B.Tech. (PHYSICS)
SHIFT V

1. Energy stored in the capacitor is

(A) $U = \frac{1}{2}\varepsilon_0 E^2 d$

(B) $U = \frac{1}{2}\varepsilon_0 E^2 2d$

(C) $U = \frac{1}{2}\varepsilon_0 E^2 Ad$

(D) $U = \frac{1}{2}\varepsilon_0 E^2$

2. Which magnetic pole does not exist?

(A) Dipole
(B) Quadrupole
(C) Octupole
(D) Monopole

3. When the source move away from the observer, the frequency as measured by the observer will be

(A) Larger
(B) Smaller
(C) Infinite
(D) Zero

4. The structural determination of the solids can be obtained by using

(A) Ultraviolet rays
(B) Cosmic rays
(C) Gamma rays
(D) X-rays

5. In a p-type semiconductor, there is

(A) excess of one electron
(B) a missing of atom
(C) a donor level
(D) absence of one electron

6. What will be the energy of the photon of red color compared with that of violet color?

(A) Equal
(B) Larger
(C) Smaller
(D) Cannot be compared

7. When a system is at equilibrium, the free energy of the reaction is

(A) positive
(B) negative
(C) zero
(D) can be negative or positive

8. A lead bullet penetrates into a solid object and melts. The initial temperature of the bullet is 27°C and its melting point is 327°C. Latent heat of fusion of lead = 2.5×10^4 J/kg and specific heat capacity of lead is 125 J/kg/K. Assuming that 50% of its kinetic energy was used to heat it, then the initial speed of the bullet is

(A) 200 m/sec
(B) 300 m/sec
(C) 400 m/sec
(D) 500 m/sec

9. If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle between A and B is

(A) π
(B) $\frac{\pi}{3}$
(C) $\frac{\pi}{2}$
(D) $\frac{\pi}{4}$

10. The height up to which water will rise in capillary tube will be

(A) Same at all temperatures
(B) Maximum when the temperature of water is 0°C
(C) Maximum when the temperature of water is 4°C
(D) Minimum when the temperature of water is 4°C

11. If Young's double slit experiment is performed in water

(A) The fringe width decreases
(B) The fringe width increases
(C) The fringe width is unchanged
(D) There will be no fringes observed

12. If the earth stops rotating about its axis, the acceleration due to gravity will remain unchanged at

(A) Equator
(B) 45° latitude
(C) 60° latitude
(D) Poles

13. No current flows between two charged bodies when connected, if they have same

(A) capacity
(B) potential
(C) resistance
(D) charges

14. Kinetic energy and stopping potential are zero, when the frequency of incident radiation is

(A) equal to the threshold frequency
(B) very minimum
(C) lower than the threshold frequency
(D) very high

15. What happens during the regulation action of a Zener diode?

(A) The current and voltage across the Zener diode remains fixed
(B) The Zener resistance is constant
(C) The resistance offered by the Zener diode changes
(D) The current through the series resistance (R_S) does not change

16. Which of the following electromagnetic radiation has maximum penetrating power?

(A) Radio waves
(B) Microwaves
(C) Ultraviolet rays
(D) Gamma rays

17. The lines of forces due to the Earth's horizontal magnetic field are

(A) elliptical
(B) curved lines
(C) parallel and straight
(D) concentric circles

18. In the transverse waves the direction of vibration in medium of particle is

(A) perpendicular to propagation of wave
(B) parallel to propagation
(C) alternate parallel and perpendicular
(D) in all three directions

19. de Broglie proposed that electron has

(A) dual characters of wave and particle nature
(B) only particle nature
(C) only wave nature
(D) either wave or particle nature

20. The Speed of Light in Vacuum is

(A) $\frac{\mu_0}{\varepsilon_0}$

(B) $\mu_0\varepsilon_0$

(C) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$

(D) $\frac{1}{\mu_0\varepsilon_0}$

21. The working of a scent sprayer is based on

(A) Archimedes' principle
(B) Charles' law
(C) Boyle's law
(D) Bernoulli's principle

22. A body absorbs all the radiation incident over it is called

(A) perfect black body
(B) perfect white body
(C) emitter
(D) poor absorber

23. The K_α X-ray of molybdenum has wavelength 71 pm. If the energy of a molybdenum atom with a *K* electron knocked out is 23.32 keV, what will be the energy of this atom when an *L* electron is knocked out?

(A) 5.82 eV
(B) 6.52 eV
(C) 8.22 eV
(D) 4.32 eV

24. What is immaterial for an electric fuse wire?

(A) Specific resistance
(B) Radius
(C) Length
(D) Current flowing through it

25. Pressure exerted by a liquid depends upon

(A) density
(B) viscosity
(C) surface tension
(D) buoyancy

26. The temperature coefficient of resistance is positive for

(A) Carbon
(B) Germanium
(C) Electrolyte
(D) Aluminium

27. Two coils of self inductances L_1 and L_2 are placed close together, if mutual inductance between them is M, then M is proportional to ……., where the proportionality constant is known as ……..

(A) $\frac{L_1}{L_2}$, coefficient of coupling

(B) $L_1 L_2$, coefficient of coupling

(C) $(L_1 L_2)^2$, coefficient of coupling

(D) $\sqrt{L_1 L_2}$, coupling coefficient

28. In a plane electromagnetic wave, if the electric field oscillates sinusoidally with a frequency 2×10^{10} Hz and amplitude of 48 Vm^{-1}, then the wavelength of the wave and strength of the oscillating magnetic field are

(A) 600 m, 6×10^7 tesla

(B) 3×10^8 m, 24×10^{-10} tesla

(C) 1.5×10^{-2} m, 1.6×10^{-7} tesla

(D) 3×10^8 m, 1.6×10^7 tesla

29. A student sets a source at a distance 10 cm away from a double slit which are separated by 5 cm apart and keeps the micrometer eye piece at 60 cm from the double slit φ, but unable to observe the interference fringes. You must advice him to

(A) increase the distance of the source
(B) decrease the distance between the double slit
(C) replace the light with white light source
(D) replace the micrometer eyepiece with telescope

30. The molecular weights of oxygen and hydrogen are 32 and 2 respectively. The root mean square velocities of oxygen and hydrogen at NTP are in the ratio

(A) 4 : 1
(B) 1 : 16
(C) 16 : 1
(D) 1 : 4

31. What is the unit of self-inductance?

(A) Henry
(B) Weber
(C) Volt
(D) Fermi

32. Sparkling of diamond is due to

(A) reflection
(B) diffraction
(C) total internal reflection
(D) the high refractive index of diamond

33. Magnetic domain formation is the necessary feature of

(A) diamagnetism
(B) ferromagnetism
(C) paramagnetism
(D) superconductivity

34. The average power consumed in a purely inductive circuit is

(A) $I_{max} \times V_{max}$
(B) zero
(C) 1
(D) $\frac{I_{max}}{V_{max}}$

35. Neutrino is

(A) chargeless, fermion of negligible mass
(B) massless, chargeless
(C) massless, fermion of charge $\left(\frac{1}{3}\right)e$
(D) chargeless, spinless boson

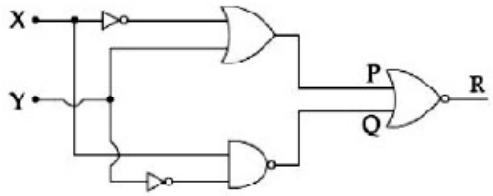
36. Which law states that the pressure exerted by a gaseous mixture is equal to the sum of partial pressure of each component present in the mixture?

(A) Graham's law
(B) Boyle's law
(C) Dalton's law
(D) Charles' law

37. If the intensity of sound is increased three times of its initial intensity, by how many decibels does the sound level increase?

(A) Remains same
(B) Tripled
(C) 4.77 dB
(D) 6 dB

38. To get output 1 at *R* for the given logic gate circuit, the input values must be



(A) $X = 0, Y = 1$
(B) $X = 1, Y = 1$
(C) $X = 1, Y = 0$
(D) $X = 0, Y = 0$

39. Which of the following principle is used in optical fibres?

(A) Diffraction
(B) Scattering
(C) Total internal reflection
(D) Refraction

40. A particle executes simple harmonic motion. The amplitude of oscillation of particle is 2 cm. The displacement of particle in one time period is

(A) 1 cm
(B) 2 cm
(C) 4 cm
(D) Zero

41. In a circuit, if the alternating current is represented by $I = 4 \cos(\omega t + \phi)$, then the r.m.s value of current is

(A) $\sqrt{2}$
(B) $4\sqrt{2}$
(C) $2\sqrt{2}$
(D) $1/\sqrt{2}$

42. Work function of three metals A, B and C are 4.7 eV, 4.5 eV and 3.5 eV respectively. If a light of wavelength 3310 A° is incident on the metals, then photoelectrons are emitted by

(A) All the metals
(B) C alone
(C) A and B alone
(D) No metals

43. Mirror nuclei are nuclei having

(A) same mass number but with different atomic number
(B) same mass number but with proton number and neutron number interchanged
(C) equal number of neutrons
(D) mirror images

44. An athlete completes one round of a circular track of radius R in 20 seconds. What will be his displacement at the end of 2 minutes 20 seconds?

(A) Zero
(B) 2R
(C) $2\pi R$
(D) $7\pi R$

45. A marble block of mass 2 kg lying on ice when given a velocity of 6 m/s is stopped by friction in 10 s. Then the coefficient of friction is

(A) 0.01
(B) 0.02
(C) 0.03
(D) 0.06

46. The pair of physical quantities that has the different dimensions is

(A) Reynolds number and coefficient of friction
(B) Curie and frequency of a light wave
(C) Latent heat and gravitational potential
(D) Planck's constant and torque

47. The position of a particle varies with time t as $x = pt^2 - qt^3$. The acceleration of the particle will be

(A) $2pt - 3qt^2$
(B) p/q
(C) $2p - 6qt$
(D) zero

48. Which one of the following is the unit of solid angle?

(A) Degree
(B) Radian
(C) Steradian
(D) Second

49. A certain carbon resistor has following colour codes:

I band – Yellow; II band – Violet; III band – Orange; IV band – Gold

Then

(A) the value of the resistance is 4.7 KΩ ±5% tolerance
(B) the value of the resistance is 47 KΩ ±5% tolerance
(C) the value of the resistance is 47 KΩ ±10% tolerance
(D) the value of the resistance is 4.7 KΩ ±10% tolerance

50. A 600 W electric heater is designed to operate from 240 V lines. Then it would draw a current of

(A) 0.4 A
(B) 2.5 A
(C) 5 A
(D) 15 A

51. Fermi level in the case of intrinsic semiconductor lies

(A) close to the conduction band
(B) close to the valence band
(C) in the middle of the forbidden energy gap
(D) above the conduction band

52. A metal wire is first stretched beyond its elastic limit and then released. It

(A) loses its elastic property completely and it will not contract
(B) will contract to its original length
(C) will contract to its length at elastic limit
(D) will contract but final length will be greater than original length

53. If there were no gravity, which one of the following will not be there for a fluid?

(A) Viscosity
(B) Surface tension
(C) Pressure
(D) Archimedes upthrust or Buoyant force

54. The energy radiated by unit area in unit time of a planet is 5.67×10^{4} Watt. Its surface temperature is then (Given Stefan's constant $\sigma = 5.67 \times 10^{-8}$ W/m^2K^4)

(A) 1273°C
(B) 1000°C
(C) 727°C
(D) 727 K

55. Bonding in Germanium crystal is

(A) Ionic
(B) van der Waals' type
(C) Metallic
(D) Covalent

56. The percentage of U^{235} present in natural Uranium is

(A) 100%
(B) 0.714%
(C) 99.28%
(D) 0.006%

57. The image formed by the objective of a compound microscope is

(A) virtual and enlarged
(B) virtual and diminished
(C) real and diminished
(D) real and enlarged

58. When the angle of incidence on a certain material is 60°, the reflected light is completely polarized. The refractive index of the material is then

(A) 1.732
(B) 0.866
(C) 0.577
(D) 1.5

59. In case of a common emitter transistor amplifier, the ratio of the collector current to the emitter current Ic /Ie is 0.96. The current gain of the amplifier is

(A) 6
(B) 48
(C) 24
(D) 12

60. The decimal equivalent of the binary number 1111 is

(A) 15
(B) 4
(C) 14
(D) 1

61. In Young's double slit experiment the slits are separated by 0.28 mm and the screen is placed 1.4 m away. The distance between the central bright fringe and the fourth fringe is measured to be 1.2 cm. Determine the wavelength of light used in this experiment.

(A) 650 nm
(B) 400 nm
(C) 500 nm
(D) 600 nm

62. If an electron and a photon propagate in the form of waves having same wavelength, it implies that they have same

(A) speed
(B) momentum
(C) energy
(D) All of the above

63. A book of mass *m*, placed on an inclined table, making an angle of 30° with the horizontal, slides down with an acceleration of $\frac{g}{3}$. The frictional force acting on the book is

(A) 1 mg
(B) $\frac{2}{3}$ mg
(C) $\frac{1}{3}$ mg
(D) $\frac{1}{6}$ mg

64. A ball of mass 50 g is dropped from a height of 10 m. It reaches the ground with a speed of 1.5 m/s. The work done by the air-friction is

(A) 5.056 J
(B) 4.954 J
(C) –4.954 J
(D) –5.056 J

65. A circular disc having a moment of inertia 4 kg m^2 about its axis rotates at 40 rpm. The torque required to stop the wheel in 2 minutes is

(A) $\left(\frac{2}{45}\right)\pi$ Nm
(B) $\left(\frac{1}{45}\right)\pi$ Nm
(C) $\left(\frac{2}{25}\right)\pi$ Nm
(D) $\left(\frac{1}{25}\right)\pi$ Nm

66. A particle undergoes simple harmonic motion of time period T. The time taken by the particle to go directly from the mean position to half the amplitude is

(A) $\frac{T}{2}$

(B) $\frac{T}{3}$

(C) $\frac{T}{6}$

(D) $\frac{T}{12}$

67. A U-shaped tube has areas of cross-sections 2 cm^2 and 20 cm^2 at its two ends. It is filled with water, and a force of 10 N is applied in the thinner arm using a piston. For the water to remain in equilibrium the force to be applied in the thicker arm is

(A) 20 N
(B) 40 N
(C) 100 N
(D) 200 N

68. The first overtone frequency of an open organ pipe is equal to the fundamental frequency of a closed organ pipe. What is the length of the closed pipe, if the length of open pipe is 80 cm?

(A) 20 cm
(B) 40 cm
(C) 60 cm
(D) 80 cm

69. An ambulance moves away from an observer at a speed of 20.00 m/s. The siren in the ambulance is detected by the observer and is found to be at a frequency of 2200.00 Hz. Considering the observer to be immobile and speed of sound to be 320.00 m/s, what is the original frequency of the siren?

(A) 2200.00 Hz
(B) 2337.44 Hz
(C) 2557.35 Hz
(D) 3201.23 Hz

70. The beam from a laser source is incident on a double slit with the distance between them being 430 micron. A screen is placed at a distance of 2.00 m from the double slit to observe the fringes. The first bright fringe is observed at 2.2 mm from the central fringe. The wavelength of the laser source is

(A) 355.05 nm
(B) 423.24 nm
(C) 468.09 nm
(D) 532.01 nm

71. A monochromatic beam of light is incident on a glass block at an angle of 60° with respect to the surface normal. The reflected beam is observed to be completely polarised. The critical angle for the glass block is

(A) 15.77°
(B) 25.34°
(C) 35.27°
(D) 55.71°

72. A sealed glass container has a volume of 3 liters. It contains 0.5 mole of oxygen and 0.3 mole of nitrogen. If the contents of the container are at 300 K, then the pressure in the chamber is

(A) 2.50×10^5 Pa
(B) 4.16×10^5 Pa
(C) 6.65×10^5 Pa
(D) 8.32×10^5 Pa

73. A vertically falling charged liquid droplet of mass 2×10^{-5} kg is balanced in air by a vertical electric field of magnitude 3.00×10^5 N/C. The charge on the droplet is

(A) 3.00×10^{-10} C
(B) 3.57×10^{-10} C
(C) 6.67×10^{-10} C
(D) 1.60×10^{-19} C

74. In a circuit, at a given time, 20 C of charge is passed through a battery, whose plates are maintained at a potential difference of 20 V. The work done by the battery is

(A) 1 J
(B) 10 J
(C) 20 J
(D) 400 J

75. A parallel plate capacitor has plates of area 300.00 cm^2 with the separation between them being 2.00 mm. If a charge of 2 nC is given to the capacitor, what will be the potential difference that is developed between the plates?

(A) 5.42 V
(B) 15.04 V
(C) 20.12 V
(D 75.00 V

CHEMISTRY UG
(SHIFT V FINAL)

76. In a reversible isothermal process, the change in internal energy

(A) $\Delta E = 0$
(B) $\Delta E > 0$
(C) $\Delta E < 0$
(D) $\Delta E \geq 0$

77. Which of the following two gases can be cooled from room temperature by the Joule-Thomson effect?

(A) Hydrogen and oxygen
(B) Helium and nitrogen
(C) Helium and hydrogen
(D) Nitrogen and oxygen

78. A weak acid has a dissociation constant of 1×10^{-4}. The equilibrium constant for its reaction with a strong base is

(A) 1.0×10^{-4}
(B) 1.0×10^{-10}
(C) 1.0×10^{10}
(D) 1.0×10^{14}

79. A plant cell shrinks when it is kept in

(A) Hypertonic solution
(B) Hypotonic solution
(C) Water
(D) Isotonic solution with cell sap

80. Two platinum electrodes were immersed in a solution of copper sulphate and electric current was passed till the solution becomes colourless. The colourless solution contains

(A) Platinum sulphate
(B) Copper hydroxide
(C) Only water
(D) Dilute sulphuric acid

81. To protect iron against corrosion, the most durable metal plating on it is

(A) Tin plating
(B) Copper plating
(C) Zinc plating
(D) Nickel plating

82. For a first order reaction, $t_{0.75}$ is 138.6 sec. Its specific rate constant (in sec) is

(A) 10^{-2}
(B) 10^{-4}
(C) 10^{-5}
(D) 10^{-6}

83. If the rate law for a reaction is, rate = $k[A][B]^2$, the unit for k is

(A) mol L^{-1} s^{-1}
(B) mol s^{-1}
(C) L^2 mol^{-2} s^{-1}
(D) mol^2 L^{-2} s^{-1}

84. For a linear plot of $\log\left(\frac{x}{m}\right)$ versus $\log p$ in a Freundlich adsorption isotherm, the correct statement is (k and n are constants).

(A) Both k and $\frac{1}{n}$ appear in the slope term

(B) $\frac{1}{n}$ appears as the intercept

(C) Only $\frac{1}{n}$ appears as the slope

(D) $\log\left(\frac{1}{n}\right)$ appears as the intercept

85. Multilayer adsorption is assumed in

(A) Langmuir equation
(B) Freundlich equation
(C) BET equation
(D) Both Langmuir equation and BET equation

86. The intensive property listed below is

(A) Internal energy
(B) Volume
(C) Mole fraction
(D) Mass

87. When a system releases 10 kJ of energy to the surroundings as work, the internal energy of the system

(A) decreases by 10 kJ
(B) increases by 5 Kj
(C) reduced 20 kJ
(D) remains constant

88. Quantitative relation between pressure and solubility of a gas in a solvent is given by …….. law.

(A) Le Chatelier
(B) Dalton
(C) Henry
(D) Raoult

89. Which of the following relation is true for Rhombohedral crystal system?

(A) $\alpha = \beta = \gamma = 90°$
(B) $\alpha \neq \beta = \gamma = 90°$
(C) $\alpha = \beta = 90°\ \gamma = 120°$
(D) $\alpha = \beta = \gamma \neq 90°$

90. Schottky defect is an example of

(A) point defect
(B) metal deficiency
(C) metal excess
(D) electron defect

91. In Ziegler Natta catalyst the commonly used catalyst system is

(A) $TiCl_4$, $Al(C_2H_5)_3$
(B) $(\eta^5\text{-cp})_2$ $TiCl_2$, $Al(OEt)_3$
(C) VO $(acac)_2$ $Al_2(CH_3)_6$
(D) $TiCl_4$, BF_3

92. In an isothermal expansion of an ideal gas, the internal energy of molecules

(A) may increase or decrease
(B) does not change
(C) increase
(D) decrease

93. The combined form of first and second law of thermodynamics is given by (p = Pressure, V = Volume, T = Temperature, U = Internal energy, S = Entropy, Q = Quantity of heat)

(A) $TdS = dU + pdV$
(B) $dQ = TdS + pdV$
(C) $dU = TdS + dQ$
(D) $TdS = dU - pdV$

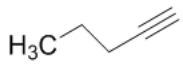
94. In which case rate of diffusion is highest if all are present in the same container at the same temperature?

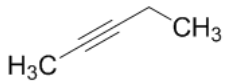
(A) 4g H_2
(B) 32g O_2
(C) 22g CO_2
(D) 56g N_2

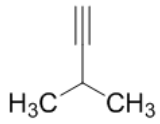
95. One mole of an ideal gas is expanded from 10 L to 20 L at 298 K isothermally and reversibly. The correct statement describing the entropy change for the above process is

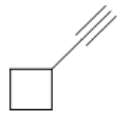
(A) $\Delta S = nRTln\ 2$
(B) $\Delta S = nRTln\ \frac{1}{2}$
(C) $\Delta S = nRln\ 2$
(D) $\Delta S = nRln\ \frac{1}{2}$

96. An alkyne on treatment with dilute H_2SO_4 and $HgSO_4$ gave a mixture of two isomeric ketones ($C_5H_{10}O$). Identify the structure of the alkyne.

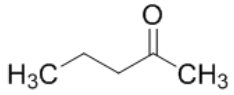
(A) 

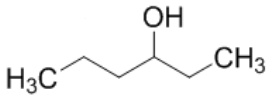
(B) 

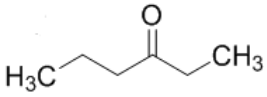
(C) 

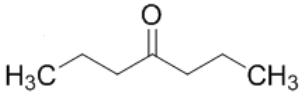
(D) 

97. Propionaldehyde is reduced in presence of sodium borohydride to compound **P** which is treated first with thionyl chloride and the resultant compound **Q** is treated with magnesium in dry ether to form **R**. **R** can react with propionaldehyde to form **S**. What product is formed when **S** is oxidized with potassium dichromate?

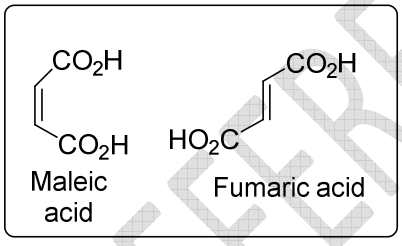
(A) 

(B) 

(C) 

(D) 

98. Maleic acid (shown below) is a geometrical isomer of fumaric acid. Which of the statements given below is true? (pK_a is a measure of acidity)



(A) Both have same pK_a (1^{st} and 2^{nd})

(B) 1^{st} pK_a of maleic acid < 1^{st} pK_a of fumaric acid

(C) 2^{nd} pK_a of maleic acid < 2^{nd} pK_a of fumaric acid

(D) 1^{st} pK_a of maleic and fumaric acids are same, while 2^{nd} pK_a of maleic acid < 2^{nd} pK_a of fumaric acid

99. An epimer of glucose is (remember, All Altruists Gladly Make Gum In Gallon Tanks):

(A) Mannose
(B) Fructose
(C) Allose
(D) Tallose

100. Coagulation of blood is promoted by Vitamin

(A) B
(B) C
(C) D
(D) K

101. Which of the following is a polyamide?

(A) Polyurethane
(B) Nylon 6
(C) Polyaniline
(D) Melamine formaldehyde resin

102. A more environmentally friendly alternative to using CFC for refrigeration is:

(A) Tetrafluoroethylene
(B) Hydrofluorocarbons
(C) Bromoflurocarbons
(D) Tetrachloroethylene

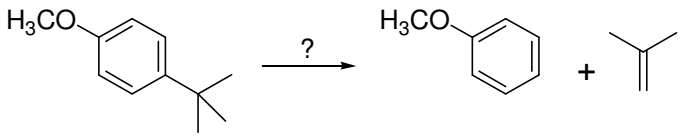
103. Cyclohexene can be converted to adipic acid [$CO_2H(CH_2)_4CO_2H$] using

(A) O_3, $NaBH_4$
(B) O_3, Me_2S
(C) O_3, H_2O
(D) O_3, H_2O_2

104. In which of the following compounds π-delocalization is **NOT** possible

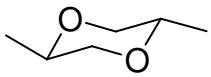
(A) 1,3-Butadiene
(B) 1,2-Butadiene
(C) 1,3,5-Hexatriene
(D) Benzene

105. The following reaction is best accomplished by



(A) Treating with strong base
(B) Neat heating at 50 °C
(C) Treating with strong acids like conc. H_2SO_4
(D) Using free radical initiators

106. Explain why 2,5-dimethyl-1,4-dioxane (shown below) is not chiral.



(A) It has an axis of symmetry
(B) It has a plane of symmetry
(C) It has no chiral carbons
(D) It has a centre of symmetry

107. Which among the following is a β-lactam antibiotic?

(A) Chloramphenicol
(B) Penicillin
(C) Vitamin K
(D) Griesofulvin

108. Oximes of benzophenones rearranges on reacting with $SOCl_2$ to form the corresponding Benzanilides. This rearrangement reaction is an example for

(A) Hofmann Rearrangment
(B) Curtius Rearrangement
(C) Wagner-Meerwein Rearrangement
(D) Beckmann Rearrangement

109. Among the following, the amino acid which has phenolic side chain is?

(A) Aspartic Acid
(B) Asparagine
(C) Leucine
(D) Tyrosine

110. The principle involved in column chromatography over silica gel is

(A) Absorption
(B) Partition
(C) Adsorption
(D) Size exclusion

111. An organic compound which has the ability to exhibit optical activity is

(A) 2–Methylbutane
(B) 3–Methylpentane
(C) Methylcyclopentane
(D) 3–Methylhexane

112. Iodoalkane is obtained by the reaction of the corresponding bromoalkane or chloroalkane with NaI in dry acetone. The reaction is known as

(A) Hunsdiecker reaction
(B) Wurtz reaction
(C) Finkelstein reaction
(D) Iodoform reaction

113. Williamson's ether synthesis works most efficiently in

(A) acidic medium
(B) basic medium
(C) neutral conditions
(D) neat heating above 50 °C

114. The percent composition of an organic compound was estimated as: 72% C, 12% H. The molar mass is 100 g/mole. What is the molecular formula of this compound?

(A) $C_5H_8O_2$
(B) C_7H_{16}
(C) $C_6H_{12}O$
(D) $C_4H_4O_3$

115. SN_2 substitution proceeds through

(A) carbocation intermediate
(B) carbanion intermediate
(C) free radical intermediate
(D) no intermediate, only a transition state

116. Which of the following metal cannot be obtained by electrolysis of an aqueous solution?

(A) Copper
(B) Magnesium
(C) Calcium
(D) Chromium

117. Solubility of the alkaline earth metal sulphates in water decreases in the sequence

(A) Ba > Mg > Sr > Ca
(B) Mg >Ca > Sr > Ba
(C) Ca > Sr > Ba > Mg
(D) Sr >Ca > Mg > Ba

118. Among the alkali earth metals, which one forms an insoluble sulfide, and what specific factor contributes to this behavior?

(A) Beryllium (Be); Small size and high lattice energy
(B) Magnesium (Mg); Low ionization energy
(C) Calcium (Ca); Exceptionally stable Ca^{2+} ions
(D) Barium (Ba); Increased atomic size

119. Calculate the electron gain enthalpy of sodium ion, whose first ionisation potential is 5.1 eV.

(A) –2.55 eV
(B) 5.1 eV
(C) 10.2 eV
(D) 2.55 eV

120. Calomel on reaction with NH_4OH gives

(A) Hg_2O
(B) HgO
(C) $HgNH_2Cl$
(D) NH_2Hg_2Cl

121. Which of the following elements and its specific factor which can form superconducting compounds at relatively higher temperatures in comparison to other d-block elements?

(A) Chromium (Cr); Due to its exceptional hardness
(B) Vanadium (V); Exhibits variable oxidation states
(C) Yttrium (Y); Forms oxygen deficient compounds
(D) Manganese (Mn); Displays diverse magnetic properties

122. Which among the following catalysts and the unique property made them to act both as homogeneous and heterogeneous catalyst?

(A) Platinum (Pt); Due to its high surface area
(B) Iron (Fe); Exhibits redox activity
(C) Palladium (Pd); Forms stable complexes in solution
(D) Zeolites; Possess well-defined porous structures

123. Among the following lanthanides, which element is known for exhibiting an unusual oxidation state, +4, in addition to its more common oxidation states, and what is the specific compound where this unusual oxidation state is observed?

(A) Europium (Eu); Exhibits +4 oxidation state in europium (IV) oxide
(B) Cerium (Ce); Shows +4 oxidation state in cerium (IV) fluoride
(C) Praseodymium (Pr); Displays +4 oxidation state in praseodymium(IV) sulfide
(D) Gadolinium (Gd); Demonstrates +4 oxidation state in gadolinium(IV) chloride

124. Among the lanthanides, which element is employed in certain medical imaging applications due to its ability to emit X-rays when exposed to high-energy photons, and what is the specific medical imaging technique where this element is utilized?

(A) Gadolinium (Gd); Used in magnetic resonance imaging (MRI)
(B) Samarium (Sm); Employed in positron emission tomography (PET)
(C) Lutetium (Lu); Utilized in single-photon emission computed tomography (SPECT)
(D) Terbium (Tb); Applied in X-ray fluorescence imaging

125. The number of ions per molecule of the complexes $CoCl_3.5NH_3$ in aqueous solution will be

(A) 2
(B) 3
(C) 4
(D) 9

126. The crystal field splitting energy for octahedral (Δ_o) and tetrahedral (Δ_t) complexes is related as

(A) $\Delta_t = 4/9\ \Delta_o$
(B) $\Delta_t = 1/2\ \Delta_o$
(C) $\Delta_o = 1/2\ \Delta_t$
(D) $\Delta_o = 4/9\ \Delta_t$

127. The complexes $[Co(NH_3)_5\ NO_2]Cl_2$ and $[Co(NH_3)_5\ ONO]Cl_2$ are examples of

(A) Linkage isomers
(B) Ionisation isomers
(C) Geometrical isomers
(D) Co-ordination isomers

128. Which of the following is hexadentate ligand?

(A) Acetylacetonate
(B) 1,10-phenanthroline
(C) Ethylene diamine
(D) Ethylene diamine tetraacetate

129. The metal atoms present in Haemoglobin and Vitamin B_{12} respectively is

(A) Fe, Mg
(B) Fe, Co
(C) Co, Fe
(D) Co, Mg

130. The IUPAC name of the compound $K_4[Fe(CN)_6]$ is

(A) Potassium hexacyanoferrate(II)
(B) Potassium hexacyanoferrate(III)
(C) Hexacyano potassiumferrate(II)
(D) Hexacyano potassiumferrate(III)

131. Principal, azimuthal and magnetic quantum numbers are respectively related to

(A) size, shape and orientation
(B) shape, size and orientation
(C) size, orientation and shape
(D) None of the above

132. To which block do the elements with atomic number 56 belongs?

(A) p
(B) f
(C) d
(D) s

133. The elements with atomic number 35, 53 and 85 are

(A) Noble gas
(B) Halogens
(C) Alkali metals
(D) Alkaline earth metals

134. Ionic bonds will be formed more easily between the elements having comparatively

(A) low ionization enthalpy and high electron affinity
(B) high ionization enthalpy and high electron affinity
(C) low ionization enthalpy and low electron affinity
(D) high ionization enthalpy and low electron affinity

135. Which state of matter has the highest kinetic energy?

(A) Solid
(B) Liquid
(C) Gas
(D) Plasma

MATHEMATICS UG
(SHIFT V **FINAL**)

136. In a group of eight girls, two girls are sisters. The number of ways in which the girls can sit in a row so that two sisters are not sitting together is

(A) 4820
(B) 1410
(C) 2830
(D) 30240

137. The sum of the factors of 8! which are odd and are the form $3m+2$, where m is a natural number is

(A) 8
(B) 35
(C) 40
(D) 45

138. If $|x|<1$, then $1+n\left(\frac{2x}{1+x}\right)+\frac{n(n+1)}{2}\left(\frac{2x}{1+x}\right)^2+\ldots$ is equal to

(A) $\left(\frac{2x}{1+x}\right)^n$

(B) $\left(\frac{1+x}{1-x}\right)^n$

(C) $\left(\frac{1+x}{2x}\right)^n$

(D) $\left(\frac{1-x}{1+x}\right)^n$

139. If $A=\begin{bmatrix}1 & 2 & -1\\ -1 & 1 & 2\\ 2 & -1 & 1\end{bmatrix}$, then $\det\left(adj\left(adj\left(A\right)\right)\right)=$

(A) 14
(B) 14^2
(C) 14^3
(D) 14^4

140. If the system of equations $ax+y=3,\ x+2y=3,\ 3x+4y=7$ is consistent, then the value of a is equal to

(A) 0
(B) -1
(C) 1
(D) 2

141. Sum of the series $1+\frac{1}{2!}+\frac{2}{3!}+\frac{2^2}{4!}+...+\infty$ is

(A) e^2
(B) $\frac{1}{2}\left(e^2+1\right)$
(C) $\frac{1}{4}\left(e^2+1\right)$
(D) e^2-1

142. The coefficient of x^k in the expansion of $\frac{1-2x-x^2}{e^{-x}}$ is

(A) $\frac{1-k-k^2}{k!}$
(B) $\frac{k^2+1}{k!}$
(C) $\frac{1-k}{k!}$
(D) $\frac{1}{k!}$

143. A binary relation ρ, defined in R by $x \rho y$ if $1+xy>0$ for $x, y \in R$, is

(A) reflexive and symmetric
(B) an equivalence relation
(C) symmetric and transitive
(D) only transitive

144. Three natural numbers are taken at random from the set $A=\{x \mid 1 \le x \le 100,\ x \in N\}$. The probability that the AM of the numbers taken is 15, is

(A) $\frac{{}^{44}C_{42}}{{}^{100}C_3}$

(B) $\frac{{}^{15}C_2}{{}^{100}C_3}$

(C) $\frac{{}^{44}C_{42}}{{}^{100}C_{15}}$

(D) $\frac{{}^{15}C_2}{{}^{100}C_{15}}$

145. Probability of getting positive integral roots of the equation $x^2-n=0$ for the integer $n,\ 1 \le n \le 40$ is

(A) $\frac{1}{5}$

(B) $\frac{1}{10}$

(C) $\frac{3}{20}$

(D) $\frac{1}{20}$

146. The value of $\sqrt{2+\sqrt{2+\sqrt{2+2\cos 8\theta}}}$ where $0<\theta<\frac{\pi}{8}$, is equal to

(A) $\cos\theta$
(B) $2\cos\theta$
(C) $2\sin\theta$
(D) $-2\cos\theta$

147. If $f(x)=\cos x\left(\sin x+\sqrt{\sin^2 x+\sin^2\theta}\right)$, where θ is a constant, then the maximum value of $f(x)$ is

(A) $\sqrt{1-\cos^2\theta}$

(B) $\sqrt{1+\sin^2\theta}$

(C) $|\cos\theta|$

(D) $|\sin\theta|$

148. If $f(x)=\sin^6 x+\cos^6 x$, then the range of $f(x)$ is

(A) $\left[1,\frac{5}{4}\right]$

(B) $\left[\frac{1}{4},\frac{3}{4}\right]$

(C) $\left[\frac{3}{4},\frac{5}{4}\right]$

(D) $\left[\frac{1}{4},1\right]$

149. Let $x=\cos 55°$, $y=\cos 65°$ and $z=\cos 175°$. Then $\frac{1}{x}+\frac{1}{y}+\frac{z}{xy}=$

(A) -1
(B) 1
(C) 0
(D) ∞

150. If A, B and C are angles of a triangle such that angle A is obtuse, then $\tan B\cdot\tan C$ will be less than

(A) $\frac{1}{\sqrt{3}}$

(B) $\frac{\sqrt{3}}{2}$

(C) 1

(D) 2

151. If $\tan^{-1}\left(\frac{a}{x}\right)+\tan^{-1}\left(\frac{b}{x}\right)=\frac{\pi}{2}$, then x is equal to

(A) $\sqrt{a^2b}$
(B) $\sqrt{2ab}$
(C) $2ab$
(D) $\sqrt{ab}$

152. Let o be the origin and $p(\alpha,\beta)$ where α is the least value of $\frac{x^2-1}{x^2+1}$ and $\beta=\int_{-1}^{1}\left(x-[x]\right)dx$. Then $op=$

(A) 0
(B) 1
(C) $\sqrt{2}$
(D) 2

153. The equation to the line touching both the parabolas $y^2=4x$ and $x^2=-32y$ is

(A) $x-2y+3=0$
(B) $x-4y+2=0$
(C) $x-2y+4=0$
(D) $x-4y+3=0$

154. Let $y=\left(1+\frac{1}{x}\right)\left(1+\frac{2}{x}\right)...\left(1+\frac{n}{x}\right)$ and $x\neq 0$. Then $\frac{dy}{dx}$ at $x=-1$ is

(A) $(n-1)!$
(B) $(-1)^n(n-1)!$
(C) $(-1)^n n!$
(D) $n!$

155. Let $f:R\to R,$ be defined by $f(x)=(x+1)^2-1,\ x\geq 1.$ Then $f^{-1}(x)$

(A) does not exists as f is not one-to-one
(B) does not exists as f is not onto
(C) $=-1-\sqrt{x+1}$
(D) $=-1+\sqrt{x+1}$

156. $\lim_{x\to 0}\frac{d}{dx}\int\frac{1-\cos x}{x^2}dx =$

(A) 0

(B) $\frac{1}{2}$

(C) 1

(D) ∞

157. The value of k in order that $f(x)=\sin x-\cos x-kx+l$ decreases for all real values, is given by

(A) $k<1$

(B) $k\geq 1$

(C) $k<\sqrt{2}$

(D) $k\geq\sqrt{2}$

158. The value of $\int_1^3(x-1)(x-2)(x-3)dx$ is

(A) $\frac{1}{3}$

(B) $\frac{9}{4}$

(C) $\frac{1}{2}$

(D) $\frac{9}{2}$

159. A curve passing through $(2,3)$ and satisfying $\int_0^x t\,y(t)\,dt=x^2y(x),\ (x>0)$ is

(A) $\frac{x^2}{8}+\frac{y^2}{18}=1$

(B) $xy=C$

(C) $x^2+y^2=13$

(D) $y^2=\frac{9}{2}x$

160. If $a+b+c=6,$ then $\sqrt{4a+1}+\sqrt{4b+1}+\sqrt{4c+1}$

(A) ≤ 9
(B) ≥ 9
(C) >9
(D) <9

161. For $a,b,x,y\in R,$ the correct statement is

(A) $a>b\Rightarrow ax>bx; x\neq 0$

(B) $|x|>|y|\Rightarrow x>y$

(C) $a>b\Rightarrow \frac{1}{a}>\frac{1}{b}$

(D) $a>b\Rightarrow a+c>b+c$

162. If $(a+ib)^5=\alpha+i\beta,$ then $(b+ia)^5$ is equal to

(A) $\beta+i\alpha$
(B) $\alpha-i\beta$
(C) $\beta-i\alpha$
(D) $-\alpha-i\beta$

163. If $z=\left(\frac{\sqrt{3}+i}{2}\right)^5+\left(\frac{\sqrt{3}-i}{2}\right)^5,$ then

(A) $\text{Re}(z)=0$
(B) $\text{Im}(z)=0$
(C) $\text{Re}(z)>0, \text{Im}(z)>0$
(D) $\text{Re}(z)>0, \text{Im}(z)<0$

164. If $z=x+iy$ and 'a' is a real number such that $|z-ai|=|z+ai|,$ then the locus of z is

(A) x-axis
(B) y-axis
(C) $x=y$
(D) $x^2+y^2=1$

165. If $(1+x)\left(1+x^2\right)\left(1+x^4\right)...\left(1+x^{128}\right)=\sum_{r=0}^{n}x^r$, then n is

(A) 255
(B) 127
(C) 60
(D) 90

166. If S_n denotes the sum of n terms of an A.P., then $S_{n+3}-3S_{n+2}+3S_{n+1}-S_n$ is equal to

(A) 2
(B) 1
(C) $\frac{1}{2}$
(D) 0

167. If $x\in R$, the number of solutions of $\sqrt{x+1}-\sqrt{x-1}=1$, is

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

168. If roots of $x^2-(k-3)x+k=0$ are such that both of them are greater than 2, then

(A) $k\in[7,9]$
(B) $k\in[7,\infty)$
(C) $k\in[9,10)$
(D) $k\in[7,9)$

169. If $\sin\alpha,\cos\alpha$ are the roots of the equation $ax^2+bx+c=0,\ c\neq 0,$ then

(A) $a^2+b^2+2ac=0$
(B) $b^2-a^2-2ac=0$
(C) $a^2-b^2-2ac=0$
(D) $a^2-b^2+2ac=0$

170. In ΔABC, let $AB = 6\sqrt{3}$ cm, $AC = 12$ cm and $BC = 6$ cm. Then the angle of B is

(A) $120°$
(B) $60°$
(C) $90°$
(D) $45°$

171. For a real y, the expression $\dfrac{y^2 + 2y - 11}{y - 3}$ takes all real values except those which lie between m and n, then m and n are

(A) 1, 2
(B) 4, 12
(C) $4, -12$
(D) $-1, 4$

172. The sum of first n terms of the series $1 + \dfrac{3}{2} + \dfrac{7}{4} + \dfrac{15}{8} + \dfrac{31}{16} + \ldots$ is equal to

(A) $2n - \dfrac{1}{2^n}$

(B) $2 + \dfrac{1}{2^n}$

(C) $2^n - \dfrac{1}{2^n}$

(D) $2(n-1) + \dfrac{1}{2^{n-1}}$

173. A common tangent to $9x^2 - 16y^2 = 144$ and $x^2 + y^2 = 9$ is

(A) $y = \dfrac{3x}{\sqrt{7}} + \dfrac{15}{\sqrt{7}}$

(B) $y = 3\sqrt{\dfrac{2}{7}}x + \dfrac{15}{\sqrt{7}}$

(C) $y = 2\sqrt{\dfrac{3}{7}}x + 15\sqrt{7}$

(D) $y = 3\sqrt{\dfrac{2}{7}}x + 15\sqrt{7}$

174. Which of the following functions from Z to Z is a bijection?

(A) $f(x) = x^3$

(B) $f(x) = x + 3$

(C) $f(x) = 3x + 1$

(D) $f(x) = x^2 + 3$

175. The mean and variance of a binomial variable *X* are 2 and 1 respectively. The probability that *X* takes values greater than 1, is

(A) $\frac{5}{16}$

(B) $\frac{9}{16}$

(C) $\frac{11}{16}$

(D) $\frac{2}{3}$

176. If $\frac{1}{2}\operatorname{cosec} x,\ 2\cot x,\ 2\operatorname{cosec} x,$ where $0 < x < \frac{\pi}{2},$ are in Geometric Progression, then *x* is equal to

(A) 2π

(B) π

(C) $\frac{\pi}{2}$

(D) $\frac{\pi}{3}$

177. If A and B are two independent events of an experiment such that $P(A \cup B) = 0.6$ and $P(A) = 0.3$, then $P(B) =$

(A) $\frac{1}{10}$

(B) $\frac{4}{10}$

(C) $\frac{3}{10}$

(D) $\frac{2}{10}$

178. The sum of the focal distances from any point on the ellipse $9x^2 + 16y^2 = 144$ is

(A) 32
(B) 18
(C) 16
(D) 8

179. The vertex of the parabola whose parametric equations are $x = t^2 + 1, y = t + 1 \ t \in \mathbb{R}$ is

(A) (1, 2)
(B) (1,−2)
(C) (1, 1)
(D) (−1, 1)

180. For all real numbers of x, the value of $\cos^4 x + \sin^2 x$ lies in the interval

(A) (1, 2)

(B) [1, 2]

(C) $\left[\frac{3}{4}, 1\right]$

(D) $\left[\frac{5}{4}, 2\right]$

181. Let $t_n = \frac{n}{(n+1)!}$. Then $\sum_{n=1}^{20} t_n$ is equal to

(A) $\frac{20!-1}{20!}$

(B) $\frac{21!-1}{21!}$

(C) $\frac{1}{2(n-1)!}$

(D) $\frac{1}{2(n+1)!}$

182. If $x^x y^y z^z = a$, then $\frac{\partial z}{\partial x}$ is equal to

(A) $-\left(\frac{1+\log x}{1+\log z}\right)$

(B) $\left(\frac{1+\log x}{1+\log z}\right)$

(C) $-\left(\frac{1-\log x}{1-\log z}\right)$

(D) $\left(\frac{1-\log x}{1-\log z}\right)$

183. The value of $\lim_{x\to\infty} x\left[\tan^{-1}\left(\frac{x+1}{x+2}\right) - \tan^{-1}\left(\frac{x}{x+2}\right)\right]$ equals

(A) 1

(B) -1

(C) $-\frac{1}{2}$

(D) $\frac{1}{2}$

184. The number of real roots of $\sin(e^x) = 5^x + 5^{-x}$ is

(A) 0
(B) 1
(C) 2
(D) infinitely many

185. Let B be a matrix such that $B^2 = B$ and let $A = I - B$. Then

(A) $A^2 = A$

(B) $A^2 = I$

(C) $AB \neq 0$

(D) $BA \neq 0$

186. Two dice are thrown n times in succession. The probability of obtaining a double six at least once is

(A) $\left(\frac{1}{36}\right)^n$

(B) $\left(\frac{1}{12}\right)^n$

(C) $1-\left(\frac{1}{12}\right)^n$

(D) $1-\left(\frac{35}{36}\right)^n$

187. The unit vector in ZOX plane makes an angle 60° and 45° with $\vec{a} = \hat{j} - \hat{k}$ and $\vec{b} = 2\hat{i} + 2\hat{j} - \hat{k}$ respectively. Then the unit vector is

(A) $\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{k}$

(B) $\frac{1}{3\sqrt{2}}\hat{i} + \frac{4}{3\sqrt{2}}\hat{j} + \frac{1}{3\sqrt{2}}\hat{k}$

(C) $\frac{1}{\sqrt{2}}\hat{i} - \frac{1}{\sqrt{2}}\hat{k}$

(D) $\frac{1}{\sqrt{2}}\hat{j} - \frac{1}{\sqrt{2}}\hat{k}$

188. The singularities of the analytic function $f(z)=\dfrac{z-1}{z^2+1}$ are at

(A) i and $-i$
(B) 1 and $-i$
(C) 1 and i
(D) 1 and -1

189. A coin is tossed independently four times. The probability of the event "the number of times head shown up is greater than the number of times tail shown up" is

(A) $\dfrac{5}{16}$

(B) $\dfrac{1}{16}$

(C) $\dfrac{1}{8}$

(D) $\dfrac{1}{4}$

190. For any complex number z, the minimum value of $|z|+|z-2i|$ is

(A) 2
(B) 1
(C) 0
(D) $\sqrt{3}$

191. The rank of a 3×3 matrix $Z = XY$, found by multiplying a non-zero column matrix X of size 3×1 and a non-zero row matrix Y of size 1×3, is

(A) 0
(B) 1
(C) 2
(D) 3

192. A box contains 2 pens, 3 pencils and 4 chocolates. Items are drawn from the box at random one at a time without replacement. The probability of drawing 2 pens first followed by 3 pencils and subsequently the 4 chocolates is

(A) $\frac{2}{315}$

(B) $\frac{1}{630}$

(C) $\frac{1}{1260}$

(D) $\frac{1}{2520}$

193. A mapping is selected at random from the set of all the mappings of the set $A = \{1, 2, ..., n\}$ into itself. The probability that the mapping selected is an injection is

(A) $\frac{1}{n^n}$

(B) $\frac{1}{n!}$

(C) $\frac{(n-1)!}{n^{n-1}}$

(D) $\frac{n!}{n^{n-1}}$

194. If the graph of the function $f(x)$ has a unique tangent at the point $(a, 0)$, then $\lim_{x \to a} \log \frac{(1+6f(x))}{3f(x)}$ is

(A) 1
(B) 0
(C) 2
(D) $\frac{1}{3}$

195. If a and b are roots of the equation $y^2 - 2y + 4 = 0$. Then $a^6 + b^3 =$

A) 60
(B) 56
(C) 128
(D) 256

196. If the equation $\sin^4 x + a\sin^4 x + 1 = 0$ has a solution, then a lies in

(A) $(-\infty, -2)$
(B) $(-\infty, 2)$
(C) $(2, \infty)$
(D) $(-2, \infty)$

197. Let ω be the cube root of unity. The number of complex numbers satisfying the system of equations $z^3 + \bar{\omega}^7 = 0$ and $z^5 + \omega^{11} = 1$ is

(A) 2
(B) 1
(C) 0
(D) 4

198. Let $f(x) = \left[x^3 - 3\right]$, where [.] denotes the greatest integer function. Then the number of points in the interval (1, 2) where $f(x)$ is discontinuous, is

(A) 4
(B) 2
(C) 6
(D) 5

199. If $\int f(x)dx = f(x)$, then $\int (f(x))^2 dx$ is equal to

(A) $\frac{1}{2}(f(x))^2$
(B) $(f(x))^2$
(C) $\frac{1}{3}(f(x))^3$
(D) 0

200. If the sum of the distance of a point to two perpendicular lines in a plane is 1, then its locus is

(A) square
(B) circle
(C) straight line
(D) two intersecting lines

201. Equation $\frac{x^2}{k}+\frac{y^2}{k-1}=1$ represents an ellipse if

(A) $0 < k < 1$
(B) $k > 1$
(C) $k < 0$ or $k > 1$
(D) $1 < k < 2$

202. The least value of $\operatorname{cosec}^2\theta + 36\sec^2\theta$ is

(A) 36
(B) 40
(C) 49
(D) 72

203. If $f(x)$ is an odd periodic function with period 2, then $f(4)$ equals

(A) –4
(B) 4
(C) 2
(D) 0

204. If A is symmetric as well as skew symmetric matrix, then A is

(A) diagonal
(B) null
(C) upper triangular
(D) lower triangular

205. The number of divisors of 9600 including 1 and 9600 are

(A) 60
(B) 58
(C) 48
(D) 46

206. The minimum value of $4^{\sin^2 x} + 4^{\cos^2 x}$ is

(A) 4
(B) 5
(C) 1
(D) 8

207. If $A = \{x \text{ is a prime number and} < 30\}$, then the number of rational numbers whose numerator and denominator belong to A is

(A) ${}^{10}P_2$
(B) ${}^{10}P_2 + 1$
(C) ${}^{10}P_2 - 1$
(D) ${}^{10}P_2 + 2$

208. The number of non negative integer solutions of $x + y + z = 10$ is

(A) ${}^{12}C_2$
(B) ${}^{12}C_4$
(C) ${}^{10}C_3$
(D) ${}^{11}C_3$

209. There are two bags one of which contains 3 black and 4 white balls while the other contains 4 black and 3 white balls. A die is cast. If the face 1 or 3 turns up with, a ball is taken from the first bag and if any other face turn up with, a ball is chosen from the second bag. The probability of choosing a black ball is

(A) $\frac{13}{21}$
(B) $\frac{11}{31}$
(C) $\frac{11}{21}$
(D) $\frac{16}{21}$

210. If $a = 99^{100}$ and $b = 100^{99}$, then

(A) $a > b$
(B) $a = b$
(C) $a < b$
(D) $a + 2b = 101^{100}$

211. The points $A(2, 3)$, $B(3, 5)$, $C(7, 7)$ and $D(4, 5)$ are such that

(A) $ABCD$ is a parallelogram
(B) A, B, C, D are colinear
(C) D lies inside the triangle ABC
(D) D lies on the boundary of the triangle ABC

212. The value of $\log(\tan 1) \cdot \log(\tan 2) \cdots \log(\tan 89) =$

(A) 0
(B) -1
(C) 2
(D) -2

213. If a is an integer lying in $[-5, 30]$, then the probability that the graph of $y = x^2 + 2(a+4)x - 5a + 64$ is strictly above the x-axis is

(A) $\frac{1}{6}$
(B) $\frac{7}{36}$
(C) $\frac{2}{9}$
(D) $\frac{3}{5}$

214. Equation of the tangent to the circle with centre $(2, -1)$ is $3x + y = 0$. The square of the length of the tangent to the circle from the point (23, 17) is

(A) 1354
(B) 1452
(C) 1320
(D) 1525

215. If p and q are distinct primes and $x^2 - px + q = 0$ has distinct positive integral roots, then $p + q$ equals,

(A) 5
(B) 7
(C) 19
(D) 40

216. $\dfrac{2}{\sqrt{2+\sqrt{2+\sqrt{2+2\cos 4x}}}} =$

(A) $\sec\left(\dfrac{x}{2}\right)$

(B) $\sec x$

(C) $\operatorname{cosec} x$

(D) 1

217. The number of solutions of the equation $\sin^{-1}\left(\dfrac{1+x^2}{2x}\right) = \dfrac{\pi}{2}\left(\sec(x-1)\right)$ is

(A) 0
(B) 1
(C) 2
(D) 3

218. If the system of linear equations $x + y + z = 6,\ x + 2y + 3z = 14$ and $2x + 5y + \lambda z = \mu,\ (\lambda, \mu \in \mathbb{R})$ has a unique solution, then

(A) $\lambda \neq 8$
(B) $\lambda = 8, \mu \neq 36$
(C) $\lambda = 8, \mu = 36$
(D) $\lambda \neq 8, \mu = 36$

219. If $f(x) = \begin{vmatrix} 1 & 3\cos x & 1 \\ \sin x & 1 & 3\cos x \\ 1 & \sin x & 1 \end{vmatrix}$, the maximum value of $f(x)$ is

(A) 10
(B) 11
(C) 6
(D) 7

220. If A is a 3×3 matrix such that $A'A = I$ and $|A| = 1,$ then the value of $|A - I|$ is

(A) 1
(B) 2
(C) 0
(D) 3

221. Let p be a prime number such that $p \geq 23$. Let $n = p! + 1$. The number of primes in the list $n+1, n+2, n+3, ..., n+p-1$ is

(A) $p-1$
(B) 2
(C) 1
(D) 0

222. If $\overline{a} = b, c \in \mathbb{R}$ and $|b^2| > c,$ then $z\overline{z} + az + b\overline{z} + c = 0$ represents

(A) a circle
(B) a parabola
(C) a straight line
(D) a hyperbola

223. If the slope of one of the lines given by $36x^2 + 2hxy + 72y^2 = 0$ is four times the other, then the value of h^2 is equal to

(A) 4050
(B) 4020
(C) 3040
(D) 3050

224. If $F_1 = (3,0), F_2 = (-3,0)$ and P is any point on the curve $16x^2 + 25y^2 = 400,$ then $PF_1 + PF_2$ equals

(A) 8
(B) 6
(C) 10
(D) 12

225. If α and β are the roots of $x^2+x+1=0$, then $\alpha^{2020}+\beta^{2020}$ is

(A) –2
(B) –1
(C) 1
(D) 2

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SI No.	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**
1	C	31	A	61	D	91	A	121	C	151	D	181	B	211	C
2	D	32	C	62	B	92	B	122	C	152	C	182	A	212	A
3	B	33	B	63	D	93	A	123	B	153	C	183	D	213	C
4	D	34	B	64	C	94	A	124	D	154	B	184	A	214	D
5	D	35	A	65	A	95	C	125	B	155	D	185	A	215	A
6	C	36	C	66	D	96	B	126	A	156	B	186	D	216	A
7	C	37	C	67	C	97	C	127	A	157	D	187	C	217	B
8	D	38	C	68	A	98	B	128	D	158	C	188	A	218	A
9	A	39	C	69	B	99	A	129	B	159	B	189	A	219	A
10	D	40	D	70	C	100	D	130	A	160	A	190	A	220	C
11	A	41	C	71	C	101	B	131	A	161	D	191	B	221	D
12	D	42	B	72	C	102	B	132	D	162	A	192	C	222	A
13	B	43	B	73	C	103	D	133	B	163	B	193	C	223	A
14	A	44	A	74	D	104	B	134	A	164	A	194	C	224	C
15	C	45	D	75	B	105	C	135	D	165	A	195	B	225	B
16	D	46	D	76	A	106	D	136	D	166	D	196	A		

17	B	47	C	77	D	107	B	137	C	167	A	197	A
18	A	48	C	78	C	108	D	138	B	168	C	198	C
19	A	49	B	79	A	109	D	139	D	169	D	199	A
20	C	50	B	80	D	110	C	140	D	170	C	200	A
21	D	51	C	81	C	111	D	141	C	171	B	201	B
22	A	52	D	82	A	112	C	142	A	172	D	202	C
23	A	53	D	83	C	113	B	143	A	173	B	203	D
24	C	54	C	84	C	114	C	144	A	174	B	204	B
25	A	55	D	85	C	115	D	145	C	175	C	205	C
26	D	56	B	86	C	116	C	146	B	176	D	206	A
27	D	57	D	87	A	117	B	147	B	177	C	207	B
28	C	58	A	88	C	118	A	148	D	178	D	208	A
29	B	59	C	89	D	119	B	149	C	179	C	209	C
30	D	60	A	90	A	120	C	150	C	180	C	210	A