

TEST FOR PHYSICS CHEMISTRY MATHEMATICS SHIFT I

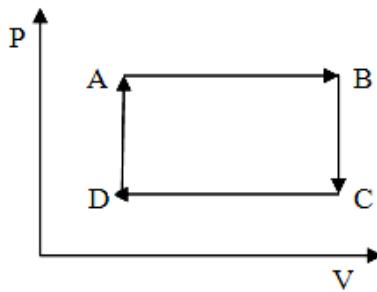
PHYSICS UG SHIFT I  
(FINAL)

1. In an instrument used for measuring angle, 29 divisions of the main scale exactly coincides with 30 divisions of the Vernier scale. If the smallest division on the main scale is  $0.5^\circ$ , then the least count of the instrument will be
  - (A) one degree
  - (B) half minute
  - (C) half degree
  - (D) one minute
2. A particle is executing simple harmonic motion from centre with an amplitude  $A$  and time period  $T$ . Its displacement after  $2T$  will be
  - (A)  $A$
  - (B)  $2A$
  - (C)  $4A$
  - (D) zero
3. If a spring extends by  $x$  on loading, the energy stored in the spring is ( $T$  is the tension in the spring and  $K$  is the spring constant)
  - (A)  $\frac{T^2}{2K}$
  - (B)  $\frac{2K}{T^2}$
  - (C)  $\frac{T}{2K}$
  - (D)  $\frac{T}{K}$
4. A mercury drop does not spread on a glass plate because the angle of contact between glass and mercury is
  - (A) less than  $90^\circ$
  - (B) more than  $90^\circ$
  - (C) zero
  - (D)  $90^\circ$

5. Water is used as a coolant in engines because

- (A) water is a bad conductor of heat
- (B) water has low density
- (C) water has high specific heat
- (D) water is polar solvent

6. In the following P-V diagram for a gas which one of the following is **CORRECT**?



- (A) The temperature of the gas will increase as it goes from A to B
- (B) The temperature of the gas will increase as it goes from B to C
- (C) The temperature of the gas remain constant during these changes
- (D) The temperature of the gas decrease as it goes from D to A

7. A swimmer is swimming 10 m below the water surface of a lake. He then experiences a pressure of

- (A) 2 atm
- (B) 5 atm
- (C) 1 atm
- (D) 7 atm

8. A capacitor works as a charge storing device in

- (A) AC circuits
- (B) DC circuits
- (C) both AC and DC circuits
- (D) None of the above

9. A uniform electric field having a magnitude  $E_o$  and direction along the positive  $X$ -axis exists. If the potential at a point  $x = 0$  is  $V$ , then the additional potential at  $X = +x$  will be

- (A)  $+x E_o$
- (B)  $-x E_o$
- (C)  $+x^2 E_o$
- (D)  $-x^2 E_o$

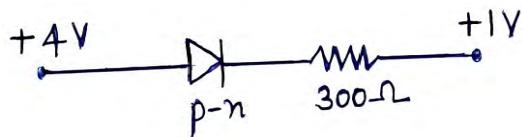
10. A small signal AC voltage  $V(t) = V_o \sin \omega t$  applied across an ideal capacitor. Then which one of the following is **TRUE**?

- (A) Current  $I(t)$  leads the voltage  $V(t)$  by  $90^\circ$
- (B) Current  $I(t)$  lags the voltage  $V(t)$  and average power dissipated in the capacitor is zero
- (C) Current  $I(t)$  is in phase with voltage  $V(t)$
- (D) Current  $I(t)$  leads voltage  $V(t)$  by  $180^\circ$

11. When the mass of the electron becomes equal to three times its rest mass, its speed will become ( $c$  = velocity of light)

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

12. In the circuit given below, the value of the current is



(A) Zero  
(B)  $10^{-2}$  A  
(C)  $10^{-1}$  A  
(D)  $10^{-3}$

13. In Young's double slit experiment, two waves interfere to produce an interference pattern. The third minima of the pattern have a

(A) Phase difference of  $3\pi$   
(B) Phase difference of  $\frac{5\pi}{2}$   
(C) Path difference of  $3\lambda$   
(D) Path difference of  $\frac{5\lambda}{2}$

14. If  $\omega_c$  is the frequency of a carrier wave and  $\omega_m$  is the frequency of the modulation signal, then the amplitude modulated wave will have frequencies

(A)  $\omega_c$  and  $\omega_m$   
(B)  $\omega_c$ ,  $\omega_c + \omega_m$  and  $\omega_c - \omega_m$   
(C)  $\omega_c$  and  $\sqrt{\omega_m \omega_c}$   
(D)  $\omega_c$  and  $\omega_c \cdot \omega_m$

15. For a head-on collision of  $\alpha$ - particles with a gold nucleus, the impact parameter is

(A) zero  
(B) of the order of  $10^{-6}$  m  
(C) of the order of  $10^{-10}$  m  
(D) of the order of  $10^{-14}$  m

16. The damping force of an oscillator is directly proportional to the velocity. The unit of constant of proportionality is

(A)  $\text{kgs}^{-1}$   
(B)  $\text{kgs}$   
(C)  $\text{kgms}^{-1}$   
(D)  $\text{kgms}^{-2}$

17. A tube closed at one end and filled with air produces when excited; it produces the fundamental note of frequency 512 Hz. If the tube is open at both ends, the fundamental frequency that can be produced is

(A) 128 Hz  
(B) 256 Hz  
(C) 512 Hz  
(D) 1024 Hz

18. A particle covers half of the circle of radius  $r$ . The displacement and distance of the particle are, respectively

(A)  $\pi r, r$   
(B)  $2r, \pi r$   
(C)  $\frac{\pi r}{2}, 2r$   
(D)  $2\pi r, 0$

19. An equiconvex lens has a focal length  $f$ . If the lens is cut along the line perpendicular to the principal axis and passing through the pole, what will be the focal length of any half part?

(A)  $\frac{f}{2}$   
(B)  $2f$   
(C)  $f$   
(D)  $\frac{f}{4}$

20. When 40 g of water at 10°C is mixed with 80 g of water at 100°C. The resultant temperature is

- (A) 55°C
- (B) 60°C
- (C) 65°C
- (D) 70°C

21. A long thin flat sheet has a uniform surface charge density  $\sigma$ . The magnitude of electric field at a distance  $r$  from it is

- (A)  $\frac{\sigma}{\epsilon_0}$
- (B)  $\frac{\sigma}{\epsilon_0 r}$
- (C)  $\frac{\sigma}{2\epsilon_0}$
- (D)  $\frac{\sigma}{2\epsilon_0 r}$

22. A point charge  $q$  is moved on an equipotential surface with potential  $V$ . The work done is

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

23. A wire of resistance  $8 \Omega$  is bent into a circle. The resistance between the ends of a diameter of the circle is

- (A)  $\frac{1}{4} \Omega$
- (B)  $\frac{1}{8} \Omega$
- (C)  $2 \Omega$
- (D)  $16 \Omega$

24. The SI unit of luminous intensity is

- (A) Lux
- (B) Lumen
- (C) Candela
- (D) Candela power

25. Which of the following particles can be added to the nucleus without changing its chemical properties?

- (A) Electrons
- (B) Neutrons
- (C) Protons
- (D)  $\beta$ -particles

26. Which one of the following is a non-polar molecule?

- (A) HCl
- (B) CO
- (C) H<sub>2</sub>O
- (D) O<sub>2</sub>

27. When a bulk piece of conductor is subjected to changing magnetic flux, induced currents are produced in them. However, their flow patterns resemble swirling in water. These currents are called

- (A) Saturation current
- (B) Eddy current
- (C) Leak current
- (D) Dark current

28. A standard 100 watt incandescent light bulb emits approximately

- (A) 17 lumens
- (B) 170 lumens
- (C) 1700 lumens
- (D) 1.7 lumens

29. In 1929, Nobel Prize in Physics was awarded to ..... for his discovery of the wave nature of electrons.

- (A) Schrodinger
- (B) Hamiltonian
- (C) Debye
- (D) de Broglie

30. Rydberg constant, R is

- (A)  $1.097 \times 10^{-7} \text{ m}^{-1}$
- (B)  $1.097 \times 10^7 \text{ m}^{-1}$
- (C)  $1.97 \times 10^9 \text{ m}^{-1}$
- (D)  $1.097 \times 10^{11} \text{ m}^{-1}$

31. The mass (kg) of observable Universe is about

- (A)  $10^{55}$
- (B)  $10^{41}$
- (C)  $10^{30}$
- (D)  $10^{25}$

32. On an average, a human heart is found to beat 75 times in a minute. Then its period is

- (A) 0.4 s
- (B) 0.8 s
- (C) 1.2 s
- (D) 2.4 s

33. Match the following.

**Technology**

- (a) Production of ultra high magnetic fields
- (b) Cyclotron
- (c) Aeroplane
- (d) Rocket propulsion
- (e) Electric generator

**Scientific Principle**

- (i) Bernoulli's principle
- (ii) Superconductivity
- (iii) Motion of charged particles in electromagnetic fields
- (iv) Faraday's law of induction
- (v) Newton's law of motion

- (A) (a)-(iv); (b)-(v); (c)-(i); (d)-(ii); (e)-(iii)
- (B) (a)-(ii); (b)-(v); (c)-(iv); (d)-(iii); (e)-(i)
- (C) (a)-(ii); (b)-(iii); (c)-(i); (d)-(v); (e)-(iv)
- (D) (a)-(v); (b)-(iv); (c)-(iii); (d)-(ii); (e)-(i)

34. A ray of light travelling in the direction  $\frac{1}{2}(\hat{i} + \sqrt{3}\hat{i})$  is incident on a plane mirror.

After reflection, it travels along the direction  $\frac{1}{2}(\hat{i} - \sqrt{3}\hat{i})$ . The angle of incidence is

- (A)  $30^\circ$
- (B)  $60^\circ$
- (C)  $45^\circ$
- (D)  $75^\circ$

35. Two springs of force constant 1200 N/m and 2400 N/m respectively are stretched with a same force. Their potential energies will be in the ratio of

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

36. Water in a bucket is whirled in a vertical circle with a string attached to it. The Water does not fall down even when the bucket is inverted at the top of its path. We conclude that in this position

- (A)  $mg = \frac{mv^2}{r}$
- (B)  $mg$  is greater than  $\frac{mv^2}{r}$
- (C)  $mg$  is not greater than  $\frac{mv^2}{r}$
- (D)  $mg$  is not less than  $\frac{mv^2}{r}$

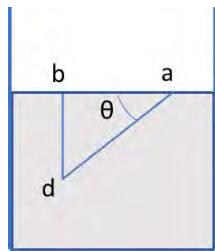
37. Choose the **CORRECT** option from the following.

- (A) Gauss's law is valid only for symmetrical charge distributions
- (B) Gauss's law is valid only for charges placed in vacuum
- (C) The electric field calculated by Gauss's law is the field due to the charges inside the Gaussian surface
- (D) The flux of the electric field through a closed surface due to all the charges is equal to the flux due to the charges enclosed by the surface

38. The motion of a rocket is based on the principle of conservation of

- (A) linear momentum
- (B) angular momentum
- (C) kinetic energy
- (D) mass

39. A glass prism of  $\mu = 1.5$  is immersed in water as shown in the figure. A beam of light incident normally on the face  $ab$  is internally reflected from the face  $ad$  so as to incident normally on face  $bd$ . Given that refractive index of water is  $\frac{4}{3}$ . Then the value of  $\theta$  is



- (A)  $\theta > \sin^{-1}\left(\frac{8}{9}\right)$
- (B)  $\theta > \sin^{-1}\left(\frac{2}{3}\right)$
- (C)  $\theta < \sin^{-1}\left(\frac{2}{3}\right)$
- (D)  $\theta < \sin^{-1}\left(\frac{4}{3}\right)$

40. Which of the following is **WRONGLY** matched?

- (A) Raman effect – Scattering of light
- (B) Thomson effect – Thermoelectricity
- (C) Hall effect – Work function
- (D) Photoelectric effect – Quantum nature of light

41. Due to relative motion of the magnet with respect to coil, an emf is induced in the coil in accordance with

- (A) Ampere's circuital law
- (B) Faraday's law
- (C) Gauss's law
- (D) Biot-Savart law

42. For photoelectric emission from certain metal, the cut off frequency is  $\nu$ . If radiation of frequency  $2\nu$  impinges on the metal plate, the maximum possible velocity of the emitted electron will be ( $m$  is the mass of the electron)

- (A)  $\sqrt{\frac{h\nu}{2m}}$
- (B)  $\sqrt{\frac{h\nu}{m}}$
- (C)  $\sqrt{\frac{2h\nu}{m}}$
- (D)  $2\sqrt{\frac{h\nu}{m}}$

43. A carbon resistor of  $(47 \pm 4.7) \text{ k}\Omega$  is to be marked with rings of different colours for its identification. The colour code sequence will be

- (A) Violet-Yellow-Orange-Silver
- (B) Green-Orange-Violet-Gold
- (C) Yellow-Green-Violet-Gold
- (D) Yellow-Violet-Orange-Silver

44. An AC voltage source of variable angular frequency  $\omega$  and fixed amplitude  $V_0$  is connected in series with a capacitance  $C$  and an electric bulb of resistance  $R$  (inductance zero). When  $\omega$  increased,

- (A) the bulb glows dimmer
- (B) the bulb glows brighter
- (C) the total impedance of the circuit is unchanged
- (D) total impedance of the circuit increases

45. The spring constant of a spring balance is  $5 \times 10^2 \text{ Nm}^{-1}$ . It is initially stretched by 5 cm from the unstretched position. Then the work done to stretch it further by another 5 cm is

(A) 18.75 J  
(B) 25.0 J  
(C) 6.25 J  
(D) 12.5 J

46. A toy boat containing pieces of iron is floating in a dish of water. If one of the pieces of iron is removed from the boat and placed in the water outside the boat, then

(A) the level of water in the dish will rise  
(B) the level of water in dish will fall  
(C) the level of water in the dish will remain unchanged  
(D) the toy boat will sink

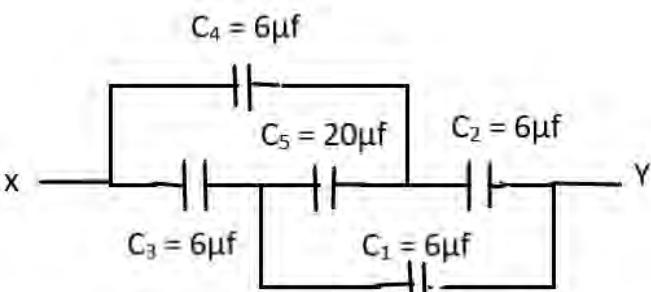
47. Which one of the following is a simple harmonic motion?

(A) Wave moving through a string fixed at both ends  
(B) Earth spinning about its own axis  
(C) Ball bouncing between two rigid vertical walls  
(D) Particle moving in a circle with uniform speed

48. Faraday's laws of electromagnetic induction are consequence of conservation of

(A) energy  
(B) energy and magnetic field  
(C) charge  
(D) magnetic field

49. What is the effective capacitance between points X and Y?



(A) 24  $\mu\text{F}$   
(B) 18  $\mu\text{F}$   
(C) 12  $\mu\text{F}$   
(D) 6  $\mu\text{F}$

50. In an induction coil the current increases from zero to 6 amp in 0.3 s by which induced emf of 30 V is produced. The value of coefficient of self induction of coil will be

- (A) 1 Henry
- (B) 1.5 Henry
- (C) 2 Henry
- (D) 3 Henry

51. The truth table given below is for which gate?

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

- (A) XOR
- (B) OR
- (C) AND
- (D) NAND

52. A source of light is placed at a distance of 1 m from the photocell and the cut-off potential is found to be  $V_0$ . If the lamp is moved to a distance of 2 m then the cut-off potential will become

- (A)  $2 V_0$
- (B)  $\frac{V_0}{2}$
- (C)  $\frac{V_0}{4}$
- (D)  $V_0$

53. The dimension of torque is

- (A)  $MLT^{-2}$
- (B)  $ML^2T^{-2}$
- (C)  $M^2L^2T^{-2}$
- (D)  $M^2LT^{-2}$

54. An arrow of mass 20 g, moving at 150 m/s penetrates 5 cm into a log and then comes to rest. Assuming that the force exerted by the log is uniform, the magnitude of the force is

(A) 450 N  
(B) 4500 N  
(C) 22500 N  
(D) 2250000 N

55. A wheel of perimeter 220 cm rolls on a level road at a speed of 9 km/h. How many revolutions does the wheel make per second?

(A)  $\frac{25}{22}$  rev/s  
(B)  $\frac{9}{220}$  rev/s  
(C)  $\frac{90000}{22}$  rev/s  
(D)  $\frac{9 \times 2\pi}{220}$  rev/s

56. The volume of water decreases from its initial volume of  $1000 \text{ cm}^3$ , under a pressure change from  $10^5 \text{ N/m}^2$  to  $10^{11} \text{ N/m}^2$ . If the compressibility of water is  $50 \times 10^{-11} \text{ N}^{-1} \text{ m}^2$ , the decrease in volume of water is

(A)  $0.45 \text{ cm}^3$   
(B)  $2.22 \text{ cm}^3$   
(C)  $8.42 \text{ cm}^3$   
(D)  $50.22 \text{ cm}^3$

57. An object is seen through a simple microscope of focal length 12 cm. Find the angular magnification produced if the image is formed at the near point of the eye which is 25 cm away from it.

(A) 2.08  
(B) 3.08  
(C) 6.16  
(D) 9.24

58. Two particles A and B having charges  $8.0 \times 10^{-6}$  C and  $-2.0 \times 10^{-6}$  C respectively are held fixed with a separation of 20 cm. At what distance from B should a third charged particle be placed so that it does not experience a net electric force?

(A) 2 cm  
(B) 20 cm  
(C) 40 cm  
(D) 80 cm

59. An inductor of inductance 100 mH is connected in series with a resistance, a variable capacitance and an AC source of frequency 2.0 kHz. What should be the value of the capacitance so that maximum current may be drawn into the circuit?

(A) 6.3 nF  
(B) 12.6 nF  
(C) 43.4 nF  
(D) 63.0 nF

60. A particle moves in a circle of radius 10.0 cm at a speed that uniformly increases. If the speed changes from 5.0 m/s to 6.0 m/s in 2.0 s, find the angular acceleration.

(A)  $0.5 \text{ rad/s}^2$   
(B)  $1.0 \text{ rad/s}^2$   
(C)  $2.5 \text{ rad/s}^2$   
(D)  $5.0 \text{ rad/s}^2$

61. Two sound waves move in the same direction in the same medium. The pressure amplitudes of the waves are equal but the wavelength of the first wave is double the second wave. Let the average power transmitted across a cross section by the first wave be  $P_1$  and that by the second wave be  $P_2$ . Then

(A)  $P_1 = P_2$   
(B)  $P_1 = 4P_2$   
(C)  $P_2 = 2P_1$   
(D)  $P_1 = \frac{P_2}{2}$

62. The charge on two plates of a parallel plate capacitor of capacitance  $C$  are  $3Q$  and  $-Q$ , respectively. The potential of the capacitor is [None of the plates of capacitor is grounded]

(A)  $\frac{Q}{C}$

(B)  $\frac{3Q}{C}$

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

(D)  $\frac{2Q}{C}$

63. A silver wire has a resistance of  $2.1 \Omega$  at  $27.5^\circ\text{C}$ , and a resistance of  $2.7 \Omega$  at  $100^\circ\text{C}$ . What is the temperature coefficient of resistivity of silver?

(A)  $0.0059^\circ\text{C}^{-1}$

(B)  $0.0039^\circ\text{C}^{-1}$

(C)  $0.0129^\circ\text{C}^{-1}$

(D)  $0.0030^\circ\text{C}^{-1}$

64. An induced e.m.f. is produced when a magnet is plunged into a coil. The strength of the induced e.m.f. is independent of

(A) the strength of the magnet

(B) number of turns of coil

(C) the resistivity of the wire of the coil

(D) speed with which the magnet is moved

65. In which of the following series, does the  $121.5 \text{ nm}$  line of the spectrum of the hydrogen atom lies?

(A) Lyman series

(B) Balmer series

(C) Paschen series

(D) Brackett series

66. The waves used by artificial satellites in communication is

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

67. When a body is taken from the equator to the poles, its weight

- (A) remains the same
- (B) decreases
- (C) increases
- (D) increases at north pole and decreases at south pole

68. When a body is stationary

- (A) there is no force acting on it
- (B) the forces acting on it are not in contact with it
- (C) the combination of the forces acting on it balance each other
- (D) the body is in vacuum

69. When a planet moves around the Sun

- (A) the angular momentum remains conserved
- (B) the angular speed remains constant
- (C) the linear velocity remains constant
- (D) the linear momentum remains constant

70. The V-I Characteristics of the diode lie in the

- (A) 1<sup>st</sup> and 2<sup>nd</sup> quadrant
- (B) 1<sup>st</sup> and 3<sup>rd</sup> quadrant
- (C) 1<sup>st</sup> and 4<sup>th</sup> quadrant
- (D) only in the 1<sup>st</sup> quadrant

71. Force  $F$  applied on a body moves it through a distance  $S$  along  $F$ . Energy spent is

- (A)  $F \times S$
- (B)  $\frac{F}{S}$
- (C)  $F \times S^2$
- (D)  $\frac{F}{S^2}$

72. What is the surface energy of an air bubble inside a soap solution?

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

(B)  $8\pi r^2 T$

(C)  $2\pi r^2 T$

(D)  $\pi r^2 T$

73. Temperature can be expressed as a derived quantity in terms of

(A) length and mass

(B) mass and time

(C) length, mass and time

(D) length and time

74. Which of the following is a non-central force?

(A) Electrostatic force

(B) Nuclear force

(C) Gravitational force

(D) Spring force

75. The unit of angular acceleration in the SI system is

(A)  $N \text{ kg}^{-1}$

(B)  $\text{m s}^{-2}$

(C)  $\text{rad s}^{-2}$

(D)  $\text{m kg}^{-1} \text{K}$

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

76. A radioactive source has a half-life of 40 s, how long will it take for  $\frac{5}{8}$  of the source to decay?

(A) 127 s

(B) 57 s

(C) 147 s

(D) 560 s

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

(A) Hydrogen and Oxygen  
(B) Helium and Nitrogen  
(C) Helium and Hydrogen  
(D) Nitrogen and Oxygen

78. The increase in internal energy of the system is 100 J when 300 J heat is supplied to it. What is the amount of work done by the system?

(A) 100 J  
(B) 200 J  
(C) 300 J  
(D) 400 J

79. A container of volume 5.0 L is divided into two compartments of equal size. In the left compartment there is nitrogen at 1.0 atmosphere pressure and 25°C, in the right compartment there is hydrogen at the same temperature and pressure. What will happen when the partition is removed?

(A) The entropy increases, and the free energy decreases  
(B) The entropy decreases, and the free energy decreases  
(C) The entropy increases, and the free energy increases  
(D) The entropy decreases, and the free energy increases

80. A unit cell has the following characteristics,  $a \neq b \neq c$ ;  $\alpha = \gamma = 90^\circ$ ,  $\beta \neq 90^\circ$ . The unit cell belongs to the crystal system

(A) Orthorhombic  
(B) Rhombohedral  
(C) Monoclinic  
(D) Triclinic

81. The hydrogen electrode is dipped in a solution of pH 3 at 25°C, the potential of the cell would be (the value of  $\frac{2.303RT}{F} = 0.059$  V )

(A) +0.177 V  
(B) -0.177 V  
(C) +0.087 V  
(D) +0.059 V

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

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

83. The rate constant of a zero-order reaction is  $0.04 \text{ M sec}^{-1}$ . The concentration of the reactant remaining after 25 sec is 0.5 M. The initial concentration of the reactant is

- (A) 0.5 M
- (B) 1.25 M
- (C) 0.125 M
- (D) 1.5 M

84. The pH of the blood is maintained by buffer system given by

- (A) NaCl and HCl
- (B) NH<sub>4</sub>Cl and NH<sub>4</sub>OH
- (C) Sodium citrate and Citric acid
- (D) HCO<sub>3</sub><sup>-</sup> and H<sub>2</sub>CO<sub>3</sub>

85. Ferrous oxide has a cubic structure, with the edge length of 5.0 Å. If the density of the solid is  $3.84 \text{ g cm}^{-3}$ , the number of Fe<sup>2+</sup> and O<sup>2-</sup> ions present per unit cell is  $(N_A = 6.02 \times 10^{23})$

- (A)  $2\text{Fe}^{2+}$  and  $2\text{O}^{2-}$
- (B)  $\text{Fe}^{2+}$  and  $\text{O}^{2-}$
- (C)  $4\text{Fe}^{2+}$  and  $4\text{O}^{2-}$
- (D)  $3\text{Fe}^{2+}$  and  $4\text{O}^{2-}$

86. The Clausius-Clayperon equation helps to calculate

- (A) Latent heat of vaporization
- (B) Melting point of the solvent
- (C) Heat of neutralization
- (D) Molecular weight of solute

87. Electrical conductivity of an electrolyte depends upon the

- number of molecules in the electrolytes
- number of ions present in the electrolytes
- number of molecules present in the solvent
- number of charges present in the solution

88. Addition of  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Fe}^{3+}$  and  $\text{Si}^{4+}$  causes coagulation of negatively charged colloidal sol. Then which of the following is true?

- $\text{Fe}^{3+} > \text{Si}^{4+} > \text{Pb}^{2+} > \text{Ag}^+$
- $\text{Ag}^+ < \text{Pb}^{2+} < \text{Fe}^{3+} < \text{Si}^{4+}$
- $\text{Ag}^+ > \text{Pb}^{2+} > \text{Fe}^{3+} > \text{Si}^{4+}$
- $\text{Ag}^+ = \text{Pb}^{2+} = \text{Fe}^{3+} = \text{Si}^{4+}$

89. The root mean square velocity (u), average velocity (p) and most probable velocity (q) of a molecule are related to each other. Then which of the following is true?

- $q > p > u$
- $p > q > u$
- $u > p > q$
- $u = p = q$

90. A plant cell shrinks when it is kept in

- Hypertonic solution
- Hypotonic solution
- Water
- Isotonic solution with cell sap

91. One Einstein of energy is

- $$E = \frac{2.859}{\lambda} \times 10^5 \text{ cal mol}^{-1}$$
- $$E = \frac{2.859}{\lambda} \times 10^{-5} \text{ k cal mol}^{-1}$$
- $$E = \frac{2.859}{\lambda} \times 10^5 \text{ J mol}^{-1}$$
- $$E = \frac{2.859}{\lambda} \times 10^{-5} \text{ kJ mol}^{-1}$$

92. The correct unit of Van der Waal's constant 'a' is

- (A)  $\text{atm mol}^2 \text{ L}^{-2}$
- (B)  $\text{atm mol}^{-2} \text{ L}^2$
- (C)  $\text{atm}^{-1} \text{ mol}^{-2} \text{ L}^2$
- (D)  $\frac{\text{atm mol}^2 \text{ L}^2}{\text{atm mol L}}$

93. If travelling at same speeds, which of the following matter waves have the shortest wave length?

- (A) Electron
- (B) Alpha particle
- (C) Neutron
- (D) Proton

94. In  $\text{H}_2\text{-O}_2$  fuel cell, the reaction occurring at cathode is

- (A)  $2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$
- (B)  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
- (C)  $\text{H} + \text{OH}^- \rightarrow \text{H}_2\text{O}$
- (D)  $\text{H} + \text{e}^- \rightarrow \frac{1}{2}\text{H}_2$

95. For 10 M  $\text{CH}_3\text{COOH}$  solution if  $K_a$  is  $10^{-5}$  then find out  $\alpha$  (degree of dissociation)

- (A)  $10^{-6}$
- (B)  $10^{-5}$
- (C)  $10^{-3}$
- (D)  $10^{-2}$

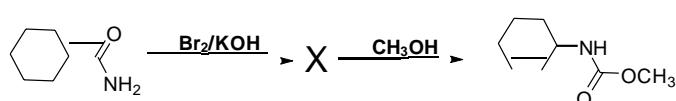
96. What is the hybridization of carbons in  $\text{C}_{60}$  (buckminsterfullerene)? Identify the number of pentagons and hexagons in  $\text{C}_{60}$ .

- (A) Both  $\text{sp}$  and  $\text{sp}^2$ . 12 pentagons, 20 hexagons
- (B)  $\text{sp}$  only. 12 pentagons, 20 hexagons
- (C)  $\text{sp}$ ,  $\text{sp}^2$  and  $\text{sp}^3$ . 12 pentagons, 24 hexagons
- (D)  $\text{sp}^2$  only. 12 pentagons, 20 hexagons

97. Number of isomers possible for  $C_2H_2Cl_2$  is/are

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

98. Identify X in the following chemical reaction



- (A)
- (B)
- (C)
- (D)

99. Which among the following name reaction yields alkanes?

- (A) Wurtz-Fittig reaction
- (B) Wurtz reaction
- (C) Friedel-Crafts reaction
- (D) Vilsmeier-Haack reaction

100. Turmeric is a good source for

- (A) Curcumin
- (B) Nicotine
- (C) Terramycin
- (D) Anabasine

101. Pick the closest change in the HCH bond angle in **ethene** when it reacts with bromine to give 1,2-dibromoethane

- (A)  $30^\circ$
- (B)  $60^\circ$
- (C)  $10^\circ$
- (D)  $0^\circ$

102. An amino acid having secondary amine component is

- (A) Alanine
- (B) Tryptophan
- (C) Asparagine
- (D) Proline

103. The eclipsed and staggered confirmations of n-butane differ drastically in

- (A) C<sub>2</sub>-C<sub>3</sub> bond distance
- (B) angle between C<sub>1</sub>-C<sub>2</sub>-C<sub>3</sub> and C<sub>2</sub>-C<sub>3</sub>-C<sub>4</sub> planes
- (C) C<sub>1</sub>-C<sub>2</sub>-C<sub>3</sub> bond angle
- (D) H-C-H bond angles

104. 2-Methylbutane on reacting with I<sub>2</sub> in presence of sunlight gives mainly

- (A) 2-iodo-2-methylbutane
- (B) unchanged 2-methylbutane
- (C) 1-iodo-2-methylbutane
- (D) 1-iodo-3-methylbutane

105. In the reaction below, A and B are respectively



- (A) CH<sub>3</sub>COOH, Cl<sub>3</sub>CCOOH
- (B) CH<sub>3</sub>CH<sub>2</sub>OH, CH<sub>3</sub>CH<sub>2</sub>Cl
- (C) CH<sub>3</sub>CHO, Cl<sub>3</sub>CCHO
- (D) CH<sub>3</sub>COCH<sub>3</sub>, Cl<sub>3</sub>CCOCH<sub>3</sub>

106. Diethyl oxalate forms a solid oxamide derivative with

- (A) both primary and secondary amines
- (B) both secondary and tertiary amines
- (C) primary amines only
- (D) aromatic secondary amines only

107. Most crucial function of insulin in human body is to

- (A) regulate blood sugar level
- (B) regulate kidney function
- (C) regulate hormone balance in body
- (D) regulate hydrolysis of starch

108. Acetic anhydride is a controlled substance in India since it is

- (A) highly toxic
- (B) used in the synthesis of illegal substances like heroin
- (C) extremely expensive
- (D) highly explosive

109. Among carbon tetrachloride, chlorobenzene and benzyl chloride which will give a white precipitate with alcoholic silver nitrate?

- (A) Carbon tetrachloride and chlorobenzene
- (B) Carbon tetrachloride and benzyl chloride
- (C) Benzyl chloride only
- (D) All the three halides

110. Iodoform ( $\text{CHI}_3$ ) on heating with Ag powder forms

- (A) Ethyne
- (B) Ethene
- (C) Ethane
- (D) Methanoic acid

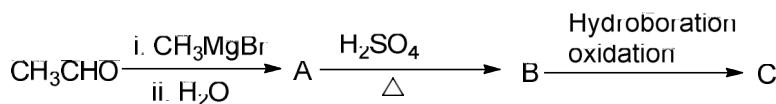
111. One mole of methoxybenzene (anisole,  $\text{C}_6\text{H}_5\text{OCH}_3$ ) on heating with conc. HI gives

- (A) One mole of  $\text{CH}_3\text{OH}$  and one mole of  $\text{C}_6\text{H}_5\text{I}$
- (B) One mole of  $\text{CH}_3\text{I}$  and one mole of  $\text{C}_6\text{H}_5\text{OH}$
- (C) One mole of  $\text{CH}_3\text{I}$  and one mole of  $\text{C}_6\text{H}_5\text{I}$
- (D) 4-Iodoanisole as the only product

112. Schiff's bases are prepared by

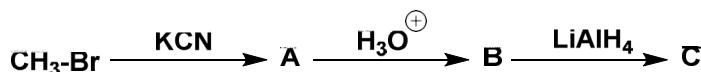
- (A) condensation of aldehydes and ketones with hydrazine
- (B) condensation of aldehydes and ketones with secondary amines
- (C) condensation of aldehydes and ketones with primary amines
- (D) condensation of aldehydes and hydroxylamine

113. Compounds 'A' and 'C' in the following reaction are



- (A) identical
- (B) positional isomers
- (C) functional isomers
- (D) optical isomers

114. In the following reaction sequence



The end product (C) is

- (A) Acetaldehyde
- (B) Ethyl alcohol
- (C) Acetone
- (D) Ethane

115. What is common between Heme and Chlorophyl?

- (A) Both are red in colour
- (B) Both have magnesium in them
- (C) Both are proteins
- (D) Both are co-ordination complexes of porphyrinic ligands

116. The group having isoelectronic species is

- (A)  $\text{O}^{2-}, \text{F}^-, \text{Na}^+, \text{Mg}^{2+}$
- (B)  $\text{O}_2^-, \text{F}^-, \text{Na}, \text{Mg}$
- (C)  $\text{O}_2^-, \text{F}^-, \text{Na}, \text{Mg}^{2+}$
- (D)  $\text{O}^-, \text{F}^-, \text{Na}^+, \text{Mg}^{2+}$

117. The electronic configuration with the highest first ionization energy is

- (A)  $[\text{Ne}]3s^23p^1$
- (B)  $[\text{Ne}]3s^23p^2$
- (C)  $[\text{Ne}]3s^23p^3$
- (D)  $[\text{Ne}]3s^23p^4$

118. The number and type of bonds in  $C_2^{2-}$  ion in  $CaC_2$  are

- (A) One  $\sigma$  bond and one  $\pi$  – bond
- (B) One  $\sigma$  bond and two  $\pi$  – bonds
- (C) Two  $\sigma$  bonds and two  $\pi$  – bonds
- (D) Two  $\sigma$  bonds and one  $\pi$  – bond

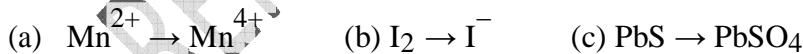
119. Which of the following is an amphoteric hydroxide?

- (A)  $Be(OH)_2$
- (B)  $Ca(OH)_2$
- (C)  $Mg(OH)_2$
- (D)  $Sr(OH)_2$

120. 0.5 moles of gas A and  $x$  moles of gas B exert pressure of 200 Pa in a container of  $3$   $m^3$  at 1000 K. Given  $R$  is the gas constant  $JK^{-1}mol^{-1}$ ,  $x$  is

- (A)  $\frac{2R}{4 + R}$
- (B)  $\frac{2R}{4 - R}$
- (C)  $\frac{4 + R}{2R}$
- (D)  $\frac{4 - R}{2R}$

121. In basic medium,  $H_2O_2$  exhibits which of the following reactions?



Choose the most appropriate answer from the options given below.

- (A) (a) and (c)
- (B) (a) and (b)
- (C) (a) only
- (D) (b) only

122. In graphite and diamond, the percentage of p-character in their hybrid orbitals respectively are

- (A) 33 and 25
- (B) 67 and 75
- (C) 50 and 75
- (D) 33 and 75

123. Which of the following has the maximum C – C bond length?

(A) Graphite  
(B) Naphthalene  
(C)  $C_{60}$   
(D) Diamond

124. Which of the following represents the general electronic configuration of an element belonging to the p-block of the periodic table?

(A)  $(n-1)^0 f^0 2^0 6^2 (n-1)d^0 ns^0 np^0$   
(B)  $(n-1)^0 f^1 10^2 6^1 (n-1)d^0 ns^0 np^0$   
(C)  $(n-1)^0 f^0 2^0 6^1 (n-1)d^0 ns^0 np^0$   
(D)  $(n-1)^{1-10} 10^2 6^1 (n-1)d^0 ns^0 np^0$

125. The number of P-O bonds in  $P_4O_6$  is

(A) 9  
(B) 6  
(C) 12  
(D) 18

126. Which of the following has the highest crystal field stabilization energy?

(A)  $[Fe(OH)_5]^{3-}$   
(B)  $[Fe(Cl)_6]^{3-}$   
(C)  $[Fe(CN)_6]^{3-}$   
(D)  $[Fe(H_2O)_6]^{3+}$

127. Magnetic moment of  $Gd^{3+}$  ion ( $Z = 64$ ) is

(A) 3.62 BM  
(B) 9.72 BM  
(C) 7.9 BM  
(D) 10.60 BM

128. The coordination number of Th in  $\text{K}_4[\text{Th}(\text{C}_2\text{O}_4)_4(\text{H}_2\text{O})_2]$  is

(A) 14  
(B) 6  
(C) 8  
(D) 10

129. How many number of molecules and atoms are present in 2.24 L of a diatomic gas at STP?

(A)  $3.0 \times 10^{22}$ ;  $6.0 \times 10^{22}$   
(B)  $6.02 \times 10^{23}$ ;  $15.0 \times 10^{22}$   
(C)  $6.0 \times 10^{22}$ ;  $12.0 \times 10^{22}$   
(D)  $15.0 \times 10^{22}$ ;  $7.5 \times 10^{22}$

130. Which of the following series of lines are the only lines in the hydrogen spectrum, which appear in the near infrared region?

(A) Lyman  
(B) Balmer  
(C) Paschen  
(D) Brackett

131. Number of angular nodes for 4f orbital

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

132. If A, B, C and D are four different ligands, how many geometrical isomers will be formed for square planar  $[\text{Pt}^{2+}\text{ABCD}]$ ?

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

133. 0.2 mol AgCl is obtained, when 0.1 mol of the complex,  $\text{MCl}_3(\text{NH}_3)_5$ , is treated with excess of  $\text{AgNO}_3$ . The complex will be

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

134. Which of the following alkali metals does react with water least vigorously?

- (A) Li
- (B) Na
- (C) K
- (D) Cs

135. The most stable radioactive isotope of hydrogen is

- (A) deuterium
- (B) hydronium
- (C) protium
- (D) tritium

**MATHEMATICS UG  
(SHIFT – I FINAL)**

136. If  $x^2 + mx + 1 = 0$  and  $(b - c)x^2 + (c - a)x + (a - b) = 0$  have both roots common, then

- (A)  $m = -2$
- (B)  $m = -3$
- (C)  $a, b, c$  are in A.P.
- (D)  $a, b, c$  are in G.P.

137. A box contains 2 white balls, 3 black balls and 4 red balls. The number of ways in which 3 balls can be drawn from the box if at least one black ball is to be included in the draw is

- (A) 32
- (B) 64
- (C) 96
- (D) 128

138. If  ${}^{2n+1}P_{n-} : {}^{2n-1}P_n = 3 : 5$ , then  $n$  is equal to

- (A) 4
- (B) 3
- (C) 6
- (D) 5

139. Let  $n$  be a positive integer such that  $(1+x+x^2)^n = a_0 + a_1x + \dots + a_{2n}x^{2n}$ , then  $\sum_{r=0}^{2n} a_r$

(A)  $3^{n-2}$

(B)  $3^{n-1}$

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

(D)  $3^n$

140. If  $A$  and  $B$  are square matrices of same order and  $A$  is non-singular, then, for a positive integer  $n$ ,  $(A^{-1}BA)^n$  is

(A)  $A^{-n}B^nA^n$

(B)  $A^nB^nA^{-n}$

(C)  $A^{-1}B^nA$

(D)  $n(A^{-1}BA)$

141. If  $\begin{bmatrix} 0 & x \\ y & 0 \end{bmatrix}^4 = I$ , then

(A)  $x=1=2y$

(B)  $x=y$

(C)  $x=y^2$

(D)  $xy=1$

142. If  $S = \frac{1}{2} \left( \frac{1}{2} + \frac{1}{3} \right) - \frac{1}{4} \left( \frac{1}{2^2} + \frac{1}{3^2} \right) + \frac{1}{6} \left( \frac{1}{2^3} + \frac{1}{3^3} \right) + \dots$  then  $S$  is equal to

(A)  $\log 1$

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

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

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

143. The domain of the relation  $R = \{(x, y) : x, y \in Z, x^2 + y^2 \leq 4\}$  in  $Z$  is

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

144. Let  $f : R \rightarrow R$  be defined by  $f(x) = \log\left(\frac{1+x}{1-x}\right)$  for  $x \in R$ . Then  $f(m) + f(n) =$

- (A)  $f(m+n)$
- (B)  $f\left(\frac{m+n}{1+mn}\right)$
- (C)  $f(m \cdot n)$
- (D) 0

145. Three numbers are chosen at random without replacement from 1, 2, 3, ..., 10. The probability that the minimum of the chosen numbers is 4 or their maximum 8, is

- (A)  $\frac{1}{40}$
- (B)  $\frac{7}{40}$
- (C)  $\frac{3}{40}$
- (D)  $\frac{11}{40}$

146. If the probability density function of a random variable  $X$  is  $f(x) = \frac{x}{2}$ , in  $0 \leq x \leq 2$ , then  $P(X > 1.5/X > 1)$  is

(A)  $\frac{7}{16}$

(B)  $\frac{3}{4}$

(C)  $\frac{7}{12}$

(D)  $\frac{21}{64}$

147.  $\cos \frac{2\pi}{7} + \cos \frac{4\pi}{7} + \cos \frac{6\pi}{7} =$

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

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

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

(D) 1

148. Let  $a = \frac{1}{5\cos x + 12\sin x}$  for all real  $x$ . Then

(A)  $a \geq \frac{1}{13}$

(B)  $a = 1$

(C)  $a = -\frac{2}{13}$

(D)  $a = \frac{2}{13}$

149. Let  $\lambda_1$  and  $\lambda_2$  be two values lying in  $[0, 2\pi]$  for which  $\tan \lambda = \theta$ . Then

$$\tan \frac{\lambda_1}{2} \cdot \tan \frac{\lambda_2}{2} =$$

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

150. If  $\tan A = 2 \tan B + \cot B$ , then  $2 \tan(A - B) =$

- (A)  $2 \tan B$
- (B)  $2 \cot B$
- (C)  $\cot B$
- (D)  $\tan B$

151. If the sines of two angles of a triangle are equal to  $\frac{3}{5}$  and  $\frac{15}{17}$ , then the cosine of the third angle is

- (A)  $\frac{11}{85}$
- (B)  $\frac{13}{85}$
- (C)  $\frac{23}{85}$
- (D)  $\frac{19}{85}$

152. If  $\tan^{-1} \left( \frac{1-x}{1+x} \right) = \frac{1}{2} \tan^{-1} x$ , then the value of  $x$  is

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

153. The pair of points which lie on the same side of the straight line  $3x - 8y - 7 = 0$  is

- (A) (0, -1), (0, 0)
- (B) (-1, -1), (3, 7)
- (C) (-1, -1), (3, -7)
- (D) (0, 1), (3, 0)

154. Let  $A = (3, 0)$  and  $B = (-3, 0)$ . Let  $P$  be any point on the curve  $16x^2 + 25y^2 = 400$ . Then  $PA + PB =$

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

155. Let  $y = |\cos x| + |\sin x|$ . Then  $\frac{dy}{dx}$  at  $x = \frac{2\pi}{3}$  is

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

156.  $\lim_{x \rightarrow 1} \frac{\sqrt[3]{x^2} - 2\sqrt[3]{x} + 1}{(x-1)^2} =$

- (A)  $\frac{1}{3}$
- (B)  $\frac{1}{9}$
- (C)  $\frac{2}{3}$
- (D)  $\frac{2}{9}$

157. The minimum value of  $f(x) = a \sec x - b \tan x$ ,  $a > b > 0$ , is

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

158. The minimum value of  $e^{|2x^2-2x+1|} \sin^2 x$  is

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

159. Let  $f(x) = \max \{x + \lfloor x \rfloor, x - \lceil x \rceil\}$  where  $\lfloor x \rfloor$  denotes the greatest integer less than or

equal to  $x$ . Then  $\int_{-2}^2 f(x) dx =$

- (A) 5
- (B) 3
- (C) -2
- (D) 1

160. If  $y(t)$  is a solution of  $(1+t) \frac{dy}{dt} - ty = 1$  and  $y(0) = -1$ , then  $y(1) =$

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

161. For all  $x \in R$ , if  $kx^2 - 9kx + 5k + 1 > 0$ , then  $k$  lies in the interval

(A)  $\left(-\frac{4}{61}, 0\right)$   
(B)  $\left[0, -\frac{61}{4}\right)$   
(C)  $\left[0, \frac{4}{61}\right)$   
(D)  $\left(-\frac{4}{61}, \frac{4}{61}\right)$

162. The minimum value of  $P = bcx + cay + abz$  when  $xyz = abc$  is

(A)  $3abc$   
(B)  $6abc$   
(C)  $abc$   
(D)  $4abc$

163. If  $z_1 = 9y^2 - 4 - 10ix$ ,  $z_2 = 8y^2 - 20i$  and  $z_1 = \bar{z}_2$ , then  $z = x + iy$  is equal to

(A)  $2 + 2i$   
(B)  $-2 \pm 2i$   
(C)  $-2 \pm i$   
(D)  $2 - i$

167. The inequality  $|z-4| < |z-2|$  represents the region given by

(A)  $\operatorname{Re}(z) > 0$   
(B)  $\operatorname{Re}(z) < 0$   
(C)  $\operatorname{Re}(z) > 2$   
(D)  $\operatorname{Re}(z) > 3$

165. If  $w$  is a non-real cube root of unity, then the value of

$$1 \cdot (2-w)(2-w^2) + 2 \cdot (3-w)(3-w^2) + \dots + (n-1)(n-w)(n-w^2) \text{ is}$$

(A)  $n^3$   
(B)  $\frac{n^2(n-1)^2}{4} - n + 1$   
(C)  $\left(\frac{n(n+1)}{2}\right)^2 - n$   
(D)  $\left(\frac{n(n-1)}{4}\right)^2$

166. Sum to  $n$  terms of the series  $\frac{4}{1 \cdot 2 \cdot 3} + \frac{5}{2 \cdot 3 \cdot 4} + \frac{6}{3 \cdot 4 \cdot 5} + \dots$

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

167. Sum to infinity of the series  $1 + \frac{4}{5} + \frac{7}{5^2} + \frac{10}{5^3} + \dots$  is

(A)  $\frac{16}{25}$   
(B)  $\frac{11}{8}$   
(C)  $\frac{35}{16}$   
(D)  $\frac{8}{11}$

168. If  $x^3 - ax + b = 0$  and  $x^2 - px + q = 0$  have a root in common and the second equation has equal roots, then

- (A)  $b + q = ap$
- (B)  $p + q = a$
- (C)  $a + p = q$
- (D)  $2(b + q) = pa$

169. Let  $a, b, c$  be real numbers with  $a \neq 0$  and let  $\alpha, \beta$  be the roots of the equation  $ax^2 + bx + c = 0$ . Then  $a^3x^2 + abcx + c^3 = 0$  has roots

- (A)  $\alpha^2\beta, \alpha\beta^2$
- (B)  $\alpha\beta^2$
- (C)  $\alpha^2\beta, \beta\alpha$
- (D)  $\alpha^3\beta, \alpha\beta^3$

170. The total number of proper factors of 7875 is

- (A) 23
- (B) 24
- (C) 22
- (D) 21

171. In a Poisson distribution, if  $P(X = 2) = P(X = 3)$ , then  $P(X = 4)$  is equal to

- (A)  $e^{-2}$
- (B)  $\frac{27e^{-2}}{4}$
- (C)  $\frac{27e^{-3}}{8}$
- (D)  $\frac{2e^{-3}}{4}$

172. If  $f(x) = \sin^4 x + \cos^4 x + 1$ , then the range of  $f(x)$  is

- (A)  $\left[ \frac{3}{2}, 2 \right]$
- (B)  $\left[ 1, \frac{3}{2} \right]$
- (C)  $[1, 2]$
- (D)  $[2, 3]$

173. The fifth term of a GP is 2. Then the product of first 9 terms is

- (A) 128
- (B) 64
- (C) 256
- (D) 512

174.  $\lim_{x \rightarrow 0} \frac{\sqrt{1-\cos 2x}}{\sqrt{2x}}$

- (A) exists and equal to 1
- (B) exists and equal to -1
- (C) exists
- (D) does not exist

175. If  $A = \begin{bmatrix} 2 & -0.1 \\ 0 & 3 \end{bmatrix}$  and  $A^{-1} = \begin{bmatrix} 1 & a \\ 2 & b \end{bmatrix}$ , then  $a + b$  is equal to

- (A)  $\frac{7}{20}$
- (B)  $\frac{3}{20}$
- (C)  $\frac{19}{60}$
- (D)  $\frac{11}{20}$

176. If the points  $(x, y)$ ,  $(x', y')$  and  $(x-x', y-y')$  are collinear, then

- (A)  $xy = x'y'$
- (B)  $xx' = yy'$
- (C)  $xy' = x'y$
- (D)  $x' - y' = 1$

177. The maximum value of  $S = 5 + 4\frac{2}{3} + 4\frac{1}{3} + \dots$  is equal to

- (A) 30
- (B) 40
- (C) 55
- (D) 60

178. The ordinary differential equation corresponding to the general solution  $y = A\sin 2t + B\cos 2t$  is

- (A)  $\frac{d^2y}{dt^2} + \frac{dy}{dt} + 4y = 0$
- (B)  $\frac{d^2y}{dt^2} - 4y = 0$
- (C)  $\frac{d^2y}{dt^2} + 8y = 0$
- (D)  $\frac{d^2y}{dt^2} - 4y = 0$

179. If  $\frac{1-3p}{2}$ ,  $\frac{1+4p}{3}$ ,  $\frac{1+p}{6}$  are the probability of three mutually exclusive and exhaustive events, then the set of all values of 'p' is in

- (A)  $\left(-\frac{1}{4}, \frac{1}{3}\right)$
- (B)  $(0, 1)$
- (C)  $\left(0, \frac{1}{3}\right)$
- (D)  $\left(-\frac{1}{4}, 0\right)$

180. The equation of the largest circle with centre  $(1, 0)$  that can be inscribed in the ellipse  $x^2 + 4y^2 = 16$  is

(A)  $(x-1)^2 + (y-0)^2 = \frac{1}{3}$   
(B)  $(x-1)^2 + (y-0)^2 = \frac{7}{3}$   
(C)  $(x-1)^2 + (y-0)^2 = \frac{11}{3}$   
(D)  $(x-1)^2 + (y-0)^2 = \frac{13}{3}$

181. The imaginary part of  $(z-1)(\cos \alpha - i \sin \alpha) + (z-1)-1(\cos \alpha + i \sin \alpha)$  is zero if

(A)  $|z-1| = 2$   
(B)  $\arg(z-1) = 2\alpha$   
(C)  $\arg(z-1) = \alpha$   
(D)  $|z| = 1$

182.  $a, b, c$  are three unequal numbers such that  $a, b, c$  are in AP and  $b-a, c-b, a$  are in GP. Then  $a : b : c$  is

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

183. The number of solutions of the equation  $a^{f(x)} + g(x) = 0$ ,  $a > 0$ ,  $g(x) \neq 0$  and has minimum value of  $\frac{1}{2}$ , is

(A) one  
(B) two  
(C) zero  
(D) infinitely many

184. The set of points of discontinuity of the function  $\frac{1}{\log|x|}$  in  $\mathbb{R}$  is

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

185. The solution set for  $\left(\sqrt{2+\sqrt{2}}\right)^x + \left(\sqrt{2-\sqrt{2}}\right)^x = 2 \cdot 2^{x/4}$  is

- (A)  $\{0\}$
- (B)  $\{0, 2\}$
- (C)  $\{2\}$
- (D)  $[0, 2]$

186. Let  $f(x) = \begin{vmatrix} x^3 & \sin x \\ 1 & 2 \end{vmatrix}$ . Then  $\int_{-a}^a f(x) dx$  is equal to

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

187. The value of  $\frac{\cos\theta}{1+\sin\theta}$  is equal to

- (A)  $\tan\left(\frac{\pi}{3} - \frac{\theta}{4}\right)$
- (B)  $\tan\left(\frac{\pi}{4} - \frac{\theta}{3}\right)$
- (C)  $\tan\left(\frac{\theta}{3} - \frac{\pi}{4}\right)$
- (D)  $\tan\left(\frac{\theta}{4} - \frac{\pi}{3}\right)$

188. Let  $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ ,  $\vec{b} = 3\hat{i} - \hat{j} + \hat{k}$  and  $\vec{c} = \hat{i} + \hat{j} + 3\hat{k}$ . If  $\vec{r} \cdot \vec{a} = \vec{r} \cdot \vec{b}$  and  $\vec{r} \cdot \vec{c} = 0$ , then  $\vec{r}$  is equal to

- (A)  $\frac{1}{2}(\hat{i} + \hat{j} + \hat{k})$
- (B)  $2(-\hat{i} + \hat{j} + \hat{k})$
- (C)  $2(\hat{i} + \hat{j} + \hat{k})$
- (D)  $\frac{1}{2}(\hat{i} - \hat{j} + \hat{k})$

189. The roots of the algebraic equation  $x^3 + x^2 + x + 1 = 0$  are

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

190. If the imaginary part of  $\frac{2z+1}{iz+1}$  is  $-4$ , then the locus of the point representing  $z$  in the complex plane is

- (A) a straight line
- (B) a parabola
- (C) an ellipse
- (D) a circle

191. The equation of the circle passing through  $(1, -3)$  and the points common to 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)  $3x^2 + 3y^2 + 5x - 7y - 19 = 0$

192.  $\lim_{n \rightarrow \infty} \left(1 - \frac{1}{n}\right)^{2n} =$

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

193. The function  $f(x) = x^2 + mx + n$ , where  $m$  and  $n$  real constants, describes

- (A) a one-to-one mapping
- (B) an onto mapping
- (C) a non one-to-one but an onto mapping
- (D) a mapping which is neither one-to-one nor onto

194. If  $|g(x) - g(y)| \leq |(x - y)^2|$ ;  $x, y \in R$  and  $g(0) = 1$ , then

- (A)  $g(x)$  can take any value
- (B)  $g(x) < 0$ ,  $x \in R$
- (C)  $g(x) > 0$ ,  $x \in R$
- (D)  $g(x) = 0$ ,  $x \in R$

195. All possible values of  $\sqrt{x^2 - 4}$  lie in

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

196. If  $a, b, p, q$  are non-zero real numbers, then number of common roots of two equations  $2a^2x^2 - 2abx + b^2 = 0$  and  $p^2x^2 + 2pqx + q^2 = 0$  is

- (A) 1
- (B) 0
- (C) 2
- (D)  $\infty$

197. The number of complex numbers  $z$  satisfying  $\operatorname{Re}(z^2) = 0$  and  $|z| = \sqrt{3}$  is

- (A) 0
- (B) 2
- (C) 3
- (D) 4

198. The degree of the polynomial  $(1+x)(1+x^6)(1+x^{11})\dots(1+x^{101})$  is

- (A) 21
- (B) 101
- (C) 1071
- (D) 501

199. Let  $f(x)$  be a continuous function defined for  $1 \leq x \leq 3$ . If  $f(x)$  takes rational values for all  $x$  and  $f(2) = 10$ , then  $f(1.5)$  is

- (A) 0
- (B) 10
- (C) not defined
- (D) a constant

200. If  $\int \frac{1}{x+x} dx = f(x) + c$ , then  $\int \frac{x^4}{x+x^5} dx$  is equal to

- (A)  $\log|x| + f(x) + c$
- (B)  $\log|x| - f(x) + c$
- (C)  $x^4 f(x) + c$
- (D)  $\log f(x) + x + c$

201. If  $a, b, c$  are in A.P., then the straight line  $ax + by + c = 0$  will always pass through the point

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

202. Lines  $\vec{r} = \vec{a}_1 + t\vec{b}_1$  and  $\vec{r} = \vec{a}_2 + s\vec{b}_2$  lie on a plane, if

(A)  $\vec{a}_1 \times \vec{a}_2 = 0$   
(B)  $\vec{b}_1 \times \vec{b}_2 = 0$   
(C)  $(\vec{a}_1 - \vec{a}_2) \cdot (\vec{b}_1 - \vec{b}_2) = 0$   
(D)  $(\vec{a}_1 \cdot \vec{a}_2) \cdot (\vec{b}_1 \cdot \vec{b}_2) = 0$

203. Let  $R$  be a reflexive relation on a finite set  $A$  having  $n$  elements and let there be  $m$  ordered pairs in  $R$ . Then

(A)  $m \geq n$   
(B)  $m \leq n$   
(C)  $m = n$   
(D)  $m^2$

204. Let  $f : R \rightarrow R$  and  $g : R \rightarrow R$  be given by  $f(x) = |x|$  and  $g(x) = [x]$  for each  $x \in R$ . Then  $\{x \in R : g(f(x)) \leq f(g(x))\}$  is equal to

(A)  $\mathbb{Q} \cup (-\infty, 0)$   
(B)  $(-\infty, 0)$   
(C)  $\mathbb{Q}$   
(D)  $\mathbb{R}$

205. If coefficient of  $x^n$  in  $(1+x)^{101}(1-x+x^2)^{100}$  is non-zero, then  $n$  cannot be of the form

(A)  $3t+1$   
(B)  $3t$   
(C)  $3t+2$   
(D)  $6t+1$

206. The sum of all natural numbers less than 200, that are divisible neither by 3 nor by 5, is

(A) 10730  
(B) 10732  
(C) 15375  
(D) 8022

207. The maximum value of  $(7-x)^4(2+x)^5$ , when  $x$  lies between  $-2$  and  $7$ , is

(A)  $(4^45^5)^6$

(B)  $(4^45^4)^9$

(C)  $(4^45^5)^9$

(D)  $(4^55^4)^9$

208. The number of words that can be formed with the letters of the word MATHEMATICS by rearranging them is

(A)  $\frac{11!}{2!2!}$

(B)  $\frac{11!}{2!2!2!}$

(C)  $\frac{11!}{2!}$

(D)  $11!$

209. If the number of terms in the expansion  $(x + y + z)^n$  is 36, then the value of  $n$  is

(A) 8

(B) 7

(C) 9

(D) 10

210. With reference to a universal set, the relation of inclusion of a subset in another, is

(A) a symmetric relation

(B) an equivalence relation

(C) a reflexive relation

(D) not a transitive relation

211. If  $\alpha, \beta, \gamma$  are the roots of  $x^3 + px^2 + q = 0$ , where  $q \neq 0$ , then  $\Delta =$

$$\begin{vmatrix} 1 & 1 & 1 \\ \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix}$$

is equal to

(A)  $\frac{p}{q}$

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

(C)  $\frac{p^2}{q}$

(D) 0

212. If one of the lines given by the equation  $2x^2 + axy + 3y^2 = 0$  coincide with one of those given by  $2x^2 + bxy - 3y^2 = 0$  and the other lines represented by them be perpendicular, then

(A)  $a = -5, b = 1$

(B)  $a = 5, b = -1$

(C)  $a = 5, b = 1$

(D)  $a = -5, b = -1$

213. The number of natural numbers which are smaller than  $2 \times 10^8$  and which can be written by means of the digits 1 and 2 is

(A) 766

(B) 856

(C) 656

(D) 866

214. If  $\alpha + \beta = \gamma$  and  $\tan \gamma = 22$ , 'a' is the arithmetic and 'b' is the geometric mean respectively of  $\tan \alpha$  and  $\tan \beta$ , then the value of  $\frac{a^3 - 3}{(1 - b^2)}$  is equal to

- (A) 1331
- (B) 1320
- (C) 1330
- (D) 1335

215. If  $z = 4 + i\sqrt{7}$ , then value of  $z^3 - 4z^2 - 9z + 91$  equals

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

216. If  $S = \{x \in \mathbb{R} : (\log_{0.6} 0.216)\log_5(5 - 2x) \leq 0\}$ , then  $S$  is equal to

- (A)  $[2.5, \infty)$
- (B)  $[2, 2.5)$
- (C)  $(2, 2.5)$
- (D)  $(0, 2.5)$

217. If the lines joining the origin to the intersection of the line  $y = mx + 2$  and the curve  $x^2 + y^2 = 1$  are at right angles, then

- (A)  $m^2 = 1$
- (B)  $m^2 = 3$
- (C)  $m^2 = 7$
- (D)  $2m^2 = 1$

218. If  $P$  is a point  $(x, y)$  on the line  $y = -3x$  such that  $P$  and the point  $(3, 4)$  are on the opposite sides of the line  $3x - 4y = 8$ , then

(A)  $x > \frac{8}{15}, y < -\frac{8}{5}$

(B)  $x > \frac{8}{5}, y < -\frac{8}{15}$

(C)  $x = \frac{8}{15}, y = -\frac{8}{5}$

(D)  $x \neq 8, y = 36$

219. Two integers  $r$  and  $s$  are drawn one at a time without replacement from the set  $\{1, 2, \dots, n\}$ . If  $P_k = P(r \leq k | s \leq k)$ , and  $n = 25$ , then  $8P_7 =$

(A) 1

(B) 0

(C) 2

(D) 4

220. If the numerical value of  $\left| \cos^{-1}\left(\frac{4}{5}\right) + \tan^{-1}\left(\frac{2}{7}\right) \right|$  is  $\frac{a}{b}$ , then

(A)  $a+b=23$

(B)  $a+b=0$

(C)  $3b=a+2$

(D)  $2a=3b$

221. A fair coin is tossed  $n$  times. If the probability that head occurs 6 times is equal to the probability that head occurs 8 times, then value of  $n$  is

(A) 24

(B) 48

(C) 14

(D) 16

222. If  $A$  and  $B$  are acute positive angles satisfying the equations  $3\sin^3 A + 2\sin^2 B = 1$  and  $3\sin 2A - 2\sin 2B = 0$ , then  $A + 2B$  is equal to

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

223. If  $\sin^{-1} x + \sin^{-1} y + \sin^{-1} z = \frac{3\pi}{2}$  then the value of  $3000(x+y+z) \frac{816}{x^2+y^2+z^2}$  is

equal to

- (A) 8724
- (B) 8728
- (C) 8772
- (D) 8767

224. Let  $P, Q, R$  be three points on a parabola  $y^2 = 4ax$  whose ordinates are in geometrical progression, then the tangents at  $P$  and  $R$  meet on

- (A) the line through  $Q$  parallel to  $x$ -axis
- (B) the line through  $Q$  parallel to  $y$ -axis
- (C) the line joining  $Q$  and the vertex
- (D) the line joining  $Q$  and the focus

225. Let  $f : \{2, 3, 4, 5\} \rightarrow \{3, 4, 5, 9\}$  and  $g : \{3, 4, 5, 9\} \rightarrow \{7, 11, 15\}$  be functions defined as  $f(2) = 3, f(3) = 4, f(4) = f(5) = 5$  and  $g(3) = g(4) = 7$  and  $g(5) = g(9) = 11$ . Then  $g \circ f(2, 3, 4, 5) =$

- (A) (7, 7, 11, 11)
- (B) (3, 5, 7, 4)
- (C) (5, 7, 11, 7)
- (D) (9, 9, 15, 15)

## FINAL ANSWER KEY

**Subject Name: TEST FOR PHYSICS CHEMISTRY MATHEMATICS SHIFT I**

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

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