Physics

1. Which of the following statement is incorrect?

(a) Conservation laws have deep connection with symmetries of nature.
(b) Weak nuclear force is weakest among all fundamental forces of nature.
(c) A conservation law is hypothesis based on observations and experiments.
(d) In a nuclear process mass gets converted to energy or vice-versa.

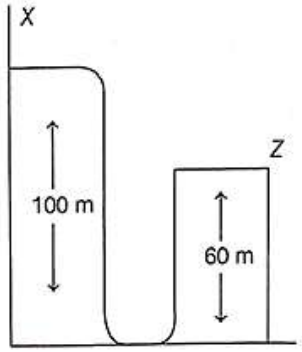
2. The dimensions of σb^4, where σ is Stefan's constant and b is Wien's constant are

(a) $[M^0L^0T^0]$ (b) $[ML^4\ T^{-3}]$
(c) $[ML^{-2}]$ (d) $[ML^6\ T^{-3}]$

3. A car travels in a straight line along a road. Its distance x from a stop sign is given as a function of t by the equation $x(t) = \alpha t + \beta t^3$, where $\alpha = 2.0\ m/s$, $\beta = 0.01\ m/s^3$. Calculate the average velocity of the car in the time interval $t = 2.00\ s$ to 4.00 s .

(a) 2.28 m/s (b) 4.94 m/s
(c) 3.34 m/s (d) 4.12 m/s

4. A car driver is trying to jump across a path as shown in figure by driving horizontally off a cliff X at the speed 10 m/s. When he touches peak Z (ignore air resistance). What would be speed? (Use, $g = 10\ m/s^2$)



(a) 30 m/s (b) 40 m/s
(c) 15 m/s (d) 50 m/s

5. Find the angle between the two vectors $a = 3\hat{i} + 2\hat{j} + 5\hat{k}$, $b = 5\hat{i} + 3\hat{j} + \hat{k}$.

(a) $\cos^{-1}\left(\frac{26}{\sqrt{1330}}\right)$ (b) $\sin^{-1}\left(\frac{26}{\sqrt{1330}}\right)$
(c) $\cos^{-1}\left(\frac{26}{\sqrt{1335}}\right)$ (d) $\tan^{-1}\left(\frac{26}{\sqrt{1330}}\right)$

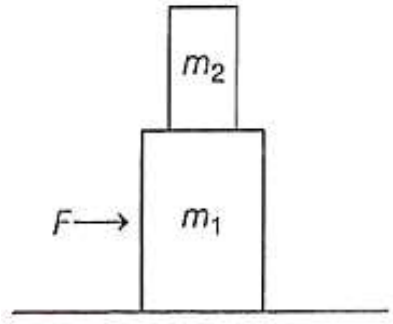
6. A particle moves over an xy-plane with a constant acceleration $a = (4\hat{i} + 4\hat{j})m/s^2$. At time $t = 0$, the velocity is $(4\hat{i})m/s^2$. The speed of the particle when it is displaced by 6.0 m parallel to the X-axis is

(a) $4\sqrt{5}$ m/s (b) $\sqrt{60}$ m/s
(c) $3\sqrt{10}$ m/s (d) $\sqrt{20}$ m/s

7. Block A of mass 3 kg rests on another block B of mass 7 kg . The coefficient of friction between A and B is 0.4, while the coefficient of friction between B and the horizontal floor on which B rests is 0.55. Find the force of friction between A and B, when a horizontal force of 50 N is applied on the block B. (Use $g = 10\ m/s^2$)

(a) 0 (b) 5 N
(c) 4 N (d) 12 N

8.



What is the maximum force F that can be applied on block m_1, so that both m_1 and m_2 will move together? There is no friction between m_1 and the horizontal table. The coefficient of friction between m_1 and m_2 is μ

(a) $\mu m_2 g$ (b) $\mu(m_1 + m_2)g$

(c) $\mu \frac{m_1 m_2}{(m_1+m_2)} g$ (d) $\mu m_1 g$

9. The potential energy of a particle in a central field has the form $U(r) = \frac{1}{r^2} - \frac{1}{r}$, where r is the distance from the centre of the field. The magnitude of the maximum attractive force (in N) is

(a) $\frac{1}{27}$ (b) $\frac{1}{9}$ (c) $\frac{1}{3}$ (d) 1

10. Consider a rocket is being fired. The kinetic energy of the rocket is increased by 16 times whereas its total mass is reduced by half through the burning of fuel. The factor by which its momentum increases is

(a) 8 (b) $2\sqrt{2}$

(c) 4 (d) $4\sqrt{2}$

11. A rigid body of mass m and radius R rolls without slipping on an inclined plane of inclination θ, under gravity. Match the type of body in Column I with magnitude of the force of friction Column II.

Column I	Column II
(A) For ring	(1) $\frac{mg\sin\theta}{2.5}$
(B) For solid sphere	(2) $\frac{mg\sin\theta}{3}$
(C) For solid cylinder	(3) $\frac{mg\sin\theta}{3.5}$
(D) For hollow cylinder	(4) $\frac{mg\sin\theta}{2}$

Codes

	A	B	C	D
(a)	4	3	2	4
(b)	1	2	4	4
(c)	2	1	4	3
(d)	2	4	1	3

12. A small disc of mass 500 g and radius 5 cm rolls down an inclined plane without slipping. Speed of its centre of mass when it reaches the bottom of the inclined plane depends on

(a) mass and radius
(b) mass and height of the incline
(c) height of the incline
(d) height of the incline and acceleration due to gravity

13. A body of mass 1 kg is executing simple harmonic motion (SHM). Its displacement y (in cm) at time t given by $y = \left[6\sin\left(100t + \frac{\pi}{4}\right)\right]$ cm. Its maximum kinetic energy is

(a) 1.8 J (b) 18 J

(c) 180 J (d) 0.18 J

14. What is the change in mass of a body, when taken 64 km below the surface of the earth? [Take, radius of the earth as 6400 km]

(a) Increases by 2% (b) Remains constant

(c) Increase by 1% (d) Decreases by 1%

15. Consider a rod of length 1.0 m with a cross-sectional area of $0.50\ cm^2$. The rod supports a 500 kg platform that hangs attached to the rod's lower end. What is elongation of the rod under the stress ignoring the weight of the rod? Consider the Young's modulus to be 10^{11} Pa and $g = 10\ m/s^2$.

(a) 2 mm (b) 0.5 mm

(c) 1.5 mm (d) 1 mm

16. Water is pumped steadly out of a flooded basement, at the speed of $10\ m/s$ through a hose (tube) of radius 1 cm, passing through a window 3 m above the water level. The power of the pump is (Assume $g = 10\ m/s^2$, density of water $= 1000\ kg/m^3$)

(a) 80π W (b) 30π W
(c) 50π W (d) 90π W

17. A U-shaped tube is partially filled with an incompressible liquid of density $1.2\ g/cm^3$. Oil which does not mix with the liquid is next poured into left side of the U-tube until the liquid rises by 15 cm on the right side of U-tube. If the density of the oil is $0.9\ g/cm^3$, the oil level will stand higher than the liquid level of right side of U-tube by

(a) 15 cm (b) 10 cm
(c) 12 cm (d) 9 cm

18. The ratio of linear expansivity to the co-efficient of a real expansion of a rectangular sheet of a solid is

(a) 2 (b) 0.5 (c) 1 (d) 1.5

19. Two rods whose lengths are l_1 and l_2 with heat conductivity coefficients K_1 and K_2 are placed end-to-end. The heat conductivity coefficient of a uniform rod of length $l_1 + l_2$ whose conductivity is same as that of the system of these two rods is

(a) $\frac{(I_1+I_2)K_1K_2}{K_2I_1+K_1I_2}$ (b) $\frac{(I_1+I_2)K_1K_2}{K_1I_1+K_2I_2}$
(c) $\frac{K_1I_1+K_2I_2}{(I_1+I_2)K_1K_2}$ (d) $\frac{K_1I_2+K_2I_1}{(I_1+I_2)K_1K_2}$

20. Consider a two stage Carnot engine. In the first stage heat Q_1 is absorbed at temperature T and heat Q_2 is expelled at temperature αT (where $\alpha < 1$). In the second stage heat Q_2 is absorbed at temperature αT and heat Q_3 is expelled at temperature $\beta T(\beta < \alpha)$. The efficiency of the Carnot engine will be

(a) $1-\alpha-\beta$ (b) $1-\alpha$
(c) $1-\beta$ (d) $1-\alpha\beta$

21. A diatomic gas of volume $2\ m^3$ at a pressure $2\times10^5\ N/m^2$ is compressed adiabatically to a volume $0.5\ m^3$. The work done in this process is [Use $4^{1.4} = 6.96$]

(a) 2.96×10^5 J (b) -2.96×10^5 J
(c) -7.4×10^5 J (d) 7.4×10^5 J

22. As per kinetic theory of gases which of the following statement(s) is/are true?
(I) Temperature of a gas is a measure of average kinetic energy of a molecule.
(II) Temperature of a gas depends on the nature of the gas.
(III) Heavier molecule has lower average speed.
(IV) Lighter molecule has lower average speed.

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

23. A wave is represented by the equation $y = (0.02)\sin(5\pi x - 20t)m$. The minimum distance between the two particles always having the same speed is
(Assume x and t are in SI units)

(a) 0.02 m (b) 0.4 m
(c) 0.8 m (d) 0.2 m

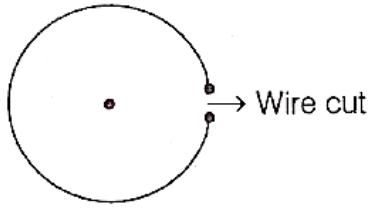
24. A screen is placed 90 cm from an object. The image is formed by using a convex lens twice on the screen by putting the lens at two different locations separated by 20 cm. The focal length of the lens is approximately equal to

(a) 21.38 cm (b) 30.0 cm
(c) 35.0 cm (d) 24 cm

25. What would be the angular separation between the consecutive bright fringes in Young's double slit experiment with blue-green light of wavelength 400 nm? The separation between the slits is 0.001 m.

(a) 4×10^{-4}rad (b) 3×10^{-4}rad
(c) 2×10^{-4}rad (d) 1×10^{-4}rad

26. A circular wire loop of radius 10 cm carries a total charge of $10^{-5}C$ distributed uniformly over its length. A small length of 3.14×10^{-6} m of wire is cut off. The magnitude to electric field at the centre due to the remaining wire is
(Assume, $\frac{1}{4\pi\varepsilon_0} = 9\times10^9$ SI units)



(a) 30 N/C (b) 40 N/C
(c) 35 N/C (d) 45 N/C

27. Consider the charged cylindrical capacitor. The magnitude of electric field E in its annual region

(a) varies as $\frac{1}{r}$, where r is the distance from its axis.
(b) is zero
(c) is same throughout and $|E| > 0$
(d) varies as $\frac{1}{r^2}$, where r is the distance from its axis

28. A spherical capacitor consists of two concentric spherical conductors. Find the capacitance of the spherical capacitor if the outer radius is 2R and the inner radius is R.

(a) $4\pi\varepsilon_0 R$ (b) $8\pi\varepsilon_0 R$
(c) $\frac{8\pi\varepsilon_0}{R}$ (d) $\frac{4\pi\varepsilon_0}{R}$

29. A wire of length l carries a current I along the X-axis. The magnetic force acting on the wire is given by $F = IB_0l(\hat{K} - \hat{j})T$, where B_0 is a constant. The existing magnetic fieid B is

(a) $B_0\hat{i}$ (b) $B_0(\hat{i} + \hat{j} - \hat{k})$
(c) $B_0(\hat{i} + \hat{j} + \hat{k})$ (d) $B_0(\hat{i} - \hat{j} - \hat{k})$

30. Two long wires with no contact are placed perpendicular to each other, i_1 and i_2 are currents flowing through these wires, respectively. The magnetic force on a small length dl of the second wire situated at a distance l from first wire is proportional to

(a) $i_1 i_2$ (b) i
(c) $\frac{1}{i_1 i_2}$ (d) i^2

31. A solenoid has a core of a material with relative permeability 501. The windings of the solenoid are insulated from the core and carry a current of 2.5 A. If the number of turns are 900 per metre. The magnetisation (in A/m) is

(a) 1.12×10^6 (b) 2.8×10^6
(c) 2.25×10^6 (d) 1.69×10^6

32. A long straight solenoid with cross-sectional radius a and number of turns per unit length n has a current varying with time as $I(As^{-1})$. The magnitude of the electric field as a function of distance r from the solenoid axis is

(a) $\frac{n\mu_0 a^2 l}{2r}$ (b) $\frac{\mu_0/n}{2a}$
(c) $\frac{na^2 l}{2\mu_0 r}$ (d) $\frac{\mu_0/2}{2n}$

33. An alternating current is given by $i = (2\sin\omega t + 6\cos\omega t)$ A. The rms current (in A) is

(a) $2\sqrt{5}$ (b) $2\sqrt{10}$
(c) $\sqrt{5}$ (d) $10\sqrt{2}$

34. For an EM wave, the electric and magnetic fields are 300 V/m and 7.9 A/m, respectively. The maximum rate of energy flow is

(a) $2730\frac{W}{m^2}$ (b) $2790\frac{W}{m^2}$
(c) $2370\frac{W}{m^2}$ (d) $2390\frac{W}{m^2}$

35. Which of the following particle has the shortest de-Broglie waveiength?

(a) Proton (b) Electron
(c) α-particle (d) X-rays

36. Hydrogen atom in the ground state absorbs ΔE amount of energy. If the orbital angular momentum of the electron is increased by $\frac{h}{2\pi}$ (h = Planck's constant), then the magnitude of ΔE is

(a) 12.09 eV (b) 12.75 eV
(c) 10.2 eV (d) 13.6 eV

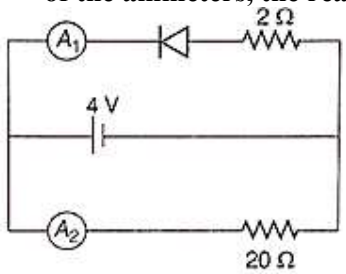
37. In a nuclear reactor, the main purpose of the moderator is to

(a) initiate that fission process by giving away its neutron
(b) slow down the fast neutrons
(c) cool down the excess of heat generated in the reactor
(d) absorb excess of neutrons and control the reaction rate

38. If the temperature of the semi-conductor is increased, which of the following is correct statement?

(a) It's resistance increases.
(b) The number of electrons in valence band increases.
(c) The number of electrons in conduction band increases.
(d) The number of holes in valence band decreases.

39. Two ammeters A_1 and A_2 are connected as shown in the given figure. By neglecting the internal resistance of the ammeters, the reading in the ammeter A_1 is



(a) 2 A (b) 0 (c) 1 A (d) 4 A

40. A message signal of frequency f_m is used to modulate a carrier of frequency f_c. If the side bands are f_1 and f_2, then the ratio $\frac{f_c}{f_m}$ is

(a) $\frac{f_1+f_2}{f_2-t_1}$ (b) $\frac{(f_1+t_2)^2}{t_1 f_2}$
(c) $\frac{f_1-f_2}{f_2+t_1}$ (d) $\frac{f_1 f_2}{(f_1+f_2)^2}$

Chemistry

41. Heisenberg's uncertainty principle is in general significant to

(a) planets
(b) cricket ball of 500 g
(c) cars
(d) micro particles having a very high speed

42. Which of the following relations is correct, if the wavelength (λ) is equal to the distance travelled by the electron in one second? h is the Planck's constant and m is the mass of electron

(a) $\lambda = \frac{h}{p}$ (b) $\lambda = \frac{h}{m}$
(c) $\lambda = \sqrt{\frac{h}{p}}$ (d) $\lambda = \sqrt{\frac{h}{m}}$

43. The set of amphoteric oxides among the given oxides are
$Ga_2O_3, As_4O_{10}, Sb_4O_{10}, B_2O_3, Tl_2O$

(a) TI_2O, B_2O_3
(b) $Sb_4O_{10}, B_2O_3, Ga_2O_3$
(c) $Ga_2O_3, Tl_2O, As_4O_{10}$
(d) $Ga_2O_3, As_4O_{10}, Sb_4O_{10}$

44. The first ionisation energies (in $kJmol^{-1}$) of four consecutive elements of the second period are given in the options. The first ionisation energy of nitrogen is

(a) 1086 (b) 1402
(c) 1681 (d) 1314

45. Highest covalent character is found in which of the following?

(a) CaF_2 (b) $CaCl_2$
(c) $CaBr_2$ (d) CaI_2

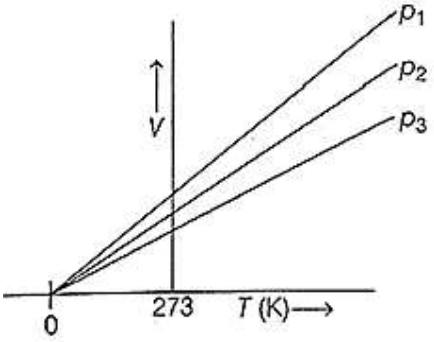
46. The correct sequence of bond order is

(a) $O_2^+ > O_2^- > O_2 > O_2^{2-}$
(b) $O_2^+ > O_2 > O_2^- > O_2^{2-}$
(c) $O_2^+ > O_2 > O_2^{2-} > O_2^-$
(d) $O_2^+ > O_2^{2-} > O_2^- > O_2$

47. The most probable velocity of a gas at 7200 K is equal to the RMS velocity of He gas at 27°C. The gas is

(a) O_2 (b) CO
(c) N_2 (d) SO_2

48. A plot of volume of the gas versus T(K) is shown below. Which of the options is correct for the plot?



(a) $p_1 < p_2 < p_3$ (b) $p_3 < p_2 < p_1$
(c) $p_1 = p_2 \neq p_3$ (d) $p_1 = p_2 = p_3 = 0$ at 273 K

49. In the balanced equation of the following reaction, the ratio of $\frac{a}{b}$ is a

$$aCaCO_3 + bH_3PO_4 \longrightarrow pCa_3(PO_4)_2 + qCO_2 + rH_2O$$

(a) $\frac{2}{3}$ (b) $\frac{3}{2}$ (c) $\frac{1}{2}$ (d) $\frac{7}{5}$

50. The number of grams of oxygen is 32.2 g of $Na_2SO_4 \cdot 10H_2O$ is approximately

(a) 32.2 g (b) 22.4 g
(c) 11.2 g (d) 64.4 g

51. Enthalpy of hydrogenation of one mole of benzene to cyclohexane is [Resonance energy of benzene $= -150.4$ kJ/mol, enthalpy of hydrogenation of cyclohexene $= -119.5$ kJ/mol]

(a) -208.1 kJ/mol (b) -358.1 kJ/mol
(c) $+150.4$ kJ/mol (d) -269.9 kJ/mol

52. Match the following columns.

	Column-I (Acid)		Column-II (K_A Ionisation constant)]
(A)	HCN	(1)	6.8×10^{-4}
(B)	$H_2C_2O_4$	(2)	8.9×10^{-8}
(C)	H_2S	(3)	4.9×10^{-10}
(D)	Niacin	(4)	5.6×10^{-2}
		(5)	1.5×10^{-5}

The correct match is

Codes

	A	B	C	D
(a)	1	3	4	5
(b)	5	2	3	4
(c)	2	3	4	5
(d)	3	4	2	5

53. If the molar concentrations of base and its conjugate acid are same, then pOH of the buffer solution is

(a) same as pK_b of base (b) same as pK_a of base
(c) same as pK_a of acid (d) same as pK_b of acid

54. $H_2 + CO +$ **alkene** $\xrightarrow{\text{Catalyst}}$ 1° **alcohol**

What is the stable intermediate and the nature of the reaction?

(a) Acid, reduction
(b) Aldehyde, oxidation
(c) Aldehyde, reduction
(d) Alcohol, oxidation

55. The correct order of electrical conductivity of alkali metals ions in their aqueous solution for Cs^+, K^+, Na^+ and $Li^+$is

(a) $Cs^+ > K^+ > Na^+ > Li^+$
(b) $K^+ > Cs^+ > Li^+ > Na^+$
(c) $Cs^+ > K^+ > Li^+ > Na^+$
(d) $Li^+ > Na^+ > K^+ > Cs^+$

56. Which of the following complex ions does not exist?

(a) $[B(H_2O)_6]^{3+}$ (b) $[Al(H_2O)_6]^{3+}$
(c) $[Ga(H_2O)_6]^{3+}$ (d) $[In(H_2O)_6]^{3+}$

57. Which of the following statements are correct?

(A) The isotope of carbon containing 7 neutrons has natural abundance of 1.1%.
(B) Among the IVA group elements, Sn has the lowest melting point
(C) Silicon is the 2nd (by mass) most abundant element in the Earth's crust.
(D) Element carbon shows the highest electrical resistivity among the 14 group elements.

(a) A, C and D (b) A, B and C
(c) B, C and D (d) A, B, C and D

58. Which of the following chemicals can be used as dry -cleaning agents?

(A) $Cl_2C = CCl_2$ **(B)** CO_2 **(liq.)**
(C) H_2O_2 **(D)** CH_3CHO

(a) A, B, C and D (b) A, B and C
(c) B, C and D (d) A and B

59. The number of sp and sp^2 carbon in hepta-1, 3-dien-5-yne, respectively, are

(a) 2.4 (b) 4,3
(c) 2,2 (d) 2,5

60. When propyne is passed through a red hot iron tube at 873 K , the reaction gives product having molecular formula of

(a) C_7H_8 (b) C_9H_{12}
(c) C_8H_{10} (d) C_6H_6

61. Total number of aromatic compounds from below is

(a) 2 (b) 3 (c) 4 (d) 5

62. A compound made up of elements A and B (with a general formula A_xB_y), where B form a hcp lattice and A occupy $2/3^{rd}$ of the tetrahedral voids. The formula of the compound is

(a) A_2B_3 (b) A_3B_4
(c) A_4B_3 (d) A_3B_2

63. If the density of a 2 M solution of ethylene glycol in water is 1.11 g/mL, the molality (in ' m ') of the solution is approximately

(a) 1.92 (b) 1.57
(c) 2.05 (d) 2.15

64. Given,

Sol A Phenol and aniline

Sol B Chloroform and acetone

Which of the following is correct as per Raoult's law?

(a) Sol A shows - ve and B shows + ve deviation
(b) Both solutions A and B show - ve deviation
(c) Sol A shows + ve and B shows - ve deviation
(d) Both solutions A and B show + ve deviation

65. Salts of A (atomic weight 8), B (atomic weight 18) and C (atomic weight 50) were electrolysed under identical conditions using the same quantity of electricity. It was found that 2.4 g of A was deposited, the weight of B and C deposited are 1.8 g and 7.5 g , respectively. The valences of A, B and C are, respectively,

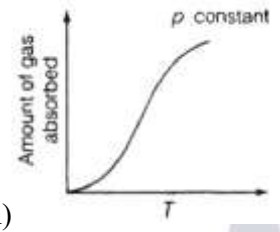
(a) 3,1 and 2 (b) 1, 2 and 3
(c) 1,3 and 2 (d) 3,2 and 1

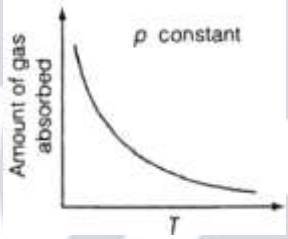
66. What will be the overall order of a reaction for which the rate expression is given as

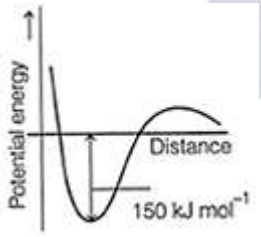
$\textbf{Rate} = k[A]^{\frac{1}{2}}[B]^{\frac{3}{2}}$

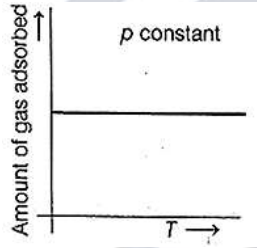
(a) second order (b) first order
(c) zero order (d) third order

67. Which of the following options are correct?

(A)


(B)


(C)


(D)


(a) A and C represent physisorption
(b) A and D represent physisorption
(c) A and C represent chemisorption
(d) B and C represent chemisorption

68. The main products formed when copper metal is reacted with concentrated HNO_3 are

(a) $Cu(NO_3)_2 : NO$ (b) $Cu(NO_3)_2 : H_2$
(c) $Cu(NO_3)_2 : NO_2$ (d) $Cu(NO_3) : NO$

69. Assertion (A) SF_6 is highly stable.

Reason (R) SF_6 is a gas.

The correct option among the following is

(a) (A) is true, (R) is true and (R) is the correct explanation for (A)
(b) (A) is true, (R) is true but (R) is not the correct explanation for (A)
(c) (A) is true but (R) is false
(d) (A) is false but (R) is true

70. Complete hydrolysis of XeF_4 and XeF_6 gives its oxides P and Q respectively. Identify P and Q.

P	Q
(a) XeO_2	XeO_3

(b) XeO XeO_2
(c) XeO_3 XeO_3
(d) XeO_2 XeO_2^1

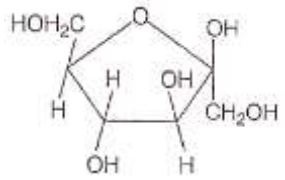
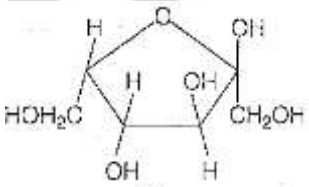
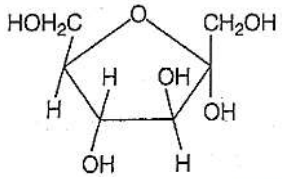
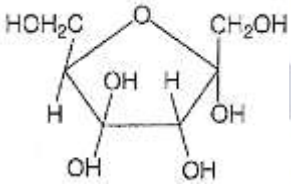
71. Match the following.

Column-I (Reaction)	Column-II (Main product)
(A) $4FeCl_3 + 3\ K_4[Fe(CN)_6] \rightarrow$	(1) $Fe_4[Fe(CN)_6]_3$
(B) $ZnCl_2 + 4NaOH \rightarrow$	(2) $FeCl_2$
(C) $2FeCl_3 + H_2S \rightarrow$	(3) $Zn(OH)Cl$
	(4) $Fe_3[Fe(CN)_6]_3$
	(5) Na_2ZnO_2
	(6) FeS

The correct match is
Codes

	A	B	C
(a)	1	3	6
(b)	1	5	2
(c)	4	5	2
(d)	4	3	6

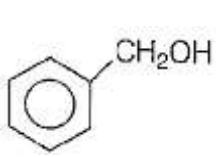
72. The oxidation number of central metal in $[Pt(NH_3)_2Cl(NO_2)]$ and $[CoCl_2(en)_2]^{\oplus}$ respectively, are
(a) $+2:+1$ (b) $+2:+2$
(c) $+2:+3$ (d) $+3:+2$

73. The structure of α-D-fructofuranose is
(a) 
(b) 
(c) 
(d) 

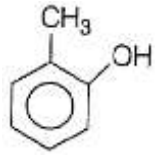
74.
$CH_3 - CH_2 - Br + Nu^{\ominus} \rightarrow CH_3 - CH_2 - Nu + Br^{\ominus}$
The decreasing order of the reaction rate with nucleophile $(Nu^{\ominus})$ is
$Nu^{\ominus}$ = (I) $PhO^{\ominus}$: (II) $CH_3COO^{\ominus}$: (III) $OH^{\ominus}$: (IV) $CH_3O^{\ominus}$
(a) IV > III > I > II (b) IV > III > II > I
(c) I > II > III > IV (d) III > IV > II > I

75. Identify Z in the following reaction
$CH_3CH_2OH \xrightarrow{PBr_3} X \xrightarrow{\text{Alc. KOH}} Y \xrightarrow[\text{(ii) } H_2O,\ \text{heat}]{\text{(i) } H_2SO_4, RT} Z$
(a) $CH_2 = CH_2$
(b) CH_3CH_2OH
(c) $CH_3CH_2 - O - CH_2CH_3$
(d) $CH_3CH_2 - SO_3H$

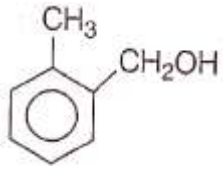
76. In which of the following compounds deoxygenation is possible when heated with Zn?



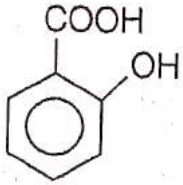
(A)



(B)



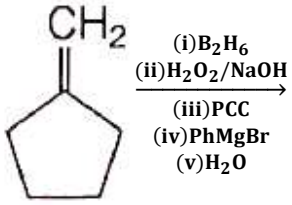
(C)



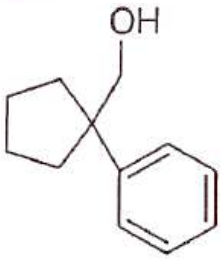
(D)

(a) A, B and C (b) A, C and D
(c) B and D (d) B and C

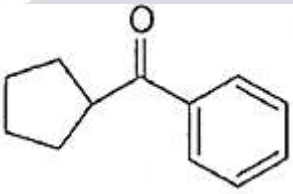
77. The major product of the following reactions is



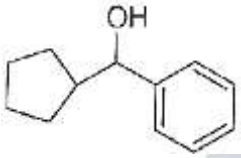
(a)



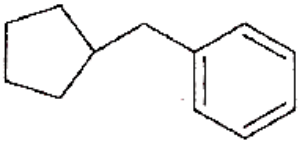
(b)



(c)



(d)



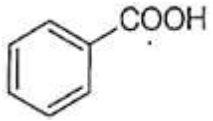
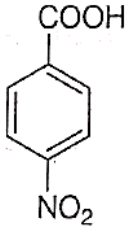
78. Match the following.

Column-I (Reaction of carbonyl compound with)	Column-II (Product)
(A) Hydroxylamine	(1) Hydrazone
(B) Alcohol	(2) Schiff's base (Substituted imine)
(C) Hydrazine	(3) Oxime
(D) Amine	(4) Ketal

The correct match is
Codes

	A	B	C	D
(a)	3	4	1	2
(b)	3	2	1	4
(c)	1	4	3	2
(d)	1	2	3	4

79. Match the following.

	Column-I (Acid)		Column-II (pK_a value)
(A)	CH_3COOH	1.	0.23
(B)	F_3CCOOH	2.	3.41
(C)		3	4.19
(D)		4	4.76

The correct match is

Codes

	A	B	C	D
(a)	4	1	3	2
(b)	1	4	2	3
(c)	4	1	2	3
(d)	4	3	2	1

80. Products that are formed in the given reaction including by products are

$CH_3CH_2CH_2CH_2CONH_2 + Br_2 + 4NaOH \rightarrow$

(a) $CH_3CH_2CH_2CH_2CH_2NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

(b) $CH_3CH_2CH_2CH_2NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

(c) $CH_3CH_2CH_2CH_2CH_2NH_2 + 2NaHCO_3 + Br_2 + 2H_2O$

(d) $CH_3CH_2CH_2CH_2NH_2 + 2Na_2CO_3 + Br_2 + 2H_2O$

Mathematics

81. If $f: R \rightarrow R$ is defined as $f(x+y) = f(x) + f(y), \forall x, y \in R$ and $f(1) = 10$, then $\sum_{r=1}^{n} (f(r))^2$ is equal to

(a) $\frac{7}{2}n(n+1)$ (b) $5n(n+1)$

(c) $\frac{50}{3}n(n+1)(2n+1)$ (d) $\frac{100}{4}n^2(n+1)^2$

82. If $f: R \rightarrow R$ is defined as $f(x) = \frac{3^x + 3^{-x}}{2}, \forall x \in R$ and it satisfies $f(x+y) + f(x-y) = af(x)f(y)$, then a is equal to

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

83. For all $n \in N, \frac{1}{2 \cdot 5} + \frac{1}{5 \cdot 8} + \cdots + \frac{1}{(3n-1)(3n+2)}$ is equal to

(a) $\frac{n}{6n+4}$ (b) $\frac{n^2}{6n+4}$

(c) $\frac{1}{2} \cdot \frac{n^2}{6n+4}$ (d) $\frac{n}{6n^2+4}$

84. If the system of equations $3x - 2y + z = 0, \lambda x - 14y + 15z = 0$ and $x + 2y - 3z = 0$ has a solution other than $x = y = z = 0$, then λ is equal to

(a) 1 (b) 2 (c) 3 (d) 5

85. If $\Delta = \begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = K(a-b)(b-c)(c-a)$, then K is equal to

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

86. If $x = \alpha, y = \beta$ and $z = \gamma$ is the unique solution of the system of equations $5x - 7y + 3z = 0, 7x + 10y - 8z = 3$ and $2x + 3y - 4z + 4 = 0$, then β is equal to

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

87. If $(a + ib)^{\frac{1}{4}} = 2 + 3i$, then $3b - 2a$ is equal to

(a) -22 (b) -122
(c) -598 (d) -698

88. ω is a complex cube root of unity. Match the items of List-I to the items of List-II

	List-I	List-II
(A)	$\omega^{1010} + \omega^{2020}$	(1) 0
(B)	$(1 + \omega - \omega^2)(1 - \omega + \omega^2)$	(2) 1
(C)	$(2 + \omega^2 + \omega^4)^5$	(3) -1
(D)	$(3 + 5\omega + 3\omega^2)^3$	(4) 4
		(5) 8

Codes

	A	B	C	D
(a)	3	4	1	5
(b)	1	4	2	5
(c)	3	4	2	5
(d)	3	1	2	4

89. If the roots of the equation $(z-4)^3 = 8i$ are $a-2i, b+i$ and $c+i$, then $\sqrt{abc}$ is equal to
(a) $13\sqrt{3}$ (b) $4\sqrt{13}$
(c) $2\sqrt{13}$ (d) $5\sqrt{3}$

90. If $\frac{\alpha}{\alpha+1}$ and $\frac{\beta}{\beta+1}$ are the roots of the quadratic equation $x^2 + 7x + 3 = 0$, then the equation having roots α and β is
(a) $3x^2 - x - 3 = 0$
(b) $11x^2 + 13x + 3 = 0$
(c) $13x^2 + 11x + 13 = 0$
(d) $11x^2 + 3x + 13 = 0$

91. If $y = \frac{x^2+14x+9}{x^2+2x+3}$, $\forall x \in R$, then the interval of maximum length in which y lies is
(a) $[-5,4]$ (b) $[-4,5]$
(c) $\left[\frac{1}{3}, 3\right]$ (d) $\left[\frac{-1}{3}, 3\right]$

92. The equation whose roots are squares of the roots of $x^4 - 2x^3 + 6x - 21 = 0$ is
(a) $x^4 - 4x^3 - 18x^2 - 36x + 441 = 0$
(b) $x^4 + 18x^3 - 4x^2 + 36x + 441 = 0$
(c) $x^4 - 2x^3 + 4x^2 + 6x + 441 = 0$
(d) $x^4 + 3x^3 - 5x^2 + 6x + 441 = 0$

93. If α, β and γ are the roots of $x^3 - x + 1 = 0$, then $\frac{1+\alpha}{1-\alpha} + \frac{1+\beta}{1-\beta} + \frac{1+\gamma}{1-\gamma}$ is equal to
(a) 1 (b) 0 (c) 2 (d) -2

94. ${}^{34}C_5 + \sum_{r=0}^{4} {}^{(38-r)}C_4$ is equal to
(a) $22 \times {}^{39}C_4$ (b) ${}^{39}C_4$
(c) ${}^{3\times39}C_5$ (d) ${}^{39}C_5$

95. If ${}^{22}P_{r+1} : {}^{20}P_{r+2} = 11 : 52$, then r is equal to
(a) 3 (b) 5 (c) 7 (d) 9

96. The value of the numerically greatest term in the expansion of $(2x + 3y)^{11}$, when $x = \frac{1}{2}$ and $y = \frac{1}{3}$ is
(a) 462 (b) ${}^{11}C_5 \left(\frac{2}{3}\right)^6$
(c) ${}^{11}C_6 \left(\frac{3}{2}\right)^5$ (d) 576

97. The coefficient of x^4 in the expansion of $(1 - x - x^2 + x^3)^6$ is
(a) 120 (b) 15 (c) -75 (d) -60

98. The sum of the coefficients in the expansion of $\left(1+\frac{x}{2}\right)^{12}$ is

(a) 0 (b) 2^{11}

(c) $\left(\frac{3}{2}\right)^{12}$ (d) 2^{12}

99. For any quadratic polynomial $f(x)$, it is true that $f(x)=f(a)+f'(a)(x-a)+\frac{f''(a)}{2!}(x-a)^2$, where a is any real number. If $\frac{3x^2+4x+7}{(x-2)^3}=\frac{A}{(x-2)^3}+\frac{B}{(x-2)^2}+\frac{C}{(x-2)}$ and $g(x)=3x^2+4x+7$, then $A+B+C$ is equal to

(a) $g(2)+g'(2)+g'(2)$

(b) $g'^{(2)}+2g(2)+\frac{g'(1)}{2!}$

(c) $g(2)+g'(2)+\frac{g(2)}{2!}$

(d) $2g(2)+2g'(2)+\frac{g(2)}{2!}$

100. $\cot\frac{\pi}{16}\cdot\cot\frac{2\pi}{16}\cdot\cot\frac{3\pi}{16}\cdot\cot\frac{4\pi}{16}\cdot\cot\frac{5\pi}{16}\cdot\cot\frac{6\pi}{16}\cdot\cot\frac{7\pi}{16}$ is equal to

(a) 0 (b) 1 (c) $\frac{1}{2}$ (d) 2

101. Let ACB be a triangle with right-angle at C. Let $AB=29$ units, $BC=21$ units and $\angle ABC=\theta$. Then, $\cos^2\theta-\sin^2\theta$ is equal to

(a) 1 (b) $\frac{41}{841}$ (c) $\frac{40}{441}$ (d) $\frac{41}{800}$

102. $\frac{1-\cos 2\theta+\sin 2\theta}{1+\cos 2\theta+\sin 2\theta}$ is equal to

(a) $\cot\theta$ (b) $\cos 2\theta$

(c) $\tan\theta$ (d) $\tan 2\theta$

103. Let $y=4\sin^2\theta-\cos 2\theta$. If l and m are the minimum and maximum values of y respectively, then

(a) $lm=\frac{m}{l}$ (b) $lm=\frac{l}{m}$

(c) $l+m=\frac{1}{m}$ (d) $\frac{lm}{1-m}=1+m$

104. If $\cos\theta=-\frac{1}{\sqrt{2}}$ and $\tan\theta=1$, then the general value of θ is

(a) $2n\pi+\frac{\pi}{4}, n=0,1,2,3,\ldots$

(b) $(2n+1)\pi+\frac{\pi}{4}, n=0,1,2,3,\ldots$

(c) $n\pi+\frac{\pi}{4}, n=0,1,2,3,\ldots$

(d) $n\pi\pm\frac{\pi}{4}, n=0,1,2,3,\ldots$

105. If $\sin^{-1}x<\cos^{-1}x$, then

(a) $-1\le x<\frac{1}{\sqrt{2}}$ (b) $-\sqrt{3}\le x<-1$

(c) $\frac{1}{\sqrt{2}}<x\le 1$ (d) $1<x<\sqrt{3}$

106. $\coth^{-1}(2)+\operatorname{cosech}^{-1}(-2\sqrt{2})$ is equal to

(a) $\log\sqrt{\frac{3}{2}}$ (b) $\log\sqrt{6}$

(c) $\log\frac{3}{\sqrt{2}}$ (d) $\log\frac{3}{2}$

107. In $\triangle ABC$, $\angle B=\frac{\pi}{4}$ and $\angle C=\frac{\pi}{3}$. If the area of the triangle is $54+18\sqrt{3}$ sq units, then a is equal to

(a) $\sqrt{3}+1$ (b) $2(\sqrt{3}+1)$

(c) $4(\sqrt{3}+1)$ (d) $6(\sqrt{3}+1)$

108. If a, b and c are the sides of a $\triangle ABC$ and exradii r_1, r_2 and r_3 are 12,6 and 4 respectively. Then, $a+2b+3c$ is equal to

(a) 24 (b) 44 (c) 30 (d) 54

109. In a $\triangle ABC$, if $a:b:c=4:5:6$, then $\frac{1}{4R}[r_1+r_2+r_3]$ is equal to

(a) $\frac{71}{64}$ (b) $\frac{4}{5}$ (c) $\frac{81}{84}$ (d) $\frac{7}{9}$

110. In a $\triangle ABC$, with usual notation, if $a=12, b=16$ and $c=20$, then the ratio of the exradii of the triangle opposite to the angles in the order $\angle C, \angle B$ and $\angle A$ is

(a) 3: 4: 5 (b) 6: 3: 2
(c) 12: 7: 5 (d) 2: 3: 5

111. If the vectors $-3\hat{i}+4\hat{j}+\lambda\hat{k}$ and $\mu\hat{i}+8\hat{j}+6\hat{k}$ are collinear, then $\lambda-\mu$ is equal to
(a) 0 (b) -3 (c) 6 (d) 9

112. The angle between the vectors $2\hat{k}-3\hat{j}$ and $\hat{i}-2\hat{k}$ is
(a) $\cos^{-1}\left(\frac{8}{\sqrt{65}}\right)$ (b) $\cos^{-1}\left(\frac{-4}{\sqrt{65}}\right)$
(c) $\cos^{-1}\left(\frac{2}{\sqrt{65}}\right)$ (d) $\cos^{-1}\left(\frac{3}{\sqrt{13}}\right)$

113. Three vectors $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$ satisfy $\mathbf{a}+\mathbf{b}+\mathbf{c}=\mathbf{0}$. If $|\mathbf{a}|=3, |\mathbf{b}|=4, |\mathbf{c}|=2$, then $\mathbf{a}\cdot\mathbf{b}+\mathbf{b}\cdot\mathbf{c}+\mathbf{c}\cdot\mathbf{a}+2(|\mathbf{a}|+|\mathbf{b}|+|\mathbf{c}|)$ is equal to
(a) $\frac{-7}{2}$ (b) $\frac{7}{2}$ (c) $\frac{-11}{2}$ (d) $\frac{11}{2}$

114. $(\mathbf{a}+2\mathbf{b}-\mathbf{c})\cdot\{(\mathbf{a}-\mathbf{b})\times(\mathbf{a}-\mathbf{b}-\mathbf{c})\}$ is equal to
(a) 2[abc] (b) [abc]
(c) 3[abc] (d) $[abc]^2$

115. If $\mathbf{a}=\hat{i}+\hat{j}+\hat{k}, \mathbf{c}=\hat{j}-\hat{k}$ are given vectors, then a vector $\mathbf{b}$ satisfying the equations $\mathbf{a}\times\mathbf{b}=\mathbf{c}$ and $\mathbf{a}\cdot\mathbf{b}=3$ is
(a) $5\hat{i}+2\hat{j}+2\hat{k}$ (b) $\frac{5}{2}\hat{i}+\hat{j}+\hat{k}$
(c) $\frac{5}{3}\hat{i}+\frac{2}{3}\hat{j}+\frac{2}{3}\hat{k}$ (d) $\hat{i}+\frac{2}{5}\hat{j}+\frac{2}{5}\hat{k}$

116. Let $\mathbf{a}=2\hat{i}-3\hat{j}+\hat{k}, \mathbf{b}=\hat{i}+2\hat{j}-3\hat{k}, \mathbf{c}=\hat{i}-\hat{j}$ and $\mathbf{d}=\hat{i}+\hat{j}+x\hat{k}$. If $(\mathbf{a}\times\mathbf{b})\times\mathbf{c}$ is perpendicular to $\mathbf{d}$, then x is equal to
(a) $\frac{3}{2}$ (b) 2 (c) $\frac{2}{3}$ (d) 1

117. If 10 is the mean of the data $2, 3, 5, 18, 17, 15, 13, x, 9$ and 7, then the mean deviation of this data about its mean is
(a) 4.7 (b) 4.8
(c) 4.9 (d) 5.0

118. A, B and C are aiming to shoot a balloon. A will succeed 4 times out of 6 attempts. The chance of B to shoot the balloon is 3 out of 5 and that of C is 2 out of 3. If the three aim to shoot the balloon simultaneously. Then, the probability that at least two of them hit the balloon is
(a) $\frac{5}{9}$ (b) $\frac{9}{25}$ (c) $\frac{4}{9}$ (d) $\frac{32}{45}$

119. ω is a complex cube root of unity. When an unbiased die is thrown 3 times, if β_1, β_2 and β_3 are the numbers appeared on the die, then the probability that β_1, β_2 and β_3 satisfy $\omega^{\beta_1}+\omega^{\beta_2}=-\omega^{\beta_3}$ is
(a) $\frac{212}{513}$ (b) $\frac{1}{3}$ (c) $\frac{3}{5}$ (d) $\frac{2}{9}$

120. If $P(A/B)=\frac{3}{10}, P(B/A)=\frac{4}{5}$ and $P(A\cup B)=KP(B)$, then $\frac{1}{K}$ is equal to
(a) $\frac{40}{49}$ (b) $\frac{40}{43}$ (c) $\frac{100}{101}$ (d) 1

121. If the probability that an individual will suffer a bad reaction from an injection is 0.001, then the probability that out of 2000 individuals, exactly 3 individuals suffer a bad reaction is
(a) $\frac{4}{3e^2}$ (b) $\frac{2}{e^2}$ (c) $\frac{2}{3e^2}$ (d) $\frac{4}{5e^2}$

122. A fair coin is tossed 15 times. The probability that the tail will appear at least thrice is
(a) $1-\frac{10^5}{2^{15}}$ (b) $1-\frac{121}{2^{15}}$
(c) $1-\frac{1}{2^{15}}$ (d) $1-\frac{16}{2^{15}}$

123. A rod of length 6 units slides with its ends on the coordinate axes. The locus of the mid-point of the rod is
(a) $x^2+y^2=9$ (b) $x+y=3$
(c) $x^2+y^2=36$ (d) $x+y=6$

124. The transformed equation of the curve $2x^2+y^2-3x+5y-8=0$, when the origin is translated to the point $(-1,2)$ is

(a) $2x^2 + y^2 - 7x + 9y + 11 = 0$
(b) $2x^2 + y^2 + 7x + 9y + 11 = 0$
(c) $2x^2 + y^2 - x + y + 11 = 0$
(d) $2x^2 + y^2 + 7x - 9y + 11 = 0$

125. The point on the line $4x - y - 2 = 0$ which is equidistant from the point $(-5, 6)$ and $(3, 2)$ is

(a) (2,6) (b) (4,14)
(c) (1,2) (d) (3,10)

126. The incentre of the triangle having the vertices $(1, \sqrt{3}), (0, 0)$ and $(2, 0)$ is

(a) $\left(1, \frac{\sqrt{3}}{2}\right)$ (b) $\left(\frac{2}{3}, \frac{1}{\sqrt{3}}\right)$
(c) $\left(\frac{2}{3}, \frac{\sqrt{3}}{2}\right)$ (d) $\left(1, \frac{1}{\sqrt{3}}\right)$

127. If $P'(a, b)$ is the image of the point $P(-1, 2)$ with respect to the line $x - 2y + 3 = 0$, then the length of the perpendicular from P' on to the line $2x + y - 7 = 0$ is

(a) $\frac{3}{\sqrt{5}}$ units (b) 5 units
(c) $\frac{7}{\sqrt{5}}$ units (d) 7 units

128. If the vertices of a $\triangle ABC$ are $A(1, 7), B(-5, -1)$ and $C(7, 4)$, then the equation of a bisector of $\angle ABC$ is

(a) $7x - 9y + 26 = 0$ (b) $9x - 7y + 38 = 0$
(c) $7x + 9y + 44 = 0$ (d) $9x + 7y + 52 = 0$

129. The combined equation of the two diameters of a circle which divide the circle into four sectors is $ax^2 + 2hxy + by^2 = 0$. If the area of the bigger sector is 5 times the area of the smaller sector, then $\frac{|a+b|}{\sqrt{(a-b)^2+4h^2}}$ is equal to

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

130. If $9x^2 - 24xy + 16y^2 + \alpha x + \beta y + 6$ represents a pair of parallel lines of 1 unit apart and one of those lines passes through (1,1), then $\frac{\alpha}{\beta}$ is equal to

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

131. If (a, b) is the centre of the circle passing through the vertices of the triangle formed by $x + y = 6, 2x + y = 4$ and $x + 2y = 5$, then (a, b) is

(a) $(-17, -16)$ (b) $\left(\frac{17}{2}, \frac{19}{2}\right)$
(c) (17,18) (d) $\left(\frac{-17}{2}, \frac{-19}{2}\right)$

132. The locus of the mid-points of the chords of the circle $x^2 - 2x + y^2 = 0$ drawn from a point $(0, 0)$ on it is

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

133. The number of possible common tangents that can be drawn to the circles $x^2 + y^2 + 4x - 6y - 3 = 0$ and $x^2 + y^2 + 4x - 2y + 1 = 0$ is

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

134. The equation of the circle passing through $(1, 1)$ and through the points of intersection of the circles $x^2 + y^2 + 13x - 3y = 0$ and $2x^2 + 2y^2 + 4x - 7y - 25 = 0$ is

(a) $4x^2 + 4y^2 + 30x - 13y - 25 = 0$
(b) $2x^2 + 2y^2 + 15x - 19y = 0$
(c) $4x^2 + 4y^2 + 25x + 12y - 45 = 0$
(d) $4x^2 + 4y^2 + 13x - 30y + 9 = 0$

135. If the circles $(x - 2)^2 + (y - 3)^2 = 25$ and $25x^2 + 25y^2 - 40x - 70y - 160 = 0$ touch inernally at (α, β), then $\alpha + \beta$ is equal to

(a) 0 (b) -2 (c) -1 (d) 1

136. A point on the parabola whose focus and vertex are respectively at $\left(\frac{5}{4}, -2\right)$ and $(1, -2)$ is

(a) (4,0) (b) (15,2)
(c) $(3, -1)$ (d) (10,1)

137. **The parametric equations of the parabola $y^2 - 4x - 8y - 12 = 0$ are**

(a) $x = 7 + 2t$ and $y = -4 + t^2$
(b) $x = -7 + 2t$ and $y = 4 + 2t$
(c) $x = -7 + t^2$ and $y = -4 + 2t$
(d) $x = -7 + t^2$ and $y = 4 + 2t$

138. **A focus of an ellipse having eccentricity $\frac{1}{2}$ is at $(0, 0)$ and a directrix is the line $x = 4$. Then, the equation of one such ellipse is**

(a) $\frac{9x^2}{64} + \frac{3y^2}{16} = 1$
(b) $\frac{(2x+1)^2}{32} + \frac{y^2}{16} = 1$
(c) $\frac{(3x+4)^2}{64} + \frac{y^2}{32} = 1$
(d) $(3x + 4)^2 + 12y^2 = 64$

139. **The area (in sq units) of the quadrilateral formed by joining the focii of the two ellipses $\frac{x^2}{9} + \frac{y^2}{5} = 1$ and $\frac{x^2}{5} + \frac{y^2}{9} = 1$ is**

(a) 4 (b) 2 (c) 6 (d) 8

140. **The lines $x\cos\alpha + y\sin\alpha = P, \alpha \in R$ are chords of the hyperbola $\frac{x^2}{9} - \frac{y^2}{36} = 1$ and they subtend a right angle at the centre of the hyperbola. The locus of the poles of these lines with respect to the given hyperbola is**

(a) $x^2 - 16y^2 = 108$
(b) $16x^2 - y^2 = 108$
(c) $16x^2 + y^2 = 108$
(d) $x^2 + 16y^2 = 108$

141. **If $\left(\frac{9}{4}, \frac{5}{4}, \frac{15}{4}\right)$ is the centroid of a tetrahedron whose vertices are $(a, 2, 1), (1, b, 4), (4, 0, c)$ and $(1, 1, 7)$, then**

(a) $a = b = c$ (b) $a = b = c + 1$
(c) $b = c = a + 1$ (d) $a = c = b + 1$

142. **The direction cosines of the line making angles $\frac{\pi}{4}, \frac{\pi}{3}$ and $\theta\left(0 < \theta < \frac{\pi}{2}\right)$ respectively with X, Y and Z-axes, are**

(a) $\frac{1}{\sqrt{2}}, \frac{1}{2}, \frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}, \frac{1}{2}, \frac{\sqrt{3}}{2}$
(c) $\frac{1}{\sqrt{2}}, \frac{1}{2}, \frac{1}{\sqrt{2}}$ (d) $\frac{1}{\sqrt{2}}, \frac{\sqrt{3}}{2}, \frac{1}{\sqrt{2}}$

143. **The point on the plane $2x - 2y + 4z + 5 = 0$ that is nearer to $\left(1, \frac{3}{2}, 2\right)$ is**

(a) $\left(0, \frac{5}{2}, 0\right)$ (b) $\left(-5, \frac{-5}{2}, 0\right)$
(c) $\left(0, 0, \frac{-5}{4}\right)$ (d) $\left(-\frac{1}{2}, 0, -1\right)$

144. $\lim_{x \to 1} \frac{\log x}{(1-x)}$ **is equal to**

(a) 1 (b) -1 (c) 0 (d) $\frac{-1}{2}$

145. **Let $f(x) = \frac{2-\sqrt{x+4}}{\sin 2x}, x \neq 0$. In order that $f(x)$ is continuous at $x = 0, f(0)$ is to be defined as**

(a) $\frac{-1}{8}$ (b) $\frac{1}{2}$ (c) 1 (d) $\frac{1}{8}$

146. **If $f(x) = \begin{cases} 1 + \cos x, & x \leq 0 \\ a - x, & 0 < x \leq 2 \\ x^2 - b^2, & x > 2 \end{cases}$ is continuous everywhere, then $a^2 + b^2$ is equal to**

(a) 4 (b) 8 (c) 6 (d) 12

147. **If $x = 5(1 - \sin t), y = 5(t + \cos t)$, then $\frac{dx}{dy}$ is equal to**

(a) $\frac{\sin t-1}{\cos t}$ (b) $\frac{\cos t}{\sin t-1}$
(c) $\tan\frac{t}{2}$ (d) $\frac{\cos t/2-\sin t/2}{\cos t/2+\sin t/2}$

148. Let $g: [-2,2] \to R$ and $f: [-2,2] \to R$ are two functions defined as $g(x) = \begin{cases} -1, & \text{if } -2 \le x < 0 \\ x^2-1, & \text{if } 0 \le x \le 2 \end{cases}$ and $f(x) = |g(x)| + g(|x|) + 2$. In the interval $(-2,2)$, f is not differentiable at x is equal to

(a) 0 (b) 1 (c) $\frac{1}{2}$ (d) -1

149. Consider the following statements
(I) If a function is differentiable at a point ' p ', then it is not continuous at ' p '.
(II) If a function is not continuous at $x = a$, then it is not differentiable at $x = a$.
(III_ If $f(x) = |x|$, then $f(x)$ is not differentiable but continuous on R.
(IV) If $f(x) = x - [x]$, then $f'(1) = 1$.
Which of the above statements are (is) correct?

(a) Only II (b) II and III
(c) Only III (d) III and IV

150. If $x^2 + xy + y^2 = k$, then $\frac{d^2y}{dx^2}$ is equal to

(a) $\frac{-6k}{(x+2y)^3}$ (b) $\frac{-6k}{(x+2y)^2}$
(c) $\frac{x^2+xy+y^2}{(2x+y)^2}$ (d) 0

151. The approximate value of $(8.01)^{4/3} + (8.01)^2$ upto 3 decimal places is

(a) 80.116 (b) 80.216
(c) 80 (d) 80.186

152. If the tangent at a point P on the curve $y = 4x^4 + x$ is perpendicular to the tangent to the same curve at (0, 0), then the point P is

(a) $\left(\frac{-1}{2},\frac{-1}{4}\right)$ (b) $\left(\frac{1}{2},\frac{3}{4}\right)$
(c) $(1,5)$ (d) $(-1,3)$

153. The angle between the curves $2x^2 + y^2 = 20$ and $4y^2 - x^2 = 8$ at a point where they intersect in the IVth quadrant is

(a) 0 (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

154. If the function $f(x) = x(x+3)e^{\frac{-x}{2}}$ satisfies all the conditions of Rolle's theorem in $[-3,0]$, then a root of $f'(x) = 0$ is

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

155. $\int \frac{dx}{\sin x+\cos x}$ is equal to

(a) $\frac{1}{\sqrt{2}}\log\left|\tan\left(\frac{x}{2}+\frac{\pi}{8}\right)\right| + C$
(b) $\frac{1}{\sqrt{2}}\log\left|\tan\left(\frac{x}{2}+\frac{\pi}{4}\right)\right| + C$
(c) $\frac{1}{\sqrt{2}}\log\left|\tan\left(\frac{x}{4}+\frac{\pi}{2}\right)\right| + C$
(d) $\frac{1}{\sqrt{2}}\log\left|\tan\left(\frac{x}{8}+\frac{\pi}{2}\right)\right| + C$

156. $\int (x+2)\sqrt{x+3}dx$ is equal to

(a) $\frac{2}{15}\sqrt{x+3}(3x^2-13x+12) + C$
(b) $\frac{2}{15}\sqrt{x+3}(3x^2+13x+12) + C$
(c) $\frac{2}{5}\sqrt{x+3}(3x^2-12x+13) + C$
(d) $\frac{2}{5}\sqrt{x+3}(3x^2+12x+13) + C$

157. $\int \frac{(1-\cos x)^{2/7}}{(1+\cos x)^{9/7}}dx$ is equal to

(a) $\frac{7}{11}\left(\tan\frac{x}{2}\right)^{\frac{11}{7}}+C$ (b) $\frac{7}{11}\left(\tan\frac{x}{2}\right)^{\frac{7}{11}}+C$

(c) $\frac{7}{11}\left(\cot\frac{x}{2}\right)^{\frac{11}{7}}+C$ (d) $\frac{11}{7}\left(\cot\frac{x}{2}\right)^{\frac{7}{11}}+C$

158. $\int_5^9 \frac{\log 3x^2}{\log 3x^2+\log(588-84x+3x^2)}dx$ **is equal to**

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

159. $\int_{-1}^{1}\frac{\log(1+x)}{1+x^2}dx=\int_0^1\frac{\log(1+x)}{1+x^2}dx+\int_0^1 f(x)dx$, **then** $f(x)$ **is equal to**

(a) $\frac{\log(1+x)}{1+x^2}$ (b) $-\frac{\log(1+x)}{1+x^2}$

(c) $\frac{\log(1-x)}{1+x^2}$ (d) 0

160. **The general solution of** $\frac{dy}{dx}=x+\sin x\cos y+x\cos y+\sin x$ **is**

(a) $\tan\frac{x}{2}=\frac{y^2}{2}-\cos y+C$

(b) $\tan\frac{y}{2}=\frac{x^2}{2}-\cos x+C$

(c) $\sec^2\frac{y}{2}=\frac{x^2}{2}-\cos x+C$

(d) $\tan\frac{y}{2}=\frac{x^2}{2}+\cos x+C$