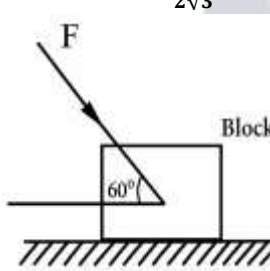
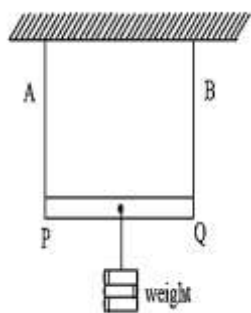


PHYSICS

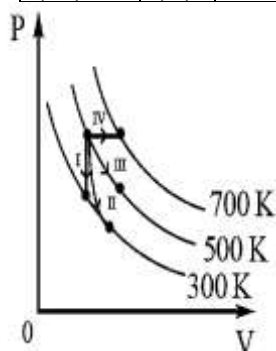
- Among the following, the physical quantity having the dimensions of Young's modulus is
(a) strain
(b) gravitational potential
(c) surface energy
(d) energy density
- If a car travels 40% of the total distance with a speed v_1 and the remaining distance with a speed v_2 then average speed of the car is
(a) $\frac{1}{2}\sqrt{v_1 v_2}$
(b) $\frac{v_1 + v_2}{2}$
(c) $\frac{2v_1 v_2}{v_1 + v_2}$
(d) $\frac{5v_1 v_2}{3v_1 + 2v_2}$
- If bullets are fired in all possible directions from same point with equal velocity of 10 m s^{-1} and with an angle of projection 45° , then the area covered by the bullets on the ground is nearly (Acceleration due to gravity 10 m s^{-2})
(a) 682 m^2
(b) 314 m^2
(c) 157 m^2
(d) 79 m^2
- A ball is projected from a point with a speed V_0 at certain angle with the horizontal. From the same point and at the same instant, a person starts running with a constant speed $0.5 V_0$ to catch the ball. If the person catches the ball after some time, then the angle of projection of the ball is
(a) 60°
(b) 30°
(c) 45°
(d) 53°
- The power required for an engine to maintain a constant speed of 50 m s^{-1} for a train of mass $3 \times 10^6 \text{ kg}$ on rough rails is (The coefficient of kinetic friction between the rails and wheels of the train is 0.05 and acceleration due to gravity = 10 m s^{-2})
(a) 75 MW
(b) 40 MW
(c) 75 KW
(d) 65 MW
- As shown in the figure, a force F is applied on a block of mass $\sqrt{3} \text{ kg}$ placed on a rough horizontal surface. The maximum value of F for the block not to move is (Coefficient of static friction between the block and the surface is $\frac{1}{2\sqrt{3}}$ and acceleration due to gravity = 10 m s^{-2})

(a) 5 N
(b) 10 N
(c) 15 N
(d) 20 N
- The linear momentum of a body of mass 8 kg is 24 kg m s^{-1} . If a constant force of 24 N acts on the body in the direction of motion of the body for a time of 3 s, then the increase in the kinetic energy of the body is
(a) 480 J
(b) 540 J
(c) 270 J
(d) 240 J
- A person holds a ball of mass 0.25 kg in his hand and throws it, so that it leaves his hand with a speed of 12 m s^{-1} . In this process, if his hand moved through a distance of 0.9 m, then the net force acted on the ball is
(a) 40 N
(b) 20 N
(c) 25 N
(d) 10 N
- If the radius of gyration of a thin circular ring about an axis passing through its centre and perpendicular to its plane is $10\sqrt{2} \text{ cm}$, then its radius of gyration about its diameter is
(a) 10
(b) 20
(c) $10\sqrt{2} \text{ cm}$
(d) $20\sqrt{2} \text{ cm}$

10. If a wheel starting from rest is rotating with an angular acceleration of $\pi \text{ rad s}^{-2}$, then the number of rotations made by the wheel in the first 6 seconds time is
 (a) 36 (b) 9
 (c) 18 (d) 12
11. If the displacement y (in cm) of a particle executing simple harmonic motion is given by the equation $y = 5\sin(3\pi t) + 5\sqrt{3}\cos(3\pi t)$, then the amplitude of the particle is
 (a) 5 cm (b) $5\sqrt{3}$ cm
 (c) $5(1 + \sqrt{3})$ cm (d) 10 cm
12. The angular frequency of a block of mass 0.1 kg oscillating with the help of a spring of force constant 2.5 Nm^{-1} is
 (a) 0.2 rad s^{-1} (b) 5 rad s^{-1}
 (c) 10 rad s^{-1} (d) 2 rad s^{-1}
13. An infinite number of objects each 1 kg mass are placed on the x -axis on both sides of $x = 0$ at $\pm 1 \text{ m}, \pm 2 \text{ m}, \pm 4 \text{ m}, \pm 8 \text{ m} \dots$ and so on. The magnitude of the resultant gravitational potential (in SI units) at $x = 0$ is (G - Universal gravitational constant)
 (a) $-G$ (b) $-2G$
 (c) $-3G$ (d) $-4G$
14. As shown in the figure, a light uniform rod PQ of length 150 cm is suspended from the ceiling horizontally using two metal wires A and B tied to the ends of the rod. The ratios of the radii and the Young's moduli of the materials of the two wires A and B are respectively 2:3 and 3:2. The position at which a weight should be suspended from the rod such that the elongations of the two wires become equal is



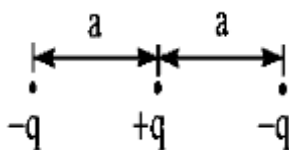
- (a) 90 cm from P (b) 100 cm from P
 (c) 40 cm from Q (d) 45 cm from Q
15. If water flows with a velocity of 20 cm s^{-1} in a pipe of radius 2 cm, then the flow is
 (The coefficient of viscosity of water is $10^{-3} \text{ kg m}^{-1} \text{ s}^{-1}$ and density of water is 10^3 kg m^{-3}).
 (a) turbulent (b) steady flow
 (c) non-viscous (d) unsteady
16. An electric kettle takes 4 A current at 220 V. If the entire electric energy is converted into heat energy, then the time (in minutes) taken to increase the temperature of 1 kg of water from 34°C to 100°C is
 (a) 7.50 (b) 4.50
 (c) 5.25 (d) 6.25
17. According to zeroth law of thermodynamics, the physical quantity which is same for two bodies in thermal equilibrium is
 (a) heat (b) temperature
 (c) volume (d) pressure
18. If a refrigerator of coefficient of performance of 5 has a freezer at a temperature of -13°C , then the room temperature is
 (a) 325°C (b) 225°C
 (c) 39°C (d) 29°C
19. From the figure shown for a thermodynamic system, match the curves with their respective thermodynamic processes.
 (P - Pressure and V - volume)

Curve		Process
(I)	(A)	Adiabatic
(II)	(B)	Isobaric
(III)	(C)	Isochoric
(IV)	(D)	Isothermal



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

20. If 2 moles of an ideal monoatomic gas at a temperature of 27°C is mixed with 4 moles of another ideal monoatomic gas at a temperature of 327°C , then the temperature of mixture of the two gases is
 (a) 300°C (b) 227°C
 (c) 233°C (d) 327°C
21. Two sound waves of wavelengths 99 cm and 100 cm produce 10 beats in a time of t seconds. If the speed of sound in air is 330 m s^{-1} , then the value of t in seconds is
 (a) 12 (b) 9
 (c) 6 (d) 3
22. If the far point of a short sighted person is 400 cm, then the power of the lens required to enable him to see very distant objects clearly is
 (a) -0.5D (b) $+0.5\text{D}$
 (c) $+0.25\text{D}$ (d) -0.25D
23. In Young's double slit experiment, the wavelengths of red and blue lights used are $7.5 \times 10^{-5}\text{ cm}$ and $5 \times 10^{-5}\text{ cm}$ respectively. If n^{th} bright fringe of red color coincides with $(n + 1)^{\text{th}}$ bright fringe of blue colour, then the value of ' n ' is
 (a) 1 (b) 2
 (c) 4 (d) 8
24. The force between two point charges kept with a separation of 9 cm in air is 98 N. If a dielectric slab of constant 4, thickness 6 cm and another dielectric slab of constant 9, thickness 3 cm are introduced between the two charges, then the new force becomes
 (a) 18 N (b) 36 N
 (c) 49 N (d) 84 N
25. Three point charges shown in the figure lie along a straight line. The energy required to exchange the position of central charge with one of the negative charges is



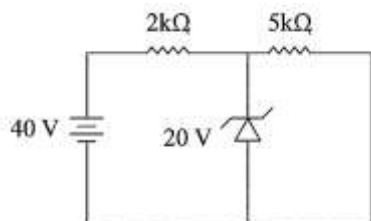
- (a) $\frac{q^2}{8\pi\epsilon_0 a}$ (b) $\frac{3q^2}{8\pi\epsilon_0 a}$
 (c) $\frac{q^2}{4\pi\epsilon_0 a}$ (d) $\frac{5q^2}{4\pi\epsilon_0 a}$

26. A capacitor of capacitance $2\mu\text{F}$ is charged to 50 V and then disconnected from the source. Later the gap between the plates of the capacitor is filled with a dielectric material. If the energy stored in the capacitor is decreased by 25% of its initial value, then the dielectric constant of the dielectric material is
- (a) $\frac{2}{3}$ (b) $\frac{4}{3}$
(c) $\frac{3}{4}$ (d) $\frac{3}{2}$
27. A wire of resistance 100Ω is stretched so that its length increases by 20% . The stretched wire is then bent in the form of a rectangle whose length and breadth are in the ratio $3:2$. The effective resistance between the ends of any diagonal of the rectangle is
- (a) 36Ω (b) 72Ω
(c) 28.8Ω (d) 43.2Ω
28. In a potentiometer experiment, when two cells of emfs E_1 and E_2 ($E_2 > E_1$) are connected in series, the balancing length is 160 cm . If one of the cells is reversed, the balancing length decreases by 75% . If $E_1 = 1.2\text{ V}$, then $E_2 =$
- (a) 2 V (b) 2.4 V
(c) 1.8 V (d) 1.5 V
29. The magnetic field at a distance of 10 cm from a long straight thin wire carrying a current of 4 A is
- (a) $6\mu\text{ T}$ (b) $16\mu\text{ T}$
(c) $8\mu\text{ T}$ (d) $4\mu\text{ T}$
30. A velocity selector is to be constructed to select ions with a velocity of 6 km s^{-1} . If the electric field used is 400 V m^{-1} , then the magnetic field to be used is
- (a) $\frac{11}{20}\text{ T}$ (b) $\frac{2}{3}\text{ T}$
(c) $\frac{1}{15}\text{ T}$ (d) $\frac{2}{15}\text{ T}$
31. A closely wound solenoid of 1200 turns and area of cross-section 5 cm^2 carries a current. If the magnetic moment of the solenoid is 1.2 J T^{-1} , then the current through the solenoid is
- (a) 2.5 A (b) 2 A
(c) 3 A (d) 1.5 A
32. If the magnetic field inside a solenoid is B , then the magnetic energy stored in it per unit volume is (c - speed of light in vacuum and ϵ_0 is permittivity of free space)
- (a) $\epsilon_0 c^2 B^2$ (b) $\frac{\epsilon_0 c^2 B^2}{2}$
(c) $2\epsilon_0 c^2 B^2$ (d) $\frac{\epsilon_0 c^2 B^2}{4}$
33. The resonant frequency of an LC circuit is f_0 . If a dielectric slab of constant 16 is inserted completely between the plates of the capacitor, then the resonant frequency is
- (a) $\frac{f_0}{2}$ (b) $2f_0$
(c) $\frac{f_0}{4}$ (d) $4f_0$
34. In a plane electromagnetic wave, the magnetic field is given by $\vec{B} = 3 \times 10^{-7} \sin(100\pi x + 10^{12}t)\text{I}$, then the wavelength of the wave is (In the equation x is in metre and t is in second)
- (a) 0.02 m (b) 0.2 m
(c) 0.4 m (d) 0.04 m
35. If the linear momentum of a proton is changed by p_0 , then the de Broglie wavelength associated with the proton changes by 0.25% . Then the initial linear momentum of the proton is
- (a) $100p_0$ (b) $\frac{p_0}{400}$
(c) $400p_0$ (d) $\frac{p_0}{100}$
36. If an electron in the excited state falls to ground state, a photon of energy 5 eV is emitted, then the wavelength of the photon is nearly
- (a) 748 nm (b) 598 nm
(c) 398 nm (d) 248 nm

37. An element X of a half-life of 1.4×10^9 years decays to form another stable element Y. A sample is taken from a rock that contains both X and Y in the ratio 1: 7. If at the time of formation of the rock, Y was not present in the sample, then the age of the rock in years is

- (a) 4.2×10^9 (b) 1.4×10^9
(c) 0.35×10^9 (d) 2.8×10^9

38. A Zener diode of breakdown voltage 20 V is connected as shown in the given circuit. The current through Zener diode is



- (a) 10 mA (b) 4 mA
(c) 6 mA (d) 8 mA

39. The voltage gains of two amplifiers connected in series are 8 and 12.5 . If the voltage of the input signal is $200\mu\text{V}$, then the voltage of the output signal is

- (a) $50\mu\text{V}$ (b) $20\mu\text{V}$
(c) 20mV (d) 50mV

40. If the sum of heights of transmitting and receiving antennas in line of sight of communication is ' h ', then the height of receiving antenna, to have the range maximum is

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

CHEMISTRY

41. When a metal surface is irradiated with light of frequency x Hz, the kinetic energy of emitted photoelectrons is zj . When the same metal is irradiated with light of frequency y Hz, the kinetic energy of emitted electrons is $\frac{z}{3}$ J. What is the threshold frequency (in Hz) of metal?

- (a) $\frac{3}{2}(y - x)$ (b) $\left(\frac{3y-x}{2}\right)$
(c) $\left(\frac{2y-x}{3}\right)$ (d) $\frac{2}{3}(y - x)$

42. Identify the correct statements from the following

- (I) Isotopes of an element show different chemical behaviour
(II) Lyman series of lines of hydrogen spectrum appear in UV region
(III) The oscillating electric and magnetic field components of electromagnetic radiation are perpendicular to each other and both are perpendicular to the direction of propagation of radiation

- (a) (II) & (III) only (b) (I) & (II) only
(c) (I) & (III) only (d) (I), (II), (III)

43. Match the following

List-(I) (Atomic number, Z)		List-(II) (Block)	
(A)	112	(I)	s
(B)	116	(II)	p
(C)	88	(III)	d
(D)	100	(IV)	f

The correct answer is

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

44. In which of the following intramolecular H -bonding is absent?

- (a) Salicylic acid
- (b) Salicylaldehyde
- (c) Quinol
- (d) Catechol

45. Identify the correct set of molecules with zero dipole moment.

- (a) CO_2 , NH_3 , H_2O
- (b) NH_3 , NF_3 , BF_3
- (c) PF_3 , NH_3 , CH_4
- (d) CH_4 , BF_3 , CO_2

46. Consider the following

Statement-I : If the intermolecular forces are stronger than thermal energy, the substance prefers to be in gaseous state.

Statement-II : Among all elements, the total number of elements available as gases at room temperature is 10 .

The correct answer is

- (a) Both statement-I and statement-II are correct
- (b) Both statement-I and statement-II are not correct
- (c) Statement-I is correct, but statement-II is not correct
- (d) Statement-I is not correct, but statement-II is correct

47. Identify the conditions at which van der Waals equation of state changes to ideal gas equation.

- (a) high temperature and high pressure
- (b) low temperature and high pressure
- (c) high temperature and low pressure
- (d) low temperature and low pressure

48. Observe the following

(I) 0.0063 (II) 132.00 (III) 1004

The number of significant figures in I, II and III is respectively

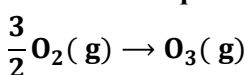
- (a) 4, 3, 5
- (b) 4, 5, 4
- (c) 4, 3, 4
- (d) 2, 5, 4

49. At 273 K the maximum work done when pressure on 10 g of hydrogen is reduced from 10 atm to 1 atm under isothermal, reversible conditions is (Assume the gas behaves ideally) ($R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$)

- (a) -52.18 kJ
- (b) $+26.09 \text{ kJ}$
- (c) -26.09 kJ
- (d) $+52.18 \text{ kJ}$

50. At 298 K, $\Delta_r G^\ominus$ for the following reaction is $165.469 \text{ kJ mol}^{-1}$.

What is the equilibrium constant for this reaction? ($R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$)

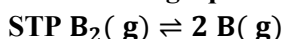


- (a) 10^{29}
- (b) 10^{-29}
- (c) 5×10^{-27}
- (d) $5 \times 10^{+27}$

51. At T(K), the solubility product of AgBr is 4×10^{-13} . What is its solubility in 0.1 M KBr solution ?

- (a) $2 \times 10^{-6} \text{ M}$
- (b) $4 \times 10^{-10} \text{ M}$
- (c) $4 \times 10^{-12} \text{ M}$
- (d) $4 \times 10^{-14} \text{ M}$

52. The following equilibrium is established at STP.



Atoms of B occupy 20% of total volume at STP. The total pressure of the system is 1 bar. What is its K_p ? (STP volume = 22.7 L)

- (a) 0.05
- (b) 0.1
- (c) 0.5
- (d) 0.025

53. The volume (in mL) of 10 volume H_2O_2 solution required to completely react with 200 mL of 0.4M KMnO_4 solution in acidic medium is

- (a) 112
- (b) 336
- (c) 224
- (d) 448

54. Which of the following statements is incorrect with reference to alkaline earth metals?

- (a) Solubility of carbonates in water decreases down the group
- (b) All the sulphates are thermally stable

- (c) All the nitrates decompose on heating
(d) All halides are ionic in nature.

55. Consider the following.

Statement-I : The order of electronegativity of B, Al, In, Tl is $B > Tl > Al > In$

Statement-II : Boric acid is a weak protonic acid

The correct answer is

- (a) Both statement-I and statement-II are correct
(b) Both statement-I and statement-II are not correct
(c) Statement-I is correct, but statement-II is not correct
(d) Statement-I is not correct, but statement-II is correct

56. Which of the following does not exist?

- (a) $[SiCl_6]^{2-}$ (b) $[GeCl_6]^{2-}$
(c) $[SiF_6]^{2-}$ (d) $[Sn(OH)_6]^{2-}$

57. Consider the following.

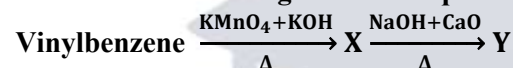
Assertion (A) : CO is poisonous to living beings

Reason (R) : CO binds to haemoglobin forming carboxy haemoglobin, which is less stable than oxygen-haemoglobin complex.

Correct answer is

- (a) (A) and (R) both are correct and (R) is the correct explanation for (A)
(b) (A) and (R) both are correct and (R) is not the correct explanation for (A)
(c) (A) is correct, but (R) is not correct
(d) (A) is not correct, but (R) is correct

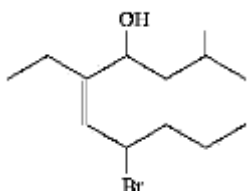
58. Consider the following reaction sequence



'Y' can also be formed from

- (a) Polymerisation of ethylene
(b) Polymerisation of propyne
(c) Aromatisation of n-hexane
(d) Aromatisation of n-heptane

59. The IUPAC name of the following compound is



- (a) 6-Ethyl-9-methyl-4-bromodec-5-en-7-ol
(b) 7-Bromo-2-methyl-5-ethyldec-5-en-4-ol
(c) 7-Bromo-5-ethyl-2-methyldec-5-en-4-ol
(d) 4-Bromo-6-ethyl-9-methyldec-5-en-7-ol

60. Gold crystallises in fcc lattice. The edge length of the unit cell is $4\text{\AA}$. The closest distance between gold atoms is 'x' $\text{\AA}$ and density of gold is 'y' g cm^{-3} . What are x and y respectively?

(Molar mass of gold = 197 g mol^{-1} ; $N = 6 \times 10^{23} \text{ mol}^{-1}$)

- (a) $\sqrt{2}$, 41.04 (b) $2\sqrt{2}$, 20.52
(c) $2\sqrt{3}$, 10.25 (d) $\sqrt{3}$, 5.15

61. 248 g of ethylene glycol ($C_2H_6O_2$) is added to 200 g of water to prepare antifreeze. What is the molality of resultant solution?

(C = 12u; H = 1u; O = 16u)

- (a) 5m (b) 10m
(c) 20m (d) 40m

62. A solution containing 7.5 g of urea (molar mass = 60 g mol^{-1}) in 1 kg of water freezes at the same temperature as another solution containing 15 g of solute X, in the same amount of water. The molar mass of X (g mol^{-1}) is

- (a) 60 (b) 180
(c) 120 (d) 240

63. What is E_{cell} (in V) of the following cell at 298 K ?

$$\left(E_{\text{Zn}^{2+}/\text{Zn}}^{\ominus} = -0.76 \text{ V}; E_{\text{Ni}^{2+}/\text{Ni}}^{\ominus} = -0.25 \text{ V}; \frac{2.303RT}{F} = 0.06 \text{ V} \right)$$



- (a) 0.51 (b) 0.48
(c) 0.57 (d) 0.54

64. $A \rightarrow$ products, is a first order reaction. The following data is obtained for this reaction at T(K). The value of x: y is

Rate ($\text{mol L}^{-1} \text{ min}^{-1}$)	[A]
0.2	0.02M
0.4	xM
1.0	yM

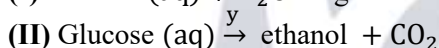
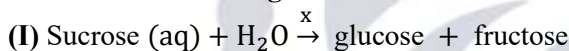
- (a) 1:5 (b) 2:3
(c) 5:2 (d) 2:5

65. Identify the correct statements from the following (only $\Rightarrow$)

- (I) Sulphur sol is an example for multi molecular colloid.
(II) Starch sol is an example for associated colloid.
(III) Artificial rubber is an example for macromolecular colloid.

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

66. Observe the following reactions



What are x and y respectively ?

- (a) Invertase, Zymase
(b) Zymase, Diastase
(c) Diastase, Zymase
(d) Diastase, Invertase

67. Kaolinite, a form of clay is the ore of metal x and malachite is the ore of metal y. x and y respectively are

- (a) Cu, Zn (b) K, Cu
(c) Al, Cu (d) Zn, Al

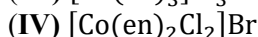
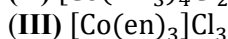
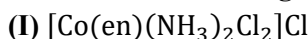
68. Gas X is obtained in Deacon's process. X on reacting with iodine and water gives

- (a) HIO_4 (b) HIO_2
(c) HIO (d) HIO_3

69. The alloy that contains copper and Zn is x and the one that contains copper and Ni is y. What are x and y respectively?

- (a) Brass, Bronze
(b) Bronze, 'Silver' UK coin
(c) German silver, Bronze
(d) Brass, 'Silver' UK coin

70. Which of the following complexes exhibit geometrical isomerism?



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

71. In which polymer preparation, Ziegler - Natta catalyst is used ?

- (a) Low density polythene
- (b) Teflon
- (c) Polyacrylonitrile
- (d) High density polythene

72. The incorrect statement about amylose is

- (a) It is water soluble
- (b) In this α - D - (+)-glucose units are held by C - 1 to C - 4 glycosidic linkages
- (c) It is a highly branched polymer of α -D- (+)-glucose units
- (d) It is present in starch to an extent of 15-20%

73. The improper functioning of ' X ' results in Addison's disease. Hormone ' Y ' is responsible for the development of secondary female characteristics. ' X ' and ' Y ' are respectively

- (a) Adrenal Cortex, estradiol
- (b) Adrenal Cortex, progesterone
- (c) Thyroid, progesterone
- (d) Thyroid, estradiol

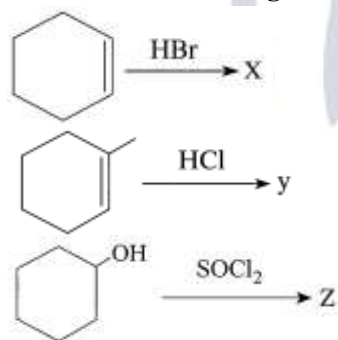
74. Which of the following is not an example of antacid ?

- (a) Cimetidine
- (b) Ranitidine
- (c) Sodium hydrogen carbonate
- (d) Phenelzine

75. When ethyl bromide and n-propyl bromide are allowed to react with Na metal in dry ether, the number of different alkanes formed is

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

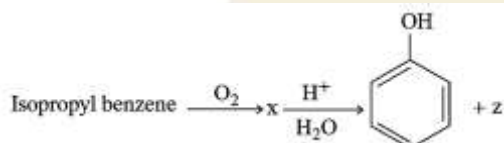
76. Observe the following reactions



The order of reactivity of x, y, z towards $\text{S}_{\text{N}}1$ reaction is

- (a) $x > z > y$
- (b) $x > y > z$
- (c) $y > x > z$
- (d) $y > z > x$

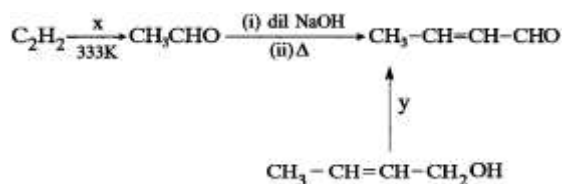
77. Consider the following sequence of reactions



The incorrect statement about z is

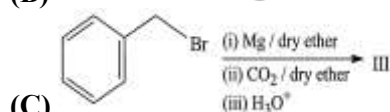
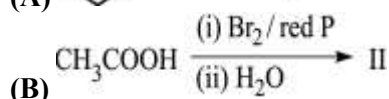
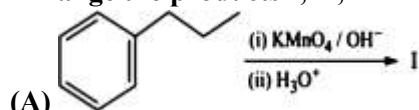
- (a) z gives yellow precipitate of CHI_3 with $\text{NaOH} + \text{I}_2$ solution
- (b) z gives isopropyl alcohol on reduction with H_2 in the presence of Pd catalyst
- (c) z on reaction with CH_3MgBr followed by hydrolysis gives 2° alcohol Z
- (d) z does not give positive test with Fehling's reagent

78. What are x and y in the following reaction sequence?



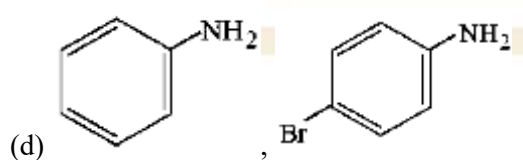
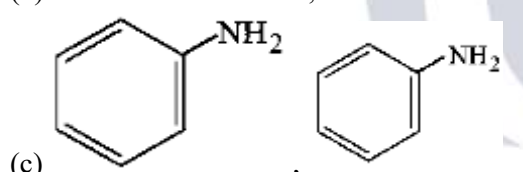
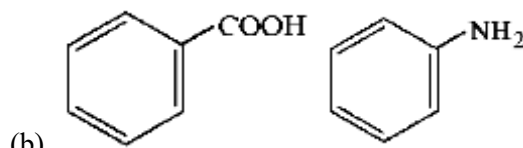
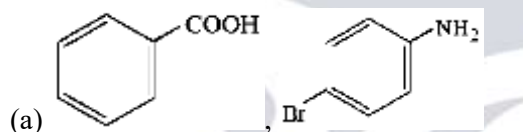
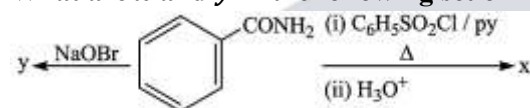
- (a) $\text{H}_2\text{O}/\text{H}_2\text{SO}_4$; KMnO_4/H^+
 (b) $\text{H}_2\text{O}/\text{H}_2\text{SO}_4$; PCC
 (c) $\text{H}_2\text{O}/\text{H}_2\text{SO}_4$, Hg^{2+} ; KMnO_4/H^+
 (d) $\text{H}_2\text{O}/\text{H}_2\text{SO}_4$, Hg^{2+} ; PCC

79. Arrange the products I, II, III from the following reactions in decreasing order of their acid strength.



- (a) III > II > I (b) III > I > II
 (c) II > I > III (d) I > II > III

80. What are x and y in the following set of reactions?



MATHEMATICS

81. The domain and range of a real valued function $f(x) = \cos x - 3$ are respectively. $f(x) = \cos x - 3$

- (a) $\mathbb{R} \setminus \{0\}$ and $[-1, 1]$
 (b) $\mathbb{R}$ and $[-1, 1]$
 (c) $\mathbb{R} \setminus \{0\}$ and $[-4, -2]$
 (d) $\mathbb{R}$ and $[-4, -2]$

82. If $f: \mathbb{R} \rightarrow \mathbb{R}$ and $g: \mathbb{R} \rightarrow \mathbb{R}$ are two functions defined by $f(x) = 2x - 3$ and $g(x) = 5x^2 - 2$, then the least value of the function $(g \circ f)(x)$ is

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

83. For all $n \in N$, if $1^3 + 2^3 + 3^3 + \dots + n^3 > x$, then a value of x among the following is

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

84. If A and B are both 3×3 matrices, then which of the following statements are true?

- (i) $AB = 0 \Rightarrow A = 0$ or $B = 0$
(ii) $AB = I_3 \Rightarrow A^{-1} = B$
(iii) $(A - B)^2 = A^2 - 2AB + B^2$
(a) (i) is false and (ii), (iii) are true
(b) (ii) is true and (i), (iii) are false
(c) (i) and (ii) are true, (iii) is false
(d) All are true

85. If $A = \begin{bmatrix} 1 & -1 & 2 \\ -2 & 3 & -3 \\ 4 & -4 & 5 \end{bmatrix}$ is the given matrix and A^T represents the transpose of A , then $AA^T - A - A^T =$

- (a) $\begin{bmatrix} 4 & 8 & 12 \\ 8 & 16 & -28 \\ 12 & -28 & 47 \end{bmatrix}$ (b) $\begin{bmatrix} 4 & -8 & 12 \\ -8 & 16 & -28 \\ 12 & -28 & 47 \end{bmatrix}$
(c) $\begin{bmatrix} 4 & -8 & 12 \\ -8 & 16 & 28 \\ 12 & 28 & 47 \end{bmatrix}$ (d) $\begin{bmatrix} 4 & -8 & -12 \\ -8 & 16 & -28 \\ -12 & -28 & 47 \end{bmatrix}$

86. If $A = \begin{bmatrix} x & 2 & 1 \\ -2 & y & 0 \\ 2 & 0 & -1 \end{bmatrix}$, x and y are non-zero real numbers, trace of $A = 0$ and determinant of $A = -6$, then

the minor of the element 1 of A is

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

87. If $i = \sqrt{-1}$, then $\sum_{n=2}^{30} i^n + \sum_{n=30}^{65} i^{n+3} =$

- (a) 0 (b) -1
(c) i (d) $-i$

88. If z_1 and z_2 are two of the n^{th} roots of unity such that the line segment joining them subtends a right angle at the origin then for a positive integer k, n take the form

- (a) $4k$ (b) $4k+1$
(c) $4k+2$ (d) $4k+3$

89. $(\sqrt{\sqrt{2}+1} + i\sqrt{\sqrt{2}-1})^8$

- (a) 64 (b) $64i$
(c) -64 (d) $-64i$

90. If the harmonic mean of the roots of the equation $\sqrt{2}x^2 - bx + (8 - 2\sqrt{5}) = 0$ is 4, then the value of b is

- (a) 3 (b) 2
(c) $4 - \sqrt{5}$ (d) $4 + \sqrt{5}$

91. All the values of k such that the quadratic expression $2kx^2 - (4k+1)x + 2$ is negative for exactly three integral values of x , lie in the interval

- (a) $[\frac{1}{12}, \frac{1}{10})$ (b) $(\frac{1}{6}, \frac{1}{5})$
(c) $[-1, 2)$ (d) $[2, 6)$

92. If α and β ($\alpha > \beta$) are the multiple roots of the equation $4x^4 + 4x^3 - 23x^2 - 12x + 36 = 0$, then $2\alpha - \beta =$

- (a) -1 (b) 3
(c) 5 (d) -7

93. If α, β and γ are the roots of the equation $x^3 - 13x^2 + kx + 189 = 0$ such that $\beta - \gamma = 2$, then $\beta + \gamma : k + \alpha =$

- (a) 4:3 (b) 2:1
(c) 6:5 (d) 3:4

94. The number of all possible positive integral solutions of the equation $xyz = 30$
- (a) 24 (b) 25
(c) 26 (d) 27
95. The number of all five letter words (with or without meaning) having atleast one repeated letter that can be formed by using the letters of the word INCONVENIENCE is
- (a) 2025 (b) 2765
(c) 3265 (d) 3205
96. The number of ways of arranging all the letters of the word PERFECTION such that there must be exactly two consonants between any two vowels is
- (a) $4!+6!$ (b) $3!+6!$
(c) $2!3!6!$ (d) $\frac{6!}{4!}$
97. If $(1+x)^n = \sum_{r=0}^{11} C_r x^r$, then the value of $C_0 + (C_0 + C_1) + (C_0 + C_1 + C_2) + \dots + (C_0 + C_1 + C_2 + \dots + C_n)$ is
- (a) $n2^{n-1}$ (b) 2^{n+n}
(c) $(n+2)2^n$ (d) $(n+2)2^{n-1}$
98. If x is so large that terms containing $x^{-3}, x^{-4}, x^{-5}, \dots$ can be neglected, then the approximate value of $\left(\frac{3x-5}{4x^2+3}\right)^{-4/5}$ is
- (a) $\left(\frac{3}{4x}\right)^{4/5} \left(1 - \frac{4}{3x} - \frac{7}{5x^2}\right)$
(b) $\left(\frac{4x}{3}\right)^{4/5} \left(1 + \frac{4}{3x} + \frac{13}{5x^2}\right)$
(c) $\left(\frac{4x}{3}\right)^{4/5} \left(1 + \frac{4}{3x} - \frac{13}{5x^2}\right)$
(d) $\left(\frac{3}{4x}\right)^{4/5} \left(1 - \frac{4}{3x} + \frac{7}{5x^2}\right)$
99. Let $H(x) = 3x^4 + 6x^3 - 2x^2 + 1$ and $g(x)$ be a linear polynomial. If $\frac{H(x)}{(x-1)(x+1)(x-2)} = f(x) + \frac{g(x)}{(x-1)(x+1)(x-2)}$, then $H(-1) + 2H(2) - 3H(1) =$
- (a) $f(-1) + 2f(2) - 3f(1)$
(b) $H(-1) + f(2) + g(3)$
(c) $g(-1) + 2g(2) - 3g(1)$
(d) $H(1) + 2f(2) - g(1)$
100. If $630^\circ < \theta < 810^\circ$ and $\tan \theta = -\frac{7}{24}$, then $\cos\left(\frac{\theta}{4}\right) =$
- (a) $-\sqrt{\frac{7+5\sqrt{2}}{10\sqrt{2}}}$ (b) $\sqrt{\frac{7+5\sqrt{2}}{2\sqrt{2}}}$
(c) $-\sqrt{\frac{5\sqrt{2}-7}{10\sqrt{2}}}$ (d) $\sqrt{\frac{5\sqrt{2}-7}{2\sqrt{2}}}$
101. For $\theta \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ if $2\cos\theta + \sin\theta = 1$, and $7\cos\theta + 6\sin\theta = k$, then the possible values of k are
- (a) 8, -2 (b) 6, 2
(c) 12, 4 (d) 7, 6
102. $\sum_{k=0}^{12} \frac{1}{\sin\left((k+1)\frac{\pi}{6} + \frac{\pi}{4}\right)\sin\left(\frac{k\pi}{6} + \frac{\pi}{4}\right)} =$
- (a) $2(\sqrt{3} + 1)$ (b) $2(3 - \sqrt{3})$
(c) $2(2 - \sqrt{3})$ (d) $2(\sqrt{3} - 1)$
103. The number of solutions of the equation $2\sin^2\theta - 3\cos^2\theta = \sin\theta\cos\theta$ lying in the interval $(-\pi, \pi)$ is
- (a) 2 (b) 4
(c) 3 (d) 1
104. $\tan^{-1} \frac{\sqrt{8-2\sqrt{15}}}{\sqrt{15}+1} + \tan^{-1} \frac{1}{\sqrt{5}} =$
- (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

105. If $\cos \alpha = \operatorname{sech} \beta$, then $\beta =$

- (a) $\log(\sec \alpha + \tan \alpha)$ (b) $\log(\sec \alpha - \tan \alpha)$
(c) $\log(\sin \alpha + \cos \alpha)$ (d) $\log(\cos \alpha + \cot \alpha)$

106. In $\triangle ABC$, the sum of the lengths of two sides is x and the product of those lengths is y . If c is the length of its third side and $x^2 - c^2 = y$, then the circumradius of that triangle is

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

107. If the area of a triangle ABC is $4\sqrt{5}$ sq. units, length of the side CA is 6 units and $\tan \frac{B}{2} = \frac{\sqrt{5}}{4}$, then its smallest side is of length

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

108. In a $\triangle ABC$ if $r_1 = 2r_2 = 3r_3$ then $a : b$ is

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

109. Let $2\bar{i} - \bar{j} - \bar{k}$, $5\bar{i} + \bar{j} - 2\bar{k}$, $-13\bar{i} - 11\bar{j} + 4\bar{k}$ be the position vectors of three points A, B, C respectively.

If $\overline{AB} = \lambda \overline{BC}$ and $\overline{AC} = \mu \overline{CB}$, then $\lambda + \mu =$

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

110. $\bar{a}, \bar{b}$ are position vectors of the points A and B respectively, C and D are points on the line AB such that

$\overline{AB}, \overline{AC}$ and $\overline{BD}, \overline{BA}$ are two pairs of like vectors. If $\overline{AC} = 3\overline{AB}$ and $\overline{BD} = 2\overline{BA}$, then $\overline{CD} =$

- (a) $3\bar{b} - 4\bar{a}$ (b) $4\bar{a} - 4\bar{b}$
(c) $4\bar{a} - 3\bar{b}$ (d) $3\bar{b} - 3\bar{a}$

111. If $\bar{a}, \bar{b}, \bar{c}$ are three unit vectors such that $|\bar{a} - \bar{b}|^2 + |\bar{b} - \bar{c}|^2 + |\bar{c} - \bar{a}|^2 = 15$, then $|\bar{a} - \bar{b} - \bar{c}|^2 - 4(\bar{b} \cdot \bar{c}) =$

- (a) 6 (b) 15
(c) 12 (d) 10

112. If $\bar{a} = \bar{i} + p\bar{j} - 3\bar{k}$, $\bar{b} = p\bar{i} - 3\bar{j} + \bar{k}$, $\bar{c} = -3\bar{i} + \bar{j} + 2\bar{k}$ are three vectors such that $|\bar{a} \times \bar{b}| = |\bar{a} \times \bar{c}|$, then $p =$

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

113. If $\bar{a} = 2\bar{i} - 3\bar{j} + 4\bar{k}$, $\bar{b} = \bar{i} + 2\bar{j} - \bar{k}$, $\bar{c} = 3\bar{i} - \bar{j} + 2\bar{k}$ and $\bar{d} = \bar{i} + \bar{j} + \bar{k}$ are four vectors, then

$(\bar{a} \times \bar{b}) \times (\bar{c} \times \bar{d}) =$

- (a) $17\bar{i} - 15\bar{j} + 9\bar{k}$ (b) $31\bar{i} - \bar{j} + 23\bar{k}$
(c) $17\bar{i} - \bar{j} + 23\bar{k}$ (d) $31\bar{i} - 15\bar{j} + 9\bar{k}$

114. The variance of the ungrouped data 2, 12, 3, 11, 5, 10, 6, 7 is

- (a) 11.875 (b) 11
(c) 12 (d) 10.765

115. If A and B are events of a random experiment such that $P(A \cup B) = \frac{3}{4}$, $P(A \cap B) = \frac{1}{4}$, $P(\bar{A}) = \frac{2}{3}$, then $P(\bar{A} \cap B) =$

- (a) $\frac{5}{8}$ (b) $\frac{5}{12}$
(c) $\frac{3}{8}$ (d) $\frac{2}{5}$

116. Two cards are drawn at random from a pack of 52 playing cards. If both the cards drawn are found to be black in colour, then the probability that atleast one of them is a face card is

- (a) $\frac{3}{13}$ (b) $\frac{3}{5}$
(c) $\frac{9}{65}$ (d) $\frac{27}{65}$

117. A person is known to speak the truth in 3 out of 4 occasions. If he throws a die and reports that it is six, then the probability that it is actually six is
- (a) $\frac{3}{8}$ (b) $\frac{2}{7}$
(c) $\frac{1}{9}$ (d) $\frac{4}{5}$
118. 70% of the total employees of a factory are men. Among the employees of that factory, 30% of men and 15% of women are technical assistants. If an employee chosen at random is found to be a technical assistant, then the probability that this employee is a man is
- (a) $\frac{9}{23}$ (b) $\frac{3}{17}$
(c) $\frac{14}{17}$ (d) $\frac{14}{23}$
119. If a discrete random variable X has the probability distribution
- $$P(X = x) = k \frac{2^{2x+1}}{(2x+1)!}, x = 0, 1, 2 \dots \infty, \text{ then } k =$$
- (a) $\sinh 2$ (b) $\sec 2$
(c) $\operatorname{cosech} 2$ (d) $\cosh 2$
120. A random variable X follows a binomial distribution in which the difference between its mean and variance is 1. If $2P(x = 2) = 3P(x = 1)$, then $n^2P(x > 1) =$
- (a) 13 (b) 11
(c) 15 (d) 12
121. If the distance of a variable point P from a point A(2, -2) is twice the distance of P from Y-axis, then the equation of locus of P is
- (a) $3x^2 - y^2 + 4x - 4y - 8 = 0$
(b) $x^2 - 4x + 4y + 8 = 0$
(c) $3x^2 - y^2 + 4x - 4y + 8 = 0$
(d) $y^2 - 4x + 4y + 8 = 0$
122. If the transformed equation of the equation $2x^2 + 3xy - 2y^2 - 17x + 6y + 8 = 0$ after translating the coordinate axes to a new origin (α, β) is $aX^2 + 2hXY + bY^2 + c = 0$, then $3\alpha + c =$
- (a) h (b) 2h
(c) 2β (d) β
123. P(6, 4) is a point on the line $x - y - 2 = 0$. If A(α, β) and B(γ, δ) are two points on this line lying on either side of P at a distance of 4 units from P, then $\alpha^2 + \beta^2 + \gamma^2 + \delta^2 =$
- (a) 136 (b) $\frac{85}{\sqrt{2}}$
(c) $23 + \frac{5}{\sqrt{2}}$ (d) 52
124. If the straight line $2x + 3y + 1 = 0$ bisects the angle between two other straight lines one of which is $3x + 2y + 4 = 0$, then the equation of the other straight line is
- (a) $3x + 16y - 7 = 0$
(b) $9x + 46y - 28 = 0$
(c) $9x - 23y - 26 = 0$
(d) $18x - 23y + 15 = 0$
125. If the slopes of both the lines given by $x^2 + 2hxy + 6y^2 = 0$ are positive and the angle between these lines is $\tan^{-1}\left(\frac{1}{7}\right)$, then the product of the perpendiculars drawn from the point (1, 0) to the given pair of lines is
- (a) $\frac{1}{6}$ (b) $\frac{1}{5\sqrt{2}}$
(c) $\frac{5}{6}$ (d) $\frac{1}{3\sqrt{2}}$
126. If one of the lines represented by $ax^2 + 2hxy + by^2 = 0$ bisects the angle between the positive coordinate axes, then
- (a) $a + b = 2h$ (b) $a - b = 2h$
(c) $a + 2h + b = 0$ (d) $a + 2h - b = 0$

127. From a point P on the circle $x^2 + y^2 = 4$, two tangents are drawn to the circle $x^2 + y^2 - 6x - 6y + 14 = 0$. If A and B are the points of contact of those lines, then the locus of the centre of the circle passing through the points P, A and B is
- $x^2 + y^2 - 3x - 3y + 4 = 0$
 - $2x^2 + 2y^2 + 6x + 6y - 7 = 0$
 - $x^2 + y^2 + 3x + 3y - 4 = 0$
 - $2x^2 + 2y^2 - 6x - 6y + 7 = 0$
128. If the product of the lengths of the perpendicular drawn from the ends of a diameter of the circle $x^2 + y^2 = 4$ on to the line $x + y + 1 = 0$ is maximum, then the two ends of that diameter are
- $(-2, 0), (2, 0)$
 - $(\sqrt{3}, 1), (-\sqrt{3}, -1)$
 - $(\sqrt{2}, \sqrt{2}), (-\sqrt{2}, -\sqrt{2})$
 - $(0, 2), (0, -2)$
129. If the intercepts made by a variable circle on the X-axis and Y-axis are 8 and 6 units respectively, then the locus of the centre of the circle is
- $x^2 - y^2 + 28 = 0$
 - $y^2 - x^2 - 7 = 0$
 - $x^2 - y^2 - 28 = 0$
 - $x^2 - y^2 - 7 = 0$
130. The slope of the non-vertical tangent drawn from the point $(3, 4)$ to the circle $x^2 + y^2 = 9$ is
- $\frac{2}{3}$
 - $\frac{3}{2}$
 - $\frac{7}{24}$
 - $\frac{24}{7}$
131. If the acute angle between the circles $S \equiv x^2 + y^2 + 2kx + 4y - 3 = 0$ and $S^1 \equiv x^2 + y^2 - 4x + 2ky + 9 = 0$ is $\cos^{-1}\left(\frac{3}{8}\right)$ and the centre of $S^1 = 0$ lies in the first quadrant, then the radical axis of $S = 0$ and $S^1 = 0$ is
- $x - 5y + 6 = 0$
 - $x - 5y - 4 = 0$
 - $5x - y - 6 = 0$
 - $5x - y - 4 = 0$
132. If L is the normal drawn to the parabola $y^2 = 8x$ at the point $t = \frac{1}{\sqrt{2}}$, then the foot of the perpendicular drawn from the focus of the parabola on to the normal L is
- $(3, 2)$
 - $(5, \sqrt{2})$
 - $(0, \sqrt{2})$
 - $(3, \sqrt{2})$
133. If tangents are drawn to the ellipse $x^2 + 2y^2 = 2$, then the locus of the midpoints of the intercepts made by the tangents between the coordinate axes is
- $\frac{x^2}{4} + \frac{y^2}{2} = 1$
 - $\frac{x^2}{2} + \frac{y^2}{4} = 1$
 - $\frac{1}{4x^2} + \frac{1}{2y^2} = 1$
 - $\frac{1}{2x^2} + \frac{1}{4y^2} = 1$
134. One of the latus recta of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ subtends an angle $2\tan^{-1}\left(\frac{3}{2}\right)$ at the centre of the hyperbola. If $b^2 = 36$ and e is the eccentricity of the given hyperbola, then $\sqrt{a^2 + e^2} =$
- 4
 - $\sqrt{14}$
 - 6
 - $\sqrt{21}$
135. If the equation of the hyperbola having $(8, 3), (0, 3)$ as foci and $\frac{4}{3}$ as eccentricity is $\frac{(x-\alpha)^2}{p} - \frac{(y-\beta)^2}{q} = 1$ then $p + q =$
- β^2
 - $\alpha + \beta$
 - α^2
 - $\alpha\beta$
136. $G(1, 0, 1)$ is the centroid of the triangle ABC. If $A = (1, -4, 2)$ and $B = (3, 1, 0)$ then $AG^2 + CG^2 =$
- BG^2
 - $2BG^2$
 - $6BG^2$
 - $5BG^2$

137. If the sum of the distances of the point $(3, 4, \alpha)$, $\alpha \in \mathbb{R}$ from X -axis, Y -axis and Z -axis is minimum, then $\sec \alpha =$
- (a) 2 (b) 1
(c) 0 (d) -1
138. If the equation of the plane passing through the point $(2, -1, 3)$ and perpendicular to each of the planes $3x - 2y + z = 8$ and $x + y + z = 6$ is $7x + my + nz = 1$, then $4m + 2n - 3l =$
- (a) 0 (b) $-\frac{20}{11}$
(c) 1 (d) 3
139. $\lim_{x \rightarrow 0} \frac{(\sqrt{2}) - \sqrt{1 + \cos x}}{\sqrt{15 + \cos 2x} - 4} =$
- (a) $-\frac{1}{\sqrt{2}}$ (b) $\frac{1}{\sqrt{2}}$
(c) $\sqrt{2}$ (d) $-\sqrt{2}$
140. If a real valued function $f(x) = \begin{cases} \frac{x^2 + (a+3)x + (a+1)}{x+3}, & \text{when } x \neq -3 \\ -\frac{5}{2}, & \text{when } x = -3 \end{cases}$ is continuous at $x = -3$, then $\lim_{x \rightarrow a} (x^2 + x + 1) =$
- (a) $\frac{7}{4}$ (b) $\frac{5}{2}$
(c) $\frac{4}{7}$ (d) $\frac{2}{5}$
141. $\lim_{x \rightarrow 0} \frac{x \tan 2x - 2x \tan x}{(1 - \cos 3x)(\operatorname{cosec} x - \cot x)^2} =$
- (a) $\frac{4}{9}$ (b) $\frac{8}{9}$
(c) $\frac{16}{9}$ (d) $\frac{32}{9}$
142. Match the functions in Column I with their properties in Column II. In the following $[x]$ denotes the greatest integer less than or equal to x
- | Column (I) | Column (II) |
|-------------------------------|---|
| (A) $x x $ | (I) Strictly increasing and continuous in $(-1, 1)$ |
| (B) $\sqrt{ x }$ | (II) Continuous but not differentiable in $(-1, 1)$ |
| (C) $x + [x]$ | (III) Differentiable in $(-1, 1)$ |
| (D) $ x - 1 + x + 1 + x $ | (IV) Differentiable in $(-1, 0) \cup (0, 1)$ |
| | (V) Strictly increasing and not differentiable in $(-1, 1)$ |
- The correct match is
- (a) A-III, B-V, C-II, D-I
(b) A-II, B-III, C-I, D-V
(c) A-I, B-II, C-V, D-IV
(d) A-IV, B-I, C-V, D-III
143. The derivative of $\sec^{-1} \left(\frac{1}{2x^2 - 1} \right)$ with respect to $\sqrt{1 - x^2}$ at $x = \frac{1}{2}$ is
- (a) -2 (b) 1
(c) 2 (d) 4

144. If $5f(x) + 3f\left(\frac{1}{x}\right) = x + 2$ and $y = xf(x)$, then $\frac{dy}{dx}$ at $x = 1$ is equal to

- (a) 14 (b) $\frac{7}{8}$
(c) 1 (d) 7

145. The area (in square units) of the triangle formed by the X - axis, the tangent and the normal drawn at $(1, 1)$ to the curve $x^3 + y^3 = 2xy$ is

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

146. The value c of the Rolle's theorem for the function $f(x) = 2\sin x + \sin 2x$ in the interval $[0, \pi]$ is

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

147. If the function $y = g(x)$ representing the slopes of the tangents drawn to the curve $y = 3x^4 - 5x^3 - 12x^2 + 18x + 3$ is strictly increasing then the domain of $g(x)$ is

- (a) $\left[-\frac{1}{2}, \frac{4}{3}\right]$ (b) $\left(\frac{-1}{2}, \frac{4}{3}\right)$
(c) $\mathbb{R} - \left(\frac{-1}{2}, \frac{3}{4}\right)$ (d) $\mathbb{R} - \left[\frac{-1}{2}, \frac{4}{3}\right]$

148. Consider the following functions

$$(I) f(x) = \begin{cases} \frac{1}{2} - x, & x < \frac{1}{2} \\ \left(\frac{1}{2} - x\right)^2, & x \geq \frac{1}{2} \end{cases}$$

$$(II) f(x) = |3x - 1|$$

$$(III) f(x) = x|x|$$

$$(IV) f(x) = |x|$$

Then on $[0, 1]$ Lagrange's mean value theorem is applicable to the functions

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

149. $\int \frac{e^{\sin x}(\sin 2x - 8\cos x)}{2(\sin x - 3)^2} dx =$

- (a) $e^{\sin x}(\sin x - 3) + c$ (b) $\frac{e^{\sin x}}{(\sin x - 3)^2} + c$
(c) $e^{\sin x}(\sin x - 3)^2 + c$ (d) $\frac{e^{\sin x}}{\sin x - 3} + c$

150. If $\int \left(3t^2 \sin \frac{1}{t} - t \cos \frac{1}{t}\right) dt = f(t) \sin \left(\frac{1}{t}\right) + c$, then $f(2) =$

- (a) 2 (b) -12
(c) 8 (d) -16

151. $\int (\log x)^3 x^4 dx =$

- (a) $x^5 \left[\frac{1}{5} (\log x)^3 - \frac{3}{25} (\log x)^2 + \frac{6}{125} \log x - \frac{6}{625} \right] + c$
(b) $x^5 \left[\frac{1}{5} (\log x)^3 - \frac{2}{25} (\log x)^2 + \frac{6}{125} \log x - \frac{12}{125} \right] + c$
(c) $x^5 \left[\frac{1}{5} (\log x)^3 - \frac{4}{25} (\log x)^2 - \frac{9}{125} \log x - \frac{8}{125} \right] + c$
(d) $x^5 \left[\frac{1}{5} (\log x)^3 + \frac{3}{25} (\log x)^2 - \frac{6}{125} \log x - \frac{6}{125} \right] + c$

152. $\int \frac{\sin 2x}{\sin^2 x + 3\cos x - 3} dx$

- (a) $2 \log \left| \frac{\cos x - 2}{\cos x - 1} \right| + c$
(b) $\log \left(\frac{(\cos x - 2)^2}{(\cos x - 1)^4} \right) + c$
(c) $\log \left(\frac{(\cos x - 2)^2}{|\cos x - 1|} \right) + c$
(d) $\log \left(\frac{(\cos x - 2)^4}{(\cos x - 1)^2} \right) + c$

153. If $\int \frac{dx}{\sin^3 x + \cos^3 x} = A \log \left| \frac{\sqrt{2}+t}{\sqrt{2}-t} \right| + B \tan^{-1}(t) + c$, then $\left(\frac{B}{A}, t \right) =$

- (a) $(3\sqrt{2}, \sin x - \cos x)$ (b) $(2\sqrt{2}, \sin x - \cos x)$
 (c) $\left(\frac{\sqrt{2}}{3}, \sin x - \cos x \right)$ (d) $\left(\frac{3}{\sqrt{2}}, \sin x + \cos x \right)$

154. $\int_{\pi/4}^{\pi/3} \frac{\cos x - \sin x}{\sin 2x} dx =$

- (a) $\frac{1}{2} \log \left[\frac{(3+2\sqrt{2})(2-\sqrt{3})}{\sqrt{3}} \right]$
 (b) $\frac{1}{2} \log \left[\frac{(3-2\sqrt{2})(2+\sqrt{3})}{\sqrt{3}} \right]$
 (c) $\log \left[\frac{(3-2\sqrt{2})(2-\sqrt{3})}{\sqrt{3}} \right]$
 (d) $\log \left[\frac{(3+2\sqrt{2})(2-\sqrt{3})}{\sqrt{3}} \right]$

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

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

156. $\lim_{n \rightarrow \infty} \left[\frac{n+1}{n^2+1^2} + \frac{n+2}{n^2+2^2} + \frac{n+3}{n^2+3^2} + \dots + \frac{n+2n}{n^2+4n^2} \right] =$

- (a) $\tan^{-1} 2 + \frac{1}{2} \log 3$ (b) $\frac{\pi}{4} + \frac{1}{2} \log 3$
 (c) $\tan^{-1} 2 + \frac{1}{2} \log 5$ (d) $\frac{\pi}{4} + \frac{1}{2} \log 5$

157. $\int_0^{\pi} \frac{x \sin x}{1 + \cos^2 x} dx =$

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

158. The differential equation corresponding to the family of parabolas whose axis is along $x = 1$ is

- (a) $\frac{d^2 y}{dx^2} - (x-1) \frac{dy}{dx} = 0$
 (b) $(x-1) \frac{d^2 y}{dx^2} - \frac{dy}{dx} = 0$
 (c) $\frac{d^2 y}{dx^2} + (x-1) \frac{dy}{dx} - y = 0$
 (d) $(x-1) \frac{d^2 y}{dx^2} + \frac{dy}{dx} = 0$

159. The general solution of the equation $\frac{dy}{dx} + \frac{1}{x} y = \frac{1}{x} e^x$ is

- (a) $y = x e^x + c$ (b) $y = x e^x + c e^{-x}$
 (c) $y = \frac{e^x + c}{x}$ (d) $y = \frac{e^{-x} + c x}{x}$

160. The general solution of the differential equation $\left(x \sin \frac{y}{x} \right) dy = \left(y \sin \frac{y}{x} - x \right) dx$ is

- (a) $\log x + \tan \frac{y}{x} = c$
 (b) $\log x + \cos \frac{y}{x} = c$
 (c) $\log x - \sin \frac{y}{x} = c$
 (d) $\log x - \cos \frac{y}{x} = c$