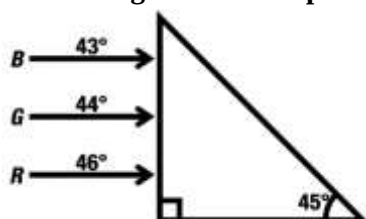
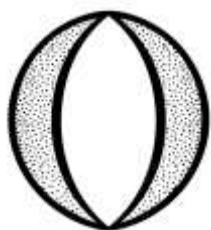


PHYSICS

1. A ray of light enters from a rarer to a denser medium. The angle of incidence is i . Then, the reflected and refracted rays are mutually perpendicular to each other. The critical angle for the pair of media is
 (a) $\sin^{-1}(\tan i)$ (b) $\tan^{-1}(\sin i)$
 (c) $\sin^{-1}(\cot i)$ (d) $\cos^{-1}(\tan i)$
2. A fish in water (refractive index n) looks at a bird vertically above in the air. If y is the height of the bird and x is the depth of the fish from the surface, then the distance of the bird as estimated by the fish is
 (a) $x + y \left(1 - \frac{1}{n}\right)$ (b) $x + ny$
 (c) $x + y \left(1 + \frac{1}{n}\right)$ (d) $y + x \left(1 - \frac{1}{n}\right)$
3. Figure shows a mixture of blue, green and red coloured rays incident normally on a right angled prism. The critical angles of the material of the prism for red, green and blue are 46° , 44° and 43° , respectively. The arrangement will separate

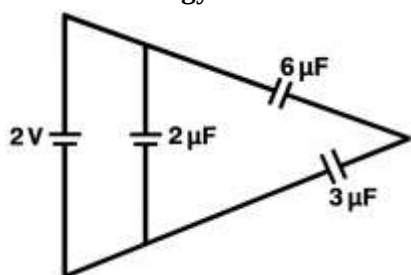


- (a) red colour from blue and green
 (b) blue colour from red and green
 (c) green colour from red and blue
 (d) All the three colours
4. A convex and a concave lens separated by distance d are then put in contact. The focal length of the combination
 (a) decreases (b) increases
 (c) becomes zero (d) remains the same
5. A convex lens is made of 3 layers of glass of 3 different materials as in the figure. A point object is placed on its axis. The number of images of the object are



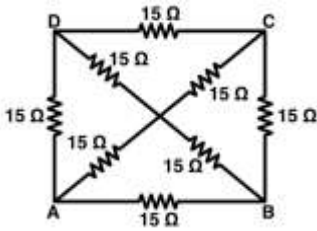
- (a) 1 (b) 2
 (c) 3 (d) 4
6. If μ_0 is permeability of free space and ϵ_0 is permittivity of free space, then the speed of light in vacuum is given by
 (a) $\sqrt{\mu_0 \epsilon_0}$ (b) $\sqrt{\mu_0 / \epsilon_0}$
 (c) $\sqrt{\frac{1}{\mu_0 \epsilon_0}}$ (d) $\sqrt{\epsilon_0 / \mu_0}$
7. In Young's double slit experiment, a third slit is made in between the double slits. Then,
 (a) intensity of fringes totally disappears
 (b) only bright light is observed on the screen
 (c) fringes of unequal width are formed
 (d) contrast between bright and dark fringes is reduced
8. The maximum number of possible interference maxima when slit separation is equal to 4 times the wavelength of light used in a double slit experiment is

- (a) ∞ (b) 3
(c) 8 (d) 4
9. In a Fraunhofer diffraction experiment at a single slit using a light of wavelength 400 nm, the first minimum is formed at an angle of 30° . The direction θ of the first secondary maximum is given by
(a) $\sin^{-1}(2/3)$ (b) $\sin^{-1}(3/4)$
(c) $\sin^{-1}(1/4)$ (d) $\tan^{-1}(2/3)$
10. Maximum diffraction takes place in a given slit for
(a) γ -rays (b) ultraviolet light
(c) infrared light (d) radio waves
11. An unpolarised beam of intensity I_0 falls on a polaroid. The intensity of the emergent light is
(a) $I_0/2$ (b) I_0
(c) $I_0/4$ (d) Zero
12. Which of the following is a dichroic crystal?
(a) Quartz (b) Tourmaline
(c) Mica (d) Selenite
13. Two identical metal spheres charged with $+12\mu\text{F}$ and $-8\mu\text{F}$ are kept at certain distance in air. They are brought into contact and then kept at the same distance. The ratio of the magnitudes of electrostatic forces between them before and after contact is
(a) 12 : 1 (b) 8 : 1
(c) 24 : 1 (d) 4 : 1
14. A small conducting sphere of radius r is lying concentrically inside a bigger hollow conducting sphere of radius R . The bigger and smaller spheres are charged with Q and q ($Q > q$) and are insulated from each other. The potential difference between the spheres will be
(a) $\frac{1}{4\pi\epsilon_0} \left(\frac{q}{r} - \frac{q}{R} \right)$ (b) $\frac{1}{4\pi\epsilon_0} \left(\frac{q}{R} - \frac{Q}{r} \right)$
(c) $\frac{1}{4\pi\epsilon_0} \left(\frac{q}{r} - \frac{Q}{R} \right)$ (d) $\frac{1}{4\pi\epsilon_0} \left(\frac{Q}{R} + \frac{q}{r} \right)$
15. The charges Q , $+q$ and $+q$ are placed at the vertices of an equilateral triangle of side l . If the net electrostatic potential energy of the system is zero, then Q is equal to
(a) $-q/2$ (b) $-q$
(c) $+q/2$ (d) Zero
16. How many $6\mu\text{F}$, 200 V condensers are needed to make a condenser of $18\mu\text{F}$, 600 V ?
(a) 9 (b) 18
(c) 3 (d) 27
17. The total energy stored in the condenser system shown in the figure will be



- (a) $2\mu\text{J}$ (b) $4\mu\text{J}$
(c) $8\mu\text{J}$ (d) $16\mu\text{J}$
18. A metal wire is subjected to a constant potential difference. When the temperature of the metal wire increases, the drift velocity of the electron in it
(a) increases, thermal velocity of the electron decreases
(b) decreases, thermal velocity of the electron decreases
(c) increases, thermal velocity of the electron increases
(d) decreases, thermal velocity of the electron increases

19. The equivalent resistance between the points A and B will be (each resistance is 15Ω)

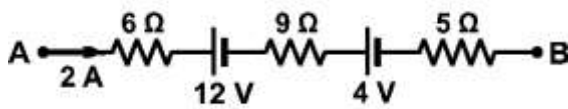


- (a) 30Ω (b) 8Ω
(c) 10Ω (d) 40Ω

20. The terminals of a 18 V battery with an internal resistance of 1.5Ω are connected to a circular wire of resistance 24Ω at two points distant at one quarter of the circumference of a circular wire. The current through the bigger arc of the circle will be

- (a) 0.75 A (b) 1.5 A
(c) 2.25 A (d) 3 A

21. The potential difference between A and B in the following figure is

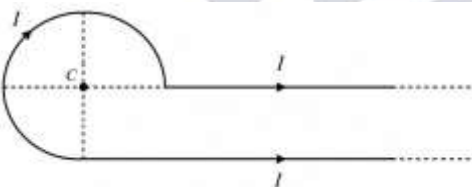


- (a) 32 V (b) 48 V
(c) 24 V (d) 14 V

22. The magnetic field at the centre of a circular current carrying conductor of radius r is B_c . The magnetic field on its axis at a distance r from the centre is B_a . The value of $B_c : B_a$ will be

- (a) $1 : \sqrt{2}$ (b) $1 : 2\sqrt{2}$
(c) $2\sqrt{2} : 1$ (d) $\sqrt{2} : 1$

23. Current I is flowing in a conductor shaped as shown in the figure. The radius of the curved part is r and the length of straight portion is very large. The value of the magnetic field at the centre O will be

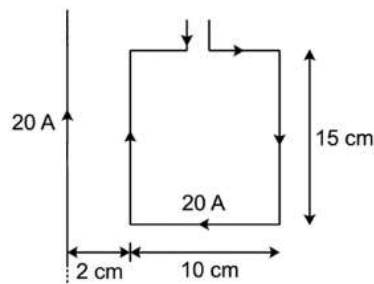


- (a) $\frac{\mu_0 I}{4\pi r} \left(\frac{3\pi}{2} + 1 \right)$ (b) $\frac{\mu_0 I}{4\pi r} \left(\frac{3\pi}{2} - 1 \right)$
(c) $\frac{\mu_0 I}{4\pi r} \left(\frac{\pi}{2} + 1 \right)$ (d) $\frac{\mu_0 I}{4\pi r} \left(\frac{\pi}{2} - 1 \right)$

24. Two tangent galvanometers A and B are identical except in their number of turns. They are connected in series. On passing a current through them, deflections of 60° and 30° are produced. The ratio of the number of turns in A and B is

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

25. The resultant force on the current loop PQRS due to a long current carrying conductor will be



- (a) 10^{-4} N (b) $3.6 \times 10^{-4}\text{ N}$
(c) $1.8 \times 10^{-4}\text{ N}$ (d) $5 \times 10^{-4}\text{ N}$

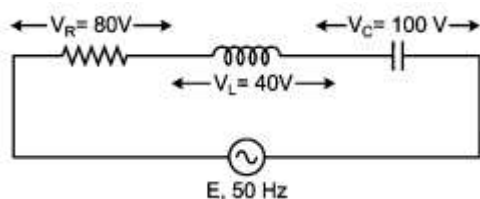
26. A certain current on passing through a galvanometer produces a deflection of 100 divisions. When a shunt of one ohm is connected, then the deflection reduces to 1 division. The galvanometer resistance is

- (a) 100Ω (b) 99Ω
(c) 10Ω (d) 9.9Ω

27. Two similar circular loops carry equal currents in the same direction. On moving the coils further apart, the electric current will

- (a) increase in both
(b) decrease in both
(c) remain unaltered
(d) increases in one and decreases in the second

28. The value of alternating emf E in the given circuit will be



- (a) 220 V (b) 140 V
(c) 100 V (d) 20 V

29. A current of 5 A is flowing at 220 V in the primary coil of a transformer. If the voltage produced in the secondary coil is 2200 V and 50 % of power is lost, then the current in the secondary will be

- (a) 2.5 A (b) 5 A
(c) 0.25 A (d) 0.5 A

30. For a series L – C – R circuit at resonance, the statement which is not true?

- (a) Peak energy stored by a capacitor = peak energy stored by an inductor
(b) Average power = Apparent power
(c) Wattless current is zero.
(d) Power factor is zero.

31. Solar spectrum is an example for

- (a) line emission spectrum
(b) continuous emission spectrum
(c) hand absorption spectrum
(d) line absorption spectrum

32. When a piece of metal is illuminated by a monochromatic light of wavelength λ , then stopping potential is 3 V -s. When same surface is illuminated by light of wavelength 2λ , then stopping potential becomes V_s . The value of threshold wavelength for photoelectric emission will be

- (a) 4λ (b) 8λ
(c) $4/3\lambda$ (d) 6λ

33. The maximum kinetic energy of emitted electrons in a photoelectric effect does not depend upon

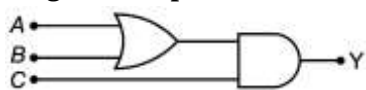
- (a) wavelength (b) frequency
(c) intensity (d) work-function

34. The ratio of minimum wavelength of Lyman and Balmer series will be

- (a) 1.25 (b) 0.25
(c) 5 (d) 10

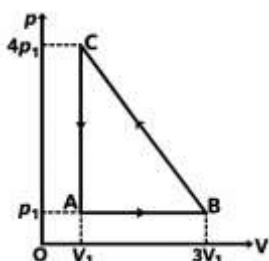
35. Hydrogen atom does not emit X-rays because

- (a) it contains only a single electron
(b) energy levels in it are far apart
(c) its size is very small
(d) energy levels in it are very close to each other

36. If an electron and a proton have the same de-Broglie wavelength, then the kinetic energy of the electron is
 (a) Zero
 (b) less than that of a proton
 (c) more than that of a proton
 (d) equal to that of a proton
37. Two protons are kept at a separation of $40\text{\AA}$. F_a is the nuclear force and F_e is the electrostatic force between them. Then,
 (a) $F_n \gg F_e$ (b) $F_n = F_e$
 (c) $F_n \ll F_e$ (d) $F_n \simeq F_e$
38. Blue colour of sea water is due to
 (a) interference of sunlight reflected from the water surface
 (b) scattering of sunlight by the water molecules
 (c) image of sky in water
 (d) refraction of sunlight
39. The ratio of the nuclear radii of elements with mass numbers 216 and 125 is
 (a) 216:125 (b) $\sqrt{216}:\sqrt{125}$
 (c) 6:5 (d) None of these
40. On bombarding U^{235} by slow neutron, 200 MeV energy is released. If the power output of atomic reactor is 1.6 MW, then the rate of fission will be
 (a) $5 \times 10^{22}/s$ (b) $5 \times 10^{16}/s$
 (c) $8 \times 10^{16}/s$ (d) $20 \times 10^{16}/s$
41. The masses of two radioactive substances are same and their half-lives are 1 year and 2 years. respectively. The ratio of their activities after 6 years will be
 (a) 1:4 (b) 1:2
 (c) 1:3 (d) 1:6
42. ${}_{92}U^{235}$ undergoes successive disintegrations with the end product of ${}_{82}Pb^{243}$. The number of α and β particles emitted are
 (a) $\alpha = 6, \beta = 4$ (b) $\alpha = 6, \beta = 0$
 (c) $\alpha = 8, \beta = 6$ (d) $\alpha = 3, \beta = 3$
43. The most stable particle in Baryon group is
 (a) neutron (b) omega-particle
 (c) proton (d) lamda-particle
44. In an unbiased p – n junction
 (a) potential at p is more than that at n
 (b) potential at p is less than that at n
 (c) potential at p is equal to that at n
 (d) potential at p is + ve and that at n is - ve
45. To get an output $Y = 1$ from the circuit shown, the inputs A,B and C must be respectively
- 
- (a) 0, 1, 0 (b) 1, 0, 0
 (c) 1, 0, 1 (d) 1, 1, 0
46. Dimensional formula for the universal gravitational constant G is
 (a) $[M^{-1} L^2 T^{-2}]$ (b) $[M^0 L^0 T^0]$
 (c) $[M^{-1} L^3 T^{-2}]$ (d) $[M^{-1} L^3 T^{-1}]$
47. A body is projected vertically upwards. The times corresponding to height h, while ascending and descending are t_1 and t_2 , respectively. Then, the velocity of projection is (g is acceleration due to gravity)

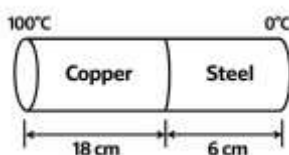
- (a) $g\sqrt{t_1 t_2}$ (b) $\frac{gt_1 t_2}{t_1 + t_2}$
 (c) $\frac{g\sqrt{t_1 t_2}}{2}$ (d) $\frac{g(t_1 + t_2)}{2}$

48. A mass of 10 kg is suspended from a spring balance. It is pulled a side by a horizontal string, so that it makes an angle of 60° with the vertical. The new reading of the balance is
 (a) 20 kg - wt (b) 10 kg - wt
 (c) $10\sqrt{3}$ kg - wt (d) $20\sqrt{3}$ kg - wt
49. A body weight 50 g in air and 40 g in water. How much would it weight in a liquid of specific gravity 1.5 ?
 (a) 30 g (b) 35 g
 (c) 65 g (d) 45 g
50. A body of mass 4 kg is accelerated upon by a constant force, travels a distance of 5 m in the 1 st second and a distance of 2 m in the 3rd second. The force acting on the body is
 (a) 2 N (b) 4 N
 (c) 6 N (d) 8 N
51. A simple pendulum is suspended from the ceiling of a lift. When the lift is at rest its time period is T. With what acceleration should the lift be accelerated upwards in order to reduce its period to $T/2$? (g is acceleration due to gravity)
 (a) 2 g (b) 3g
 (c) 4g (d) g
52. If γ is the ratio of specific heats and R is the universal gas constant, then the molar specific heat at constant volume C_V is given by
 (a) γR (b) $\frac{(\gamma-1)R}{\gamma}$
 (c) $\frac{R}{\gamma-1}$ (d) $\frac{\gamma R}{\gamma-1}$
53. An ideal gas is taken via path ABCA as shown in figure.



The network done in the whole cycle is

- (a) $3p_1 V_1$ (b) $-3p_1 V_1$
 (c) $6p_1 V_1$ (d) Zero
54. In which of the processes, does the internal energy of the system remain constant?
 (a) Adiabatic (b) Isochoric
 (c) Isobaric (d) Isothermal
55. The coefficient of thermal conductivity of copper is 9 times that of steel. In the composite cylindrical bar shown in the figure, what will be the temperature at the junction of copper and steel?



- (a) 75°C (b) 67°C
 (c) 25°C (d) 33°C

56. The equation of a simple harmonic wave is given by $y = 6\sin 2\pi(2t - 0.1x)$, where x and y are in mm and t is in seconds. The phase difference between two particles 2 mm apart at any instant is

- (a) 18° (b) 36°
(c) 54° (d) 72°

57. With what velocity should an observer approach a stationary sound source, so that the apparent frequency of sound should appear double the actual frequency? (v is velocity of sound).

- (a) $v/2$ (b) $3v$
(c) $2v$ (d) v

58. If a black body emits 0.5 J of energy per second when it is at 27°C , then the amount of energy emitted by it when it is at 627°C will be

- (a) 40.5 J (b) 162 J
(c) 13.5 J (d) 135 J

59. A string vibrates with a frequency of 200 Hz. When its length is doubled and tension is altered, it begins to vibrate with a frequency of 300 Hz. The ratio of the new tension to the original tension is

- (a) 9:1 (b) 1:9
(c) 3:1 (d) 1:3

60. How many times more intense is a 60 dB sound than a 30 dB sound?

- (a) 1000 (b) 2
(c) 100 (d) 4

CHEMISTRY

61. Which of the following is not an ore of magnesium?

- (a) Carnallite (b) Dolomite
(c) Calamine (d) Sea water

62. The atomic numbers of Ni and Cu are 28 and 29 respectively. The electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ represents

- (a) Cu^+ (b) Cu^{2+}
(c) Ni^{2+} (d) Ni

63. In the following, the element with the highest ionisation energy is

- (a) $[\text{Ne}]3s^2, 3p^1$ (b) $[\text{Ne}]3s^2, 3p^3$
(c) $[\text{Ne}]3s^2, 3p^2$ (d) $[\text{Ne}]3s^2, 3p^4$

64. In the conversion of Br_2 to BrO_3^- , the oxidation number of Br changes from

- (a) zero to +5 (b) +1 to +5
(c) zero to -3 (d) +2 to +5

65. Among the alkali metals caesium is the most reactive because

- (a) its incomplete shell is nearest to the nucleus
(b) it has a single electron in the valence shell
(c) it is the heaviest alkali metal
(d) the outermost electron is more loosely bound than the outermost electron of the other alkali metals.

66. Which of the following represents the Lewis structure of N_2 molecule?

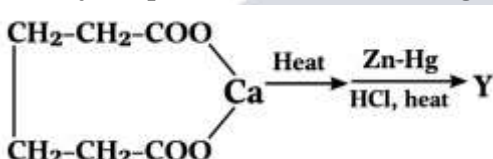
- (a) $\overset{\times}{\underset{\times}{\text{N}}} \equiv \overset{\times}{\underset{\times}{\text{N}}}$ (b) $\overset{\times\times}{\underset{\times}{\text{N}}} \equiv \overset{\times\times}{\underset{\times}{\text{N}}}$
(c) $\overset{\times\times}{\underset{\times\times}{\text{N}}} - \overset{\times\times}{\underset{\times\times}{\text{N}}}$ (d) $\overset{\times\times}{\underset{\times\times}{\text{N}}} = \overset{\times\times}{\underset{\times\times}{\text{N}}}$

67. Hydrogen bond is strongest in

- (a) $\text{S} - \text{H} - - - \text{O}$ (b) $\text{O} - \text{H} - - - \text{S}$
(c) $\text{F} - \text{H} - - - \text{F}$ (d) $\text{O} - \text{H} - - - \text{N}$

68. The decomposition of a certain mass of CaCO_3 gave 11.2dm^3 of CO_2 gas at STP. The mass of KOH required to completely neutralise the gas is

- (a) 56 g (b) 28 g
(c) 42 g (d) 20 g

69. The density of a gas is 1.964 gdm^{-3} at 273 K and 76 cm Hg. The gas is
 (a) CH_4 (b) C_2H_6
 (c) CO_2 (d) Xe
70. 0.06 mole of KNO_3 solid is added to 100 cm^3 of water at 298 K. The enthalpy of $\text{KNO}_3(\text{aq})$ solution is 35.8 kJ mol^{-1} . After the solute is dissolved the temperature of the solution will be
 (a) 293 K (b) 298 K
 (c) 301 K (d) 304 K
71. 4 moles each of SO_2 and O_2 gases are allowed to react to form SO_3 in a closed vessel. At equilibrium 25% of O_2 is used up. The total number of moles of all the gases present at equilibrium is
 (a) 6.5 (b) 7.0
 (c) 8.0 (d) 2.0
72. An example for auto-catalysis is
 (a) oxidation of NO_2 to NO_2
 (b) oxidation of SO_2 to SO_3
 (c) decomposition of KClO_3 to KCl and O_2
 (d) oxidation of oxalic acid by acidified KMnO_4
73. During the fusion of an organic compound with sodium metal, nitrogen of the compound is converted into
 (a) NaNO_2 (b) NaNH_2
 (c) NaCN (d) NaNC
74. Identify the product Y in the following reaction sequence
- 
- (a) pentane (b) cyclobutane
 (c) cyclopentane (d) cyclopentanone
75. The reaction $\text{C}_2\text{H}_5\text{ONa} + \text{C}_2\text{H}_5\text{I} \rightarrow \text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + \text{NaI}$ is known as
 (a) Kolbe's synthesis
 (b) Wurtz's synthesis
 (c) Williamson's synthesis
 (d) Grignard's synthesis
76. ΔG° vs T plot in the Ellingham's diagram, slopes downwards for the reaction
 (a) $\text{Mg} + \frac{1}{2} \text{O}_2 \rightarrow \text{MgO}$ (b) $2\text{Ag} + \frac{1}{2} \text{O}_2 \rightarrow \text{Ag}_2\text{O}$
 (c) $\text{C} + \frac{1}{2} \text{O}_2 \rightarrow \text{CO}$ (d) $\text{CO} + \frac{1}{2} \text{O}_2 \rightarrow \text{CO}_2$
77. Which of the following reaction taking place in the blast furnace is endothermic?
 (a) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
 (b) $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$
 (c) $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
 (d) $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$
78. Liquor ammonia bottles are opened only after cooling. This is because
 (a) it is a mild explosive
 (b) it is a corrosive liquid
 (c) it is a lachrymatory
 (d) it generates high vapour pressure
79. The formation of $\text{O}_2^+[\text{PtF}_6]^-$ is basis for the formation of xenon fluorides. This is because
 (a) O_2 and Xe have comparable sizes
 (b) Both O_2 and Xe are gases

- (c) O_2 and Xe have comparable ionisation energies
 (d) O_2 and Xe have comparable electronegativities
80. The highest magnetic moment is shown by the transition metal ion with the configuration
 (a) $3d^2$ (b) $3d^5$
 (c) $3d^7$ (d) $3d^9$
81. A transition metal ion exists in its highest oxidation state. It is expected to behave as
 (a) a chelating agent
 (b) a central metal, in a coordination compound
 (c) an oxidising agent
 (d) a reducing agent
82. In which of the following complex ion, the central metal ion is in a state of sp^3d^2 hybridisation?
 (a) $[CoF_6]^{3-}$ (b) $[Co(NH_3)_6]^{3+}$
 (c) $[Fe(CN)_6]^{3-}$ (d) $[Cr(NH_3)_6]^{3+}$
83. Which of the following can participate in linkage isomerism?
 (a) NO_2 (b) $H_2\ddot{N}CH_2CH_2\ddot{N}_2$
 (c) H_2O (d) $\cdot NH_3$
84. Which of the following has the highest bond order?
 (a) N_2 (b) O_2
 (c) He_2 (d) H_2
85. Which of the following is diamagnetic?
 (a) H_2^+ (b) O_2
 (c) Li_2 (d) He_2^+
86. The concentration of a reactant X decreases from 0.1 M to 0.025 M in 40 min. If the reaction follows 1st order kinetics, the rate of the reaction when the concentration of X is 0.01 M will be
 (a) $1.73 \times 10^{-4} Mmin^{-1}$
 (b) $3.47 \times 10^{-4} Mmin^{-1}$
 (c) $3.47 \times 10^{-5} Mmin^{-1}$
 (d) $1.73 \times 10^{-5} Mmin^{-1}$
87. Chemical reactions with very high E_a values are generally
 (a) very fast (b) very slow
 (c) moderately fast (d) spontaneous
88. Which of the following does not conduct electricity?
 (a) Fused NaCl (b) Solid NaCl
 (c) Brine solution (d) Copper
89. When a quantity of electricity is passed through $CuSO_4$ solution, 0.16 g of copper gets deposited. If the same quantity of electricity is passed through acidulated water, then the volume of H_2 liberated at STP will be [Given, atomic weight of Cu = 64]
 (a) $4.0 cm^3$ (b) $56 cm^3$
 (c) $604 cm^3$ (d) $80 cm^3$
90. Solubility product of a salt AB is $1 \times 10^{-8} M^2$ in a solution in which the concentration of A^+ ions is $10^{-3} M$. The salt will precipitate when the concentration of B^- ions is kept
 (a) between $10^{-8} M$ to $10^{-7} M$
 (b) between $10^{-7} M$ to $10^{-6} M$
 (c) $> 10^{-5} M$
 (d) $< 10^{-8} M$
91. Which one of the following condition will increase the voltage of the cell represented by the equation.
 $Cu(s) + 2Ag^+(aq) \rightleftharpoons Cu^{2+}(aq) + 2Ag(s)$

- (a) increase in the dimensions of Cu electrode
 (b) increase in the dimensions of Ag electrode
 (c) increase in the concentration of Cu^{2+} ions
 (d) increase in the concentration of Ag^+ ions
92. The pH of 10^{-8}M HCl solution is
 (a) 8 (b) more than 8
 (c) between 6 and 7 (d) slightly more than 7
93. The mass of glucose that should be dissolved in 50 g of water in order to produce the same lowering of vapour pressure as is produced by dissolving 1g of urea in the same quantity of water is
 (a) 1 g (b) 3 g
 (c) 6 g (d) 18 g
94. Osmotic pressure observed when benzoic acid is dissolved in benzene is less than that expected from theoretical considerations. This is because
 (a) benzoic acid is an organic solute
 (b) benzoic acid has higher molar mass than benzene
 (c) benzoic acid gets associated in benzene
 (d) benzoic acid gets dissociated in benzene
95. For a reaction to be spontaneous at all temperatures
 (a) ΔG and ΔH should be negative
 (b) ΔG and ΔH should be positive
 (c) $\Delta G = \Delta S = 0$
 (d) $\Delta H < \Delta G$
96. Which of the following electrolyte will have maximum flocculation value for $\text{Fe}(\text{OH})_3$ sol.?
 (a) NaCl (b) Na_2S
 (c) $(\text{NH}_4)_3\text{PO}_4$ (d) K_2SO_4
97. For a reversible reaction, $\text{X}(\text{g}) + 3\text{Y}(\text{g}) \rightleftharpoons 2\text{Z}(\text{g})$
 $\Delta H = -40 \text{ kJ}$ the standard entropies of X, Y and Z are $60, 40$ and $50 \text{ J K}^{-1} \text{ mol}^{-1}$ respectively.
 The temperature at which the above reaction attains equilibrium is about
 (a) 400 K (b) 500 K
 (c) 273 K (d) 373 K
98. The radii of Na^+ and Cl^- ions are 95 pm and 181 pm respectively. The edge length of NaCl unit cell is
 (a) 276 pm (b) 138 pm
 (c) 552 pm (d) 415 pm
99. Inductive effect involves
 (a) displacement of σ -electrons
 (b) delocalisation of π -electrons
 (c) delocalisation of σ -electrons
 (d) displacement of π -electrons
100. The basicity of aniline is less than that of cyclohexylamine. This is due to
 (a) + R-effect of $-\text{NH}_2$ group
 (b) -I-effect of $-\text{NH}_2$ group
 (c) -R-effect of $-\text{NH}_2$ group
 (d) hyperconjugation effect
101. Methyl bromide is converted into ethane by heating it in ether medium with
 (a) Al (b) Zn
 (c) Na (d) Cu
102. Which of the following compound is expected to be optically active?
 (a) $(\text{CH}_3)_2\text{CHCHO}$ (b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
 (c) $\text{CH}_3\text{CH}_2\text{CHBrCHO}$ (d) $\text{CH}_3\text{CH}_2\text{CBr}_2\text{CHO}$

103. Which cycloalkane has the lowest heat of combustion per CH_2 group?

- (a)cyclopropane (b)cyclobutane
(c)cyclopentane (d)cyclohexane

104. The catalyst used in the preparation of an alkyl chloride by the action of dry HCl on an alcohol is

- (a)anhydrous AlCl_3 (b) FeCl_3
(c)anhydrous ZnCl_2 (d) Cu

105. In the reaction, $\text{R} - \text{X} \xrightarrow[\text{KCN}]{\text{Alcoholic}} \text{A} \xrightarrow[\text{HCl}]{\text{Dilute}} \text{B}$, the product B is

- (a)alkyl chloride (b)aldehyde
(c)carboxylic acid (d)ketone

106. Which of the following compound would not evolve CO_2 when treated with NaHCO_3 solution?

- (a)Salicylic acid (b)Phenol
(c)Benzoic acid (d)4-nitro benzoic acid

107. By heating phenol, with chloroform in alkali, it is converted into

- (a)salicylic acid (b)salicylaldehyde
(c)anisole (d)phenyl benzoate

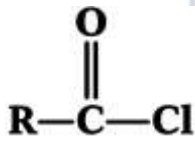
108. When a mixture of calcium benzoate and calcium acetate is dry distilled, the resulting compound is

- (a)acetophenone (b)benzaldehyde
(c)benzophenone (d)acetaldehyde

109. Which of the following does not give benzoic acid on hydrolysis?

- (a)Phenyl cyanide (b)Benzoyl chloride
(c)Benzyl chloride (d)Methyl benzoate

110. Which of the following would undergo Hofmann reaction to give a primary amine?



- (a) (b) RCO NH CH_3
(c) RCONH_2 (d) RCOOR

111. Glucose contains in addition to aldehyde group

- (a)one secondary OH and four primary OH groups
(b)one primary OH and four secondary OH groups
(c)two primary OH and three secondary OH groups
(d)three primary OH and two secondary OH groups

112. A distinctive and characteristic functional group of fats is

- (a)a peptide group (b)an ester group
(c)an alcoholic group (d)a ketonic group

113. At $\text{pH} = 4$ glycine exists as

- (a) $\text{H}_3\text{N}^+ - \text{CH}_2 - \text{COO}^-$
(b) $\text{H}_3\text{N}^+ - \text{CH}_2 - \text{COOH}$
(c) $\text{H}_2\text{N} - \text{CH}_2 - \text{COOH}$
(d) $\text{H}_2\text{N} - \text{CH}_2 - \text{COO}^-$

114. Insulin regulates the metabolism of

- (a)minerals (b)amino acids
(c)glucose (d)vitamins

115. The formula mass of Mohr's salt is 392 g. The iron present in it is oxidised by KMnO_4 in acid medium.

The equivalent mass of Mohr's salt is

- (a)392 (b)31.6
(c)278 (d)156

116. The brown ring test for nitrates depends on

- (a) the reduction of nitrate to nitric oxide
- (b) oxidation of nitric oxide to nitrogen dioxide
- (c) reduction of ferrous sulphate to iron
- (d) oxidising action of sulphuric acid

117. Acrolein test is positive for

- (a) polysaccharides
- (b) proteins
- (c) oils and fats
- (d) reducing sugars

118. An organic compound which produces a bluish green coloured flame on heating in presence of copper is

- (a) chlorobenzene
- (b) benzaldehyde
- (c) aniline
- (d) benzoic acid

119. For a reaction, $A + B \rightarrow C + D$, If the concentration of A is doubled without altering the concentration of B, the rate gets doubled. If the concentration of B is increased by nine times without altering the concentration of A, the rate gets tripled. The order of the reaction is

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

120. Which of the following solutions will exhibit highest boiling point?

- (a) 0.01M $\text{Na}_2\text{SO}_4(\text{aq})$
- (b) 0.01M $\text{KNO}_3(\text{aq})$
- (c) 0.015 M urea (aq)
- (d) 0.015 M glucose (aq)

MATHEMATICS

121. If $u = a - b$, $v = a + b$, and $|a| = |b| = 2$, then $|u \times v|$ is

- (a) $2\sqrt{16 - (a \cdot b)^2}$
- (b) $2\sqrt{4 - (a \cdot b)^2}$
- (c) $\sqrt{16 - (a \cdot b)^2}$
- (d) $\sqrt{4 - (a \cdot b)^2}$

122. The volume of the tetrahedron formed by the points (1, 1, 1), (2, 1, 3) (3, 2, 2) and (3, 3, 4) in cubic units is

- (a) $\frac{5}{6}$
- (b) $\frac{6}{5}$
- (c) 5
- (d) $\frac{2}{3}$

123. Unit vector perpendicular to $\hat{i} - 2\hat{j} + 2\hat{k}$ and lying in the plane containing $\hat{i} + \hat{j} - 2\hat{k}$ and $-\hat{i} + 2\hat{j} + \hat{k}$ is

- (a) $8\hat{i} - 7\hat{j} + 11\hat{k}$
- (b) $8\hat{i} + 7\hat{j} - 11\hat{k}$
- (c) $8\hat{i} - 7\hat{j} - 11\hat{k}$
- (d) $\frac{1}{\sqrt{234}}(8\hat{i} - 7\hat{j} - 11\hat{k})$

124. In the group $Q - \{1\}$ under the binary operation $*$ defined by $a * b = a + b + ab$ the inverse of 10 is

- (a) $\frac{1}{10}$
- (b) $\frac{11}{10}$
- (c) $\frac{-11}{10}$
- (d) $\frac{-10}{11}$

125. In the group $\{1, 2, 3, 4, 5, 6\}$ under multiplication mod 7, $2^{-1}X_7^4 =$

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

126. The group $(Z, +)$ has

- (a) exactly one sub-group
- (b) only two sub-groups
- (c) no sub-groups
- (d) infinitely many subgroups

127. If $3x \equiv 5(\text{mod } 7)$, then

- (a) $x \equiv 2(\text{mod } 7)$
- (b) $x \equiv 3(\text{mod } 7)$
- (c) $x \equiv 4(\text{mod } 7)$
- (d) None of these

128. The argument of the complex number $\sin\left(\frac{6\pi}{5}\right) + i\left(1 + \cos\frac{6\pi}{5}\right)$ is

- (a) $\frac{\pi}{10}$ (b) $\frac{5\pi}{6}$
(c) $\frac{-\pi}{10}$ (d) $\frac{2\pi}{5}$

129. The maximum value of $n < 101$, such that $1 + \sum_{k=1}^n i^k = 0$ is

- (a) 96 (b) 97
(c) 99 (d) 100

130. The value of $(-1 + \sqrt{-3})^{62} + (-1 - \sqrt{-3})^{62}$ is

- (a) 2^{62} (b) 2^{+3}
(c) -2^{62} (d) 0

131. All complex number z which satisfy the equation $\left|\frac{z-6i}{z+6i}\right| = 1$ lie on the

- (a) imaginary axis (b) real axis
(c) neither of the axes (d) None of the above

132. The value of $\sin[\cot^{-1}\{\cos(\tan^{-1}x)\}]$ is

- (a) $\left(\sqrt{\frac{1+x^2}{2+x^2}}\right)$ (b) $\left(\sqrt{\frac{2+x^2}{1+x^2}}\right)$
(c) $\left(\sqrt{\frac{x^2-2}{x^2-1}}\right)$ (d) $\left(\sqrt{\frac{x^2-1}{x^2-2}}\right)$

133. The value of $\alpha (\neq 0)$ for which the function $f(x) = 1 + \alpha x$ is the inverse of itself is

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

134. If x occurs in the expansion of $\left(x + \frac{1}{x}\right)^n$, then its coefficient is

- (a) $\frac{n!}{(r!)^2}$ (b) $\frac{n!}{(r+1)!(r-1)!}$
(c) $\frac{n!}{\left(\frac{n+r}{2}\right)!\left(\frac{n-r}{2}\right)!}$ (d) $\frac{n!}{\left[\left(\frac{n}{2}\right)\right]^2}$

135. If $\tan A - \tan B = x$ and $\cot B - \cot A = y$, then $\cot(A - B) =$

- (a) $\frac{1}{y} - \frac{1}{x}$ (b) $\frac{1}{x} - \frac{1}{y}$
(c) $\frac{1}{x} + \frac{1}{y}$ (d) None of these

136. $\cos^2 \frac{\pi}{12} + \cos^2 \frac{\pi}{4} + \cos^2 \frac{5\pi}{12} =$

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

137. If $\sin\theta, \cos\theta$ and $\tan\theta$ are in GP, then $\cot^6\theta - \cot^2\theta$ is

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

138. If $\frac{3x^2-2x+4}{(x-1)^6} = \frac{A_1}{x+1} + \frac{A_2}{(x+1)^2} + \frac{A_3}{(x+1)^3} + \frac{A_4}{(x+1)^4} + \frac{A_5}{(x+1)^5} + \frac{A_6}{(x+1)^6}$, then $(A_1 + A_2 + A_3 - A_4 - A_5 - A_6) =$

- (a) (0,0) (b) (-8, -12)
(c) (8, -12) (d) (-8, 12)

139. If $\log_2(2^{x-1} + 6) + \log_2(4^{x-1}) = 5$, then $x =$

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

140. If a, b, c , and d are the roots of the equation $x^4 + 2x^3 + 3x^2 + 4x + 5 = 0$, then $1 + a^2 + b^2 + c^2 + d^2$ is equal to

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

141. If $c_0, c_1, c_2, \dots, c_n$ are binomial coefficients of order n , then the value of $\frac{c_1}{2} + \frac{c_2}{4} + \frac{c_3}{6} + \dots$

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

142. The value of $(0.2) \log_{\sqrt{5}} \left(\frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \dots \infty \right)$ is

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

143. If $n(A) = n(B) = m$, then the number of possible bijection from A to B is

- (a)m (b) m^2
(c) $m!$ (d) $2m$

144. $\sin^{-1}[x\sqrt{1-x} - \sqrt{x}\sqrt{1-x^2}] =$

- (a) $\sin^{-1}x - \sin^{-1}\sqrt{1-x^2}$
(b) $\sin^{-1}x + \sin^{-1}\sqrt{1-x}$
(c) $\sin^{-1}x - \sin^{-1}\sqrt{x}$
(d) $\sin^{-1}x + \sin^{-1}\sqrt{x}$

145. If $\tan\theta + \tan 4\theta + \tan 7\theta = \tan\theta \tan 4\theta \tan 7\theta$, then the general solution is

- (a) $\theta = \frac{n\pi}{4}$ (b) $\theta = \frac{n\pi}{12}$
(c) $\theta = \frac{n\pi}{6}$ (d)None of these

146. If a circle with the point $(-1, 1)$ as its center touches the straight line $x + 2y + 9 = 0$, then the coordinates of the points of contact is

- (a) $(-3, 3)$ (b) $(-3, -3)$
(c) $(0, 0)$ (d) $\left(\frac{7}{3}, -\frac{17}{3}\right)$

147. If the circles $x^2 + y^2 + 2gx + 2fy = 0$ and $x^2 + y^2 + 2g'x + 2f'y = 0$ touch each other, then

- (a) $fg = f'g'$ (b) $f'g = fg'$
(c) $ff' = gg'$ (d)None of these

148. The number of common tangents to the circles $x^2 + y^2 = 4$ and $x^2 + y^2 - 4x + 2y - 4 = 0$ is

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

149. The length of the tangent drawn from any point on the circle $x^2 + y^2 - 4x + 6y - 4 = 0$ to the circle $x^2 + y^2 - 4x + 6y = 0$ is

- (a)8 (b)4
(c)2 (d)None of these

150. If the foci of the ellipse $\frac{x^2}{25} + \frac{y^2}{b^2} = 1$ and the hyperbola $\frac{x^2}{144} - \frac{y^2}{81} = \frac{1}{25}$ coincide, then the value of b^2 is

- (a)25 (b)9
(c)16 (d)4

151. The latusrectum of the ellipse is half the minor axis. Then, its eccentricity is

- (a) $\frac{1}{\sqrt{2}}$ (b) $\frac{1}{\sqrt{3}}$
(c) $\frac{\sqrt{3}}{2}$ (d)None of these

152. The ends of the latusrectum of the parabola $x^2 + 10x - 16y + 25 = 0$ are

- (a) $(3, 4), (-13, 4)$ (b) $(5, -8), (-5, 8)$
(c) $(3, -4), (13, 4)$ (d) $(-3, 4), (13, -4)$

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

- (a) $\cos(|x|) + |x|$ (b) $\cos(|x|) - |x|$
 (c) $\sin(|x|) + |x|$ (d) $\sin(|x|) - |x|$

154. If $x = a \left(\cos t + \log \tan \frac{t}{2} \right)$, $y = a \sin t$, then $\frac{dy}{dx} =$

- (a) $\tan t$ (b) $\cot t$
 (c) $-\cot t$ (d) $\tan t$

155. If $\begin{bmatrix} 1 & -\tan \theta \\ \tan \theta & 1 \end{bmatrix} \begin{bmatrix} 1 & \tan \theta \\ -\tan \theta & 1 \end{bmatrix} = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$, then

- (a) $a = 1 = b$
 (b) $a = \cos 2\theta, b = \sin 2\theta$
 (c) $a = \sin 2\theta, b = \cos 2\theta$
 (d) $a = \cos \theta, b = \sin \theta$

156. If $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$, then A^n is

- (a) $\begin{bmatrix} 1 & 2^n - 2 \\ 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & n^2 \\ 0 & 1 \end{bmatrix}$
 (c) $\begin{bmatrix} 1 & 2n \\ 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & n^2 \\ 1 & 1 \end{bmatrix}$

157. If α, β, γ are the roots of the equation $x^3 + px + q = 0$, then the value of the determinant $\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix}$ is

- (a) q (b) 0
 (c) p (d) $p^2 - 2q$

158. The number of distinct real roots of $\begin{vmatrix} \sin x & \cos x & \cos x \\ \cos x & \sin x & \cos x \\ \cos x & \cos x & \sin x \end{vmatrix}$ in the interval $\left[-\frac{\pi}{4}, \frac{\pi}{4} \right]$ is

- (a) 0 (b) 1
 (c) 2 (d) 3

159. The sum of non-prime positive divisors of 450 is

- (a) 1209 (b) 1299
 (c) 1199 (d) 1099

160. The last digit of $\sum_{1 < p < 100} p! - \sum_{n=1}^{50} (2n)!$ is

- (a) 2 (b) 4
 (c) 6 (d) 8

161. The interval I such that $\int_0^1 \frac{dx}{\sqrt{1+x^4}} \in I$ is given by

- (a) $\left[0, \frac{1}{\sqrt{2}} \right]$ (b) $\left[\frac{1}{\sqrt{2}}, 1 \right]$
 (c) $\left[\sqrt{2}, 2 \right]$ (d) $\left[\sqrt{2}, \frac{7}{4} \right]$

162. $\int_0^{\pi/2} \log(\tan x) dx =$

- (a) $\frac{\pi}{2}$ (b) 0
 (c) 1 (d) $\frac{\pi}{4}$

163. The value of $\int_{-2}^2 (ax^3 + bx + c) dx$ depends on the

- (a) value of b (b) value of c
 (c) value of a (d) values of a and b

164. The area of the region bound by the curves $y = x^2$ and $y = 4x - x^2$ is

- (a) $\frac{16}{3}$ sq. units (b) $\frac{8}{3}$ sq. units
(c) $\frac{4}{3}$ sq. units (d) $\frac{2}{3}$ sq. unit

165. The particular solution of $\frac{y}{x} \frac{dy}{dx} = \frac{1+y^2}{1+x^2}$, when $x = 1, y = 2$ is

- (a) $5(1 + y^2) = 2(1 + x^2)$
(b) $2(1 + y^2) = 5(1 + x^2)$
(c) $5(1 + y^2) = (1 + x^2)$
(d) $(1 + y^2) = 2(1 + x^2)$

166. The solution of the differential equation $\frac{dy}{dx} = (x + y)^2$ is

- (a) $\frac{1}{x+y} = c$
(b) $\sin^{-1}(x + y) = x + c$
(c) $\tan^{-1}(x + y) = c$
(d) $\tan^{-1}(x + y) = x + c$

167. The maximum value of $\left(\frac{1}{x}\right)^{2x^2}$ is

- (a) $e^{1/e}$ (b) $\sqrt{e}$
(c) 1 (d) e^2

168. Let x be a number which exceeds its square by the greatest possible quantity, then $x =$

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

169. The subtangent at $x = \pi/2$ on the curve $y = x \sin x$ is

- (a) 0 (b) 1
(c) $\pi/2$ (d) None of these

170. The value of $\int \frac{10^{x/2}}{\sqrt{10^{-x} - 10^x}} dx$ is

- (a) $\frac{1}{\log_e 10} \sin^{-1}(10^x) + c$
(b) $2\sqrt{10^{-x} + 10^x} + c$
(c) $\frac{1}{\log_e 10} \sinh^{-1}(10^x) + c$
(d) $\frac{-1}{\log_e 10} \sinh^{-1}(10^x) + c$

171. $\int e^x \left\{ \frac{1 + \sin x \cos x}{\cos^2 x} \right\} dx =$

- (a) $e^x \cos x + c$ (b) $e^x \sec x \tan x + c$
(c) $e^x \tan x + c$ (d) $e^x \cos^2 x - 1 + c$

172. $\int \frac{x^2 + 1}{x^4 + 1} dx$

- (a) $\frac{1}{\sqrt{2}} \log_e(x^2 + 1) + c$
(b) $\frac{1}{\sqrt{2}} \tan^{-1} \left(\frac{x^2 + 1}{x\sqrt{2}} \right) + c$
(c) $\frac{1}{\sqrt{2}} \tan^{-1}(x^2 - 1) + c$
(d) $\frac{1}{\sqrt{2}} \tan^{-1} \left(\frac{x^2 - 1}{x\sqrt{2}} \right) + c$

173. The locus of the mid-point of the intercept of the line $x \cos \alpha + y \sin \alpha = p$ between the coordinate axes is

- (a) $x^{-2} + y^{-2} = 4p^{-2}$ (b) $x^{-2} + y^{-2} = p^{-2}$
(c) $x^2 + y^2 = 4p^{-2}$ (d) $x^2 + y^2 = p^2$

174. If the line through $A = (4, -5)$ is inclined at an angle 45° with the positive direction of the X-axis, then the coordinates of the two points on opposite sides of A at a distance of $3\sqrt{2}$ units are

- (a) (7,2), (1,8) (b) (7,2), (1, -8)
 (c) (7, -2), (1, -8) (d) (7,2), (-1,8)

175. If the line $px + qy = 0$ coincides with one of the lines given by $ax^2 + 2hxy + by^2 = 0$, then

- (a) $ap^2 + 2hpq + bq^2 = 0$
 (b) $aq^2 + 2hpq + bp^2 = 0$
 (c) $aq^2 - 2hpq + bp^2 = 0$
 (d) None of these

176. The function $f(x) = \left(\frac{\log_e(1+ax) - \log_e(1-bx)}{x} \right)$ is undefined at $x = 0$. The value which should be assigned to f at $x = 0$ so that it is continuous at $x = 0$ is

- (a) $\frac{a+b}{2}$ (b) $a + b$
 (c) $\log_e(ab)$ (d) $a - b$

177. $\lim_{n \rightarrow \infty} \frac{(1^2 + 2^2 + \dots + n^2)^{\frac{1}{n}}}{(n+1)(n+10)(n+100)} =$

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

178. The number of triangles in a complete graph with 10 non-collinear vertices is

- (a) 360 (b) 240
 (c) 120 (d) 60

179. The angle between hands of a clock when the time is 4.25 AM is signed to

- (a) $17 \frac{1}{2}^\circ$ (b) $14 \frac{1}{2}^\circ$
 (c) $13 \frac{1}{2}^\circ$ (d) $12 \frac{1}{2}^\circ$

180. The point (5, -7) lies outside the circle

- (a) $x^2 + y^2 - 8x = 0$
 (b) $x^2 + y^2 - 5x + 7y = 0$
 (c) $x^2 + y^2 - 5x + 7y - 1 = 0$
 (d) $x^2 + y^2 - 8x + 7y - 2 = 0$