

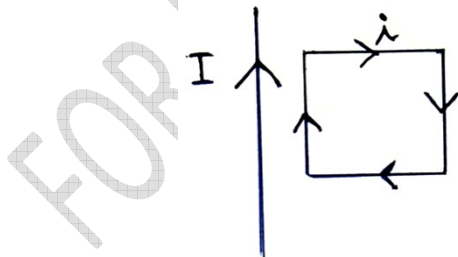
TEST FOR PHYSICS CHEMISTRY MATHEMATICS SHIFT IV

PHYSICS UG SHIFT IV

(FINAL)

1. A flywheel experiencing a torque  $\tau$  by an external motor rotates with an angular velocity  $\omega$ . Then which one of the following is **TRUE**?
  - (A)  $\omega$  is proportional to  $\tau$
  - (B)  $\omega$  is proportional to  $\frac{1}{\tau}$
  - (C)  $\omega$  is proportional to  $\sqrt{\tau}$
  - (D)  $\omega$  is proportional to  $\frac{1}{\sqrt{\tau}}$
2. Two satellites of masses  $m_1$  and  $m_2$  ( $m_1 > m_2$ ) are revolving round the earth in circular orbits of radius  $r_1$  and  $r_2$  ( $r_1 > r_2$ ) respectively. Which one of the following is true of their speeds  $v_1$  and  $v_2$ ?
  - (A)  $v_1 = v_2$
  - (B)  $v_1 > v_2$
  - (C)  $v_1 < v_2$
  - (D)  $\frac{v_1}{r_1} = \frac{v_2}{r_2}$
3. According to Hooke's law of elasticity, if the stress is increased to 4 times its previous value, the ratio of stress to strain
  - (A) increases by 4 times
  - (B) increases by 2 times
  - (C) remains unchanged
  - (D) depends on the material property
4. The coefficient of linear expansion of a crystalline substance in the  $x$ ,  $y$  and  $z$  directions are  $1 \times 10^{-4}/^\circ\text{C}$ ,  $2 \times 10^{-4}/^\circ\text{C}$  and  $3 \times 10^{-4}/^\circ\text{C}$  respectively. The coefficient of cubical expansion of the crystal is equal to
  - (A)  $36 \times 10^{-4}/^\circ\text{C}$
  - (B)  $6 \times 10^{-4}/^\circ\text{C}$
  - (C)  $10^{-4}/^\circ\text{C}$
  - (D)  $2 \times 10^{-4}/^\circ\text{C}$

5. In an adiabatic expansion of a gas, the gas does  $25\text{ J}$  of work. Then the difference in the internal energy in the process is
- (A)  $25\text{ J}$   
 (B)  $-25\text{ J}$   
 (C) Zero  
 (D)  $50\text{ J}$
6. The equation of state for  $8\text{ g}$  of  $\text{O}_2$  molecule will be
- (A)  $PV = 8RT$   
 (B)  $PV = \frac{RT}{4}$   
 (C)  $PV = RT$   
 (D)  $PV = \frac{RT}{2}$
7. A ball of mass  $5\text{ kg}$  is taken to a height of  $3\text{ m}$  above the ground. Then the potential energy stored by the ball is about
- (A)  $121.2\text{ J}$   
 (B)  $147.15\text{ J}$   
 (C)  $227.31\text{ J}$   
 (D)  $182.21\text{ J}$
8. A rectangular loop carrying a current  $i$  is placed near a long straight wire carrying a steady current  $I$  such that the wire is parallel to one of the side of the loop and is in plane of the loop, as shown in the figure below.

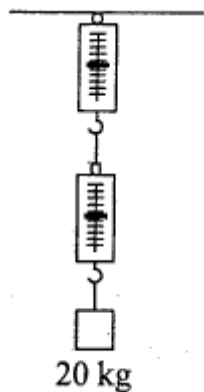


The loop then the

- (A) rotates about an axis parallel to the long wire  
 (B) moves away from the wire  
 (C) moves towards the wire  
 (D) remains stationary

9. The self inductance of a coil is  $L$ . Keeping the length and area same, the number of turns in the coil is increased to four times. The self inductance of the coil will be
- (A)  $\frac{1}{4}L$
  - (B)  $L$
  - (C)  $4L$
  - (D)  $16L$
10. The average electric field of electromagnetic waves in certain region of free space is  $9 \times 10^{-4} \text{ NC}^{-1}$ . Then the average magnetic field in the same region is of the order of
- (A)  $27 \times 10^{-4} \text{ T}$
  - (B)  $3 \times 10^{-12} \text{ T}$
  - (C)  $3 \times 10^{-4} \text{ T}$
  - (D)  $\frac{1}{3} \times 10^{-4} \text{ T}$
11. The colour code on a resistor is red, red, black. The value of its resistance is
- (A)  $(22 \pm 2.2) \Omega$
  - (B)  $22 \Omega$
  - (C)  $(22 \pm 0.44) \Omega$
  - (D)  $(22 \pm 4.4) \Omega$
12. An unstable heavy nucleus at rest breaks into two daughter nuclei which move away with velocities in the ratio 9 : 27. The ratio of the radii of the nuclei (assuming them to be spherical) is
- (A) 9 : 27
  - (B) 2 : 3
  - (C) 4 : 9
  - (D) 3 : 2
13. The focus of all particles in a medium vibrating in the same phase is called
- (A) wavelet
  - (B) wavefront
  - (C) wave train
  - (D) wave function

14. A stone dropped from the top of a tower hits the ground after 6 s. How much time does it take to cover the first one-third of the distance from the top of the tower?
- (A) 4 s  
(B)  $2\sqrt{3}$  s  
(C)  $\sqrt{3}$  s  
(D) 2 s
15. A cube of ice is floating in water contained in a vessel. When the ice melts, the level of water in the vessel
- (A) falls  
(B) rises  
(C) remains unchanged  
(D) falls at first and then rises
16. A 20 kg block is suspended by two light spring balances as shown in the figure. What will be reading of both scales?



- (A) 20 kg, 20 kg  
(B) 10 kg, 10 kg  
(C) 0 kg, 20 kg  
(D) 20 kg, 0 kg
17. Two circular loops  $A$  and  $B$  of radii  $R$  and  $NR$  respectively are made from a uniform wire. The moment of inertia of  $B$  about its axis is 3 times the moment of inertia of  $A$  about its axis. The value of  $N$  is
- (A)  $3^{-1/3}$   
(B)  $3^{1/3}$   
(C)  $3^{2/3}$   
(D)  $3^{-2/3}$

18. In Young's double slit experiment, the central point on the screen is
- (A) dark
  - (B) bright
  - (C) first bright and then dark
  - (D) first dark and then bright
19. The root mean square speed of the molecule of an enclosed gas is  $v$ . If the pressure is doubled keeping the temperature constant, the root mean square speed will be
- (A)  $v$
  - (B)  $2v$
  - (C)  $\frac{v}{2}$
  - (D)  $\sqrt{2}v$
20. Two uniform aluminium rods  $A$  and  $B$  of length  $l$  and  $2l$  and radius  $r$  and  $2r$  respectively are heated to same temperature. The ratio of the increase in the length of  $A$  to that of  $B$  is
- (A) 1 : 2
  - (B) 2 : 1
  - (C) 1 : 1
  - (D) 1 : 4
21. A milliammeter of resistance  $40 \Omega$  has a range of 0-30 mA. What will be the resistance used in series to convert it into a voltmeter of range 0-15 V?
- (A)  $300 \Omega$
  - (B)  $360 \Omega$
  - (C)  $400 \Omega$
  - (D)  $460 \Omega$
22. The magnetic field in a travelling electromagnetic wave has a peak value of 40 nT. The peak value of electric field strength is
- (A) 1 V/m
  - (B) 4 V/m
  - (C) 8 V/m
  - (D) 12 V/m

23. Two circular current carrying coils of radii 2 cm and 3 cm are equivalent to magnetic dipoles having equal magnetic moments. The ratio of currents through the coils are
- (A)  $\frac{4}{9}$
  - (B)  $\frac{9}{4}$
  - (C)  $\frac{2}{3}$
  - (D)  $\frac{3}{4}$
24. The time taken by light to pass through a glass slab of thickness 5 mm and refractive index 1.5 is
- (A)  $2.5 \times 10^{-13}$  s
  - (B)  $3 \times 10^{-13}$  s
  - (C)  $2.5 \times 10^{-11}$  s
  - (D)  $3 \times 10^{-11}$  s
25. The collector current in a transistor is 4 mA and the base current is  $200 \mu\text{A}$ . The current gain for the common base configuration is
- (A) 0.95
  - (B) 0.90
  - (C) 0.85
  - (D) 0.80
26. The television uses the ..... to generate magnetic fields needed
- (A) solenoid
  - (B) toroid
  - (C) both solenoid and toroid
  - (D) solar cell
27. Which one of the following *cannot* be used for detection of X-Rays?
- (A) Photographic film
  - (B) Photocells
  - (C) Geiger tubes
  - (D) Ionisation chamber

28. A microscope ..... objects and produces their larger image
- (A) magnifies
  - (B) resolves
  - (C) capture
  - (D) reduce
29. The ground state energy of hydrogen atom is
- (A) 13.6 eV
  - (B) 27.2 eV
  - (C) -13.6 eV
  - (D) infinity
30.  $\beta$ -decay emits
- (A) electrons or positrons
  - (B) proton
  - (C) phonon
  - (D) hole
31. A cylinder is stretched by two equal forces applied normal to its cross-sectional area. The restoring force per unit area in this case is called
- (A) Poisson ratio
  - (B) Compressive strength
  - (C) Tensile stress
  - (D) Micro strain
32. A particle starts rotating from rest according to  $\theta = \frac{3t^3}{20} - \frac{t^2}{3}$ , then the angular acceleration at the end of 5 seconds is
- (A) 7.92 rad/sec
  - (B) 3.83 rad/sec<sup>2</sup>
  - (C) 5.48 rad/sec
  - (D) 8.23 rad/sec<sup>2</sup>

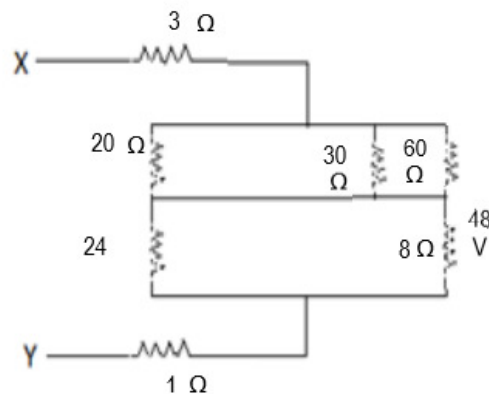
33. If Young's double slit apparatus is immersed in a liquid of refractive index  $\mu$ , the fringe width  $\beta'$
- (A) reduces to  $\frac{\beta}{\mu}$
  - (B) increases to  $\mu\beta$
  - (C) remains constant
  - (D) increases to  $(\mu + 1)\beta$
34. Air is pushed into a soap bubble of radius  $r$  to double its radius. If the surface tension of the soap solution is  $S$ , the work done in the process is
- (A)  $8\pi r^2 S$
  - (B)  $24\pi r^2 S$
  - (C)  $16\pi r^2 S$
  - (D)  $4\pi r^2 S$
35. How much water a pump of 2 kW can raise in one minute to a height of 10 m?  
(Take  $g = 9.8\text{m/s}^2$ )
- (A) 1000 litres
  - (B) 100 litres
  - (C) 1200 litres
  - (D) 2000 litres
36. The moment of inertia of a circular loop of radius  $R$  at a distance of  $\frac{R}{2}$  around a rotating axis parallel to horizontal diameter of loop is
- (A)  $MR^2$
  - (B)  $\frac{1}{2}MR^2$
  - (C)  $2MR^2$
  - (D)  $\frac{3}{4}MR^2$



37. Longitudinal waves **CANNOT**
- (A) have a unique wavelength
  - (B) have a unique wave velocity
  - (C) transmit energy
  - (D) be polarized
38. The charge of a parallel plate capacitor is varying as  $q = q_0 \sin 2\pi vt$ . The plates are very large and close together. Neglecting edge effects, the displacement current through the capacitor is
- (A)  $\frac{q}{A\epsilon_0}$
  - (B)  $\frac{q_0}{\epsilon_0} \sin 2\pi vt$
  - (C)  $2\pi v q_0 \cos 2\pi vt$
  - (D)  $\frac{2\pi v q_0}{\epsilon_0} \cos 2\pi vt$
39. Mechanism of light transmission in optical fibers are based on
- (A) total internal reflection
  - (B) scattering
  - (C) refraction
  - (D) absorption
40. A charge  $q$  is placed at the centre of the line joining two equal positive charges  $Q$ . The system of the three charges will be in equilibrium, if  $q$  is equal to
- (A)  $-\frac{Q}{2}$
  - (B)  $-\frac{Q}{4}$
  - (C)  $+\frac{Q}{2}$
  - (D)  $+\frac{Q}{4}$

41. A particle is moving in a circle of radius  $r$  under the action of a force  $F = \alpha r^2$  which is directed towards centre of the circle. Total mechanical energy (which is sum of kinetic energy and potential energy), of the particle is (Take potential energy is = 0 for  $r = 0$ )
- (A)  $\frac{1}{2}\alpha r^3$   
(B)  $\frac{5}{6}\alpha r^3$   
(C)  $\frac{4}{3}\alpha r^3$   
(D)  $\alpha r^3$
42. Two identical particles move towards each other with velocities  $2v$  and  $v$  respectively. The velocity of their centre of mass will be
- (A)  $v$   
(B)  $\frac{v}{3}$   
(C)  $\frac{v}{2}$   
(D)  $2v$
43. Choose the **INCORRECT** statement.
- (A) Newton proposed corpuscular theory of light  
(B) Huygens replaced Newton's theory by wave theory of light  
(C) Einstein put forward quantum theory of light  
(D) de Broglie gave the concept of dual nature of matter
44. In a carnival ride, a passenger travel in a merry-go-around at constant speed in a circle of radius 5 m and he took 4 sec to complete. The acceleration is
- (A)  $12 \text{ m/s}^2$   
(B)  $49 \text{ m/s}^2$   
(C)  $3 \text{ m/s}^2$   
(D)  $8 \text{ m/s}^2$

45. A dancer on a turn table if suddenly folds her hands, then the speed of the turntable
- decreases
  - remain unchanged
  - increases
  - None of the above
46. An isochoric process is one which takes place at
- constant internal energy
  - constant entropy
  - constant volume
  - constant pressure
47. Two simple harmonic motions in the  $x$ - $y$  plane are described by  $x = A \cos \omega t$  and  $y = A \cos(\omega t + \varphi)$ . The superposition of these two motions is a straight line. The value of  $\varphi$  would then be
- $\frac{\pi}{2}$
  - $\frac{3\pi}{2}$
  - $\pi$
  - $\frac{\pi}{4}$
48. The potential difference across  $8 \Omega$  resistance is  $48 \text{ V}$  as shown in the figure. The value of potential difference across  $X$  and  $Y$  points will be



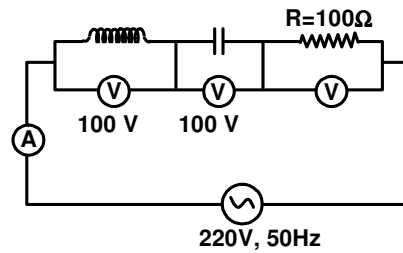
- 160 V
- 128 V
- 80 V
- 62 V

49. An electron and a proton enter a magnetic field perpendicularly. Both have same kinetic energy. Which of the following is **TRUE**?
- (A) Trajectory of electron is less curved
  - (B) Trajectory of proton is less curved
  - (C) Both trajectories are equally curved
  - (D) Both move on straight path
50. The refractive index of the water is 1.33. What will be the speed of light in water?
- (A)  $3 \times 10^8 \text{ ms}^{-1}$
  - (B)  $2.25 \times 10^8 \text{ ms}^{-1}$
  - (C)  $4 \times 10^8 \text{ ms}^{-1}$
  - (D)  $1.33 \times 10^8 \text{ ms}^{-1}$
51. When an electron jumps from the fourth orbit to the second orbit, one gets
- (A) second line of Paschen series
  - (B) second line of Lyman series
  - (C) second line of Balmer series
  - (D) first line of Pfund series
52. Zener diode is used as a
- (A) amplifier
  - (B) voltage regulator
  - (C) rectifier
  - (D) oscillator
53. A ball is dropped from a balloon going up with a uniform velocity of 5.0 m/s. If the balloon was 50 m high when the ball was dropped, find its height when the ball hits the ground.
- (A) 50.0 m
  - (B) 63.3 m
  - (C) 68.5 m
  - (D) 74.4 m

54. An elevator weighing 500 kg is to be lifted up at a constant velocity of 0.20 m/s. The minimum power of the motor that required is
- (A) 500 W
  - (B) 1000 W
  - (C) 1500 W
  - (D) 10000 W
55. The density of air near earth's surface is  $1.3 \text{ kg/m}^3$  and the atmospheric pressure is  $1 \times 10^5 \text{ N/m}^2$ . If the atmosphere had uniform density, same as that observed at the surface of the earth, what would be the height of the atmosphere to exert the same pressure?
- (A)  $10^5 \text{ m}$
  - (B) 8848 m
  - (C) 7692 m
  - (D) 4231 m
56. A sound wave of frequency 10 kHz is travelling in air with a speed of 340 m/s. Find the minimum separation between two points where the phase difference is  $60^\circ$ .
- (A) 340.00 cm
  - (B) 57.00 cm
  - (C) 3.40 cm
  - (D) 0.57 cm
57. The internal energy of a monoatomic ideal gas is  $1.5 \text{ nRT}$ . One mole of helium is kept in a cylinder of cross-section  $8.5 \text{ cm}^2$ . The cylinder is closed by a light frictionless piston. The gas is heated slowly in a process during which a total of 42 J heat is given to the gas. If the temperature rises through  $2^\circ\text{C}$ , find the distance moved by the piston. (Atmospheric pressure = 100 kPa)
- (A) 0.2 m
  - (B) 0.4 m
  - (C) 0.6 m
  - (D) 0.8 m

58. A battery of emf 2 V and internal resistance  $0.5 \Omega$  is connected across a resistance of  $9.5 \Omega$ . How many electrons cross through a cross-section of the resistance in 1 second?
- (A)  $1.25 \times 10^{18}$   
(B)  $3.25 \times 10^{18}$   
(C)  $1.25 \times 10^{15}$   
(D)  $3.25 \times 10^{15}$
59. The magnitude of a vector E is 5 unit, F has a magnitude of 6 unit and the cross product of E and F has a magnitude of 15 units. The angle between E and F is
- (A)  $0^\circ$   
(B)  $30^\circ$   
(C)  $60^\circ$   
(D)  $90^\circ$
60. A ball starts from rest and falls on ground vertically from a height of 20 m. The distance traveled by the ball during the last 0.3 s is
- (A) 2.35 m  
(B) 4.85 m  
(C) 5.65 m  
(D) 7.25 m
61. The angle of contact at the interface of water-glass is  $0^\circ$ , Ethylalcohol-glass is  $0^\circ$ , mercury-glass is  $140^\circ$  and Methyl iodide-glass is  $30^\circ$ . A glass capillary is put in a trough containing one of these four liquids. It is observed that the meniscus is convex upward. The liquid in the trough is
- (A) water  
(B) ethyl alcohol  
(C) mercury  
(D) methyl iodide

62. What will be the reading of the voltmeter across the resistance and ammeter in the circuit shown in the figure?



- (A) 300 V, 2A  
(B) 800 V, 2A  
(C) 100 V, 2A  
(D) 220 V, 2.2A
63. A current carrying loop is placed in a uniform magnetic field. The torque acting on it does not depend upon
- (A) area of the loop  
(B) value of the current  
(C) the magnetic field  
(D) shape of the loop
64. When current in a coil changes from 5 A to 2 A in 0.1 s, average voltage of 50 V is produced. The self-inductance of the coil is
- (A) 1.67 H  
(B) 6 H  
(C) 3 H  
(D) 0.67 H
65. What is the charge on sphere with diameter of 2.4 m and has a surface charge density of  $80 \mu\text{C}/\text{m}^2$ ?
- (A)  $1.45 \times 10^{-3} \text{ C}$   
(B)  $2.35 \times 10^{-3} \text{ C}$   
(C)  $1.35 \times 10^{-3} \text{ C}$   
(D)  $1.45 \times 10^{-5} \text{ C}$

66. The magnification of an image by a convex lens is positive only when the object is placed
- (A) at its focus F
  - (B) between F and 2F
  - (C) at 2F
  - (D) between F and optical centre
67. A sine wave is travelling in a medium. The minimum distance between the two particles always having same speed is
- (A)  $\frac{\lambda}{4}$
  - (B)  $\frac{\lambda}{3}$
  - (C)  $\frac{\lambda}{2}$
  - (D)  $\lambda$
68. When a copper ball is heated, the largest percentage increase will occur in its
- (A) diameter
  - (B) area
  - (C) volume
  - (D) density
69. At absolute temperature, an intrinsic semiconductor has
- (A) a few free electrons
  - (B) many holes
  - (C) many free electrons
  - (D) no holes or free electrons
70. If a solid sphere, disc and hollow cylinder are allowed to roll down an inclined plane without slipping from the same height,
- (A) the cylinder will reach the bottom first
  - (B) the disc will reach the bottom first
  - (C) the sphere will reach the bottom first
  - (D) all will reach the bottom at the same time



71. The phase difference between the displacement and acceleration of a particle executing simple harmonic motion is
- (A) Zero
  - (B)  $\frac{\pi}{2}$
  - (C)  $\pi$
  - (D)  $2\pi$
72. Work-Energy theorem is valid in the case of
- (A) external forces only
  - (B) internal forces only
  - (C) conservation forces only
  - (D) all types of forces
73. Optical fibers for communication use are mostly fabricated from
- (A) Plastic
  - (B) Silica or multicomponent glass
  - (C) Ceramics
  - (D) Copper
74. Which of the following is smallest unit?
- (A) Millimetre
  - (B) Angstrom
  - (C) Fermi
  - (D) Micrometre
75. In a metallic conductor, electric current is generally due to the movement of
- (A) Ions
  - (B) Phonons
  - (C) Electrons
  - (D) Protons

CHEMISTRY (UG) – **SHIFT IV**  
(FINAL)

76. The most suitable coagulating agent for ferric hydroxide sol is
- (A) potassium ferricyanide
  - (B) potassium chloride
  - (C) potassium oxalate
  - (D) potassium sulphate
77. The relation between  $K_p$  and  $K_c$  of a reversible reaction is
- (A)  $K_c = K_p(RT)^{\Delta n}$
  - (B)  $K_p = K_c(RT)^{\Delta n}$
  - (C)  $K_c = K_p$
  - (D)  $K_p = 1/K_c$
78. Find out the **WRONG** statement.
- (A) A non-volatile solute dissolved in water lowers vapor pressure
  - (B) A non-volatile solute dissolved in water raises boiling point
  - (C) A non-volatile solute dissolved in water raises density
  - (D) A non-volatile solute dissolved in water lowers osmotic pressure
79. The standard reduction potentials of three metallic ions X, Y, Z are 0.52 V, -3.03 V, -1.18 V respectively. The order of reducing power of the corresponding metals is
- (A)  $Y > Z > X$
  - (B)  $X > Y > Z$
  - (C)  $Z > Y > X$
  - (D)  $Z > X > Y$
80. For a monoatomic gas, the specific heat ratio is
- (A) 0
  - (B) 1.40
  - (C) 1.67
  - (D) 1.33

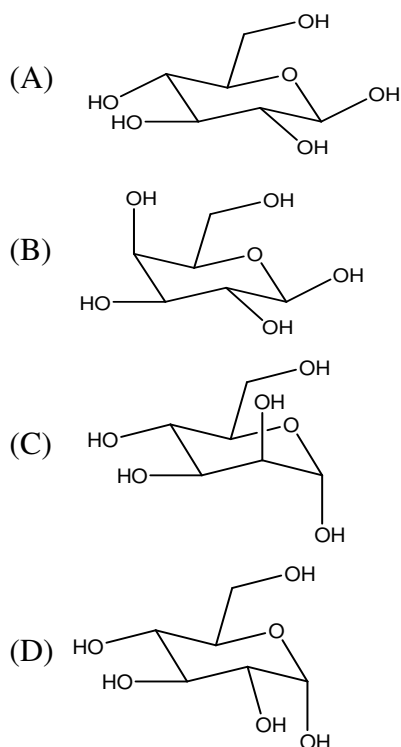
81. What is the solubility of AgCl in water if  $K_{sp} = 1.6 \times 10^{-10}$ ?
- (A)  $1.6 \times 10^{-5}$   
(B)  $3.2 \times 10^{-10}$   
(C)  $1.3 \times 10^{-5}$   
(D)  $1.6 \times 10^{-10}$
82. The half-life period of a first order reaction which takes 40 min for 30% decomposition is
- (A) 77.7 min  
(B) 52.5 min  
(C) 22.7 min  
(D) 46.2 min
83. How many coulombs of electricity is required to reduce 1 mole of  $\text{Cr}_2\text{O}_7^{2-}$  in acidic medium?
- (A) 4  
(B) 6  
(C) 2  
(D) 1
84. van't Hoff factor of 0.005M aqueous solution of KCl is 1.95. The degree of ionization is
- (A) 0.94  
(B) 0.96  
(C) 0.95  
(D) 0.59
85. What is the degree of dissociation of 0.1 M acetic acid? ( $K_a = 10^{-5}$ )
- (A)  $10^{-3}$   
(B)  $10^{-2}$   
(C)  $10^{-1}$   
(D) 1.0

86. In a zero-order reaction for every  $10^{\circ}\text{C}$  rise of temperature the rate is doubled. If the temperature is increased from  $10^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  the rate of the reaction will be
- (A) 256 times
  - (B) 512 times
  - (C) 64 times
  - (D) 128 times
87. For a second-order reaction, what is the unit of the rate of the reaction?
- (A)  $\text{s}^{-1}$
  - (B)  $\text{mol L}^{-1} \text{s}^{-1}$
  - (C)  $\text{mol}^{-1} \text{L s}^{-1}$
  - (D)  $\text{mol}^{-2} \text{L}^2 \text{s}^{-1}$
88. The role of a catalyst is to lower the
- (A) Gibbs energy of reaction
  - (B) enthalpy of reaction
  - (C) activation energy of reaction
  - (D) equilibrium constant
89. The equivalent conductance of  $\text{Ba}^{2+}$  and  $\text{Cl}^{-}$  are respectively 127 and 76  $\text{ohm}^{-1} \text{cm}^{-1} \text{eq}^{-1}$  at infinite dilution. The equivalent conductance of  $\text{BaCl}_2$  at infinite dilution will be
- (A) 139.5
  - (B) 203
  - (C) 279
  - (D) 101.5

90. Consider the cell reaction  $\text{Cd(s)} | \text{Cd}^{2+} (1.0 \text{ M}) || \text{Cu}^{2+} (1.0 \text{ M}) | \text{Cu(s)}$ . The voltage can be lowered by
- (A) increasing the concentration of  $\text{Cd}^{2+}$  and  $\text{Cu}^{2+}$
  - (B) increasing only the concentration of  $\text{Cd}^{2+}$  to 2.0 M
  - (C) increasing only the concentration of  $\text{Cu}^{2+}$  to 2.0 M
  - (D) increasing the concentration of  $\text{Cd}^{2+}$  2.0 M and decreasing the concentration of  $\text{Cu}^{2+}$  0.1 M
91. The value for Henry's constant for helium, hydrogen, nitrogen and oxygen at 293 K are 144.97 kbar, 69.16 kbar, 76.48 kbar and 34.86 kbar respectively. Which of the gas will be having maximum solubility?
- (A) Hydrogen
  - (B) Oxygen
  - (C) Helium
  - (D) Nitrogen
92. Calculate the osmotic pressure associated with 50.0 g of an enzyme of molecular weight 98,000 g/mol dissolved in water to give 2600 mL of solution at 30.0°C.
- (A) 3.71 torr
  - (B) 1.68 torr
  - (C) 1.96 torr
  - (D) 2.48 torr
93. An azeotropic solution of two liquids has boiling point lower than either when it
- (A) shows a negative deviation from Raoult's law
  - (B) shows no deviation from Raoult's law
  - (C) shows positive deviation from Raoult's law
  - (D) is saturated
94. The density of a metal which crystallises in bcc lattice with unit cell edge length 300 pm and molar mass  $50 \text{ g mol}^{-1}$  will be
- (A)  $10 \text{ g cm}^{-3}$
  - (B)  $14.2 \text{ g cm}^{-3}$
  - (C)  $6.15 \text{ g cm}^{-3}$
  - (D)  $9.32 \text{ g cm}^{-3}$

95.  $\text{Fe}_3\text{O}_4$  (magnetite) is an example of
- (A) normal spinel structure
  - (B) inverse spinel structure
  - (C) fluorite structure
  - (D) antiferrofluorite structure
96. Which among the following is an example for Diels-Alder reaction?
- (A) Reaction of benzene with acetyl chloride in the presence of anhydrous  $\text{AlCl}_3$  to give acetophenone
  - (B) Reaction between 1,3-butadiene and ethene to give cyclohexene
  - (C) Anhydrous  $\text{AlCl}_3$  catalyzed rearrangement of phenyl acetate to give a mixture of 2- and 4-hydroxyacetophenones
  - (D) Acid catalyzed rearrangement of 1,2-diols to give ketones
97. Pick the statement that is **TRUE** for E2 eliminations.
- (A) Follows unimolecular kinetics
  - (B) Follows bimolecular kinetics
  - (C) Involves free radical intermediates
  - (D) It is catalyzed by weak acids
98. Which among the following pigments is predominantly present in photosystem II of land plants?
- (A) Chlorophyll *a*
  - (B) Chlorophyll *b*
  - (C)  $\beta$ -carotene
  - (D) Xanthophyll
99. Which among following compounds, fails to undergo Cannizzaro reaction?
- (A) Benzaldehyde
  - (B) Trichloroacetaldehyde
  - (C) 2,2-dimethylpropanal
  - (D) Formaldehyde
100. Which among the following natural amino acids is achiral?
- (A) Threonine
  - (B) Tyrosine
  - (C) Alanine
  - (D) Glycine

101.  $\beta$ -D-Glucose is represented as:



102. Atropisomerism in stereoisomerism originating due to

- (A) restricted rotation around a single bond
- (B) four groups attached to carbon are different
- (C) helical nature of polymers
- (D) sheet like geometry of polymers

103. Choose the weakest base among the following

- (A) 4-chloroaniline
- (B) 4-methylaniline
- (C) 4-methoxyaniline
- (D) 4-nitroaniline

104. Mono nitration of which among the following compounds is expected to yield the corresponding meta nitro derivative as the major product?

- (A)  $C_6H_5-CH_3$
- (B)  $C_6H_5-CH_2Cl$
- (C)  $C_6H_5-CHCl_2$
- (D)  $C_6H_5-CCl_3$

105. Methyl isocyanate ( $\text{CH}_3\text{-N=C=O}$ ), the chemical responsible for Bhopal gas tragedy is an intermediate involved in

- (A) reaction between methylamine and carbon dioxide
- (B) reaction of acetamide ( $\text{CH}_3\text{CONH}_2$ ) with  $\text{Br}_2$  in presence of  $\text{NaOH}$
- (C) reaction between methylamine and formaldehyde
- (D) reaction of ammonium formate ( $\text{HCO}_2\text{NH}_4$ ) with methanol

106. Free radical intermediates are involved in

- (A) Hydroboration-oxidation of propene to give propan-1-ol
- (B) Hunsdiecker Reaction
- (C) Hell Volhard Zelinsky Reaction
- (D) Chlorination of benzene in the presence of  $\text{Cl}_2$  and a halogen carrier

107. Styrene-butadiene rubber finds application in

- (A) Styrofoam
- (B) Bubble gums
- (C) Flame retardant coatings
- (D) High-performance elastomer for space application

108. Which among the following is an example of Sandmeyer reaction?

- (A)  $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- \xrightarrow{\text{CuCl/HCl}} \text{C}_6\text{H}_5\text{Cl}$
- (B)  $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- \xrightarrow{\text{H}_2\text{O}/\Delta} \text{C}_6\text{H}_5\text{OH}$
- (C)  $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- \xrightarrow{\text{HBF}_4} \text{C}_6\text{H}_5\text{F}$
- (D)  $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- \xrightarrow{\text{KI/warm}} \text{C}_6\text{H}_5\text{I}$

109. 2-Hydroxybenzaldehyde can be prepared by treating Phenol with

- (A) Formaldehyde in the presence of anhydrous aluminium chloride
- (B) Carbon dioxide under pressure in sodium hydroxide solution
- (C) Chloroform and concentrated sodium hydroxide
- (D) Carbon monoxide and 5N HCl



110. The reaction between sodium alkoxide and alkyl halide to give the corresponding ether is called
- (A) Wurtz reaction
  - (B) Kolbe's reaction
  - (C) Williamson's synthesis
  - (D) Zeisel reaction
111. Benzene diazonium chloride on treatment with phenol in the presence of NaOH gives
- (A) diphenyl ether
  - (B) 4-hydroxybiphenyl
  - (C) an azo dye
  - (D) polyaniline, a conducting polymer
112. Among vitamins A, C, and E, which is/are considered as dietary antioxidant/s?
- (A) Vitamin C only
  - (B) Vitamins A and C only
  - (C) Vitamins C and E only
  - (D) Vitamins A, C and E
113. The chemical reaction between aldehydes and Borche's reagent (2,4-dinitrophenylhydrazine) to give an orange coloured precipitate is an example of
- (A) Condensation reaction
  - (B) Addition reaction
  - (C) Substitution reaction
  - (D) Polymerization reaction
114. **Formation of phenol-formaldehyde resin involves the reaction between**
- (A) three equivalents of formaldehyde with one equivalent of phenol
  - (B) one equivalent of formaldehyde with three equivalents of phenol
  - (C) one equivalent of formaldehyde with one equivalent of phenol
  - (D) six equivalents of formaldehyde with one equivalent of phenol
115. Which among the following food additives is effective in controlling rancidity of unsaturated edible oils?
- (A) Butylated hydroxytoluene (BHT)
  - (B) Monosodium glutamate (MSG)
  - (C) Sodium nitrate
  - (D) Caramel

116. If the magnetic moment of a dioxygen species is 1.73 B.M, it may be
- (A)  $O_2^-$  or  $O_2^+$
  - (B)  $O_2$  or  $O_2^+$
  - (C)  $O_2$  or  $O_2^-$
  - (D)  $O_2$ ,  $O_2^-$  or  $O_2^+$
117. Which of the following has highest solubility in water?
- (A) KF
  - (B) LiF
  - (C) NaF
  - (D) RbF
118. The decreasing order of catenation is
- (A)  $C > Sn > Si > Ge$
  - (B)  $C > Si > Ge > Sn$
  - (C)  $Si > Sn > C > Ge$
  - (D)  $Ge > Sn > Si > C$
119. The electrolytes usually used in the electroplating of gold and silver, respectively are
- (A)  $[Au(CN)_2]^-$  and  $[Ag(CN)_2]^-$
  - (B)  $[Au(CN)_2]^-$  and  $[Ag(Cl)_2]^-$
  - (C)  $[Au(OH)_4]^-$  and  $[Ag(OH)_2]^-$
  - (D)  $[Au(NH_3)_2]^-$  and  $[Ag(CN)_2]^-$
120. Trigonal bipyramidal geometry is shown by
- (A)  $XeO_2F_2$
  - (B)  $XeO_3F_2$
  - (C)  $FXeOSO_2F$
  - (D)  $[XeF_8]^{2-}$

121. Which of the following ions has the maximum magnetic moment?
- (A)  $\text{Mn}^{2+}$
  - (B)  $\text{Fe}^{2+}$
  - (C)  $\text{Ti}^{2+}$
  - (D)  $\text{Cr}^{2+}$
122. The elements  $x$ ,  $y$  and  $z$  are present in one period of the periodic table. Chemically their oxides are acidic, amphoteric and basic respectively. Arrange the elements in order of increasing atomic number.
- (A)  $x, y, z$
  - (B)  $z, y, x$
  - (C)  $y, z, x$
  - (D)  $y, x, z$
123. Which of the following has the least bond angles?
- (A)  $\text{NH}_3$
  - (B)  $\text{PH}_3$
  - (C)  $\text{AsH}_3$
  - (D)  $\text{SbH}_3$
124. The **WRONG** statement among the following is
- (A) Nitrogen atom and nitride ion have same atomic number
  - (B) Aluminium atom and its ion have same mass number
  - (C) Iron atom and ferrous ion have same electron configuration
  - (D) Nuclear charge is same in both chlorine atom, chloride ion
125. A double bond resulting in  $\text{O}_2$  molecule is from
- (A) two  $\sigma$  bonding electrons
  - (B) four  $\pi$ -bonding electrons
  - (C) two  $\pi$ -bonding and two  $\pi$ -anti bonding electrons
  - (D) two  $\sigma$  bonding, four  $\pi$ -bonding and two  $\pi$ -anti bonding electrons

126. According to VSEPR theory
- (A) bp-bp > lp-bp > lp-lp
  - (B) bp-lp > bp-bp > lp-lp
  - (C) lp-lp > lp-bp > bp-bp
  - (D) lp-lp < lp-bp < bp-bp
- where bp is bond pair and lp is lone pair.
127. Which of the following is most stable in aqueous solution?
- (A)  $\text{Mn}^{2+}$
  - (B)  $\text{Cr}^{3+}$
  - (C)  $\text{V}^{3+}$
  - (D)  $\text{Ti}^{3+}$
128. The complex that absorbs light of shortest wavelength is
- (A)  $[\text{CoF}_6]^{3-}$
  - (B)  $[\text{Co}(\text{H}_2\text{O})_6]^{+3}$
  - (C)  $[\text{Co}(\text{NH}_3)_6]^{+3}$
  - (D)  $[\text{Co}(\text{ox})_3]^{3-}$
- (ox = oxalate ion)
129. The characteristics of the blue solution of sodium in liquid ammonia is /are
- (a) diamagnetic
  - (b) paramagnetic
  - (c) reducing in nature
  - (d) conducts electricity
- (A) (a) only
  - (B) (b), (c) and (d) only
  - (C) (b) and (c) only
  - (D) (a), (c) and (d) only
130. In the manufacture of sulphuric acid by contact process Tyndall box is used to
- (A) convert  $\text{SO}_2$  and  $\text{SO}_3$
  - (B) test the presence of dust particles
  - (C) filter dust particles
  - (D) remove impurities

131. Electronic configuration of a transition element X in +3 oxidation state is  $[\text{Ar}]3d^5$ .  
What is its atomic number?
- (A) 25  
(B) 26  
(C) 27  
(D) 24
132. What is the weight of CuO, that will react with 2.6 L of hydrogen at NTP (molar mass of CuO is 79.5 g)?
- (A) 79.5 g  
(B) 2.2 g  
(C) 9.23 g  
(D) 11.2 g
133. The third line of Balmer series in the emission spectrum of hydrogen atom is due to the transition from
- (A) fifth Bohr orbit to the second Bohr orbit  
(B) fourth Bohr orbit to the first Bohr orbit  
(C) sixth Bohr orbit to the third Bohr orbit  
(D) eight Bohr orbit to the fourth Bohr orbit
134. How many orbitals have the values  $n = 4$ ,  $l = 2$  and  $m_l = -2$ ?
- (A) 1 orbital  
(B) 2 orbitals  
(C) 3 orbitals  
(D) 4 orbitals
135. For a complex, the order of energy of d orbitals,  $d_{z^2} = d_{x^2-y^2} > d_{xy} = d_{xz} = d_{yz}$ . The complex has
- (A) octahedral structure  
(B) square planar structure  
(C) tetrahedral structure  
(D) square pyramidal structure

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136. If  $A$  is a matrix of order 3, then  $\det(kA)$  is

- (A)  $k^3 \det(A)$
- (B)  $3 \det(A)$
- (C)  $\det(A)$
- (D)  $3k \det(A)$

137. If the rank of the matrix  $\begin{pmatrix} \lambda & -1 & 0 \\ 0 & \lambda & -1 \\ -1 & 0 & \lambda \end{pmatrix}$  is 2, then  $\lambda$  is

- (A) 2
- (B) 3
- (C) 1
- (D) any real number

138. The value of  $\lim_{n \rightarrow \infty} \left[ \frac{1}{1-n^4} + \frac{8}{1-n^4} + \dots + \frac{n^3}{1-n^4} \right]$  is

- (A)  $\frac{1}{4}$
- (B)  $\frac{1}{8}$
- (C)  $\frac{1}{2}$
- (D)  $\frac{-1}{4}$

139. If  $A$  is a square matrix of order  $n$ , then  $|\text{adj } A|$  is

- (A)  $|A|^2$
- (B)  $|A|^n$
- (C)  $|A|^{n-1}$
- (D)  $|A|$

140. If  $\binom{n}{4}$ ,  $\binom{n}{5}$  and  $\binom{n}{6}$  are in Arithmetic progression, then the value of  $n$  can be

- (A) 6
- (B) 7
- (C) 8
- (D) 9

141. Given  $f(x) = \begin{cases} x^2; & 0 < x < 2 \\ x+2; & 2 \leq x \leq 5 \end{cases}$  and  $f(x+5) = f(x)$  for all  $x$ . Then  $\frac{f(11) - f(-11)}{f(11) + f(-11)} =$

- (A)  $\frac{-5}{7}$
- (B)  $\frac{-7}{5}$
- (C)  $\frac{7}{5}$
- (D)  $\frac{15}{7}$

142. Sum of the series  $S = 1^2 - 2^2 + 3^2 - 4^2 = \dots - 2008^2 + 2009^2$  is

- (A) 2019045
- (B) 1005004
- (C) 2000506
- (D) 2026042

143. If  $\log_4 [\log_3 [\log_2 x]] = 1$ , then  $x$  is

- (A)  $2^{64}$
- (B) 9
- (C) 24
- (D)  $2^{81}$

144. Let ' $f$ ' and ' $g$ ' be two bijective functions defined on a set  $A$  and such that  $f(x) = 2x + 1$  and  $(g \circ f)(x) = 3x + 2$ . Then  $g(x)$  is
- (A)  $\frac{3}{2}x - \frac{5}{2}$   
(B)  $\frac{3}{2}x + \frac{1}{2}$   
(C)  $2x - \frac{3}{2}$   
(D)  $5x + 3$
145. If in a triangle  $ABC$ ,  $\tan A + \tan B + \tan C = 3\sqrt{3}$ , then the triangle is
- (A) right-angled but not isosceles  
(B) right-angled and isosceles  
(C) equilateral  
(D) isosceles but not right-angled
146. If  $|\vec{a}| = 2$ ,  $|\vec{b}| = 5$  and  $|\vec{a} \times \vec{b}| = 8$  then  $|\vec{a} \cdot \vec{b}|$  is equal to
- (A) 4  
(B) 6  
(C) 5  
(D) 8
147. The difference of a whole number consisting of two digits from the number formed by inter changing the digits is always divisible by
- (A) 11  
(B) 10  
(C) 9  
(D) 6
148. Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be any function. Define  $g : \mathbb{R} \rightarrow \mathbb{R}$  by  $g(x) = |f(x)|$  for all  $x$ . Then which of following is true?
- (A)  $g$  is 1-1 if  $f$  is 1-1  
(B)  $g$  may be bounded even if  $f$  is unbounded  
(C)  $g$  is continuous if  $f$  is continuous  
(D)  $g$  is differentiable if  $f$  is differentiable



149. If  $e^{x+y} = x^y$ , then  $\frac{dy}{dx}$  is

(A)  $\frac{\log x}{(\log x - 1)^2}$

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

(C)  $\frac{\log x - 2}{(\log x - 1)^2}$

(D) 1

150. The value of  $\lim_{x \rightarrow 0} \frac{e^{x^2} - \cos x}{x^2}$  is equal to

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

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

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

(D) 2

151.  $\lim_{x \rightarrow \frac{\pi}{2}} (\cos x)^{\cos x}$  is

(A) 1

(B) 0

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

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

152. Let  $a_1, a_2, \dots, a_{10}$  be in Arithmetic Progression and  $h_1, h_2, \dots, h_{10}$  be in harmonic Progression. If  $a_1 = h_1 = 2$  and  $a_{10} = h_{10} = 3$  then  $a_4 h_7$  is

(A) 2

(B) 3

(C) 5

(D) 6

153. Let  $g(x)$  be a function satisfying  $g'(x) = g(x)$  with  $g(0) = 1$  and  $f(x)$  be a function that satisfies  $f(x) + g(x) = x^2$ . Then the value of the integral  $\int_0^1 f(x) g(x) dx$  is

(A)  $\frac{e-7}{4}$

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

(C)  $e - \frac{e^2+3}{2}$

(D)  $e + \frac{e^2+3}{2}$

154. The locus of the point of intersection of the lines  $x \sin \theta + (1 - \cos \theta)y = a \sin \theta$  and  $x \sin \theta - (1 + \cos \theta)y + a \sin \theta = 0$  is

(A)  $x^2 - y^2 = a^2$

(B)  $x^2 + y^2 = a^2$

(C)  $y^2 = ax$

(D)  $y^2 - x^2 = a^3$

155. If  $I_1 = \int_e^{e^2} \frac{1}{\log x} dx$  and  $I_2 = \int_1^2 \frac{e^x}{x} dx$ , then

(A)  $I_1 = 2I_2$

(B)  $2I_1 = I_2$

(C)  $I_1 + I_2 = 0$

(D)  $I_1 - I_2 = 0$

156. The equation of a common tangent to the curves  $y^2 = 8x$  and  $xy = -1$  is

(A)  $3y = 9x + 2$

(B)  $y = 2x + 1$

(C)  $2y = x + 8$

(D)  $y = x + 2$

157. If  $f(x) = A \cdot 2^x + B$  and such that  $f'(x) = 2$  and  $\int_0^3 f(x) dx = 7$ , then  $B$  is

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

(B)  $\frac{7}{3} \left[1 - (\log_2 e)^2\right]$

(C)  $\frac{7}{3} \left[1 + (\log_2 e)^2\right]$

(D)  $\frac{7}{3} \left[1 - (\log_2 e)\right]$

158. Let  $A^T$  be the transpose of  $A$ . If  $A = \begin{pmatrix} x & 3 & 2 \\ -3 & y & -7 \\ -2 & 7 & 0 \end{pmatrix}$  and  $A = -A^T$  then  $x + y$  is equal to

(A) 2

(B) -1

(C) 0

(D) 12

159. If  $\frac{dy}{dx} = x + \int_0^1 y(x) dx$ ,  $y(0) = 1$ , then  $\int_0^1 xy(x) dx$  is

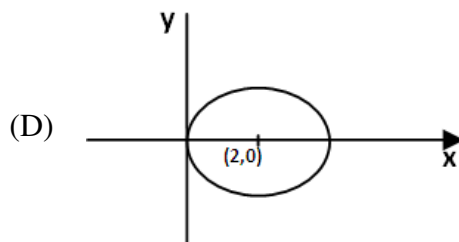
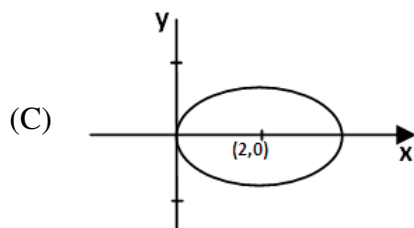
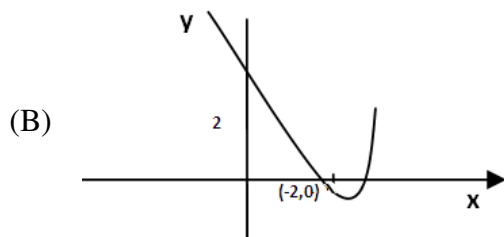
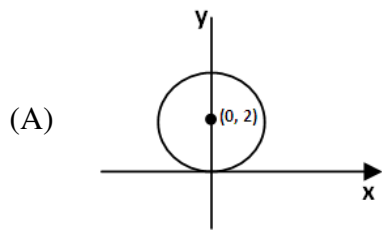
(A)  $\frac{13}{36}$

(B)  $\frac{19}{48}$

(C)  $\frac{7}{36}$

(D)  $\frac{101}{72}$

160. The graph of  $f(x) = \sqrt{4 - (x-2)^2}$  is



161. If  $\int_0^{\infty} \frac{dx}{(x^2+4)(x^2+9)} = k\pi$  then the value of  $k$  is

(A)  $\frac{1}{60}$

(B)  $\frac{1}{80}$

(C)  $\frac{1}{40}$

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

162. The value of the  $k$  which makes  $f(x) = \begin{cases} \frac{\sin 5x}{x}, & x \neq 0 \\ k, & x = 0 \end{cases}$  continuous at  $x=0$  is
- (A) 1  
(B) 2  
(C) 5  
(D) 6
163. The number of words that can be formed by using the letters of the word MATHEMATICS that start as well as end with T is
- (A) 80720  
(B) 90720  
(C) 20860  
(D) 37258
164. Two finite sets have  $m$  and  $n$  elements respectively. The total number of subsets of first set is 56 more than the total number of subsets of the second set. The values of  $m$  and  $n$  respectively are
- (A) 7, 6  
(B) 6, 3  
(C) 5, 1  
(D) 8, 7
165. If the acute angle between the lines  $x + ky + 3 = 0$  and  $2x + y - 7 = 0$  is  $\tan^{-1}\left(\frac{3}{4}\right)$ , then '  $k$  ' is
- (A) 1  
(B) 2  
(C) 3  
(D) 4
166. Let  $f(x) = \frac{\log(1+x^2)}{x^4 - 26x^2 + 25}$ . Then
- (A)  $f$  is continuous on  $[6, 10]$   
(B)  $f$  is continuous on  $[-2, 2]$   
(C)  $f$  is continuous on  $[-6, 6]$   
(D)  $f$  is continuous on  $[1, 7]$

167. The complex number  $z = x + iy$  which satisfy the equation  $\left| \frac{z-5i}{z+5i} \right| = 1$  lie on
- (A) the  $x$ -axis
  - (B) the straight line  $y = 5$
  - (C) a circle passing through the origin
  - (D) the line  $x = y$
168. If the points  $(2a, a)$ ,  $(a, 2a)$  and  $(a, a)$  enclose a triangle of area 72, then the coordinates of the centroid of the triangle is
- (A) (16, 16)
  - (B) (4, 4)
  - (C) (12, 12)
  - (D) (-4, -4)
169. The value of  $k$  for which the points  $A = (1, 0, 3)$ ,  $B = (-1, 3, 4)$ ,  $C = (1, 2, 1)$  and  $D = (k, 2, 5)$  are coplanar is
- (A) 1
  - (B) 2
  - (C) 0
  - (D) -1
170. If the line  $y = 3x + \lambda$  touches the hyperbola  $9x^2 - 5y^2 = 45$ , then the value of  $\lambda^2$  is
- (A) 45
  - (B) 36
  - (C) 6
  - (D) 15
171. The number of real solutions of  $\frac{1}{x+1} + \frac{1}{x+5} = \frac{1}{x+2} + \frac{1}{x+4}$  is
- (A) 0
  - (B) 1
  - (C) 2
  - (D) 3

172. If the points  $P(h, k)$  and  $Q(k, h)$  lie on  $3x + 2y - 13 = 0$  and  $4x - y - 5 = 0$  respectively, then the equation of  $PQ$  is
- (A)  $x - y = 6$
  - (B)  $x + y = 5$
  - (C)  $x - y + 5 = 0$
  - (D)  $2x + 2y = 5$
173. A fair coin is tossed 100 times. The probability of getting tails an odd number of times is
- (A)  $\frac{1}{2}$
  - (B)  $\frac{1}{8}$
  - (C)  $\frac{3}{8}$
  - (D) None of the above
174. The equation of the directrix of the parabola  $4y^2 + 12x - 12y + 39 = 0$  is
- (A)  $x = -\frac{7}{4}$
  - (B)  $y = \frac{3}{4}$
  - (C)  $x - y = 0$
  - (D)  $2x - 3y = 0$
175. Consider an infinite geometric series with the first term  $a$  and the common ratio  $r < 1$ . If its sum is 4 and the second term is  $\frac{3}{4}$ , then
- (A)  $a = \frac{4}{7}, r = \frac{3}{7}$
  - (B)  $a = 2, r = \frac{3}{8}$
  - (C)  $a = \frac{3}{2}, r = \frac{1}{2}$
  - (D)  $a = 3, r = \frac{1}{4}$

176. The projection of  $\vec{a}$  on  $\vec{b}$  is twice the projection of  $\vec{b}$  on  $\vec{a}$  if

(A)  $\vec{a} = \vec{b}$

(B)  $|\vec{a}| = |\vec{b}|$

(C)  $|\vec{a}| - |\vec{b}| = |\vec{b}|$

(D)  $|\vec{a}| - |\vec{b}| = |\vec{a}|$

177. A line which is parallel to the  $x$ -axis and crosses the curve  $y = \sqrt{x}$  at an angle of  $45^\circ$  is

(A)  $x = \frac{1}{4}$

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

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

(D)  $y = 1$

178. A function, which is differentiable everywhere, is

(A)  $f(x) = |x|$

(B)  $f(x) = \frac{1}{x}$

(C)  $f(x) = (x+3)^4$

(D)  $f(x) = \ln x$

179. The equation of the horizontal tangent to the graph of the function  $y = e^x + e^{-x}$  is

(A)  $y = -2$

(B)  $y = -1$

(C)  $y = 2$

(D)  $y = 1$



180. The differential equation of all circles passing through the origin and having their centres on the  $x$ -axis is

(A)  $x^2 = y^2 + xy \frac{dy}{dx}$

(B)  $x^2 = y^2 + 3xy \frac{dy}{dx}$

(C)  $y^2 = x^2 + 2xy \frac{dy}{dx}$

(D)  $y^2 = x^2 - 2xy \frac{dy}{dx}$

181. If a line OP through the origin O makes angles  $\alpha, 45^\circ$  and  $60^\circ$  with  $x, y$  and  $z$  axis respectively, then the direction cosines of OP are

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

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

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

(D) 1,1,1

182. The orthocentre of the triangle formed by the lines  $xy = 0$  and  $2x + 3y - 5 = 0$  is

(A) (2, 3)

(B) (3, 2)

(C) (0, 0)

(D) (5, -5)

183. Let  $\vec{a} = (\vec{i} + \vec{j} + \vec{k})$ ;  $\vec{b} = (\vec{i} - \vec{j} + 2\vec{k})$  and  $\vec{c} = (x\vec{i} + (x-2)\vec{j} - \vec{k})$ . If the vector  $\vec{c}$  lies in the plane of  $\vec{a}$  and  $\vec{b}$ , then  $x$  equals to

(A) 0

(B) 1

(C) -4

(D) -2

184. The number of times the function  $y = (x^2 + 1)^{80}$  is to be differentiated in order to get a polynomial of degree 50 is
- (A) 70  
(B) 80  
(C) 110  
(D) 30
185. If the centroid of the triangle with vertices  $(3c + 2, 2, 0)$ ,  $(2c, -1, -1)$  and  $(c + 2, 3c + 1, c + 3)$  lies in the plane  $z = c$ , then the coordinates of the centroid are
- (A)  $\left(-\frac{2}{3}, -\frac{1}{3}, \frac{1}{3}\right)$   
(B)  $\left(\frac{10}{3}, \frac{5}{3}, 1\right)$   
(C)  $\left(\frac{4}{3}, \frac{2}{3}, \frac{2}{3}\right)$   
(D)  $\left(\frac{2}{3}, \frac{1}{3}, -\frac{1}{3}\right)$
186. Three numbers are chosen at random without replacement from  $\{1, 2, \dots, 10\}$ . The probability that minimum of the chosen number is 3 or their maximum is 7 is
- (A)  $\frac{11}{30}$   
(B)  $\frac{11}{40}$   
(C)  $\frac{1}{7}$   
(D)  $\frac{1}{8}$
187. The length of the perpendicular drawn from the point  $(3, -1, 11)$  to the line  $\frac{x}{2} = \frac{y-2}{3} = \frac{z-3}{4}$  is
- (A)  $\sqrt{29}$   
(B)  $\sqrt{33}$   
(C)  $\sqrt{53}$   
(D)  $\sqrt{66}$

188. If  $f(x+y) = f(xy)$  for all  $x, y \in \mathbb{R}$  and  $f(2003) = 2003$ , then  $f(-2003)$  equals

- (A) 2003
- (B) 0
- (C) -2003
- (D) 4006

189. The three numbers are chosen from 1 to 30. Then the probability that they are not consecutive is

- (A)  $\frac{142}{145}$
- (B)  $\frac{144}{145}$
- (C)  $\frac{143}{145}$
- (D)  $\frac{1}{145}$

190. Let  $f(x) = \lim_{n \rightarrow \infty} \frac{x}{1 + (2 \sin x)^{2n}}$ . Then  $f$  is discontinuous at

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

191. The probability of drawing a diamond card in each of the two consecutive draws from a well shuffled pack of cards, if the card drawn is not replaced after the first draw, is

- (A)  $\frac{4}{17}$
- (B)  $\frac{13}{17}$
- (C)  $\frac{1}{17}$
- (D) 0

192. If  $x = -2$  and  $\Delta = \begin{vmatrix} x+y & x & x \\ 5x+4y & 4x & 2x \\ 10x+8y & 8x & 3x \end{vmatrix}$ , then the numerical value of  $\Delta$  is equal to
- (A) 8  
(B) -8  
(C) 4  
(D) -4
193. If  $A$  and  $B$  are independent events of a random experiment such that  $P(B) = \frac{2}{7}$  and  $P(A \cup \bar{B}) = 0.8$ , then  $P(A)$  is equal to
- (A) 0.1  
(B) 0.2  
(C) 0.4  
(D) 0.3
194. The interior angles of a polygon are in Arithmetic Progression. If the smallest angle is  $100^\circ$  and the common difference is  $4^\circ$ , then the number of sides is
- (A) 5  
(B) 7  
(C) 36  
(D) 44
195. A problem in Mathematics is given to three students A, B, C and their respective probability of solving the problem are  $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ . Then the probability that the problem is solved is
- (A)  $\frac{3}{4}$   
(B)  $\frac{2}{3}$   
(C)  $\frac{1}{2}$   
(D)  $\frac{1}{4}$

196. The locus of the centre of a circle which touches the circle  $|z - z_1| = a$  externally is

- (A) an ellipse
- (B) a hyperbola
- (C) a circle
- (D) a pair of straight lines

197. Let  $f(x)$  be a function satisfying  $f'(x) = f(x)$  and  $f(0) = 2$ . Then  $\int \frac{f(x)}{3+4f(x)} dx$  is equal to

- (A)  $\frac{1}{4} \log(3+8e^x) + C$
- (B)  $\frac{1}{2} \log(3+5e^x) + C$
- (C)  $\frac{1}{4} \log(3+4e^{2x}) + C$
- (D)  $C + \frac{1}{2x^3} \log(xe)$

198. Equation of the directrix of the parabola  $y^2 + 4y + 4x + 2 = 0$  is

- (A)  $x = -1$
- (B)  $x = 1$
- (C)  $x = \frac{-3}{2}$
- (D)  $x = \frac{3}{2}$

199. If  $\int_e^x t f(t) dt = \sin x - x \cos x - \frac{x^2}{2}$  for all  $x \in \mathbb{R} - \{0\}$ , then the value of  $f\left(\frac{\pi}{6}\right)$  is

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

200. If  $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots = \frac{\pi}{4}$  then the value of  $\frac{1}{1.3} + \frac{1}{5.7} + \frac{1}{9.11} + \dots$  is

- (A)  $\frac{\pi}{8}$
- (B)  $\frac{\pi}{6}$
- (C)  $\frac{\pi}{4}$
- (D)  $\frac{\pi}{34}$

201. The sum  $\lim_{n \rightarrow \infty} S_n$  if  $S_n = \frac{1}{2n} + \frac{1}{\sqrt{4n^2 - 1}} + \frac{1}{\sqrt{4n^2 - 4}} + \dots + \frac{1}{\sqrt{3n^2 + 2n - 1}}$  is

- (A)  $\frac{\pi}{2}$
- (B) 2
- (C) 1
- (D)  $\frac{\pi}{6}$

202. If  $a + ib = \sum_{k=1}^{101} i^k$ , then  $(a, b) =$

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

203. The value of  $1 - \frac{\sin^2 A}{1 + \cos A} + \frac{1 + \cos A}{\sin A} - \frac{\sin A}{1 - \cos A}$ , is

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

204. If  $\left(\frac{1+i}{1-i}\right)^n = -1$ ,  $n \in N$ , then the least value of  $n$  is

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

205. The value of  $\lim_{x \rightarrow 0} \frac{x \tan 2x - 2x \tan x}{(1 - \cos 2x)^2}$  is

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

206. If  $|z-1| = |z-2i| = |z+1|$ , then the value of  $|z|$  is

- (A) 1
- (B) 2
- (C)  $\frac{5}{4}$
- (D)  $\frac{3}{4}$

207. Let  $\alpha, \beta$  be roots of the equation  $x^2 - px + r = 0$  and  $\frac{\alpha}{2}, 2\beta$  be the roots of the equation  $x^2 - qx + r = 0$ . Then the value of  $r$  is

- (A)  $\frac{2}{9}(p-q)(2q-p)$
- (B)  $\frac{2}{9}(q-p)(2p-q)$
- (C)  $\frac{2}{9}(q-2p)(2q-p)$
- (D)  $\frac{2}{9}(2p-q)(2q-p)$

208. The complex numbers  $z = x + iy$  which satisfy the equation  $\left| \frac{z-5i}{z+5i} \right| = 1$ , lie on

- (A) the  $x$ -axis
- (B) the straight line  $y = 5$
- (C) a circle passing through origin
- (D)  $\operatorname{Re}(z) > 3$

209. A solution of the equation  $x \frac{dy}{dx} = y(\log y - \log x + 1)$  is

- (A)  $y = xe^{cx}$
- (B)  $\frac{y^2}{x} = cx$
- (C)  $y^2 = cx \log x$
- (D)  $\log y = cx$

210. A value of  $\theta$  for which  $z = \frac{2+3i \sin \theta}{1-2i \sin \theta}$  is purely imaginary, is

- (A)  $\frac{\pi}{3}$
- (B)  $\frac{\pi}{6}$
- (C)  $\sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$
- (D)  $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

211. The number of complex numbers  $z$  such that  $|z| < \frac{1}{3}$  and  $\sum_{r=1}^n a_r z^r = 1$

where  $|a_r| < 2$  is

- (A) 0
- (B) 1
- (C) 4
- (D) infinite



212. If  $4^x - 3^{x-\frac{1}{2}} = 3^{x+\frac{1}{2}} - 2^{2x-1}$ , then value of  $x$  is

- (A)  $\frac{5}{2}$
- (B) 2
- (C)  $\frac{3}{2}$
- (D)  $4\sqrt{7}$

213. If  $A = \{4^n - 3n - 1 : n \in \mathbb{N}\}$  and  $B = \{9n - 9, n \in \mathbb{N}\}$  then  $A \cup B$  is equal to

- (A)  $B$
- (B)  $A$
- (C)  $\mathbb{N}$
- (D)  $A \cap B$

214. The least value of  $\operatorname{cosec}^2 x + 25 \sec^2 x$  is

- (A) 26
- (B) 28
- (C) 36
- (D) 0

215. Let  $S$ : If a number  $n$  is even, then  $n^2$  is even.

Then the converse of  $S$  is

- (A) if a number  $n^2$  is even, then  $n$  is even
- (B) neither  $n$  nor  $n^2$  is even
- (C) if  $n$  is not even, then  $n^2$  is not even
- (D) if a number  $n^2$  is not even, then  $n$  is even

216. The number of integral solutions of  $x^2 + y^2 = x^2 y^2$  is

- (A) 0
- (B) 1
- (C) infinite
- (D) None of the above

217. Let  $f$  be defined on  $[-5, 5]$  as  $f(x) = \begin{cases} x & \text{if } (x) \text{ is rational} \\ -x & \text{if } (x) \text{ is irrational} \end{cases}$ . Then

- (A)  $f(x)$  is continuous at every  $x$ , except  $x = 0$
- (B)  $f(x)$  is discontinuous at every  $x$ , except  $x = 0$
- (C)  $f(x)$  is continuous everywhere
- (D)  $f(x)$  is discontinuous everywhere

218. The order of  $-3$  in the group  $(\mathbb{Z}, +)$  is

- (A) 3
- (B) 0
- (C) 1
- (D)  $\infty$

219. If  $y = a \log x + bx^2 + x$  has its extreme values at  $x=1$  and  $x=2$ , then the values of 'a' and 'b' are

- (A)  $a = -\frac{2}{3}, b = -\frac{1}{6}$
- (B)  $a = -\frac{1}{6}, b = \frac{4}{3}$
- (C)  $a = -\frac{4}{3}, b = \frac{1}{6}$
- (D)  $a = \frac{4}{3}, b = -\frac{1}{6}$

220. If  $a, b, c$  are in Arithmetic Progression,  $p, q, r$  are in Harmonic Progression and  $ap, bq, cr$  are in Geometric Progression, then  $\frac{p}{r} + \frac{r}{p}$  is equal to

- (A)  $\frac{a}{c} + \frac{c}{a}$
- (B)  $\frac{a}{c} - \frac{c}{a}$
- (C)  $\frac{b}{q} + \frac{q}{b}$
- (D)  $\frac{b}{q} - \frac{a}{p}$

221. The differential equation of the family of circles with fixed radius 5 units and center on the line  $y = 2$  is

- (A)  $(x-2)(y')^2 = 25 - (y-2)^2$
- (B)  $(y-2)(y')^2 = 25 - (y-2)^2$
- (C)  $(y-2)^2(y')^2 = 25 - (y-2)^2$
- (D)  $(x-2)^2(y')^2 = 25 - (y-2)^2$

222. The angles of elevation of the top of a tower from the top and bottom of a building 100 meters tall are  $30^\circ$  and  $45^\circ$ . The height of the tower is

- (A)  $100\sqrt{3}$  meters
- (B)  $50(3 + \sqrt{3})$  meters
- (C)  $50(\sqrt{3} + 1)$  meters
- (D)  $100(\sqrt{3} + 1)$  meters

223. If  $|z| = 3$ , the area of the triangle whose sides are  $z, \omega z$  and  $z + \omega z$  (here  $\omega$  is a complex cube root of unity) is

- (A)  $\frac{9\sqrt{3}}{4}$
- (B)  $\frac{3\sqrt{3}}{2}$
- (C)  $\frac{5}{2}$
- (D)  $\frac{8\sqrt{3}}{3}$

224. Let  $X = \{x : x = n^3 + 2n + 1, n \in \mathbb{R}\}$  and  $Y = \{x : x = 3n^2 + 7, n \in \mathbb{R}\}$ . Then  $X \cap Y$  is a subset of

- (A)  $X = \{x : x = 3n + 5, n \in \mathbb{N}\}$
- (B)  $X = \{x : x = n^2 + n + 1, n \in \mathbb{N}\}$
- (C)  $X = \{x : x = 7n - 1, n \in \mathbb{N}\}$
- (D) None of the above

225. If  $z_1, z_2, z_3$  are the vertices of an isosceles triangle, right angled at the vertex  $z_2$ , then value of  $(z_1 - z_2)^2 + (z_2 - z_3)^2$  is

(A)  $-1$

(B)  $0$

(C)  $(z_1 - z_3)^2$

(D)  $1$

FOR REFERENCE ONLY - CUSAT

FINAL ANSWER KEY									
TEST FOR PHYSICS CHEMISTRY MATHEMATICS SHIFT IV									
SI No.	Key	SI No.	Key	SI No.	Key	SI No.	Key	SI No.	Key
1	B	31	C	61	C	91	B	121	A
2	C	32	B	62	D	92	A	122	B
3	C	33	A	63	D	93	C	123	D
4	B	34	B	64	A	94	C	124	C
5	B	35	C	65	A	95	B	125	D
6	B	36	D	66	D	96	B	126	C
7	B	37	D	67	C	97	B	127	B
8	C	38	C	68	C	98	B	128	C
9	D	39	A	69	D	99	B	129	B
10	B	40	B	70	C	100	D	130	B
11	B	41	B	71	C	101	A	131	B
12	D	42	C	72	D	102	A	132	C
13	B	43	C	73	B	103	D	133	A
14	B	44	A	74	C	104	D	134	A
15	C	45	C	75	C	105	B	135	A
16	A	46	C	76	A	106	B	136	A
17	B	47	C	77	B	107	B	137	C
18	B	48	A	78	D	108	A	138	D
19	A	49	B	79	A	109	C	139	C
20	A	50	B	80	C	110	C	140	B
21	D	51	C	81	C	111	C	141	A
22	D	52	B	82	A	112	D	142	A
23	B	53	C	83	B	113	A	143	D
24	C	54	B	84	C	114	A	144	B
25	A	55	C	85	B	115	A	145	C
26	A	56	D	86	B	116	A	146	B
27	B	57	A	87	B	117	D	147	C
28	A	58	A	88	C	118	B	148	C
29	C	59	B	89	A	119	A	149	C
30	A	60	C	90	D	120	B	150	B

SI No.	Key	SI No.	Key	SI No.	Key
151	A	181	C	211	A
152	D	182	C	212	C
153	C	183	D	213	A
154	B	184	C	214	C
155	D	185	B	215	A
156	D	186	B	216	B
157	B	187	C	217	B
158	C	188	A	218	D
159	D	189	B	219	A
160	D	190	D	220	A
161	A	191	C	221	C
162	C	192	B	222	B
163	B	193	B	223	A
164	B	194	A	224	C
165	B	195	A	225	B
166	A	196	B		
167	A	197	A		
168	A	198	D		
169	D	199	C		
170	B	200	A		
171	B	201	D		
172	B	202	A		
173	A	203	A		
174	A	204	B		
175	D	205	C		
176	C	206	D		
177	C	207	D		
178	C	208	A		
179	C	209	A		
180	C	210	D		