Physics

1. The r.m.s speed of the molecules of a gas at $100^\circ C$ is v. The temperature at which the r.m.s. speed will be $\sqrt{3}v$ is.

(a) $546^\circ C$ (b) $646^\circ C$
(c) $746^\circ C$ (d) $846^\circ C$

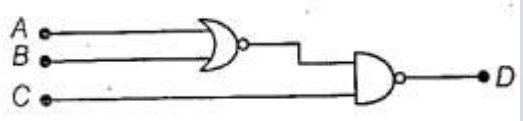
2. The equation of state of a gas is given by $\left(p+\frac{a}{v^3}\right)(V-b^2)=cT$, where p, V, T are pressure, volume and temperature respectively and a, b, c are constants. The dimensions of a and b are respectively.

(a) $[ML^8T^{-2}$ and $L^{3/2}]$
(b) $[ML^{-\cdots}$ and $L^3]$
(c) $[MI$ nd $L^6]$
(d) [ML, − andL $^{3/2}]$

3. A frictionless piston-cylinder based enclosure contains some amount of gas at a pressure of 400 kPa . Then heat is transferred fo the gas at constant pressure in a quasi-static process. The piston moves up slowly through a height of 10 cm . If the piston has a cross-sectional area of $0.3\ m^2$, the work done by the gas in this process is.

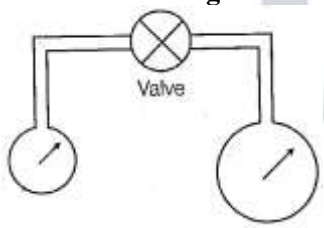
(a) 6 kJ (b) 12 kJ
(c) 7.5 kJ (d) 24 kJ

4. ANOR gate and a NAND gate are connected as shown in the figure. Two different sets of inputs are given to this setup. In the first case, the inputs to the gates are $A=0, B=0, C=0$. In the second case, the inputs are $A=1, B=0, C=1$. The output D in the first case and second case respectively are.



(a) 0 and 0 (b) 0 and 1
(c) 1 and 0 (d) 1 and 1

5. Two soap bubbles of radii r and $2r$ are connected by a capillary tube-valve arrangement shown in the diagram. The valve is now opened. Then which one of the following will result.



(a) The radii of the bubbles will remain unchanged
(b) The bubbles will have equal radii
(c) The radius of the smaller bubble will decrease and that of the bigger bubble will decrease
(d) The radius of the smaller bubble will decrease and that of the bigger bubble will increase

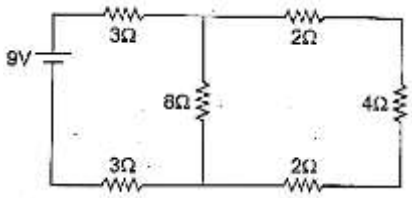
6. The velocity of a car travelling on a straight road is $3.6 kmh^{-1}$ at an instant of time. Now travelling with uniform acceleration for 10 s , the velocity becomes exactly double. If the wheel radius of the car is 25 cm , then which of the following is the closest to the number of revolutions that the wheel makes during this 10 s?

(a) 84 (b) 95
(c) 126 (d) 135

7. The ionization energy of the hydrogen atom is 13.6 eV . The potential energy of the electron in $n=2$ state of hydrogen atom is.

(a) +3.4 eV
(b) -3.4 eV
(c) +6.8 eV
(d) -6.8 eV

8. In the electrical circuit shown in the figure, the current through the 4Ω resistor is.



(a) 1 A (b) 0.5 A
(c) 0.25 A (d) 0.1 A

9. A current of 1 A is flowing along positive x-axis through a straight wire of length 0.5 m placed in a region of a magnetic field given by $\mathbf{B} = (2\mathbf{i} + 4\mathbf{j})$ T. The magnitude and the direction of the force experienced by the wire respectively are.

(a) $\sqrt{18}$ N, along positive z-axis
(b) $\sqrt{20}$ N, along positive x -axis
(c) 2 N , along positive z-axis
(d) 4 N , along positive y-axis

10. S_1 and S_2 are the coherent point sources of light located in the xy-plane at points $(0, 0)$ and $(0, 3\lambda)$ respectively. Here λ is the wavelength of light. At which one of the following points (given as coordinates), the intensity of interference will be maximum?.

(a) $(3\lambda, 0)$ (b) $(4\lambda, 0)$
(c) $(5\lambda/4, 0)$ (d) $(2\lambda/3, 0)$

11. Four small objects each of mass m are fixed at the corners of a rectangular wire-frame of negligible mass and of sides a and $b (a > b)$. If the wire frame is now roated about an axis passing along the side of length b, then the moment of inertia of the system for this axis of rotation is.

(a) $2ma^2$ (b) $4ma^2$
(c) $2m(a^2 + b^2)$ (d) $2m(a^2 - b^2)$

12. The de-Broglie wavelength of an electron (mass $= 1 \times 10^{-30}$ kg, charge $= 1.6 \times 10^{-19}$C) with a kinetic energy of 200 eV is (Planck's constant $= 6.6 \times 10^{-34}$Js.

(a) 9.60×10^{-11} m
(b) 8.25×10^{-11} m
(c) 6.25×10^{-11} m
(d) 5.00×10^{-11} m

13. The number of atoms of a radioactive substance of half-life T is N_0 at $t = 0$. The time necessary to decay from $N_0/2$ atoms to $N_0/10$ atoms will be.

(a) $\frac{5}{2}T$ (b) $T\log 5$
(c) $T\log\left[\frac{5}{2}\right]$ (d) $\frac{T}{2}\log 5$

14. A mass M at rest is broken into two pieces having masses m and $(M - m)$. The two masses are then separated by a distance r. The gravitational force between them will be the maximum when the ratio of the masses [m: $(M - m)$] of the two parts is.

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

15. A bullet of mass m travelling with a speed v hits a block of mass M initially at rest and gets embedded in it. The combined system is free to move and there is no other force acting on the system. The heat generated in the process will be.

(a) Zero (b) $\frac{mv^2}{2}$
(c) $\frac{Mmv^2}{2(M-m)}$ (d) $\frac{mMv^2}{2(M+m)}$

16. A planet moves around the sun in an elliptical orbit with the sun at one of its foci. The physical quantity associated with the motion of the planet that remains constant with time is.

(a) velocity
(b) centripetal force
(c) linear momentum
(d) angular momentum

17. A particle of mass M and charge q is released from rest in a region of uniform electric field

magnitude E. After a time t, the distance travelled by the charge is S and the kinetic energy attained by the particle is T. Then, the ratio T/S.
(a) remains constant with time t
(b) varies linearly with the mass M of the particle
(c) is independent of the charge q
(d) is independent of the magnitude of the electric field E

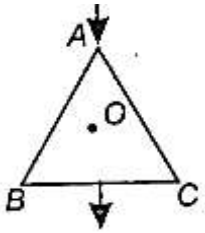
18. The specific heat C of a solid at low temperature shows temperature dependence according to the relation $C = DT^3$, where D is a constant and T is the temperature is kelvin. A piece of this solid of mass m kg is taken and its temperature is raised from 20 K to 30 K . The amount of heat required in the process in energy units is.
(a) 5×10^4Dm
(b) $(33/4) \times 10^4$Dm
(c) $(65/4) \times 10^4$Dm
(d) $(5/4) \times 10^4$Dm

19. The least distance of vision of a long sighted person is 60 cm . By using a spectacle lens, this distance is reduced to 12 cm . The power of the lens is.
(a) +5.0 D (b) $+(20/3)$D
(c) $-(10/3)$D (d) +2.0 D

20. A particle of mass M and charge q, initially at rest, is accelerated by a uniform electric field E through a distance D and is then allowed to approach a fixed static charge Q of the same sign. The distance of the closest approach of the charge q will then be.
(a) $\frac{qQ}{4\pi\varepsilon_0 D}$ (b) $\frac{Q}{4\pi\varepsilon_0 ED}$
(c) $\frac{qQ}{2\pi\varepsilon_0 D^2}$ (d) $\frac{Q}{4\pi\varepsilon_0 E}$

21. At two different places, the angles of dip are respectively $30°$ and $45°$. At these two places the ratio of horizontal component of earth's magnetic field is.
(a) $\sqrt{3}:\sqrt{2}$ (b) $1:\sqrt{2}$
(c) $1:2$ (d) $1:\sqrt{3}$

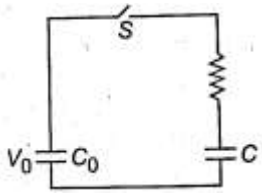
22. An equilateral triangle is made by uniform wires AB, BC, CA. A current I enters at A and leaves from the mid point of BC. If the lengths of each side of the triangle is L, the magnetic field B at the centroid O of the triangle is.



(a) $\frac{\mu_0}{4\pi}\left(\frac{4L}{L}\right)$ (b) $\frac{\mu_0}{2\pi}\left(\frac{4L}{L}\right)$
(c) $\frac{\mu_0}{4\pi}\left(\frac{2L}{L}\right)$ (d) zero

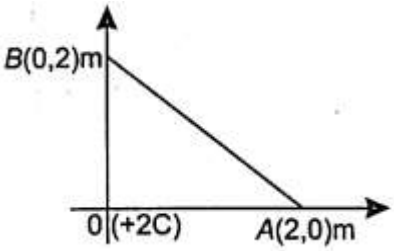
23. A particle is moving with a uniform speed v in a circular path of radius r with the centre at O. When the particle moves from a point P to Q on the circle such that $\angle POQ = \theta$, then the magnitude of the change in velocity is.
(a) $2v\sin(2\theta)$ (b) zero
(c) $2v\sin\left(\frac{\theta}{2}\right)$ (d) $2v\cos\left(\frac{\theta}{2}\right)$

24. A capacitor of capacitance C_0 is charged to a potential V_0 and is connected with another capacitor of capacitance C as shown. After closing the switch S, the common potential across the two capacitors becomes V. The capacitance C is given by.



(a) $\frac{C_0(V_0-V)}{V_0}$ (b) $\frac{C_0(V-V_0)}{V_0}$
(c) $\frac{C_0(V+V_0)}{V}$ (d) $\frac{C_0(V_0-V)}{V}$

25. As shown in figure below, a charge $+2C$ is situated at the origin O and another charge +5 C is on the x-axis at the point A. The later charge from the point A is then brought to a point B on the y-axis. The work done is



(given $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ m/F).

(a) 45×10^9 J (b) 90×10^9 J
(c) zero (d) -45×10^9 J

26. An electric cell of emf E is connected across a copper wire of diameter d and length l. The drift velocity of electrons in the wire is v_d. If the length of the wire is changed to $2l$, the new drift velocity of electrons in the copper wire will be.

(a) v_d (b) $2v_d$
(c) $v_d/2$ (d) $v_d/4$

27. A bar magnet has a magnetic moment of $200 Am^2$. The magnet is suspended in a magnetic field of $0.30 NA^{-1}$ m^{-1}. The torque required to rotate the magnet from its equilibrium position through an angle of $30°$, will be.

(a) 30 N − m
(b) $30\sqrt{3}$ N − m
(c) 60 N − m
(d) $60\sqrt{3}$ N − m

28. An ideal mono-atomic gas of given mass is heated at constant pressure. In this process, the fraction of supplied heat energy used for the increase of the internal energy of the gas is.

(a) 3/8 (b) 3/5
(c) ¾ (d) 2/5

29. The glass prisms P_1 and P_2 are to be combined together to produce dispersion without deviation. The angles of the prisms P_1 and P_2 are selected as $4°$ and $3°$ respectively. If the refractive index of prism P_1 is 1.54 , then that of P_2 will be.

(a) 1.48 (b) 1.58
(c) 1.62 (d) 1.72

30. Water is flowing in streamline motion through a horizontal tube. The pressure at a point in the tube is p where the velocity of flow is v. At another point, where the pressure is $p/2$, the velocity of flow is [density of water = ρ].

(a) $\sqrt{v^2 + \frac{\rho}{\rho}}$ (b) $\sqrt{v^2 - \frac{p}{\rho}}$
(c) $\sqrt{v^2 + \frac{2p}{p}}$ (d) $\sqrt{v^2 - \frac{2p}{\rho}}$

31. A wire of initial length L and raidus r is stretched by a length l. Another wire of same material but with initial length $2L$ and radius $2r$ is stretched by a length $2l$. The ratio of stored elastic energy per unit volume in the first and second wire is.

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

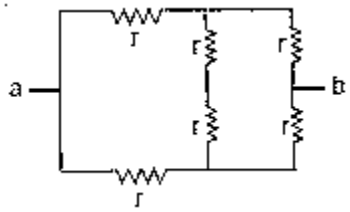
32. Two spheres of the same material, but of radii R and $3R$ are allowed to fall vertically downwards through a liquid of density ρ. The ratio of their terminal velocities is.

(a) 1:3 (b) 1:6
(c) 1:9 (d) 1:1

33. An alpha particle $\left({}^{4}\mathrm{He}\right)$ has a mass of 4.00300 amu. A proton has a mass of 1.00783 amu and a neutron has a mass of 1.00867 amu respectively. The binding energy of alpha estimated from these data is the closest to.

(a) 27.9 MeV
(b) 22.3 MeV
(c) 35.0 MeV
(d) 20.4 MeV

34. The equivalent resistance between the points a and b of the electrical network shown in the figure is.



(a) $6r$ (b) $4r$
(c) $2r$ (d) r

35. An object placed at a distance of 16 cm from a convex lens produces an image of magnification $m(m > 1)$. If the object is moved towards the lens by 8 cm , then again an image of magnification m is obtained. The numerical value of the focal length of the lens is.

(a) 12 cm (b) 14 cm
(c) 18 cm (d) 20 cm

36. A travelling acoustic wave frequency 500 Hz is moving along the positive x-direction with a velocity of $300\ \mathrm{ms}^{-1}$. The phase difference between two points x_1 and x_2 is $60°$. Then the minimum separation between the two points is.

(a) 1 mm (b) 1 cm
(c) 10 cm (d) 10 mm

37. A shell of mass $5M$, acted upon by no external force and initially at rest, bursts into three fragments of masses $M, 2M$ and $2M$ respectively. The first two fragments move in opposite directions with velocities of magnitudes $2v$ and v respectively. The third fragment will.

(a) move with a velocity v in a direction perpendicular to the other two
(b) move with a velocity $2v$ in the direction of velocity of the first fragment
(c) be at rest
(d) move with velocity v in the direction of velocity of the second fragment

38. A particle moves along x-axis and its displacement at any time is given by $x(t) = 2t^3 - 3t^2 + 4t$ in SI units. The velocity of the particle when its acceleration is zero, is.

(a) $2.5\ \mathrm{ms}^{-1}$
(b) $3.5\ \mathrm{ms}^{-1}$
(c) $4.54\ \mathrm{ms}^{-1}$
(d) $8.5\ \mathrm{ms}^{-1}$

39. The fundamental frequency of a closed pipe is equal to the frequency of the second harmonic of an open pipe. The ratio of their lengths is.

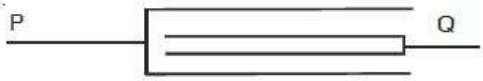
(a) 1:2 (b) 1:4
(c) 1:8 (d) 1:16

40. An alternating current in a circuit is given by $I = 20\sin(100\pi t + 0.05\pi)$ A. The r.m.s. value and the frequency of current respectively are.

(a) 10 A and 100 Hz
(b) 10 A and 50 Hz

(c) $10\sqrt{2}$ A and 50 Hz
(d) $10\sqrt{2}$ A and 100 Hz

41. Four identical plates each of area a are separated by a distance d. The connection is shown below. what is the capacitance between P and Q ?



(a) $2a\varepsilon_0/d$ (b) $a\varepsilon_0/(2d)$
(c) $a\varepsilon_0/d$ (d) $4a\varepsilon_0/d$

42. A particle is acted upon by a constant power. Then, which of the following physical quantity remains constant?
(a) Speed
(b) Rate of change of accoleration
(c) Kinetic energy
(d) Rate of change of kinetic energy.

43. In an $n-p-n$ transistor.
(a) the emitter has higher degree of doping compared to that of the collector
(b) the collector has higher degree of doping compared to that of the emitter
(c) both the emitter and collector have same degree of doping
(d) the base region is most heavily doped

44. The vectors are given by $\hat{A} = \hat{i} + 2\hat{j} + 2\hat{k}$ and $B = 3\hat{i} + 6\hat{j} + 2\hat{k}$. Another vector C has the same magnitude as B but has the same direction as A. Then which of the following vectors represents C ?.
(a) $\frac{7}{3}(\hat{i} + 2\hat{j} + 2\hat{k})$
(b) $\frac{3}{7}(\hat{i} - 2\hat{j} + 2\hat{k})$
(c) $\frac{7}{9}(\hat{i} - 2\hat{j} + 2\hat{k})$
(d) $\frac{9}{7}(\hat{i} + 2\hat{j} + 2\hat{k})$

45. A car moving at a velocity of $17\ ms^{-1}$ towards an approaching bus that blows a horn at a frequency of 640 Hz on a straight track. The frequency of this horn appears to be 680 Hz to the car driver. If the velocity of sound in air is $340\ ms^{-1}$, then the velocity of the approaching bus is.
(a) $2\ ms^{-1}$ (b) $4\ ms^{-1}$
(c) $8\ ms^{-1}$ (d) $10\ ms^{-1}$

Category II

46. A small mass m, attached to one end of a spring with a negligible mass and an unstretched length L, executes virtual oscillation with angular frequency ω_0. When the mass is rotated with an angular speed ω by holding the other end of the spring at a fixed point, the mass moves uniformly in a circular path in a horizontal plane. Then the increase in length of the spring during the rotation is.
(a) $\frac{\omega^2 L}{\omega_0^2 - \omega^2}$ (b) $\frac{\omega_0^2 L}{\omega^2 - \omega_0^2}$
(c) $\frac{\omega^2 L}{\omega_0^2}$ (d) $\frac{\omega_0^2 L}{\omega^2}$

47. A sphere of radius R has a volume density of charge $\rho = kr$, where r is the distance from the center of the sphere and k is constant. The magnitude of the electric field which exists at the surface of the sphere is given by (ε_0 = permittivity of free space).
(a) $\frac{4\pi k R^4}{3\varepsilon_0}$ (b) $\frac{kR}{3\varepsilon_0}$
(c) $\frac{4\pi kR}{\varepsilon_0}$ (d) $\frac{kR^2}{4\varepsilon_0}$

48. A body is projected from the ground with a velocity $v = (3\hat{i} + 10\hat{j})ms^{-1}$. The maximum height attained and the range of the body respectively are (given $g = 10\ ms^{-2}$).
(a) 5 m and 6 m
(b) 3 m and 10 m
(c) 6 m and 5 m
(d) 3 m and 5 m

49. A cell of emf$E$ is connected to a resistance R_1 for time t and the amount of heat generated

in it is H. If the resistance R_1 is replaced by another resistance R_2 and is connected to the cell at the same time t, the amount of heat generated in R_2 is 4 H . Then internal resistance of the cell is.

(a) $\frac{2R_1+R_2}{2}$ (b) $\sqrt{R_1R_2}\frac{2\sqrt{R_2}-\sqrt{R_1}}{\sqrt{R_2}-2\sqrt{R_1}}$

(c) $\sqrt{R_1R_2}\frac{\sqrt{R_2}-2\sqrt{R_1}}{2\sqrt{R_2}-\sqrt{R_1}}$ (d) $\sqrt{R_1R_2}\frac{\sqrt{R_2}-\sqrt{R_1}}{\sqrt{R_2}+\sqrt{R_1}}$

50. A magnetic field $B = 2t + 4t^2$ (where, t = time) is applied perpendicular to the plane of a circular wire of radius r and resistance R. If all the units are in SI the electric charge that flows through the circular wire during $t = 0$ s to $t = 2$ s is.

(a) $\frac{6\pi r^2}{R}$ (b) $\frac{20\pi r^2}{R}$

(c) $\frac{32\pi r^2}{R}$ (d) $\frac{48\pi r^2}{R}$

51. Two simple harmonic motions are given by

$$x_1 = a\sin\omega t + a\cos\omega t \text{ and}$$

$$x_2 = a\sin\omega t + \frac{a}{\sqrt{3}}\cos\omega t$$

The ratio of the amplitudes of first and second motion and the phase difference between them are respectively

(a) $\sqrt{\frac{3}{2}}$ and $\frac{\pi}{12}$ (b) $\frac{\sqrt{3}}{2}$ and $\frac{\pi}{12}$

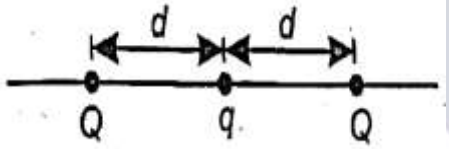
(c) $\frac{2}{\sqrt{3}}$ and $\frac{\pi}{12}$ (d) $\sqrt{\frac{3}{2}}$ and $\frac{\pi}{6}$

52. A cylindrical block floats vertically in a liquid of density ρ_1 kept in a container such that the fraction of volume of the cylinder inside the liquid is x_1. Then some amount of another immiscible liquid of density $\rho_2(\rho_2 < \rho_1)$ is added to the liquid in the container so that the cylinder now floats just fully immersed in the liquids with x_2 fraction of volume of the cylinder inside the liquid of density ρ_1. The ratio ρ_1/ρ_2 will be.

(a) $\frac{1-x_2}{x_1-x_2}$ (b) $\frac{1-x_1}{x_1+x_2}$

(c) $\frac{x_1-x_2}{x_1+x_2}$ (d) $\frac{x_2}{x_1}-1$

53. A particle of mass M and charge q is at rest at the mid point between two other fixed similar charges each of magnitude Q placed a distance $2d$ apart. The system is collinear as shown in the figure. The particle is now displaced by a small amount $x(x \ll d)$ along the joining the two charges and is left to itself. It will now oscillate about the mean position with a time period (ε_0 = permittivity of free space).



(a) $2\sqrt{\frac{\pi^3 M\varepsilon_0 d}{Qq}}$ (b) $2\sqrt{\frac{\pi^2 M\varepsilon_0 d^3}{Qq}}$

(c) $2\sqrt{\frac{\pi^3 M\varepsilon_0 d^3}{Qq}}$ (d) $2\sqrt{\frac{\pi^3 M\varepsilon_0}{Qqd^3}}$

54. The stopping potential for photoelectrons from a metal surface is V_1 when monochromatic light of frequency nv is incident on it. The stopping potential becomes V_2 when monochromatic light of another frequency is incident on the same metal surface. If h be the Planck's constant and e be the charge of an electron, then the frequency of light in the second case is.

(a) $v_1 - \frac{e}{h}(V_2 + V_1)$

(b) $v_1 + v\frac{e}{h}(V_2 + V_1)$

(c) $v_1 - \frac{e}{h}(V_2 - V_1)$

(d) $v_1 + \frac{e}{h}(V_2 - V_1)$

55. 3 moles of mono-atomic gas ($\gamma = 5/3$) is mixed with 1 mole of a diatomic gas ($\gamma = 7/3$).

The value of γ for the mixture will be.

(a) $\frac{9}{11}$ (b) $\frac{11}{7}$

(c) $\frac{12}{7}$ (d) $\frac{15}{7}$

56. An electron of charge e and mass m is moving in a circular of radius r with a uniform angular speed ω. Then which of the following statements are correct?

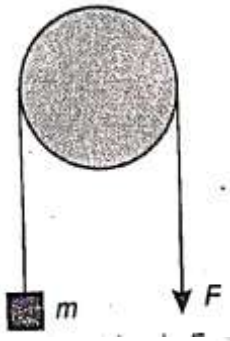
(a) The equivalent current flowing in the circular path is proportional to r^2

(b) The magnetic moment due to circular current loop. is independent of m

(c) The magnetic moment due to circular current loop equal to $2e/\text{m}$ times the angular momentum of the electron

(d) The angular momentum of the particle is proportional to the areal velocity of electron.

57. A block of mass m ($= 0.1$ kg) is hanging over a frictionless light fixed pulley by an inextensible string of negligible mass. The other end of the string is pulled by a constant force F in the vertically downward direction. The linear momentum of the block increases by 2kgms^{-1} in 1 s after the block starts from rest. Then, (given $g = 10\ \text{ms}^{-2}$)



(a) The tension in the string is F

(b) The tension in the string is 3 N .

(c) The work done by the tension on the block is 20 J during this 1 s

(d) The work done against the force of gravity is 10 J

58. If E and B are the magnitudes of electric and magnetic fields respectively in some region of space, then the possibilities for which a charged particle may move in that space with a uniform velocity of magnitude v are.

(a) $E = vB$

(b) $E \neq 0, B = 0$

(c) $E = 0, B \neq 0$

(d) $E \neq 0, B \neq 0$

59. A bar of length marrying a small mass m at one of its ends rotates with a uniform angular speedω in a vertical plane about the mid point of the bar. During the rotation, at some instant of time when the bar is horizontal, the mass is detached from the bar but the bar continues to rotate with some ω. The mass moves vertically up, comes back and reaches the bar at the same point. At that place, the acceleration due to gravity is g.

(a) This possible if the quantity $\frac{\omega^2 l}{2\pi g}$ is an integer

(b) The total time of flight of the mass is proportional to ω^2

(c) The total distance travelled by the mass in air is proportional to ω^2

(d) The total distance travelled by the mass in air and its total time of flight are both independent on its mass.

60. A biconvex lens of focal length f and radii of curvature of both the surfaces R is made of a material of refractive index n_1. This lens is placed in a liquid of refractive index n_2. Now this lens will behave like

(a) either as a convex or as a concave lens depending solely on R

(b) a convex lens depending on n_1 and n_2

(c) a concave lens depending on n_1 and n_2

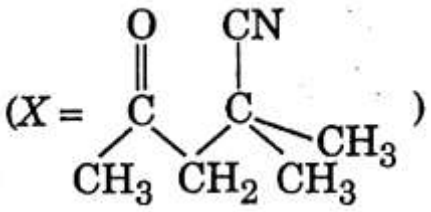
(d) a convex lens of same focal length irrespective of R, n_1 and n_2

Chemistry

61. At 25°C, the solubility product of salt of MX_2 type is 3.2×10^{-8} in water. The solubility (in

mol/L) of MX_2 in water at the same temperature will be
(a) 1.2×10^{-3}
(b) 2×10^{-3}
(c) 3.2×10^{-3}
(d) 1.75×10^{-3}

62. The IUPAC name of the compound *X* is.



(a) 4-cyano-4-methyl-2-oxopentane
(b) 2-cyano-2-methyl-4-oxopentane
(c) 2, 2-dimethyl-4-oxopentanenitrile
(d) 4-cyano-4-methyl-2-pentanone

63. In $SOCl_2$, the $Cl-S-Cl$ and $Cl-S-O$ bond angles are .
(a) 130° and 115°
(b) 106° and 96°
(c) 107° and 108°
(d) 96° and 106°

64. (+)-2-chloro-2-phenylethane in toluene racemises slowly in the presence of small amount of $SbCl_2$, due to the formation of.
(a) carbanion
(b) carbene
(c) free-radical
(d) carbocation

65. Acid catalyzed hydrolysis of ethyl acetate follows a pseudo-first order kinetics with respect to ester. If the reaction is carried out with large excess of ester, the order with respect to ester will be.
(a) 1.5 (b) 0
(c) 0.5 (d) 1

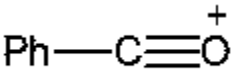
66. The different colours of litmus in acidic, neutral and basic solutions are, respectively.
(a) red, orange and blue
(b) blue, violet and red
(c) red, colourless and blue
(d) red, violet and blue

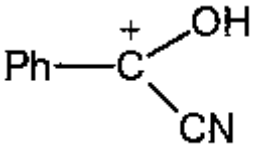
67. Baeyer's reagent is.
(a) alkaline potassium permanganate
(b) acidified potassium permanganate
(c) neutral potassium permanganate
(d) alkaline potassium manganate

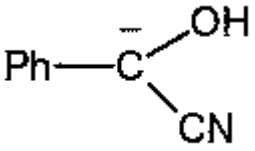
68. The correct order of equivalent conductance's at infinite dilution in water at room temperature for H^+, K^+, CH_3COO^- and HO^- ions is.
(a) $HO^- > H^+ > K^+ > CH_3COO^-$
(b) $H^+ > HO^- > K^+ > CH_3COO^-$
(c) $H^+ > K^+ > HO^- > CH_3COO^-$
(d) $H^+ > K^+ > CH_3COO^- > HO^-$

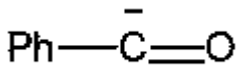
69. Nitric acid can be obtained from ammonia via the formations of the intermediate compounds.
(a) nitric oxide and nitrogen dioxide
(b) nitrogen and nitric oxide
(c) nitric oxide and dinitrogen pentoxide
(d) nitrogen and nitrous oxide

70. In the following species, the one which is likely to be the intermediate during benzoin condensation of benzaldehyde is.

(a) 

(b) 

(c) 

(d) 

71. In O_2 and H_2O_2, the $O-O$ bond lengths are 1.21 and 1.48Å respectively. In ozone, the average $O-O$ bond length is.

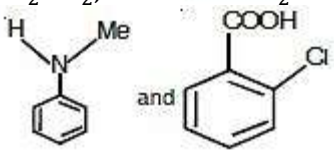
(a) 1.28Å
(b) 1.18Å
(c) 1.44Å
(d) 1.52Å

72. The change of entropy (dS) is defined as.

(a) $dS = \frac{\delta q}{T}$
(b) $dS = \frac{dH}{T}$
(c) $dS = \frac{\delta q_{\text{rev}}}{T}$
(d) $dS = \frac{dH - dG}{T}$

73. Correct pair of compounds which gives blue colouration/precipitate and white precipitate, respectively, when their Lassaigne's test is separately done is.

(a) NH_2NH_2, HCl and $ClCH_2COOH$
(b) NH_2CSNH_2 and $PhCHCH_2Cl$
(c) NH_2NH_2, COOH and NH_2CONH_2



(d)

74. Chlorine gas reacts with red hot calcium oxide to give.

(a) bleaching powder and dichlorine monoxide
(b) bleaching powder and water
(c) calcium chloride and chlorine dioxide
(d) calcium chloride and oxygen

75. For a chemical reaction at $27°C$, the activation energy is $600R$. The ratio of the rate constants at $327°C$ to that of at $27°C$ will be.

(a) 2 (b) 40
(c) e (d) e^2

76. 2-methylpropane on monochlorination under photochemical condition give.

(a) 2-chloro-2-methylpropane as major product
(b) (1: 1) mixture of 1-chloro-2-methylpropane and 2-chloro-2-methylpropane
(c) 1-chloro-2-methylpropane as a major product
(d) (1:9) mixture of 1-chloro-2-methylpropane and 2-chloro-2-methylpropane

77. The half-life for decay of ^{14}C by β-emission is 5730 yr . The fraction of ^{14}C decays, in a

sample that is 22920 yr old, would be.

(a) $\frac{1}{8}$ (b) $\frac{1}{16}$

(c) $\frac{7}{8}$ (d) $\frac{15}{16}$

78. A van der Waals' gas may behave ideally when.

(a) the volume is very low

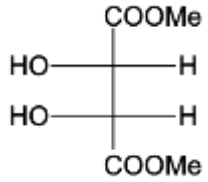
(b) the temperature is very high

(c) the pressure is very low

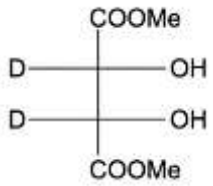
(d) the temperature, pressure and volume all are very high

79. The optically active molecule is.

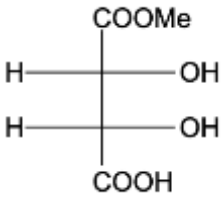
(a)



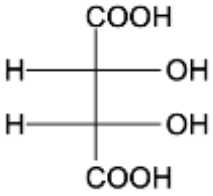
(b)



(c)



(d)



80. In diborane, the number of electrons that accounts for bonding in the bridges is.

(a) six (b) two

(c) eight (d) four

81. The reaction of nitroprusside anion with sulphide ion gives purple colouration due to the formation of.

(a) the tetranionic complex of iron (II) coordinating to one NOS^- ion

(b) the dianoinic complex of iron (II) coordinating to one NCS^- ion

(c) the trianoionic complex of iron (III) coordinating to one NOS^- ion

(d) the tetranionic complex of iron (III) coordinating to one NCS^- ion

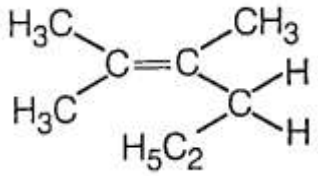
82. At $25^\circ C$, pH of a 10^{-8}M aqueous KOH solution will be.

(a) 6.0 (b) 7.02

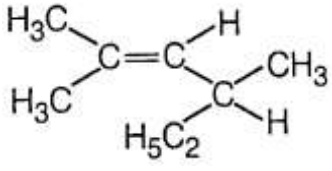
(c) 8.02 (d) 9.02

83. An optically active compound having molecular formula C_2H_{16} on ozonolysis gives acetone as one of the products. The structure of the compound is.

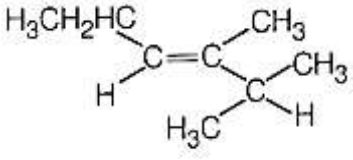
(a)

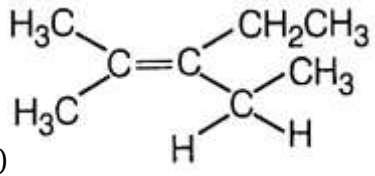


(b)



(c)





(d)

84. Mixing of two different ideal gases under isothermal reversible condition will lead to.
(a) increase of Gibbs free energy of the system
(b) no change of entropy of the system
(c) increase of entropy of the system
(d) increase of enthalpy of the system

85. The ground state electronic configuration of CO molecule is.
(a) $1\sigma^2 2\sigma^2 1\pi^4 3\sigma^2$
(b) $1\sigma^2 2\sigma^2 3\sigma^2 1\pi^2 2\pi^2$
(c) $1\sigma^2 2\sigma^2 1\pi^2 3\sigma^2 2\pi^2$
(d) $1\sigma^2 1\pi^2 2\sigma^2 2\sigma^2$

86. When aniline is nitrated with nitrating mixture in ice cold condition, the major product obtained Is.
(a) p-nitroaniline
(b) 2, 4-dinitroaniline
(c) o-nitroaniline
(d) m-nitroaniline

87. The measured freezing point depression for a 0.1 m aqueous CH_3COOH solution is $0.19°C$. The acid dissociation constant K_a at this concentration will be (Given, K_f the molal cryoscopic constant $= 1.86$ K kgmol^{-1}).
(a) 4.76×10^{-5}
(b) 4×10^{-5}
(c) 8×10^{-5}
(d) 2×10^{-5}

88. The ore chromite is.
(a) $FeCr_2O_4$
(b) $CoCr_2O_3$
(c) $CrFe_2O_4$
(d) $FeCr_2O_3$

89. 'Sulphan' is.
(a) a mixture of SO_3 and H_2SO_5
(b) 100% conc. H_2SO_4
(c) a mixture of gypsum and conc. H_2SO_4
(d) 100% oleum (a mixture of 100%SO_3 in 100% H_2SO_4)

90. Pressure-volume (pV) work done by an ideal gaseous system at constant volume is (where E is internal energy of the system).
(a) $-\Delta p/p$ (b) zero
(c) $-V\Delta p$ (d) $-\Delta E$

91. Amongst $[Ni(H_2O)_6]^{2+}$, $[Ni(PPh_3)_2Cl_2]$, $[Ni(CO)_4]$ and $[Ni(CN_4)]^{2-}$ the paramagnetic species Are.
(a) $[NiCl_4]^{2-}$, $[Ni(H_2O)_6]^{2+}$, $[Ni(PPh_3)_2Cl_2]$
(b) $[Ni(CO)_4]$, $[Ni(PPh_3)_2Cl_2]$, $[NiCl_4]^{2-}$
(c) $[Ni(CN)_4]^{2-}$, $[Ni(H_2O)_6]^{2+}$, $[NiCl_4]^{2-}$
(d) $[NI(PPh_3)_2Cl_2][Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$

92. Ribose and . 2 -deoxyribose can be differentiated by.
(a) Fehling's reagent
(b) Tollen's reagent
(c) Barfoed's reagent
(d) Osazone formation

93. Number of hydrogen ions present in 10 milionth part of 1.33 cm^3 of pure water at $25°C$ is.

(a) 6.023 million
(b) 60 million
(c) 8.01 million
(d) 80.23 million

94. The correct order of acid strength of the following substituted phenols in water at 28°C is.

(a) p-nitrophenol <p-fluorophenol <p-chlorophenol
(b) p-chlorophenol $<$ p-fluorophenol $<$ p-nitrophenol
(c) p-fluorophenol $<$ p-chlorophenol < p-nitrophenol
(d) p-flurophenol < p-nitrophenol < p-chlorophenol

95. For isothermal expansion of an ideal gas, the correct combination of the thermodynamic parameters will be.

(a) $\Delta U = 0, Q = 0, W \neq 0$ and $\Delta H \neq 0$
(b) $\Delta U \neq 0, Q \neq 0, W \neq 0$ and $\Delta H = 0$
(c) $\Delta U = 0, Q \neq 0, W = 0$ and $\Delta H \neq 0$
(d) $\Delta U = 0, Q \neq 0, W \neq 0$ and $\Delta H = 0$

96. Addition of excess potassium iodide solution to a solution of mercuric chloride gives the halide Complex.

(a) tetrahedral $K_2[HgI_4]$
(b) trigonal $K[HgI_3]$
(c) linear Hg_2I_2
(d) square planar $K_2[HgCl_2I_2]$

97. Amongst the following, the one which can exist in free state as a stable compound is.

(a) C_7H_9O
(b) $C_8H_{12}O$
(c) $C_6H_{12}O$
(d) $C_{10}H_{17}O$

98. A conductivity cell has been calibrated with a 0.01 M 1 : 1 electrolyte solution (specific conductance, $k = 1.25 \times 10^{-3}$ S cm^{-1}) in the cell and the measured resistance was 800Ω at 25°C. The cell constant will be.

(a) 1.02 cm^{-1}
(b) 0.102 cm^{-1}
(c) 1.00 cm^{-1}
(d) 0.5 cm^{-1}

99. The orange solid on heating gives a colourless gas and a green solid which can be reduced to metal by aluminium powder. The orange and the green solids are, respectively.

(a) $NH_4Cr_2O_7$ and Cr_2O_3
(b) $Na_2Cr_2O_7$ and Cr_2O_3
(c) $K_2Cr_2O_7$ and CrO_3
(d) $(NH_4)_2CrO_4$ and CrO_3

100. The best method for the preparation of 2, 2-dimethylbutane is via the reaction of.

(a) Me_3CBr and $MeCH_2Br$ in Na /ether
(b) $(Me_3C)_2CuLi$ and $MeCH_2Br$
(c) $(MeCH_2)_2CuLi$ and Me_3CBr
(d) Me_3CMgl and Me CH_2I

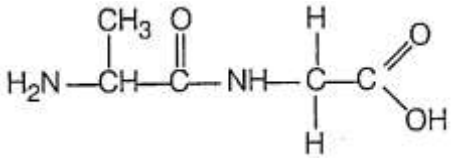
101. The condition of spontaneity of a process is.

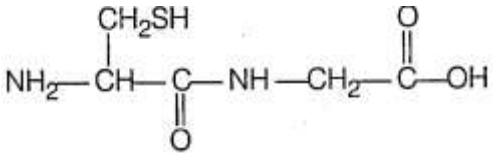
(a) lowering of entropy at constant temperature and pressure
(b) lowering of Gibbs free energy of system at constant temperature and pressure
(c) increase of entropy of system at constant temperature and pressure
(d) increase of Gibbs free energy of the universe at constant temperature and pressure

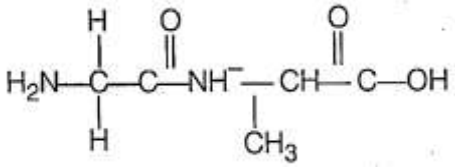
102. The increasing order of O − N − O bond angle in the species NO_2, NO_2^+ and NO_2^- is

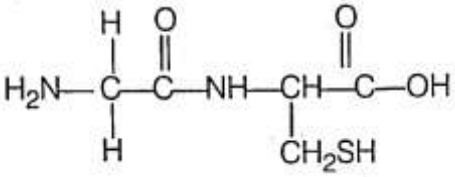
(a) $NO_2^- < NO_2 < NO_2^+$
(b) $NO_2 < NO_2^- < NO_2^+$
(c) $NO_2^+ < NO_2^- < NO_2$
(d) $NO_2 < NO_2^+ < NO_2^-$

103. The correct structure of the dipeptide gly-ala is.

(a) 

(b) 

(c) 

(d) 

104. Equivalent conductivity at infinite dilution for sodium-potassium oxalate $[(COO^-)_2Na^+K^+]$ will be [given molar conductivities of oxalate, K^+ and Na^+ ions at infinite dilution are 148.2, 50.1, 73.5 S cm^2 mol^{-1} respectively].

(a) 271.8 S cm^2eq^{-1}
(b) 67.95 S cm^2eq^{-1}
(c) 543.6 S cm^2eq^{-1}
(d) 135.9 S cm^2eq^{-1}

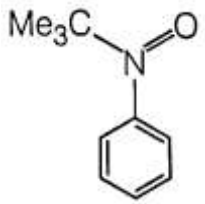
105. For BCl_3, $AlCl_3$ and $GaCl_3$ the increasing order of ionic character is.

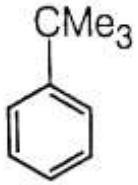
(a) $BCl_3 < AlCl_3 < GaCl_3$
(b) $GaCl_3 < AlCl_3 < BCl_3$
(c) $BCl_3 < GaCl_3 < AlCl_3$
(d) $AlCl_3 < BCl_3 < GaCl_3$

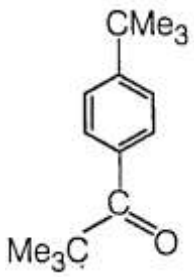
106. In borax the number of $B-O-B$ links and $B-OH$ bonds present are, respectively

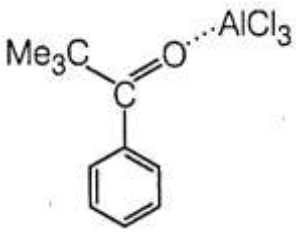
(a) five and four
(b) four and five
(c) three and four
(d) five and five

107. Reaction of benzene with Me_3CCOCl in the presence of anhydrous $AlCl_3$ gives.

(a) 

(b) 

(c) 

(d) 

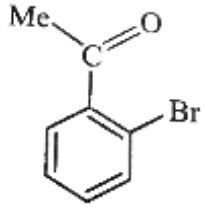
108. 1×10^{-3} mole of HCl is added to a buffer solution made up of 0.01 M acetic acid and 0.01

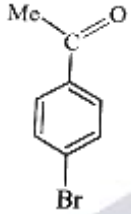
M sodium acetate. The final pH of the buffer will be (given, pK_a of acetic acid is 4.75 at 25°C).
(a) 4.60 (b) 4.66
(c) 4.75 (d) 4.8

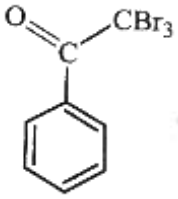
109. On heating, chloric acid decomposes to.
(a) $HClO_4, Cl_2, O_2$ and H_2O
(b) $HClO_2, Cl_2, O_2$ and H_2O
(c) $HClO, Cl_2O$ and H_2O_2
(d) $HCl, HClO, Cl_2O$, and H_2O

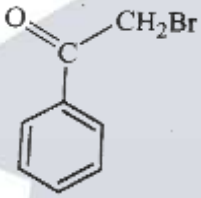
110. The best method for preparation of Me_3CCN is.
(a) to react Me_3COH with HCN
(b) to react Me_3CBr with NaCN
(c) to react Me_3CMgBr with ClCN
(d) to react Me_3CLi with NH_2CN

111. Bromination of PhCOMe in acetic medium produces mainly.

(a) 

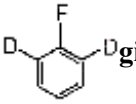
(b) 

(c) 

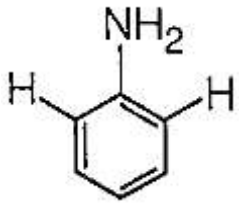
(d) 

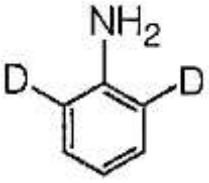
112. The standard Gibbs free energy change (ΔG°) at 25°C for the dissociation of $N_2O_4(g)$ to $NO_2(g)$ is (given, equilibrium constant $= 0.15, R = 8.314 JK/mol$).
(a) 1.1 KJ (b) 4.7 KJ
(c) 8.1 KJ (d) 38.2 KJ

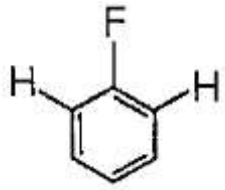
113. Silicon oil is obtained from the hydrolysis and polymerisation of
(a) trimetylchlorosilane and dimethyldichlorosilane
(b) trimethylchlorosilane and methyldichlorosilane
(c) methyltrichlorosilane and dimethyldichlorosilane
(d) triethylchlorosilane and dimethyldichlorosilane

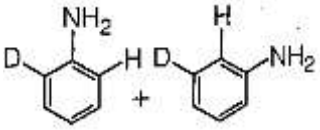
114. Treatment of 

gives. with $NaNH_2$ /liq. NH_3 gives.

(a) 

(b) 

(c) 

(d) 

115. Identify the correct statement.

(a) Quantum numbers (n, l, m, s) are arbitrarily

(b) All the quantum numbers (n, l, m, s) for any pair of electron in an atom can be identical under special circumstance

(c) All the quantum numbers (n, l, m, s) may not be required to describe an electron of an atom completely

(d) All the quantum numbers (n, l, m, s) are required to describe an electron of an atom completely

116. In basic medium the amount of Ni^{2+} in a solution can be estimated. with the dimethylglyoxime reagent. The correct statement(s) about the reaction and the product is (are)

(a) in a ammoniacal solution Ni^{2+} salts give chery-red precipitate of nickel(II) dimethylglyoximate

(b) two dimethylglyoximate units are bound to one Ni^{2+}

(c) in the complex two dimethylglyoximate units are hydrogen bonded to each other

(d) each dimethylglyoximate unit forms a six membered chelate ring with Ni^{2+}

117. Correct statement(s) in cases of n-butanol and t-butanol is (are)

(a) both are having equal solubility in water

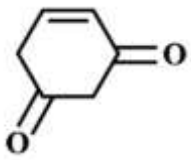
(b) t-butanol is more soluble in water than n-butanol

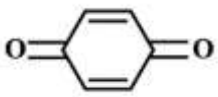
(c) boiling point of t-butanol is lower than n-butanol

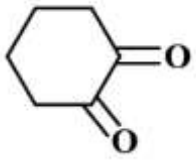
(d) boiling point of n-butanol is lower than t-butanol

118. Tautomerism is exhibited by.

(a) $(Me_3CCO)_3CH$

(b) 

(c) 

(d) 

119. The important advantage(s) of Lintz and Donawitz (L.D.) process for the manufacture of steel is (are)

(a) the process is very quick

(b) operating costs are low

(c) better quality steel is obtained

(d) scrap iron can be used

120. Consider the following reaction for $2NO_2(g) + F_2(g) \longrightarrow 2NO_2F(g)$. The expression for the rate of reaction in terms of the rate of change of partial pressure of reactant and product is/are

(a) rate $= -\frac{1}{2}\left[\frac{dp(NO_2)}{dt}\right]$

(b) rate $= \frac{1}{2}\left[\frac{dp(NO_2)}{dt}\right]$

(c) rate $= -\frac{1}{2}\left[\frac{dp(NO_2\ F)}{dt}\right]$

(d) rate $= \frac{1}{2}\left[\frac{dp(NO_2\ F)}{dt}\right]$

Mathematics

121. Each of a and b can take values 1 or 2 with equal probability. The probability that the equation $ax^2 + bx + 1 = 0$ has real roots, is equal to.

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

(c) $\frac{1}{8}$ (d) $\frac{1}{16}$

122. Cards are drawn one-by-one without replacement from a well shuffled pack of 52 cards. Then, the probability that a face card (jack, queen or king) will appear for the first time on the third turn is equal to.

(a) $\frac{300}{2197}$ (b) $\frac{36}{85}$

(c) $\frac{12}{85}$ (c) $\frac{4}{51}$

123. There are two coins, one unbiased with probability $\frac{1}{2}$ or getting heads and the other one is biased with probability $\frac{3}{4}$ of getting heads. A coin is selected at random and tossed. It shows heads up. Then, the probability that the unbiased coin was selected is.

(a) $\frac{2}{3}$ (b) $\frac{3}{5}$

(c) $\frac{1}{2}$ (d) $\frac{2}{5}$

124. Lines $x + y = 1$ and $3y = x + 3$ intersect the ellipse $x^2 + 9y^2 = 9$ at the points P, Q and R. The area of the $\triangle PQR$ is.

(a) $\frac{36}{5}$ (b) $\frac{18}{5}$

(c) $\frac{9}{5}$ (d) $\frac{1}{5}$

125. For the variable, the locus of the point of intersection of the lines $3tx - 2y + 6t = 0$ and $3x + 2ty - 6 = 0$ is.

(a) the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$

(b) the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$

(c) the hyperbola $\frac{x^2}{4} - \frac{y^2}{9} = 1$

(d) the hyperbola $\frac{x^2}{9} - \frac{y^2}{4} = 1$

126. The locus of the mid-points of the chords of an ellipse $x^2 + 4y^2 = 4$ that are drawn from the positive end of the minor axis, is.

(a) a circle with centre $\left(\frac{1}{2}, 0\right)$ and radius 1

(b) a parabola with focus $\left(\frac{1}{2}, 0\right)$ and directrix $x = -1$

(c) an ellipse with centre $\left(0, \frac{1}{2}\right)$, major axis 1 and minor axis $\frac{1}{2}$

(d) a hyperbola with centre $\left(0, \frac{1}{2}\right)$, transverse axis 1 and conjugate axis $\frac{1}{2}$

127. A point P lies on the circle $x^2 + y^2 = 169$. If $Q = (5, 12)$ and $R = (-12, 5)$, then the $\angle QPR$ is.

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$

(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

128. A point moves, so that the sum of squares of its distance from the points $(1, 2)$ and $(-2, 1)$ is always 6 . Then, its locus is

(a) the straight line $y - \frac{3}{2} = -3\left(x + \frac{1}{2}\right)$

(b) a circle with centre $\left(-\frac{1}{2},\frac{3}{2}\right)$ and radius $\frac{1}{\sqrt{2}}$
(c) a parabola with focus $(1,2)$ and directrix passing through $(-2,1)$
(d) an ellipse with foci $(1,2)$ and $(-2,1)$ ·

129. A circle passing through $(0,0),(2,6),(6,2)$ cut the x-axis at the point $P \neq (0,0)$. Then, the lenght of OP, where O is the origin, is.
(a) $\frac{5}{2}$ (b) $\frac{5}{\sqrt{2}}$
(c) 5 (d) 10

130. For the variable t, the locus of the points of intersection of lines $x-2y=t$ and $x+2y=\frac{1}{t}$ Is.
(a) the straight line $x=y$
(b) the circle with centre at the origin and radius 1
(c) the ellipse with centre at the origin and one focus $\left(\frac{2}{\sqrt{5}},0\right)$
(d) the hyperbola with centre at the origin and one focus $\left(\frac{\sqrt{5}}{2},0\right)$

131. The number of onto functions from the set $\{1,2,\ldots,11\}$ to the set $\{1,2,\ldots,10\}$ is.
(a) 5×111 (b) 10 !
(c) $\frac{11!}{2}$ (d) 10×111

132. Let $p(x)$ be a quadratic polynomial with constant term 1 . Suppose $p(x)$, when divided by $x-1$ leaves remainder 2 and when divided by $x+1$ leaves remainder 4 . Then, the sum of the roots of $p(x)=0$ is
(a) -1 (b) 1
(c) $-\frac{1}{2}$ (d) $\frac{1}{2}$

133. The limit of $\left[\frac{1}{x^2}+\frac{(2013)^x}{e^x-1}-\frac{1}{e^x-1}\right]$ as $x\to 0$
(a) approaches $+\infty$
(b) approaches $-\infty$
(c) is equal to $\log_e(2013)$
(d) does not exist

134. Eleven apples are distributed among a girl and a boy, Then, which one of the following statements is true?
(a) atleast one of them will receive 7 apples
(b) the girl receives atleast 4 apples or the boy receives atleast 9 apples
(c) the girl receives atleast 5 apples or the boy receives atleast 8 apples
(d) the girl receives atleast 4 apples or the boy receiv es atleast 8 apples

135. If $z_1=2+3i$ and $z_2=3+4i$ be two points on the complex plane. Then, the set of complex number z satisfying $|z-z_1|^2+|z-z_2|^2=|z_1-z_2|^2$ represents.
(a) a straight line
(b) a point
(c) a circle
(d) a pair of straight line

136. Five numbers are in HP. The middle term is 1 and the ratio of the second and the fourth terms is 2:1. Then, the sum of the first three terms is.
(a) $\frac{11}{2}$ (b) 5
(c) 2 (d) $\frac{14}{3}$

137. If $p=\begin{pmatrix}\cos\frac{\pi}{4} & -\sin\frac{\pi}{4}\\ \sin\frac{\pi}{4} & \cos\frac{\pi}{4}\end{pmatrix}$ and $X=\begin{pmatrix}\frac{1}{\sqrt{2}}\\ \frac{1}{\sqrt{2}}\end{pmatrix}$. Then, P^3X is equal to.

(a) $\begin{pmatrix}0\\1\end{pmatrix}$ (b) $\begin{pmatrix}-\frac{1}{\sqrt{2}}\\\frac{1}{\sqrt{2}}\end{pmatrix}$

(c) $\begin{pmatrix}-1\\0\end{pmatrix}$ (d) $\begin{pmatrix}-\frac{1}{\sqrt{2}}\\-\frac{1}{\sqrt{2}}\end{pmatrix}$

138. If α and β are roots of $x^2 - x + 1 = 0$, then the value of $\alpha^{2013} + \beta^{2013}$ is.

(a) 2 (b) -2

(c) -1 (d) 1

139. The number of solutions of the equation $x + y + z = 10$ where x, y and z are positive integers.

(a) 36 (b) 55

(c) 72 (d) 45

140. The value of the integral $\int_{-1}^{1} \left\{\frac{x^{2013}}{e^{|x|}(x^2+\cos x)} + \frac{1}{e^{|x|}}\right\} dx$ is equal to.

(a) 0 (b) $1 - e^{-1}$

(c) $2e^{-1}$ (d) $2(1 - e^{-1})$

141. For $0 \le P, Q \le \frac{\pi}{2}$, if $\sin P + \cos Q = 2$, then the value of $\tan\left(\frac{P+Q}{2}\right)$ is equal to.

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

(c) $\frac{1}{2}$ (d) $\frac{\sqrt{3}}{2}$

142. If $f(x) = 2^{100}x + 1, g(x) = 3^{100}x + 1$, then the set of real numbers x such that $f\{g(x)\} = x$ Is.

(a) empty

(b) a singleton

(c) a finite set with more than one element

(d) infinite

143. The limit of $\left\{\frac{1}{x}\sqrt{1+x} - \sqrt{1+\frac{1}{x^2}}\right\}$ as $x \to 0$

(a) does not exist

(b) is equal to $\frac{1}{2}$

(c) is equal to 0

(d) is equal to 1

144. The value of $\cos^2 75^\circ + \cos^2 45^\circ + \cos^2 15^\circ - \cos^2 30^\circ - \cos^2 60^\circ$ is.

(a) 0 (b) 1

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

145. The maximum and minimum values of $\cos^6\theta + \sin^6\theta$ are respectively.

(a) 1 and $\frac{1}{4}$ (b) 1 and 0

(c) 2 and 0 (d) 1 and $\frac{1}{2}$

146. If $z = x + iy$, where x and y are real numbers and $i = \sqrt{-1}$, then the points (x, y) for which $\frac{z-1}{z-i}$ is real, lie on.

(a) an ellipse

(b) a circle

(c) a parabola

(d) a straight line

147. If a, b and c are in AP , then the straight line $ax + 2by + c = 0$ will always pass through a fixed point whose coordinates are.

(a) $(1, -1)$

(b) $(-1, 1)$

(c) $(1, -2)$

(d) $(-2, 1)$

148. The equation $2x^2 + 5xy - 12y^2 = 0$ represents a

(a) circle

(b) pair of non-perpendicular intersecting straight lines

(c) pair of perpendicular straight lines
(d) hyperbola

149. If one end of a diameter of the circle $3x^2 + 3y^2 - 9x + 6y + 5 = 0$ is $(1, 2)$, then the other end Is.

(a) (2,1) (b) (2,4)
(c) $(2, -4)$ (d) $(-4,2)$

150. The line $y = x$ intersects the hyperbola $\frac{x^2}{9} - \frac{y^2}{25} = 1$ at the points P and Q. The eccentricity of ellipse with PQ as major axis and minor axis of length $\frac{5}{\sqrt{2}}$ is.

(a) $\frac{\sqrt{5}}{3}$ (b) $\frac{5}{\sqrt{3}}$
(c) $\frac{5}{9}$ (d) $\frac{2\sqrt{2}}{9}$

151. The limit of $x\sin\left(e^{\frac{1}{x}}\right)$ as $x \to 0$.

(a) is equal to 0
(b) is equal to 1
(c) is equal to $\frac{e}{2}$
(d) does not exist

152. The value of $1000\left[\frac{1}{1\times2} + \frac{1}{2\times3} + \frac{1}{3\times4} + \cdots + \frac{1}{999\times1000}\right]$ is.

(a) 1000 (b) 999
(c) 1001 (d) $\frac{1}{999}$

153. If $I = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ and $P = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{pmatrix}$. Then, the matrix $P^3 + 2P^2$ is equal to.

(a) P (b) $I - P$
(c) $21 + P$ (d) $21 - P$

154. The value of determinant

$$\begin{vmatrix} 1 + a^2 - b^2 & 2ab & -2b \\ 2ab & 1 - a^2 + b^2 & 2a \\ 2b & -2a & 1 - a^2 - b^2 \end{vmatrix}$$ **is**

(a) 0
(b) $(1 + a^2 + b^2)$
(c) $(1 + a^2 + b^2)^2$
(d) $(1 + a^2 + b^2)^3$

155. If α, β are the roots of the quadratic equation $x^2 + ax + b = 0, (b \neq 0)$, then the quadratic equation whose roots are $\alpha - \frac{1}{\beta}, \beta - \frac{1}{\alpha}$, is.

(a) $ax^2 + a(b-1)x + (a-1)^2 = 0$
(b) $bx^2 + a(b-1)x + (b-1)^2 = 0$
(c) $x^2 + ax + bv = 0$
(d) $abx^2 + bx + a = 0$

156. If the distance between the foci of an ellipse is equal to the length of the latusrectum, then its eccentricity is.

(a) $\frac{1}{4}(\sqrt{5} - 1)$ (b) $\frac{1}{2}(\sqrt{5} + 1)$
(c) $\frac{1}{2}(\sqrt{5} - 1)$ (d) $\frac{1}{4}(\sqrt{5} + 1)$

157. The equation of the circle passing through the point $(1, 1)$ and the points of intersection of $x^2 + y^2 - 6x - 8 = 0$ and $x^2 + y^2 - 6 = 0$ is.

(a) $x^2 + y^2 + 3x - 5 = 0$
(b) $x^2 + y^2 - 4x + 2 = 0$
(c) $x^2 + y^2 + 6x - 4 = 0$
(d) $x^2 + y^2 - 4y - 2 = 0$

158. The number of lines which pass through the point $(2, -3)$ and are at a distance 8 from the

point $(-1, 2)$ is.
(a) infinite (b) 4
(c) 2 (d) 0

159. Six positive numbers are in GP, such that their product is 1000 . If the fourth term is 1 , then the last term is.
(a) 1000 (b) 100
(c) $\frac{1}{100}$ (d) $\frac{1}{1000}$

160. If α and β are the roots of the quadratic equation $ax^2 + bx + c = 0$, and $3b^2 = 16ac$, then.
(a) $\alpha = 4\beta$ or $\beta = 4\alpha$
(b) $\alpha = -4\beta$ or $\beta = -4\alpha$
(c) $\alpha = 3\beta$ or $\beta = 3\alpha$
(d) $\alpha = -3\beta$ or $\beta = -3\alpha$

161. In the set of all 3×3 real matrices a relation is defined as follows. A matrix A is related to a matrix B, if and only if there is a non-singular 3×3 matrix P, such that $B = P^{-1}AP$. This relation is.
(a) reflexive, symmetric but not transitive
(b) reflexive, transitive but not symmetric
(c) symmetric, transitive but not reflexive
(d) an equivalence relation

162. For any two real numbers a and b, we define aRb if and only if $\sin^2 a + \cos^2 b = 1$. The relation R is.
(a) reflexive but not symmetric
(b) symmetric but not transitive
(c) transitive but not reflexive
(d) an equivalence relation

163. For the curve $x^2 + 4xy + 8y^2 = 64$ the tangents are parallel to the x-axis only at the points.
(a) $(0, 2\sqrt{2})$ and $(0, -2\sqrt{2})$
(b) $(8, -4)$ and $(-8, 4)$
(c) $(8\sqrt{2}, -2\sqrt{2})$ and $(-8\sqrt{2}, 2\sqrt{2})$
(d) $(9, 0)$ and $(-8, 0)$

164. If $f(x) = \begin{cases} x^3 - 3x + 2, & x < 2, \\ x^3 - 6x^2 + 9x + 2, & x \geq 2 \end{cases}$ then.
(a) $\lim_{x \to 2} f(x)$ does not exist
(b) f is not continuous at $x = 2$
(c) f is continuous but not differentiable at $x = 2$
(d) f is continuous and differentiable at $x = 2$

165. The value of $I = \int_0^{\frac{\pi}{4}} (\tan^{n+1} x) dx + \frac{1}{2}\int_0^{\frac{\pi}{2}} \tan^{n+1}\left(\frac{x}{2}\right) dx$ is.
(a) $\frac{1}{n}$ (b) $\frac{n+2}{2n+1}$
(c) $\frac{2n-1}{n}$ (d) $\frac{2n-3}{3n-2}$

166. The limit of $\sum_{n=1}^{1000} (-1)^n x^n$ as $x \to \infty$.
(a) does not exist
(b) exists and equals to 0
(c) exists and approaches to $+\infty$
(d) exists and approaches $-\infty$

167. Let $f(\theta) = (1 + \sin^2 \theta)(2 - \sin^2 \theta)$. Then, for all values of θ.
(a) $f(\theta) > \frac{9}{4}$
(b) $f(\theta) < 2$
(c) $f(\theta) > \frac{11}{4}$
(d) $2 \leq f(\theta) \leq \frac{9}{4}$

168. If $f(x) = e^x(x-2)^2$, then.

(a) f is increasing in $(-\infty, 0)$ and $(2, \infty)$ and decreasing in $(0,2)$.
(b) f is increasing in $(-\propto, 0)$ and decreasing in $(0, \infty)$.
(c) f is increasing in $(2, \infty)$ and decreasing in $(-\infty, 0)$.
(d) f is increasing in $(0,2)$ and decreasing in $(-\infty, 0)$ and $(2, \infty)$.

169. Let n be a positive even integer. If the ratio of the largest coefficient and the 2nd largest coefficient in the expansion of $(1+x)^n$ is $11:10$. Then, the number of terms in the expansion of $(1+x)^n$ is.

(a) 20 (b) 21
(c) 10 (d) 11

170. Five numbers are in AP with common difference $\neq 0$. If the 1st, 3rd and 4th terms are in GP, Then.

(a) the 5 th term is always 0 .
(b) the 1 st term is always 0 .
(c) the middle term is always 0 .
(d) the middle term is always --2.

171. Let exp (x) denote the exponential function e^x. If $f(x) = \exp\left(x^{\frac{1}{x}}\right), x > 0$, then the minimum value of f in the interval $[2, 5]$ is.

(a) $\exp\left(e^{\frac{1}{e}}\right)$ (b) $\exp\left(2^{\frac{1}{2}}\right)$
(c) $\exp\left(5^{\frac{1}{5}}\right)$ (d) $\exp\left(3^{\frac{1}{3}}\right)$

172. The minimum value of the function $f(x) = 2|x-1| + |x-2|$ is.

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

173. The sum of the series.

$\frac{1}{1\times2}\,{}^{25}C_0 + \frac{1}{2\times3}\,{}^{25}C_1 + \frac{1}{3\times4}\,{}^{25}C_2 + \cdots + \frac{1}{26\times27}\,{}^{25}C_{25}$ is

(a) $\frac{2^{27}-1}{26\times27}$ (b) $\frac{2^{27}-28}{26\times27}$
(c) $\frac{1}{2}\left(\frac{2^{26}+1}{26\times27}\right)$ (d) $\left(\frac{2^{26}-1}{52}\right)$

174. If P, Q and R are angles of an isosceles triangle and $\angle P = \frac{\pi}{2}$, then the value of.

$$\cos\frac{P}{3} - i\sin\frac{P}{3} + (\cos P - i\sin P)$$

$$(\cos R - i\sin R) + (\cos P - i\sin P)$$

$(\cos Q - i\sin Q)(\cos R - i\sin R)$ is

(a) i (b) $-i$
(c) 1 (d) -1

175. Let $f: R \to R$ be such that f is injective and $f(x)f(y) = f(x+y)$ for all $x, y \in R$, if $f(x), f(y)$ and $f(z)$ are in GP, then x, y and z are in.

(a) AP always
(b) GP always
(c) AP depending on the values of x, y and z
(d) GP depending on the values of x, y and z

176. The value of the integral $\int_1^2 e^x\left(\log_e x + \frac{x+1}{x}\right)dx$ is.

(a) $e^2(1+\log_\theta 2)$
(b) $e^2 - e$
(c) $e^2(1+\log_e 2) - e$
(d) $e^2 - e(1+\log_e 2)$

177. The number of solutions of the equation $\frac{1}{2}\log_{\sqrt{3}}\left(\frac{x+1}{x+5}\right) + \log_9(x+5)^2 = 1$ is.

(a) 0 (b) 1
(c) 2 (d) infinite

178. If $P = 1 + \frac{1}{2\times2} + \frac{1}{3\times2^2} + \cdots$ and $Q = \frac{1}{1\times2} + \frac{1}{3\times4} + \frac{1}{5\times6} + \cdots$, then.

(a) $P = Q$ (b) $2P = Q$

(c) $P = 2Q$ (d) $P = 4Q$

179. The area of the region bounded by the parabola $y = x^2 - 4x + 5$ and the straight line $y = x + 1$ is.

(a) $\frac{1}{2}$ (b) 2

(c) 3 (d) $\frac{9}{2}$

180. If $f(x) = \sin x + 2\cos^2 x, \frac{\pi}{4} \le x \le \frac{3\pi}{4}$. Then, f attains its.

(a) minimum at $x = \frac{\pi}{4}$

(b) maximum at $x = \frac{\pi}{2}$

(c) minimum $x = \frac{\pi}{2}$

(d) maximum at $x = \sin^{-1}\left(\frac{1}{4}\right)$

181. An objective type test paper has 5 questions. Out of these 5 questions, 3 questions have four options each (a, b, c, d) with one option being the correct answer. The other 2 questions have two options each, namely true and false. A candidate randomly ticks the options. Then, the probability that he/she will tick the correct option in at least four questions, is

(a) $\frac{5}{32}$ (b) $\frac{3}{128}$

(c) $\frac{3}{256}$ (d) $\frac{3}{64}$

182. The solution of the differential equation $(y^2 + 2x)\frac{dy}{dx} = y$ satisfies $x = 1, y = 1$. Then, the solution is.

(a) $x = y^2(1 + \log_e y)$

(b) $y = x^2(1 + \log_e x)$

(c) $x = y^2(1 - \log_e y)$

(d) $y = x^2(1 - \log_e x)$

183. A family of curves is such that the length intercepted on the y-axis between the origin and the tangent at a point is three times the ordinate of the point of contact. The family of curves is.

(a) $xy = C, C$ is a constant

(b) $xy^2 = C, C$ is a constant

(c) $x^2y = C, C$ is a constant

(d) $x^2y^2 = C, C$ is a constant

184. The solution of the differential equation $y\sin\left(\frac{x}{y}\right)dx = \left\{x\sin\left(\frac{x}{y}\right) - y\right\}dy$ satisfying $y\left(\frac{\pi}{4}\right) = 1$ Is.

(a) $\cos\frac{x}{y} = -\log_e y + \frac{1}{\sqrt{2}}$

(b) $\sin\frac{x}{y} = \log_e y + \frac{1}{\sqrt{2}}$

(c) $\sin\frac{x}{y} = \log_e x - \frac{1}{\sqrt{2}}$

(d) $\cos\frac{x}{y} = -\log_\theta x - \frac{1}{\sqrt{2}}$

185. A line passing through the point of intersection of $x + y = 4$ and $x - y = 2$ makes an angle $\tan^{-1}\left(\frac{3}{4}\right)$ with the x-axis. It intersects the parabola $y^2 = 4(x - 3)$ at points (x_1, y_1) and (x_2, y_2) respectively. Then, $|x_1 - x_2|$ is equal to.

(a) $\frac{16}{9}$ (b) $\frac{32}{9}$

(c) $\frac{40}{9}$ (d) $\frac{80}{9}$

186. If $\sin^2\theta + 3\cos\theta = 2$, then $\cos^3\theta + \sec^3\theta$ is equal out to.

(a) 1 (b) 4

(c) 9 (d) 18

187. If $[a]$ denote the greatest integer which is less than or equal to a. Then, the value of the integral $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} [\sin x \cos x]dx$ is.

(a) $\frac{\pi}{2}$ (b) π

(c) $-\pi$ (d) $-\frac{\pi}{2}$

188. If $x = 1 + \frac{1}{2\times1!} + \frac{1}{4\times2!} + \frac{1}{8\times3!} + \cdots$ and $y = 1 + \frac{x^2}{1!} + \frac{x^4}{2!} + \frac{x^6}{3!} + \cdots$ Then, the value of $\log_e y$ is.

(a) e (b) e^2

(c) 1 (d) $\frac{1}{e}$

189. If $P = \begin{pmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{pmatrix}$, then P^5 is equal to.

(a) P (b) $2P$

(c) $-P$ (d) $-2P$

190. The value of the infinite series $\frac{1^2+2^2}{3!} + \frac{1^2+2^2+3^2}{4!} + \frac{1^2+2^2+3^2+4^2}{5!} + \cdots$ is

(a) e (b) $5\,e$

(c) $\frac{5e}{6} - \frac{1}{2}$ (d) $\frac{5e}{6}$

191. The value of integral $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{(\sin x - x\cos x)}{x(x+\sin x)}dx$ is.

(a) $\log_e \left\{\frac{2(\pi+3)}{(2\pi+3\sqrt{3})}\right\}$

(b) $\log_e \left\{\frac{\pi+3}{2(2\pi+3\sqrt{3})}\right\}$

(c) $\log_\theta \left\{\frac{2\pi+3\sqrt{3}}{2(\pi+3)}\right\}$

(d) $\log_e \left\{\frac{2(2\pi+3\sqrt{3})}{\pi+3}\right\}$

192. If $f(x) = x^{2/3}, x \geq 0$. Then, the area of the region enclosed by the curve $y = f(x)$ and the three lines $y = x, x = 1$ and $x = 8$ is.

(a) $\frac{63}{2}$ (b) $\frac{93}{5}$

(c) $\frac{105}{7}$ (d) $\frac{129}{10}$

193. If $f(x) = x\left(\frac{1}{x-1} + \frac{1}{x} + \frac{1}{x+1}\right), x > 1$. Then,

(a) $f(x) \leq 1$

(b) $1 < f(x) \leq 2$

(c) $2 < f(x) \leq 3$

(d) $f(x) > 3$

194. If P be a point on the parabola $y^2 = 4ax$ with focus F. Let Q denote the foot of the perpendicular from P onto the directrix. Then, $\frac{\tan\angle PQF}{\tan\angle PFQ}$ is.

(a) 1 (b) $\frac{1}{2}$

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

195. If $F(x) = \int_0^x \frac{\cos t}{(1+t^2)}dt; 0 \leq x \leq 2\pi$. Then,

(a) F is increasing in $\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$ and decreasing in $\left(0, \frac{\pi}{2}\right)$ and $\left(\frac{3\pi}{2}, 2\pi\right)$.

(b) F is increasing in $(0, \pi)$ and decreasing in $(\pi, 2\pi)$.

(c) F is increasing $(\pi, 2\pi)$ and decreasing in $(0, \pi)$.

(d) F is increasing in $\left(0, \frac{\pi}{2}\right)$ and $\left(\frac{3\pi}{2}, 2\pi\right)$ and decreasing in $\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$.

196. The equations of the circles, which touch both the axes and the line $4x + 3y = 12$ and have centres in the first quadrant, are

(a) $x^2 + y^2 + x - y + 1 = 0$

(b) $x^2 + y^2 - 2x - 2y + 1 = 0$
(c) $x^2 + y^2 - 12x - 12y + 36 = 0$
(d) $x^2 + y^2 - 6x - 6y + 36 = 0$

197. The area of the region enclosed between parabola $y^2 = x$ and the line $y = mx$ is $\frac{1}{48}$. Then, the value of m is.

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

198. If $\sin\alpha, \cos\alpha$ be the roots of the equation $x^2 - bx + c = 0$. Then, which of the following statements is/are correct?.

(a) $c \leq \frac{1}{2}$ (b) $b \leq \sqrt{2}$
(c) $C > \frac{1}{2}$ (d) $b > \sqrt{2}$

199. Consider the system of equations

$$x + y + z = 0 \; \alpha x + \beta y + \gamma z = 0$$
$$\alpha^2 x + \beta^2 y + \gamma^2 z = 0$$

Then, the system of equations has

(a) a unique solution for all values of α, β and γ.
(b) infinite number of solutions, if any two of α, β, γ are equal.
(c) a unique solution, if α, β and γ are distinct.
(d) more than one, but finite number of solutions depending on values of α, β and γ.

200. Which of the following real valued functions is/are not even functions?

(a) $f(x) = x^3 \sin x$
(b) $f(x) = x^2 \cos x$
(c) $f(x) = e^x x^3 \sin x$
(d) $f(x) = x - [x]$, where $[x]$ denotes the greatest integer less than or equal to x.