UPSEE - 2002

Full Paper

Section-1

Phusics

1. This symbol represents :

1) NOR gate
2) AND gate
3) OR gate
4) NAND gate

2. The equation of state of some gases can be expressed as

$$\left(p + \frac{a}{V^2}\right)(V - b) = RT$$

where P is the pressure, V the volume, T the absolute temperature and *a* and *b* are constants. The dimensional formula of *a* is :

1) $[ML^5T^{-2}]$
2) $[M^{-1}L^5T^{-2}]$
3) $[ML^{-1}T^{-2}]$
4) $[ML^{-5}T^{-2}]$

3. A can filled with water is rotated in a vertical circle. What must be the minimum velocity given to the can, so that water does not fall ?

1) $v = \sqrt{rg}$
2) $v = \sqrt{(r)/g}$
3) $v = 1/\sqrt{rg}$
4) $v = g/\sqrt{r}$

4. A shell is fired from a cannon with a velocity v at an angle θ with the horizontal direction. At the highest point in its path, it explodes into two pieces of equal masses. One of the pieces retraces its path to the cannon. The speed of the other piece immediately after the explosion is :

1) 3 v cos θ
2) 2 v cos θ
3) (3/2) v cos θ
4) v cos θ

5. A 16 kg block moving on a frictionless horizontal surface with a velocity of 4 m/s compresses an ideal spring and comes to rest. If the force constant of the spring be 100 N/m, then the spring is compressed by :

1) 1.6 m
2) 4 m
3) 6.1 m
4) 3.2 m

6. A mass of 6×10^{24} kg is to be compressed in a sphere in such a way that the escape velocity from the sphere is 3×10^8 m/s. What should be the radius of the sphere ?
($G = 6.67 \times 10^{-11}$ N-m^2/kg^2)

1) 9 km
2) 9 m
3) 9 cm
4) 9 mm

7. A large cylindrical tank has a hole of area A at its bottom. Water is poured in the tank by a tube of equal cross-sectional area A, ejecting water at the speed v. Which one of the following situations will be realised ?

1) No water will stay in the tank
2) The water level will keep on rising
3) The water level will rise to a height $v^2/2g$ and then stop
4) The water level will oscillate with mean height v^2/g

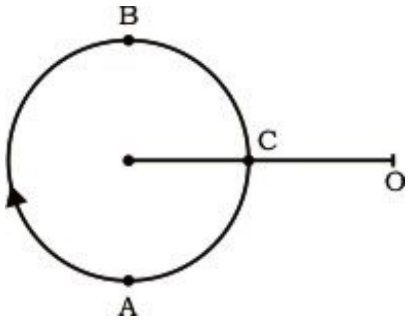
8. A drop of mercury of radius 2 mm is split into 8 identical droplets. Find the increase in surface energy. (Surface tension of mercury is 0.465 J/m^2)

1) 23.4 µJ
2) 18.5 µJ
3) 26.8 µJ
4) 16.8 µJ

9. A wire of length L and radius r fixed at one end and a force F applied to the other end produces an extension *l*. The extension produced in another wire of the same material of length 2L and radius 2 r by a force 2 F, is :

1) *l*
2) 2 *l*
3) 4 *l*
4) *l/2*

10. A small source of sound moves on a circle as shown in the figure and an observer is sitting on O. Let V_1, V_2 and V_3 be the frequencies heard when the sources are at A, B and C respectively. Then,



1) $v_1 > v_2 > v_3$

2) $v_2 > v_3 > v_1$

3) $v_1 = v_2 > v_3$

4) $v_2 > v_1 > v_3$

11. A transverse wave is described by the equation

$$y = y_0 \sin 2\pi \left(ft - \frac{x}{\lambda}\right)$$

The maximum particle velocity is equal to four times the wave velocity, if :

1) $\lambda = (\pi y_0/4)$

2) $\lambda = (\pi y_0/2)$

3) $\lambda = \pi y_0$

4) $\lambda = 2\pi y_0$

12. A particle executes a simple harmonic motion of time period T. Find the time taken by particle to go directly from its mean position to half the amplitude.

1) T/2 2) T/4 3) T/8 4) T/12

13. Two trains are moving towards each other with speeds of 20 m/s and 15 m/s relative to the ground. The first train sounds a whistle of frequency 600 Hz, the frequency of the whistle heard by a passenger in the second train before the train meets is :
(the speed of sound in air is 340 m/s)

1) 600 Hz

2) 585 Hz

3) 645 Hz

4) 666 Hz

14. Two coherent sources of different intensities send waves which interfere. The ratio of maximum intensity to the minimum intensity is 25. The intensities of the sources are in the ratio :

1) 25 : 1

2) 5 : 1

3) 9 : 4

4) 25 : 16

15. The optical path of a monochromatic light is same, if it goes through the thickness of 4.0 cm of glass and 4.5 cm of water. If the refractive index of glass is 1.3, the refractive index of the water is :

1) 1.30 2) 1.36 3) 1.42 4) 1.46

16. A microscope is focussed on a mark on a piece of paper and then a slab of glass of thickness 3 cm and refractive index 1.5 is placed over a mark. How should the microscope be moved to get the mark again in focus ?

1) 1 cm upward
2) 4.5 cm downward
3) 1 cm downward
4) 2 cm upward

17. A thin lens made of glass of refractive index $\mu = 1.5$ has a focal length equal to 12 cm in air. It is now immersed in water ($\mu = (4/3)$). Its new focal length is :

1) 48 cm
2) 36 cm
3) 24 cm
4) 12 cm

18. Two points separated by a distance of 0.1 mm can just be resolved in a microscope when a light of a wavelength 6000 Å is used. If the light of wavelength 4800 Å is used, the limit of resolution becomes :

1) 0.08 mm
2) 0.10 mm
3) 0.12 mm
4) 0.06 mm

19. Solar radiation emitted by sun resembles that emitted by a black body at a temperature of 6000 K. Maximum intensity is emitted at a wave length of about 4800 Å. If the sun were to cool down from 6000 K to 3000 K, then the peak intensity would occur at a wavelength :

1) 4800 Å
2) 9600 Å
3) 7200 Å
4) 6400 Å

20. Air is pumped into an automobile tube up to a pressure of 200 kPa in the morning when the air temperature is 22°C. During the day, temperature rises to 42°C and the tube expands by 2%. The pressure of the air in the tube at this temperature, will be approximately :

1) 212 kPa
2) 209 kPa
3) 206 kPa
4) 200 kPa

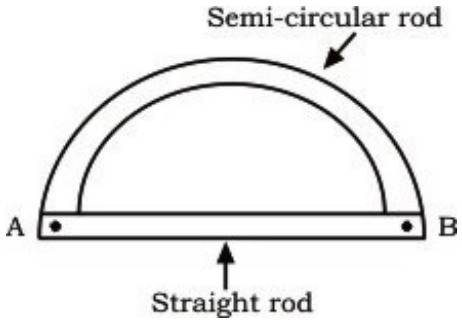
21. A block of mass 100 g slides on a rough horizontal surface. If the speed of the block decreases from 10 m/s to 5 m/s, the thermal energy developed in the process is :

1) 3.75 J
2) 37.5 J
3) 0.375 J
4) 0.75 J

22. An ideal gas at 27°C is compressed adiabatically to (8/27) of its original volume. If $\gamma = (5/3)$, then the rise in temperature is :

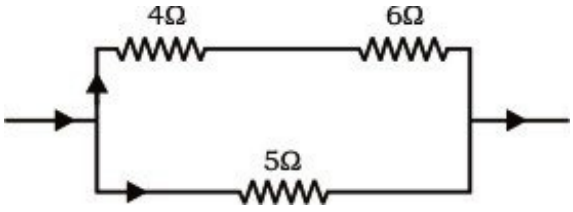
1) 575 K
2) 450 K
3) 225 K
4) 375 K

23. Two rods (one semicircular and other straight) of same material and of same cross-sectional area are joined as shown in the figure. The points A and B are maintained at different temperatures. The ratio of the heat transferred through a cross-section of a



1) 2 : π
2) 1 : 2
3) π : 2
4) 3 : 2

24. In the circuit shown, the heat produced in the 5Ω resistor is 10 cal/s. The heat generated in the 4Ω resistor is :



1) 1 cal/s
2) 2 cal/s
3) 6 cal/s
4) 8 cal/s

25. A radioactive material decays by simultaneous emission of two particles with half-lives 1620 and 810 year respectively. The time in year after which one-fourth of the material remains, is :

1) 4860 year

2) 3240 year

3) 2340 year

4) 1080 year

26. A potential barrier of 0.50 V exists across a p-n junction. If the depletion region is 5.0×10^{-7}m wide, the intensity of the electric field in this region is :

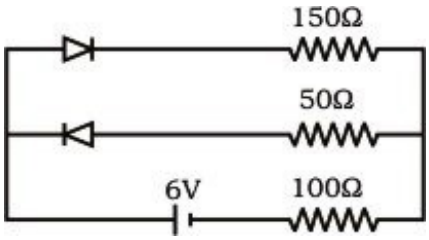
1) 1.0×10^6 V/m

2) 1.0×10^5 V/m

3) 2.0×10^5 V/m

4) 2.0×10^6 V/m

27. The circuit shown in the figure contains two diodes each with a forward resistance of 50Ω and with finite backward resistance. If the battery of 6V, the current through the 100Ω resistance (in ampere) is :



1) zero

2) 0.02

3) 0.03

4) 0.036

28. If the velocity of light (c), gravitational constant (G) and Planck's constant (h) are chosen as fundamental units, then the dimensions of mass in new system is :

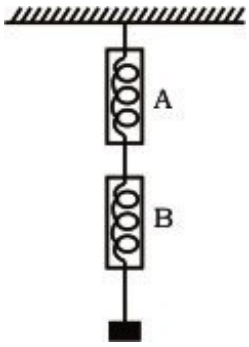
1) $c^{1/2}G^{1/2}h^{1/2}$

2) $c^{1/2}G^{1/2}h^{-1/2}$

3) $c^{1/2}G^{-1/2}h^{1/2}$

4) $c^{-1/2}G^{1/2}h^{1/2}$

29. A block of mass 2 kg is suspended through two light spring balance A and B as shown in figure. These balances A and B will respectively read :



1) 2 kg and zero
2) zero and 2 kg
3) 2 kg and 2 kg
4) 1 kg and 1 kg

30. A stone dropped from a balloon which is at a height h, reaches the ground after t seconds. From the same balloon, if two stones are thrown, one upwards and the other downwards, with the same velocity u and they reach the ground after t_1 and t_2 seconds respectively, then :

1) $t = t_1 - t_2$
2) $t = ((t_1 + t_2)/2)$
3) $t = \sqrt{t_1 t_2}$
4) $t = \sqrt{(t_1^2 - t_2^2)}$

31. A shell at rest at the origin explodes into three fragments of masses 1 kg, 2 kg and m kg. The 2 kg and 1 kg pieces fly off with speeds of 12 m/s along x-axis and 16 m/s along y-axis respectively. If the m kg piece flies off with a speed of 40 m/s, the total mass of the shell must be :

1) 3.7 kg
2) 4 kg
3) 4.5 kg
4) 5 kg

32. If a sphere is rolling, then the ratio at its rotational kinetic energy to the total kinetic energy is :

1) 1 : 2
2) 2 : 5
3) 2 : 7
4) 5 : 7

33. A geostationary satellite is orbiting the earth at a height of 6 R above the surface of earth, R being the radius of earth. The time period of another satellite at a height of 2.5 R from the surface of earth, is :

1) 10 h
2) $(6/\sqrt{2})$ h

3) 6 h

4) $6\sqrt{2}$ h

34. A body weights w newton at the surface of the earth. Its weight at a height equal to half the radius of the earth, will be :

1) w/2 2) 2w/3 3) 4w/9 4) 8w/27

35. A spring of force constant k is cut into two pieces such one piece is three times the length of the other. The longer piece will have a force constant of :

1) (3/4) k

2) (4/3) k

3) 4 k

4) 9 k

36. For an ideal gas of diatomic molecules, where C_P and C_V are the two specific heats of the gas and R the gas constant, then :

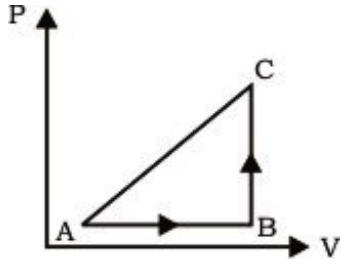
1) $C_P = (5/2)R$

2) $C_V = (3/2)R$

3) $C_P - C_V = 2R$

4) $C_P = (7/2)R$

37. The P-V diagram of a system undergoing thermodynamic transformation is shown in figure. The work done by the system in going from A → B → C is 50 J and 20 cal heat is given to the system. The change in internal energy between A and C is :



1) 34 J

2) 70 J

3) 84 J

4) 134 J

38. Two rods of the same length and material transfer a given amount of heat in 12 s when they are joined end to end. But when they are joined lengthwise, they will transfer the same amount of heat, in the same conditions, in :

1) 1.5 s

2) 3 s

3) 24 s

4) 48 s

39. Two identical flutes produce fundamental notes of frequency 300 Hz at 27°C. If the temperature of air at one flute is increased to 31°C, the number of the beats heard per second, will be :

1) 1 2) 2 3) 3 4) 4

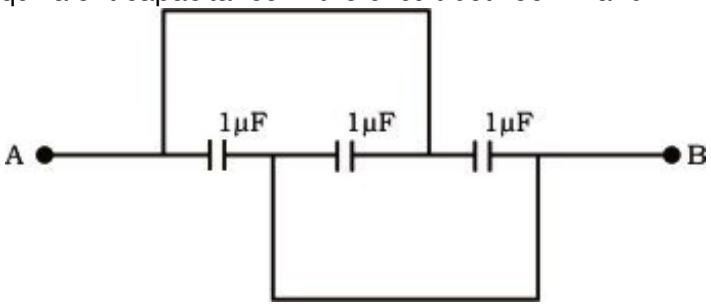
40. A source of sound of frequency 256 Hz is moving rapidly towards a wall with a velocity of 5 m/s. The speed of sound is 330 m/s. If the observer is in between the wall and the source, then beats per second heard will be :

1) 7.8 Hz
2) 9.7 Hz
3) 3.9 Hz
4) zero

41. The coefficient of performance of a Carnot's refrigerator working between 30°C and 0°C is :

1) 10 2) 1 3) 9 4) zero

42. The equivalent capacitance in the circuit between A and B will be :



1) 1 μ F
2) 2 μ F
3) 3 μ F
4) (1/3) μ F

43. The electric potential at a point (x, y) in the x-y plane is given by V = -kxy. The field intensity at a distance r from the origin varies as :

1) r^2
2) r
3) 1/r
4) $1/r^2$

44. If n drops, each of capacitance C, coalesce to form a single big drop, then the ratio of the energy stored in the big drop to that in each small drop, will be :

1) n : 1
2) $n^{1/3}$: 1
3) $n^{5/3}$: 1
4) n^2 : 1

45. 125 cm of potentiometer wire balances the emf of a cell and 100 cm of the wire is required for balance, if the poles of the cell are joined by a 2Ω resistor. Then the internal resistance of the cell is :

1) 0.25 Ω
2) 0.5 Ω
3) 0.75 Ω
4) 1.25 Ω

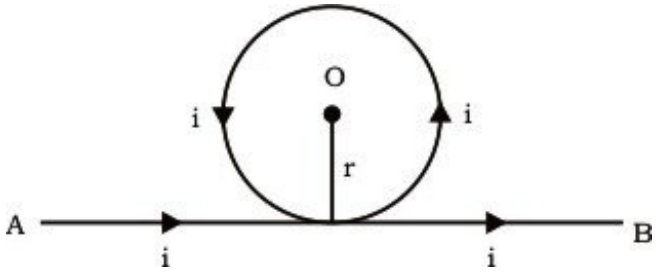
46. Three bulbs of 40 W, 60 W and 100 W are connected in series to a current source of 200 V. Which of the following statements is true ?

1) 40 W bulb glow brightest
2) 60 W bulb glow brightest
3) 100 W bulb glow brightest
4) All bulbs glow with same brightest

47. At room temperature, copper has free electron density of $8.4 \times 10^{28}/m^3$. The copper conductor has a cross-section of $10^{-6}m^2$ and carries a current of 5.4 A. The electron drift velocity in copper is :

1) 400 m/s
2) 0.4 m/s
3) 0.4 mm/s
4) 72 m/s

48. A part of a long wire carrying a current *i* is bent into a circle of radius r as shown in figure. The net magnetic field at the centre O of the circular loop is :



1) $\frac{\mu_0 i}{4 r}$
2) $\frac{\mu_0 i}{2 r}$
3) $\frac{\mu_0 i}{2 \pi r}(\pi + 1)$
4) $\frac{\mu_0 i}{2 \pi r}(\pi - 1)$

49. A charged particle moving with velocity v is subjected to electric field E and magnetic field B. The paritcle will go undetected, if :

1) E is perpendicular to B
2) E is parallel to v and perpendicular to B
3) E and B both are parallel to v
4) E, B and v are mutually perpendicular but v = (E/B)

50. A 36 Ω galvanometer is shunted by resistance of 4 Ω. The percentage of the total current, which passes through the galvanometer is :

1) 8% 2) 9% 3) 10% 4) 91%

51. The meniscus of a liquid contained in one of the limbs of a narrow U-tube is placed between the pole pieces of an electromagnet with the meniscus in line with the field. When the electromagnet is switched on, the liquid is seen to rise in the limb. This indicates that the liquid is :

1) non-magnetic
2) paramagnetic
3) diamagnetic
4) ferromagnetic

52. Which of the following statements is incorrect about hysteresis ?

1) This effect is common to all ferromagnetic substances
2) The hysteresis loop area is proportional to the thermal energy developed per unit volume of the material
3) The hysteresis loop area is independent of the thermal energy developed per unit volume of the material
4) The shape of the hysteresis loop is characteristic of the material

53. A motor having an armature of resistance 2Ω is designed to operate at 220 V mains. At full speed, it develops a back emf of 210 V. When the motor is running at full speed, the current in the armature is :

1) 5 A
2) 105 A
3) 110 A
4) 215 A

54. A helium nucleus makes full rotation in a circle of radius 0.8 m in 2 s. The value of magnetic field B at the centre of the circle, will be :
(μ_0 = permeability constant)

1) $\frac{2 \times 10^{-19}}{\mu_0}$
2) $2 \times 10^{-19}\ \mu_0$
3) $10^{-19}\ \mu_0$

4) $\frac{10^{-19}}{\mu_0}$

55. The luminous intensity of lamp which produces an illuminance of 12 lux at a distance of 5 m from it, is :

1) 4 cd
2) 60 cd
3) 300 cd
4) 720 cd

56. To print a photograph from a negative, the time of exposure to light from a lamp placed.
60 cm away is 2.5 s. If the lamp is placed 1.2 m away, then the exposure time required is :

1) 5 s
2) 10 s
3) 15 s
4) 20 s

57. If two +5D lenses are mounted at some distance apart, the equivalent power will always be negative, if the distance is :

1) greater than 40 cm
2) equal to 40 cm
3) equal to 10 cm
4) less than 10 cm

58. The population inversion necessary for laser action used in solid state lasers is :

1) electrical discharge
2) inelastic atom-atom collision
3) direct conversion
4) optical pumping

59. The work of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately :

1) 540 nm
2) 400 nm
3) 310 nm
4) 220 nm

60. The innermost orbit of the hydrogen atom has a diameter 1.06 Å. The diameter of tenth orbit is :

1) 5.3 Å
2) 10.6 Å
3) 53 Å

4) 106 Å

61. Which one of the following statements about uranium is correct ?

1) ^{235}U is fissionable by thermal neutrons

2) fast neutrons trigger the fission process in ^{235}U

3) ^{238}U is broken into fragments when bombarded by slow neutrons

4) ^{235}U is an unstable isotope and undergoes spontaneous fission

62. The decay constant of a radioactive substances is λ. The half-life and mean-life of the substance are respectively given by :

1) $\frac{1}{\lambda}$ and $\frac{(\ln 2)}{\lambda}$

2) $\frac{(\ln 2)}{\lambda}$ and $\frac{1}{\lambda}$

3) $\frac{1}{\lambda}$ and $\lambda\,(\ln 2)$

4) $\lambda\,(\ln 2)$ and $\frac{1}{\lambda}$

63. ^{22}Ne nucleus, after absorbing energy, decays into two α particles and an unknown nucleus. The unknown nucleus is :

1) nitrogen

2) carbon

3) boron

4) oxygen

64. A logic gate having two inputs A and B and output C has the following truth table

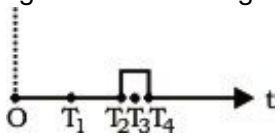
A	B	C
1	1	0
1	0	1
0	1	1
0	0	1

This gate is :

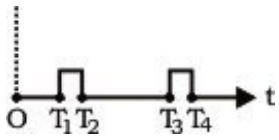
1) OR 2) AND 3) NOT 4) NAND

65. The given figure shows the wave forms for two inputs A and B and that for the output Y of a logic circuit. The logic circuit is :

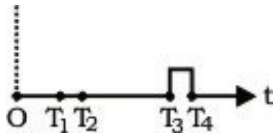
A.



B.



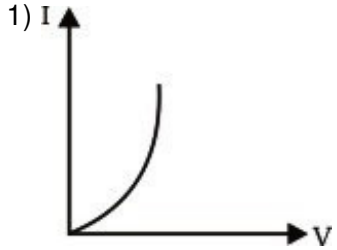
Y.



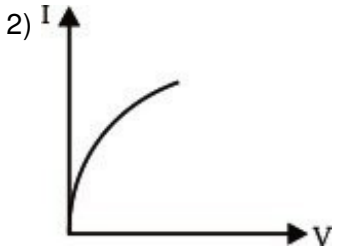
1) an AND gate
2) an OR gate
3) a NAND gate
4) a NOT gate

66. The current voltage characteristic of a p-n junction diode is represented by the graph :

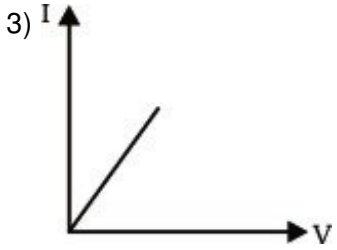
1)



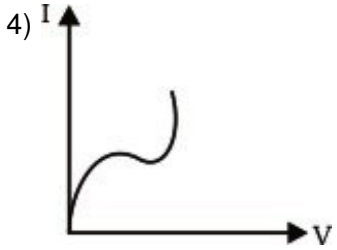
2)



3)



4)



67. If L, C and R denote the inductance, capacitance and resistance respectively, the dimensional formula for $C^2L\ R$ is :

1) $[ML^2T^{-1}I^0]$
2) $[M^0L^0T^3I^0]$
3) $[M^{-1}L^{-2}T^6I^2]$
4) $[M^0L^0T^2I^0]$

68. A cricketer can throw a ball to a maximum horizontal distance of 100 m. With the same effort, he throws the ball vertically upwards. The maximum height attained by the ball is :

1) 100 m
2) 80 m
3) 60 m
4) 50 m

69. From the top of a tower, a particle is projected with a velocity of 19.6 m/s at an angle of 30° with the horizontal. If g = 9.8 m/s^2, the particle will move at right angles to its initial direction of motion after a time of :

1) 1 s
2) 4 s
3) 6 s
4) 8 s

70. A can filled with water is revolved in a vertical circle of radius 4 m and the water does not fall down. The time period for a revolution is about :

1) 2 s
2) 4 s
3) 8 s
4) 10 s

71. If boiling point of water is 95°F, what will reduction at Celsius scale ?

1) 7°C
2) 65°C
3) 63°C
4) 35°C

72. The centre of mass of three particles of masses 1 kg, 2 kg and 3 kg is at (3, 3, 3) with reference to a fixed co-ordinate system. Where should a fourth particle of mass 4 kg be placed, so that the centre of mass of the system of all particles shifts to a point (1, 1, 1) ?

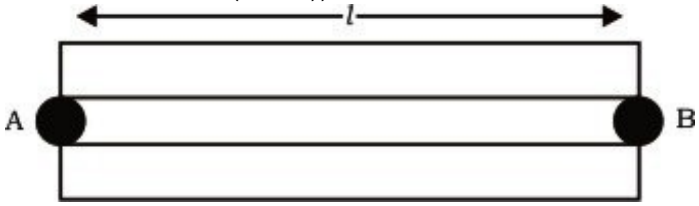
1) (-1, -1, -1)
2) (-2, -2, -2)
3) (2, 2, 2)
4) (1, 1, 1)

73. A pulley fixed to the ceiling carries a string with blocks of masses m and 3 m attached to its ends. The masses of string and pulley are negligible. When the system is released, its centre of mass with what acceleration ?

1) zero 2) -g/4 3) g/2 4) -g/2

74. A uniform rod of length *l* and mass m is free to rotate in a vertical plane about A. The rod

initially in horizontal position is released. The initial angular acceleration of the rod is (Moment of inertia of rod about A is ($ml^2/3$)) :



1) $3g/2l$
2) $2l/3g$
3) $3g/2l^2$
4) $mg\ (l/2)$

75. Suppose the law of gravitational attraction suddenly changes and becomes an inverse cube law, *i.e.*, $F \propto (1/r^3)$, but still remaining a central force. Then :
1) Kepler's law of areas still holds
2) Kepler's law of periods still holds
3) Kepler's law of areas and periods still holds
4) neither the law of areas, nor the law of periods still holds

76. Water rises in a vertical capillary tube up to a height of 2.0 cm. If the tube is inclined at an angle of 60° with the vertical, then upto what length the water will rise in the tube ?
1) 2.0 cm
2) 4.0 cm
3) $4/\sqrt{3}$ cm
4) $2\sqrt{2}$ cm

77. A particle of mass m is under the influence of a force F which varies with the displacement x according to the relation $F = -kx + f_0$ in which k and f_0 are constants. The particle when disturbed will oscillate about:
1) $x = 0$ with $\omega \neq \sqrt{(k/m)}$
2) $x = 0$ with $\omega = \sqrt{(k/m)}$
3) $x = f_0/k$ with $\omega = \sqrt{(k/m)}$
4) $x = f_0/k$ with $\omega \neq \sqrt{(k/m)}$

78. A pan with set of weights is attached with a light spring. When disturbed, the mass-spring system oscillates with a time period 0.6 s. When some additional weights are added, then time period is 0.7 s. The extension caused by the additional weights is approximately given by :
1) 1.38 cm
2) 3.3 cm
3) 1.75 cm
4) 2.45 cm

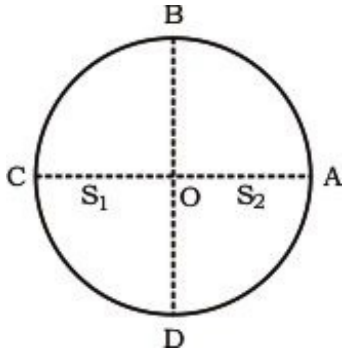
79. Two waves represented by the following equations are travelling in the same medium
$y_1 = 5 \sin 2\pi (75t - 25x)$
$y_2 = 10 \sin 2\pi (150t - 50x)$
The intensity ratio I_1/I_2 of the two waves is :

1) 1 : 2
2) 1 : 4
3) 1 : 8
4) 1 : 16

80. A source of sound placed at the open end of a resonance column sends an acoustic wave of pressure amplitude P_0 inside the tube. If the atmospheric pressure is P_A, then the ratio of maximum and minimum pressure at the closed end of the tube will be :

1) $(P_A + P_0) / (P_A - P_0)$
2) $(P_A + P_0) (P_A - 2P_0)$
3) P_A, P_A
4) $\left(P_A + \frac{1}{2}P_0\right)\left(P_A - \frac{1}{2}P_0\right)$

81. Two sources S_1 and S_2 each emitting waves of wavelength λ are kept symmetrically on either side of centre O of a circle ABCD such that $S_1O = S_2O = 1.5\lambda$. If a detector is



1) 8 2) 12 3) 16 4) 10

82. An ideal gas expands in such a manner that its pressure and volume comply with the condition PV^2 = constant. During this process, the gas is :

1) heated
2) cooled
3) neither heated nor cooled
4) first heated and then of a cooled

83. Energy of all molecules of a monoatomic gas having a volume V and pressure P is (3/2) PV. The total translational kinetic energy of all molecules of a diatomic gas at the same volume and pressure, is :

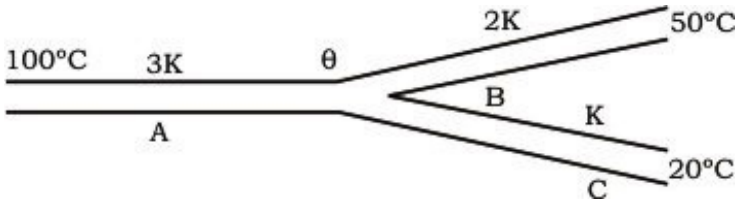
1) (1/2) PV
2) (3/2) PV

2) (3/2) PV

3) (5/2) PV

4) 3 PV

84. Three rods of the same dimensions have thermal conductivities 3K, 2K and K. They are arranged as shown in figure with their ends at 100°C, 50°C and 20°C. The temperature of their junction is :



1) 60° 2) 70° 3) 50° 4) 35°

85. An electron moving in a circular orbit of radius r makes n revolutions per second. As a result the magnetic field produced at the centre is :

1) $B = \mu_0 ne / 2\pi r$

2) $B = \mu_0 n^2 e / 2 r$

3) $B = \mu_0 ne / 2 r$

4) $B = 0$

86. A concave mirror of radius of curvature 1 m is placed at the bottom of a tank of water. The mirror forms an image of the sun, when it is directly overhead. Calculate the distance of the image from the mirror for 80 cm of water in the tank :

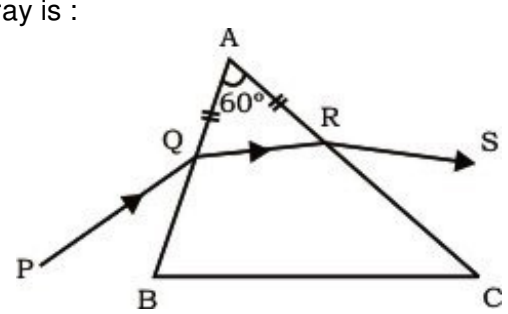
1) 30 cm

2) 50 cm

3) 40 cm

4) 10 cm

87. A ray PQ incident on the refracting face BA is refracted in the prism BAC as shown in the figure and emerges from the other refracting face AC as RS, such that AQ = AR. If the angle of prism A = 60° and the refractive index of the material of prism is $\sqrt{(3)}$, then the angle of deviation of the ray is :



1) 60°

2) 45°

3) 30°

4) none of these

88. When an object is moved along the axis of a convex lens, the size of image is obtained half times the size of the object. When the object is at a distance d_1 or at a distance d_2 from the lens, then the focal length of the lens is :

1) $\sqrt{(d_1\ d_2)}$

2) d_2 / d_1

3) $(1/2)\ (d_1 + d_2)$

4) $(1/2)\ (d_1 - d_2)$

89. In a Galilean telescope, the inverted image formed by its objective serves as a virtual object for its eyepiece. If the eyepiece has to form an inverted and magnified image of the virtual object, the eyepiece has to be a concave lens and it must be so placed that the virtual object falls :

1) within F

2) between F and 2 F

3) at 2 F

4) beyond 2 F

90. In Fraunhofer diffraction pattern due to narrow slit a screen is placed 2m away from the lens to obtain the pattern. If the slit width is 0.2 mm on either sides of the central maximum, the wavelength of light used is :

1) 5000 Å

2) 2000 Å

3) 1500 Å

4) 1000 Å

91. In an electromagnetic field, the amplitude of magnetic field is 3×10^{-10} T. If the frequency of the wave is 10^{12} Hz, then the amplitude of the associated electric field will be :

1) 9×10^{-2} V/m

2) 3×10^{-2} V/m

3) 3×10^{-10} V/m

4) 9 V/m

92. The centre of a circular table has radius r. The illuminance at the centre of the table is eight times that at its circumference. The height of the lamp above the table is :

1) r

2) $r/\sqrt{2}$

3) $r/\sqrt{3}$

4) $r/\sqrt{7}$

93. The spectral lines of Lyman series lie in which region of the spectrum ?

1) Ultraviolet

2) Visible

3) Near infrared

4) Far infrared

94. For an atom, the energy level corresponding to ground state is E_1, the metastable state is E_2 and an excited state above the metastable state is E_3. If the number of atoms in these states are N_1, N_2 and N_3 respectively, then in relation to laser action, the population inversion means that :

1) $N_2 < N_1$

2) $N_2 > N_1$

3) $N_3 < N_2$

4) $N_3 > N_1$ 95. An alpha particle is accelerated through a potential difference of 200 V.

The increase in its
kinetic energy is :

1) 100 eV

2) 200 eV

3) 400 eV

4) 800 eV

96. The rest mass of an electron as well as that of positron is 0.51 MeV. When an electron and positron are annihilated, they produce gamma-rays of wavelength :

1) 0.012 Å

2) 0.024 Å

3) 0.012 Å to ∞

4) 0.024 Å to ∞

97. When forward bias is applied to a p-n junction, then what happens to the potential barrier V_B, and the width of charge depleted region x ?

1) V_B increases, x decreases

2) V_B decreases, x increases

3) V_B increases, x increases

4) V_B decreases, x decreases

98. Zener breakdown in a semiconductor diode occurs when :

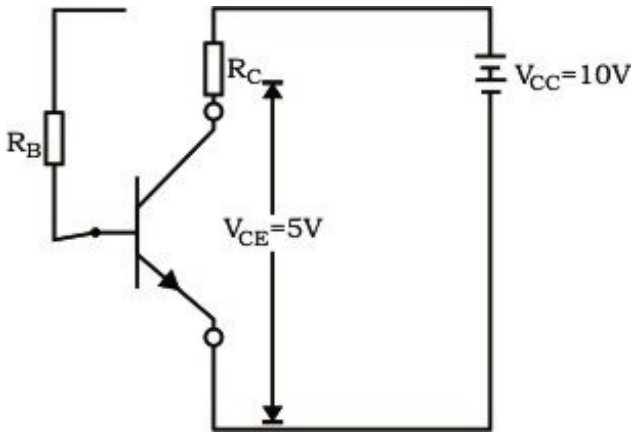
1) forward current exceeds certain value

2) reverse bias exceeds certain value

3) forward bias is equal to certain value

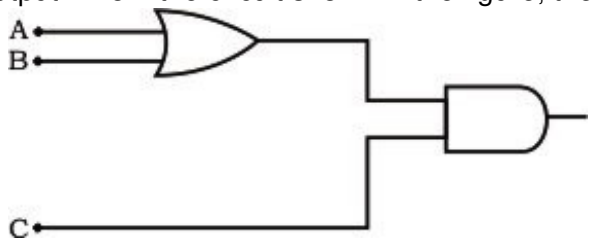
4) potential barrier is reduced to zero

99. A transistor connected in common-emitter configuration has input resistance R_{CE} = 2 kΩ and load resistance of 5 kΩ. If β = 60 and an input signal 12 mV is applied. Calculate the voltage gain, the power gain and the value of output voltage are :



1) A_V = 150, V_{out} = 1.8 V and power gain = 9000
2) A_V = 20, V_{out} = 1 V and power gain = 2000
3) A_V = 150, V_{out} = 1.5 V and power gain = 8500
4) A_V = 20, V_{out} = 1.5 V and power gain = 2000

100. To get an output 1 from the circuit shown in the figure, the input must be :



1) A = 0, B = 1, C = 0
2) A = 1, B = 0, C = 0
3) A = 1, B = 0, C = 1
4) A = 1, B = 1, C = 0

Section-2

Chemistry

101. The lightest particle is :

1) α-particle
2) positron
3) proton
4) neutron

102. In a gaseous reversible reaction

$N_2 + O_2 \rightleftharpoons 2\,NO$ + heat

If pressure is increased then the equilibrium constant would be :

1) unchanged
2) increased
3) decreased
4) sometimes increased sometimes decreased

103. Bohr model can explain :

1) the solar spectrum
2) the spectrum of hydrogen molecule
3) spectrum of any atom or ion containing one electron only
4) the spectrum of hydrogen atom only

104. Gamma rays have :

1) no mass and no charge
2) mass only
3) charge only
4) mass and charge both

105. Zeeman effect refers to the :

1) splitting up of the lines in an emission spectrum in the presence of an external electrostatic field
2) random scattering of light by colloidal particles
3) splitting up of the lines in an emission spectrum in a magnetic field
4) emission of electrons from metals when light falls upon them

106. Correct gas equation is :

1) $\frac{P_1 T_1}{V_1} = \frac{P_2 T_2}{V_2}$
2) $\frac{V_1 T_2}{P_1} = \frac{V_2 T_1}{P_2}$
3) $\frac{P_1 V_1}{P_2 V_2} = \frac{T_1}{T_2}$
4) $\frac{V_1 V_2}{T_1 T_2} = P_1 P_2$

107. Which combinations of quantum numbers, *n*, *l*, *m* and *s* for the electron in an atom does not provide a permissible solution of the wave equation ?

1) 3, 2, 1, (1/2)
2) 3, 1, 1, -(1/2)
3) 3, 3, 1, -(1/2)
4) 3, 2, -2, (1/2)

108. Ca^{2+} is isoelectronic with :

1) Na^{+}
2) Ar
3) Mg^{2+}
4) Kr

109. Which element is used for making a transistor ?

1) Sn 2) Sb 3) Si 4) Mg

110. The rate constant for a first order reaction whose half-life, is 480 s is :

1) $2.88 \times 10^{-3}\ s^{-1}$

2) $2.72 \times 10^{-3}\ s^{-1}$

3) $1.44 \times 10^{-3}\ s^{-1}$

4) $1.44\ s^{-1}$

111. For the following homogeneous reaction, the unit of rate constant is :

$A + B \xrightarrow{k} C$

1) $mol^{-1}\ L\ s^{-1}$

2) s^{-1}

3) s

4) $s^{-1}\ mol\ L^{-1}$

112. A sample of rock from moon contains equal number of atoms of uranium and lead. $t_{1/2}$ for $U = 4.5 \times 10^9$ yr. The age of the rock would be :

1) 2.25×10^9 yr

2) 13.5×10^9 yr

3) 9.0×10^9 yr

4) 4.5×10^9 yr

113. The half-life period of a radioactive material is 15 min. What per cent of radioactivity of that material will remain after 45 min ?

1) 17.5% 2) 15% 3) 12.5% 4) 10%

114. In terms of energy 1 amu is equal to :

1) 100 J

2) 931.1 kcal

3) 931.1 MeV

4) 10^7 erg

115. A biological catalyst is :

1) the N_2 molecule

2) an enzyme

116. The action of enzymes in living system is to :

1) supply energy to tissues
2) create immunity
3) circulate oxygen
4) enhance the rate of biochemical reactions

117. Amongst the following, the molecule that is linear is :

1) SO_2
2) CO_2
3) ClO_2
4) NO_2

118. The hydrogen bond is strongest in :

1) F—H.....O
2) F—H.....F
3) S—H.....S
4) O—H.....O

119. Dipole moment is shown by :

1) cis-1, 2-dichloro ethene
2) trans-1, 2-dichloro ethene
3) trans-1, 2-dichloro-2-pentene
4) both (1) and (3)

120. The compound 1, 2-butadiene has :

1) sp, sp^2 and sp^3 -hybridised carbon atoms
2) only sp^2 -hybridised carbon atoms
3) only sp-hybridised carbon atoms
4) both sp and sp^2 -hybridised carbon atoms

121. The C—H bond distance is the longest in :

1) C_2H_6
2) C_2H_2
3) $C_2H_2Br_2$
4) C_2H_4

122. Which one of the following solutions has the highest B.P. ?

1) 0.1 M NaCl
2) 0.1 M urea
3) 0.1 M $BaCl_2$

4) 0.1 M glucose

123. The freezing point of 1% solution of lead nitrate in water will be :

1) 2°C
2) 1°C
3) 0°C
4) below 0°C

124. The amount of urea to be dissolved in 500 cc of water (k = 1.86°C) to produce a depression of 0.186°C in the freezing point is :

1) 9 g
2) 9 g
3) 3 g
4) 0.3 g

125. The solubility of AgI in NaI solution is less than that in pure water because :

1) the temperature of the solution decreases
2) solubility product of AgI is less than that of NaI
3) of common ion effect
4) AgI forms complex with NaI

126. Which is chemically most active non-metal ?

1) S
2) O_2
3) F_2
4) N_2

127. Which one of the given transition metal ions is diamagnetic ?

1) Cu^{2+}
2) Co^{2+}
3) Cr^{3+}
4) Zn^{2+}

128. Which of the following isoelectronic species has the largest size ?

1) Na^{+}
2) O^{2-}
3) N^{3-}
4) F^{-}

129. Molecular formula of Glauber's salt is :

1) $Na_2SO_4 \cdot 10H_2O$

2) $FeSO_4 \cdot 7H_2O$

3) $CuSO_4 \cdot 5H_2O$

4) $MgSO_4 \cdot 7H_2O$

130. Cyanide process is used for the extraction of :

1) Au

2) Ag

3) Cu

4) both (1) and (2)

131. Which of the following metal is correctly matched with its ore ?

	Metal	Ore
(a)	Zinc	Calamine
(b)	Silver	Ilmenite
(c)	Magnesium	Cassiterite
(d)	Tin	Azurite

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

132. An example of a Lewis acid is :

1) $MgCl_2$

2) $SnCl_4$

3) $AlCl_3$

4) NaCl

133. Which solution has pH equal to 10 ?

1) 10^{-4} M KOH

2) 10^{-10} M KOH

3) 10^{-10} M HCl

4) 10^{-4} M HCl

134. Solubility product of $BaCl_2$ is 4×10^{-9} mol/L. Its solubility would be

:

1) 1×10^{-27}

2) 1×10^{-3}

3) 1×10^{-7}

4) 1×10^{-2}

2) Mosley
3) Mulliken
4) Werner

136. In methane the bond angle is :
1) 180°
2) 90°
3) 109°
4) 120°

137. Oxidation number of 'N' in N_3H (hydrazoic acid) is :
1) -(1/3) 2) +3 3) 0 4) -3

138. Phosphorus has the oxidation state of +3 in :
1) phosphorous acid
2) pyrophosphoric acid
3) orthophosphoric acid
4) metaphosphoric acid

139. Which of the following has highest pH ?
1) (M/4) KOH
2) (M/4) NaOH
3) (M/4) NH_4OH
4) (M/4) $Ca(OH)_2$

140. The heat of neutralisation of HCl by NaOH is -55.9 kJ/mol, the energy of dissociation of HCN is :
1) 43.8 kJ
2) -43.8 kJ
3) -68 kJ
4) 68 kJ

141. Bronze is an alloy of :
1) Pb + Sn + Zn
2) Cu + Sn
3) Pb + Zn
4) Cu + Zn

142. In photography we use :
1) AgI
2) NH_3

3) AgCl
4) AgBr

143. The treatement of Cu with dilute HNO_3 gives :

1) N_2O
2) NO
3) NH_4^+
4) NO_2

144. A mixture of camphor and benzoic acid can be separated by :

1) sublimation
2) extraction with a solvent
3) chemical method
4) fractional crystallisation

145. The empirical formula of a compound is CH_2. One mole of this compound has a mass of
42 g. It molecular formula is :

1) C_3H_6
2) C_3H_8
3) CH_2
4) C_2H_2

146. How many isomers are possible for the alkane C_4H_{10}

?

1) 3 2) 5 3) 2 4) 4

147. Geometrical isomerism is possible in case of :

1) pentene-2
2) propane
3) pentane
4) ethene

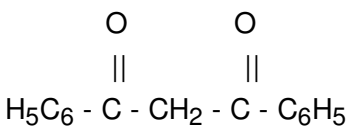
148. The wrong IUPAC name of the compound $CH_3CHOH \cdot CH_2CH_3$ is ?

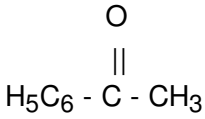
1) Butan-2-ol
2) 2-butanol
3) Butanol-2
4) 1-methylpropanol-1

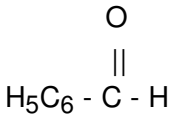
150. The number of ether isomers possible for $C_4H_{10}O$ are :

1) 2 2) 5 3) 4 4) 3

151. Keto-enol tautomerism is observed in :

1) 

2) 

3) 

4) Both (1) and (2)

152. Which of the following compounds will show geometrical isomerism ?

1) 1-phenyl propene
2) Propene
3) 2-methyl-2-butene
4) 2-butene

153. The number of primary amines of formula $C_4H_{11}N$ is :

1) 1 2) 3 3) 4 4) 2

154. Lyophobic colloids are :

1) gun proteins
2) protective colloids
3) irreversible colloids
4) reversible colloids

155. White vitriol has the formula :

1) $CaSO_4 \cdot 2H_2O$
2) $CuSO_4 \cdot 5H_2O$
3) $ZnSO_4 \cdot 7H_2O$
4) $FeSO_4 \cdot 7H_2O$

156. The decomposition temperature is maximum for :

1) $MgCO_3$
2) $SrCO_3$
3) $CaCO_3$

4) $BaCO_3$

157. What is the molarity of 0.2 N Na_2CO_3 solution ?

1) 0.05 M
2) 0.4 M
3) 0.1 M
4) 0.2 M

158. The strength of 10 cc of "10 volume" solution of H_2O_2 in terms of normality is :

1) 6.8 N
2) 1.7857 N
3) 4.4 N
4) 30.35 N

159. Zeolite which shows ion exchanging ability :

1) can provide H^+ in place of Na^+ ions
2) is a sodium aluminosilicate
3) is an ion-exchange resin
4) is a close-packed assemblance of silicon and oxygen atoms

160. Which of the following is an electrophile ?

1) Lewis acid
2) Lewis base
3) Negative species
4) None of the above

161. Strongest acid is :

1) 2, 4, 6-trinitro phenol
2) ethanol
3) ether
4) phenol

162. Which one of the following species is isoelectronic with ammonia ?

1) $\ddot{C}H_2$
2) $\overset{+}{C}H_2$
3) $\overset{-}{C}H_3$
4) $\dot{C}H_2$

163. The addition of HBr is easiest with :

1) $(CH_3)_2C = CH_2$

2) $CH_3 - CH = CH_2$

3) ClCH = CHCl

4) $CH_2 = CH - Cl$

164. Dry ice is :

1) solid ice

2) solid CO_2

3) solid NH_3

4) solid CH_4

165. When potassium ferrocyanide crystals are heated with conc. sulphuric acid, the gas evolved is :

1) sulphur dioxide

2) ammonia

3) carbon monoxide

4) carbondioxide

166. Potassium cyanide is obtained from :

1) $K_4[Fe(CN)_6]$

2) $K_3[Fe(CN)_6]$

3) $K_3[Fe(CN)_4]$

4) none of the above

167. Ammonia on reaction with hypochlorite anion can form :

1) NO

2) N_2H_4

3) NH_4Cl

4) both (2) and (3)

168. On heating sodium acetate with sodium hydroxide, the gas evolved will be :

1) ethylene

2) methane

3) acetylene

4) ethane

169. Calcium carbide when treated with water gives :

1) ethylene

2) methane

3) acetylene

4) ethane

170. Natural gas is a mixture of :

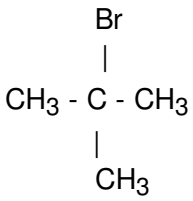
1) $CH_4 + C_2H_6 + C_3H_8$

2) $CO + H_2 + CH_4$

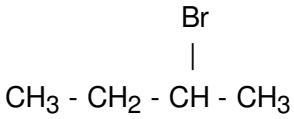
3) $CO + H_2$

4) $H_2O + CO_2$

171. At 130°C, normal butane reacts with bromine, the product will be :

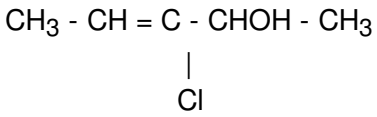
1)


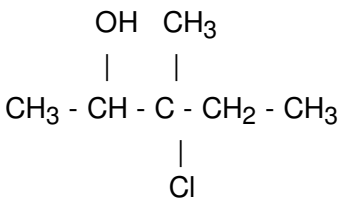
2) $CH_3CH_2CH_2CH_2 - Br$

3)


4) all of the above

172. HOCl reacts on 3-methyl-2-pentene, the main product will be :

1)


2)


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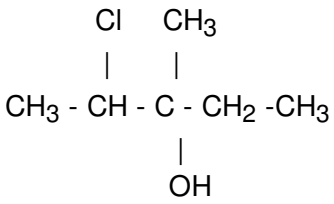


4) none of the above

173. An alkyne has the general formula :

1) C_nH_{2n}

2) C_nH_{2n+1}

3) C_nH_{2n+2}

4) C_nH_{2n-2}

174. In the reaction

$CH_3 - C \equiv C^- - Na^+ + (CH_3)_2 CH - Cl \rightarrow ?$

The product formed is :

1) propene
2) propyne
3) propyne and propene
4) 4-methyl pentyne-2

175. Which of the following metal ions is not coloured ?

1) Ti^{3+}
2) Fe^{3+}
3) V^{2+}
4) Cu^{+}

176. Which has maximum paramagnetic nature ?

1) $[Mn(H_2O)_6]^{2+}$
2) $[Cu(NH_3)_4]^{2+}$
3) $[Fe(CN)_6]^{4-}$
4) $[Cu(H_2O)_4]^{2+}$

177. Lucas test is done to differentiate between :

1) alcohol and ketone
2) alcohol and aromatic ketones
3) 1°, 2° and 3° alcohols
4) none of the above

178. Phenol is more acidic than alcohol. Why ?

1) Phenol is more stable than water
2) Phenol is aromatic and alcohol is aliphatic
3) Phenol is resonance stabilised
4) None of the above

179. Aldehyde and ketones are distinguished by which of the following test ?

1) Lucas test
2) Tollen's test
3) $KMnO_4$ solution (Bayer's test)
4) None of the above

180. Aldehydes and ketones are generally reduced by :

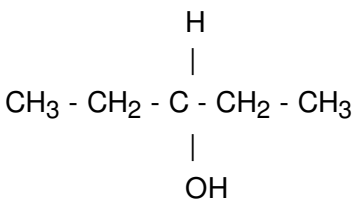
1) Clemmensen reduction
2) H_2S
3) H_2/Ni

4) none of the above

181. Which one gives positive iodoform test ?

1) $(CH_3)_2CHCH_2OH$

2) C_6H_5 - OH

3)


4) CH_3CH_2OH

182. What is the meaning of o/p directing group ?

1) A group which increases the electron density at m-position

2) No reaction occur at o/p position

3) A group which increases the electron density at o/p positions when attached to benzene ring and direct the electrophile to this site

4) None of the above

183. $CH_3COOH \xrightarrow{A} CH_3COCl$. What is A ?

1) PCl_5

2) Cl_2

3) HCl

4) COCl

184. Cyclohexene on reaction with cold alkaline $KMnO_4$ form :

1) *trans*-hexanediol

2) hexadiketone

3) *cis*-hexanediol

4) none of these

185. CH_3 - CH = CH - CH_3 on ozonolysis give :

1) O_2

2) CH_3 - CH_2 - OH

3) CH_3 - CO - CH_3

4) CH_3 - CHO

186. Which is monosaccharide ?

1) Sucrose

2) Lactose

3) Fructose
4) None of these

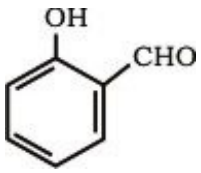
187. In which reaction, > C = O can be reduced to > CH_2 ?

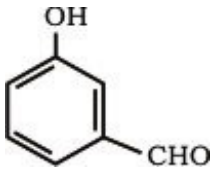
1) Wolff-Kishner reaction
2) Reimer-Tiemann reaction
3) Wurtz reaction
4) None of the above

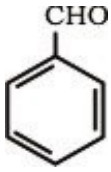
188. Phenol on reaction with Zn dust form :

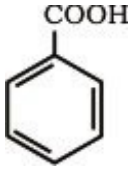
1) ZnO + benzene
2) toluene
3) benzaldehyde
4) benzoic acid

189. Phenol on reaction with chloroform and aqueous KOH form a major product :

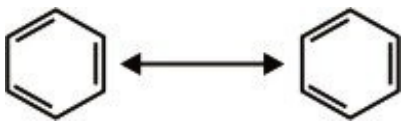
1) 

2) 

3) 

4) 

190. Resonance energy of benzene represents :

1) stability of benzene
2) energy required to break C - C bond
3) energy required to break C - H bond
4) energy for 

191. Two structures of cyclohexatriene given by Kekule represent :

1) an equilibrium mixture of two cyclohexatriene

2) an equal mixture of two isomer
3) a structure which has some resemblence with benzene structure
4) none of the above

192. In $Ni(CO)_4$ oxidation number of Ni is :

1) 4 2) -4 3) 0 4) +2

193. Ethyl acetate on reaction with Grignard's reagent, forms :

1) alcohol
2) ketone
3) ether
4) hydrocarbon

194. LPG mainly contains :

1) ethyne
2) butane
3) methane
4) ethane

195. $K_4[Fe(CN)_6]$ is a :

1) double salt
2) complex compound
3) acid
4) base

196. Write the following in decreasing order towards electrophilic substitution reaction :

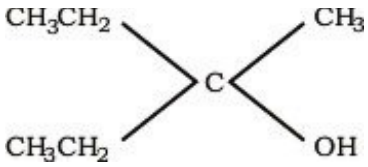
1. benzene
2. chlorobenzene
3. nitrobenzene
4. toluene

1) 1 > 2 > 3 > 4
2) 4 > 1 > 2 > 3
3) 2 > 3 > 4 > 1
4) 2 > 1 > 4 > 3

197. IUPAC name of $CH_3 - CH = CH - C \equiv CH$ is :

1) pent-2-ene-4-yne
2) pent-1-yne-3-ene
3) pent-3-ene-1-yne
4) none of the above

198. Name of the following compound is :



1) 2-ethyl butanol-2
2) 1-ethyl, 1-methyl propanol-1
3) 3-methyl pentanol-3
4) diethyl ethanol

199. Number of unpaired electrons in Ni^{2+} (28) is :

3) 6 4) 8

200. Which of the following have polyamide structure ?

1) Bakelite
2) Nylon-6, 6
3) PVC
4) None of these

Section-3

Mathematics

201. The value of $\sqrt{2+\sqrt{2+\sqrt{2+\ldots\infty}}}$ is equal to :

1) 5
2) 3
3) 2
4) none of these

202. If $3^x - 3^{x-1} = 6$, then x^x is equal to :

1) 2
2) 4
3) 9
4) none of these

203. The determinant $\begin{vmatrix} a & b & a-b \\ b & c & b-c \\ 2 & 1 & 0 \end{vmatrix}$ is equal to zero, if a, b, c are in :

1) GP
2) AP
3) HP
4) none of these

204. The value of
$(1 + \omega^2 + 2\omega)^{3n} - (1 + \omega + 2\omega^2)^{3n}$ is
:

1) zero
2) 1
3) ω
4) ω^2

205. The value of $i^{1/3}$ is :

1) $(\sqrt{(3)} + i) / 2$
2) $(\sqrt{(3)} - i) / 2$
3) $(1 + i\sqrt{3}) / 2$
4) $(1 - i\sqrt{3}) / 2$

206. $\left(\frac{1+i\sqrt{3}}{1-i\sqrt{3}}\right)^n$ is an integer, is :

1) 1 2) 2 3) 3 4) 4

207. If $A = \begin{bmatrix} -2 & 6 \\ -5 & 7 \end{bmatrix}$, then adj (A) is equal to :

1) $\begin{bmatrix} 7 & -6 \\ 5 & -2 \end{bmatrix}$
2) $\begin{bmatrix} 2 & -6 \\ 5 & -7 \end{bmatrix}$
3) $\begin{bmatrix} 7 & -5 \\ 6 & -2 \end{bmatrix}$
4) none of these

208. If $\sin^{-1}\left(x - \frac{x^2}{2} + \frac{x^3}{4} - \ \ldots\right) + \cos^{-1}\left(x^2 - \frac{x^4}{2} + \frac{x^6}{4} + \ \ldots\right) = \frac{\pi}{2}$
for $1 < |x| < \sqrt{(2)}$, then the value of x is :

1) 1/2
2) 1
3) -1/2
4) none of these

209. If $I = \int_0^{\pi/2} \frac{\sqrt{\cos x}}{\sqrt{\sin x} + \sqrt{\cos x}}\, dx$, then the value of I is equal to :

1) $\pi/2$
2) $\pi/4$
3) $\pi/6$

4) none of these

210. If $\sin\theta + \operatorname{cosec}\theta = 2$, then $\sin^n\theta + \operatorname{cosec}^n\theta$ is equal to :

1) 2
2) 2^n
3) 2^{n-1}
4) none of these

$1+\frac{2}{x}+\frac{4}{x^2}+\frac{8}{x^3}+\ \ldots\ \infty$ is a finite number, then :

1) $x < 2$
2) $x > 2$
3) $x > (1/2)$
4) none of these

212. The sum of n terms of the $\frac{1}{\sqrt{1}+\sqrt{3}}+\frac{1}{\sqrt{3}+\sqrt{5}}+\frac{1}{\sqrt{5}+\sqrt{7}}+\ldots\ldots$ is equal to :

1) $\sqrt{(2n+1)}$
2) $\sqrt{(2n+1)}/2$
3) $\sqrt{(2n+1)} - 1$
4) $(\sqrt{(2n+1)} - 1)/2$

213. A person travelling with a velocity v_1 for some time and with uniform velocity v_2 for the next equal time. The average velocity v' is given by :

1) $v' = \frac{v_1+v_2}{2}$
2) $v' = \sqrt{v_1 v_2}$
3) $\frac{2}{v'} = \frac{1}{v_1}+\frac{1}{v_2}$
4) $\frac{1}{v'} = \frac{1}{v_1}+\frac{1}{v_2}$

214. In the binomial expansion
$(a + bx)^{-3} = (1/8) + (9/8)x + \ldots\ldots$, then the value of *a* and *b* are :

1) a = 2, b = 3
2) a = 2, b = -6
3) a = 3, b = 2
4) a = -3, b = 2

215. The value of determinant

$\begin{vmatrix} (a^x + a^{-x})^2 & (a^x - a^{-x})^2 & 1 \\ (b^x + b^{-x})^2 & (b^x - b^{-x})^2 & 1 \\ (c^x + c^{-x})^2 & (c^x - c^{-x})^2 & 1 \end{vmatrix}$, is :

1) 0
2) 2 abc
3) $a^2b^2c^2$
4) none of these

216. If one root of the equation $x^2 + px + q = 0$ is $2 + \sqrt{3}$, then values of p and q are :

1) -4, 1
2) 4, -1
3) 2, $\sqrt{3}$
4) -2, $-\sqrt{3}$

217. If x is real, then value of the expression $\frac{x^2 + 14x + 9}{x^2 + 2x + 3}$ lies between :

1) 5 and 4
2) 5 and -4
3) -5 and 4
4) none of these

218. The coefficient of x^4 in the expansion of $\left(\frac{x}{2} - \frac{3}{x^2}\right)^{10}$ is equal to :

1) 405/256
2) 504/259
3) 450/263
4) none of these

219. $2 \tan^{-1} (\cos x) = \tan^{-1} (\text{cosec}^2 x)$, then x is equal to :

1) π/2 2) π 3) π/6 4) π/3

220. Period of $\sin^2 x$ is equal to :

1) π
2) 2π
3) π/2
4) none of these

221. If $\int \sqrt{2}\sqrt{(1 + \sin x)}\, dx = -4 \cos (ax + b) + c$, then the value of (a, b) is equal to :

1) (1/2), (π/4)
2) 1, (π/2)

3) 1, 1

4) none of these

222. Among 15 players, 8 are batsmen and 7 are bowlers. The probability that a team is chosen of 6 batsmen and 6 bowlers, is :

1) $(({}^{8}C_{6} \times {}^{7}C_{5})/{}^{15}C_{11})$

2) 28/15

3) 15/28

4) none of these

223. In the expansion of $(1 + x)^n$, coefficients of 2nd, 3rd and 4th terms are in AP. Then, n is equal to :

1) 7

2) 9

3) 11

4) none of these

224. The degree and order of the equation $\left[1+\left(\frac{dy}{dx}\right)^2\right]^{-3/2} = k\left(\frac{d^2y}{dx^2}\right)$ is :

1) (2, 2)

2) (3, 2)

3) (2, 3)

4) none of these

225. If $\vec{a}$ and $\vec{b}$ are two unit vectors inclined at an angle θ, then sin θ/2 is equal to :

1) 1

2) 1/2

3) -1/2

4) none of these

226. If (a/b), (b/c), (c/a) are in HP, then :

1) a^2b, c^2a, b^2c are in AP

2) a^2b, b^2c, c^2a are in HP

3) a^2b, b^2c, c^2a are in GP

4) none of the above

227. If $\begin{vmatrix} a & b & (ax+b)/x \\ b & c & bx+c \\ ax+b & bx+c & 0 \end{vmatrix} = 0$, then a, b, c are in :

1) AP

3) HP

4) none of these

228. If $x^2 - 5x + 6 > 0$, then $\in$:

1) $(-\infty, 2) \cup (3, \infty)$

2) [2, 3]

3) (2, 3]

4) none of these

229. If $x > 0$ and $x \neq 1$, $y > 0$ and $y \neq 1$, $z > 0$ and $z \neq 1$, then the value of $\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 1 & \log_y z \\ \log_z x & \log_z y & 1 \end{vmatrix}$ is equal to :

1) 1

2) -1

3) zero

4) none of these

230. If matrix $A = \begin{bmatrix} 3 & -2 & 4 \\ 1 & 2 & -1 \\ 0 & 1 & 1 \end{bmatrix}$ and $A^{-1} = \frac{1}{k}$ adj (A), then k is equal to :

1) 7 2) -7 3) 15 4) 11

231. The projection of the vector $\hat{i} - 2\hat{j} + \hat{k}$ on the vector $4\hat{i} - 4\hat{j} + 7\hat{k}$ is equal to :

1) $5\sqrt{6}/10$

2) 19/9

3) 9/19

4) $\sqrt{6}/19$

232. If $\vec{a} = 2\hat{i} + 4\hat{j} - 5\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$, then $|\vec{a} \times \vec{b}|$ is equal to :

$2\hat{i} - 6\hat{j} + 8\hat{k}$ is equal to :

1) $5\sqrt{3}$

2) $5\sqrt{2}$

3) $25\sqrt{3}$

4) $25\sqrt{2}$

234. The most general solution of tan θ = -1 and cos θ = (1/√2) is :

1) nπ + (7π/4)
2) nπ + $(-1)^n$ (7π/4)
3) 2nπ + (7π/4)
4) none of these

235. The value of $\int_0^{\pi} \frac{x \tan x \, dx}{\sec x + \cos x}$ dx is equal to :

1) $\pi^2/4$
2) $\pi^2/2$
3) $3\pi^2/2$
4) $\pi^2/3$

236. If $y = e^{x + e^{x + e^{x + \ldots \infty}}}$, $\frac{dy}{dx}$ is equal to :

1) x/(1 - x)
2) y/(1 + y)
3) y/(1 - y)
4) (1 - y)/y

237. $\lim_{x \to 0} \frac{\cos 2x^3 - 1}{\sin^6 2x}$ is equal to :

1) (1/16)
2) -(1/16)
3) (1/32)
4) -(1/32)

238. If x = *a* sin θ and y = *b* cos θ, then (d^2y/dx^2) is equal to :

1) (a/b^2) $\sec^2 \theta$
2) -(b/a) $\sec^2 \theta$
3) $-(b/a^2)$ $\sec^3 \theta$
4) (b/a^2) $\sec^3 \theta$

239. Differential equation of y = sec $(\tan^{-1} x)$ is :

1) $(1 + x^2)$ (dy/dx) = y + x
2) $(1 + x^2)$ (dy/dx) = y - x
3) $(1 + x^2)$ (dy/dx) = xy

240. If 'H' is the harmonic mean between P and Q, then (H/P) + (H/Q) is :

1) 2
2) (PQ/(P + Q))
3) ((P + Q)/PQ)
4) none of these

241. If $\frac{\tan 3x - \tan 2x}{1 + \tan 3x \tan 2x} = 1$, then x is equal to :

1) ϕ
2) π/4
3) [nπ + (π/4), n = 1, 2, 3, ...]
4) [2nπ + (π/4), n = 1, 2, 3, ...]

242. The value of $2(\sin^6 \theta + \cos^6 \theta) - 3(\sin^4 \theta + \cos^4 \theta) + 1$ is equal to :

1) 2 2) zero 3) 4 4) 6

243. If $u_n = \int_0^{\pi/4} \tan^n \theta \, d\theta$, then $u_n + u_{n-2}$ is equal to :

1) (1/(n - 1))
2) (1/(n + 1))
3) (1/(2n - 1))
4) (1/(2n + 1))

244. The equation of the normal to the hyperbola $(x^2/16) - (y^2/9) = 1$ at (-4, 0) is :

1) y = 0
2) y = x
3) x = 0
4) x = -y

245. $\int \frac{x \, dx}{1 + x^4}$ is equal to :

1) $\log (1 + x^2) + c$
2) $\tan^{-1} x^2 + c$
3) $(1/2) \tan^{-1} x^2 + c$
4) none of these

246. The value of

$$\left(\frac{a-b}{a}\right) + \frac{1}{2}\left(\frac{a-b}{a}\right)^2 + \frac{1}{3}\left(\frac{a-b}{a}\right)^3 + \cdots \infty$$

1) log (b/a)
2) log a - log b
3) log a + log b
4) none of these

247. If $y = a \log x + bx^2 + x$ has its extremum value at x = 1 and x = 2, then (a, b) is :
1) (1, (1/2))
2) ((1/2), 2)
3) (2, -(1/2))
4) (-(2/3), -(1/6))

248. $y^2 + xy + Px^2 - x - 2y + P = 0$ represent two straight lines, if P is equal to :
1) 2 2) 2/3 3) 1/4 4) 1/2

249. If $f(x)$ is a differentiable function, then $\lim_{x \to a} \frac{a f(x) - x f(a)}{x - a}$ is equal to :
1) $af'(a) - f(a)$
2) $af(a) - f'(a)$
3) $af'(a) + f(a)$
4) $af(a) - f'(a)$

250. If z = x + iy, then the area of a triangle with vertices z, iz and z + iz is equal to :
1) $(3/2)\,|z|^2$
2) $|z|^2$
3) $(1/2)\,|z|^2$
4) $(1/4)\,|z|^2$

251. If sets A and B are defined as
$A = \{(x, y); y = e^x, x \in R\}$,
$B = \{(x, y); y = x, x \in R\}$, then :
1) $B \subset A$
2) $A \subset B$
3) $A \cap B = \phi$
4) $A \cup B = A$

252. Number of ways in which 7 men and 7 women can sit on a round table such that no two women sit together are :
1) $(7\,!)^2$
2) $7\,! \times 6\,!$
3) $(6\,!)^2$

253. Let $\vec{a}$ and $\vec{b}$ be two equal vectors inclined at an angle θ, then sin θ/2 is equal to :

1) $((1/2)\ |\vec{a} - \vec{b}|) / |\vec{a}|$
2) $((1/2)\ |\vec{a} + \vec{b}|) / |\vec{a}|$
3) $|\vec{a} - \vec{b}|$
4) $|\vec{a} + \vec{b}|$

254. The angle of intersection between the curves $x^2 = 4(y + 1)$ and $x^2 = -4(y + 1)$ is :

1) π/6 2) π/4 3) zero 4) π/2

255. If $\vec{a}$, $\vec{b}$, $\vec{c}$ are three vectors such that $|\vec{a}| = 3$, $|\vec{b}| = 4$, $|\vec{c}| = 5$, $|\vec{a} + \vec{b} + \vec{c}| = 0$, then the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ is equal to :

1) -20 2) -25 3) 25 4) 50

256. The value of $\int_0^9 [\sqrt{x} + 2]\, dx$ where [.] is the greatest integer function :

1) 31
2) 22
3) 23
4) none of these

257. $\lim_{x \to 0} \cos \frac{1}{x}$ is :

1) continuous at x = 0
2) differentiable at x = 0
3) does not exist
4) none of the above

258. The work done by the force $\vec{F} = \hat{i} + 2\hat{j} + \hat{k}$ in displacing an object from $\vec{r}_1 = \hat{i} + 5\hat{j} - 3\hat{k}$ to $\vec{r}_2 = 3\hat{i} + 8\hat{j} - 5\hat{k}$ is equal to :

1) 0 unit
2) 20 unit
3) 15 unit
4) none of these

259. Equation $3x^2 + 7xy + 2y^2 + 5x + 5y + 2 = 0$ represents :

1) a pair of straight lines
2) an ellipse
3) a hyperbola

260. If an angle θ divided into two parts A and B such that A - B = k and tan A : tan B = k : 1, then the value of sin k is :

1) ((k + 1)/(k - 1)) sin θ

2) (k/(k + 1)) sin θ

3) ((k - 1)/(k + 1)) sin θ

4) none of these

261. Which is true about matrix multiplication :

1) it is commutative

2) it is associative

3) both (1) and (2)

4) none of these

262. Inverse of the function, y = 2x - 3 is equal to :

1) (x + 3)/2

2) (x - 3)/2

3) 1/(2x - 3)

4) none of these

263. In a right angled triangle, the hypotenuse is four times as long as the perpendicular to it from the opposite vertex, one of the acute angles is :

1) 15°

2) 30°

3) 45°

4) none of these

264. Angle between two curves $x^2 = 4(y + 1)$ and $x^2 = -4(y + 1)$ is :

1) 0 2) 90° 3) 60° 4) 30°

265. If the binomial expansion of $(a + bx)^{-2}$ is (1/4) - 3x + ..., then (a, b) is equal to :

1) (2, 12)

2) (2, 8)

3) (-2, -12)

4) none of these

266. The range of a projectile fixed at an angle of 15° is 50 m. If it is fixed with the same speed at an angle of 45°, then the range will be :

1) 50 m

2) 100 m

3) 150 m

4) none of these

267. Matrix $A = \begin{bmatrix} 1 & 0 & k \\ 2 & 1 & 3 \\ k & 0 & 1 \end{bmatrix}$ is not invertible for :

1) k = 1
2) k = 2
3) k = 0
4) all real values of k

268. If $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$, then A^{100} is equal to :

1) 2^{100} A
2) 2^{99} A
3) 2^{101} A
4) none of these

269. The probability that the two digit number formed by digits 1, 2, 3, 4, 5 is divisible by 4, is :

1) 1/30
2) 1/20
3) 1/5
4) none of these

270. Let $f(x + y) = f(x)\, f(y)$ $\forall$ x, y $\in$ R, $f(5) = 2$, $f'(0) = 3$, then $f'(5)$ equals :

1) 4 2) 1 3) 1/2 4) 6

271. A particle is projected down from the top of tower 5 m high and at the same moment another particle is projected upward from the bottom of the tower with a speed of 10 m/s, meet at a distance 'h' from the top of tower, then h is equal to :

1) 1.25 m
2) 2.5 m
3) 3 m
4) none of these

272. If a couple is acting on two particles of mass 1 kg attached with a rigid rod of length 4 m, fixed at centre acting at the end and the angular acceleration of system about centre is 1 rad/s^2, then magnitude of force is equal to :

1) 2 N
2) 4 N
3) 1 N
4) none of these

273. The integral factor of expansion $(x^2 + 1)(dy/dx) + 2xy = x^2 - 1$, is :

1) $x^2 + 1$

2) $2x/(x^2 + 1)$

3) $(x^2 - 1)/(x^2 + 1)$

4) none of these

274. From a pack of cards, 2 cards are drawn at random one by one with replacement. The probability that the first is heart and second is king, is equal to :

1) 1/26 2) 1/52 3) 1/13 4) 1/10

275. Eccentricity of the curve $x^2 - y^2 = a^2$ is equal to :

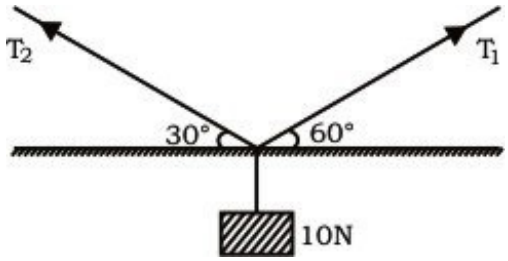
1) 2

2) $\sqrt{2}$

3) 4

4) none of these

276. A weight of 10 N is hanged by two ropes as shown in figure, tensions T_1 and T_2 are :



1) 5 N, $5\sqrt{3}$ N

2) $5\sqrt{3}$ N, 5 N

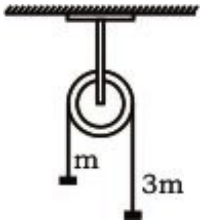
3) 5 N, 5 N

4) $5\sqrt{3}$ N, $5\sqrt{3}$ N

277. Let A and B be two events such that P(A) = 0.3, P(A ∪ B) = 0.8. If A and B are independent events, then P(B) is equal to :

1) 5/7 2) 5/13 3) 1/3 4) 1/2

278. Two masses are attached to the pulley as shown in figure. Acceleration of centre of mass is :



1) g/4 2) -g/4 3) g/2 4) -g/2

279. A particle is thrown with velocity *u* at an angle of 30° from horizontal line, it becomes perpendicular to its original position at time :

1) u/2g
2) 2ug
3) u√(3)/g
4) none of these

280. In the following, one-one function is :
1) e^x
2) e^{x^2}
3) sin x
4) none of these

281. The value of $(e^x - 1)$ is always :
1) greater than 1 for all real values
2) less than 1 for all real values
3) greater than 1 for some real values
4) none of the above

282. If the force represented by $3\hat{j} + 2\hat{k}$ is acting through the point $5\hat{i} + 4\hat{j} - 3\hat{k}$, then its moment about the point (1, 3, 1) is :
1) $14\hat{i} - 8\hat{j} + 12\hat{k}$
2) $-14\hat{i} + 8\hat{j} - 12\hat{k}$
3) $-6\hat{i} - \hat{j} + 9\hat{k}$
4) $6\hat{i} + \hat{j} - 9\hat{k}$

283. Coefficient of x^2 in the expansion $\left(x - \frac{1}{2x}\right)^8$ is equal to :
1) 1/7 2) -1/7 3) -7 4) 7

284. If $A = \begin{bmatrix} 0 & 3 \\ 2 & 0 \end{bmatrix}$ and $A^{-1} = \lambda (A)$, then λ is equal to :
1) -(1/6)
2) (1/3)
3) -(1/3)
4) (1/6)

285. Minimum value $\frac{1 - x + x^2}{1 + x + x^2}$ for all real 'x' is equal to :
1) zero 2) 1/3 3) 1 4) 3

286. $[\hat{i}\ \hat{k}\ \hat{j}] + [\hat{k}\ \hat{j}\ \hat{i}] + [\hat{j}\ \hat{k}\ \hat{i}]$ is equal to :
1) -1 2) 3 3) -3 4) -2

287. If x, 2x + 2, 3x + 3 are in GP, then the fourth term is :

1) 27 2) -27 3) 13.5 4) -13.5

288. If ${}^{n}C_{12} = {}^{n}C_{8}$, then n is equal to :

1) 20 2) 12 3) 6 4) 30

289. If $A = \begin{bmatrix} 1 & -2 \\ 3 & 0 \end{bmatrix}, B = \begin{bmatrix} -1 & 4 \\ 2 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$, then 5A - 3B + 2C is equal to :

1) $\begin{bmatrix} 8 & 20 \\ 7 & 9 \end{bmatrix}$

2) $\begin{bmatrix} 8 & -20 \\ 7 & -9 \end{bmatrix}$

3) $\begin{bmatrix} -8 & 20 \\ -7 & 9 \end{bmatrix}$

4) $\begin{bmatrix} 8 & 7 \\ -20 & -9 \end{bmatrix}$

290. $\begin{vmatrix} 11 & 12 & 13 \\ 12 & 13 & 14 \\ 13 & 14 & 15 \end{vmatrix}$ is equal to :

1) 1 2) zero 3) -1 4) 67

291. If $y = \sec^{-1}\left(\frac{x+1}{x-1}\right) + \sin^{-1}\left(\frac{x-1}{x+1}\right), \frac{dy}{dx}$ is equal to :

1) 1

2) (x - 1)/(x + 1)

3) zero

4) (x + 1)/(x - 1)

292. If sin y = x sin (a + y), then (dy/dx) is equal to :

1) $\frac{\sin a}{\sin a \sin^2 (a+y)}$

2) $\frac{\sin^2(a+y)}{\sin a}$

3) sin a $\sin^2$ (a + y)

4) $\frac{\sin^2(a-y)}{\sin a}$

293. The two curves $x^3 - 3xy^2 + 2 = 0$ and $3x^2y - y^3 = 2$:

1) cut at right angle

2) touch each other

3) cut at an angle (π/3)

4) cut at an angle (π/4)

294. $\int \frac{dx}{x^2(x^4+1)^{3/4}}$ is equal to :

1) $\left(1+\frac{1}{x^4}\right)^{1/4}+c$

2) $(x^4+1)^{1/4}+c$

3) $\left(1-\frac{1}{x^4}\right)^{1/4}+c$

$-\left(1+\frac{1}{x^4}\right)^{1/4}+c$

295. The value of the integral $\int_{-1/2}^{1/2} \cos x \log\left(\frac{1+x}{1-x}\right) dx$ is :

1) zero

2) 1/2

3) -1/2

4) none of these

296. A fair coin is tossed repeatedly. If tail appears on first four tosses, then the probability of head appearing on fifth toss equals :

1) 1/2 2) 1/32 3) 31/32 4) 1/5

297. There are four machines and it is known that exactly two of them are faulty. They are tested one by one in a random order till both the faulty machines are identified. Then, the probability that only two tests are needed, is :

1) 1/3 2) 1/6 3) 1/2 4) 1/4

298. If fifth term of an GP is 2, then the product of its 9 terms is :

1) 256

2) 512

3) 1024

4) none of these

299. If p and q are the roots of the equation $x^2 + px + q = 0$, then :

1) p = 1

2) p = 0 or 1

3) p = -2

4) p = -2 or zero

300. Let A and B be two finite sets having m and n elements respectively. Then, the total number of mappings from A to B is :

1) mn

2) 2^{mn}

3) m^n

4) n^m

Answer Key

1) 4	2) 1	3) 1	4) 1	5) 1	6) 4	7) 1	8) 1	9) 1	10) 2
11) 2	12) 4	13) 4	14) 3	15) 2	16) 1	17) 1	18) 1	19) 2	20) 2
21) 1	22) 4	23) 1	24) 2	25) 4	26) 1	27) 2	28) 3	29) 3	30) 3
31) 1	32) 3	33) 4	34) 3	35) 2	36) 4	37) 1	38) 3	39) 2	40) 1
41) 3	42) 3	43) 2	44) 2	45) 2	46) 1	47) 3	48) 3	49) 4	50) 3
51) 2	52) 2	53) 1	54) 3	55) 3	56) 2	57) 1	58) 4	59) 3	60) 4
61) 1	62) 2	63) 2	64) 4	65) 1	66) 1	67) 2	68) 4	69) 1	70) 2
71) 4	72) 2	73) 3	74) 1	75) 4	76) 2	77) 3	78) 2	79) 2	80) 1
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281) 3	282) 2	283) 3	284) 4	285) 2	286) 1	287) 4	288) 1	289) 2	290) 2
291) 3	292) 2	293) 1	294) 4	295) 1	296) 1	297) 2	298) 2	299) 2	300) 4

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