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CUSAT CAT 2022 Question Paper

Cochin University of Science and Technology Common Admission Test (CUSAT CAT)

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Test in Physics Chemistry and Mathematics (Shift 1)

1. Force between two charges is given by

(A) $\frac{Qq}{4\pi\varepsilon_0 r^2}$

(B) $\frac{Qq}{4\pi\varepsilon_0 r^3}$

(C) $\frac{Qq}{4\pi\varepsilon_0 r}$

(D) Zero

2. Which quantity is same when resistances are connected in parallel?

(A) Current
(B) Potential difference and Current
(C) Potential difference
(D) Capacitance

3. How much power is dissipated when 2 A current passes through a wire of 10 Ohm resistance?

(A) 40 watt
(B) 30 watt
(C) 20 watt
(D) 10 watt

4. Magnetic field is produced by

(A) rest charge alone
(B) moving charge alone
(C) moving charge with intrinsic magnetic moment
(D) intrinsic magnetic moment alone

5. Which magnetism shows Curie temperature?

(A) Diamagnetism
(B) Paramagnetism
(C) Ferromagnetism
(D) Ferrimagnetism

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6. Inconsistency of Ampere's circuit law is due to

(A) standard current
(B) flow of current
(C) displacement current
(D) zero current

7. What are the components present in electromagnetic waves?

(A) Electric field
(B) Electric field and velocity
(C) Magnetic field
(D) Electric field and Magnetic field

8. Which radiation is having higher energy in electromagnetic spectrum?

(A) X-ray
(B) Gamma ray
(C) Microwave
(D) Radio wave

9. What is the frequency of LC circuit?

(A) $\frac{1}{2\pi\sqrt{LC}}$

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

(C) $2\pi\sqrt{LC}$

(D) $2\pi LC$

10. If the focal length of a lens is 2 cm, then its power is

(A) 3 dioptre
(B) 0.4 dioptre
(C) 0.7 dioptre
(D) 0.5 dioptre

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11. The angle of incidence at which reflected light is totally polarised for reflection from air to glass (refractive index n), is

(A) $\tan^{-1}(1/n)$

(B) $\sin^{-1}(1/n)$

(C) $\sin^{-1}(n)$

(D) $\tan^{-1}(n)$

12. The number of electron in M shell is limited to

(A) 2
(B) 10
(C) 18
(D) 32

13. Which of the following ray is emitted during the radioactive decay process?

(A) Alpha ray
(B) Gamma Ray
(C) Beta ray
(D) All the above

14. Formation of shadows can be explained by

(A) rectilinear propagation of light
(B) curvilinear propagation of light
(C) the total internal reflection
(D) refraction

15. When the temperature of the semiconductor is increased, its

(A) resistivity increases
(B) charge carrier reduces
(C) conductivity increases
(D) temperature coefficient becomes zero

16. Which of the following is an active device?

(A) Electric bulb
(B) Transformer
(C) Silicon controlled rectifier
(D) Loud speaker

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17. The material suitable for making electromagnets should have

(A) high retentivity and high coercivity
(B) low retentivity and low coercivity
(C) high retentivity and low coercivity
(D) low retentivity and high coercivity

18. A carbon resistor has color code as Brown, Black, Blue and Silver. The resistance and tolerance values are

(A) 10 MΩ ±10%
(B) 20 MΩ ±5%
(C) 10 MΩ ±5%
(D) 20 kΩ ±10%

19. Which unit is appropriate for specifying magnetic induction?

(A) Tesla
(B) V/m
(C) A/m^2
(D) Henry

20. Two particles *A* and *B* initially at rest move towards each other by mutual forces of attraction. At an instant when the speed of *A* is *V* and the speed for *B* is 2 *V*, then the speed of centre of mass is

(A) 1 *V*
(B) 2 *V*
(C) 3 *V*
(D) Zero

21. The blue colour of the sky is due to

(A) reflection of sunlight
(B) polarization of sunlight
(C) scattering of sunlight
(D) refraction of sunlight

22. Which of the following statements is wrong?

(A) Sound travels in a straight line
(B) Sound travels as waves
(C) Sound is a form of energy
(D) Sound travels faster in vacuum than that in air

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23. A proton and an electron are accelerated through the same accelerating potential. Which one of these two has the greater momentum?

(A) Proton
(B) Electron
(C) Equal momentum
(D) Zero momentum

24. In a circuit containing inductor and resistor, as the frequency of the applied alternating current increases, the impedance

(A) remain constant
(B) decreases
(C) first increases and then decreases
(D) increases

25. How many electron flow per second in 1 Ampere of current?

(A) 6.25×10^{18}
(B) 6×10^{18}
(C) 1.6×10^{19}
(D) 1.6×10^{23}

26. If copper and silicon are heated, then their resistance will

(A) increase and decrease respectively
(B) increase and increase respectively
(C) decrease and increase respectively
(D) decrease and decrease respectively

27. The unit of Universal Gravitational constant is

(A) Nm^2/kg^2
(B) Nm/kg^2
(C) Unit less
(D) m/s^2

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28. Adiabatic expansion of a gas results in

(A) heating
(B) cooling
(C) no change in temperature
(D) initial cooling and then heating

29. The function of the moderator in the nuclear reactor is to

(A) decrease the speed of neutron
(B) increase the speed of neutron
(C) fuel the reactor
(D) increase the temperature of the reactor

30. $\int \frac{dx}{\sqrt{2ax - x^2}} = a^n \sin^{-1}\left(\frac{x}{a} - 1\right)$, then the value of n is

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

31. A raindrop falls near the surface of the earth with almost uniform velocity because

(A) its weight is negligible
(B) the force of surface tension balances its weight
(C) the force of viscosity of air balances its weight
(D) the drops are charged and atmospheric electric field balances its weight

32. The susceptibility of magnesium at 300 K is 1.2×10^{-5}. At what temperature will the susceptibility increase to 1.8×10^{-5}?

(A) 400 K
(B) 300 K
(C) 600 K
(D) 200 K

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33. A convex lens is placed 8 cm from a light source and it makes a sharp image on a screen, kept 8 cm from the lens. Now a glass block (refractive index 1.5) of 1.2 cm thickness is placed in contact with the light source. To get the sharp image again, the screen is shifted by a distance *d*. Then *d* is

(A) 0.44 cm towards the lens
(B) 1.6 cm away from the lens
(C) 0.44 cm away from the lens
(D) 0

34. The resistance of 3 Ω and 6 Ω are joined in series are connected across a battery of emf 10 V and internal resistance 1 Ω. The power dissipated by the battery is

(A) 3 W
(B) 8 W
(C) 9 W
(D) 10 W

35. Consider two light sources of wavelength λ_1 and λ_2 ($\lambda_2 > \lambda_1$) which are emitting n_1 and n_2 photons respectively, in a given time. Assume equal power for both sources, then

(A) $n_1 > n_2$
(B) $n_1 < n_2$
(C) $n_1 = n_2$
(D) None of the above

36. As the orbit number increases, the distance between two consecutive orbits in an atom

(A) increases
(B) decreases
(C) remains the same
(D) first increases and then becomes constant

37. For audible sound, the time interval between two words should be

(A) 0.1 s
(B) 3 s
(C) 0.4 s
(D) 2 s

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38. If S is stress and Y is Young's modulus of material of a wire, the energy stored in the wire per unit volume is

(A) $2S^2Y$

(B) $S^2/2Y$

(C) $2Y/S^2$

(D) $S/2Y$

39. If a charge Q is to be divided into two parts q and $(Q - q)$, such that the force between them is maximum at a certain distance, then the value of q must be

(A) $Q / 3$
(B) $Q / 2$
(C) $Q / 4$
(D) $3Q / 4$

40. If the electric field in a region of space is given by $5\mathbf{i} + 4\mathbf{j} + 9\mathbf{k}$. The electric flux through a surface of area 20 units lying in the y-z plane is

(A) 100 units
(B) 4 units
(C) 500 units
(D) 44 units

41. A 25 Watt -220 V bulb and 100 Watt-220 V bulb are connected in series across 220 V line. Which bulb will glow more brightly?

(A) 25 Watt bulb
(B) 100 Watt bulb
(C) Both will glow with equal brightness
(D) Each bulb will glow bright alternatively

42. A proton is projected horizontally eastward in a uniform magnetic field which is horizontal and southward in direction. The proton will be deflected

(A) upward
(B) downward
(C) southward
(D) northward

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43. Two long parallel wires separated by a distance ‘r’ have equal current ‘I’ flowing in each. The magnetic field of one exerts a force ‘F’ on the other. If the distance between them is doubled and the current in each wire is halved, the force between them will become

(A) 4 F
(B) unchanged
(C) F / 4
(D) F / 8

44. The magnetic field energy in an inductor changes from maximum value to minimum value in 2.5 ms, when connected to an AC source. The frequency of the source is

(A) 100 Hz
(B) 400 Hz
(C) 50 Hz
(D) 25 Hz

45. Alternating current / e.m.f measuring instrument measures its

(A) peak value
(B) r.m.s value
(C) average value
(D) square of current and voltage

46. In vacuum, the speed of electromagnetic waves depend up on

(A) wavelength
(B) frequency
(C) electric and magnetic field
(D) None of the above

47. A convex mirror has a focal length ‘f ’ . A real object placed at a distance ‘f ’ in front of it from the pole produces an image at

(A) infinity
(B) f
(C) f/2
(D) 2f

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48. The refracting angle of a prism is A and refractive index of the material of the prism is cot A/2. Then, the angle of minimum deviation is

(A) 180 – 3A
(B) 180 + 2A
(C) 90 – A
(D) 180 – 2A

49. Which one of the following cannot be polarised?

(A) Radio waves
(B) Ultraviolet rays
(C) Infrared rays
(D) Ultrasonic waves

50. Threshold wavelength for a metal having work function φ_0 is λ. What is the threshold wavelength for the metal having work function $\varphi_0/2$?

(A) 4λ
(B) 2λ
(C) λ
(D) $\lambda/2$

51. Bohr's atomic model cannot explain

(A) quantization of the angular momentum of the orbiting electrons
(B) emission of photon due to the transition of electron from one orbit to other
(C) intensity of spectral lines
(D) spectral series of hydrogen like atom

52. The process underlying β-decay is the

(A) conversion of neutron to proton
(B) conversion of proton to neutron
(C) emission of gamma rays
(D) emission of helium nucleus

53. A sample of radioactive element has a mass of 10 gm at an instant t = 0. The approximate mass of the element in the sample after two mean lives is

(A) 2.5 gm
(B) 3.7 gm
(C) 6.30 gm
(D) 1.35 gm

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54. A potential difference of V is applied at the ends of a copper wire of length 'l' and diameter 'd'. On doubling the 'd' value , the drift velocity

(A) becomes two times
(B) becomes half
(C) becomes one fourth
(D) does not change

55. If a resistance is introduced in series with the cell in the secondary circuit of a potentiometer, the balancing length

(A) increases
(B) decreases
(C) remains the same
(D) cannot be found

56. A vernier calliper has its main scale of 10 cm equally divided into 200 equal parts. Its vernier scale of 25 divisions coincides with 12 mm on the main scale. The least count of the instrument is

(A) 0.020 cm
(B) 0.002 cm
(C) 0.010 cm
(D) 0.001 cm

57. A body starts from rest and with a uniform acceleration of 10 ms^{-2} for 5 seconds. During the next 10 seconds, it moves with uniform velocity. The total distance traveled by the body is

(A) 100 m
(B) 125 m
(C) 500 m
(D) 625 m

58. Two capacitors of equal capacity are first connected in parallel and then in series. The ratio of the total capacities in the two cases will be

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

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59. The strength of the magnetic field of a vibration magnetometer is increased to 4 times its original value. The frequency of oscillation of the magnet would then become

(A) twice
(B) four times
(C) half
(D) one-fourth

60. An endoscope is employed by a physician to view the internal parts of a body organ. It is based on the principle of

(A) refraction
(B) reflection
(C) total internal reflection
(D) dispersion

61. What will be the direction in the following reaction upon increasing pressure of the system?

$$N_2O_4\ (g) \rightleftharpoons 2NO_2(g)$$

(A) Formation of N_2O_4 favored
(B) Formation of NO_2 favored
(C) No change in reaction
(D) Increase in equilibrium constant

62. When solid NH_4Cl is added to NH_4OH solution, the equilibrium shifts to the left, due to

(A) common ion effect
(B) buffer formation
(C) neutralization
(D) keep pH constant

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63. The obtained slope in the Arrhenius plot of log k Vs $\frac{1}{T}$ is equal to

(A) $\frac{E_a}{R}$

(B) $-\frac{E_a}{R}$

(C) $\frac{E_a}{(2.303)R}$

(D) $-\frac{E_a}{(2.303)R}$

64. If the first order rate constant for a reaction is $6.93 \times 10^{-4}\ s^{-1}$, calculate the half life for the reaction.

(A) 100 s
(B) 200 s
(C) 500 s
(D) 1000 s

65. The standard E^0_{red} values of A, B and C are 0 V, +0.68 V and –0.50 V, respectively. The order of their power as reducing agent is

(A) $B > A > C$
(B) $A > B > C$
(C) $C > A > B$
(D) $C > B > A$

66. If the ratio of composition of oxidised and reduced species in an electrochemical cell is given as $\frac{[O]}{[R]} = e^2$, the correct potential difference will be

(A) $E - E^0 = +\frac{2RT}{nF}$

(B) $E - E^0 = -\frac{2RT}{nF}$

(C) $E - E^0 = +\frac{RT}{nF}$

(D) $E - E^0 = -\frac{RT}{nF}$

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67. If we pass 1 Coulomb of charge in an electrolytic cell, then 10 mg of substance will get deposited. Calculate the gram equivalent of the substance.
(1 Faraday = 96500 C)

(A) 9.65
(B) 96.5
(C) 965
(D) 9650

68. The packing fraction efficiency of a simple cubic lattice is close to

(A) 34.0%
(B) 52.4%
(C) 68.0%
(D) 74.0%

69. How many NaCl are in the unit cell of sodium chloride crystal?

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

70. Alkali halides do not show Frenkel defect because

(A) cations and anions have high coordination number
(B) cations and anions have low coordination number
(C) anions cannot be accommodated in voids
(D) cations and anions have almost equal size

71. Coordination number for body centered cubic is

(A) 2
(B) 4
(C) 6
(D) 8

72. Which one of the following is **NOT** applicable to chemisorption?

(A) Its heat of adsorption is high
(B) It takes place at high temperature
(C) It is reversible
(D) It forms mono-molecular layers

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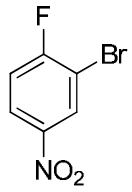
73. Lyophilic colloids are stable due to

(A) small size of the particle
(B) large size of the particle
(C) layer of dispersion medium on the particle
(D) high Tyndall effect

74. IUPAC name for the following compound is

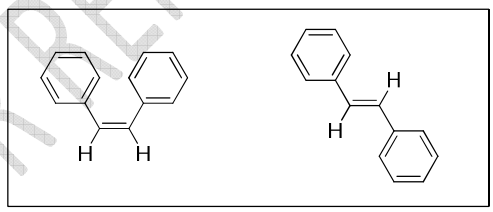


(A) 2-bromo-1-fluoro-4-nitrobenzene
(B) 3-bromo-4-fluoro-1-nitrobenzene
(C) 2-fluoro-5-nitro-1-bromobenzene
(D) 1-bromo-6-fluoro-3-nitrobenzene

75. Dumas method is preferred over Kjeldahl's method for determining nitrogen quantitatively in

(A) explosives such as trinitrotoluene
(B) aminoacids
(C) amides
(D) compounds containing both sulfur and nitrogen

76. Pick the statement that is **NOT** true for a pair of cis and trans isomers such as 1,2-diphenylethene (stilbene).



(A) trans isomer has a higher melting point
(B) trans isomer has higher heat of combustion
(C) trans isomer has a higher retardation factor (R_f) in adsorption chromatography over silica gel
(D) planarity is better maintained in the trans isomer

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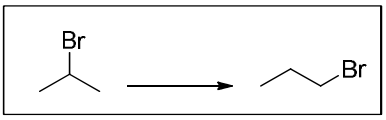
77. How will you selectively convert 2-bromopropane to 1-bromopropane?



(A) Treatment with alcoholic potassium chloride followed by reaction with HBr
(B) Reaction with metallic sodium followed by reaction with bromine
(C) Reaction with magnesium metal followed by treatment with HOBr
(D) Reaction with alcoholic potassium hydroxide followed by heating with HBr in the presence of benzoyl peroxide.

78. Pick the **WRONG** statement about propyne.

(A) Addition of excess HBr to propyne gives 1,2-dibromopropane
(B) It is less acidic than acetylene
(C) Upon reaction with dilute sulfuric acid in the presence of mercuric sulfate, it gives acetone as the major product
(D) It reacts with sodamide ($NaNH_2$) to give sodium propynide

79. In aromatic electrophilic substitution reactions carried out under kinetically controlled conditions

(A) all activating groups are *meta* orienting
(B) all deactivating groups are *ortho-para* orienting
(C) all deactivating groups are *meta* orienting
(D) deactivating groups possessing unshared pair of electrons on atoms directly attached to aromatic ring are *ortho-para* orienting

80. Compounds possessing certain distinct structural features give a yellow precipitate of iodoform on reacting with iodine in the presence of a base. This question is based on the ability of alcohols having no other functional groups to undergo iodoform reaction. Pick the **WRONG** statement.

(A) Ethanol is the only primary alcohol that gives a positive iodoform test
(B) Several secondary alcohols give positive iodoform test
(C) All tertiary alcohols test negative for iodoform reaction
(D) All alcohols test negative for iodoform reaction

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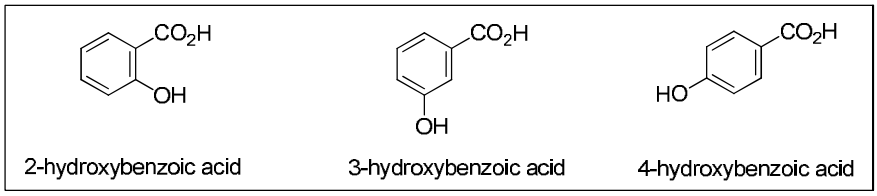
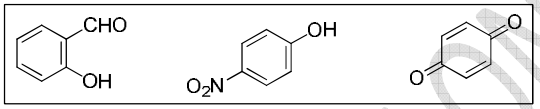
81. Acidity of compounds is decided by several factors including electrometric effects, *H*-bonding, aromaticity etc. for acids and their conjugate bases. Pick the correct statement. pK_a of



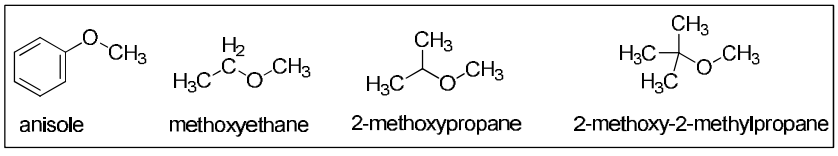
(A) 2-hydroxybenzoic acid > 3-hydroxybenzoic acid > 4-hydroxybenzoic acid
(B) 4-hydroxybenzoic acid > 3-hydroxybenzoic acid > 2-hydroxybenzoic acid
(C) 3-hydroxybenzoic acid > 2-hydroxybenzoic acid > 4-hydroxybenzoic acid
(D) 4-hydroxybenzoic acid ≈ 2-hydroxybenzoic acid > 3-hydroxybenzoic acid

82. The following statements are on the reactivity of phenols. Pick the **WRONG** statement.



(A) Bubbling carbon dioxide through a solution of phenol in aqueous sodium hydroxide followed by acidification gives 2-hydroxybenzoic acid (salicylic acid)
(B) Treatment of phenol with chloroform in the presence of sodium hydroxide followed by acidification of the reaction mixture gives 2-hydroxybenzaldehyde (salicylaldehyde)
(C) Phenol on treatment with concentrated nitric acid gives 4-nitrophenol as the only product
(D) Phenol on oxidation with sodium dichromate in the presence of concentrated sulfuric acid gives 1,4-benzoquinone

83. On refluxing with constant boiling hydroiodic acid (57% HI in water), most methyl ethers are cleaved to give methyl iodide and an alcohol as the products. Which among the following methyl ethers is most likely to give methanol instead of methyl iodide upon treatment with constant boiling HI?



(A) anisole
(B) methoxyethane
(C) 2-methoxypropane
(D) 2-methoxy-2-methylpropane

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84. Carbonyl compounds can be separated from aliphatic hydrocarbons by

(A) extraction with acid
(B) extraction with base
(C) as bisulfite addition compounds by treating with sodium bisulfite
(D) as picrates by treating with picric acid

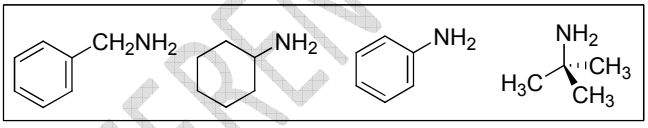
85. Which among the following methods is **NOT** suitable for the preparation of hydrocarbons?

(A) Meerwein-Verley-Ponndorf reduction of aldehydes
(B) Clemmensen reduction of ketones
(C) Wolff-Kishner reduction of aldehydes
(D) Treatment of alkyl chlorides with metallic sodium in dry ether

86. An organic compound gave positive tests with 2,4-DNP reagent, Tollens reagent and Fehling solution. Upon treatment with iodine in the presence of sodium hydroxide it gave iodoform and methanoic acid. The compound most probably is

(A) methanal
(B) ethanal
(C) ethanoic acid
(D) acetone

87. Gabriel phthalimide synthesis is **NOT** a viable method for the direct synthesis of



(A) benzylamine
(B) cyclohexanamine
(C) aniline
(D) 2-methylpropan-2-amine

88. While H_2S and H_2Se are gases, H_2O is liquid due to

(A) smaller size of oxygen
(B) arrangement of molecules
(C) presence of H-bonding
(D) difference in bonding of their molecule

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89. Cd and Cu can be separated and analyzed using

(A) KCN

(B) H_2S

(C) NH_4OH

(D) H_2SO_4

90. What will be the product of the reaction $_{26}Fe^{58}$ (d, p)?

(A) $_{25}Mn^{59}$

(B) $_{26}Fe^{60}$

(C) $_{26}Fe^{59}$

(D) $_{25}Mn^{60}$

91. $[Cu(NH_3)_4]^{2+}$ ion has a …….. structure.

(A) square planar
(B) trigonal
(C) pyramidal
(D) tetrahedral

92. In Ellingham diagram, the slope obtained is equal to

(A) ΔG
(B) ΔH
(C) ΔS
(D) ΔE

93. How many 2c-2e centered bonds are present in diborane?

(A) 5
(B) 6
(C) 4
(D) 7

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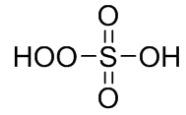
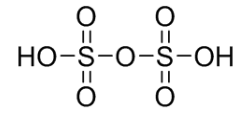
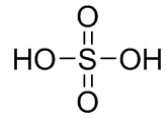
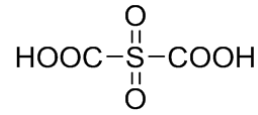
94. Choose the correct structure for Caro`s acid.

(A) 

(B) 

(C) 

(D) 

95. Balmer lines are observed in

(A) UV region
(B) IR region
(C) microwave region
(D) visible region

96. Hybridization of Mn in $KMnO_4$ is

(A) sp^2
(B) sp^2d
(C) dsp^2
(D) sp^3

97. The magnetic moment for the complex $[CoF_6]^{3-}$ is

(A) 4.89 BM
(B) 1.73 BM
(C) 0 BM
(D) 5.90 BM

98. With respect to diamond and graphite, which of the following statement is **CORRECT**?

(A) Graphite is lower thermal conductor than diamond
(B) Graphite is harder than diamond
(C) Graphite is lower bond order than diamond
(D) Graphite has higher electrical conductivity than diamond

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99. The hybridisation and magnetic behavior of complexes $[Ni(CO)_4]$ and $[Ni(CN)_4]^{2-}$ is

(A) dsp^2 and sp^3, both are paramagnetic

(B) dsp^2 and sp^3, both are diamagnetic

(C) sp^3 and dsp^2, paramagnetic and diamagnetic

(D) sp^3 and dsp^2, both are diamagnetic

100. Two electrons occupying the same orbital are distinguished by

(A) Magnetic quantum number
(B) Azimuthal quantum number
(C) Spin quantum number
(D) Principal quantum number

101. The number of onto functions from $\{1, 2, ..., n\}$ to itself is

(A) n
(B) n – 1
(C) $(n-1)!$
(D) $n!$

102. $\lim\limits_{x\to\frac{\pi}{6}} \dfrac{2\sin^2 x+\sin x-1}{2\sin^2 x-3\sin x+1}$ is equal to

(A) 3
(B) -3
(C) 6
(D) 0

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

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

104. Let $f(x)=a+b|x|+c|x|^2$, where a,b and c are real constants. Then $f'(0)$ exists if

(A) $b=0$
(B) $c=0$
(C) $a=0$
(D) $b=c$

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105. The equation of the circle passing through $(1,-3)$ and the points common to the two circles $x^2+y^2-6x+8y-16=0$ and $x^2+y^2+4x-2y-8=0$ is

(A) $x^2+y^2-4x+6y+24=0$

(B) $2x^2+2y^2+3x+y-20=0$

(C) $3x^2+3y^2-5x+7y-19=0$

(D) $x^2+y^2+4x-6y+24=0$

106. Let $f(x)=\int_1^x \sqrt{2-t^2}\,dt$. Then the roots of the equation $x^2-f'(x)=0$ are

(A) ± 1

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

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

(D) 0 and 1

107. If $\left(\vec{i}+\vec{j}-\vec{k}\right)\times\left(3\vec{i}+a\vec{j}+b\vec{k}\right)=0$, then the values of a and b are

(A) $a=1,\ b=3$

(B) $a=-3,\ b=3$

(C) $a=3,\ b=-3$

(D) $a=\frac{1}{3},\ b=\frac{-1}{3}$

108. The number of ways that a ring can be made out of 6 black and 4 white men standing on a ring, so that all the white men come together is

(A) 8564
(B) 8640
(C) 8644
(D) 8665

109. In the interval $0<x<2$, the function $f(x)=x^2$ has

(A) maximum = 2 and minimum = 0
(B) maximum = 4 and minimum = 0
(C) no maximum and no minimum
(D) some maximum but no minimum

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110. For the curve $y = 5x - 2x^3$, if x increases at the rate of 2 units/sec then at $x = 3$, the slope of the curve is changing at

(A) 12 units/sec
(B) -49 units/sec
(C) -72 units/sec
(D) 72 units/sec

111. The LCM of smallest two digit composite number and the smallest composite number is

(A) 12
(B) 4
(C) 20
(D) 44

112. The number of binary operations on a set {1, 2, 3} is

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

113. The angle between two vectors $\vec{a}$ and $\vec{b}$ with respective magnitude 2 and 3 such that $\vec{a} \cdot \vec{b} = 3$ is

(A) $\frac{\pi}{2}$
(B) 0
(C) $\frac{\pi}{6}$
(D) $\frac{\pi}{3}$

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114. The mean of n observation is $\bar{x}$. If the first observation is increased by 1, second by 2, the third by 3, and so on, then the new mean is

(A) $\bar{x}+(2n+1)$

(B) $\bar{x}+\frac{n+1}{2}$

(C) $\bar{x}+(n+1)$

(D) $\bar{x}-\frac{n+1}{2}$

115. The domain of the function $f(t)=\sqrt{t-\frac{t}{1-t}}$ is

(A) $[1, \infty)$
(B) $(-\infty, 1)$
(C) $(-\infty, 1]$
(D) $(1, \infty) \cup \{0\}$

116. For every natural number n, $2^{3n} - 1$ is divisible by

(A) 6
(B) 16
(C) 8
(D) 7

117. If x, y and z be greater than 1, then the value of $\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 1 & \log_y z \\ \log_z x & \log_z y & 1 \end{vmatrix}$ is

(A) $\log x \log y \log z$
(B) $\log x + \log y + \log z$
(C) 0
(D) $1-(\log x \log y \log z)$

118. The first two terms of a geometric progression add to 12. The sum of the third and the fourth terms is 48. If the terms of the geometric progression are alternately positive and negative, then the first term is

(A) -4
(B) -12
(C) 12
(D) 4

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119. Let P be a 2×2 matrix.

Statement-1: $adj(adj\ P) = P$

Statement-2: $|adj\ P| = |P|$

(A) Statement-1 is true, Statement-2 is false
(B) Statement-1 is false, Statement-2 is true
(C) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1
(D) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

120. If a line is equally inclined with the coordinate axes, then the angle of inclination is

(A) $\cos^{-1}\left(\frac{1}{2}\right)$

(B) $\cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$

(C) $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$

(D) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

121. Solution set of $|2x-3| < |x+2|$ is

(A) $\left(-\infty, \frac{1}{3}\right)$

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

(C) $\left(\frac{1}{3}, 5\right)$

(D) $\left(-\infty, -\frac{1}{3}\right)$

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122. If $\sin^x \alpha + \cos^x \alpha \geq 1,\ 0 < \alpha < \frac{\pi}{2}$, then

(A) $x \in [2, \infty)$
(B) $x \in (-\infty, 2]$
(C) $x \in [-1, 1]$
(D) $x \in [0, 1]$

123. The maximum value of $8 \cos x + 6 \sin x$ is

(A) 1
(B) 5
(C) 10
(D) 100

124. If $\tan x + \tan\left(x + \frac{\pi}{3}\right) + \tan\left(x + \frac{2\pi}{3}\right) = 3$, which of the following values is equal to 1?

(A) $\tan x$
(B) $\tan 2x$
(C) $\tan 3x$
(D) $\tan 4x$

125. The value of the expression $1 - \frac{\sin^2 y}{1 + \cos y} + \frac{1 + \cos y}{\sin y} - \frac{\sin y}{1 - \cos y}$ is equal to

(A) 0
(B) 1
(C) $\sin y$
(D) $\cos y$

126. The value of i^i is

(A) $e^{\frac{\pi}{2}}$
(B) $e^{\frac{i\pi}{2}}$
(C) $e^{\frac{-i\pi}{2}}$
(D) $e^{\frac{-\pi}{2}}$

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127. The complex number $\sqrt{2}i$ equals

(A) $2 + i$
(B) $1 + i$
(C) $1 - i$
(D) $2 - i$

128. If $a = p + q$, $b = p\omega + q\omega^2$, $c = p\omega^2 + q\omega$, where ω is the cube root of unity, then the product of a, b and c is equal to

(A) $(p + q)^3$
(B) $p^3 + q^3$
(C) $p^3 - q^3$
(D) $(p + q)^3 + 3pq(p + q)$

129. The equation $z\bar{z} + p\bar{z} + \bar{p}z + q = 0,\ q \in$ represents a circle, if

(A) $|p|^2 = q$
(B) $|p|^2 > q$
(C) $|q|^2 = b$
(D) $pq = 1$

130. Let a, b, c be three distinct real numbers and they are in a Geometric Progression. If $a + b + c = xb$, then

(A) $x \leq -1$ or $x \geq 3$
(B) $x < -1$ or $x > 3$
(C) $x < -3$ or $x > 2$
(D) $x \leq -3$ or $x \geq 2$

131. If the sum of the first n terms of a series be $5n^2 + 2n$, then its third term is

(A) 11
(B) 17
(C) 23
(D) 27

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132. Given that $\cos(x-y)$, $\cos x$, $\cos(x+y)$ are in HP. Then $\cos x \sec \frac{y}{2}$ is equal to

(A) $\sqrt{2}$

(B) $\pm\sqrt{2}$

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

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

133. Let $x^2+y^2=t+\frac{1}{t}$ and $x^4+y^4=t^2+\frac{1}{t^2}$. Then $\frac{dy}{dx}$ is equal to

(A) $\frac{y}{x}$

(B) $\frac{x}{y}$

(C) $-\frac{y}{x}$

(D) $-\frac{x}{y}$

134. Let $f(x)=\sin x$, $g(x)=2x$ and $h(x)=\cos x$. If $\phi(x)=[g\circ f\circ h](x)$, then $\phi''\left(\frac{\pi}{4}\right)$ is equal to

(A) –4
(B) 4
(C) 1
(D) 0

135. If $y=\cos^2\frac{3x}{2}-\sin^2\frac{3x}{2}$, then $\frac{d^2y}{dx^2}$ equals

(A) $-3\sqrt{1-y^2}$

(B) $9y$

(C) $-9y$

(D) $3\sqrt{1-y^2}$

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136. A rectangle $ABCD$, where $A = (0, 0)$, $B = (4, 0)$, $C = (4, 2)$, $D = (0, 2)$, undergoes the following transformations successively.

(i) $f_1(x, y) \rightarrow (y, x)$

(ii) $f_2(x, y) \rightarrow (x + 3y, y)$

(iii) $f_3(x, y) \rightarrow \left(\frac{x-y}{2}, \frac{x+y}{2}\right)$

The final figure will be

(A) a square
(B) a rhombus
(C) a rectangle
(D) a parallelogram

137. If a point $P(1, 2)$ is shifted by a distance $\sqrt{2}$ unit parallel to the line $y = x$, then coordinates of P in the new position are

(A) (2, 3)

(B) $\left(2+\sqrt{2}, 3+\sqrt{2}\right)$

(C) $\left(2-\sqrt{2}, 3-\sqrt{2}\right)$

(D) (3, 2)

138. If $5x - 12y + 10 = 0$ and $12y - 5x + 16 = 0$ are two tangents to a circle, then the radius of the circle is

(A) 1
(B) 2
(C) 4
(D) 6

139. The equation of the tangents to the circle $x^2 + y^2 = 13$ at the points, whose absissa is 2, are

(A) $2x + 3y = 13$ and $2x - 3y = 13$
(B) $3x + 2y = 13$ and $2x - 3y = 13$
(C) $2x + 3y = 13$ and $3x - 2y = 13$
(D) $3x + 2y = 13$ and $3x - 2y = 13$

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140. The equation of a common tangent to the circle $x^2 + y^2 = 2$ and the parabola $y^2 = 8x$ is

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

141. The latus rectum of an ellipse is equal to one-half of its minor axis. The eccentricity of the ellipse is

(A) $\frac{1}{\sqrt{6}}$

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

(C) $\frac{\sqrt{3}}{4}$

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

142. The image of the interval $[1,3]$ under the mapping $f : \square \to \square$, given by $f(x) = 2x^3 - 24x + 107$ is

(A) $[0,89]$
(B) $[75,89]$
(C) $[85,89]$
(D) $[75,0]$

143. The value of $\lim_{x\to 0}\left(\frac{1+5x^2}{1+3x^2}\right)^{\frac{1}{x^2}}$ is equal to

(A) e^2
(B) e
(C) e^{-1}
(D) e^{-2}

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144. $\lim_{n\to\infty}\left[\frac{1}{1\cdot 2}+\frac{1}{2\cdot 3}+\frac{1}{3\cdot 4}+\ldots+\frac{1}{n\cdot(n+1)}\right]$ is equal to

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

145. If $\lim_{x\to\infty}\left(\frac{x^3+1}{x^2+1}-(ax+b)\right)=2,$ then

(A) $a=1$ and $b=1$
(B) $a=1$ and $b=-1$
(C) $a=1$ and $b=-2$
(D) $a=1$ and $b=2$

146. If $f'(x)=\frac{1}{1+x^2}$ for all real x and $f(0)=0,$ then

(A) $f(2)<0.4$
(B) $f(2)>2$
(C) $0.4<f(2)<2$
(D) $f(2)=2$

147. $\int\frac{x^4+x^2+1}{x^2-x+1}dx$ is equal to

(A) $\frac{x^3}{3}-\frac{x^2}{2}+x+c$
(B) $\frac{x^3}{3}+\frac{x^2}{2}+x+c$
(C) $\frac{x^3}{3}-\frac{x^2}{2}-x+c$
(D) $\frac{x^3}{3}+\frac{x^2}{2}-x+c$

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148. $\int \frac{\sin^{-1} x}{\sqrt{1-x^2}} dx$ is equal to

(A) $\log\left(\sin^{-1} x\right)+c$

(B) $\frac{1}{2}\left(\sin^{-1} x\right)^2+c$

(C) $\log\left(\sqrt{1-x^2}\right)+c$

(D) $\sin\left(\cos^{-1} x\right)+c$

149. The solution of the differential equation $\frac{d^2y}{dx^2}=e^{-2x}$ is $y=c_1e^{-2x}+c_2x+c_3$, where c_1 is

(A) 1

(B) $\frac{1}{4}$

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

(D) 2

150. The area of the triangle having vertices as $\hat{i}-2\hat{j}+3\hat{k}$, $-2\hat{i}+3\hat{j}-\hat{k}$, $4\hat{i}-7\hat{j}+7\hat{k}$ is

(A) 36 sq unit
(B) 0 sq unit
(C) 39 sq unit
(D) 11 sq unit

151. If the position vectors of A, B and C are respectively $2\hat{i}-\hat{j}+\hat{k}$, $\hat{i}-3\hat{j}-5\hat{k}$, and $3\hat{i}-4\hat{j}-4\hat{k}$, then $\cos^2 A$ is equal to

(A) 0

(B) $\frac{6}{41}$

(C) $\frac{35}{41}$

(D) 1

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152. Let $*$ be the binary operation defined by $a * b = a + b + a \,.\, b$ for $a, b \in R$ where R be the set of all real numbers. Then

(A) $(R \setminus \{-1\}, *)$ is an abelian group
(B) $(R \setminus \{-1\}, *)$ is a group
(C) $(R \setminus \{0\}, *)$ is an abelian group
(D) $(R \setminus \{0\}, *)$ is a group

153. Assume that $\begin{bmatrix} 0 & a \\ b & 0 \end{bmatrix}^4 = I$. Then

(A) $a = 1 = 2b$
(B) $a = b$
(C) $a = b^2$
(D) $ab = 1$

154. If $\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ and $A_1, B_1, C_1 \ldots$ are the cofactors of $a_1, b_1, c_1 \ldots\ldots$ then $a_1A_2 + b_1B_2 + c_1C_2$ is equal to

(A) Δ
(B) 0
(C) $-\Delta$
(D) Δ^2

155. The value of $\sqrt{12 + \sqrt{12 + \sqrt{12 + \ldots\ldots}}}$ is

(A) 3.9242
(B) 3.4646
(C) 2.0000
(D) 4.0000

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156. If cos x is an integrating factor of the differential equation $\frac{dy}{dx}+Py=Q$, then $P=$

(A) $-\cot x$
(B) $\cot x$
(C) $\tan x$
(D) $-\tan x$

157. The particular integral of $f(D)y=2^x+2^2$ is

(A) $\frac{1}{f(0)}x^2+\frac{1}{f(1)}2^2$, where $f(0),\ f(1)\neq 0$

(B) $\frac{1}{f(\log 2)}2^x+\frac{1}{f(0)}2^2$, where $f(\log 2),\ f(0)\neq 0$

(C) $\frac{1}{f(0)}2^x+\frac{1}{f(\log 2)}2^2$, where $f(\log 2),\ f(0)\neq 0$

(D) $\frac{1}{f(\log 2)}\left(2^x+2^2\right)$, where $f(\log 2)\neq 0$

158. $\lim_{x\to\infty}\left(\frac{4-x^2}{x^2-1}\right)$ is equal to

(A) 1
(B) 0
(C) –4
(D) –1

159. $\int\frac{1}{x\ln x}dx$ is equal to

(A) $\frac{1}{\ln^2 x}+c$

(B) $\frac{1}{x(\ln x)^2}+c$

(C) $\ln(x\ln x)+c$

(D) $\ln(\ln x)+c$

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160. The maximum value of the function $f(x)=\frac{e^{\sin x}}{e^{-\cos x}}$ is

(A) $\sin\left(e^2\right)$

(B) e

(C) 1

(D) $e^{\sqrt{2}}$

161. The solution of the equation $|z|-z=1+i$ is

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

162. Let A be the set of all z satisfying $\log_{\frac{1}{3}}\log_{\frac{1}{2}}\left(|z|^2+4|z|+3\right)<0$. Then A is

(A) an empty set

(B) an infinite set

(C) $\{z:|z|=0\}$

(D) $-\frac{1}{\sqrt{3}}$

163. If $\sin^{-1}\left(x-\frac{x^2}{2}+\frac{x^3}{4}-\frac{x^4}{8}+\ldots\right)+\cos^{-1}\left(x^2-\frac{x^4}{2}+\frac{x^6}{4}-\frac{x^4}{8}+\ldots\right)=\frac{\pi}{2}$ for $0<|x|<\sqrt{2}$, then x equals

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

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

(C) 0

(D) 1

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164. Which of the following functions is differentiable at $x = 0$?

(A) $\cos(|x|)+|x|$

(B) $\cos(|x|)-|x|$

(C) $\sin(|x|)+|x|$

(D) $\sin(|x|)-|x|$

165. If $P(A\cup B)=P(A)+P(B)-P(A)P(B)$, then

(A) $P(B/A)=P(B)-P(A)$

(B) $P(A'\cup B')=P(B')-P(A')$

(C) $P((A\cup B'))=P(B')$

(D) $P(A/B)=P(A)$

166. If $A=\begin{bmatrix}\cos x & \sin x\\ -\sin x & \cos x\end{bmatrix}, 0<x<\frac{\pi}{2}$ and $A+A'=I$, then the value of x is

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

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

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

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

167. The maximum and minimum values of the function $f(x)=|\sin 2x+3|$ are respectively

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

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168. The area of the region bounded by the curve $|x|+y=1$ and the axis of x is given by

(A) 2
(B) 10
(C) 1
(D) 4

169. The ratio in which the area bounded by the curves $y^2=12x$ and $x^2=12y$ is divided by the line $x = 3$, is

(A) 19 : 49
(B) 15 : 49
(C) 12 : 37
(D) 1 : 3

170. The line $y = mx$ bisects the area enclosed by the lines $x = 0$, $y = 0$, $x = \frac{3}{2}$ and the curve $y=1+4x-x^2$. The value of m is

(A) $\frac{13}{6}$

(B) $\frac{13}{8}$

(C) $\frac{8}{13}$

(D) $\frac{6}{13}$

171. The value of the integral $\int_1^3 \sqrt{(2x+3)\left(3x^2+4\right)}\,dx$ cannot exceed

(A) $\sqrt{48}$
(B) $\sqrt{66}$
(C) $\sqrt{73}$
(D) $\sqrt{6}$

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172. Let * be a binary operation, on the set of all non-zero real numbers, given by $a*b=\frac{ab}{5}$ for all $a,b\in R-\{0\}$. Then the value of 'x' such that $2*(x*5)=10$, is

(A) 31
(B) 22
(C) 25
(D) 43

173. If the points $\left(au^2,2au\right)$ and $\left(av^2,2av\right)$ are the extremities of a focal chord of the parabola $y^2=4ax$, then

(A) $uv-1=0$
(B) $uv+1=0$
(C) $u+v=0$
(D) $u-v=0$

174. For a constant a, the line $y=2a^2$ meets the ellipse $\frac{x^2}{9}+\frac{y^2}{4}=1$ at the real points if

(A) $|a|\le 1$
(B) $|a|>1$
(C) $|a|<3$
(D) $-\infty<|a|$

175. The mirror image of the directrix of the parabola $y^2=4(x+1)$ in the line mirror $x+2y=3$ is

(A) $x=-2$
(B) $4y+3x=16$
(C) $3x-4y=-16$
(D) $y=-1$

176. The curve represented by $x=3(\cos t+\sin t)$ and $y=4(\cos t-\sin t)$ is

(A) an ellipse
(B) a parabola
(C) a hyperbola
(D) a circle

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177. Given $E(X + c) = 8$ and $E(X - c) = 12$ then the value of c is

(A) -2
(B) 4
(C) -4
(D) 2

178. A random variable X has the following probability distribution:

X	0	1	2	3	4	5	6	7	8
$P(X = x)$	a	$3a$	$5a$	$7a$	$9a$	$11a$	$13a$	$15a$	$17a$

The value of 'a' is

(A) $\frac{7}{81}$

(B) $\frac{5}{81}$

(C) $\frac{1}{81}$

(D) $\frac{2}{81}$

179. If $\sin\left(\sin^{-1}\left(\frac{1}{5}\right)+\cos^{-1}x\right)=1$, then the value of x is

(A) $\frac{32}{31}$

(B) $\frac{31}{32}$

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

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

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180. The equation of the normal to the curve $y = 1 - 2^{\frac{x}{2}}$ at the point of intersection with the y-axis is

(A) $2y - x\log 2 = 0$

(B) $2x - y\log 2 = 0$

(C) $y - x\log 2 = 0$

(D) $2y + x = 0$

181. If $y = x^2 + ax + b$ attains the minimum value 5 at $x = 3$, then the values of a and b are

(A) $a = 6, b = -14$
(B) $a = -6, b = 14$
(C) $a = 14, b = -6$
(D) $a = -14, b = 6$

182. The product $(32)(32)^{\frac{1}{6}}(32)^{\frac{1}{36}}...\infty$ is equal to

(A) 16
(B) 32
(C) 64
(D) 0

183. If the volume of a parallelepiped whose edges are represented by $-12\vec{i} + \lambda\vec{k}$, $3\vec{j} - \vec{k}$ and $2\vec{i} + \vec{j} - 15\vec{k}$ is 546, then the value of λ is

(A) 3
(B) –5
(C) –179
(D) 179

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184. If $3f(x)+5f\left(\frac{1}{x}\right)=\frac{1}{x}-3, \forall x(\neq 0)\in R$, then $f(x)=$

(A) $\frac{1}{16}\left(\frac{3}{x}+5x-6\right)$

(B) $\frac{1}{16}\left(-\frac{3}{x}+5x-6\right)$

(C) $\frac{1}{16}\left(-\frac{3}{x}+5x+6\right)$

(D) $\frac{1}{16}\left(-\frac{3}{x}-5x+6\right)$

185. If $1, \omega, \omega^2$ are the three cube roots of unity, then $\left(1-\omega+\omega^2\right)\left(1-\omega^2+\omega^4\right)\left(1-\omega^4+\omega^8\right)\ldots$ to $2n$ factors is equal to

(A) 2^n

(B) 2^{2n}

(C) 2^{4n}

(D) 2^{3n}

186. For the equation $\left|x^2\right|+|x|-6=0$, the roots are

(A) real and equal
(B) real with sum 0
(C) real with sum 1
(D) real with product 0

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

(A) 14^4

(B) 14^3

(C) 14^2

(D) 14^1

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188. If $\Delta = \begin{vmatrix} 1 & 3\cos\theta & 1 \\ \sin\theta & 1 & 3\cos\theta \\ 1 & \sin\theta & 1 \end{vmatrix}$, then the maximum value of Δ is

(A) 10
(B) 11
(C) 12
(D) 14

189. The value of the sum of the series $14C_0 \cdot 15C_1 + 14C_1 \cdot 15C_2 + ...14C_{14} \cdot 15C_{15}$ is

(A) $29C_{12}$

(B) $29C_{10}$

(C) $29C_{14}$

(D) $29C_{16}$

190. Let a_n be the n^{th} term of the G.P of positive numbers. Let $\sum_{n=1}^{100} a_{2n} = \alpha$ and $\sum_{n=1}^{100} a_{2n-1} = \beta$, such that $\alpha \neq \beta$. Then the common ratio is

(A) $\frac{\alpha}{\beta}$

(B) $\frac{\beta}{\alpha}$

(C) $\sqrt{\frac{\alpha}{\beta}}$

(D) $\sqrt{\frac{\beta}{\alpha}}$

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191. $\lim_{x\to 0}\frac{e^x+e^{-x}+2\cos x-4}{x^4}$ is equal to

(A) 0

(B) 1

(C) $\frac{1}{6}$

(D) $-\frac{1}{6}$

192. The value of k so that the equations $x^2-x-12=0$ and $kx^2+10x+3=0$ may have one root in common, is

(A) 5
(B) –2
(C) 3
(D) 2

193. If f and g be differentiable functions satisfying $g'(a)=2,\ g(a)=b$ and $f\circ g=I$, then $f'(b)$ is equal to

(A) 2

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

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

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

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194. $\int \frac{\sqrt{1+\sqrt{x}}}{x} dx$ is equal to

(A) $2\sqrt{1+\sqrt{x}} - 2\log\left(\frac{\sqrt{1+\sqrt{x}}-1}{\sqrt{1+\sqrt{x}}+1}\right)+C$

(B) $4\sqrt{1+\sqrt{x}} - 2\log\left(\frac{\sqrt{1+\sqrt{x}}-1}{\sqrt{1+\sqrt{x}}+1}\right)+C$

(C) $4\sqrt{1+\sqrt{x}} + 2\log\left(\frac{\sqrt{1+\sqrt{x}}-1}{\sqrt{1+\sqrt{x}}+1}\right)+C$

(D) $2\sqrt{1+\sqrt{x}} + 2\log\left(\frac{\sqrt{1+\sqrt{x}}-1}{\sqrt{1+\sqrt{x}}+1}\right)+C$

195. A book contains 1,000 pages. A page is chosen at random. The probabilities that the sum of the digits of the marked number on the page is equal to 9, is

(A) $\frac{23}{500}$

(B) $\frac{11}{200}$

(C) $\frac{7}{100}$

(D) $\frac{7}{500}$

196. If $|\vec{a}| = 10$, $|\vec{b}| = 2$ and $\vec{a}.\vec{b} = 12$, then the value of $|\vec{a} \times \vec{b}|$ is

(A) 5
(B) 10
(C) 14
(D) 16

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197. A plane meets the coordinate axes in points A, B and C and the centroid of the triangle ABC is (α, β, γ). Then the equation of the plane is

(A) $\frac{x}{\alpha}+\frac{y}{\beta}+\frac{z}{\gamma}=1$

(B) $\frac{x}{\alpha}+\frac{y}{\beta}+\frac{z}{\gamma}=3$

(C) $\alpha x+\beta y+\gamma z=3$

(D) $\alpha x+\beta y+\gamma z=\frac{1}{3}$

198. The reflection of the point (α, β, γ) in the $XOY-$plane is

(A) $(\alpha, \beta, 0)$
(B) $(0, 0, \gamma)$
(C) $(-\alpha, -\beta, \gamma)$
(D) $(\alpha, \beta, -\gamma)$

199. The mean and variance of a random variable X having binomial distribution are 3 and 2 respectively. Then the probability $P(X=2)$ is

(A) $\frac{2^7}{3^7}$

(B) $\frac{2^9}{3^7}$

(C) $\frac{2^7}{3^9}$

(D) $\frac{2^9}{3^9}$

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200. A flashlight has 8 batteries out of which 3 are dead. If 2 batteries are selected one after the other without replacement and tested, the probability that both are dead is

(A) $\frac{33}{56}$

(B) $\frac{9}{64}$

(C) $\frac{1}{14}$

(D) $\frac{3}{28}$

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KEY													
Sl No.	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**
1	A	31	C	61	A	91	A	121	C	151	C	181	B
2	C	32	D	62	A	92	C	122	B	152	A	182	C
3	A	33	C	63	D	93	C	123	C	153	D	183	D
4	C	34	D	64	D	94	A	124	C	154	B	184	B
5	C	35	A	65	C	95	D	125	D	155	D	185	B
6	C	36	A	66	A	96	D	126	D	156	D	186	B
7	D	37	A	67	C	97	A	127	B	157	B	187	A
8	B	38	B	68	B	98	D	128	B	158	D	188	A
9	A	39	B	69	D	99	D	129	B	159	D	189	C
10	D	40	A	70	D	100	C	130	A	160	D	190	A
11	D	41	A	71	D	101	D	131	D	161	B	191	C
12	C	42	B	72	C	102	B	132	B	162	A	192	C
13	D	43	D	73	C	103	C	133	C	163	D	193	C
14	A	44	A	74	A	104	A	134	A	164	D	194	C
15	C	45	B	75	A	105	B	135	C	165	D	195	B
16	C	46	D	76	B	106	A	136	D	166	A	196	D
17	C	47	C	77	D	107	C	137	A	167	A	197	B
18	A	48	D	78	A	108	B	138	A	168	C	198	D
19	A	49	D	79	D	109	C	139	A	169	B	199	B
20	D	50	B	80	D	110	C	140	B	170	A	200	D
21	C	51	C	81	B	111	C	141	B	171	B		
22	D	52	A	82	C	112	D	142	B	172	C		
23	A	53	D	83	D	113	D	143	A	173	B		
24	D	54	D	84	C	114	B	144	A	174	A		
25	A	55	C	85	A	115	D	145	C	175	C		
26	A	56	B	86	B	116	D	146	C	176	A		
27	A	57	D	87	C	117	C	147	B	177	A		
28	B	58	C	88	C	118	B	148	B	178	C		
29	A	59	A	89	A	119	D	149	B	179	D		
30	A	60	C	90	C	120	D	150	B	180	B		

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Test in Physics Chemistry and Mathematics for B Tech (Second Shift)

1. Galvanometer is used to

   (A) measure amount of current flowing
   (B) measure direction of current flow
   (C) check whether current is flowing or not
   (D) measure potential difference

2. Which one is true for super conducting behavior?

   (A) Large conductivity
   (B) Paramagnetism
   (C) Ferromagnetism
   (D) Perfect conduction and perfect diamagnetism

3. What is the critical angle of incidence for water?

   (A) 49.75°
   (B) 47.75°
   (C) 48.75°
   (D) 46.75°

4. Sunlight incident on prism is split into several colours due to

   (A) diffraction
   (B) reflection
   (C) incident
   (D) dispersion

5. 10 cm is a wavelength corresponding to the spectrum of

   (A) Radio waves
   (B) Infrared waves
   (C) Microwaves
   (D) X-rays

6. The particle nature of light is proved by which of the following?

   (A) Polarization
   (B) Diffraction
   (C) Photoelectric effect
   (D) Interference

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7. A doped semiconductor is also known as

(A) intrinsic semiconductor
(B) extrinsic semiconductor
(C) diffused semiconductor
(D) compound semiconductor

8. Which one of the following has highest mobility?

(A) Neutron
(B) Electron
(C) Positive ions
(D) Holes

9. Photoelectric effect is based on the law of conservation of

(A) Mass
(B) Energy
(C) Momentum
(D) Angular velocity

10. The main origin of the magnetism is based on the

(A) polar nature of the materials
(B) Pauli's exclusion principle
(C) intrinsic spin of the electron
(D) charge of the electron

11. Electromagnetic waves are produced due to

(A) uniformly moving charge
(B) constantly circulating charge
(C) rest charge
(D) accelerated charge

12. An equivalent representation for the Boolean expression $A' + 1$ is

(A) A
(B) A'
(C) 1
(D) 0

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13. Ohms law says

(A) $R = VI$

(B) $V = IR$

(C) $V = I^2R$

(D) $R = V^2I$

14. The reason why metals are so shiny is

(A) their hardness makes them easy to polish
(B) the electric field of the photon is forced to go to zero at the surface of the metal, generating a wave in the opposite direction
(C) because metals are so hard, photons undergo completely elastic collisions which gives them an equal and opposite momentum
(D) metals carry a large static charge at their surface that repels the photons

15. Two identical objects having mass 'm' are released from rest and they move towards each other under the influence of mutual gravitational force. Gravitational potential energy of the two particle system

(A) is zero
(B) is constant ($\neq 0$)
(C) decreases as the separation decreases
(D) increases as the separation decreases

16. Expression of Brewster's law is

(A) $\mu = \tan i_p$

(B) $\mu = \tan r$

(C) $\mu = \cos r$

(D) $\mu = \sin r$

17. What is the focal length of the combination of the two lens having power $+14D$ and $-4D$ respectively are placed in contact coaxially?

(A) 100 cm
(B) 10 cm
(C) 10 m
(D) 100 m

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18. Two electric bulbs having resistance in the ratio of 1 : 3 are connected in parallel to a constant voltage source. The power dissipated in them has the ratio of

(A) 1 : 6
(B) 1 : 3
(C) 3 : 1
(D) 6 : 1

19. The value of Young's modulus for a perfect rigid body is

(A) zero
(B) infinity
(C) one
(D) less than one

20. A body of mass of 10 kg is placed at the centre of the earth. Now, the weight of the body will be

(A) Infinite
(B) 10 kg
(C) Zero
(D) 20 kg

21. At a given temperature, the pressure of an ideal gas is

(A) directly proportional to its density
(B) inversely proportional to its density
(C) inversely proportional to square of its density
(D) independent of its density

22. Which one of the below given frequency is audible to human ears?

(A) 2 Hz
(B) 25 kHz
(C) 2000 Hz
(D) 200 kHz

23. Which of these crystal defects occurs due to the interstitial position of atoms?

(A) Schottky defect
(B) Frenkel defect
(C) Metal ion defect
(D) Screw dislocation

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24. As the accelerating potential used in a Coolidge tube to produce X-rays is increased, the cut-off wavelength

(A) increases
(B) decreases
(C) first increases, then decreases
(D) remain unchanged

25. For a P-N junction diode

(A) forward current is in *mA* and reverse current is in μA
(B) forward current is in *A* and reverse current is in *mA*
(C) both forward and reverse currents are in μA
(D) both forward and reverse currents are in *mA*

26. When a light frequency *n* is shined on the metal surface, the maximum velocity of the photoelectrons emitted from the surface is *v*. If the incident frequency is increased to 4*n*, the maximum velocity of the ejected photoelectrons will be

(A) 4*v*
(B) 2*v*
(C) *v*
(D) 3*v*

27. A time dependent force $F = 8t$ acts on a particle of mass 1 kg. If the particle starts from rest, the work done by the force during the first 2 second will be

(A) 16 J
(B) 256 J
(C) 128 J
(D) 64 J

28. Copper of fixed volume *V* is drawn into wire of length *l*. When this wire is subjected to a constant force *F*, the extension produced in the wire is Δl. Which of the following graph is a straight line?

(A) Δl versus $\frac{1}{l}$

(B) Δl versus l^2

(C) Δl versus $\frac{1}{l^2}$

(D) Δl versus l

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29. Seven capacitors each of capacitance 4 μF are to be connected to obtain a capacitance of $\frac{20}{11}\mu F$, which of the following combination is possible?

(A) 4 in parallel 3 in series
(B) 5 in parallel 2 in series
(C) 3 in parallel 4 in series
(D) 2 in parallel 5 in series

30. If the source of light used in a Young's double slit experiment is changed from red to violet,

(A) the fringes will become brighter
(B) the intensity of minima will increase
(C) consecutive fringes will come closer
(D) the consecutive fringes moves apart

31. The SI unit of $\frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ is

(A) F/m
(B) m/sec
(C) H-F
(D) m/HF

32. The permanent magnetic moment of the atoms of a material is zero. The material

(A) must be paramagnetic
(B) must be diamagnetic
(C) must be ferromagnetic
(D) must be ferrimagnetic

33. A coil of inductance 300 mH and resistance 2 Ω is connected to a 2 V voltage source. The current reaches half of its steady state value in

(A) 0.05 sec
(B) 0.1 sec
(C) 0.15 sec
(D) 0.3 sec

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34. A stone of mass m tied to a string of length l is rotated in a circle with the other end of the string as the centre. The speed of the stone is v. If the string breaks, the stone will

(A) move towards the centre
(B) move away from the centre
(C) move along the tangent
(D) stop

35. A sphere, a cube and a thin circular plate all of same material having same mass are initially heated to 200°C. Which of these will cool faster?

(A) Circular plate
(B) Sphere
(C) Cube
(D) Both the circular plate and sphere

36. The image formed by an objective of a compound microscope is

(A) Virtual and diminished
(B) Real and diminished
(C) Real and enlarged
(D) Virtual and enlarged

37. The shortest height of a vertical mirror required to see the entire image of a man will be

(A) one third of man's height
(B) half of the man's height
(C) two third of man's height
(D) one fourth of the man's height

38. A cell supplies a current of 0.9 A through a 2 Ω resistor and a current of 0.3 A through a 7 Ω resistor. What is the internal resistance of the cell?

(A) 0.5 Ω
(B) 1 Ω
(C) 1.2 Ω
(D) 2 Ω

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39. A spring of force constant k is cut into two pieces such that one piece is double the length of the other. Then the longer piece will have a force constant of

(A) $2k/3$
(B) $3k/2$
(C) $3k$
(D) $6k$

40. A body of mass 10 kg is moving on a horizontal surface by applying a force of 10 N in forward direction. If body moves with constant velocity, the work done by applied force for a displacement of 2 m is

(A) 20 J
(B) 10 J
(C) 30 J
(D) 40 J

41. Out of gravitational, electromagnetic, van der Waal's, electrostatic and nuclear forces, which of the following provides an attractive force between neutrons?

(A) gravitational and van der Waal's
(B) electrostatic and gravitational
(C) electrostatic and nuclear
(D) nuclear

42. A condenser of capacity 10 μF is charged to a potential difference of 100 V. It is now connected in parallel to another uncharged condenser. The common potential now is 40 V. The capacitance of the other condenser is

(A) 25 μF
(B) 20 μF
(C) 15 μF
(D) 10 μF

43. For ferromagnetic substances the permeability is ……..
and susceptibility is ……..

(A) very large; positive and large
(B) very large; negative and small
(C) very small; positive and large
(D) very low; negative and small

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44. The magnetic flux linked with a coil changes from 1 Weber to 0.1 Weber in 0.1 sec. The induced e.m.f is

(A) 9 Volts
(B) 10 Volts
(C) 0.009 Volts
(D) 0.1 Volts

45. A step down transformer transforms supply line voltage of 2200 V into 220 V. The primary coil has 5000 turns. The efficiency and power transmitted by the transformer are 90% and 8 kW respectively. Then the number of turns in the secondary and the power supplied are

(A) 50 turns, 9.89 kW
(B) 500 turns, 9.89 kW
(C) 500 turns, 8.89 kW
(D) 100 turns, 8.89 kW

46. On a glass plate a light ray is incident at an angle of 60°. If the reflected and refracted rays are mutually perpendicular, the refractive index of the material is

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

47. If the least distance for clear vision is 25 cm, power of objective and the eyepiece are 25 dioptre and 5 dioptre lenses respectively, with separation between them is 30 cm, the maximum magnifying power of the compound microscope is

(A) 8.4
(B) 7.4
(C) 9.4
(D) 10.4

48. A proton and an α particle are accelerated by the same potential difference.

Their ratio of the de Broglie wavelengths (λ_p, λ_α) is

(A) 1
(B) 2
(C) $\sqrt{8}$
(D) $1/\sqrt{8}$

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49. A photon and an electron have same kinetic energy. If λ_p and λ_e are the wavelengths of them respectively, then

(A) $\lambda_p < \lambda_e$

(B) $\lambda_p > \lambda_e$

(C) $\lambda_p = \lambda_e$

(D) $\lambda_p = \lambda_e = 0$

50. Ratio of wavelengths of first line of Lyman series and the first line of Balmer series is

(A) 1 : 3
(B) 27 : 5
(C) 5 : 27
(D) 4 : 9

51. If Avogadro's number is 6×10^{23} then the number of protons, neutrons and electrons in 14 gm of ${}_6C^{14}$ are respectively

(A) $36 \times 10^{23}, 48 \times 10^{23}, 36 \times 10^{23}$

(B) $36 \times 10^{23}, 36 \times 10^{23}, 36 \times 10^{23}$

(C) $48 \times 10^{23}, 36 \times 10^{23}, 48 \times 10^{23}$

(D) $48 \times 10^{23}, 48 \times 10^{23}, 36 \times 10^{23}$

52. The binding energy per nucleus of deuteron (${}_1H^2$) and helium nucleus (${}_2He^4$) is 1.1 MeV and 7 MeV respectively. If two deuteron nuclei react to form a single helium nucleus, then the energy released is

(A) 13.9 MeV
(B) 25.8 MeV
(C) 23.6 MeV
(D) 19.2 MeV

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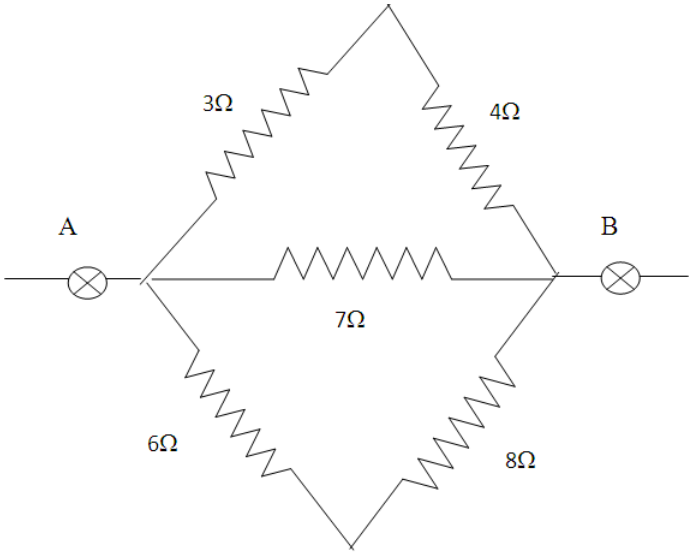
53. An aluminium rod of length 3.14 m is of square cross-section $3.14 \times 3.14\ mm^2$. What should be the radius of 1 m length of another rod of same material to have equal (same) resistance?

(A) 2 mm
(B) 4 mm
(C) 1 mm
(D) 6 mm

54. The resistance across AB in the circuit is



(A) 2.8 Ω
(B) 14/3 Ω
(C) 3/14 Ω
(D) 5/14 Ω

55. The energy band gap in conductors, semiconductors and insulators are EG_1, EG_2 and EG_3 respectively. Then the relation among them is

(A) $EG_1 = EG_2 = EG_3$

(B) $EG_1 > EG_2 > EG_3$

(C) $EG_1 < EG_2 < EG_3$

(D) $EG_1 < EG_2 > EG_3$

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56. The magnitude of average velocity is equal to the average speed when a particle moves

(A) on a curved path
(B) in a straight line
(C) with the constant acceleration
(D) with constant retardation

57. If F is the force between two point charges submerged in a medium of dielectric constant K, then on withdrawing the medium, the force between the charges becomes

(A) $F\sqrt{K}$
(B) FK
(C) $F/\sqrt{K}$
(D) F/K

58. Resistances n, each of r ohm, when connected in parallel give an equivalent resistance of R ohm. If these resistances were connected in series, the combination would have resistance in ohm, equal to

(A) R/n^2
(B) R/n
(C) nR
(D) n^2R

59. A stationary particle explodes into two particles of masses m_1 and m_2 which move in opposite directions with velocities v_1 and v_2. The ratio of their kinetic energies E_1/E_2 is

(A) m_2/m_1
(B) m_1/m_2
(C) 1
(D) m_1v_2/m_2v_1

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60. A ray of light is incident normally on one of the faces of a prism of angle 30° and refractive index $\sqrt{2}$. The angle of deviation of the ray is

(A) 0°
(B) 12.5°
(C) 15°
(D) 22.5°

61. Matter wave duality is associated with

(A) Pauli's principle
(B) De Broglie relation
(C) Schrodinger wave equation
(D) Plank's equation

62. If energy of a photon of 3 eV strikes a metal surface and resulting work function on the metal is 2 eV, calculate the kinetic energy of the emitted photon.

(A) 5 eV
(B) 2.5 eV
(C) 1.5 eV
(D) 1 eV

63. According to Graham's law of diffusion, the rate of diffusion of a gas at constant pressure is

(A) directly proportional to density of the gas
(B) inversely proportional to density of the gas
(C) directly proportional to square root of density of the gas
(D) inversely proportional to square root of density of the gas

64. In a cyclic process

(A) work done is zero
(B) work done by the system is equal to the quantity of heat given to the system
(C) work done does not depend on the quantity of heat given to the system
(D) the internal energy of the system increases

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65. If solute-solvent interaction are weaker than those between solute-solute and solvent-solvent interactions, then

(A) $\Delta H_{mix} = 0$

(B) $\Delta H_{mix} = +ve$

(C) $\Delta H_{mix} = -ve$

(D) $\Delta H_{mix} = T\Delta S$

66. When a catalyst is added to a reversible reaction in equilibrium state, the value of the equilibrium constant

(A) increases
(B) decreases
(C) does not change
(D) becomes zero

67. What is the relation between K_p and K_c?

(A) $K_p = \Delta n\ K_c\ RT$

(B) $K_p = -\Delta n\ K_c\ RT$

(C) $K_p = K_c\ (RT)^{\Delta n}$

(D) $K_p = K_c\ (RT)^{-\Delta n}$

68. Henderson–Hasselbalch equation for a buffer solution is

(A) $pH = pK_a + \log\left(\frac{[Salt]}{[Acid]}\right)$

(B) $pH = pK_a - \log\left(\frac{[Salt]}{[Acid]}\right)$

(C) $pH = pK_b + \log\left(\frac{[Salt]}{[Acid]}\right)$

(D) $pH = pK_b - \log\left(\frac{[Salt]}{[Acid]}\right)$

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69. Solubility product for a M_2S salt having solubility 's' mol lit^{-1} is

(A) $K_{sp} = 2s^2$

(B) $K_{sp} = 4s^2$

(C) $K_{sp} = 2s^3$

(D) $K_{sp} = 4s^3$

70. If half life time of a reaction is independent of initial concentration of reactant, what is the order of reaction?

(A) Zero order

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

(C) First order

(D) Second order

71. For the reaction, $4NH_3 + 5O_2 \rightarrow 4NO + 6\ H_2O$

(A) $\text{Rate} = 0.25\frac{d[NH_3]}{dt}$

(B) $\text{Rate} = -0.25\frac{d[NH_3]}{dt}$

(C) $\text{Rate} = 4\frac{d[NH_3]}{dt}$

(D) $\text{Rate} = -4\frac{d[NH_3]}{dt}$

72. The reaction $Zn^{2+} + Cu \rightarrow Zn + Cu^{2+}$ is

(The reduction potentials of Zn and Cu are –0.76 V and +0.34 V respectively)

(A) non-spontaneous process
(B) spontaneous process
(C) spontaneous at high temperature
(D) spontaneous at lower temperature

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73. Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a negative deviation from Raoult's law?

(A) Methanol and acetone
(B) Chloroform and acetone
(C) Nitric acid and water
(D) Phenol and aniline

74. The physical adsorption of gases on the solid is due to

(A) Covalent bond
(B) Hydrogen bond
(C) Ionic bond
(D) van der Waal's forces

75. Which among the following is **NOT** a facile reaction for primary amides ($RCONH_2$)?

(A) Dehydration to give the corresponding nitriles
(B) Reaction with bromine in the presence of sodium hydroxide to give primary amines with one carbon less
(C) Reaction with alkyl halides to give the corresponding secondary and tertiary amides
(D) Reaction with lithium aluminum hydride to give primary amines having the same number of carbon atoms

76. In amylopectin, branching occurs by

(A) C1-C4 glycosidic linkage
(B) C6-C6 linkage
(C) C1-C3 glycosidic linkage
(D) C1-C6 glycosidic linkage

77. Which among the following name reactions is suitable for the conversion of ethanoic acid to 2-bromoethanoic acid?

(A) Hell-Volhard-Zelinsky reaction
(B) Hunsdiecker reaction
(C) Reformatsky reaction
(D) Favorskii reaction

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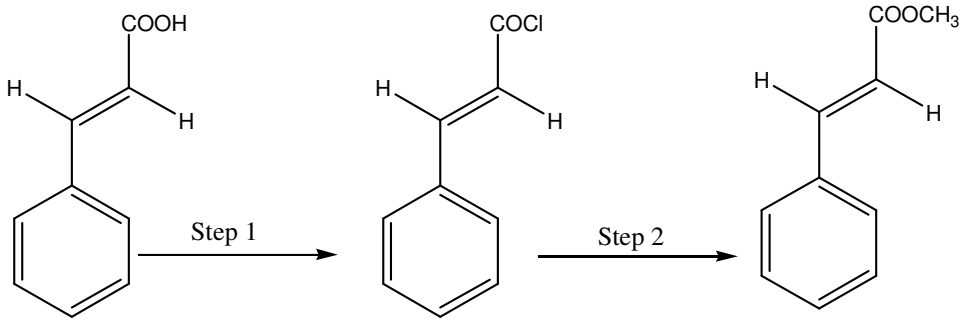
78. Methyl cinnamate can be prepared as shown



Which reagents should be used?

(A) Step 1 - HCl, Step 2 - CH_3OH

(B) Step 1 - HCl, Step 2 - CH_3CO_2H

(C) Step 1 - PCl_5, Step 2 - CH_3OH

(D) Step 1 - PCl_5, Step 2 - CH_3CO_2H

79. C60 (Fullerene) also known as buckminsterfullerene has

(A) 14 pentagons and 18 hexagons
(B) 12 pentagons and 20 hexagons
(C) 10 pentagons and 20 hexagons
(D) 20 pentagons and 12 hexagons

80. Among formaldehyde, trichloroacetaldehyde (CCl_3CHO) and benzaldehyde, the aldehydes that undergo Cannizzaro reaction are

(A) all the three aldehydes
(B) formaldehyde and trichloroacetaldehyde
(C) trichloroacetaldehyde and benzaldehyde
(D) formaldehyde and benzaldehyde

81. Which nitrogenous base is **NOT** present in Ribonucleic Acids (RNA)?

(A) Adenine
(B) Thymine
(C) Guanine
(D) Cytosine

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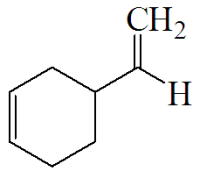
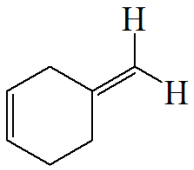
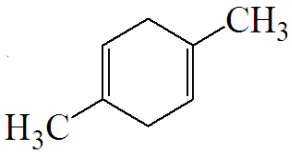
82. Which among the following is **NOT** a reducing sugar?

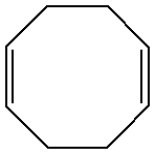
(A) 2-deoxyribose
(B) fructose
(C) glucose
(D) sucrose

83. Which of the following is formed by the dimerization of 1,3-butadiene by Diels-Alder reaction?

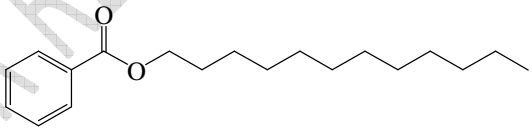
(A) 

(B) 

(C) 

(D) 

84. IUPAC name of the following compound is



(A) Dodecyl benzoate
(B) Benzyl dodeconate
(C) Benzoyl oxy dodecane
(D) Phenyl dodeconate

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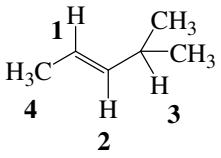
85. Which hydrogen is most easily abstracted from the below mentioned compound to give the corresponding radical intermediate?



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

86. Which among the following aromatic compounds is most reactive towards sulfonation reaction?

(A) Benzene
(B) Toluene
(C) Ethylbenzane
(D) *t*-Butylbenzene

87. Pick the statement that is **NOT** true for S_N1 substitutions.

(A) Carbocation intermediate is involved
(B) EI elimination is a possible side reaction
(C) Reaction rate is doubled when the concentration of nucleophile is doubled
(D) Primary alkyl halides seldom undergo S_N1 substitutions

88. Arrange the elements in the order of increase in ionization energy?

(A) H, Li, Na, K, Rb, Cs
(B) K, Rb, Cs, H, Li, Na
(C) Cs, H, Li, K, Rb, Na
(D) Cs, Rb, K, Na, Li, H

89. Cobalt and Nickel are

(A) diamagnetic
(B) paramagnetic
(C) ferromagnetic
(D) antiferromagnetic

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90. Chlorine exists in two isotopic forms Cl-37 and Cl-35, but its atomic mass is 35.5. What would be the approximate ratio of Cl-37 and Cl-35?

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

91. Which one is the example for linkage isomerism?

(A) $[Co(NH_3)_5(NO_2)]^{2+}$

(B) $[Pd(NH_3)_4]$

(C) $[Co(NH_3)_4ClBr]Br$

(D) $[Cr(NH_3)_5CN]$

92. The packing fraction (%) of simple cubic unit cell is

(A) 74
(B) 68
(C) 52
(D) 39

93. Calculate de Broglie wavelength for an electron moving at the speed of 6.0×10^6 m/s. ($m = 9.1 \times 10^{-31}$ Kg, $h = 6.627 \times 10^{-34}$ Js)

(A) 1.46×10^{-10} m

(B) 1.21×10^{-9} m

(C) 1.46×10^{-9} m

(D) 1.21×10^{-10} m

94. Physical properties of the elements in the periodic table depends upon the

(A) size of atom
(B) size of proton
(C) number of electrons
(D) size of neutron

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95. …….. is a polar molecule.

(A) BF_6

(B) XeF_4

(C) SF_4

(D) SiF_4

96. Which type of radioactive decay causes the atomic number of a nucleus to increase by one unit?

(A) Electron capture
(B) α- particle emission
(C) β- particle emission
(D) γ- ray emission

97. The maximum temperature that can be achieved in blast furnace is

(A) up to 1200 K
(B) up to 2200 K
(C) up to 1900 K
(D) up to 5000 K

98. The structures of beryllium chloride in solid state and vapour phase are

(A) chain and dimer, respectively
(B) linear in both phases
(C) dimer and linear, respectively
(D) chain in both phases

99. Match the following.

List I		List II	
(a)	PCl_5	(i)	Square pyramidal
(b)	SF_6	(ii)	Trigonal planar
(c)	BrF_5	(iii)	Octahedral
(d)	BF_3	(iv)	Trigonal bipyramidal

(A) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)
(B) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
(C) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
(D) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

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100. What is the correct electronic configuration of the central atom in $K_4[Fe(CN)_6]$ based on crystal field theory?

(A) $t_{2g}^4 e_g^2$

(B) $t_{2g}^6 e_g^0$

(C) $t_{2g}^3 e_g^3$

(D) $e^4 t_2^2$

101. If the non-zero numbers x, y, z are in A.P, and $\tan^{-1} x$, $\tan^{-1} y$, $\tan^{-1} z$ are also in A.P, then

(A) $x = y = z$

(B) $xy = yz$

(C) $x^2 = yz$

(D) $z^2 = xy$

102. Let $f(x)$ be a polynomial of second degree. If $f(1) = f(-1)$ and a, b, c are in A.P, then $f'(a)$, $f'(b)$ and $f'(c)$ are

(A) in A.P
(B) in G.P
(C) in H.P
(D) equal

103. How many 5 letter words, with or without meaning can be formed out of the letters of the word 'EQUATIONS' if repetition of letters is not allowed?

(A) 126

(B) 5^9

(C) 9^5

(D) 15120

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104. If $\lim_{x\to 0}(\cos x + a\sin bx)^{\frac{1}{x}} = e^2$, then

(A) $a=1,\ b=-2$

(B) $a=2\sqrt{2},\ b=\sqrt{2}$

(C) $a=2\sqrt{2},\ b=\frac{1}{\sqrt{2}}$

(D) $a=-2,\ b=1$

105. If the point $(a,-a)$ lies inside the circle $x^2+y^2-4x+2y-8=0$, then 'a' lies in the interval

(A) $(-1,4)$
(B) $(-\infty,-1)$
(C) $(4,\infty)$
(D) $[-1,4]$

106. If $(n-1)C_r = \left(k^2-3\right)nC_{r+1}$, then k lies in the interval

(A) $\left[-\sqrt{3},\sqrt{3}\right]$
(B) $(-\infty,-2)$
(C) $(2,\infty)$
(D) $\left(\sqrt{3},2\right]$

107. The remainder when $1!+2!+3!+\ldots+100!$ is divided by 240, is

(A) 187
(B) 33
(C) 73
(D) 153

108. The solution set of $f'(x) > g'(x)$ where $f(x)=\frac{1}{2}5^{2x+1}$ and $g(x)=5^x+4x\log_e 5$ is

(A) $(1,\infty)$
(B) $(0,\ 1)$
(C) $(-1,\infty)$
(D) $(0,\infty)$

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109. Let f be the greatest integer function defined by $f(x)=[x]$ and g be the modulus function defined by $g(x)=|x|$. Then the value of $(g\circ f)\left(\frac{-1}{3}\right)$ is

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

110. The probability of obtaining an even prime number on each die, when a pair of dice is rolled, is

(A) 0
(B) $\frac{1}{6}$
(C) $\frac{1}{12}$
(D) $\frac{1}{36}$

111. The product of three consecutive numbers is always divisible by

(A) 6
(B) 10
(C) 15
(D) 8

112. In the group of quarternions $Q_8=\{\pm 1,\pm i,\pm j,\pm k\}$, the order of $-j$ is

(A) 2
(B) 4
(C) 8
(D) 6

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113. If $P+\frac{1}{Q}=1$ and $Q+\frac{1}{R}=1,$ then the product of P, Q and R is

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

114. The sum of mean and variance of a binomial distribution of 5 trails is 4.8. Then the probability of success is

(A) 0.2
(B) 1.2
(C) 0.8
(D) 0.5

115. The set of all points of discontinuity of the greatest integer function $f(x)=[x]$ is

(A) the set of all integers
(B) the set of all real numbers
(C) the set of all natural numbers
(D) the set of all rational numbers

116. If $\vec{a}$ and $\vec{b}$ are two non-zero vectors such that $\left|\vec{a}\times\vec{b}\right|=\vec{a}\cdot\vec{b}$, then the angle between $\vec{a}$ and $\vec{b}$ is

(A) $\frac{\pi}{3}$
(B) $\frac{\pi}{4}$
(C) $\frac{\pi}{6}$
(D) $\frac{\pi}{2}$

117. Let the roots of $bt^2+ct+a=0$ be imaginary. For all real values of t, the expression $3b^2t^2+6bct+2c^2$ is

(A) less than $-4ab$
(B) greater than $-4ab$
(C) less than $4ab$
(D) greater than $4ab$

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118. In a triangle ABC, if $\sin A \sin B = \frac{ab}{c^2}$, then the triangle is

(A) equilateral
(B) isosceles
(C) right angled
(D) obtuse angled

119. Let $f(t) = 2t^2 + 5t + 1$. If $f(t) = a(t+1)(t-2) + b(t-2)(t-1) + c(t-1)(t+1)$ for real numbers a, b, c, then

(A) there are infinite number of choices for a, b, c
(B) only one choice for a but infinite number of choices for b and c
(C) exactly one choice for each of a, b, c
(D) more than one but finite number of choices for a, b, c

120. Let $M = \begin{pmatrix} \cos\frac{\pi}{4} & -\sin\frac{\pi}{4} \\ \sin\frac{\pi}{4} & \cos\frac{\pi}{4} \end{pmatrix}$ and $Y = \begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$. Then $M^3Y =$

(A) $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$

(B) $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$

(C) $\begin{pmatrix} \frac{-1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$

(D) $\begin{pmatrix} \frac{-1}{\sqrt{2}} \\ \frac{-1}{\sqrt{2}} \end{pmatrix}$

121. The number of real solutions of the equation $x^7 + 14x^5 + 16x^3 + 30x - 560 = 0$ is

(A) 7
(B) 1
(C) 3
(D) 5

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122. The vector $\vec{a} = \alpha\vec{i} + 2\vec{j} + \beta\vec{k}$ lies in the plane of the vectors $\vec{b} = \vec{i} + \vec{j}$ and $\vec{c} = \vec{j} + \vec{k}$ and bisects the angle between $\vec{b}$ and $\vec{c}$. Then

(A) $\alpha = 1, \beta = 1$
(B) $\alpha = 2, \beta = 2$
(C) $\alpha = 1, \beta = 2$
(D) $\alpha = 2, \beta = 1$

123. Which of the following function is not one to one?

(A) $g : \square \to \square$, $g(x) = 2x + 5$

(B) $g : [0, \pi] \to [-1, 1]$, $g(x) = \cos x$

(C) $g : \left[\frac{-\pi}{2}, \frac{\pi}{2}\right] \to [1, 7]$, $g(x) = 3\sin x + 4$

(D) $g : \square \to [-1, 1]$, $g(x) = \sin x$

124. The number of real solutions of the equation $\frac{6-x}{x^2-4} = 2 + \frac{x}{x+2}$ is

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

125. If $x_n > x_{n-1} > \ldots > x_2 > x_1$, then the value of $\log_{x_1} \log_{x_2} \log_{x_3} \ldots \log_{x_n} x_n^{x_{n-1}^{\cdot^{\cdot^{x_1}}}}$ is equal to

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

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126. If $\tan x = \frac{3}{4}$ and $\tan y = \frac{1}{7}$, then $x + y$ is equal to

(A) π

(B) 2π

(C) $\frac{\pi}{4}$

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

127. If α and β are roots of both the equations $\cos^2 x + a \cos x + b = 0$ and $\sin^2 x + p \sin x + q = 0$, then

(A) $1 + b + a^2 = p^2 - q$

(B) $a^2 + b^2 = p^2 + q^2$

(C) $b + q = a^2 + p^2 - 2$

(D) $b + q = a^2 + p^2 + 2$

128. If z_1 and z_2 are complex numbers satisfying $\left|\frac{z_1}{z_2}\right| = 1$ and $\arg(z_1 z_2) = 0$, then

(A) $z_1 = z_2$

(B) $\left|z_2^2\right| = z_1 z_2$

(C) $z_1 z_2 = 1$

(D) $z_1 . z_2 = 1$

129. $\sqrt{2+\sqrt{2+\sqrt{2+...\infty}}}$ is equal to

(A) $2i$

(B) i

(C) $-i$

(D) -1

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130. The complex numbers $\sin x + i \cos 2x$ and $\cos x - i \sin 2x$ are conjugate to each other for

(A) $x = n\pi$

(B) $x = \left(n + \frac{1}{2}\right)\pi$

(C) all values of x

(D) no value of x

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131. Let a, b, c be in Harmonic Progression. Then $\frac{a}{b+c}, \frac{b}{a+c}, \frac{c}{a+b}$ are

(A) in Harmonic Progression
(B) in Geometric Progression
(C) in Arithmetic Progression
(D) equal

132. The sum of all two digit odd numbers is

(A) 2475
(B) 2530
(C) 4095
(D) 5049

133. If $H_n = 1 + \frac{1}{2} + ... + \frac{1}{n}$, then the value of $1 + \frac{3}{2} + \frac{5}{3} + ... \frac{2n-1}{n}$ is

(A) $n + H_n$
(B) $2n + H_n$
(C) $2n - H_n$
(D) $n - H_n$

134. A person read common difference of an Arithmetic Progression as –4 instead of 4 and obtained the sum of first eight terms as 48. The correct sum of first eight terms is

(A) 212
(B) 272
(C) 312
(D) 342

135. Let $y = \left(1 + x^{\frac{1}{4}}\right)\left(1 + x^{\frac{1}{2}}\right)\left(1 - x^{\frac{1}{4}}\right)$. Then $\frac{dy}{dx}$ is equal to

(A) 1
(B) -1
(C) x
(D) $\sqrt{x}$

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136. Let $f(x)$ be a polynomial in x. Then, the second order derivative of $f\left(e^x\right)$ with respect to x is

(A) $f''\left(e^x\right).e^x + f'\left(e^x\right)$

(B) $f''\left(e^x\right).e^{2x} + f'\left(e^{2x}\right).e^{2x}$

(C) $f''\left(e^x\right).e^{2x}$

(D) $f''\left(e^x\right).e^{2x} + f'\left(e^x\right).e^x$

137. Let $y = x^{\sin x}$. Then the value of $\frac{dy}{dx}$ at $x = \frac{\pi}{2}$ is

(A) $1 + \frac{1}{\sqrt{2\pi}}$

(B) 1

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

(D) $-\frac{1}{\sqrt{2\pi}}$

138. If $f(x) = e^x \sin x$, then $f^{(6)}(x)$ is equal to

(A) $e^{6x} \sin 6x$

(B) $-8e^x \cos x$

(C) $8e^x \sin x$

(D) $8e^x \cos x$

139. Let $P(-1, 0)$, $Q(0, 0)$ and $R\left(3, 3\sqrt{3}\right)$ be three points. Then the equation of the bisector of the $\angle PQR$ is

(A) $\frac{\sqrt{3}}{2}x + y = 0$

(B) $x - \sqrt{3}y = 0$

(C) $\sqrt{3x} + y = 0$

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(D) $x+\frac{\sqrt{3}}{2}y=0$

140. The circles $x^2+y^2-12x+20=0$ and $x^2+y^2=k^2$ intersect at two distinct points, if

(A) $k<2$
(B) $2<k<10$
(C) $k>8$
(D) $k=2$

141. Given $f_1(x)=x_1$, $f_2(x)=-x$, $f_3(x)=\frac{1}{x}$ and $f_4(x)=-\frac{1}{x}$ and $\circ$ stands for composition of function. Then $\left(f_4\circ f_2\right)(x)$ is

(A) $f_1(x)$

(B) $f_2(x)$

(C) $f_3(x)$

(D) $f_4(x)$

142. Locus of the midpoint of any focal chord of $y^2=4ax$ is

(A) $y^2=a(x-2a)$
(B) $y^2=2a(x-2a)$
(C) $y^2=2a(x-a)$
(D) $y^2=a(x-a)$

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143. The latus rectum of the parabola $y^2 = 4ax$ whose focal chord is PSQ such that $SP = 3$ and $SQ = 2$ is given by

(A) $\frac{24}{5}$

(B) $\frac{12}{5}$

(C) $\frac{6}{5}$

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

144. The number of values of c such that the line $y = 4x + c$ touches the curve $\frac{x^2}{4} + y^2 = 1$, is

(A) 1
(B) 2
(C) ∞
(D) 0

145. The diameter of $16x^2 - 9y^2 = 144$ which is conjugate to $x = 2y$, is

(A) $y = \frac{16x}{9}$

(B) $y = \frac{32x}{9}$

(C) $y = \frac{16y}{9}$

(D) $y = \frac{32y}{9}$

146. The value of $n \in I$, for which the function $f(x) = \frac{\sin nx}{\sin\left(\frac{x}{n}\right)}$ has 4π as its period, is

(A) 2
(B) 3
(C) 4
(D) 5

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147. $\lim_{x\to\infty}\left(\frac{x+6}{x+1}\right)^{x+4}$ is equal to

(A) e^{-5}

(B) e^{5}

(C) 0

(D) e^{-1}

148. The points of discontinuity of the function given below is/are

$$f(x)=\begin{cases}\frac{1}{5}\left(2x^2+3\right) & x\le 1\\ 6-5x & 1<x<3\\ x-3 & x\ge 3\end{cases}$$

(A) $x = 1$
(B) $x = 3$
(C) $x = 1, 3$
(D) $x = 4$

149. If $f(x)=\sqrt{\frac{x-\sin x}{x+\cos^2 x}}$, then $\lim_{x\to\infty} f(x)$ is

(A) 0
(B) ∞
(C) 1
(D) -1

150. The point of the curve $y^2 = 2(x - 3)$ at which the normal is parallel to the line $y - 2x + 1 = 0$ is

(A) (5, 2)

(B) $\left(-\frac{1}{2},-2\right)$

(C) (5,–2)

(D) $\left(\frac{3}{2},2\right)$

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151. $\int e^x \left(\frac{1-\sin x}{1-\cos x}\right) dx$ is equal to

(A) $-e^x \tan\left(\frac{x}{2}\right)+c$

(B) $-e^x \cot\left(\frac{x}{2}\right)+c$

(C) $-\frac{1}{2}e^x \tan\left(\frac{x}{2}\right)+c$

(D) $\frac{1}{2}e^x \cot\left(\frac{x}{2}\right)+c$

152. The differential equation $\frac{dy}{dx}=\frac{x\left(1+y^2\right)}{y\left(1+x^2\right)}$ represents a family of

(A) parabola
(B) hyperbola
(C) circle
(D) ellipse

153. The solution of $\frac{dy}{dx}+1=e^{x+y}$ is

(A) $e^{-(x+y)}+x+c=0$

(B) $e^{-(x+y)}-x+c=0$

(C) $e^{(x+y)}+x+c=0$

(D) $e^{(x+y)}-x+c=0$

154. The value of $\frac{\left(\vec{a}\times\vec{b}\right)^2+\left(\vec{a}\cdot\vec{b}\right)^2}{2\vec{a}^2\cdot\vec{b}^2}$ is

(A) $\vec{a}\cdot\vec{b}$

(B) 1

(C) 0

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

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155. The points (5, –4, 2), (4, –3, 1), (7, –6, 4) and (8, –7, 5) are the vertices of a

(A) rectangle
(B) square
(C) parallelogram
(D) trapezium

156. The inverse of the mapping $f : R \to R$ defined by $f(x) = 7x - 8$ for all $x \in R$, is

(A) $g(y) = \frac{y-7}{8}$ for all $y \in R$

(B) $g(y) = \frac{y+7}{8}$ for all $y \in R$

(C) $g(y) = \frac{y+8}{7}$ for all $y \in R$

(D) $g(y) = \frac{y-8}{7}$ for all $y \in R$

157. If $\begin{bmatrix} 2 & -2 & x \\ 2 & x & 2 \\ x & -2 & 2 \end{bmatrix}$ has no inverse, then the real value of x is

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

158. If the sum of two unit vectors is a unit vector then the magnitude of their difference is

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

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159. If $\frac{1-i}{1+i}$ is a root of the equation $ax^2+bx+1=0$, where a, b are real, then (a, b) is

(A) (1, 1)
(B) (1, – 1)
(C) (0, 1)
(D) (1, 0)

160. Pipe A can fill a cistern in 36 minutes and pipe B in 48 minutes. If both the pipes are opened together, when should pipe B be closed so that the cistern may be just full in 24 minutes?

(A) 8 minutes
(B) 9 minutes
(C) 12 minutes
(D) 16 minutes

161. If $f: R \to R$ is defined by $f(x)=\cos x$ and $g: R \to R$ is defined by $g(x)=x^2$, then $f \circ g$ is

(A) $x^2 \cos x$
(B) $(\cos x)^2$
(C) $\cos x^2$
(D) $\frac{\cos x}{x^2}$

162. The order and degree of the differential equation $\left(3+\left(\frac{dy}{dx}\right)^2\right)^{\frac{1}{4}}=\left(\frac{d^3y}{dx^3}\right)^{\frac{1}{3}}$ are

(A) 2, 6
(B) 2, 3
(C) 3, 4
(D) 4, 3

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163. The value of $\int_{e}^{e^2} \log_e x\,dx$ is

(A) $2e^2$

(B) $2e^2 - e$

(C) e

(D) e^2

164. The values of x for which the graph of $f(x) = \frac{x^3}{3} - x^2 + 3$ has a horizontal tangent, are

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

165. The value of $\sum_{n=1}^{100} \left(i^n + i^{n+2}\right)$ is

(A) i
(B) $1 + i$
(C) 0
(D) $-i$

166. If $Z = \sqrt[7]{-1}$ and Z is non-real, then $Z^{86} + Z^{175} + Z^{289}$ equals

(A) Z

(B) -1

(C) Z^2

(D) $(2Z - 3)^3$

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167. The area of the region satisfying $\frac{1}{\sqrt{2}} < |(1+i)z+i| < \sqrt{2}$ is

(A) 3π

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

(C) $\frac{3\pi}{4}$

(D) $-\frac{1}{\sqrt{3}}$

168. A man from the top of a 100 meter high tower sees a car moving towards the tower at an angle of depression of 30°. After some time, the angle of depression becomes 60°. The distance (in meters) travelled by the car during this time is

(A) $\frac{200\sqrt{3}}{3}$

(B) $100\sqrt{3}$

(C) $\frac{100\sqrt{3}}{3}$

(D) $200\sqrt{3}$

169. On the interval [0, 1], the function $x^{25}(1-x)^{75}$ takes its maximum value at the point

(A) 0

(B) $\frac{1}{4}$

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

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

170. The solution set of $|x^2-5x| < 6$ is

(A) $(-1,2)\cup(3,6)$

(B) $0 \le x \le 5$

(C) $x \ge 6$

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(D) $-5 \le x \le 5$

171. A balloon which always remains spherical is being inflated by pumping in 1000 cubic centimetres of gas per second. Then the rate at which the radius of the balloon is increasing when its radius is 5 cm, is

(A) $\frac{10}{\pi}$ cm^2/sec

(B) $\frac{10}{3\pi}$ cm/sec

(C) $\frac{\pi}{10}$ cm/sec

(D) $\frac{10}{\pi}$ cm/sec

172. The function $f(x)=\frac{x^3+x^2-16x+20}{x-2}$ is not defined at $x=2$. In order to make $f(x)$ continuous at $x=2, f(2)$ should be

(A) 1
(B) 4
(C) 0
(D) –4

173. Let $\frac{d}{dx}f(x)=\left(\frac{e^{\sin x}}{x}\right)$, $x>0$. If $\int_1^4 \frac{3}{x}e^{\sin x^3}dx = f(k)-f(1)$, then one of the possible values of k, is

(A) 15
(B) 16
(C) 63
(D) 64

174. For a value of k, the area bounded by the curve $y=-x^5+8x^2$, the straight lines $x=1$ and $x=k$ and the x-axis is equal to $\frac{16}{3}$. Such a value of k is

(A) $\sqrt[3]{8-\sqrt{17}}$

(B) -1

(C) 2

(D) 3

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175. The value of $\int 7^{7^{7x}} 7^{7^x} 7^x \, dx$ is equal to

(A) $\frac{7^{7^{7x}}}{(\log 7)^3} + c$

(B) $\frac{7^{7^{7x}}}{(\log 7)^2} + c$

(C) $7^{7^{7x}} (\log 7)^3 + c$

(D) $7^{7^{7x}} + c$

176. If * is a binary operation defined by $a * b = 3a + 4b - 2$, then $4 * 5$ is

(A) $\sqrt{48}$
(B) 31
(C) 29
(D) 30

177. If $R = \{(x, y) : x + 2y = 8\}$ is a relation on the set of all natural numbers N, then the range of R is

(A) $\{1, 2, 3\}$
(B) $\{1\}$
(C) $\{2, 5\}$
(D) $\{4, 3, 1\}$

178. If b, k are intercepts of a focal chord of the parabola $y^2 = 4ax$, then k is equal to

(A) $\frac{ab}{b-a}$

(B) $\frac{b}{b-a}$

(C) $\frac{a}{b-a}$

(D) $\frac{ab}{a-b}$

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179. The equation of the tangent to the hyperbola $\frac{x^2}{4}-\frac{y^2}{3}=1$, parallel to the line $y = x + 2$, is

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

180. If θ is the angle between the asymptotes of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ with eccentricity e, then $\sec\left(\frac{\theta}{2}\right)$ is

(A) e
(B) $\frac{e}{2}$
(C) $\frac{e}{3}$
(D) $\sqrt{3}$

181. If X follows binomial distribution with parameters $n = 8$ and $p = \frac{1}{2}$, then $P\left(|X-4|\le 2\right)$ is

(A) $\frac{117}{128}$
(B) $\frac{116}{128}$
(C) $\frac{29}{128}$
(D) $\frac{119}{128}$

182. A monoid becomes a group if it also satisfies the

(A) closure axiom
(B) associative axiom
(C) identity axiom
(D) inverse axiom

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183. An example for a tautology is

(A) $p \vee q$
(B) $p \wedge q$
(C) $p \vee \sim p$
(D) $p \wedge \sim p$

184. The Arithmetic Mean of n observations is M. If the sum of $n - 4$ observations is a, then the mean of remaining 4 observations is

(A) $\frac{nM - a}{4}$

(B) $\frac{nM + a}{4}$

(C) $nM - a$

(D) $\frac{nM - a}{2}$

185. If the equation $hxy + gx + fy + c = 0, \quad h \neq 0$ represents two straight lines, then

(A) $2fgh = c^2$

(B) $2fg = ch$

(C) $fgh = c^2$

(D) $fg = ch$

186. If the absolute term in the expansion of $\left(\sqrt{x} - \frac{k}{x^2}\right)^{10}$ is 405, then 'k' is equal to

(A) ± 2
(B) ± 1
(C) ± 3
(D) 0

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187. The range of the function $f(x)=\log_e\left(3x^2-4x+5\right)$ is

(A) $\left(-\infty,\log_e\frac{11}{3}\right]$

(B) $\left[\log_e\frac{11}{3},\infty\right)$

(C) $\left[-\log_e\frac{11}{3},\log_e\frac{11}{3}\right]$

(D) $\left(-\infty,-\log_e\frac{11}{3}\right]$

188. The value of the sum $\sum_{n=1}^{13}\left(i^n+i^{n+1}\right)$, where $i=\sqrt{-1}$, equals

(A) $1-i$
(B) $i-1$
(C) $-i$
(D) 0

189. The locus represented by $|z-1|=|z+i|$ is

(A) a circle of radius 1
(B) an ellipse with foci at 1 and $-i$
(C) a line through the origin
(D) a circle on the join of 1 and $-i$ as diameter

190. Let $A=\begin{bmatrix}0 & 2b & c\\ a & b & -c\\ a & -b & c\end{bmatrix}$ be an orthogonal matrix. Then

(A) $b=\pm\frac{1}{\sqrt{6}},\ c=\pm\frac{1}{\sqrt{3}}$

(B) $a=\pm\frac{1}{\sqrt{2}},\ c=\pm\frac{1}{\sqrt{6}}$

(C) $a=\pm\frac{1}{\sqrt{2}},\ b=\pm\frac{1}{\sqrt{6}}$

(D) $a=\pm\frac{1}{\sqrt{2}},\ b=\pm\frac{1}{\sqrt{6}},\ c=\pm\frac{1}{\sqrt{3}}$

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191. If $\begin{vmatrix} \alpha & -\beta & 0 \\ 0 & \alpha & \beta \\ \beta & 0 & \alpha \end{vmatrix} = 0$ then

(A) α/β is one of the cube roots of unity

(B) α is one of the cube roots of unity

(C) β is one of the cube roots of unity

(D) $\alpha+\beta$ is one of the cube roots of unity

192. The value of λ for which the equations $x+y-3=0$, $(1+\lambda)x+(2+\lambda)y-8=0$, $x-(1+\lambda)y+(2+\lambda)=0$ are consistent is

(A) -1

(B) $\frac{5}{3}$

(C) $-5/3$

(D) $\frac{3}{5}$

193. The sum to n terms of the sequence $\log a$, $\log ar$, $\log ar^2$, ... is

(A) $\frac{n}{2}\log a^2 r^{n-1}$

(B) $n\log a^2 r^{n-1}$

(C) $\frac{3n}{2}\log a^2 r^{n-1}$

(D) $3n\log ar^{n-1}$

194. If a, b, c are positive, then the minimum value of $a^{\log b-\log c}+b^{\log c-\log a}+c^{\log a-\log b}$ is

(A) 1
(B) 3
(C) 9
(D) 16

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195. Let $f(x)$ and $g(x)$ be two differentiable functions and $f(1)=g(1)=2$. Then $\lim_{x\to 1}\dfrac{f(1)g(x)-f(x)g(1)-f(1)+g(1)}{g(x)-f(x)}$ is equal to

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

196. If $g(x)=\left(x^2+2x+3\right)f(x)$, $f(0)=5$ and $\lim_{x\to 0}\dfrac{f(x)-5}{x}=4$, then $g'(0)$ is equal to

(A) 22
(B) 20
(C) 18
(D) 12

197. If the sum of distances of a point from two perpendicular lines in a plane is 1, then its locus is

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

198. The distance between the planes $3x+2y-6z-14=0$ and $3x+2y-6z+21=0$ is

(A) 1
(B) 5
(C) 7
(D) 35

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199. If A and B are two events such that $P(A) = 0.7,\ P(B) = 0.3$ and $P\left(\frac{A}{B}\right) = 0.5$, then $P\left(\frac{A'}{B'}\right)$ is

(A) $\frac{3}{8}$

(B) $\frac{3}{12}$

(C) $\frac{3}{14}$

(D) $\frac{3}{16}$

200. Two cards are drawn from a well shuffled pack of 52 cards with replacement. The probability that both cards are aces is

(A) $\frac{1}{13} \times \frac{1}{13}$

(B) $\frac{1}{13} + \frac{1}{13}$

(C) $\frac{1}{13} \times \frac{1}{17}$

(D) $\frac{1}{13} \times \frac{4}{51}$

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KEY													
SI No.	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**	**SI No.**	**Key**
1	A	31	B	61	B	91	A	121	B	151	B	181	D
2	D	32	B	62	D	92	C	122	A	152	B	182	D
3	C	33	B	63	D	93	D	123	D	153	A	183	C
4	D	34	C	64	B	94	A	124	B	154	D	184	A
5	C	35	A	65	B	95	C	125	B	155	C	185	D
6	C	36	C	66	C	96	C	126	C	156	C	186	C
7	B	37	B	67	C	97	B	127	C	157	C	187	B
8	B	38	A	68	A	98	A	128	B	158	B	188	B
9	B	39	B	69	D	99	A	129	D	159	D	189	C
10	C	40	A	70	C	100	B	130	D	160	D	190	D
11	D	41	D	71	B	101	A	131	A	161	C	191	A
12	C	42	C	72	A	102	A	132	A	162	C	192	C
13	B	43	A	73	B	103	D	133	C	163	D	193	A
14	B	44	A	74	D	104	C	134	B	164	B	194	B
15	C	45	C	75	C	105	A	135	B	165	C	195	C
16	B	46	B	76	D	106	D	136	D	166	B	196	A
17	B	47	C	77	A	107	D	137	B	167	C	197	A
18	C	48	C	78	C	108	D	138	B	168	A	198	B
19	B	49	A	79	B	109	A	139	C	169	B	199	C
20	C	50	C	80	D	110	D	140	B	170	A	200	A
21	A	51	A	81	B	111	A	141	C	171	D		
22	C	52	C	82	D	112	B	142	C	172	C		
23	B	53	C	83	A	113	A	143	A	173	D		
24	B	54	A	84	A	114	C	144	B	174	A		
25	A	55	C	85	C	115	A	145	B	175	A		
26	B	56	B	86	B	116	B	146	A	176	D		
27	C	57	B	87	C	117	B	147	B	177	A		
28	B	58	D	88	D	118	C	148	B	178	A		
29	B	59	A	89	C	119	C	149	C	179	B		
30	C	60	C	90	D	120	A	150	C	180	A		

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101 Test in Physics Chemistry and Mathematics (Shift 3)

1. When there is an electric current through a conducting wire along its length, then an electric field must exist

   (A) outside the wire but normal to it
   (B) outside the wire but parallel to it
   (C) inside the wire but normal to it
   (D) inside the wire but parallel to it

2. A moving charge produces electric field along x-direction and magnetic field along y-direction. Then what is the direction of its velocity?

   (A) x direction
   (B) y direction
   (C) z direction
   (D) Can be in any direction

3. Phase difference between voltage and current of a purely inductive circuit is

   (A) $\frac{\pi}{4}$

   (B) $\frac{\pi}{12}$

   (C) $\frac{\pi}{8}$

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

4. When two coherent sources of same intensity interfere, the resultant intensity will be

   (A) 4 times of the initial intensity
   (B) 8 times of the initial intensity
   (C) 2 times of the initial intensity
   (D) Equal to initial intensity

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5. Wavelength of source is 6000 Å and the diameter of object is 100 inch, so the limit of resolution is

(A) 2.9×10^{-7} radians

(B) 2.8×10^{-7} radians

(C) 2.5×10^{-7} radians

(D) 2.8×10^{-5} radians

6. The SI units of radioactivity is

(A) Curie
(B) Fermi
(C) Becquerel
(D) Joule

7. The mean life for particle decay is

(A) 1.145 times greater than half life
(B) 1.445 times greater than half life
(C) 1.465 times greater than half life
(D) 1.345 times greater than half life

8. Which of the following electromagnetic waves have lowest wavelength?

(A) Green light
(B) X-rays
(C) Gamma rays
(D) Ultraviolet rays

9. Fermi energy level of the intrinsic semiconductor is located

(A) just below the valence band
(B) just above the conduction band
(C) either below or above the conduction band
(D) half way between the valence and conduction band

10. Zener diode is always used in the

(A) Forward bias condition
(B) Reverse bias condition
(C) Zero bias condition
(D) All the above

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11. At room temperature, the n-type semiconductor will have

(A) more of electrons
(B) more of ions
(C) more of holes
(D) equal number of electrons and holes

12. The SI base unit for forces is

(A) $mkgs^{-2}$
(B) N
(C) $mkgs^{2}$
(D) $m^{2}kgs^{-2}$

13. When light rays enter into a medium having different optical density, there will be change in

(A) its speed and frequency
(B) its speed and wavelength
(C) its frequency and wavelength
(D) its speed, frequency and wavelength

14. An electric dipole placed in a non uniform electric field experiences

(A) no force and no torque
(B) a force and a torque
(C) no force but a torque
(D) a force but no torque

15. Which of this experiment proves that particle has wave nature?

(A) Davisson-Germer experiment
(B) Millikan experiment
(C) Faraday's experiment
(D) Newton rings experiment

16. A proton and an alpha particle are accelerated by a constant electric field. Their acceleration will be in the ratio of

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

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17. Superconductor exhibits

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

18. At what distance from the point of equilibrium, the kinetic energy equals the potential energy for a simple harmonic oscillator of amplitude A?

(A) $\frac{A}{4}$

(B) $\frac{A^2}{4}$

(C) $\frac{A}{\sqrt{2}}$

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

19. For a given material, the Young's modulus is 6 times its rigidity modulus. Its Poisson's ratio is

(A) 0.2
(B) 2
(C) 4
(D) 0.4

20. The gravitational potential of a solid sphere is minimum

(A) at the surface of the sphere
(B) at a point outside the sphere
(C) at midpoint between the centre and surface of the sphere
(D) at the centre of the sphere

21. Adding detergent to the water, increases its

(A) surface tension
(B) viscosity
(C) wetting action
(D) angle of contact

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22. A 2 kg box sits on a 3 kg box which sits on a 5 kg box. The 5 kg box rests on a table top. What is the normal force exerted on the 5 kg box by the table top?

(A) 29.4 N
(B) 49 N
(C) 98 N
(D) 19.6 N

23. A Decoration of mass *M* is suspended by a string from the ceiling inside an elevator. The elevator is travelling upward with a constant speed. The tension in the string is

(A) equal to Mg
(B) less than Mg
(C) greater than Mg
(D) impossible to tell without knowing the speed

24. If the pressure of an ideal gas in a closed chamber is doubled, then the volume of the gas

(A) become two times
(B) becomes half
(C) remain constant
(D) become four times

25. The work done by pseudo forces is

(A) Positive
(B) Negative
(C) Zero
(D) Infinite

26. In an isothermal process, the specific heat of the gas is

(A) finite
(B) one
(C) zero
(D) infinite

27. Which theory explains that every point on a wavefront may be considered as a source of secondary spherical wavelets?

(A) Huygen's wave theory
(B) Corpuscular theory
(C) Electromagnetic theory
(D) Quantum theory

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28. Which light source is used in long distance optical fiber communication?

(A) Metal Halide light
(B) Incandescent light
(C) LED source
(D) Laser

29. The NAND gate output will be low if the two inputs are

(A) 01
(B) 00
(C) 10
(D) 11

30. Cp and Cv are specific heats at constant pressure and constant volume respectively. It is observed that $Cp - Cv = a$ for oxygen gas and $Cp - Cv = b$ for nitrogen gas. The correct relation between a and b is

(A) $8a = 7b$
(B) $7a = 8b$
(C) $a = b$
(D) $a = -b$

31. The temperature of a body falls from 40°C to 36°C in 5 minutes when placed in a surrounding of constant temperature 16°C. The time taken by the body temperature to fall from 36°C to 32°C is

(A) 8 min
(B) 6.1 min
(C) 4.2 min
(D) 5 min

32. 2 kg ice at –20°C is mixed with 5 kg water at 20°C, then final amount of water in the mixture will be (specific heat of ice is = 0.5 cal/gm°C; specific heat of water is = 1 cal/gm°C; latent heat of fusion is 80 cal/gm)

(A) 6 kg
(B) 7 kg
(C) 3.5 kg
(D) 5 kg

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33. The minimum orbital angular momentum of an electron in hydrogen atom is

(A) h

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

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

(D) $\frac{h}{\lambda}$

34. Cooking gas containers are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside will be

(A) increase
(B) decrease
(C) remain same
(D) increases for some while decreases for others

35. An electric dipole is placed at an angle of 30° in a non-uniform electric field. The dipole will experience

(A) a translational force only in the direction of the field
(B) a translational force only in a direction normal to the direction of the field
(C) a torque as well as a translational force
(D) a torque only

36. Which of the following phenomena is **NOT** common to sound and light waves?

(A) Interference
(B) Diffraction
(C) Coherence
(D) Polarization

37. If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{2+} is

(A) 30.6 eV
(B) 13.6 eV
(C) 3.4 eV
(D) 122.4 eV

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38. Heat transfer in air occurs mainly due to

(A) Conduction
(B) Convection
(C) Radiation
(D) Radiation and Conduction

39. A body weighs 40 g in air. If its volume is 10 cc, then in water it will weigh

(A) 30 g
(B) 40 g
(C) 50 g
(D) 33 g

40. The strength of the magnetic field around a straight wire is

(A) Same everywhere around the wire
(B) Obeys inverse square law
(C) Directly proportional to square of the distance from the wire
(D) Directly proportional to the distance from the wire

41. The electrostatic pressure on a charged surface having a surface charge density σ is

(A) $\sigma/2\varepsilon_0$
(B) $\sigma^2/2\varepsilon_0$
(C) σ/ε_0
(D) σ^2/ε_0

42. According to Joule's law, if the potential difference across a conductor having a material of specific resistance 'ρ' remains constant, then heat produced in the conductor is directly proportional to

(A) ρ
(B) ρ^2
(C) $1 / \rho$
(D) $1 / \sqrt{\sigma}$

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43. A circular coil of radius R carries a current I, for which the magnetic field at its centre is B. At what distance x from the centre on the axis of the coil, the magnetic field will be $B / 8$

(A) $\sqrt{2}\,R$
(B) $\sqrt{3}\,R$
(C) $2R$
(D) $3R$

44. If a magnet is enclosed in a box made up of iron, then the magnetic field outside the box will be

(A) very high but finite
(B) infinity
(C) low value but finite
(D) zero

45. A bar magnet is dropped vertically down through a wire loop held horizontally. The magnet will fall

(A) with acceleration 'g'
(B) with acceleration greater than 'g'
(C) with uniform acceleration less than 'g'
(D) with non-uniform acceleration less than 'g'

46. The mutual inductance between a pair of coils does not depend on

(A) number of turns in the coil
(B) separation between the coils
(C) relative orientation of the coil
(D) rate of change of current with coils

47. Which of the following statement is **NOT** correct?

(A) The magnification produced by a convex mirror is always less than one
(B) A virtual, erect, same-sized image can be obtained using a plane mirror
(C) A virtual, erect, magnified image can be formed using a concave mirror
(D) A real, inverted, same-sized image can be formed using a convex mirror

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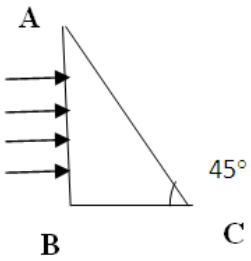
48. A beam of light consisting of red, green and blue colours is incident on AB of a right angled prism. The refractive index of the material of the prism for red, green and blue are 1.39, 1.44 and 1.47 respectively. The prism will



(A) separate red colour from the green and blue colour
(B) separate blue colour from the red and green colour
(C) separate all the colours from one another
(D) all colours propagate along same path

49. Light from the constellation Virgo is observed to increase in wavelength by 0.4%. With respect to the earth the constellation is

(A) moving away with velocity 1.2×10^6 m/s
(B) coming close with velocity 1.2×10^6 m/s
(C) moving away with velocity 4×10^6 m/s
(D) coming close with velocity 4×10^6 m/s

50. When light passes from one medium into another medium, which of the physical property does not change?

(A) Velocity
(B) Wavelength
(C) Frequency
(D) Refractive index

51. In hydrogen atom, if the difference in the energy of the electron in n = 2 and n = 3 orbits is E, the ionization energy of hydrogen atom is

(A) 13.2 E
(B) 7.2 E
(C) 5.6 E
(D) 3.2 E

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52. Nucleus with same neutron number but different atomic number is called as

(A) isobars
(B) isotones
(C) isotopes
(D) isotherm

53. The mass of one Curie of U^{234} is

(A) 3.7×10^{10} gm
(B) 2.348×10^{23} gm
(C) 1.48×10^{-11} gm
(D) 6.25×10^{-24} gm

54. A voltmeter with resistance 150 Ω is connected across a 150 V source having an internal resistance of 0.8 Ω, then the voltmeter will read

(A) 100.4
(B) 149.2
(C) 120
(D) 178.6

55. Electrical conductivity of a semiconductor

(A) decreases with the rise in its temperature
(B) increases with the rise in its temperature
(C) does not change with the rise in its temperature
(D) first increases and then decreases with the rise in its temperature

56. In an insulator, the energy gap between the valance band and conduction band is of the order of

(A) > 5 eV
(B) 2 eV
(C) 3.6 eV
(D) 4.1 eV

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57. Three small spheres, each carrying a positive charge Q, are placed on the circumference of a circle of radius 'r' to form an equilateral triangle. The electric field intensity at the center of the circle will be

(A) $3Q/r$

(B) $3Q/r^2$

(C) $Q/2r^2$

(D) zero

58. In an LCR series a.c circuit, the voltage across each of the components, L, C, and R is 50 V. The voltage across the LC combination will be

(A) 100 V
(B) $50\sqrt{2}$ V
(C) 50 V
(D) 0 V (zero)

59. A telescope has a magnifying power of 10. If one looks at a tree of height 15 meters through the telescope, then the tree appears

(A) 10 times taller
(B) 10 times farther
(C) 10 times nearer
(D) 15 times nearer

60. If the radius of the Earth's orbit is made one-fourth, the duration of one year will become

(A) 8 times

(B) 4 times

(C) $\frac{1}{4}$ times

(D) $\frac{1}{8}$ times

61. In which of the following thermodynamic processes, there is no flow of heat between the system and the surroundings?

(A) Isobaric
(B) Isochoric
(C) Adiabatic
(D) Isothermal

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62. Entropy remains constant in

(A) isothermal process
(B) adiabatic process
(C) cyclic process
(D) isobaric process

63. While charging the lead storage battery

(A) $PbSO_4$ at cathode is reduced to Pb

(B) $PbSO_4$ at anode is reduced to Pb

(C) $PbSO_4$ at cathode is oxidised to Pb

(D) $PbSO_4$ at anode is oxidised to Pb

64. Axial ratios of hexagonal will be

(A) $a = b = c$
(B) $a = b \neq c$
(C) $a \neq b \neq c$
(D) $a = 2b = 3c$

65. Structure of cesium chloride crystal is

(A) face centred cubic
(B) body centred cubic
(C) simple cubic
(D) hexagonal close packing

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66. What type of stoichiometric defect is shown by ZnS?

(A) Schottky defect
(B) Frenkel defect
(C) Both Frenkel and Schottky defects
(D) Plane defect

67. Which one of the following is **NOT** applicable to catalytic action?

(A) Catalyst reduces energy of activation
(B) Catalyst will be most effective in the finely divided state
(C) Catalyst can alter the position of equilibrium of reversible reactions
(D) Catalyst cannot initiate a reaction

68. If dispersed phase and dispersion medium are gas and liquid, respectively, then the name of the colloidal system is

(A) aerosol
(B) solid foam
(C) foam
(D) emulsion

69. The electric charge on a colloidal particle is observed by

(A) Brownian movement
(B) Electrolysis
(C) Electrodialysis
(D) Electrophoresis

70. 'All four quantum numbers cannot be the same for any two electrons in an atom'. This principle is known as

(A) Aufbau principle
(B) Hund's rule
(C) Pauli's Exclusion principle
(D) Plank's rule

71. 50 ml of 0.1 M acetic acid is mixed with 50 ml 0.1 M sodium acetate. The pH of the solution is (pK_a of acetic acid is 4.26)

(A) 13.0
(B) 7.0
(C) 4.26
(D) 1.0

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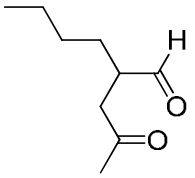
72. One mole of an ideal gas undergoes expansion from 24.6 *l* to 246.0 *l* against a constant pressure of 1 atmosphere at 300 K. The work done is

(A) 221.4 *l* atm
(B) 24.6 *l* atm
(C) 9.0 *l* atm
(D) 0.082 *l* atm

73. Aqueous solution of $CuSO_4$ is electrolyzed between the Pt electrodes. At anode

(A) Cu is oxidized to Cu^{2+}
(B) Cu^{2+} is reduced to Cu
(C) H_2 gas is evolved
(D) O_2 gas is evolved

74. IUPAC name of the following compound is



(A) 4-formyloctan-2-one
(B) 2-(2-oxopropyl)hexanal
(C) 2-butyl-4-oxopentanal
(D) 2-butyl-4-ketopentanal

75. Carbon monoxide (CO) acts as a

(A) strong π-donor and weak π-acceptor
(B) weak π-donor and strong π-acceptor
(C) weak σ-donor and strong π-acceptor
(D) strong σ-donor and good π-acceptor

76. Methoxypropane and Ethoxyethane constitute a pair of

(A) functional group isomers
(B) metamers
(C) position isomers
(D) regioisomers

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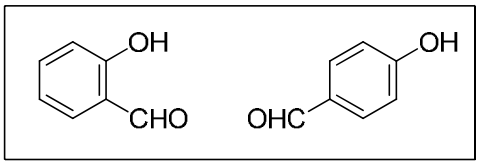
77. The stability order of methyl, ethyl, isopropyl and *tert*-butyl carbocations is

(A) methyl > ethyl > isopropyl > *tert*-butyl
(B) methyl < ethyl < isopropyl < *tert*-butyl
(C) methyl ≈ ethyl > isopropyl > *tert*-butyl
(D) methyl < ethyl ≈ isopropyl < *tert*-butyl

78. Compare the steam volatility of 2-hydroxybenzaldehyde with that of 4-hydroxybenzaldehyde.



(A) both are equally steam volatile
(B) both are not steam volatile
(C) 2-hydroxybenzaldehyde is much more steam volatile than 4-hydroxybenzaldehyde
(D) 4-hydroxybenzaldehyde is much more steam volatile than 2-hydroxybenzaldehyde

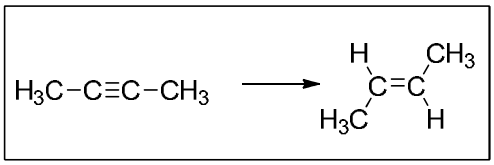
79. The active stationary phase in Partition chromatography over chromatographic paper is

(A) cellulose
(B) starch
(C) hemicellulose
(D) water trapped in chromatographic paper

80. Kolbe's electrolytic method is suitable for the generation of which among the following gases in the pure form?

(A) Methane
(B) Ethane
(C) Propane
(D) Isobutane (2-methylpropane)

81. But-2-yne is converted to (*E*)-but-2-ene by



(A) catalytic hydrogenation using Lindlar's catalyst
(B) using Raney nickel
(C) copper catalyzed partition reaction with *n*-butane
(D) reduction using controlled amount of sodium in liquid ammonia

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82. Cyclic compounds with alternating single and double bonds can be

(A) aromatic or antiaromatic
(B) aromatic or nonaromatic
(C) antiaromatic or nonaromatic
(D) aromatic, antiaromatic or nonaromatic

83. Which among the following methods is **NOT** a suitable one for the preparation of benzene?

(A) Passing ethyne under pressure through an iron tube heated up to 873 K
(B) Soda lime distillation of benzoic acid
(C) Treatment of chlorobenzene with sodium metal in dry ether
(D) Passing phenol in the gaseous state over a heated bed of zinc dust

84. Which among the following halides will undergo fastest SN1 solvolysis in water?

(A) 2-fluoro-2-methylpropane
(B) 2-chloro-2-methylpropane
(C) 2-bromo-2-methylpropane
(D) 2-iodo-2-methylpropane

85. Which among the following methods is **NOT** suitable for selective generation of butan-1-ol?

(A) Reaction of butylmagnesium bromide with water
(B) Reaction of propylmagnesium bromide with formaldehyde
(C) Reaction of ethylmagesium bromide with ethylene oxide
(D) Hydroboration of but-1-ene followed by oxidation with hydrogen peroxide in the presence of aqueous sodium hydroxide

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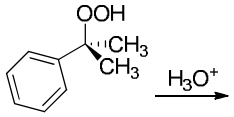
86. Predict the major products formed in the acidic hydrolysis of cumene hydroperoxide.



(A) Phenol and acetone
(B) Benzoic acid and methanol
(C) Acetophenone and ethanol
(D) Phenol and propan-2-ol

87. Which of the following nuclides is most radioactive?

(A) $^{108}_{47}Ag$

(B) $^{66}_{30}Zn$

(C) $^{37}_{17}Cl$

(D) $^{31}_{15}P$

88. Which radical can be tested with Nessler's reagent?

(A) K

(B) NH_4^+

(C) Na^+

(D) Fe^{3+}

89. The observed mass of $_{26}Fe^{56}$ is 55.9375 amu. Using the mass of proton and neutron = 1.00732 amu and 1.00866 amu respectively, calculate the mass defect?

(A) 0.6234
(B) 0.6753
(C) 0.5678
(D) 0.5126

90. The thermal stability of hydrides is in the order of

(A) HF > HCl > HBr > HI
(B) HF > HI > HCl > HBr
(C) HF > HBr > HI > HCl
(D) HF < HI < HBr > HCl

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91. Which complex is called as outer orbital complex?

(A) $[Fe(CO)_5]$

(B) $[Fe(H_2O)_6]^{2+}$

(C) $[Ni(CO)_4]$

(D) $[Fe(CN)_6]^{2-}$

92. How many atoms are present in a FCC unit cell?

(A) 3
(B) 4
(C) 2
(D) 6

93. How many elements are present in the sixth period of the modern periodic table?

(A) 18
(B) 22
(C) 36
(D) 32

94. In which of the following pairs, Dipole-induced dipole interaction is present?

(A) HCl and He atoms

(B) Cl_2 and CCl_4

(C) SiF_4 and He atoms

(D) H_2O and alcohol

95. In which of the following compounds, the maximum covalent character is shown?

(A) $MgCl_2$

(B) $FeCl_2$

(C) $SnCl_2$

(D) $AlCl_3$

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96. Which of the following is Paramagnetic?

(A) CO

(B) CN^-

(C) NO^+

(D) O_2

97. Choose the correct formula for borax.

(A) $Na_2B_4O_7.5H_2O$

(B) $Na_2B_4O_7.10H_2O$

(C) $Na_2B_4O_7.3H_2O$

(D) $Na_2B_4O_7.H_2O$

98. Diagonal relationship between beryllium and aluminium is due to the fact that

(A) the ionic radius and charge/radius ratio of Be^{2+} is nearly the same as that of Al^{3+} ion.
(B) like aluminium, beryllium is readily attacked by acids
(C) the chlorides of beryllium and aluminium are not soluble in organic solvents and are strong Lewis bases
(D) beryllium and aluminium ions have no tendency to form complexes

99. Identify the **CORRECT** statement

(A) Sodium carbonate is also called as baking soda
(B) Sodium carbonate is a white crystalline solid which exists as a decahydrate, $Na_2CO_3.10H_2O$
(C) Sodium carbonate is generally prepared by Castner-Kellner process
(D) Anhydrous sodium carbonate is called as soda lime

100. Considering the elements F, Cl, O and N, the correct order of their chemical reactivity in terms of oxidizing property is

(A) F > Cl > O > N
(B) F > O > Cl > N
(C) Cl > F > O > N
(D) O > F > N > Cl

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101. If the value of $\lim_{x\to 0}\frac{(1-x)^n-1}{x}$ is 100, then n is equal to

(A) 100
(B) -100
(C) 99
(D) -99

102. Let $f(x)$ be a polynomial of degree 2 satisfying $f(0)=1,\ f'(0)=-2$ and $f''(0)=6.$ Then $\int_{-1}^{2} f(x)\,dx$ is equal to

(A) 6
(B) 0
(C) 9
(D) 3

103. The domain of the derivative of the function $f(x)=\tan^{-1}x,$ if $|x|\le 1$ and $f(x)=\frac{1}{2}(|x|-1),$ if $|x|>1,$ is

(A) $\mathbb{R}-\{0\}$
(B) $\mathbb{R}-\{1\}$
(C) $\mathbb{R}-\{-1\}$
(D) $\mathbb{R}-\{-1,1\}$

104. The function $f:\mathbb{R}-\{0\}\to\mathbb{R}$ given by $f(x)=\frac{1}{x}-\frac{2}{e^{2x}-1}$ can be made continuous at $x=0$ by defining $f(0)$ as

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

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105. Rolle's theorem is applicable to the function

(A) $f(x)=|x|,\ -1\le x\le 1$
(B) $f(x)=\tan x,\ 0\le x\le \pi$
(C) $f(x)=\sin^2 x,\ 0\le x\le \pi$
(D) $f(x)=x^3-3x+3,\ 0\le x\le 1$

106. If $\sin^{-1}x+\sin^{-1}y=\frac{\pi}{2}$, then the value of $\cos^{-1}x+\cos^{-1}y$ is

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

107. The number of different salads that can be made from cucumber, tomatoes, onions, beetroot and carrots is

(A) 16
(B) 28
(C) 31
(D) 32

108. The total number of subsets of a finite set A has 56 more elements than the total number of subsets of another finite set B. The number of elements in the set A is

(A) 5
(B) 6
(C) 7
(D) 8

109. If $\sqrt{5}$ and $-\sqrt{5}$ are two roots of the polynomial $x^3+3x^2-5x-15$, then its third root is

(A) 3
(B) -3
(C) 5
(D) -5

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110. The value(s) of p such that the lines, represented by the pair of linear equations $3x - y - 5 = 0$ and $6x - 2y - p = 0$, be parallel is

(A) all real values except 10

(B) 10

(C) $\frac{5}{2}$

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

111. If $A = [a_{ij}]$ is a symmetric matrix of order 2×2 such that $|A| = -15$ and c_{ij} represents the cofactor of a_{ij} then the value of $a_{21}c_{12} + a_{22}c_{22}$ is

(A) 17
(B) 18
(C) 19
(D) −15

112. One ticket is selected at random from 50 tickets numbered 00, 01, 02, . . . 49. Then the probability that the sum of the digits on the selected ticket is 8, given that the product of these digits is zero, equals

(A) $\frac{5}{14}$

(B) $\frac{1}{50}$

(C) $\frac{1}{7}$

(D) $\frac{1}{14}$

113. Let $x + 8y - 22 = 0$, $5x + 2y - 34 = 0$, $2x - 3y + 13 = 0$ be the three sides of a triangle. Then the area of the triangle is

(A) 19 square unit
(B) 36 square unit
(C) 42 square unit
(D) 72 square unit

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114. For any two real numbers θ and ϕ, we define $\theta R \phi$ if and only if $\sec^2\theta - \tan^2\theta = 1$. The relation R is

(A) reflexive but not transitive
(B) symmetric but not reflexive
(C) both reflexive and symmetric but not transitive
(D) an equivalence relation

115. Let $f : R \to R$ be a positive increasing function with $\lim_{x\to\infty} \frac{f(3x)}{f(x)} = 1$. Then $\lim_{x\to\infty} \frac{f(2x)}{f(x)} =$

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

116. From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle. Then the number of such arrangement is

(A) at least 750 but less than 1000
(B) at least 1000
(C) at least 500 but less than 750
(D) less than 500

117. If the imaginary part of $\frac{2z+1}{iz+1}$ is -1, then the locus of the point representing z in the complex plane is

(A) a straight line
(B) a parabola
(C) a circle
(D) an ellipse

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118. The minimum value of $27\tan^2\theta + 3\cot^2\theta$

(A) lies between 1 and 17
(B) greater than or equal to 18
(C) less than 18
(D) lies between 2 and 12

119. If $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \frac{3\pi}{2}$, then the value of

$$x^{100} + y^{100} + z^{100} - \frac{9}{x^{101} + y^{101} + z^{101}} \text{ is}$$

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

120. Let x be an integer such that $x^2 - 3x < 4$. Then the number of possible values of x is

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

121. The product of all solutions of the equation $(x-2)^2 - 3|x-2| + 2 = 0$ is

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

122. If $\log_{0.5}\sin x = 1 - \log_{0.5}\cot x$, then the number of solutions of $x \in [-2\pi, 2\pi]$ is

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

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123. The value of $\sqrt{3}.\operatorname{cosec} 20° - \sec 20°$ is equal to

(A) 1
(B) $3\sin 20°$
(C) 4
(D) $4\cos 40°$

124. If $5\sin\alpha = 7\sin\beta$, then $\dfrac{\tan\left(\dfrac{\alpha+\beta}{2}\right)}{\tan\left(\dfrac{\alpha-\beta}{2}\right)}$ is equal to

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

125. The minimum value of $P = bcx + cay + abz$, when $xyz = abc$ is

(A) abc
(B) $2abc$
(C) $3abc$
(D) $6abc$

126. If $\sqrt{3} + i = (a + ib)(c + id)$, then $\tan^{-1}\dfrac{b}{a} + \tan^{-1}\dfrac{d}{c}$ is equal to

(A) $\dfrac{\pi}{2} + 2n\pi$ for some integer n

(B) $-\dfrac{\pi}{3} + n\pi$ for some integer n

(C) $-\dfrac{\pi}{6} + 2n\pi$ for some integer n

(D) $\dfrac{\pi}{6} + n\pi$ for some integer n

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127. If three positive unequal numbers x, y, z are in Harmonic Progression, then

(A) $x^2 + y^2 > z^2$

(B) $x - y > z$

(C) $x^2 + z^2 > 2y^2$

(D) $x^2 + y^2 + z^2 > 1$

128. Let a be positive and let M and N be the arithmetic and geometric means of the roots of $x^2 - 2ax + a^2$ respectively. Then

(A) $M = 2N$
(B) $M = -N$
(C) $M = N$
(D) $M = -2N$

129. Let $y = f\left(x^3\right)$, $z = g\left(x^5\right)$, $f'(x) = \tan x$ and $g'(x) = \sec x$. Then $\frac{dy}{dz}$ is equal to

(A) $\frac{3}{5x^2} \cdot \frac{\tan x^3}{\sec x^5}$

(B) $\frac{5x^2}{3} \cdot \frac{\sec x^5}{\tan x^3}$

(C) $\frac{3x^2}{5} \cdot \frac{\tan x^3}{\sec x^5}$

(D) $\frac{5}{3x^2} \cdot \frac{\sec x^5}{\tan x^3}$

130. Let $y = \sin^{-1}\left(\sqrt{x-ax} - \sqrt{a-ax}\right)$. Then $\frac{dy}{dx}$ is equal to

(A) $\frac{1}{\sin\sqrt{a-ax}}$

(B) $\sin\sqrt{x}.\sin\sqrt{a}$

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

(D) 0

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131. If $3^x + 3^y = 3^{x+y}$, then $\frac{dy}{dx}$ equals

(A) $\frac{3^x + 3^y}{3^x - 3^y}$

(B) $\frac{3^x + 3^y}{1 + 3^{x+y}}$

(C) $\frac{3^{x+y} - 3^y}{3^y}$

(D) $3^{x-y}\left(\frac{3^y - 1}{1 - 3^x}\right)$

132. If $P(1, 2)$, $Q(4, 6)$, $R(5, 7)$ and $S(a, b)$ are the vertices of a parallelogram $PQRS$, then

(A) $a = 2, b = 4$
(B) $a = 3, b = 4$
(C) $a = 2, b = 3$
(D) $a = 3, b = 5$

133. The area of the triangle formed by joining the origin to the points of intersection of the line $\sqrt{5}x + 2y = 3\sqrt{5}$ and the circle $x^2 + y^2 = 10$, is

(A) 6 sq units
(B) 5 sq units
(C) 4 sq units
(D) 3 sq units

134. The lines $x - y - 2 = 0$, $x + y - 4 = 0$ and $x + 3y = 6$ meet at the common point

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

135. The equation of the chord of the circle $x^2 + y^2 - 4x = 0$, whose mid point is (1, 0), is

(A) $y = 2$
(B) $y = 1$
(C) $x = 2$
(D) $x = 1$

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136. One of the diametrical chord of the circle $x^2 + y^2 - 12x + 4y + 6 = 0$ is

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

137. The equation of the line which is tangent to both the circle $x^2 + y^2 = 5$ and the parabola $y^2 = 40x$ is

(A) $2x - y \pm 5 = 0$
(B) $2x \pm y + 5 = 0$
(C) $2x \pm y - 5 = 0$
(D) $2x + y \pm 5 = 0$

138. Let the points (1, 2) and $(k, -1)$ be conjugate points with respect to the ellipse $2x^2 + 3y^2 = 6$. Then the value of k is

(A) 2
(B) 4
(C) 6
(D) 8

139. If $f(x + y, x - y) = xy$, then the arithmetic mean of $f(x, y)$ and $f(y, x)$ is

(A) y
(B) x
(C) 0
(D) xy

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

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

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141. $\lim_{x\to 2}\frac{2^x - x^2}{x^x - 2^2}$ is equal to

(A) $\frac{\log 2 - 1}{\log 2 + 1}$

(B) $\frac{\log 2 + 1}{\log 2 - 1}$

(C) 1

(D) -1

142. If $f(x) = \sum_{n=0}^{\infty}\frac{x^n}{n!}(\log a)^n$, then at $x = 0$, $f(x)$

(A) has no limit
(B) is discontinuous
(C) is continuous but not differentiable
(D) is differentiable

143. Let $f(x + y) = f(x)f(y)$ and $f(x) = 1 + \sin 2x.g(x)$, where $g(x)$ is continuous. Then $f'(x)$ equals

(A) $f(x)\, g(0)$

(B) $2f(x)\, g(0)$

(C) $2g(0)$

(D) $g(0)$

144. The area of the triangle formed by a tangent to the curve $2xy = a^2$ and the coordinate axes is

(A) $2a^2$

(B) a^2

(C) $3a^2$

(D) $4a^2$

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145. $\int \sin^3 x \cdot \cos^2 x\, dx$ is equal to

(A) $\frac{\sin^5 x}{5} - \frac{\sin^3 x}{3} + c$

(B) $\frac{\sin^5 x}{5} + \frac{\sin^3 x}{3} + c$

(C) $\frac{\cos^5 x}{5} - \frac{\cos^3 x}{3} + c$

(D) $\frac{\cos^5 x}{5} + \frac{\cos^3 x}{3} + c$

146. $\int \frac{\sin(2x)}{1+\cos^2 x} dx$ is equal to

(A) $-\frac{1}{2}\log\left(1+\cos^2 x\right) + c$

(B) $2\log\left(1+\cos^2 x\right) + c$

(C) $\frac{1}{2}\log\left(1+\cos 2x\right) + c$

(D) $c - \log\left(1+\cos^2 x\right)$

147. $\int \frac{x^3+3x^2+3x+1}{(x+1)^5} dx$ is equal to

(A) $-\frac{1}{x+1} + c$

(B) $\frac{1}{5}\log(x+1) + c$

(C) $\log(x+1) + c$

(D) $\tan^{-1} x + c$

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148. The solution of the differential equation $\frac{dy}{dx}=\frac{x(2\log x+1)}{\sin y+y\cos y}$ is

(A) $y\sin y=x^2\log x+\frac{x^2}{2}+c$

(B) $y\cos y=x^2(\log x+1)+c$

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

(D) $y\sin y=x^2\log x+c$

149. The solution of the differential equation $ydx+\left(x-y^3\right)dy=0$ is

(A) $xy=\frac{1}{3}y^3+c$

(B) $xy=y^4+c$

(C) $y^4=4xy+c$

(D) $4y=y^3+c$

150. The ratio in which $\hat{i}+2\hat{j}+3\hat{k}$ divides the join of $-2\hat{i}+3\hat{j}+5\hat{k}$ and $7\hat{i}-\hat{k}$ is

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

151. A vector perpendicular to the plane containing the points $A(1, -1, 2)$, $B(2, 0, -1)$ and $C(0, 2, 1)$ is

(A) $4\hat{i}+8\hat{j}-4\hat{k}$

(B) $8\hat{i}+4\hat{j}+4\hat{k}$

(C) $3\hat{i}+\hat{j}+2\hat{k}$

(D) $\hat{i}+\hat{j}-\hat{k}$

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152. Let the angle θ between the line $\frac{x+1}{1}=\frac{y-1}{2}=\frac{z-2}{2}$ and the plane $2x-y+\sqrt{\lambda}z+4=0$ be such that $\sin\theta=\frac{1}{3}$. Then the value of λ is

(A) $-\frac{4}{3}$

(B) $\frac{3}{4}$

(C) $-\frac{3}{5}$

(D) $\frac{5}{3}$

153. The order of the element $\overline{4}$ in the group $\left(\mathbb{Z}_{11}^{*},\cdot_{11}\right)$ is

(A) 1
(B) 3
(C) 10
(D) 11

154. Let a, b, c be the l^{th} m^{th} and n^{th} powers of a GP and all are positive.

Then $\begin{vmatrix} \log a & l & 1 \\ \log b & m & 1 \\ \log c & n & 1 \end{vmatrix}$ equals

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

155. The torque about the point $3\vec{i}-\vec{j}+3\vec{k}$ of a force $4\vec{i}+2\vec{j}+\vec{k}$ through the point $5\vec{i}+2\vec{j}+4\vec{k}$, is

(A) $\vec{i}+2\vec{j}-8\vec{k}$

(B) $\vec{i}+2\vec{j}+8\vec{k}$

(C) $\vec{i}-2\vec{j}-8\vec{k}$

(D) $\frac{\vec{i}+2\vec{j}-\vec{k}}{3}$

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156. If $i=\sqrt{-1}$, then the value of $i+i^{22}+i^{23}+i^{24}+i^{25}$ is

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

157. If $f'(x)=x$ and $f(1)=2$, then $f(x)$ is

(A) $-\frac{2}{3}\left(x\sqrt{x}+2\right)$

(B) $\frac{2}{3}\left(x\sqrt{x}+2\right)$

(C) $-\frac{1}{2}\left(x^2+3\right)$

(D) $\frac{1}{2}\left(x^2+3\right)$

158. If $f(x)=x^2$ and $g(x)=\sqrt{x}$, then

(A) $(g\circ f)(-2)=2$
(B) $(f\circ g)(2)=4$
(C) $(g\circ f)(2)=4$
(D) $(f\circ g)(3)=6$

159. The value of k, such that the function $f(x)=\begin{cases}kx^2, & x\le 2\\ 3, & x>2\end{cases}$ is continuous at $x=2$, is

(A) 2
(B) 1.75
(C) 0.75
(D) 2.75

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160. The missing vertex of a triangle whose other two vertices $(-3,-9)$, $(-1,6)$ and centroid $\left(-\frac{1}{3},2\right)$ is

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

161. The function $f(x)=|x-1|$ is not differentiable at

(A) 1
(B) $\frac{3}{4}$
(C) 2
(D) $\frac{1}{3}$

162. If $\omega\ (\neq 1)$ be a cube root of unity, then the value of $\tan\left\{\left(\omega^{10}+\omega^{20}\right)\pi+\frac{\pi}{4}\right\}$ is

(A) 1
(B) -1
(C) $\frac{1}{\sqrt{3}}$
(D) $-\frac{1}{\sqrt{3}}$

163. The two circles $|z-1-i|=\sqrt{2}$ and $|z|=\sqrt{2}$ intersect at

(A) no point
(B) one point
(C) two points
(D) four points

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164. In the binomial expansion of $(a-b)^n,\ n \geq 5,$ the sum of the 5^{th} and 6^{th} terms is zero. Then $\frac{a}{b}$ equals

(A) $\frac{n-5}{6}$

(B) $\frac{n-4}{5}$

(C) $\frac{5}{n-4}$

(D) $\frac{6}{n-5}$

165. The radius of the circle passing through the foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1,$ and having its centre at (0, 3) is

(A) 4

(B) 3

(C) $\sqrt{12}$

(D) $\frac{7}{2}$

166. The harmonic mean of the roots of the equation $\left(5+\sqrt{2}\right)x^2-\left(4+\sqrt{5}\right)x+\left(8+2\sqrt{5}\right)=0$ is

(A) 2
(B) 4
(C) 6
(D) 8

167. The point at which the tangent to the curve $y=\sqrt{4x-3}-1$ has its slope $\frac{2}{3}$ is

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

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168. The solution set of the inequality $\frac{x+3}{x-4} \geq 0$ is

(A) $(-\infty,-3] \cup (4,\infty)$

(B) $(-\infty,-3] \cup [4,\infty)$

(C) $(-\infty,-3) \cup (1,\infty)$

(D) 3 and -4

169. If $f(x) = A\left(2^x\right) + B$, where $f'(1) = 2$ and $\int_0^3 f(x)dx = 7$, then which of the following statements are not correct?

(i) $A = \frac{1}{\log 2}$

(ii) $B = \frac{7}{3(\log 2)^2}\left[(\log 2)^2 - 1\right]$

(iii) $B = \frac{7}{\log 2}$

(iv) $A = \frac{7}{3(\log 2)^2}\left[(\log 2)^2 - 1\right]$

(A) (i) only
(B) (i) and (iii)
(C) All are correct
(D) (i) and (ii)

170. The area of the portion of the circle $x^2 + y^2 = 64$ which is exterior to the parabola $y^2 = 12x$ is equal to

(A) $\frac{16}{3}(8\pi + \sqrt{3})$

(B) $\frac{8}{3}(8\pi + \sqrt{3})$

(C) $\frac{16}{3}(8\pi - \sqrt{3})$

(D) $(8\pi + \sqrt{3})$

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171. If $\int_{-3}^{2} f(x)dx = 2$ and $\int_{2}^{5}[5+f(x)]dx = 9$, then the value of the integral $\int_{5}^{-3} f(x)dx$ is

(A) 3
(B) 2
(C) 5
(D) 4

172. The relation R in the set $A = \{1, 2, 3\}$ is given by
$R = \{(1, 1), (2, 2), (3, 3), (1, 2), (2, 3)\}$ is

(A) symmetric
(B) asymmetric
(C) neither symmetric nor transitive
(D) either symmetric or reflexive

173. The locus of the poles of the focal chords of a parabola is the

(A) axis
(B) directrix
(C) tangent at the vertex
(D) circle

174. The eccentricity of the hyperbola $\frac{\sqrt{1999}}{3}\left(x^2 - y^2\right) = 1$ is

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

175. The sum of distances of any point on the ellipse $3x^2 + 4y^2 = 24$ from its foci is

(A) $8\sqrt{2}$
(B) $4\sqrt{2}$
(C) $24\sqrt{2}$
(D) $16\sqrt{2}$

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176. Two dice are thrown. The probability that the numbers appeared have a sum 8 if it is known that the second dice always exhibits 4, is

(A) $\frac{5}{6}$

(B) $\frac{6}{5}$

(C) $\frac{1}{6}$

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

177. Which of the following is not a group?

(A) $(Z_n, +_n)$

(B) $(Z, +)$

(C) $(Z, .)$

(D) $(R, +)$

178. If the value of mode and mean is 60 and 66 respectively, then the value of median is

(A) 60
(B) 64
(C) 68
(D) 63

179. The function $f(x) = \frac{\log_e(\pi + x)}{\log_e(e + x)}$ is

(A) increasing on $(0, \infty)$

(B) decreasing on $\left(0, \frac{\pi}{e}\right)$, increasing on $\left(\frac{\pi}{e}, \infty\right)$

(C) decreasing on $(0, \infty)$

(D) increasing on $\left(0, \frac{\pi}{e}\right)$, decreasing on $\left(\frac{\pi}{e}, \infty\right)$

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180. The integrating factor of the differential equation $\cos x\frac{dy}{dx}+y\sin x=1$ is

(A) $\sin x$
(B) $\cos x$
(C) $\tan x$
(D) $\sec x$

181. The circles $x^2+y^2-10x+16=0$ and $x^2-y^2=r^2$ intersect each other in two distinct points if

(A) $r<2$
(B) $r>8$
(C) $2<r<8$
(D) $2\le r\le 8$

182. Suppose $A_1, A_2, ..., A_{30}$ are thirty sets, each with five elements and $B_1, B_2, ..., B_{30}$ are n sets each with three elements. Let $\bigcup_{i=1}^{30} A_i = \bigcup_{j=1}^{n} B_j = S$. If each element of S belongs to exactly ten of the A_i's and exactly nine of the B_j's then $n =$

(A) 45
(B) 35
(C) 40
(D) 25

183. The function $f(x)=\sec\left[\log\left(x+\sqrt{1+x^2}\right)\right]$ is

(A) even
(B) odd
(C) constant
(D) neither even nor odd

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184. A solution of the equation $|z|-z=1+2i$ is

(A) $\frac{3}{2}-2i$

(B) $\frac{3}{2}+2i$

(C) $2-\frac{3}{2}i$

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

185. The equation $|z-1|^2+|z+1|^2=4$ represents on the Argand plane

(A) a straight line
(B) an ellipse
(C) a circle with centre origin and radius 2
(D) a circle with centre origin and radius unity

186. If A is a singular matrix, then $adj\ A$ is

(A) non-singular
(B) singular
(C) symmetric
(D) antisymmetric

187. The determinant $\begin{vmatrix} xp+y & x & y \\ yp+z & y & z \\ 0 & xp+y & yp+z \end{vmatrix}=0$ if

(A) x, y, z are in A.P
(B) x, y, z are in G.P
(C) x, y, z are in H.P
(D) xy, yz, zx are in A.P

188. A telegraph has 5 arms and each arm is capable of 4 distinct positions, including the position of rest. The total number of signals that can be made is

(A) 473
(B) 1023
(C) 1173
(D) 423

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189. A club consists of members whose ages are in A.P, the common difference being 3 months. If the youngest member of the club is just 7 years old and the sum of the ages of all the members is 250 years, then the number of members in the club is

(A) 15
(B) 25
(C) 20
(D) 30

190. $\lim_{x\to 5} \frac{x^2-9x+20}{x-[x]}$

(A) is 1
(B) is 0
(C) does not exist
(D) cannot be determined

191. If $f(9)=0$ and $f'(9)=1$, then $\lim_{x\to 9} \frac{3-\sqrt{f(x)}}{3-\sqrt{x}}$ is equal to

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

192. Let $f(x+y)=f(x)\cdot f(y)$ for all x, y where $f(0)\neq 0$. If $f(5)=2$ and $f'(0)=3$, then $f'(5)$ is equal to

(A) 6
(B) 0
(C) 1
(D) -1

193. The shortest distance of the point (0, 0) from the curve $y=\frac{1}{2}\left(e^x+e^{-x}\right)$ is

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

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194. A determinant is chosen at random from the set of all determinants of order 2 with elements 0 or 1 only. The probability that the value of the determinant chosen is positive is

(A) $\frac{16}{81}$

(B) $\frac{7}{16}$

(C) $\frac{3}{16}$

(D) $\frac{16}{3}$

195. If $\vec{a}$ is a unit vector and $(\vec{x}+\vec{a}).(\vec{x}-\vec{a})=24$, the $|\vec{x}|$ must be

(A) 3
(B) 4
(C) 5
(D) 6

196. The angle between two vectors $\vec{a}$ and $\vec{b}$ with magnitudes $\sqrt{5}$ and 4 respectively and $\vec{a}.\vec{b}=2\sqrt{5}$ is

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

(B) $\frac{\pi}{6}$

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

(D) $\frac{5\pi}{12}$

197. The length of perpendicular from the point $\left(1,\frac{3}{2},2\right)$ to the plane $2x-2y+4z+5=0$ is

(A) $\sqrt{3}$
(B) $\sqrt{6}$
(C) $\sqrt{5}$
(D) $\sqrt{7}$

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198. P is a point on the line segment joining the points $A(3, 2, 1)$ and $B(6, 2, -2)$. If the $x-$ coordinate of P is 5, then the $z-$ coordinate of P is

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

199. The probability of A and B solving a problem correctly is $\frac{1}{3}$ and $\frac{1}{4}$ respectively. If the probability of their making a common error is 1/20 and they obtain the same answer, then the probability of their answer to be correct is

(A) $\frac{1}{12}$

(B) $\frac{1}{40}$

(C) $\frac{13}{120}$

(D) $\frac{10}{13}$

200. A pair of dice is thrown 4 times. If getting a doublet is considered to be a success, the probability of 2 successes is

(A) $\frac{25}{216}$

(B) $\frac{29}{216}$

(C) $\frac{31}{216}$

(D) $\frac{33}{216}$

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KEY													
Sl No.	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**
1	D	31	B	61	C	91	B	121	A	151	B	181	C
2	C	32	A	62	B	92	B	122	B	152	D	182	A
3	D	33	C	63	A	93	D	123	C	153	C	183	A
4	C	34	C	64	B	94	A	124	A	154	A	184	A
5	A	35	C	65	B	95	D	125	C	155	A	185	D
6	C	36	D	66	B	96	D	126	D	156	A	186	B
7	B	37	A	67	C	97	B	127	C	157	D	187	B
8	C	38	B	68	C	98	A	128	C	158	A	188	B
9	D	39	A	69	D	99	B	129	A	159	C	189	B
10	B	40	A	70	C	100	B	130	C	160	A	190	C
11	A	41	B	71	C	101	B	131	D	161	A	191	B
12	A	42	C	72	A	102	C	132	C	162	A	192	A
13	B	43	B	73	D	103	D	133	B	163	C	193	B
14	B	44	D	74	B	104	B	134	C	164	B	194	C
15	A	45	D	75	D	105	C	135	D	165	A	195	C
16	A	46	D	76	B	106	B	136	B	166	B	196	B
17	C	47	D	77	B	107	C	137	B	167	B	197	C
18	C	48	A	78	C	108	B	138	C	168	A	198	A
19	B	49	A	79	D	109	B	139	C	169	D	199	D
20	D	50	C	80	B	110	A	140	D	170	C	200	A
21	C	51	B	81	D	111	D	141	A	171	D		
22	C	52	B	82	D	112	D	142	D	172	C		
23	A	53	C	83	C	113	A	143	B	173	B		
24	B	54	B	84	D	114	D	144	B	174	A		
25	C	55	B	85	A	115	C	145	C	175	B		
26	D	56	A	86	A	116	B	146	D	176	C		
27	A	57	D	87	A	117	C	147	A	177	C		
28	D	58	D	88	B	118	B	148	D	178	B		
29	D	59	C	89	D	119	B	149	C	179	C		
30	A	60	D	90	A	120	D	150	A	180	D		

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101 Test in Physics Chemistry and Mathematics (Shift 4)

1. The diameter of a circle is 2.486 m. Its area with due regard to significant figures is (Given $\pi = 3.142$)

   (A) $4.85454\ m^2$

   (B) $4.8545\ m^2$

   (C) $4.584\ m^2$

   (D) $4.855\ m^2$

2. The position of a particle as a function of time t is given by $x(t) = at + bt^2 - ct^3$ where, a, b and c are constants. When the particle attains zero acceleration, then its velocity will be

   (A) $a + \frac{b^2}{4c}$

   (B) $a + \frac{b^2}{3c}$

   (C) $a + \frac{b^2}{c}$

   (D) $a + \frac{b^2}{2c}$

3. A particle moves in a circular arc of radius r. In half the period of revolution, its displacement and distance covered are

   (A) $2r$ and $2\pi r$
   (B) $2r$ and πr
   (C) r and πr
   (D) r and $2\pi r$

4. In a tug of war contest, two men pull a horizontal rope from opposite sides. The winner will be the man who

   (A) exerts greater force on the rope
   (B) exerts greater force on the ground
   (C) exerts force on the rope which is greater than the tension in the rope
   (D) makes a smaller angle with the vertical

5. If m is the mass of a body and E its kinetic energy, then its linear momentum is

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

6. A rubber sheet is introduced between two charges separated by a distance. Then the force between them will

(A) increase
(B) decrease
(C) remains the same
(D) be reduced to zero

7. What is the potential difference acquired by an alpha particle accelerated through a potential difference of 10^6 V?

(A) zero
(B) 3.2×10^{-13} J
(C) 1.6×10^{-19} J
(D) 1 eV

8. A stone is dropped into a lake from a tower of 500 *m* high. The sound of the splash will be heard at the top of the tower approximately after (given velocity of sound = 330 *m/s*)

(A) 11.5 seconds
(B) 1.5 seconds
(C) 10 seconds
(D) 14 seconds

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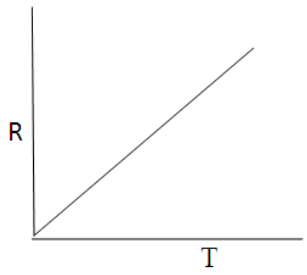
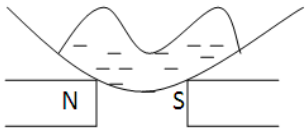
9. The variation of resistance (R) as a function of temperature (T) for a certain material is shown in the graph. The material is most likely to be



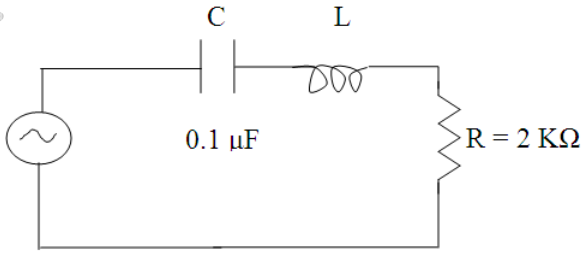
(A) pure metal
(B) impure metal
(C) semiconductor
(D) superconductor

10. A certain liquid taken in a watch glass is placed on closely spaced pole pieces of a magnet. The liquid then moves towards the pole pieces causing a depression at its center as shown. The liquid is most likely to be



(A) paramagnetic
(B) ferromagnetic
(C) diamagnetic
(D) ferrimagnetic

11. The following series resonant LCR circuit has a quality factor (Q-factor) of 0.4 and a bandwidth of 1.3 KHz. The value of inductance is then



(A) 0.1 H
(B) 0.94 H
(C) 2 H
(D) 10 H

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12. Semiconductors have

(A) positive temperature coefficient of resistance
(B) negative temperature coefficient of resistance
(C) zero temperature coefficient of resistance
(D) positive temperature coefficient at lower temperature and negative temperature coefficient at higher temperatures

13. If the average time between collisions of electrons in Copper is 2.5×10^{-14} s and the average speed of the free electrons is 1.6×10^{6} m/s, then the mean free path of the electrons will be

(A) 4×10^{-8} m
(B) 4×10^{-8} cm
(C) 4×10^{8} m
(D) 4 m

14. Which one of the following is an example of non-Ohmic resistance?

(A) Copper wire
(B) Tungsten wire
(C) Diode
(D) Carbon resistance

15. In a circuit containing two unequal resistors connected in parallel

(A) the current is the same in both the resistors
(B) a large current flows through the larger resistor
(C) the voltage drop across both the resistances is same
(D) the smaller resistance has smaller conductance

16. Two identical fuses are rated at 10 A. If they are connected

(A) in parallel, the combination acts as a fuse of rating 10 A
(B) in parallel, the combination acts as a fuse of rating 20 A
(C) in series, the combination acts as a fuse of rating 20 A
(D) in series, the combination acts as a fuse of rating 5 A

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17. The number of electrons in 1 Coulomb of charge is

(A) 6.25×10^{18}

(B) 62.5×10^{18}

(C) 6.023×10^{23}

(D) 1.6×10^{-19}

18. In a hydrogen atom, which of the following electronic transitions would involve the maximum energy change?

(A) $n = 2$ to $n = 1$
(B) $n = 3$ to $n = 1$
(C) $n = 4$ to $n = 2$
(D) $n = 3$ to $n = 2$

19. Numerical aperture of an optical fiber is a measure of

(A) attenuation of light signals in the fiber
(B) difference between the refractive indices of core and the cladding
(C) light gathering power of the fiber
(D) signal distortion in the fiber

20. Shearing stress causes change in

(A) Length
(B) Area
(C) Volume
(D) Shape

21. A liquid will not wet the surface of a solid if the angle of contact is

(A) 0°
(B) 45°
(C) greater than 90°
(D) 60°

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22. If two liquids of same volume but different densities ρ_1 and ρ_2 respectively are mixed, then the density of the mixture is

(A) $\rho_1 + \rho_2$

(B) $\frac{\rho_1 + \rho_2}{2}$

(C) $\frac{\rho_1 \rho_2}{\rho_1 + \rho_2}$

(D) $\frac{2\rho_1 \rho_2}{\rho_1 + \rho_2}$

23. The wings or fins of aircraft are so designed that the speed of air

(A) on the topside is more than on the lower side
(B) on the topside is less than on the lower side
(C) is same on both side
(D) is turbulent

24. A black body at high temperature T radiates energy at a rate of E W/m^2. When the temperature falls to one-half of its initial value, the radiated energy will be

(A) $\frac{E}{4}$

(B) $\frac{E^2}{4}$

(C) $2E$

(D) $\frac{E}{16}$

25. The efficiency of the reversible heat engine is η_R and that of irreversible heat engine is η_I. Which one of the following relations is correct?

(A) $\eta_R > \eta_I$

(B) $\eta_R < \eta_I$

(C) $\eta_R = \eta_I$

(D) $\eta_R > 1$ and $\eta_I < 1$

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26. The molar specific heat at constant pressure of an ideal gas is (7/2)R, where R is gas constant. The ratio of specific heat at constant pressure to constant volume is

(A) 9/7
(B) 7/5
(C) 8/7
(D) 5/7

27. If P, V and T are the pressure, volume and temperature of a gas in jar A, and $2P$, $V/4$ and $2T$ are the pressure, volume and temperature of another gas in jar B, then the ratio of the number of molecules in the jar A and B will be

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

28. The volume of the cubic cell is 10^{-30} m^3. Then its lattice parameter is

(A) 10^{-30} m

(B) 10^{-10} m

(C) $\frac{1}{3} \times 10^{-30}$ m

(D) $\frac{3}{4\pi} \times 10^{-30}$ m

29. The doping of the base of a transistor is

(A) Equal to the emitter or collector
(B) Slightly more than that of emitter or collector
(C) Less than that of emitter or collector
(D) Much more than that of emitter or collector

30. A source is moving away with a velocity 0.2 v, where v is the velocity of sound. If the source sounds a frequency of 800 Hz, what is the apparent frequency heard by the stationary listener?

(A) 660 Hz
(B) 867 Hz
(C) 667 Hz
(D) 956 Hz

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31. The change in potential energy, when a body of mass m is raised to a height nR from the earth's surface is (R = radius of earth)

(A) $mgR\left(\frac{n}{n-1}\right)$

(B) $nmgR$

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

(D) $mgR\left(\frac{n}{n+1}\right)$

32. If the decay constant of certain radioactive sample is 0.113 per minute, then the half-life of the sample is

(A) 6.13 min
(B) 0.078 min
(C) 0.163 min
(D) 8.85 min

33. A certain radioactive substance has a disintegration constant of 0.0231 per day. Then the time taken for $\frac{1}{8}$ th of the original number of atoms to remain unchanged is

(A) 39 days
(B) 9 days
(C) 90 days
(D) 3.9 days

34. If Δm is the mass defect of a nucleus and A its mass number, then the packing fraction is

(A) $\frac{\Delta m}{A}$

(B) $\Delta m.A$

(C) $\frac{A}{\Delta m}$

(D) Δmc^2

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35. Which one of the following statements about Peltier effect is **INCORRECT**?

(A) Peltier effect occurs only at the junction
(B) Peltier effect is irreversible
(C) Peltier effect is reversible
(D) In Peltier effect, heat evolved or absorbed depends on the nature of the metals and temperature

36. The magnetic field at any point on a straight current carrying conductor is

(A) $\frac{\mu_o I}{4\pi r^2}$

(B) $\frac{\mu_o I}{4r}$

(C) Zero

(D) $\frac{\mu_o I}{2\pi r}$

37. A coil has an inductance of 0.04 Henry. The e.m.f. induced in it when the current flowing through the coil is changing at the rate of 100 A/s is

(A) Zero
(B) 4 V
(C) – 4 V
(D) 2.5 KV

38. The current in a coil is changing at a rate of 10 A/s. Then an e.m.f. of 4 V is induced in a neighboring coil. The mutual inductance of the pair of coils is then

(A) 40 H
(B) 0.4 H
(C) 2.5 H
(D) 4 H

39. One atomic mass unit (amu) is equivalent to

(A) 931 eV
(B) 931 MeV
(C) 931 keV
(D) 931 milli eV

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40. If Z is the atomic number and n is the principal quantum number, then the total energy of an electron in the n^{th} orbit of an atom is given by

(A) $\frac{13.6Z^2}{n^2}$ eV

(B) $-\frac{13.6Z^2}{n^2}$ eV

(C) $-\frac{13.6}{n^2}$ eV

(D) $-\frac{13.6Z^2}{n}$ eV

41. If m is the mass of the particle, its de Broglie wavelength λ is proportional to

(A) $\sqrt{m}$

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

(C) $\frac{1}{\sqrt{m}}$

(D) m

42. The number of photons emitted per second from a lamp radiating a power of 10 Watt at a wavelength of 6000 A^o is about

(A) 3×10^{18} per sec

(B) 3×10^{10} per sec

(C) 3×10^{8} per sec

(D) 1×10^{24} per sec

43. Photometer is an instrument used for

(A) counting the number of photons
(B) measuring the photoconductivity of a substance
(C) measuring the luminous intensities of light sources
(D) studying photoelectric effect

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44. When light passes from one medium to another medium, then the physical property which does not change is

(A) Velocity
(B) Frequency
(C) Wavelength
(D) Refractive index

45. Two thin lenses with focal lengths f_1 and f_2 have materials with dispersive powers ω_1 and ω_2 respectively. Then to form an achromatic combination of these lenses, essential condition is that

(A) $\frac{\omega_1}{f_1} - \frac{\omega_2}{f_2} = 0$

(B) $\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0$

(C) $\omega_1 + \omega_2 = 0$

(D) $f_1 + f_2 = 0$

46. The refractive indices for red and violet colours for crown glass are 1.5155 and 1.5245 respectively. Then the dispersive power of the crown glass is

(A) 0.009
(B) 3.04
(C) 0.0045
(D) 1.52

47. For a given material of the glass, the refractive index of the glass prism depends on

(A) the angle of the prism
(B) the angle through which it deviates an incident beam of light
(C) the wavelength of the light
(D) the intensity of the incident light

48. Which one of the following phenomena is **NOT** common to both sound and light waves?

(A) Interference
(B) Polarization
(C) Diffraction
(D) Reflection

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49. If i is the polarizing angle and r is the angle of refraction, then

(A) $i - r = 90°$
(B) $i + r = 60°$
(C) $i + r = 90°$
(D) $i = r$

50. If the refractive index of glass is 1.5, the speed of light in glass is (Velocity of light in vacuum is 3×10^8 m/s)

(A) 3×10^8 m/s
(B) 3×10^{10} m/s
(C) 0.5×10^8 m/s
(D) 2×10^8 m/s

51. If the coefficient of absorption and transmission of a surface are 0.73 and 0.23 respectively, then the coefficient of reflection will be

(A) 0.06
(B) 0.04
(C) 0.96
(D) 0.24

52. Which one of the following statements about Poisson's ratio (σ) is **INCORRECT**?

(A) σ is the ratio of lateral strain to longitudinal strain
(B) σ has no units and dimensions
(C) Theoretically, σ lies between -1 and ½
(D) For some substances, value of σ is negative

53. A potential barrier of 0.50 V exists across a p-n junction. If the depletion region is 5.0×10^{-7} m wide, the intensity of the electric field in this region is

(A) 1.0×10^6 V/m
(B) 1.0×10^5 V/m
(C) 2.0×10^5 V/m
(D) 2.0×10^6 V/m

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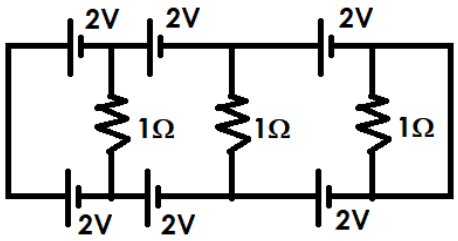
54. If a semiconductor photodiode can detect a photon with a maximum wavelength of 400 nm, then its band gap energy is
(Given Planck's constant, $h = 6.63 \times 10^{-34}$ Js; Speed of light, $c = 3 \times 10^{8}$ m/s; 1 eV = 1.602×10^{-19} J)

(A) 1.1 eV
(B) 2.0 eV
(C) 1.5 eV
(D) 3.1 eV

55. If the full wave rectifier is operating from 50 Hz mains, then the fundamental frequency in the ripple will be

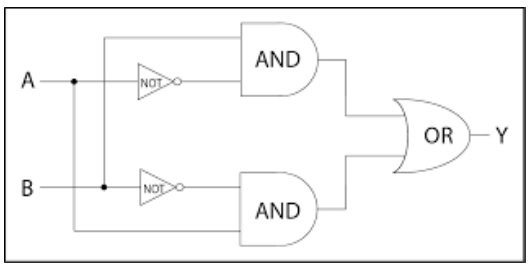
(A) 50 Hz
(B) 60 Hz
(C) 100 Hz
(D) 25 Hz

56. In the following circuit, the current in each resistor is



(A) 0.5 A
(B) 0 A
(C) 1 A
(D) 0.25 A

57. The logic circuit below represents which one of the following gates?



(A) XOR gate
(B) NAND gate
(C) XNOR gate
(D) NOR gate

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58. The fundamental radio antenna is a metal rod which has a length equal to

(A) λ in free space at the frequency of operation
(B) λ/2 in free space at the frequency of operation
(C) λ/4 in free space at the frequency of operation
(D) 3λ/4 in free space at the frequency of operation

59. If the carrier power of a 100% modulated AM wave is suppressed, the percentage saving in power will be

(A) 50%
(B) 100%
(C) 66.66%
(D) 75%

60. Parsec is the unit of

(A) Time
(B) Distance
(C) Luminosity
(D) Escape velocity

61. The conclusion that every additional electron enters the orbital with lowest possible energy has been drawn from

(A) Hund's rule
(B) Aufbau principle
(C) Pauli's exclusion principle
(D) De-Broglie's principle

62. The cathode rays have same charge to mass ratio as

(A) Anode rays
(B) γ-particles
(C) β-particles
(D) α-particles

63. The phenomenon of splitting of spectral lines under the influence of electric field is known as

(A) Stark effect
(B) Zeeman effect
(C) Compton effect
(D) Photoelectric effect

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64. ……. is the **CORRECT** order of effusion among the gases H_2, O_2, CO_2 and NH_3.

(A) $H_2 > NH_3 > O_2 > CO_2$

(B) $NH_3 > O_2 > H_2 > CO_2$

(C) $H_2 < NH_3 < O_2 < CO_2$

(D) $NH_3 < H_2 < O_2 < CO_2$

65. Which of the following is **NOT** a state function?

(A) Internal energy
(B) Gibbs free energy
(C) Work
(D) Enthalpy

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66. In an isolated system, a liquid is in equilibrium with its vapour. Then the molar entropy of the vapour is

(A) equal to that of liquid
(B) less than that of liquid
(C) more than that of liquid
(D) equal to zero

67. The rate constant for a first order reaction is $2.44 \times 10^{-3}\ s^{-1}$.
Then the half-life for the reaction is

(A) 264 s
(B) 274 s
(C) 284 s
(D) 294 s

68. Calculate the weight of Copper deposited at cathode when one Faraday of electricity is passed through $CuSO_4$ solution (Given: Atomic mass of Cu is 63.50, and current efficiency for copper deposition is 100%).

(A) 15.87 g
(B) 21.16 g
(C) 31.75 g
(D) 63.50 g

69. The potential of calomel electrode with 0.01 M KCl is ($E°$ for calomel electrode is 0.268 V)

(A) 0.150 V
(B) 0.268 V
(C) 0.327 V
(D) 0.386 V

70. For a reaction; $aA \rightarrow bB$, the rate of reaction is doubled when the concentration of A is increased by four times. The order of the reaction is equal to

(A) 0
(B) 0.5
(C) 1
(D) 2

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71. The coordination number of Zn^{2+} and S^{2-} ions in the zinc blende (ZnS) type structure is

(A) 4 : 4
(B) 6 : 6
(C) 8 : 8
(D) 4 : 8

72. The ionic strength of 0.01 M solution of an electrolyte of the type M_2X_3 is

(A) 0.01
(B) 0.03
(C) 0.06
(D) 0.15

73. The number of radial nodes in 5s atomic orbital is

(A) 5
(B) 4
(C) 3
(D) 0

74. Which of the following lines in the atomic spectrum of H appear in the visible region?

(A) Lyman
(B) Balmer
(C) Paschen
(D) Pfund

75. Which among the following undergoes SN2 substitution at the fastest rate?

(A) iodomethane
(B) iodoethane
(C) 2-iodopropane
(D) 2-iodo-2-methylpropane

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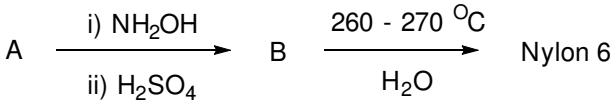
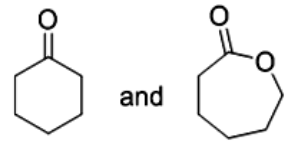
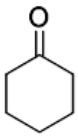
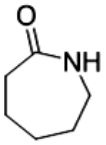
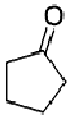
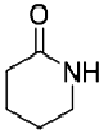
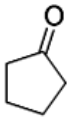
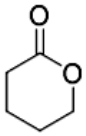
76. In the following preparation of Nylon 6, identify compounds A and B.



(A)  and

(B)  and 

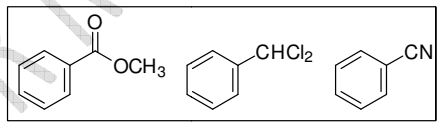
(C)  and 

(D)  and 

77. Phenol is more acidic than methanol due to

(A) aromaticity of phenol
(B) resonance stabilization of phenoxide ion
(C) less efficient solvation of phenol
(D) weaker hydrogen bonding between phenol molecules that enables easier removal of protons

78. Which among the following methods is **NOT** suitable for the preparation of benzaldehyde?



(A) Reaction of benzene with carbon dioxide and HCl in the presence of anhydrous aluminum chloride
(B) Controlled reduction of methylbenzoate with DIBAL-H
(C) Reaction of benzal chloride (a *gem*-dihalide) with water at 373 K
(D) Reaction of benzonitrile with stannous chloride in the presence of HCl followed by hydrolysis under acidic conditions

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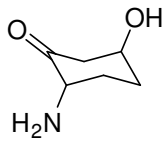
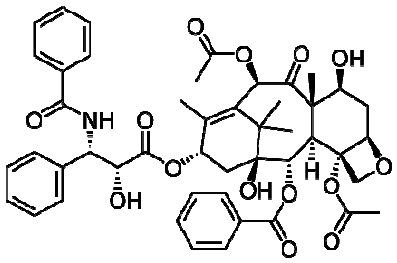
79. The IUPAC name of the following compound is



(A) 2-amino-5-hydroxycyclohexan-1-one
(B) 2-hydroxy-5-aminocyclohexan-1-one
(C) 1-amino-4-hydroxycyclohexan-2-one
(D) 1-hydroxy-4-aminocyclohexan-3-one

80. Following organic compound is the structure of paclitaxel which is an anti-cancer chemotherapeutic drug. What are the functional groups present in paclitaxel?



(A) Ester, Ether, Primary Alcohol and Alkene
(B) Ester, Ketone, Secondary Alcohol, Aldehyde
(C) Ketone, Amide, Ester, Alkene
(D) Peptide linkage, *tert*-Alcohol, Ether, Ketone

81. What is the order of stability of the following carbanions?

II I III IV

(A) IV > III > II > I
(B) III > IV > II > I
(C) IV > III > I > II
(D) III > IV > I > II

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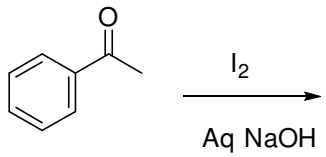
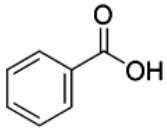
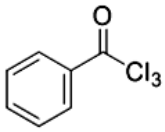
82. Identify the yellow precipitate formed in the following reaction.



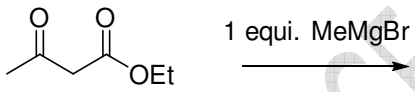
(A) NaI

(B) 

(C) CHI_3

(D) 

83. One of the products of the following reaction is a gas under standard pressure and temperature. Identify that gaseous product.



(A) H_2

(B) CO_2

(C) CH_4

(D) CO

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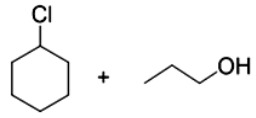
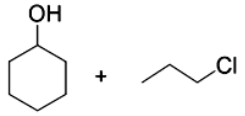
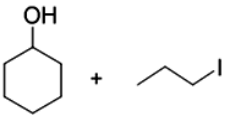
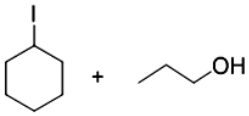
84. Which pair will be the best suited for Williamson ether synthesis of propoxycyclohexane?

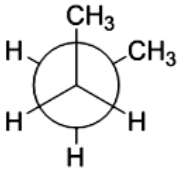
(A) 

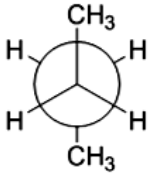
(B) 

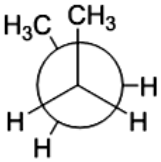
(C) 

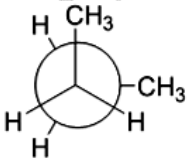
(D) 

85. Which conformation of butane is most stable?

(A) 

(B) 

(C) 

(D) 

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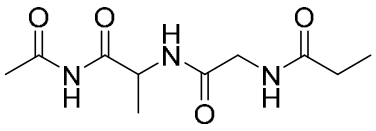
86. Number of peptide bond(s) present in the following compound is,



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

87. Which of the following combinations of enzyme, substrate and product is **CORRECT**?

(A) Enzyme: Maltase, Substrate: Maltose, Product: Glucose + Fructose
(B) Enzyme: Sucrase, Substrate: Sucrose, Product: Glucose + Fructose
(C) Enzyme: Amylase, Substrate: Lactose, Product: Galactose + Fructose
(D) Enzyme: Invertase, Substrate: Sucrose, Product: Glucose + Mannose

88. Ethylenediaminetetraacetate (EDTA) ion is

(A) hexadentate ligand with four "O" and two "N" donor atoms
(B) unidentate ligand
(C) bidentate ligand with two "N" donor atoms
(D) tridentate ligand with three "N" donor atoms

89. Zr (Z = 40) and Hf (Z = 72) have similar atomic and ionic radii because of

(A) belonging to same group
(B) diagonal relationship
(C) lanthanoid contraction
(D) having similar chemical properties

90. The **INCORRECT** statement among the following is

(A) Actinoid contraction is greater for element to element than Lanthanoid contraction
(B) Most of the trivalent lanthanoid ions are colourless in the solid state
(C) Lanthanoids are good conductors of heat and electricity
(D) Actinoids are highly reactive metals, especially when finely divided

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91. Identify the **INCORRECT** statement from the following

(A) Pig iron contains about 4% carbon and many impurities in smaller amount and it can be moulded into a variety of shapes
(B) Wrought iron is the purest form of iron
(C) Vapour phase refining is carried out for nickel by Mond's process
(D) Blister copper has blistered appearance due to evolution of CO_2

92. The type of hybridization of boron in diborane is

(A) sp- hybridization
(B) sp^2- hybridization
(C) sp^3- hybridization
(D) sp^3d- hybridization

93. Which of the following diatomic molecular species has only π bonds according to Molecular Orbital Theory?

(A) O_2
(B) N_2
(C) C_2
(D) Be_2

94. Identify the **INCORRECT** statement related to PCl_5 from the following

(A) Three equatorial P-Cl bonds make an angle of 120° with each other
(B) Two axial P-Cl bonds make an angle of 180° with each other
(C) Axial P-Cl bonds are longer than equatorial P-Cl bonds
(D) PCl_5 molecule is non-reactive

95. The existence of two different coloured complexes with the composition of $[Co(NH_3)_4Cl_2]^+$ is due to

(A) linkage isomerism
(B) geometrical isomerism
(C) coordination isomerism
(D) ionization isomerism

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96. Which of the following statements is **FALSE**?

(A) Ca^{2+} ions are important in blood clotting

(B) Ca^{2+} ions are not important in maintaining the regular beating of the heart

(C) Mg^{2+} ions are important in the green parts of plants

(D) Mg^{2+} ions form a complex with ATP

97. Bronze is an alloy of

(A) Copper and Nickel
(B) Copper and Iron
(C) Copper and Tin
(D) Copper and Aluminium

98. Pure ozone is a

(A) violet gas, dark blue liquid and pale blue solid
(B) pale blue gas, dark blue liquid and violet-black solid
(C) green gas, pale blue liquid and dark blue solid
(D) pale green gas and dark blue solid and liquid

99. Match the following.

i.	*Gypsum*	a.	PbS
ii.	*Epsom salt*	b.	$MgSO_4.7H_2O$
iii.	*Baryte*	c.	$CaSO_4.2H_2O$
iv.	*Galena*	d.	$BaSO_4$

(A) i-c, ii-b, iii-d, iv-a
(B) i-b, ii-d, iii-c, iv-a
(C) i-d, ii-c, iii-a, iv-d
(D) i-b, ii-c, iii-d, iv-a

100. Which among the following is the correct formula of chloric acid?

(A) $HOClO_2$

(B) HOClO

(C) $HOClO_3$

(D) HOCl

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101. If $n!$, $3\times n!$ and $(n+1)!$ are in G.P, then $n!$, $5\times n!$ and $(n+1)!$ are

(A) in A.P
(B) not in A.P
(C) in G.P
(D) not in G.P

102. The simplest form of $\dfrac{2}{\sqrt{2+\sqrt{2+\sqrt{2+2\cos 4x}}}}$ is

(A) $\sec\dfrac{\pi}{2}$
(B) $\sec x$
(C) $\cos x$
(D) 1

103. Sum of two positive numbers is k and the sum of whose squares is minimum. Then the numbers are

(A) $\dfrac{k}{2},\dfrac{k}{2}$
(B) $k-1,1$
(C) $k,0$
(D) $k,k-5$

104. The differential equation of the family of circles with fixed radius 5 units and center on the line $y = 2$ is

(A) $(y-2)^2 y'^2 = 25-(y-2)^2$
(B) $(x-2)^2 y'^2 = 25-(y-2)^2$
(C) $(y-2)y'^2 = 25-(y-2)^2$
(D) $(x-2)y'^2 = 25-(y-2)^2$

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105. If $x^2+6x-27>0$ and $x^2-3x-4<0$, then

(A) $x<4$

(B) $x>3$

(C) $3<x<4$

(D) $x=\frac{7}{2}$

106. If $\cos\frac{x}{a}=\sin\frac{x}{b}$, then $|a\cos 2x+b\sin 2x|$ is equal to

(A) $\sqrt{a^2b}$

(B) $\sqrt{ab^2}$

(C) $|b|$

(D) $|a|$

107. tan $5x$ tan $3x$ tan $2x$ is equal to

(A) tan $5x$ + tan $3x$ + tan $2x$
(B) 0
(C) tan $5x$ – tan $3x$ – tan $2x$
(D) 1

108. Let 1, a_1, a_2, . . . , a_{10} be the 11^{th} roots of unity. Then $(1 + a_1)$ . . . $(1 + a_{10})$ is equal to

(A) 1
(B) 2
(C) 11
(D) ∞

109. The region of the argand diagram defined by $|z-i|<3$ represents

(A) interior of a circle with centre on x axis
(B) interior of a circle with centre at origin
(C) interior of a circle with centre on y axis
(D) a pair of straight lines

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110. The first and last terms of an AP are 1 and 11. If the sum of its terms is 36, then the number of terms will be

(A) 3
(B) 4
(C) 5
(D) 6

111. Let $y = \cos^{-1}\left(\frac{2\cos x - 3\sin x}{\sqrt{13}}\right)$. Then $\frac{dy}{dx}$ is equal to

(A) 0
(B) x
(C) $2x$
(D) 1

112. ΔABC has vertices (0, 0), (10, 20), and (40, 0). If the line $y = kx$ cuts the triangle into two triangles of equal area, then k is equal to

(A) $\frac{4}{5}$
(B) $-\frac{5}{4}$
(C) $\frac{1}{2}$
(D) $\frac{1}{3}$

113. The value of $\lim_{x\to 2} \frac{e^{3x-6} - 1}{\sin(2-x)}$ is

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

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114. $\int \frac{dx}{x(x+1)}$ is equal to

(A) $\log\left|\frac{x+1}{x}\right|+c$

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

(C) $\log\left|\frac{x-1}{x}\right|+c$

(D) $\log\left|\frac{x-1}{x+1}\right|+c$

115. If $\vec{a}$ and $\vec{b}$ are two non-zero, non-collinear vectors, then $2\left[\vec{a}\quad\vec{b}\quad\hat{i}\right]\hat{i}+2\left[\vec{a}\quad\vec{b}\quad\hat{j}\right]\hat{j}+2\left[\vec{a}\quad\vec{b}\quad\hat{k}\right]\hat{k}+\left[\vec{a}\quad\vec{b}\quad\vec{a}\right]$ is equal to

(A) $2\left(\vec{a}\times\vec{b}\right)$

(B) $\vec{a}\times\vec{b}$

(C) $\vec{a}+\vec{b}$

(D) $\vec{a}-\vec{b}$

116. Solution of $\frac{dx}{dy}+mx=0$, where $m<0$ is

(A) $x=ce^{my}$

(B) $x=ce^{-my}$

(C) $x=c+my$

(D) $x=c$

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117. The sum of the infinite geometric series $1+\frac{1}{4}+\frac{1}{16}+\frac{1}{64}+...$ is

(A) $\frac{3}{5}$

(B) $\frac{3}{4}$

(C) $\frac{5}{3}$

(D) $\frac{4}{3}$

118. If $\int_1^b (b-4x)dx \geq 6-5b$ and $b>1$, then b equals

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

119. If the line $y=3x+\lambda$ touches the hyperbola $9x^2-5y^2=45$, then the value of λ^2 is

(A) 45
(B) 36
(C) 6
(D) 15

120. The unit vector parallel to the resultant of the vectors $2\vec{i}+3\vec{j}-\vec{k}$ and $4\vec{i}-3\vec{j}+2\vec{k}$ is

(A) $\frac{6\vec{i}+\vec{k}}{\sqrt{17}}$

(B) $\frac{6\vec{j}+\vec{k}}{\sqrt{17}}$

(C) $\frac{6\vec{i}-\vec{k}}{\sqrt{37}}$

(D) $\frac{6\vec{i}+\vec{k}}{\sqrt{37}}$

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121. If $2f(x) = f'(x)$ and $f(0) = 3$, then $f(2)$ equals

(A) $4e^3$

(B) $3e^4$

(C) $2e^3$

(D) $3e^2$

122. If the expression $\left(ax - 1 + \frac{1}{x}\right)$ is non-negative for all positive real x, then the minimum value of a must be

(A) 0

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

(C) $\frac{1}{4}$

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

123. The differential equation for $y = A\cos\alpha x + B\sin\alpha x$, where A and B are arbitrary constants, is

(A) $\frac{d^2y}{dx^2} - \alpha^2 y = 0$

(B) $\frac{d^2y}{dx^2} + \alpha^2 y = 0$

(C) $\frac{d^2y}{dx^2} - \alpha y = 0$

(D) $\frac{d^2y}{dx^2} + \alpha y = 0$

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124. If $\vec{a}$, $\vec{b}$ and $\sqrt{3}\vec{a}-\vec{b}$ are unit vectors, then the angle between $\vec{a}$ and $\vec{b}$ is

(A) $\frac{\pi}{6}$

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

(C) $\frac{\pi}{4}$

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

125. Suppose two cards are selected at random from a deck of 52 cards. Let X be the number of queens obtained. Then $E(X)=$

(A) $\frac{1}{13}$

(B) $\frac{2}{13}$

(C) $\frac{5}{13}$

(D) $\frac{37}{221}$

126. If n is even, then the sum of n terms of the series $1^2-2^2+3^2-4^2+5^2-6^2+\ldots$ is

(A) $\frac{-n(n+1)}{2}$

(B) $-n(n+1)$

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

(D) $\frac{n^2-n}{4}$

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127. $\lim_{x\to 0}\frac{1+x+x^2-e^x}{x^2}=$

(A) 1

(B) 2

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

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

128. A function $y=f(x)$ has a second order derivatives $f''(x)=6(x-1)$. If its graph passes through the point (2, 1) and at that point the tangent to the graph is $y=3x-5$, then the function is

(A) $(x-1)^3$

(B) $(x+1)^3$

(C) $(x-1)^2$

(D) $(x+1)^2$

129. The function $f(y)=\sin^{-1}(\tan y)$ is not differentiable at

(A) $y=0$

(B) $y=-\frac{\pi}{6}$

(C) $y=\frac{\pi}{6}$

(D) $y=\frac{\pi}{4}$

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130. The angle between the curves $y = x^2$ and $y = (x-2)^2$ at their point of intersection is

(A) $\theta = \sin^{-1}\left(\frac{1}{2}\right)$

(B) $\theta = \frac{\sin(\pi)}{\cos(0)}$

(C) $\theta = \tan^{-1}\left(\frac{1}{2}\right)$

(D) $\theta = \tan^{-1}\left(\frac{4}{3}\right)$

131. If $n = 2^3 \times 3^4 \times 5^4 \times 7$, then the number of consecutive zeros in n is

(A) 2
(B) 3
(C) 4
(D) 7

132. If A and B are two subsets of a set X, then $\{A \cap (X - B)\} \cup B$ is equal to

(A) $A \cup B$
(B) $A \cap B$
(C) X
(D) B

133. Let m, n be real numbers. If α is the root of $x^2 + 3m^2x + 5n^2 = 0$, β is a root of $x^2 + 9m^2x + 15n^2 = 0$ and $0 < \alpha < \beta$, then the equation $x^2 + 6m^2x + 10n^2 = 0$, has a root γ that always satisfies

(A) $\gamma = \frac{\alpha}{4} + \beta$

(B) $\beta < \gamma$

(C) $\alpha < \gamma < \beta$

(D) $\gamma = \frac{\alpha}{2} + \beta$

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134. If $A = \cos^2 x + \sin^4 x$, then, for all values of x,

(A) $1 \le A \le 2$

(B) $\frac{3}{4} \le A \le 1$

(C) $\frac{13}{16} \le A \le 1$

(D) $A = 3$

135. Let z_1 and z_2 be two different complex numbers such that $|z_1| = 1$ and $|z_2| = 1$.

Then $\left|\frac{z_2 - z_1}{1 - \overline{z}_1 z_2}\right|$ is equal to

(A) 1

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

(C) 2

(D) 0

136. Let $a > 1$, $b > 1$, $c > 1$ be in Geometric Progression.

Then $\frac{1}{1+\log_e a}, \frac{1}{1+\log_e b}, \frac{1}{1+\log_e c}$ are

(A) in Arithmetic Progression
(B) in Geometric Progression
(C) in Harmonic Progression
(D) not in any progression

137. Let n be an integer which leaves remainder one when divided by three. Then $\left(1+\sqrt{3}i\right)^n + \left(1-\sqrt{3}i\right)^n$ equals

(A) 2^n

(B) 2^{n+1}

(C) $(-1)^{n+1} 2^n$

(D) -2^n

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138. Let $P=(-\sin(\beta-\alpha), -\cos\beta)$, $Q=(\cos(\beta-\alpha), \sin\beta)$ and $R=(\cos(\beta-\alpha+\theta), \sin(\beta-\theta))$, $\left(0<\alpha,\beta,\theta<\frac{\pi}{4}\right)$ be the three points in a plane. Then

(A) P, Q, R are non-collinear
(B) Q lies on the line segment of RP
(C) R lies on the line segment of PQ
(D) P lies on the line segment of QR

139. The image of the point $P(2, 3)$ with respect to the line $x = y$ is the point Q and the image of Q with respect to the line $x = 0$ is $A(x, y)$. Then

(A) $x = 3, y = -2$
(B) $x = -3, y = 2$
(C) $x = 3, y = 2$
(D) $x = -3, y = -2$

140. All chords of the curve $3x^2 - y^2 - 2x + 4y = 0$ that subtends a right angle at the origin, pass through a fixed point whose coordinates are

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

141. The locus of the middle points of chords of the parabola $y^2 = 8x$ drawn through the vertex is a parabola whose

(A) focus is (2, 0)
(B) latus rectum = 4
(C) latus rectum = 8
(D) focus is (0,−1)

142. The equation of the common tangent touching the circle $(x - 3)^2 + y^2 = 9$ and parabola $y^2 = 4x$ below the x-axis is

(A) $\sqrt{3}y = -x + \sqrt{3}$
(B) $\sqrt{3}y = x + \sqrt{3}$
(C) $\sqrt{3}y = x - \sqrt{3}$
(D) $\sqrt{3}y = 2x - \sqrt{3}$

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143. It is given that the tangent at the point (2sec θ, 3tan θ) of the hyperbola $\frac{x^2}{4}-\frac{y^2}{9}=1$ is parallel to the line $3x - y + 4 = 0$. Then the value of θ is

(A) 90°
(B) 60°
(C) 45°
(D) 30°

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

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

(B) $y=\frac{3x}{\sqrt{7}}-\frac{15}{\sqrt{7}}$

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

(D) $y=3\frac{3x}{\sqrt{7}}-\frac{15}{\sqrt{7}}$

145. Let $(x+iy)^{1/3}=a+ib$. Then $\frac{x}{a}+\frac{y}{b}$ is equal to

(A) $a^2 - b^2$
(B) $4(a^2 - b^2)$
(C) $6(a^2 - b^2)$
(D) $8(a^2 - b^2)$

146. If $z = -2 + 2\sqrt{3}i$, then $z^{2n}+2^{2n}.z^n+2^{4n}$ may be equal to

(A) 1
(B) 0 , n is a multiple of 3
(C) 2^{2n} , n is not a multiple of 3
(D) 3.4^{2n}, n is a multiple of 3

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147. Assume that $\sum_{n=1}^{n} n,\ \frac{\sqrt{10}}{3},\ \sum_{n=1}^{n} n^2,\ \sum_{n=1}^{n} n^3$ are in a geometric progression. Then the value of n is

(A) 12
(B) 14
(C) 6
(D) 4

148. If $s_n = \sum_{k=1}^{n} \frac{1+2+2^2+\ldots \text{to } k \text{ terms}}{2^k}$, then s_n is equal to

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

(B) $1-\frac{1}{2^n}$

(C) $2^n-(n+1)$

(D) 2^n-1

149. If a, b, c, d, e, f are in Arithmetic Progression, then $e - c$ is equal to

(A) $2(b - c)$
(B) $f - d$
(C) $2(d - c)$
(D) $2(f - d)$

150. The sum of the infinite series $\left(\frac{1}{3}\right)^2+\frac{1}{3}\left(\frac{1}{3}\right)^4+\frac{1}{5}\left(\frac{1}{3}\right)^6+\ldots$ is equal to

(A) $\frac{1}{4}\log 2$

(B) $\frac{1}{6}\log 2$

(C) $\frac{1}{4}\log 3$

(D) $\frac{1}{6}\log 3$

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151. If $y = \sin x$, then $\frac{d^2}{dy^2}\left(\cos^7 x\right)$ is equal to

(A) $35\cos^3 x - 42\cos^5 x$

(B) $35\cos^3 x + 42\cos^5 x$

(C) $42\cos^3 x - 35\cos^5 x$

(D) $42\cos^3 x + 35\cos^5 x$

152. Let $g(x)$ be the inverse function $f(x)$ and $f'(x) = \frac{1}{1+x^3}$, then $g'(x)$ is equal to

(A) $\frac{1}{1+\left(g(x)\right)^3}$

(B) $\frac{1}{1+\left(f(x)\right)^3}$

(C) $1+\left(g(x)\right)^3$

(D) $1+\left(f(x)\right)^3$

153. The domain of the function $f(x) = \sin^{-1}\left(\frac{4}{3+2\cos x}\right)$ is

(A) $2n\pi - \frac{\pi}{6} \le x \le 0$, n is an integer

(B) $2n\pi - \frac{\pi}{6} \le x \le 2n\pi + \frac{\pi}{6}$, n is an integer

(C) $0 \le x \le 2n\pi + \frac{\pi}{6}$, n is an integer

(D) $2n\pi - \frac{\pi}{3} \le x \le 2n\pi + \frac{\pi}{3}$, n is an integer

154. Let [,] be the greatest integer function. If $\left[x + [2x]\right] < 3$, then

(A) $x \in (-\infty, 1)$

(B) $x \in [0, 1)$

(C) $x \in [-\infty, 3/2)$

(D) $x \in [0, 3/2)$

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155. Let $f : R \to R$ be defined by $f(x) = (x+1)^2 - 1,\ x \geq -1$. Then the set of values of x for which $f(x) = f^{-1}(x)$ is given by

(A) $\{0\}$
(B) $\{0, -1\}$
(C) $\{0, 1\}$
(D) $\{0, \infty\}$

156. $\lim\limits_{x\to\infty}\left(\dfrac{x^2+5x+3}{x^2+x+2}\right)^x$ equals

(A) e^2
(B) e^3
(C) e^4
(D) e^5

157. $\lim\limits_{x\to\infty}\left(\sin\sqrt{x+1} - \sin\sqrt{x}\right)$ is equal to

(A) 1
(B) -1
(C) 0
(D) ∞

158. If $f(x) = \begin{cases} \dfrac{1-\cos x}{x}, & x \neq 0 \\ k, & x = 0 \end{cases}$ is continuous at $x = 0$, then the value of k is

(A) 0
(B) $\dfrac{1}{2}$
(C) $\dfrac{1}{4}$
(D) $-\dfrac{1}{2}$

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159. Let f be a function which is continuous and differentiable for all real x. If $f(2) = -4$ and $f'(x) \geq 6$ for all $x \in [2, 4]$, then

(A) $f(4) \leq 8$
(B) $f(4) \geq 8$
(C) $f(4) \geq 12$
(D) $f(4) \leq 12$

160. Let $f(x) = \dfrac{x^2 - 1}{x^2 + 1}$ for every real number x. Then the minimum value of f

(A) does not exist because f is unbounded
(B) is not attained even though f is bounded
(C) is equal to 1
(D) is equal to -1

161. The set of all values of a satisfying $\log_2\left(ax^2 + x + a\right) \geq 1$ for all $x \in R$, is

(A) $\left(0, 1 + \dfrac{\sqrt{5}}{2}\right)$

(B) $\left(1 + \dfrac{\sqrt{5}}{2}, \infty\right)$

(C) $\left(0, 1 - \dfrac{\sqrt{5}}{2}\right)$

(D) $\left(1 - \dfrac{\sqrt{5}}{2}, 1 + \dfrac{\sqrt{5}}{2}\right)$

162. If the roots of the equation $(a^2 + b^2)y^2 - 2(ac + bd)y + c^2 + d^2 = 0$ are equal, then

(A) $ab = dc$
(B) $ac = bd$
(C) $ad = -bc$
(D) $ad = bc$

163. The number of integers k such that $1 \leq k \leq 100$ and $2^k + 3^k + 5^k$ is divisible by 4 is

(A) 47
(B) 48
(C) 49
(D) 50

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164. The number of ways of arranging letters of the word BACANA so that C and N do not appear together is

(A) 30
(B) 40
(C) 60
(D) 80

165. The system of equations

$$2x\cos^2\theta + y\sin 2\theta - 2\sin\theta = 0$$
$$x\sin 2\theta + 2y\sin^2\theta = -2\cos\theta$$
$$x\sin\theta - y\cos\theta = 0 \text{ for all values of } \theta \text{, can}$$

(A) can have a unique non-trivial solution
(B) cannot have a solution
(C) can have infinite number solutions
(D) can have only trivial solution

166. $\frac{1}{n!}+\frac{1}{2!(n-2)!}+\frac{1}{4(n-4)!}+\ldots+\infty$ is equal to

(A) $\frac{2^n}{n!}$

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

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

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

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167. An elevator starts with m passengers and steps at n floors ($m \leq n$). The probability that no two passengers alight at the same floor is

(A) $\frac{{}^{n}P_{m}}{m^{n}}$

(B) $\frac{{}^{n}C_{m}}{m^{n}}$

(C) $\frac{{}^{n}C_{m}}{n^{m}}$

(D) $\frac{{}^{n}P_{m}}{n^{m}}$

168. 10 different books and 2 different pens are given to 3 boys so that each gets equal number of things. The probability that the same boy does not receive both the pens is

(A) $\frac{7}{11}$

(B) $\frac{5}{11}$

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

(D) $\frac{5}{11}$

169. If $\tan^2\theta = 2\tan^2\phi + 1$, then $\cos 2\theta + \sin^2\phi$ is equal to

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

170. If $\sin\theta = 3\sin(\theta + 2\alpha)$, then the value of $\tan(\theta + \alpha) + 2\tan\alpha$ is

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

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171. If P is a point on the altitude AD of the triangle ABC such that $\angle CDP = \frac{B}{3}$, then AP is equal to

(A) $2a\sin\frac{C}{3}$

(B) $2b\sin\frac{C}{3}$

(C) $2c\sin\frac{B}{3}$

(D) $2c\sin\frac{C}{3}$

172. The equation of the family of curves which intersect the hyperbola $xy = 2$ orthogonally is

(A) $y = \frac{x^2}{4} + C$

(B) $y = \frac{x^3}{6} + C$

(C) $y = -\frac{x^3}{6} + C$

(D) $y = -\frac{x^2}{4} + C$

173. A normal at any point (x, y) to the curve $y = f(x)$ cuts triangle of unit area with the axes. The equation of the curve is

(A) $y^2 - x^2\left(\frac{dy}{dx}\right)^2 = 4\frac{dy}{dx}$

(B) $x^2 - y^2\left(\frac{dy}{dx}\right)^2 = \frac{dy}{dx}$

(C) $x + y\frac{dy}{dx} = y$

(D) $x^2 + 2xy\frac{dy}{dx} + y^2\left(\frac{dy}{dx}\right)^2 = 2\frac{dy}{dx}$

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174. Let z and w be two complex numbers such that $|z| \le 1$, $|w| \le 1$ and $|z + iw| = |z - \bar{w}i| = 2$. Then z is equal to

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

175. The distance between the foci of the hyperbola $x^2 - 3y^2 - 4x - 6y - 11 = 0$ is

(A) 2
(B) 4
(C) 6
(D) 8

176. If $\begin{vmatrix} g(y) & g'(y) \\ g'(y) & g''(y) \end{vmatrix} = 0$, $g(0) = 1$ and $g'(0) = 2$, then $g(1)$ belongs to the interval

(A) [5, 7]
(B) [8, 10]
(C) [9, 12]
(D) [6, 9]

177. Let M be a 3×4 real matrix and $MX = N$ be an inconsistent system of equations. Then the highest possible rank of M is

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

178. The function $f(x) = |x+1|$ on the interval $[-2, 0]$ is

(A) differentiable but not continuous
(B) continuous and differentiable
(C) continuous but not differentiable
(D) neither continuous nor differentiable

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179. The value of $\cos 105°$ is equal to

(A) $\frac{1}{4}\left(\sqrt{2}-\sqrt{3}\right)$

(B) $\frac{1}{\sqrt{2}}\left(2-\sqrt{6}\right)$

(C) $\frac{1}{4}\left(\sqrt{2}-\sqrt{6}\right)$

(D) $\frac{\sqrt{6}}{4}$

180. Let $[A]_{3\times1}, [B]_{3\times3}, [C]_{3\times5}, [D]_{5\times3}, [E]_{5\times5}$ and $[F]_{5\times1}$ be real matrices where $[B]$ and $[E]$ are symmetric. The following statements are made with respect to these matrices.

Statement (i) Matrix product $[D]^T[F][D]$ is always symmetric.

Statement (ii) Matrix product $[F]^T[C]^T[B][C][F]$ is a scalar.

Then

(A) statement (i) is true but statement (ii) is false
(B) statement (i) is false but statement (ii) is true
(C) both the statements are true
(D) both the statements are false

181. The standard deviation of a uniformly distributed random variable between 0 and 1 is

(A) $\frac{7}{\sqrt{12}}$

(B) $\frac{5}{\sqrt{12}}$

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

(D) $\frac{1}{\sqrt{12}}$

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182. For every real number t, let $f(t)=\frac{t}{1!}+\frac{3}{2!}t^2+\frac{7}{3!}t^3+\frac{15}{4!}t^4+\ldots$ Then the equation $f(t)=0$ has

(A) no real solution
(B) infinite number of real solutions
(C) exactly two real solutions
(D) exactly one real solution

183. Let $z^3=\overline{z}$, where z is a complex number not equal to zero. Then z is a solution of the equation

(A) $z^2=1$
(B) $z^3=1$
(C) $z^4=1$
(D) $z^9=1$

184. The equation of the line normal to the function $f(x)=(x-8)^{\frac{2}{3}}+1$ at the point (0, 5) is

(A) $y=3x-5$
(B) $3y=x+15$
(C) $3y=x-15$
(D) $y=3x+5$

185. The fifth term of a G.P is 2. Then the product of first 9 terms is

(A) 128
(B) 512
(C) 256
(D) 64

186. If the non-zero numbers x, y, z are in A.P, and $\tan^{-1}x$, $\tan^{-1}y$, $\tan^{-1}z$ are also in A.P, then

(A) $x=y=z$
(B) $xy=yz$
(C) $x^2=yz$
(D) $z^2=xy$

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187. Let $f(x) = m + n|x| + l|x|^2$, where m, n, and l are real constants. Then $f'(0)$ exists if

(A) $n = 0$
(B) $l = 0$
(C) $m = 0$
(D) $n = m$

188. From a pack of playing cards, two cards are drawn at random. The probability that both cards will be a king, if the first card is not replaced is

(A) $\frac{1}{221}$

(B) $\frac{1}{169}$

(C) $\frac{1}{52}$

(D) $\frac{1}{26}$

189. $\lim_{x \to 0} \frac{|x|}{x}$

(A) is zero
(B) is infinity
(C) does not exist
(D) is -1

190. Consider the region $5x + y \le 100$, $x + y \le 60$, $x \ge 0$, $y \ge 0$. In this region, the point (26, 39)

(A) lies inside
(B) lies outside
(C) lies on the boundary
(D) is the only point in the region

191. If $C_n = a^n + b^n$, $a + b = 1$, $ab = -1$, $C_{n-1} = 11$, $C_{n+1} = 29$, where $n \in$ □, then $(C_n)^2 =$

(A) 98
(B) 246
(C) 324
(D) 420

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192. The value of $\lim_{x\to 8}\frac{x^{1/3}-2}{x-8}$ is

(A) $\frac{1}{16}$

(B) $\frac{1}{12}$

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

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

193. Assume that the duration in minutes of a telephone conversation follows the exponential distribution $f(x)=\frac{1}{5}e^{x/5}$, $x\geq 0$. The probability that the conversation will exceed five minutes is

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

(B) $1-\frac{1}{e}$

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

(D) $1-\frac{1}{e^2}$

194. Let t_n denote the n^{th} term of the infinite series $\frac{1}{1!}+\frac{10}{2!}+\frac{21}{3!}+\frac{34}{4!}+\frac{49}{5!}+\ldots$

Then $\lim_{n\to\infty} t_n$ is

(A) 0

(B) e

(C) e^2

(D) 1

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195. Let $\vec{v}$ be a differentiable vector function and f be a differentiable scalar function. Then $curl(f\vec{v}) =$

(A) $\vec{0}$

(B) $f\, curl(\vec{v})$

(C) $(grad\ f) \times \vec{v}$

(D) $(grad\ f) \times \vec{v} + (f\, curl(\vec{v}))$

196. If $|z| = |z-1|$, then

(A) $\mathrm{Re}(z) = 1$

(B) $\mathrm{Re}(z) = \frac{1}{2}$

(C) $\mathrm{Im}(z) = 1$

(D) $\mathrm{Im}(z) = \frac{1}{2}$

197. If θ is an acute angle such that $\tan^2\theta = \frac{8}{7}$, then the value of $\frac{(1+\sin\theta)(1-\sin\theta)}{(1+\cos\theta)(1-\cos\theta)}$ is

(A) $\frac{8}{7}$

(B) $\frac{7}{8}$

(C) $\frac{7}{4}$

(D) $\frac{64}{49}$

198. Let R be a relation defined on the set Z of all integers and xRy when $x + 2y$ is divisible by 3. Then

(A) R is not transitive
(B) R is symmetric only
(C) R is an equivalence relation
(D) R is not an equivalence relation

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199. The range of the function $f(x)=\sqrt{\frac{x}{1+x}}$ is

(A) $(0, \infty)$

(B) $(0, \infty]$

(C) $(0, \infty]-\{1\}$

(D) $[0, \infty)$

200. If tangent to the curve $y^2+3x-7=0$ at the point (a, b) is parallel to the line $x-y=4$, then the value of b is

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

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

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

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

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KEY													
Sl No.	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**	**Sl No.**	**Key**
1	D	31	D	61	B	91	D	121	B	151	A	181	D
2	B	32	A	62	C	92	C	122	C	152	C	182	D
3	B	33	C	63	A	93	C	123	B	153	D	183	C
4	B	34	A	64	A	94	D	124	A	154	A	184	D
5	A	35	B	65	C	95	B	125	B	155	B	185	B
6	B	36	C	66	A	96	B	126	A	156	C	186	A
7	B	37	C	67	C	97	C	127	C	157	C	187	A
8	A	38	B	68	C	98	B	128	A	158	A	188	A
9	A	39	B	69	D	99	A	129	D	159	B	189	C
10	C	40	B	70	B	100	A	130	D	160	D	190	B
11	B	41	B	71	A	101	A	131	B	161	B	191	C
12	B	42	B	72	D	102	A	132	A	162	D	192	D
13	A	43	C	73	B	103	A	133	C	163	C	193	A
14	C	44	B	74	B	104	A	134	B	164	D	194	A
15	C	45	B	75	A	105	C	135	A	165	B	195	D
16	B	46	D	76	B	106	D	136	C	166	C	196	B
17	A	47	C	77	B	107	C	137	C	167	D	197	B
18	B	48	B	78	A	108	A	138	A	168	B	198	D
19	C	49	C	79	A	109	A	139	B	169	B	199	C
20	D	50	D	80	C	110	D	140	A	170	D	200	D
21	C	51	B	81	A	111	D	141	B	171	C		
22	B	52	D	82	C	112	A	142	A	172	B		
23	A	53	A	83	C	113	C	143	D	173	D		
24	D	54	D	84	C	114	B	144	C	174	C		
25	A	55	C	85	B	115	A	145	B	175	D		
26	B	56	B	86	A	116	B	146	D	176	D		
27	D	57	A	87	B	117	D	147	D	177	C		
28	B	58	C	88	A	118	B	148	A	178	C		
29	C	59	C	89	C	119	B	149	C	179	C		
30	C	60	B	90	B	120	D	150	B	180	B		

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