

Physics

- If F_1 , F_2 and F_3 are the relative strengths of the gravitational, the weak nuclear and the electromagnetic forces respectively, then
 (a) $F_1 > F_2 > F_3$ (b) $F_1 < F_2 < F_3$
 (c) $F_1 = F_2 = F_3$ (d) $F_2 > F_3 > F_1$
- Which of the following pairs has same dimensions?
 (a) Current density and charge density
 (b) Angular momentum and linear momentum
 (c) Spring constant and surface energy
 (d) Force and torque
- The relation between time t and distance x of a particle is $t = ax^2 + bx$, where a and b are constants. If v is the velocity of the particle, then its acceleration is
 (a) $-2abv^2$ (b) $2bv^3$
 (c) $-2av^3$ (d) $2av^2$
- A bomb is dropped on an enemy post on the ground by an aeroplane flying horizontally with a velocity of 60kmh^{-1} at a height of 490 m . At the time of dropping the bomb, the horizontal distance of the aeroplane from the enemy post, so that the bomb hits the target is
 (a) $\left(\frac{400}{3}\right)\text{m}$ (b) $\left(\frac{500}{3}\right)\text{m}$
 (c) $\left(\frac{1700}{3}\right)\text{m}$ (d) 498 m
- The angular speed of a particle moving in a circular path is doubled. Then, the centripetal acceleration of the particle is
 (a) 4 times the initial centripetal acceleration
 (b) halved
 (c) doubled
 (d) unchanged
- Two bodies of masses of 1 g and 4 g are moving with equal kinetic energies. The ratio of the magnitudes of their linear momenta is
 (a) 4: 1 (b) $\sqrt{2}$: 1
 (c) 1: 2 (d) 1: 16
- The displacement s of a body of mass 3 kg under the action of a force is given by $s = \frac{t^3}{3}$, where s is in metres and t is in seconds. The work done by the force in the first two seconds is
 (a) 32 J (b) 3.8 J
 (c) 5.2 J (d) 24 J
- A system consists of two particles of masses m_1 and m_2 . If the particle of mass m_1 is moved towards the centre of mass through a distance d , then the distance the second particle should be moved, so as to keep the centre of mass at the same position is
 (a) $-\frac{m_2}{m_1}d$ (b) $\frac{m_2}{m_1+m_2}d$
 (c) $-\frac{m_1}{m_2}d$ (d) $\frac{m_1}{m_2}d$
- If the radius of the earth becomes x times its present value, the new period of rotation in hours is
 (a) $6x^2$ (b) $12x^2$
 (c) $24x^2$ (d) $48x^2$
- For a particle executing simple harmonic motion, the kinetic energy of the particle at a distance of 4 cm from the mean position is $\frac{1}{3}$ rd of the maximum kinetic energy. The amplitude of the motion is
 (a) $2\sqrt{6}$ cm (b) $\frac{2}{\sqrt{6}}$ cm
 (c) $\sqrt{2}$ cm (d) $\frac{6}{\sqrt{2}}$ cm

11. A wire of length 40 cm is stretched by 0.1 cm . The strain on the wire is
 (a) 25×10^{-4} (b) 40×10^{-4}
 (c) 10×10^{-4} (d) 12.5×10^{-4}
12. A straw of circular cross-section of radius R and negligible thickness is dipped vertically into a liquid of surface tension T. If the contact angle between the liquid and the straw material is 53° . The force acting on the straw due to surface tension of the liquid is ($\cos 53^\circ = 0.6$)
 (a) $\frac{12\pi RT}{5}$ (b) $\frac{6\pi RT}{5}$
 (c) $\frac{4\pi RT}{5}$ (d) $\frac{3\pi RT}{5}$
13. A solid metal sphere released in a vertical liquid column has attained terminal velocity in the downward direction. The magnitudes of viscous force, buoyant force and gravitational force acting on it are F_V , F_B and F_W respectively. Then, the correct relation between them is
 (a) $F_B > F_V = F_W$ (b) $F_W = F_V + F_B$
 (c) $F_B = F_W + F_V$ (d) $F_V = F_B + F_W$
14. Two objects made of the same material have masses m and 2m and are at temperatures 2T and T respectively. When heat Q is supplied to the object of mass 2m, its temperature raises to 2T. If the same heat is supplied to the object of mass m, its temperature raises to
 (a) 2T (b) $\frac{3T}{2}$ (c) 4T (d) 3T
15. On a new temperature scale, the melting point of ice is $20^\circ X$ and the boiling point of water is $110^\circ X$. A temperature of $40^\circ C$ would be indicated on this new temperature scale as
 (a) $60^\circ X$ (b) $56^\circ X$
 (c) $70^\circ X$ (d) $54^\circ X$
16. The percentage of heat supplied to a diatomic ideal gas that is converted into work in an isobaric process is
 (a) 62.7 (b) 71.4
 (c) 28.6 (d) 34.6
17. Ratio of translational degrees of freedom to rotational degrees of freedom of a polyatomic linear gas molecule is
 (a) 1: 1 (b) 1: 2
 (c) 2: 3 (d) 3: 2
18. A ring has a mass M and radius R. The distance of the point on its geometric axis from its centre at which the gravitational field is strongest is
 (a) $\frac{R}{2}$ (b) $\frac{R}{4}$ (c) $\frac{R}{\sqrt{3}}$ (d) $\frac{R}{\sqrt{2}}$
19. A heavy uniform rope is suspended vertically from a ceiling and is in equilibrium. A pulse is generated at the bottom end of the rope as shown. As the pulse travels up the rope, its acceleration at any instant is (g is acceleration due to gravity)



- (a) constant and equal to $\frac{g}{2}$
 (b) variable but equal to $\frac{g}{2}$ when the pulse is exactly at the middle of the string.
 (c) constant and equal to g
 (d) variable but equal to g when the pulse is exactly at the middle of the string.
20. A wave is given by the equation $y = (0.02)\sin(\pi x - 8\pi t)$ then the velocity of the wave is (y and x are in metre and t is in second)

- (a) 16 ms^{-1} (b) 2 ms^{-1}
(c) 8 ms^{-1} (d) 18 ms^{-1}

21. An empty tank has concave mirror as its bottom. When sunlight falls normally on the mirror, it is focussed at a height of 32 cm from the mirror. If the tank is filled with water upto a height of 20 cm, then the sunlight focusses at (refractive index of water = $\frac{4}{3}$)

- (a) 16 cm above water level
(b) 9 cm above water level
(c) 16 cm below water level
(d) 9 cm below water level

22. When Young's double slit experiment is performed in air, the Y-coordinates of central maxima and 10th maxima are 2 cm and 5 cm, respectively. If the apparatus is immersed in a liquid of refractive index 1.5, the corresponding Y-coordinates will be

- (a) 2 cm, 7.5 cm (b) 3 cm, 6 cm
(c) 2 cm, 4 cm (d) $\frac{4}{3}$ cm, $\frac{10}{3}$ cm

23. A clock dial has point charges $-q, -2q, -3q, \dots$

$-12q$ at the positions of the corresponding numbers on the dial respectively. The time at which the hour's hand points the direction of the net electric field at the centre of the dial is

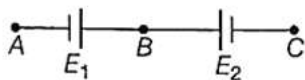
(Assume clock hands do not influence the net electric field)

- (a) 8:30 (b) 9:30
(c) 10:30 (d) 12:30

24. The electric potential at a place is varying as $V = \frac{1}{2}(y^2 - 4x)V$. Then, the electric field at $x = 1 \text{ m}$ and $y = 1 \text{ m}$ is

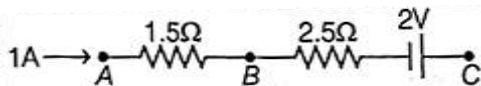
- (a) $(2\hat{i} + \hat{j})\text{Vm}^{-1}$ (b) $(-2\hat{i} + \hat{j})\text{Vm}^{-1}$
(c) $(2\hat{i} - \hat{j})\text{Vm}^{-1}$ (d) $(-2\hat{i} + 2\hat{j})\text{Vm}^{-1}$

25. When a potentiometer is connected between the points A and B as shown in the circuit, balance point is obtained at 64 cm. When it is connected between A and C, the balance point is 8 cm. If the potentiometer is connected between B and C the balance point will be



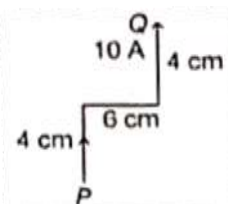
- (a) 8 cm (b) 56 cm
(c) 64 cm (d) 72 cm

26. In the given part of a circuit, the potential at point B is zero. Then, the potentials at A and C respectively, are



- (a) $-1.5 \text{ V}, +2 \text{ V}$ (b) $+1.5 \text{ V}, +2 \text{ V}$
(c) $+1.5 \text{ V}, +0.5 \text{ V}$ (d) $+1.5 \text{ V}, -0.5 \text{ V}$

27. A conducting wire PQ carries a current 10 A as shown in the figure. It is placed in a uniform magnetic field 5 T which is acting normally outside from the paper. Then, the net force experienced by it is



- (a) 0 (b) 5 N
(c) 30 N (d) 20 N

28. A long straight wire carries a current of 18 A . The magnitude of the magnetic field at a point 12 cm from it is
 (a) 1.5×10^{-5} T (b) 2×10^{-5} T
 (c) 3×10^{-5} T (d) 1.8×10^{-5} T
29. A bar magnet has coercivity $4 \times 10^3 \text{ Am}^{-1}$. It is placed inside a solenoid of 12 cm length and 60 turns. The current that should be passed through the solenoid to demagnetise, the bar magnet is
 (a) 2 A (b) 4 A (c) 6 A (d) 8 A
30. When a current i through a solenoid is increasing at a constant rate, then the induced current is
 (a) constant and it will be in the direction of i
 (b) constant and it will be in a direction opposite to the i
 (c) increased with time and it will be in the direction of i
 (d) increased with time and opposite to the direction of i
31. In a pair of adjacent coils, if the current in one coil changes from 10 A to 2 A in a time 0.2 s , an emf of 120 V is induced in another coil. The mutual inductance of the pair of the coils is
 (a) 2 H (b) 3 H
 (c) 6 H (d) 9 H
32. The power factor of an AC circuit containing peak current 2 A and peak voltage 1 V is $1/2$, then the angle between voltage and current is
 (a) 30° (b) 45° (c) 90° (d) 60°
33. If a plane electromagnetic wave has electric field oscillations of frequency 3 GHz , then the wavelength of the wave is (speed of light in vacuum = $3 \times 10^8 \text{ ms}^{-1}$)
 (a) 0.1 m (b) 0.2 m
 (c) 100 m (d) 0.003 m
34. The de-Broglie wavelength of an electron accelerated between two plates having a potential difference of 900 V is nearly
 (a) 0.015 nm (b) 0.01 nm
 (c) 0.02 nm (d) 0.04 nm
35. If an electron is moving in the 4 th orbit of the hydrogen atom, then the angular momentum of the electron in SI unit is
 (a) $\frac{h}{\pi}$ (b) $\frac{2h}{\pi}$ (c) $\frac{4h}{\pi}$ (d) $\frac{h}{2\pi}$
36. The energy equivalent to a mass of 1 kg is
 (a) 9×10^{13} J (b) 9×10^9 J
 (c) 9×10^{16} J (d) 9×10^6 J
37. If S is the surface area of a nucleus of mass number A , then
 (a) $S \propto A$ (b) $S \propto A^{1/3}$
 (c) $S \propto A^2$ (d) $S \propto A^{2/3}$
38. In a transistor, the base current is $10\mu\text{ A}$ and the emitter current is 1 mA , then the collector current is
 (a) $990\mu\text{ A}$ (b) $100\mu\text{ A}$
 (c) $1010\mu\text{ A}$ (d) $90\mu\text{ A}$
39. If the output of a NAND gate is given as input to a NOT gate, the resultant gate is
 (a) AND (b) OR
 (c) NOR (d) NOT
40. A message signal of frequency 10 kHz is used to modulate a carrier wave of frequency 6 MHz , then the side band frequencies are
 (a) 6090kHz, 610kHz (b) 5990kHz, 6010kHz
 (c) 6000 Hz, 1000 Hz (d) 6000kHz, 6100kHz

Chemistry

41. The radius of third orbit of hydrogen atom is R pm. The radius of second orbit of He^+ ion (in pm) is

- (a) $\frac{4}{3}R$ (b) $\frac{3}{4}R$
(c) $\frac{9}{2}R$ (d) $\frac{2}{9}R$

42. The threshold frequency of a metal is 10^{15} s^{-1} . The ratio of maximum kinetic energies of the photoelectrons, when the metal is made to strike with radiations of frequencies $1.5 \times 10^{15} \text{ s}^{-1}$ and $2.0 \times 10^{15} \text{ s}^{-1}$ respectively is

- (a) 2:1 (b) 1:2
(c) 4:3 (d) 3:4

43. Consider the following.

(I) The order of first ionisation enthalpy of first three elements of 3rd period is $\text{Mg} > \text{Al} > \text{Na}$.

(II) The element with electronegativity of 3.5 is chlorine.

(III) The order of sizes of ions Mg^{2+} , Na^+ , F^- and O^{2-} is $\text{Mg}^{2+} < \text{Na}^+ < \text{F}^- < \text{O}^{2-}$.

(IV) The IUPAC name of the element with atomic number 106 is bohrium.

The correct statements are

- (a) I and II only (b) II and III only
(c) I and III only (d) II and IV only

44. Match the following.

List – I

List – II

(Molecule/ion)

(Shape)

(A) SnCl_2

(I) Trigonal planar

(B) NH_3

(II) Linear

(C) I_3^-

(III) Angular

(D) SO_3

(IV) Trigonal Pyramidal

The correct answer is

- (a) A-III, B-I, C-II, D-IV
(b) A-IV, B-III, C-I, D-II
(c) A-III, B-I, C-IV, D-II
(d) A-III, B-IV, C-II, D-I

45. In which of the following set of molecules the hybridisation of central atoms is different?

- (a) H_2O , NH_3 , CH_4 (b) ClF_3 , XeF_2 , PCl_5
(c) CO_2 , CO , BeF_2 (d) SF_4 , XeF_4 , CH_4

46. At 300 K and 760 torr pressure, the density of a mixture of He and O_2 gases is 0.543 g L^{-1} . The mass percent of oxygen approximately is ($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

- (a) 33 (b) 80 (c) 20 (d) 67

47. The equivalent weight of which of the following is maximum? (Given : atomic weights $\text{Na} = 23$, $\text{Mn} = 55$, $\text{Cr} = 52$, $\text{K} = 39$, $\text{O} = 16$, $\text{C} = 12$)

- (a) $\text{Na}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ (b) KMnO_4/H^+
(c) $\text{KMnO}_4/\text{H}_2\text{O}$ (d) $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$

48. If 2.5 moles of an ideal gas at a certain temperature are allowed to expand isothermally and reversibly from an initial volume of 2 dm^3 to 20 dm^3 , the work done by the gas is -16.5 kJ . The temperature (in K) of the gas is (Round off to the nearest value) ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (a) 445 (b) 245 (c) 345 (d) 745

49. A solution is prepared by mixing 10 mL of 1.0 M acetic acid and 20 mL of 0.5 M sodium acetate and diluted to 100 mL. If the pK_a of acetic acid is 4.76, then the pH of the solution is

- (a) 4.76 (b) 3.76
(c) 5.76 (d) 9.24

50. Consider the following statements about the hydrides.

(I) Sodium hydride with water liberates oxygen gas.

(II) Methane, silane are examples of electron precise hydrides.

(III) Ammonia and water molecules are examples of electron deficient hydrides.

(IV) Hydrides of beryllium and magnesium are polymeric in structure.

The correct statements are

- (a) I and II only (b) III and IV only
(c) II and IV only (d) I and IV only

51. The nitrate of which of the following metals does not liberate NO_2 gas on heating?

- (a) Pb (b) Ba (c) Li (d) K

52. Match the following.

	List-I (Substance)		List-II (Use)
(A)	Na_2O_2	I.	Photoelectric cells
(B)	D_2O	II.	Antacid
(C)	Cs	III.	Oxidising agent
(D)	$\text{Mg}(\text{OH})_2$	IV.	Moderator

The correct answer is

- (a) A-III, B-IV, C-I, D-II (b) A-IV, B-III, C-II, D-I
(c) A-III, B-IV, C-II, D-I (d) A-II, B-IV, C-I, D-III

53. What are the correct statements about the elements of group 13 given below?

- (I) The stability of +1 oxidation state follows the order $\text{Tl} > \text{In} > \text{Ga}$.
(II) Boron has the lowest melting point and boiling point as it is a non-metal.
(III) Boron shows a maximum covalency of 4 in its compounds.
(IV) The order of atomic radius is $\text{Ga} > \text{Al} > \text{In}$.
(V) Aluminium is passive to concentrated nitric acid.

- (a) I, III and V only
(b) II, IV and V only
(c) I, II and IV only
(d) III, IV and V only

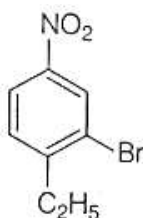
54. Assertion (A) Graphite is used as a dry lubricant in machines which run at high temperatures.

Reason (R) The layers of graphite slip one over the other when pressure is applied.

The correct option among the following is

- (a) (A) is true but (R) is false.
(b) (A) is false but (R) is true.
(c) (A) and (R) are true and (R) is the correct explanation of (A).
(d) (A) and (R) are true, but (R) is not the correct explanation of (A).

55. The correct IUPAC name of the compound given under is

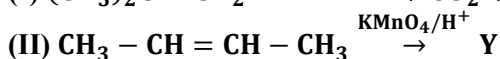
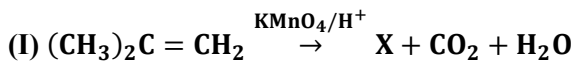


- (a) 4-ethyl-2-bromo-4-nitrobenzene
(b) 2-bromo-1-ethyl-4-nitrobenzene
(c) 3-bromo-4-ethyl-1-nitrobenzene
(d) 1-ethyl-2-bromo-4-nitrobenzene

56. In which of the following hyperconjugation is not possible?

- (a) (b)
- (c) (d) $\text{CH}_3 - \text{CH}_2 - \overset{\oplus}{\text{C}}\text{H}_2$

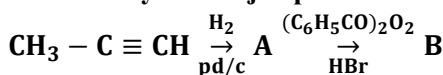
57.



The functional groups in X and Y are respectively.

- (a) (b)
- (c) (d)

58. Identify the major product B in the given sequence of reactions.



- (a) (b) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2\text{Br}$
- (c) (d) $\text{CH}_3 - \text{CH}_2 - \text{CHBr}_2$

59. At T (K), copper (atomic mass = 63.5u) has fcc structure with an edge length of xÅ. The density of copper (in gcm^{-3}) at that temperature approximately is ($N_A = 6.0 \times 10^{23} \text{ mol}^{-1}$)

- (a) $\frac{423}{x}$ (b) $\frac{4.23}{x^3}$
- (c) $\frac{423}{x^3}$ (d) $\frac{212.5}{x^3}$

60. The vapour pressure of a pure liquid A is 70 torr at 300 K . It forms an ideal solution with another liquid B. The mole fraction of B is 0.2 and total vapour pressure of the solution is 84 torr at the same temperature.

The vapour pressure of pure liquid B (in torr) is

- (a) 140 (b) 90 (c) 120 (d) 80

61. The electrode potential of chlorine electrode is maximum, when the concentration of chloride ion in the solution (in molL^{-1}) is X. What is the value of X ?

- (a) 2.5×10^{-3} (b) 7.5×10^{-3}
- (c) 7.5×10^{-2} (d) 2.5×10^{-2}

62. If benzene diazonium chloride undergoes first order decomposition at T(K) with a rate constant of $6.93 \times 10^{-2} \text{ min}^{-1}$, the time for completion of 90% of the reaction (in min) is (nearest integer) ($\log 2 = 0.30, \log 3 = 0.477$)

- (a) 15 (b) 30 (c) 33 (d) 43

63. Identify the factors which favour the physical adsorption from the following

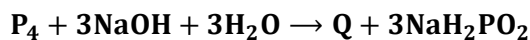
- (I) High surface area (II) Low temperatures
- (III) High temperatures (IV) Low pressures
- (V) High pressures

- (a) I, III and IV only (b) III and V only
- (c) III and V only (d) I, II and IV only

64. Sphalerite, siderite and malachite are the ores of metals X, Y and Z. The atomic numbers of them are respectively

- (a) 30,26,29 (b) 26,30,29
- (c) 30,29,26 (d) 29,30,26

65. Consider the reaction,



Identify the reaction in which Q is not the product. (equations are not balanced)

- (a) $Ca_3P_2 + H_2O \rightarrow$ (b) $H_3PO_3 \xrightarrow{\Delta}$
 (c) $PH_4I + KOH \rightarrow$ (d) $PCl_3 + H_2O \rightarrow$

66. The oxidation state of sulphur atoms and numbers of S – OH bonds in peroxydisulphuric acid are respectively

- (a) (+6, +5), 2 (b) (+6, +6), 4
 (c) (+6, +6), 2 (d) (+5, +5), 4

67. Identify the correct statements from the following.

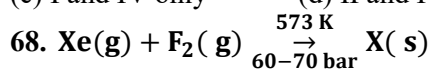
(I) Au is soluble in aqua regia but not Pt .

(II) Among the oxoacids of chlorine highest oxidation state possible for chlorine is +7 .

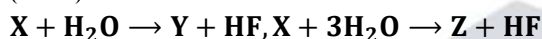
(III) Among the hydrogen halides lowest boiling point is for HCl .

(IV) The order of stability of oxides of halogens is $Cl > Br > I$.

- (a) I and II only (b) II and III only
 (c) I and IV only (d) II and IV only



(1:20)



The correct statements regarding Y and Z are

(I) Y has square pyramidal geometry.

(II) Y has linear geometry.

(III) Z has 3σ , 3π bonds and 1 lone pair of electrons on the central atom.

(IV) Z has tetrahedral geometry.

- (a) I and III only (b) II and III only
 (c) III and IV only (d) I and IV only

69. The number f-electrons in +3 oxidation state of gadolinium ($Z = 64$) is x and in +2 oxidation state of ytterbium ($Z = 70$) is y. The sum of x and y is

- (a) 13 (b) 20 (c) 18 (d) 21

70. Match the following.

List – I

(Complex)

List – II

(Electronic configuration of)

- (A) $[Co(NH_3)_6]^{3+}$ (I) $t_{2g}^5 e_g^0$
 (B) $[CoF_6]^{3-}$ (II) $t_{2g}^6 e_g^0$
 (C) $[Ni(CO)_4]$ (III) $t_{2g}^4 e_g^2$
 (D) $[Fe(CN)_6]^{3-}$ (III) $t_{2g}^4 e_g^6$

The correct answer is

- (a) A-II, B-III, C-IV, D-I
 (b) A-III, B-IV, C-II, D-I
 (c) A-IV, B-III, C-I, D – II
 (d) A-II, B-I, C-IV, D-III

71. Amongst the following, how many of them come under the category of elastomers? Natural rubber, polyethene, vulcanized rubber, bakelite, polyvinylchloride, buna-N, nylon-6, neoprene

- (a) 4 (b) 5 (c) 3 (d) 6

72. Which of the following is the incorrect statement about maltose?

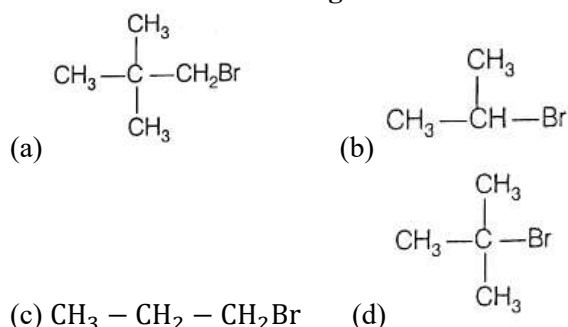
- (a) It is a reducing sugar.
 (b) It is composed of two α -D-glucose units.
 (c) It is composed of one β -D-glucose and one β -D-galactose unit.
 (d) It has 1,4-glycosidic linkage.

73. Which of the following is not correctly matched?

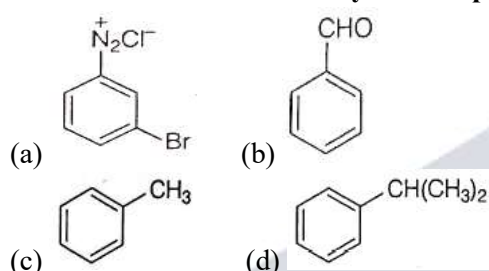
- (a) Butylated hydroxy toluene - antioxidant in food

- (b) Chloramphenicol - antiseptic
(c) Norethindrone - antifertility drug
(d) Alitame-artificial sweetner

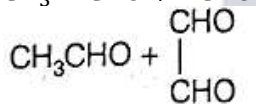
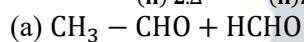
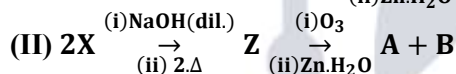
74. Which of the following is least reactive towards S_N^2 reaction?



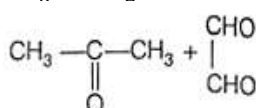
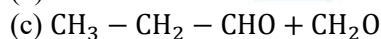
75. Phenol is mainly manufactured from a compound X by subjecting it to oxidation in air followed by treating with dilute acid. Identify the compound X.



76. Identify A and B from the following reactions,

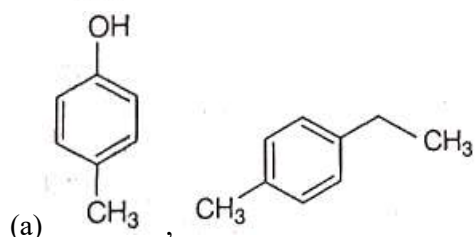
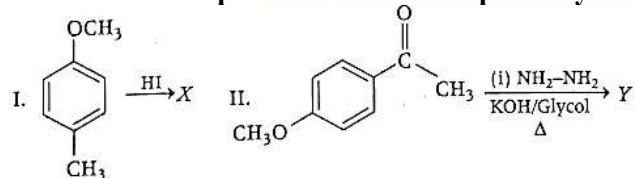


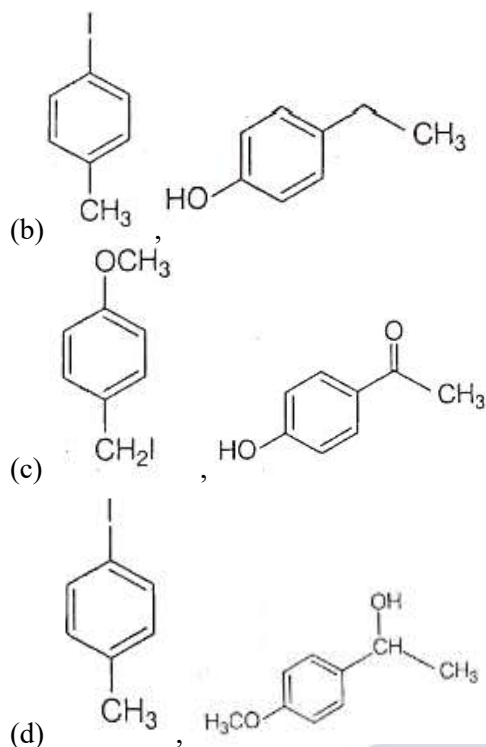
(b)



(d)

77. What are the products X and Y respectively in the reactions I and II?





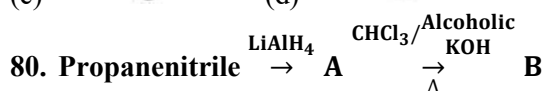
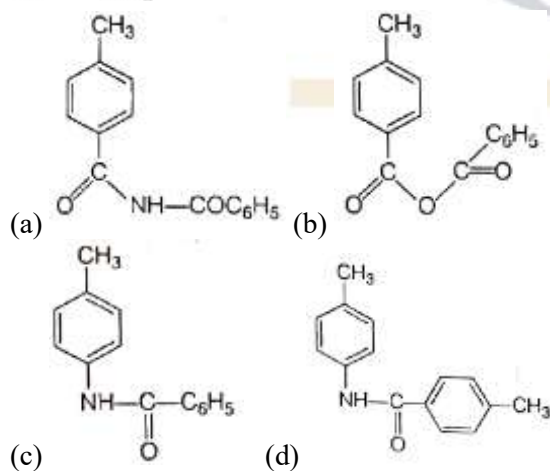
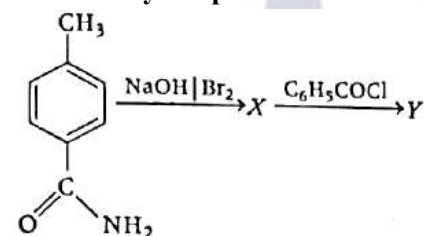
78. Consider the following reaction sequence

The correct statements about Z are

- (I) It gives yellow precipitate with I_2 and NaOH solution.
- (II) It undergoes disproportionation reaction in the presence of concentrated NaOH solution.
- (III) It undergoes Wolff-Kishner reduction.
- (IV) It forms red precipitate with Fehling's reagent.

- (a) I and II only (b) II and III only
(c) I and IV only (d) I and III only

79. Identify the product 'Y' in the following sequence of reactions.



Conversion of A to B is an example of the reaction

- (a) Reimer-Tiemann reaction
- (b) Carbylamine reaction
- (c) Stephen reaction
- (d) Sandmeyer reaction

Mathematics

81. The range of the function $f(x) = \log_{0.5}(x^4 - 2x^2 + 3)$ is

- (a) $(-\infty, \infty)$ (b) $(-\infty, -1]$
- (c) $[-1, \infty)$ (d) $[-1, 1]$

82. If P is a non-singular matrix such that $I + P + P^2 + \dots + P^n = 0$ (0 denotes the null matrix), then $P^{-1} =$

- (a) P^n
- (b) $-P^n$
- (c) $-(1 + P + \dots + P^n)$
- (d) $-(1 + P + \dots + P^{n-1})$

83. If z_1 and z_2 are complex numbers such that $|z_1 + z_2| = |z_1| + |z_2|$, then the difference in the amplitude of z_1 and z_2 is

- (a) $\frac{\pi}{4}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{2}$ (d) 0

84. If $i = \sqrt{-1}$, then $1 + i^2 + i^4 + i^6 + \dots + i^{2024} =$

- (a) i (b) -i (c) 1 (d) -1

85. If one root of the equation $4x^2 - 2x + k - 4 = 0$ is the reciprocal of the other, then the value of k is

- (a) -8 (b) 8 (c) -4 (d) 4

86. If the expression $x^3 + 3x^2 - 9x + \lambda$ is of the form $(x - \alpha)^2(x - \beta)$, then the values of λ are

- (a) 27, -5 (b) -27, -5
- (c) 27, 5 (d) -27, 5

87. The number of ways of arranging all the letters of the word "SUNITHA" so that the vowels always occupy the first, middle and last places is

- (a) 5040 (b) 24
- (c) 3 (d) 144

88. If the term independent of x in the expansion of $(\sqrt{x} - \frac{k}{x^2})^{10}$ is 405, then k =

- (a) ± 1 (b) 0 (c) ± 3 (d) ± 5

89. If $\frac{x^4}{(x-1)(x-2)(x-3)} = p(x) + \frac{A}{x-1} + \frac{B}{x-2} + \frac{C}{x-3}$, then $p\left(\frac{3}{2}\right) + C =$

- (a) 0 (b) 8
- (c) $-17/2$ (d) 48

90. For $0 \leq x \leq \pi$, if $81^{\sin^2 x} + 81^{\cos^2 x} = 30$, then x =

- (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{15}$ (d) $\frac{\pi}{8}$

91. If $\sinh(\log x) = -2$, then x =

- (a) $\sqrt{5} - 2$ (b) $2 + \sqrt{5}$
- (c) $-(2 + \sqrt{5})$ (d) $2 - \sqrt{5}$

92. In an isosceles right-angled triangle, a straight line is drawn from the mid-point of one of the equal sides to the opposite vertex. Then, a pair of possible values of the cotangents of the two angles so formed at that vertex are

- (a) 1 and 2 (b) 2 and 3
- (c) 3 and 4 (d) 4 and 5

93. If the position vectors of P and Q are $\hat{i} + 2\hat{j} - 7\hat{k}$ and $5\hat{i} - 3\hat{j} + 4\hat{k}$ respectively, then the cosine of the angle between PQ and Z-axis is

- (a) $\frac{4}{\sqrt{162}}$ (b) $\frac{11}{\sqrt{162}}$
 (c) $\frac{5}{\sqrt{162}}$ (d) $\frac{-5}{\sqrt{162}}$

94. $\mathbf{a}, \mathbf{b}, \mathbf{c}$ are three-unit vectors such that $|\mathbf{a} + \mathbf{b} + \mathbf{c}| = 1$ and $\mathbf{a}$ is perpendicular to $\mathbf{b}$. If $\mathbf{c}$ makes angles α, β with $\mathbf{a}, \mathbf{b}$ respectively, then $\cos \alpha + \cos \beta =$
 (a) 1 (b) -1 (c) 2 (d) -2
95. Two numbers $\mathbf{b}$ and $\mathbf{c}$ are chosen at random in succession without replacement from the set $\{1, 2, 3, \dots, 9\}$. Then, the probability that $x^2 + bx + c > 0, \forall x \in \mathbf{R}$ is
 (a) $\frac{29}{72}$ (b) $\frac{32}{81}$ (c) $\frac{45}{143}$ (d) $\frac{82}{125}$
96. A student is given 6 questions in an examination with true or false type of answers. If he writes 4 or more correct answers, he passes in the examination. The probability that he passes in the examination is
 (a) $\frac{5}{32}$ (b) $\frac{7}{32}$ (c) $\frac{11}{32}$ (d) $\frac{3}{32}$
97. If $P(X = x) = c \left(\frac{2}{3}\right)^x; x = 1, 2, 3, 4, \dots$ is a probability distribution function of a random variable X , then the value of c is
 (a) $\frac{1}{4}$ (b) $\frac{1}{3}$ (c) $\frac{1}{2}$ (d) $\frac{1}{6}$
98. If t is a parameter, $A = (a \sec t, b \tan t)$, $B = (-a \tan t, b \sec t)$ and $O = (0, 0)$, then the locus of the centroid of $\triangle OAB$ is
 (a) $9xy = ab$
 (b) $xy = 9ab$
 (c) $x^2 - 9y^2 = a^2 - b^2$
 (d) $x^2 - y^2 = \frac{1}{9}(a^2 - b^2)$
99. The angle by which the coordinate axes are to be rotated about the origin so that the transformed equation of $\sqrt{3}x^2 + (\sqrt{3} - 1)xy - y^2 = 0$ would be free from xy -term is
 (a) 45° (b) 22.5°
 (c) 15° (d) 7.5°
100. If the slope of a straight line passing through $A(3, 2)$ is $3/4$, then the coordinates of the two points on the same line that are 5 units away from A are
 (a) $(-7, 5), (1, -1)$
 (b) $(7, 5), (-1, -1)$
 (c) $(6, 9), (-2, 3)$
 (d) $(6, 3), (-2, -3)$
101. The range of a so that $a^2x^2 + 2xy + 4y^2 = 0$ represents two distinct lines is
 (a) $a > \frac{1}{2}$ or $a < \frac{-1}{2}$ (b) $\frac{-1}{2} \leq a \leq \frac{1}{2}$
 (c) $\frac{-1}{2} < a < \frac{1}{2}$ (d) $a \geq \frac{1}{2}$ or $a \leq \frac{-1}{2}$
102. If a diameter of the circle $x^2 + y^2 - 4x + 6y - 12 = 0$ is a chord of a circle S whose centre is at $(-3, 2)$, then the radius of S is
 (a) $5\sqrt{3}$ (b) $4\sqrt{3}$
 (c) $2\sqrt{3}$ (d) 5
103. If a circle passing through $A(1, 1)$ touches the X -axis, then the locus of the other end of the diameter through A is
 (a) $(x + 1)^2 = 4y$ (b) $(y - 1)^2 = 4x$
 (c) $(x - 1)^2 = 4y$ (d) $(y + 1)^2 = 4x$
104. If two circles $x^2 + y^2 - 6x - 6y + 13 = 0$ and $x^2 + y^2 - 8y + 9 = 0$ intersect at A and B , then the focus of the parabola whose directrix is the line AB and vertex is the point $S(a, b)$ is

- (a) $\left(\frac{3}{5}, \frac{1}{5}\right)$ (b) $\left(-\frac{3}{5}, \frac{1}{5}\right)$
 (c) $\left(-\frac{3}{5}, -\frac{1}{5}\right)$ (d) $\left(\frac{3}{5}, -\frac{1}{5}\right)$

105. A particle is travelling in clockwise direction on the ellipse $\frac{x^2}{100} + \frac{y^2}{25} = 1$. If the particle leaves the ellipse at the point $(-8, 3)$ on it and travels along the tangent to the ellipse at that point, then the point where the particle crosses the Y-axis is

- (a) $\left(0, \frac{7}{3}\right)$ (b) $\left(0, \frac{25}{3}\right)$
 (c) $(0, 9)$ (d) $\left(0, -\frac{25}{3}\right)$

106. If the equation of a hyperbola is $9x^2 - 16y^2 + 72x - 32y - 16 = 0$, then the equation of its conjugate hyperbola is

- (a) $9x^2 - 16y^2 + 72x - 32y + 272 = 0$
 (b) $9x^2 - 16y^2 + 72x - 32y + 288 = 0$
 (c) $9x^2 - 16y^2 + 72x - 32y - 38 = 0$
 (d) $9x^2 - 16y^2 + 72x - 32y + 16 = 0$

107. If the direction cosines (l, m, n) of two lines are connected by the relations $l + m + n = 0$ and $lm = 0$, then the angle between those lines is

- (a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) $\frac{\pi}{6}$

108. The sum of the squares of the perpendicular distances of a point (x, y, z) from the coordinate axes is k times the square of the distance of the point from the origin. Then, $k =$

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

109. Equation of the plane through the mid-point of the line segment joining the points $A(4, 5, -10)$ and $B(-1, 2, 1)$ and perpendicular to AB is

- (a) $10x + 6y - 22z + 135 = 0$
 (b) $10x + 6y - 22z - 135 = 0$
 (c) $5x + 3y + 11z = 135$
 (d) $10x + 6y - 22z + 185 = 0$

110. $\lim_{x \rightarrow 1} \frac{(2x-3)(\sqrt{x}-1)}{2x^2+x-3} =$

- (a) $\frac{1}{10}$ (b) $-\frac{1}{10}$
 (c) $\frac{2}{5}$ (d) $-\frac{2}{5}$

111. If $\mathbf{a}$ is a vector such that $\mathbf{a} \times \hat{\mathbf{i}} = \hat{\mathbf{j}} + \hat{\mathbf{k}}$ and $\mathbf{a} \cdot \hat{\mathbf{i}} = 1$, then equation of the line passing through the point $\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}$ and parallel to $\mathbf{a}$ is

- (a) $\mathbf{r} = (t+1)\hat{\mathbf{i}} + (1-t)\hat{\mathbf{j}} + (t+1)\hat{\mathbf{k}}$
 (b) $\mathbf{r} = (t+1)\hat{\mathbf{i}} - (2t-1)\hat{\mathbf{j}} + t\hat{\mathbf{k}}$
 (c) $\mathbf{r} = \hat{\mathbf{i}} + t\hat{\mathbf{j}} - t\hat{\mathbf{k}}$
 (d) $\mathbf{r} = 5t\hat{\mathbf{i}} + 7t\hat{\mathbf{j}} + \hat{\mathbf{k}}$

112. The equation of the normal at $t = \frac{\pi}{2}$ to the curve $x = 2\sin t, y = 2\cos t$ is

- (a) $x = 2$ (b) $y = 0$
 (c) $y = 2x + 3$ (d) $y = 3$

113. $\int \frac{\sin^8 x - \cos^8 x}{1 - 2\sin^2 x \cos^2 x} dx =$

- (a) $\frac{1}{2} \cos 2x + C$ (b) $\frac{-1}{2} \cos 2x + C$
 (c) $\frac{-1}{(1+\tan x)^2} + C$ (d) $\frac{-1}{2} \sin 2x + C$

114. $\int_{1/2}^2 |\log_{10} x| dx =$

- (a) $\log_{10} \left(\frac{8}{e} \right)$ (b) $\frac{1}{2} \log_{10} \left(\frac{8}{e} \right)$
 (c) $\log_{10} \left(\frac{2}{e} \right)$ (d) $\log_e \left(\frac{3}{e} \right)$

115. Two tangents are drawn from the point $(-1, -2)$ to the parabola $y^2 = 4x$. If θ is the angle between these tangents, then $\tan \theta =$

- (a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{6}$

116. If $f: [2, \infty) \rightarrow \mathbb{R}$ is defined by $f(x) = x^2 - 4x + 5$, then the range of f is

- (a) $\mathbb{R}$ (b) $[1, \infty)$
 (c) $[4, \infty)$ (d) $[5, \infty)$

117. If $A = \begin{bmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{bmatrix}$ and $\det(A^2) = 25$, then $|\alpha| =$

- (a) 5 (b) 5^2 (c) 1 (d) $\frac{1}{5}$

118. If $\frac{1+i\cos\theta}{1-2i\cos\theta}$ is purely real, then $\cos^3\theta + \sin^2\theta + \cos\theta + 1 =$

- (a) 0 (b) 1
 (c) 2 (d) $\frac{3}{4}(2 + \sqrt{2})$

119. If $\theta = \frac{\pi}{6}$, then the 10th term of the series $1 + (\cos\theta + i\sin\theta)^1 + (\cos\theta + i\sin\theta)^2 + \dots$ is

- (a) -1 (b) -1
 (c) $\frac{1}{2} + \frac{\sqrt{3}i}{2}$ (d) 1

120. If $(x - 2)$ is a common factor of the expressions $x^2 + ax + b$ and $x^2 + cx + d$, then $\frac{b-d}{c-a} =$

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

121. The roots of the equation $x^3 - 14x^2 + 56x - 64 = 0$ are in

- (a) arithmetic-geometric progression
 (b) harmonic progression
 (c) arithmetic progression
 (d) geometric progression

122. The number of all four digit numbers that can be formed with the digits 0, 1, 2, 3, 4, 5 when the repetition of the digits is not allowed, is

- (a) 360 (b) 600
 (c) 240 (d) 300

123. The number of rational terms in the binomial expansion $(\sqrt[4]{5} + \sqrt[5]{4})^{100}$ is

- (a) 10 (b) 20 (c) 6 (d) 5

124. $\frac{(1+\tan 13)(1+\tan 32)}{(1+\tan 12)(1+\tan 33)} =$

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

125. In a $\triangle ABC$, if $r_1 = 2r_2 = 3r_3$, then $\frac{a}{b} + \frac{b}{c} + \frac{c}{a} =$

- (a) $\frac{75}{60}$ (b) $\frac{155}{60}$
 (c) $\frac{176}{60}$ (d) $\frac{191}{60}$

126. The position vectors of the point A, B are a, b respectively. If the position vector of the point C is $\frac{a}{2} + \frac{b}{3}$, then

- (a) C lies inside $\triangle OAB$
 (b) C lies outside $\triangle OAB$ but inside $\angle AOB$
 (c) C lies outside $\triangle OAB$ but inside $\angle OAB$
 (d) C lies outside $\triangle OAB$ but inside $\angle OBA$

127. If $|a| = 1$, $|b| = 2$, $|a - b|^2 + |a + 2b|^2 = 20$, then $(a, b) =$

- (a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{6}$ (d) $\frac{2\pi}{3}$

128. In a non-leap year, the probability of getting 53 Sundays or 53 Tuesdays or 53 Thursdays is

- (a) $\frac{1}{7}$ (b) $\frac{2}{7}$ (c) $\frac{3}{7}$ (d) $\frac{4}{7}$

129. If each of the points $(a, 4)$, $(-2, b)$ lies on the line joining the points $(2, -1)$ and $(5, -3)$, then the point (a, b) lies on the line

- (a) $6x + 6y - 25 = 0$
(b) $x + 3y + 1 = 0$
(c) $2x + 6y + 1 = 0$
(d) $2x + 3y - 5 = 0$

130. If $C(\alpha, \beta)$ ($\alpha < 0$) is the centre of the circle that touches the Y-axis at $(0, 3)$ and makes an intercept of length 2 units on positive X-axis, then $(\alpha, \beta) =$

- (a) $(-3, \sqrt{10})$ (b) $(-3, -\sqrt{10})$
(c) $(-\sqrt{10}, 3)$ (d) $(-\sqrt{10}, -3)$

131. The equations of the tangents to the circle $x^2 + y^2 = 4$ drawn from the point $(4, 0)$ are

- (a) $\sqrt{3}y = \pm(x - 4)$
(b) $\sqrt{3}y = \pm 2(x - 4)$
(c) $\sqrt{3}x = \pm(y - 4)$
(d) $\sqrt{3}x = \pm 2(y - 4)$

132. The equation of parabola whose focus is $(1, 0)$ and directrix is $x + 2y - 1 = 0$ is

- (a) $4x^2 - 4xy + y^2 - 8x + 4y + 4 = 0$
(b) $4x^2 + 4xy + y^2 - 8x + 4y + 4 = 0$
(c) $4x^2 + 4xy + y^2 + 8x - 4y + 4 = 0$
(d) $4x^2 - 4xy + y^2 - 8x - 4y + 4 = 0$

133. If an ellipse with foci at $(3, 3)$ and $(-4, 4)$ is passing through the origin, then the eccentricity of that ellipse

- (a) $\frac{5}{7}$ (b) $\frac{3}{7}$ (c) $\frac{1}{7}$ (d) $\frac{4}{7}$

134. If a, b, c and k are non-zero real numbers and $\lim_{x \rightarrow \infty} x(a^{1/x} + b^{1/x} + c^{1/x} - 3k^{1/x}) = 0$, then $k =$

- (a) 0 (b) $(abc)^{1/3}$
(c) $(abc)^{-1/3}$ (d) 1

135. If $\tan y = \cot\left(\frac{\pi}{4} - x\right)$ then $\frac{dy}{dx} =$

- (a) $\frac{\operatorname{cosec}^2\left(\frac{\pi}{4} - x\right)}{1 + \cot^2\left(\frac{\pi}{4} + x\right)}$ (b) $\frac{-\operatorname{cosec}^2\left(\frac{\pi}{4} - x\right)}{\sec^2 y}$
(c) $\frac{\operatorname{cosec}^2\left(\frac{\pi}{4} - x\right)}{1 + \tan^2\left(\frac{\pi}{4} + x\right)}$ (d) $\frac{\sec^2\left(\frac{\pi}{4} + x\right)}{1 + \tan^2\left(\frac{\pi}{4} + x\right)}$

136. If $x = 3\sqrt{2}\cos^3 \theta$ and $y = 4\tan^2 \theta$, then $\left(\frac{dy}{dx}\right)_{\theta=\pi/4} =$

- (a) $\frac{32\sqrt{2}}{9}$ (b) $\frac{16}{9}$
(c) $-\frac{16}{9}$ (d) $-\frac{32}{9}$

137. If $\int \frac{x^2(\sec^2 x + \tan x)}{(x \tan x + 1)^2} dx = \frac{-x^2}{x \tan x + 1} + f(x) + C$, then $f(x) =$

- (a) $\log |x \sin x + \cos x| + C$
(b) $\log |x \cos x + \sin x| + C$
(c) $2 \log |x \sin x + \cos x| + C$
(d) $2 \log |x \cos x + \sin x| + C$

138. $\int_0^{\pi/2} \frac{\sin^2 x}{\sin x + \cos x} dx =$

- (a) $\sqrt{2} \log(\sqrt{2} + 1)$ (b) $\frac{1}{\sqrt{2}} \log(\sqrt{2} + 1)$
 (c) $\log(\sqrt{2} + 1)$ (d) $\frac{1}{\sqrt{2}} \log(\sqrt{2} - 1)$

139. If m and n are respectively the order and degree of the differential equation of the family of parabolas with origin as its focus and X -axis as its axis, then $mn - m + n =$

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

140. If $f(x) = -|x|$, then $(f \circ f \circ f)(x) + (f \circ f \circ f)(-x) =$

- (a) $-2f(x)$ (b) $|f(x)|$
 (c) $2f(x)$ (d) $-|f(x)|$

141. P is a 3×3 square matrix and $\text{Tr}(P) \neq 0$. If $\text{Tr}(P - P^T) + \text{Tr}(P + P^T) + \frac{\text{Tr}(P)}{\text{Tr}(P^T)} + \text{Tr}(P) \times \text{Tr}(P^T) = 0$, then $\text{Tr}(P) =$

- (a) 0 (b) -1 (c) 4 (d) 3

142. If α and β are non-zero integers and $z = (\alpha + i\beta)(2 + 7i)$ is a purely imaginary number, then minimum value of $|z|^2$ is

- (a) 0 (b) 2809
 (c) 2808 (d) 1

143. The sum of the roots of the equation $e^{4t} - 10e^{3t} + 29e^{2t} - 20e^t + 4 = 0$ is

- (a) $\log_8 10$ (b) $2 \log_e 2$
 (c) $\log_e 2$ (d) $2 \log_e 10$

144. The number of four digit numbers that can be formed using the digits 1, 2, 3, 4, 5, 6 and 7 which are divisible by 4, when the repetition of any digit is not allowed, is

- (a) 100 (b) 200
 (c) 300 (d) 400

145. The coefficient of x^{50} in the expansion of $(1 + x)^{101}(1 - x + x^2)^{100}$ is

- (a) 0 (b) -1 (c) 50 (d) 100

146. $\sin \alpha + \cos \alpha = m \Rightarrow \sin^6 \alpha + \cos^6 \alpha =$

- (a) $\frac{4+3(m^2-1)^2}{4}$ (b) $\frac{4-3(m^2-1)^2}{4}$
 (c) $\frac{3+4(m^2-1)^2}{4}$ (d) $\frac{4-3(m^2+1)^2}{4}$

147. If $\int \sin(101x)(\sin x)^{99} dx = \frac{\sin(100x)(\sin x)^\lambda}{\mu} + C$ then, $\frac{\lambda}{\mu} =$

- (a) 1 (b) 2 (c) 4 (d) 8

148. If A and B are two events in a random experiment such that $P(A) + P(B) = 2P(A \cap B)$, then

- (a) $P(A) + P(B) = 1$
 (b) $P(A) = P(B)$
 (c) $P(A) + P(B) > 1$
 (d) $P(A) = 0, P(B) = 1$

149. The image of every point lying on the curve $x^2 + y^2 = 1$ in the line $x + y = 1$ satisfies the equation

- (a) $x^2 + y^2 + 2x + 2y + 1 = 0$
 (b) $x^2 + y^2 - 2x + 2y + 1 = 0$
 (c) $x^2 + y^2 + 2x - 2y + 1 = 0$
 (d) $x^2 + y^2 - 2x - 2y + 1 = 0$

150. If the inverse of $P(-3, 5)$ with respect to a circle is $(1, 3)$, then polar of P with respect to that circle is

- (a) $x + 2y = 7$ (b) $2x - 2y + 4 = 0$
 (c) $2x - y + 1 = 0$ (d) $2x + y - 5 = 0$

151. The derivative of $\frac{1-x^2}{1+x^2}$ with respect to $\frac{2x}{1+x^2}$ at $x = 2$ is
 (a) 0 (b) $\frac{4}{3}$ (c) 1 (d) $-\frac{4}{3}$
152. If the function $f(x) = \frac{x}{5} + \frac{5}{x}$, ($x \neq 0$) attains its relative maximum value at $x = \alpha$, then $\sqrt{\alpha^2 + 2\alpha - 6} =$
 (a) 10 (b) 6 (c) 5 (d) 3
153. If $\int e^x (\sin^2 2x - 8\cos 4x) dx = e^x f(x) + C$, then $f\left(\frac{\pi}{4}\right) =$
 (a) 0 (b) 1 (c) -1 (d) e
154. $[.]$ is the greatest integer function, then $\int_0^{2\pi} [|\sin x| + |\cos x|] dx =$
 (a) $\frac{\pi}{2}$ (b) π (c) $\frac{3\pi}{2}$ (d) 2π
155. The general solution of $\frac{dy}{dx} + yf'(x) - f(x)f(x) = 0$, $y \neq f(x)$ is
 (a) $y = f(x) + 1 + ce^{-f(x)}$
 (b) $y = ce^{-f(x)}$
 (c) $y = f(x) - 1 + ce^{-f(x)}$
 (d) $y = f(x) + ce^{f(x)}$
156. If the system of equations $x + ky + 3z = -2$, $4x + 3y + kz = 14$, $2x + y + 2z = 3$ can be solved by matrix inversion method, then
 (a) $k \neq 0$ and $\frac{9}{2}$ (b) $k = 0$ or $\frac{9}{2}$
 (c) $k \neq \frac{1}{2}$ and 2 (d) $k = \frac{1}{2}$ or 2
157. If the slope of the tangent drawn to the curve $y = e^{a+bx^2}$ at the point $P(1, 1)$ is -2, then the value of $2a - 3b$ is
 (a) 5 (b) 6 (c) 7 (d) 8
158. If the tangent drawn at the point P on the circle $x^2 + y^2 + 6x + 6y = 2$ meets the straight line $5x - 2y + 6 = 0$ at a point Q on the Y -axis, then the length of PQ is
 (a) 5 (b) 4 (c) 2 (d) 1
159. If n is a positive integer greater than 1 and $I_n = \int \frac{\sin nx}{\sin x} dx$, then $I_{n+1} - I_{n-1} =$
 (a) $\frac{2}{n-1} \cos(n-1)x$
 (b) $\frac{2}{n-1} \sin(n-1)x$
 (c) $\frac{2}{n} \cos nx$
 (d) $\frac{2}{n} \sin nx$
160. If f is defined on R such that $f(x)f(-x) = 9$, then $\int_{-23}^{23} \frac{dx}{3+f(x)} =$
 (a) $\frac{51}{3}$ (b) $\frac{49}{3}$ (c) $\frac{46}{3}$ (d) $\frac{46}{6}$