\frac{a}{2}\log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$

27. Ge and Si diodes start conducting at 0.3 V and 0.7 V respectively. In the following figure if Ge diode connection are reversed, the value of V_0 changes by: (assume that the Ge diode has large breakdown voltage)



(1) 0.8 V (2) 0.6 V (3) 0.2 V (4*) 0.4 V

28. The energy associated with electric field is (U_E) and with magnetic field is (U_B) for an electromagnetic wave in free space. Then:

(1) $U_E < U_B$ (2) $U_E > U_B$ (3*) $U_E = U_B$ (4) $U_E = \frac{U_B}{2}$

29. The pitch and the number of divisions, on the circular scale, for a given screw gauge are 0.5 mm and 100 respectively. When the screw gauge is fully tightened without any object, the zero of its circular scale lies 3 divisions below the mean line.

The readings of the main scale and the circular scale, for a thin sheet, are 5.5 mm and 48 respectively, the thickness of this sheet is:

(1) 5.950 mm (2*) 5.725 mm (3) 5.755 mm (4) 5.740 mm

30. The magnetic field associated with a light wave is given, at the origin, by

$B = B_0 [\sin (3.14 \times 10^7)ct + \sin (6.28 \times 10^7) ct]$. If this light falls on a silver plate having a work function of 4.7 eV, what will be the maximum kinetic energy of the photo electrons?

($c = 3 \times 10^8$ ms^{-1}, $h = 6.6 \times 10^{-34}$ J-s)

(1) 12.5 eV (2) 8.52 eV (3) 6.82 eV (4*) 7.72 eV

PART-B-MATHEMATICS

31. The coefficient of t^4 in the expansion of $\left(\frac{1-t^6}{1-t}\right)^3$ is

(1) 12 (2) 10 (3*) 15 (4) 14

32. If $f(x) = \int \frac{5x^8 + 7x^6}{\left(x^2 + 1 + 2x^7\right)^2}\, dx$, $(x \geq 0)$, and $f(0) = 0$, then the value of $f(1)$ is

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

33. A hyperbola has its centre at the origin, passes through the point (4, 2) and has transverse axis of length 4 along the x-axis. Then the eccentricity of the hyperbola is

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

34. If the system of linear equations

$x - 4y + 7z = g$

$3y - 5z = h$

$-2x + 5y - 9z = k$

is consistent, then

(1) $g + h + 2k = 0$ (2) $g + 2h + k = 0$ (3) $2g + h + k = 0$ (4) $g + h + k = 0$

35. A data consists of n observations:

$x_1, x_2, ..., x_n$. If $\sum_{i=1}^{n}(x_i + 1)^2 = 9n$ and $\sum_{i=1}^{n}(x_i - 1)^2 = 5n$, then the standard deviation of this data is :

(1) $\sqrt{7}$ (2) $\sqrt{5}$ (3) 2 (4) 5

36. Let a, b and c be the 7^{th}, 11^{th} and 13^{th} terms respectively of a non-constant A.P. If these are also the three consecutive terms of a G.P., then $\frac{a}{c}$ is equal to

(1) 2 (2) $\frac{1}{2}$ (3) $\frac{7}{13}$ (4*) 4

37. The number of all possible positive integral values of α for which the roots of the quadratic equation $6x^2 - 11x + \alpha = 0$ are rational numbers is

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

38. If $\int_0^{\frac{\pi}{3}} \frac{\tan\theta}{\sqrt{2k\sec\theta}}d\theta = 1-\frac{1}{\sqrt{2}}$, (k > 0), then the value of k is:

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

39. If $0 \le x < \frac{\pi}{2}$, then the number of values of x for which sin x – sin 2x + sin 3x = 0, is

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

40. If the circle $x^2 + y^2 – 16x – 20y + 164 = r^2$ and $(x – 4)^2 + (y – 7)^2 = 36$ intersect at two distinct points, then

(1) r = 11 (2*) 1 < r < 11 (3) r > 11 (4) 0 < r < 1

41. The sum of following series $1+6+\frac{9(1^2+2^2+3^2)}{7}+\frac{12(1^2+2^2+3^2+4^2)}{9}+\frac{15(1^2+2^2+...+5^2)}{11}+...$

up to 15 terms, is

(1) 7510 (2) 7520 (3) 7830 (4*) 7820

42. If $A=\begin{bmatrix} e^t & e^{-t}\cos t & e^{-t}\sin t \\ e^t & -e^{-t}\cos t - e^{-t}\sin t & -e^{-t}\sin t + e^{-t}\cos t \\ e^t & 2e^{-t}\sin t & -2e^{-t}\cos t \end{bmatrix}$, then A is

(1) not invertible for any $t \in R$. (2) invertible for all $t \in R$

(3) invertible only if $t = \frac{\pi}{2}$ (4) invertible only if $t = \pi$.

43. The logical statement $[\sim(\sim p \wedge q) \vee (p \wedge r)] \wedge (\sim q \wedge r)$ is equivalent to

(1) $(p \wedge \sim q) \vee r$ (2) $\sim p \vee r$ (3) $(p \wedge r) \wedge \sim q$ (4) $(\sim p \wedge \sim q) \wedge r$

44. The area of the region A = {(x, y) : $0 \le y \le x|x| + 1$ and $-1 \le x \le 1$} in sq. units, is

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

45. An urn contains 5 red and 2 green balls. A ball is drawn at random from the urn. If the drawn ball is green, then a red ball is added to the urn and if the drawn ball is red, then a green ball is added to the urn; the original ball is not returned to the urn. Now, a second ball is drawn at random from it. The probability that the second ball is red, is:

(1) $\frac{26}{49}$ (2) $\frac{27}{49}$ (3) $\frac{21}{49}$ (4) $\frac{32}{49}$

46. Let f : [0, 1] $\rightarrow$ R be such that f (xy) = f (x) · f (y), for all x, y $\in$ [0, 1] and f (0) $\neq$ 0. If y = y(x) satisfies the differential equation, $\frac{dy}{dx} = f(x)$ with y (0) = 1, then $y\left(\frac{1}{4}\right) + y\left(\frac{3}{4}\right)$ is equal to

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

47. Let A = {x $\in$ R: x is not a positive integer}. Define a function f: A $\rightarrow$ R as f (x) = $\frac{2x}{x-1}$, then f is

(1) injective but not surjective (2) not injective

(3) neither injective nor surjective (4) surjective but not injective

48. Let the equation of two sides of a triangle be 3x – 2y + 6 = 0 and 4x + 5y – 20 = 0. If the orthocentre of this triangle is at (1, 1), then the equation of its third side is:

(1) 26x + 61y + 1675 = 0 (2) 122y – 26x – 1675 = 0

(3) 122y + 26x + 1675 = 0 (4*) 26x – 122y – 1675 = 0

49. If x = $\sin^{-1}$ (sin10) and y = $\cos^{-1}$ (cos10), then y – x is equal to

(1) π (2) 0 (3) 10 (4) 7π

50. If both the roots of the equation x^2 – mx + 4 = 0 are real and distinct and they lie in the interval [1, 5], then m lies in the interval:

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

51. If x = 3 tan t and y = 3 sec t, then the value of at t = $\frac{d^2y}{dx^2}$, $\frac{\pi}{4}$ is

(1) $\frac{1}{6\sqrt{2}}$ (2) $\frac{1}{3\sqrt{2}}$ (3) $\frac{1}{6}$ (4) $\frac{3}{2\sqrt{2}}$

52. The number of natural numbers less than 7,000 which can be formed by using the digits 0, 1, 3, 7, 9 (repetition of digits allowed) is equal to

(1*) 374 (2) 250 (3) 375 (4) 372

53. If the lines x = ay + b, z = cy + d and x = a'z + b', y = c'z + d' are perpendicular, then

(1) bb' + cc' + 1 = 0 (2) aa' + c + c' = 0 (3) ab' + bc' + 1 = 0 (4) cc' + a + a' = 0

54. For each x $\in$ R, let [x] be the greatest integer less than or equal to x. Then $\lim_{x\to 0^-} \frac{x([x]+|x|)\sin[x]}{|x|}$ is equal to

(1) 1 (2) 0 (3) – sin 1 (4) sin 1

55. Let f be a differentiable function from R to R such that $|f(x)-f(y)| \le 2|x-y|^{3/2}$, for all x, y $\in$ R. If f (0) = 1 then $\int_0^1 f^2(x)dx$ is equal to

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

56. Let $\vec{a} = \hat{i} + \hat{j} + \sqrt{2}\hat{k}$, $\vec{b} = b_1\hat{i} + b_2\hat{j} + \sqrt{2}\hat{k}$ and $\vec{c} = 5\hat{i} + \hat{j} + \sqrt{2}\hat{k}$ be three vectors such that the projection vector of $\vec{b}$ on $\vec{a}$ is $\vec{a}$. If $\vec{a} + \vec{b}$ is perpendicular to $\vec{c}$, then $|\vec{b}|$ is equal to

(1) $\sqrt{22}$ (2) 6 (3) $\sqrt{32}$ (4) 4

57. Let A (4, – 4) and B (9, 6) be points on the parabola, $y^2 = 4x$. Let C be chosen on the arc AOB of the parabola, where O is the origin, such that the area of ΔACB is maximum. Then, the area (in sq. units) of ΔACB, is

(1) $31\frac{3}{4}$ (2) $31\frac{1}{4}$ (3) $31\frac{1}{4}$ (4) 32

58. Let S be the set of all triangles in the xy-plane, each having one vertex at the origin and the other two vertices lie on coordinate axes with integral coordinates. If each triangle in S has area 50 sq. units, then the number of elements in the set S is

(1*) 36 (2) 32 (3) 18(4) 9

59. Let z_0 be a root of the quadratic equation, $x^2 + x + 1 = 0$. If $z = 3 + 6i\ z_0^{81} - 31\ z_0^{93}$, then arg z is equal to

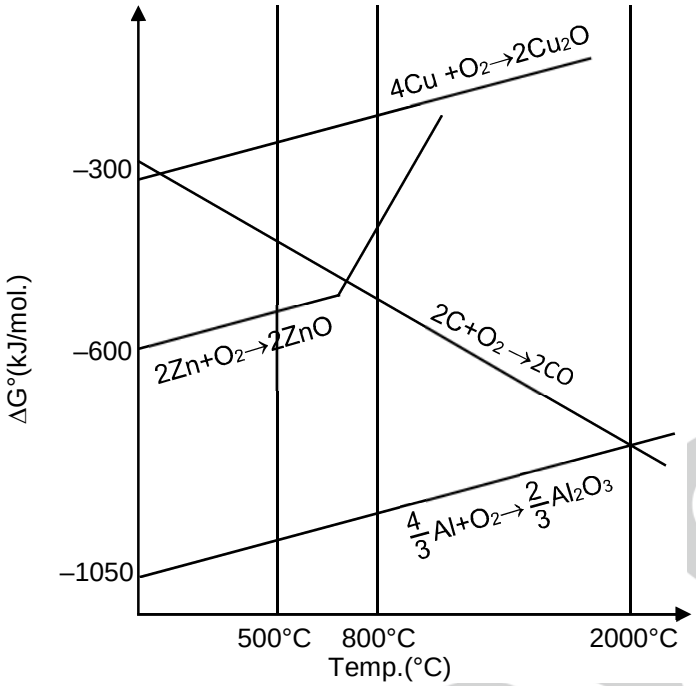
(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{6}$ (4) 0

60. The equation of the plane containing the straight line $\frac{x}{2} = \frac{y}{3} = \frac{z}{4}$ and perpendicular to the plane containing the straight lines $\frac{x}{3} = \frac{y}{4} = \frac{z}{2}$ and $\frac{x}{4} = \frac{y}{2} = \frac{z}{3}$ is

(1) 5x + 2y – 4z = 0 (2) 3x + 2y – 3z = 0 (3) x – 2y **+** z = 0 (4) x + 2y – 2z = 0

PART-C-CHEMISTRY

61. The correct statement regarding the given Ellingham diagram is:



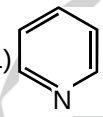
(1) At 800°C, Cu can be used for the extraction of Zn from ZnO.

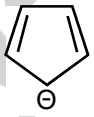
(2) At 500°C, coke can be used for the extraction of Zn from ZnO.

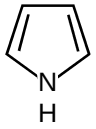
(3) At 1400°C, Al can be used for the extraction of Zn from ZnO.

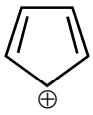
(4) Coke cannot be used for the extraction of Cu from Cu_2O.

62. Which of the following compounds is not aromatic?

(1) 

(2) 

(3) 

(4) 

63. The transition element that has lowest enthalpy of atomisation, is -

(1) Fe (2) Zn (3) V (4*) Cu

64. For the following reaction, the mass of water produced from 445 g of $C_{57}H_{110}O_6$ is:

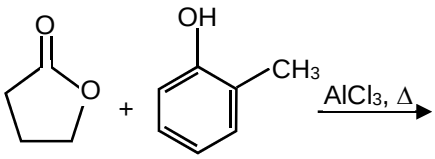
$2C_{57}H_{110}O_6(s) + 163\ O_2(g) \rightarrow 114CO_2(g) + 110H_2O(l)$

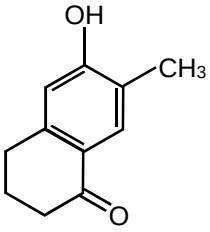
(1) 890 g (2) 495 g (3) 445 g (4) 490 g

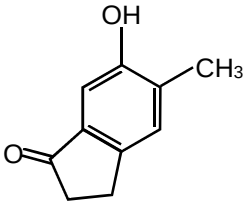
65. For coagulation of orsenious sulphide sol, which one of the following salt solution will be most effective?

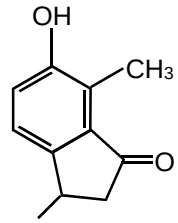
(1) NaCl (2) Na_3PO_4 (3) $AlCl_3$ (4) $BaCl_2$

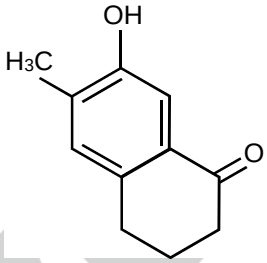
66. The major product of the following reaction is



(1) 

(2) 

(3) 

(4) 

67. For the reaction, 2A + B $\rightarrow$ products, when the concentration of A and B both were doubled, the rate of the reaction increased from 0.3 mol L^{-1} s^{-1} to 2.4 mol L^{-1} s^{-1}. When the concentration of A alone is doubled, the rate increased from 0.3 mol L^{-1} s^{-1} to 0.6 L^{-1} s^{-1}. Which one of the following statements is correct?

(1) Order of the reaction with respect to A is 2.

(2) Total order of the reaction is 4.

(3) Order of the reaction with respect to B is 1.

(4) Order of the reaction with respect to B is 2.

68. The complex that has highest crystal field splitting energy (Δ), is:

(1) $[Co(NH_3)_5Cl]Cl_2$ (2)$[Co(NH_3)_5(H_2O)]Cl_3$

(3*) $K_3[Co(CN)_6]$ (4) $K_2[CoCl_4]$

69. The correct match between **Item-I** and **Item-II** is -

	Item-I	**Item-II**
(A)	Benzaldehyde	(P) Mobile phase
(B)	Alumina	(Q) Adsorbent
(C)	Acetonitrile	(R) Adsorbate

(1) (A) $\rightarrow$ (Q); (B) $\rightarrow$ (P);(C) $\rightarrow$ (R)

(2) (A) $\rightarrow$ (P); (B) $\rightarrow$ (R);(C) $\rightarrow$ (Q)

(3) (A) $\rightarrow$ (Q); (B) $\rightarrow$ (R);(C) $\rightarrow$ (P)

(4) (A) $\rightarrow$ (R); (B) $\rightarrow$ (Q);(C) $\rightarrow$ (P)

70. The increasing basicity order of the following compounds is:

(A) $CH_3CH_2NH_2$ (B) $CH_3CH_2NH(CH_2CH_3)$ (C) $H_3C-N(CH_3)-CH_3$ (D) $Ph-N(CH_3)-H$

(1) (A) < (B) < (D) < (C) (2) (D) < (C) < (A) < (B)

(3) (A) < (B) < (C) < (D) (4) (D) < (C) < (B) < (A)

71. Which of the following combination of statements is true regarding the interpretation of the atomic orbitals?

(a) An electron in an orbital of high angular momentum stays away from the nucleus than an electron in the orbital of lower angular momentum.

(b) For a given value of the principal quantum number, the size of the orbit is inversely proportional to the azimuthal quantum number.

(c) According to wave mechanics, the ground state angular momentum is equal to $h/2\pi$.

(d) The plot of Ψ vs r for various azimuthal quantum numbers, shows peak shifting towards higher r value.

(1) (a), (c) (2) (b), (c) (3) (a), (d) (4) (a), (b)

72. The pH of rain water, is approximately:

(1) 5.6 (2) 6.5 (3) 7.0 (4) 7.5

73. The metal that forms nitride by reacting directly with N_2 of air, is :

(1) Rb (2*) Li (3) Cs (4) K

74. At 100°C, copper (Cu) has FCC unit cell structure with cell edge length of x Å. What is the approximate density of Cu (in g cm^{-3}) at this temperature? [Atomic mass of Cu = 63.55 u]

(1) $\frac{205}{x^3}$ (2) $\frac{422}{x^3}$ (3) $\frac{105}{x^3}$ (4) $\frac{211}{x^3}$

75. If the standard electrode potential for a cell is 2V at 300K, the equilibrium constant (K) for the reaction:

$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Cu(s)$

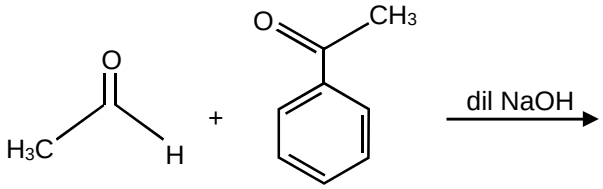
At 300K is approximately. [R = 8 JK^{-1} mol^{-1}, F = 96000 C mol^{-1})

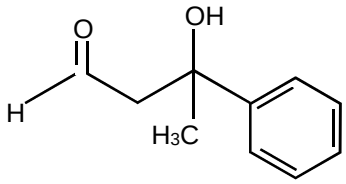
(1) e^{320} (2) e^{-160} (3) e^{-80} (4) e^{160}

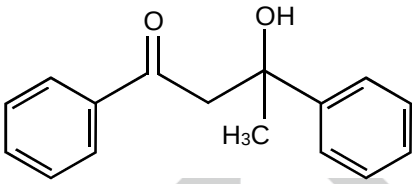
76. Homoleptic octahedral complexes of a metal ion M^{3+} with three monodentate ligands L_1, L_2 and L_3 absorb wavelengths in the region of green, blue and red respectively. The increasing order of the ligand strength is:

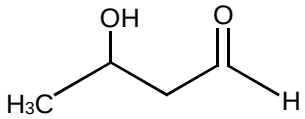
(1*) $L_3 < L_1 < L_2$ (2) $L_2 < L_1 < L_3$ (3) $L_3 < L_2 < L_1$ (4) $L_1 < L_2 < L_3$

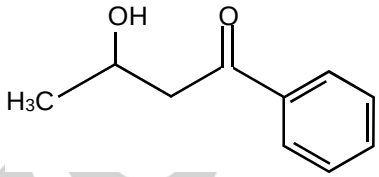
77. The major product formed in the following reaction is:



(1) 

(2) 

(3) 

(4) 

78. Consider the following reversible chemical reactions:

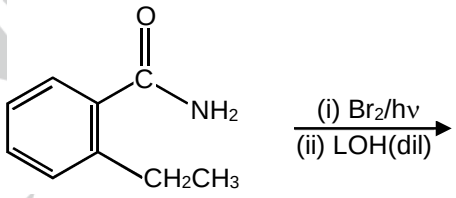
$A_2(g) + B_2(g) \underset{}{\overset{K_1}{\rightleftharpoons}} 2AB(g)$ .....(1)

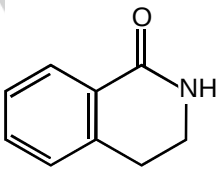
$6AB(g) \underset{}{\overset{K_2}{\rightleftharpoons}} 3A_2(g) + 2B_2(g)$ .....(2)

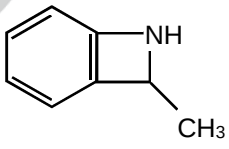
The relation between K_1 and K_2 is :

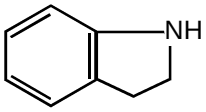
(1) $K_2 = K_1^3$ (2) $K_1K_2 = 3$ (3) $K_2 = K_1^{-3}$ (4) $K_1K_2 = \frac{1}{3}$

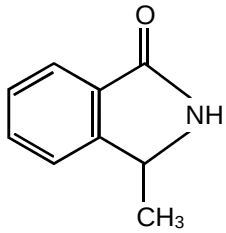
79. The major product of the following reaction is:



(1) 

(2) 

(3) 

(4) 

80. Which of the following conditions in drinking water causes methemoglobinema?

(1) > 50 ppm of chloride (2) > 50 ppm of lead

(3) > 100 ppm of sulphate (4) > 50 ppm of nitrate

81. When the first electron gain enthalpy ($\Delta_{eg}H$) of oxygen is – 141 kJ/mol, its second electron gain enthalpy is:

(1) a more negative value than the first (2) negative, but less negative than the first

(3*) a positive value (4) almost the same as that of the first.

82. Good reducing nature of H_3PO_2 is attributed to the presence of:

(1) Two P–OH bonds (2*) Two P–H bonds (3) One P–OH bond (4) One P–H bond

83. The entropy change associated with the conversion of 1 kg of ice at 273 K to water vapours at 383 K is : (Specific heat of water liquid and water vapour are 4.2 kJ K^{-1} kg^{-1} and 2.0 kJ K^{-1} kg^{-1}; heat of liquid fusion and vapourisation of water are 334 kJ kg^{-1} and 2491 kJ kg^{-1} , respectively).

(log 273 = 2.436, log 373 = 2.572, log 383 = 2.583)

(1) 8.49 kJ kg^{-1} K^{-1} (2) 7.90 kJ kg^{-1} K^{-1} (3) 9.26 kJ kg^{-1} K^{-1} (4) 2.64 kJ kg^{-1} K^{-1}

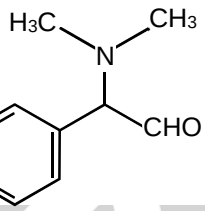
84. The temporary hardness of water is due to:

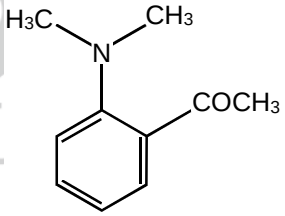
(1) Na_2SO_4 (2) $CaCl_2$ (3) NaCl (4*) $Ca(HCO_3)_2$

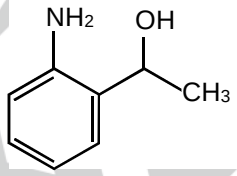
85. The tests performed on compound X and their inferences are:

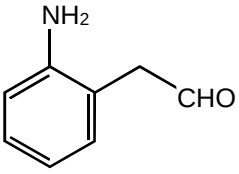
Test	**Inference**
(a) 2,4-DNP test	Coloured precipitate
(b) Iodoform test	Yellow precipitate
(c) Azo-dye test	No dye formation

Compound 'X' is:

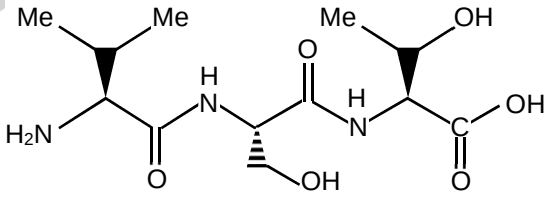
(1) 

(2) 

(3) 

(4) 

86. The correct sequence of amino acids present in the tripeptide given below is:

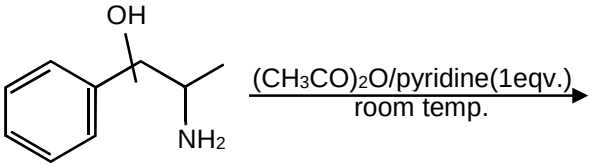


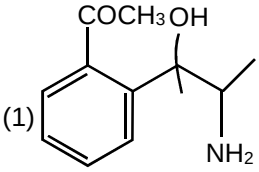
(1) Thr-Ser-Val (2) Leu-Ser-Thr (3) Val-Ser-Thr (4) Thr-Ser-Leu

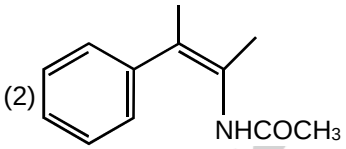
87. A solution containing 62 g ethylene glycol in 250 g water is cooled to – 10°C. If K_f for water is 1.86 K kg mol^{-1}, the amount of water (in g) separated as ice is:

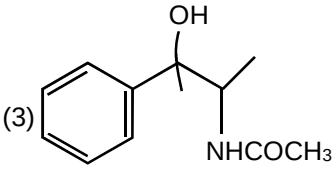
(1) 64 (2) 16 (3) 32 (4) 48

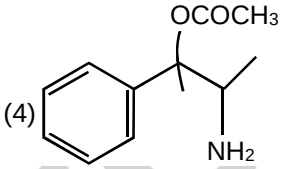
88. The major product obtained in the following reaction is:



(1) 

(2) 

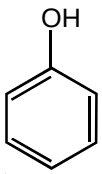
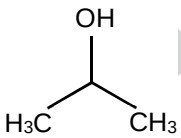
(3) 

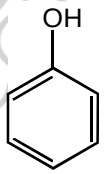
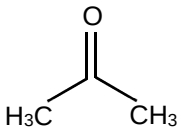
(4) 

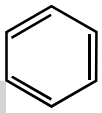
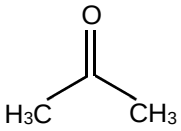
89. In which of the following processes, the bond order has increased and paramagnetic character has changed to diamagnetic?

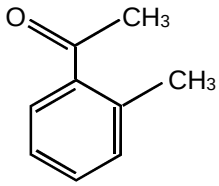
(1) $O_2 \rightarrow O_2^{2-}$ (2) $O_2 \rightarrow O_2^{+}$ (3) $N_2 \rightarrow N_2^{+}$ (4*) $NO \rightarrow NO^{+}$

90. The products formed in the reaction of cumene with O_2 followed by treatment with dil. HCl are:

(1)  and 

(2)  and 

(3)  and 

(4)  and $CH_3 - OH$