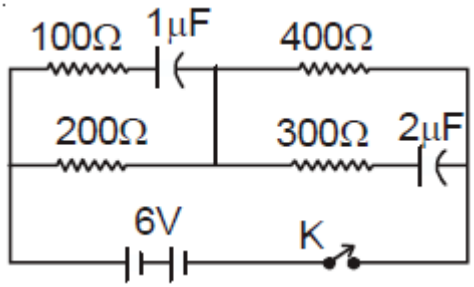
Physics

1. Four resistors, $100\Omega, 200\Omega, 300\Omega$ and 400Ω are connected to form four sides of a square. The resistors can be connected in any order. What is the maximum possible equivalent resistance across the diagonal of the square?

(a) 210Ω (b) 240Ω
(c) 300Ω (d) 250Ω

2. What will be current through the 200Ω resistor in the given circuit, a long time after the switch K is made on?

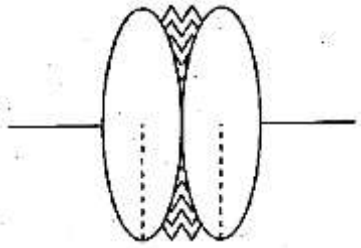


(a) Zero (b) 100 mA
(c) 10 mA (d) 1 mA

3. A point source is placed at coordinates $(0, 1)$ in xy-plane. A ray of light from the source is reflected on a plane mirror placed along the X-axis and perpendicular to the xy-plane. The reflected ray passes through the point $(3, 3)$. What is the path length of the ray from $(0, 1)$ to $(3, 3)$?

(a) 5 (b) $\sqrt{13}$
(c) $2\sqrt{3}$ (d) $1 + 2\sqrt{3}$

4. Two identical equiconvex lenses, each of focal length f are placed side by side in contact with each other with a layer of.



water in between them as shown in the figure. If refractive index of the material of the lenses is greater than that of water, how the combined focal length F is related to f ?

(a) $F > f$ (b) $\frac{f}{2} < F < f$
(c) $F < \frac{f}{2}$ (d) $F = f$

5. There is a small air bubble at the center of a solid glass sphere of radius r and refractive index μ. What will be the apparent distance of the bubble from the centre of the sphere, when viewed from outside?.

(a) r (b) $\frac{r}{\mu}$
(c) $r\left(1 - \frac{1}{\mu}\right)$ (d) Zero

6. If Young's double slit experiment is done with white light, which of the following statements will be true?

(a) All the bright fringes will be coloured.
(b) All the bright fringes will be white.
(c) The central fringe will be white.
(d) No stable interference pattern will be visible.

7. How the linear velocity v of an electron in the Bohr orbit is related to its quantum number n ?

(a) $v \propto \frac{1}{n}$ (b) $v \propto \frac{1}{n^2}$
(c) $V \propto \frac{1}{\sqrt{n}}$ (d) $V \propto n$

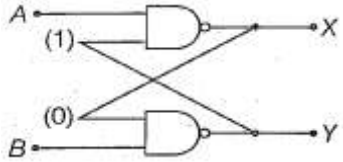
8. If the half-life of a radioactive nucleus is 3 days, nearly what fraction of the initial number of nuclei will decay on the third day? (Given, $\sqrt[3]{0.25} \approx 0.63$).

(a) 0.63 (b) 0.5
(c) 0.37 (d) 0.13

9. An electron accelerated through a potential of 10000 V from rest has a de-Broglie wave length λ. What should be the accelerating potential, so that the wavelength is doubled?

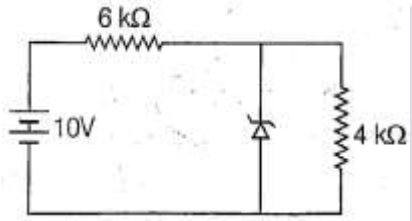
(a) 20000 V (b) 40000 V
(c) 5000 V (d) 2500 V

10. In the circuit shown, inputs A and B are in states 1 and 0 respectively. What is the only possible stable state of the outputs X and Y ?



(a) $X = 1, Y = 1$
(b) $X = 1, Y = 0$
(c) $X = 0, Y = 1$
(d) $X = 0; Y = 0$

11. What will be the current flowing through the 6kΩ resistor in the circuit shown, where the breakdown voltage of the Zener is 6 V ?



(a) $\frac{2}{3}$ mA (b) 1 mA
(c) 10 mA (d) $\frac{3}{2}$ mA

12. In case of a simple harmonic motion, if the velocity is plotted along the X-axis and the displacement (from the equilibrium position) is plotted along the Y-axis, the resultant curve happens to be an ellipse with the ratio: $\frac{\text{major axis (along } X)}{\text{minor axis (along } Y)} = 20\pi$
What is the frequency of the simple harmonic motion?.

(a) 100 Hz (b) 20 Hz
(c) 10 Hz (d) $\frac{1}{10}$ Hz

13. A block of mass m_2 is placed on a horizontal table and another block of mass m_1 is placed on top of it. An increasing horizontal force $F = \alpha t$ is exerted on the upper block but the lower block never moves as a result. If the coefficient of friction between the blocks is μ_1 and that between the lower block and the table is μ_2, then what is the maximum possible value of μ_1/μ_2 ?

(a) $\frac{m_2}{m_1}$ (b) $1 + \frac{m_2}{m_1}$
(c) $\frac{m_1}{m_2}$ (d) $1 + \frac{m_1}{m_2}$

14. In a triangle ABC, the sides AB and AC are represented by the vectors $3\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + \hat{k}$, respectively. Calculate the angle $\angle ABC$.

(a) $\cos^{-1}\sqrt{\frac{5}{11}}$
(b) $\cos^{-1}\sqrt{\frac{6}{11}}$
(c) $\left(90° - \cos^{-1}\sqrt{\frac{5}{11}}\right)$
(d) $\left(180° - \cos^{-1}\sqrt{\frac{5}{11}}\right)$

15. The velocity (v) of a particle (under a force F) depends on its distance (x) from the origin (with $x > 0$) $v \propto \frac{1}{\sqrt{x}}$. Find how the magnitude of the force (F) on the particle depends on x ?

(a) $F \propto \frac{1}{x^{3/2}}$ (b) $F \propto \frac{1}{x}$

(c) $F \propto \frac{1}{x^2}$ (d) $F \propto x$

16. The ratio of accelerations due to gravity $g_1 : g_2$ on the surfaces of two planets is $5:2$ and the ratio of their respective average densities $\rho_1 : \rho_2$ is $2:1$. What is the ratio of respective escape velocities $v_1 : v_2$ from the surface of the planets?.

(a) $5:2$ (b) $\sqrt{5}:\sqrt{2}$

(c) $5:2\sqrt{2}$ (d) $25:4$

17. A spherical liquid drop is placed on a horizontal plane. A small disturbance causes the volume of the drop to oscillate. The time period of oscillation (T) of the liquid drop depends on radius (r) of the drop, density (ρ) and surface tension (S) of the liquid. Which among the following will be a possible expression for T (where, k is a dimensionless constant)?

(a) $k\sqrt{\frac{\rho r}{S}}$ (b) $k\sqrt{\frac{\rho^2 r}{S}}$

(c) $k\sqrt{\frac{\rho r^3}{S}}$ (d) $k\sqrt{\frac{\rho r^3}{S^2}}$

18. The stress along the length of a rod (with rectangular cross-section) is 1% of the Young's modulus of its material. What is the approximate percentage of change of its volume? (Poisson's ratio of the material of the rod is 0.3.).

(a) 3% (b) 1%

(c) 0.7% (d) 0.4%

19. What will be the approximate terminal velocity of a rain drop of diameter 1.8×10^{-3} m, when density of rain water $\approx 10^3 \text{kgm}^{-3}$ and the coefficient of viscosity of air $\approx 1.8 \times 10^{-5}$ N-sm $^{-2}$? (Neglect buoyancy of air)

(a) 49 ms^{-1} (b) 98 ms^{-1}

(c) 392 ms^{-1} (d) 980 ms^{-1}

20. The water equivalent of a calorimeter is 10 g and it contains 50 g of water at 15°C. Some amount of ice, initially at $-10°\text{C}$ is dropped in it and half of the ice melts till equilibrium is reached. What was the initial amount of ice that was dropped (when specific heat of ice $= 0.5 \text{calgm}^{-1}\,°\text{C}^{-1}$, specific heat of water $= 1.0$ calgm $^{-10}\text{C}^{-1}$ and latent heat of melting of ice $= 80 \text{calgm}^{-1}$) ?

(a) 10 g (b) 18 g

(c) 20 g (d) 30 g

21. One mole of a monoatomic ideal gas undergoes a quasistatic process, which is depicted by a straight line joining points (V_0, T_0) and ($2V_0, 3T_0$) in a V-T diagram. What is the value of the heat capacity of the gas at the point (V_0, T_0)?

(a) R (b) $\frac{3}{2}R$.

(c) $2R$ (d) 0

22. For an ideal gas with initial pressure and volume p_i and V_i respectively, a reversible isothermal expansion happens, when its volume becomes V_0. Then, it is compressed to its original volume V_i by a reversible adiabatic process. If the final pressure is p_f, then which of the following statement(s) is/are true?

(a) $p_f = p_i$ (b) $p_f > p_i$

(c) $p_f < p_i$ (d) $\frac{p_f}{V_0} = \frac{p_i}{V_i}$

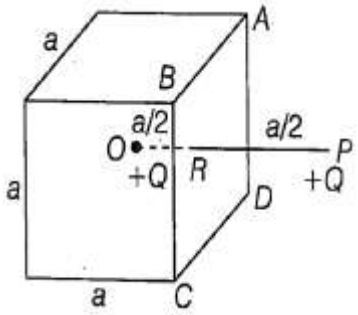
23. A point charge $-q$ is carried from a point A to another point B on the axis of a charged ring of radius r carrying a charge $+q$. If the point A is at a distance $\frac{4}{3}r$ from the centre of the ring and the point B is $\frac{3}{4}r$ from the centre but on the opposite side, what is the net work that need to be done for this?

(a) $-\frac{7}{5} \cdot \frac{q^2}{4\pi\varepsilon_0 r}$ (b) $-\frac{1}{5} \cdot \frac{q^2}{4\pi\varepsilon_0 r}$

(c) $\frac{7}{5} \cdot \frac{q^2}{4\pi\varepsilon_0 r}$ (d) $\frac{1}{5} \cdot \frac{q^2}{4\pi\varepsilon_0 r}$

24. Consider a region in free space bounded by the surfaces of an imaginary cube having sides

of length a as shown in the figure. A charge $+Q$ is placed at the centre O of the cube. P is such a point outside the cube that the line OP perpendicularly intersects the surface $ABCD$ at R and also $OR = RP = a/2$. A charge $+Q$ is placed at point P also. What is the total electric flux through the five faces of the cube other than $ABCD$?



(a) $\frac{Q}{\varepsilon_0}$ (b) $\frac{5Q}{6\varepsilon_0}$

(c) $\frac{10Q}{6\varepsilon_0}$ (d) zero 8302429830

25. Four equal charges of value $+Q$ are placed at any four vertices of a regular hexagon of side ' a '. By suitably choosing the vertices, what can be the maximum possible magnitude of electric field at the center of the hexagon?

(a) $\frac{Q}{4\pi\varepsilon_0 a^2}$ (b) $\frac{\sqrt{2}Q}{4\pi\varepsilon_0 a^2}$

(c) $\frac{\sqrt{3}Q}{4\pi\varepsilon_0 a^2}$ (d) $\frac{2Q}{4\pi\varepsilon_0 a^2}$

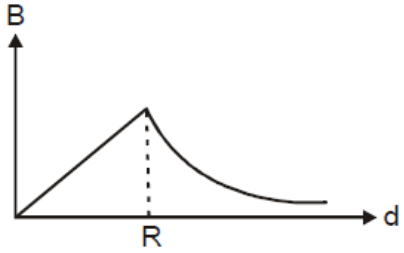
26. A proton of mass m moving with a speed v (<<c, velocity of light in vacuum) completes a circular orbit in time T in a uniform magnetic field. If the speed of the proton is increased to $\sqrt{2}v$, what will be time needed to complete the circular orbit?.

(a) $\sqrt{2}T$ (b) T

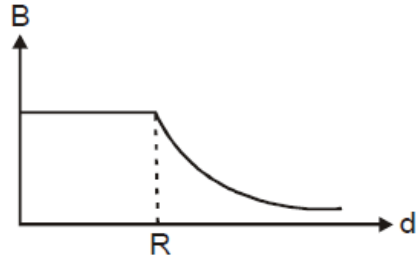
(c) $\frac{T}{\sqrt{2}}$ (d) $\frac{T}{2}$

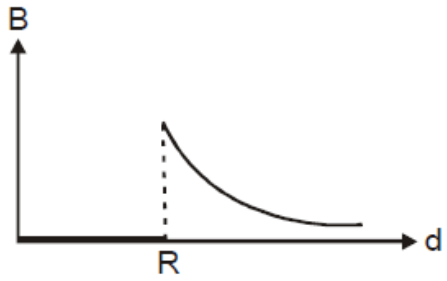
27. A uniform current is flowing along the length of an infinite, straight, thin, hollow cylinder of radius R. The magnetic field B produced at a perpendicular distance d from the axis of the cylinder is plotted in a graph. Which of the following figures looks like the plot?

(a)

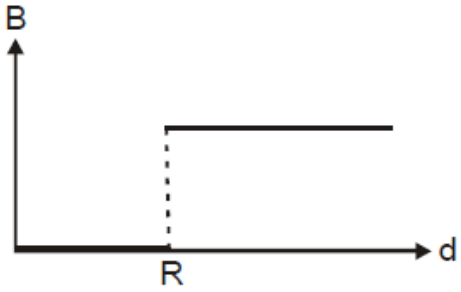


(b)





(c)



(d)

28. A circular loop of radius r of conducting wire connected with a voltage source of zero internal resistance produces a magnetic field B at its centre. If instead, a circular loop of radius $2r$, made of same material, having the same cross-section is connected to the same voltage source, what will be the magnetic field at its centre?

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

29. An alternating current is flowing through a series $L-C-R$ circuit. It is found that the current reaches a value of 1 mA at both 200 Hz and 800 Hz frequency. What is the resonance frequency of the circuit?

(a) 600 Hz (b) 300 Hz
(c) 500 Hz (d) 400 Hz

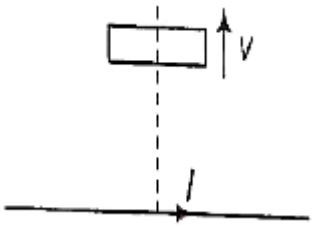
30. An electric bulb, a capacitor, a battery and a switch are all in series in a circuit. How does the intensity of light vary when the switch is turn on?

(a) Continues to increase gradually
(b) Gradually increases for sometime and then becomes steady
(c) Sharply rises initially and then gradually decreases
(d) Gradually increases for sometime and then gradually decreases

31. A light charged particle is revolving in a circle of radius r in electrostatic attraction of a static heavy particle with opposite charge. How does the magnetic field B at the centre of the circle due to the moving charge depend on r ?

(a) $B \propto \frac{1}{r}$ (b) $B \propto \frac{1}{r^2}$
(c) $B \propto \frac{1}{r^{3/2}}$ (d) $B \propto \frac{1}{r^{5/2}}$

32. As shown in the figure, a rectangular loop of a conducting wire is moving away with a constant velocity v in a perpendicular direction from a very long straight conductor carrying a steady current I. When the breadth of the rectangular loop is very small compared to its distance from the straight conductor, how does the emf. E induced in the loop vary with time t ?



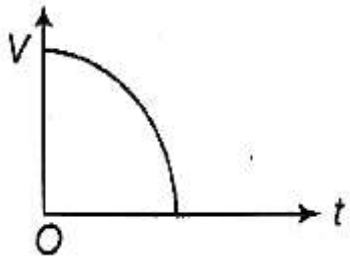
(a) $E \propto \frac{1}{t^2}$ (b) $E \propto \frac{1}{t}$
(c) $E \propto -\ln(t)$ (d) $E \propto \frac{1}{t^3}$

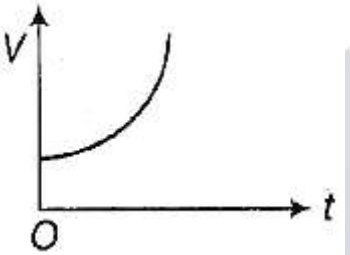
33. A solid spherical ball and a hollow spherical ball of two different materials of densities ρ_1 and ρ_2 respectively have same outer radii and same mass. What will be the ratio, the moment of inertia (about an axis passing through the center) of the hollow sphere to that of the solid sphere?

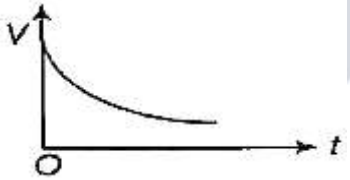
(a) $\frac{\rho_2}{\rho_1}\left(1-\frac{\rho_2}{\rho_1}\right)^{\frac{5}{3}}$ (b) $\frac{\rho_2}{\rho_1}\left[1-\left(1-\frac{\rho_2}{\rho_1}\right)^{\frac{5}{3}}\right]$

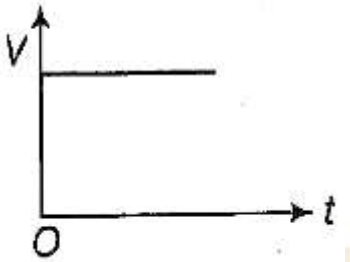
(c) $\frac{\rho_2}{\rho_1}\left(1-\frac{\rho_1}{\rho_2}\right)^{\frac{5}{3}}$ (d) $\frac{\rho_2}{\rho_1}\left[1-\left(1-\frac{\rho_1}{\rho_2}\right)^{\frac{5}{3}}\right]$

34. The insulated plates of a charged parallel plate capacitor (with small separation between the plates) are approaching each other due to electrostatic attraction.
Assuming no other force to be operative and no radiation taking place, which of the following graphs approximately shows the variation with time (t) of the potential difference (V) between the plates?

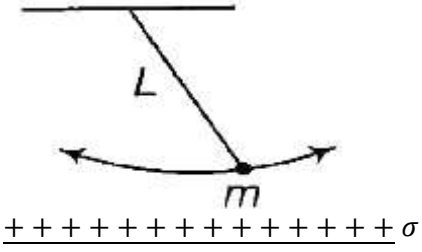
(a)


(b)


(c)


(d)


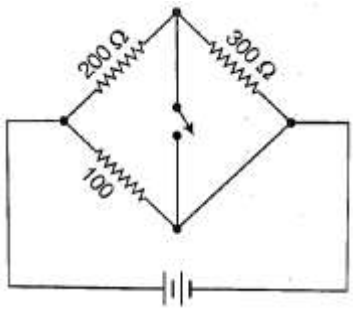
35. The bob of a pendulum of mass m, suspended by an inextensible string of length L as shown in the figure carries a small charge q. An infinite horizontal planeconductor with uniform surface charge density σ is placed below it. What will be the time period of the pendulum for small amplitude oscillations?



(a) $2\pi\sqrt{\frac{L}{\left(g-\frac{mq}{\varepsilon_0\sigma}\right)}}$ (b) $\sqrt{\frac{L}{\left(g-\frac{mq\sigma}{\varepsilon_0}\right)}}$

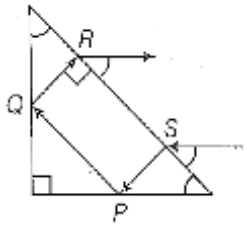
(c) $\frac{1}{2\pi}\sqrt{\frac{L}{\left(g-\frac{q\sigma}{\varepsilon_0 m}\right)}}$ (d) $2\pi\sqrt{\frac{L}{\left(g-\frac{q\sigma}{\varepsilon_0 m}\right)}}$

36. A non-zero current passes through the galvanometer G shown in the circuit when the key K is closed and its value does not change when the key is opened. Then, which of the following statement(s) is/are true?



(a) The galvanometer resistance is infinite.
(b) The current through the galvanometer is 40 mA .
(c) After the key is closed, the current through the 200Ω resistor is same as the current through the 300Ω resistor.
(d) The galvanometer resistance is 150Ω.

37. A ray of light is incident on a right angled isosceles prism parallel to its base as shown in the figure. Refractive index of the material of the prism is $\sqrt{2}$. Then,



which of the following statement(s) is/are true?
(a) The reflection at P is total internal.
(b) The reflection at Q is total internal.
(c) The ray emerging at R is parallel to the ray incident at S.
(d) Total deviation of the ray is 150°.

38. The intensity of a sound appears to an observer to be periodic. Which of the following can be the cause of it?
(a) The intensity of the source is periodic
(b) The source is moving towards the observer
(c) The observer is moving away from the source
(d) The source is producing a sound composed of two nearby frequencies

39. Which of the following statements(s) is/are true?
"Internal energy of an ideal gas "
(a) decreases in an isothermal process.
(b) remains constant in an isothermal process.
(c) increases in an isobaric process.
(d) decreases in an isobaric expansion.

40. Two positive charges Q and $4Q$ are placed at points A and B respectively, where B is at a distance d units to the right of A. The total electric potential due to these charges is minimum at P on the line through A and B. What is (are) the distance (s) of P from A ?
(a) $\frac{d}{3}$ units to the right of A
(b) $\frac{d}{3}$ units to the left of A

(c) $\frac{d}{5}$ units to the right of A
(d) d units to the left of A

Chemistry

41. Cl_2O_7 is the anhydride of.
(a) HOCl (b) $HClO_2$
(c) $HClO_3$ (d) $HClO_4$

42. The main reason that $SiCl_4$ is easily hydrolysed as compared to CCl_4 is that.
(a) $Si-Cl$ bond is weaker than $C-Cl$ bond
(b) $SiCl_4$ can form hydrogen bonds
(c) $SiCl_4$ is covalent
(d) Si can extend its coordination number beyond four

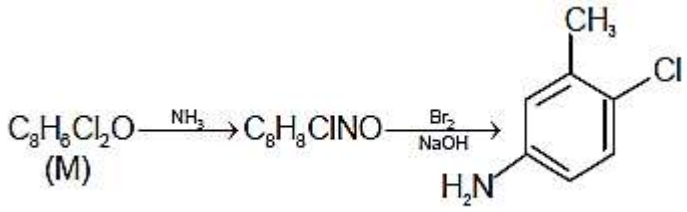
43. Silver chloride dissolves in excess of ammonium hydroxide solution. The cation present in the resulting solution is.
(a) $[Ag(NH_3)_6]^+$
(b) $[Ag(NH_3)_4]^+$
(c) Ag^+
(d) $[Ag(NH_3)_2]^+$

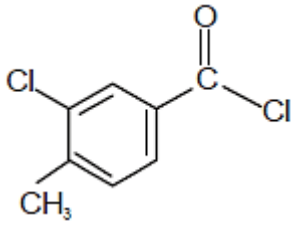
44. The ease of hydrolysis in the compounds CH_3COCl(I), $CH_3-CO-O-COCH_3$(II), $CH_3COOC_2H_5$ (III) and CH_3CONH_2 (IV) is of the order.
(a) I > II > III > IV
(b) IV > III > II > I
(c) I > II > IV > III
(d) II > I > IV > III

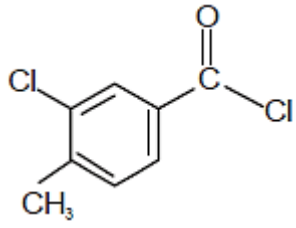
45. $CH_3-C\equiv CMgBr$ can be prepared by the reaction of.
(a) $CH_3-C\equiv C-Br$ with $MgBr_2$
(b) $CH_3-C\equiv CH$ with $MgBr_2$
(c) $CH_3-C\equiv CH$ with KBr and Mg metal
(d) $CH_3-C\equiv CH$ with CH_3MgBr

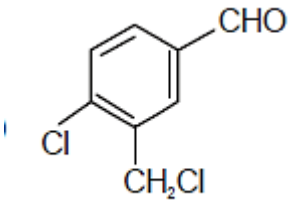
46. The number of alkene (s) which can produce 2-butanol by the successive treatment oin tetrahydrofuran solvent and (ii) alkaline H_2O_2 solution is.
(a) 1 (b) 2
(c) 3 (d) 4

47. Identify ' *M* ' in the following sequence of reactions.

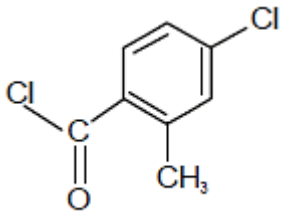


(a)


(b)




(c)



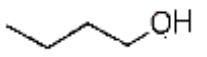
(d)

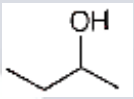
48. Methoxybenzene on treatment with HI produces.

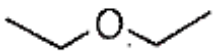
(a) iodobenzene and methanol
(b) phenol and methyl iodide
(c) iodobenzene and methyl iodide
(d) phenol and methanol

49. $C_4H_{10}O \xrightarrow[H_2SO_4]{.K_2Cr_2O_7} C_4H_8O \xrightarrow[\text{Warm}]{I_2/NaOH} CHI_3$

Here, *N* is.

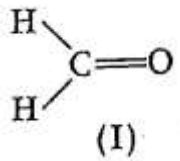
(a) 

(b) 

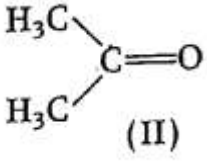
(c) 

(d) 

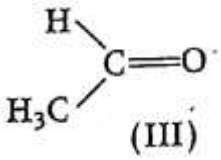
50. The correct order of reactivity for the addition reaction of the following carbonyl compounds with ethylmagnesium iodide is.



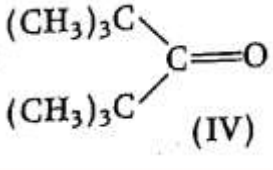
(I)



(II)



(III)



(IV)

(a) I > III > II > IV
(b) IV > III > II > I
(c) I > II > IV > III
(d) III > II > I > IV

51. If aniline is treated with conc. H_2SO_4 and heated at 200°C, the product is.

(a) anilinium sulphate
(b) benzenesulphonic acid
(c) m-aminobenzenesulphonic acid
(d) sulphanilic acid

52. Which of the following electronic configuration is not possible?

(a) $n = 3, l = 0, m = 0$
(b) $n = 3, I = 1, m = -1$
(c) $n = 2, I = 0, m = -1$
(d) $n = 2, l = 1, m = 0$

53. **The number of unpaired electrons in Ni (atomic number = 28) are.**
(a) 0 (b) 2
(c) 4 (d) 8

54. **Which of the following has the strongest H-bond?**
(a) $O-H\ldots S$
(b) $S-H\ldots O$
(c) $F-H\ldots F$
(d) $F-H\ldots O$

55. **The half-life of C^{14} is 5760 years. For a 200 mg sample of C^{14}, the time taken to change to 25 mg Is.**
(a) 11520 years
(b) 23040 years
(c) 5760 years
(d) 17280 years

56. **Ferric ion forms a prussian blue precipitate due to the formation of.**
(a) $K_4[Fe(CN)_6]$
(b) $K_3[Fe(CN)_6]$
(c) $Fe(CNS)_3$
(d) $Fe_4[Fe(CN)_6]_3$

57. **The nucleus $^{64}_{29}Cu$ accepts an orbital electron to yield,**
(a) $^{65}_{28}Ni$ (b) $^{64}_{30}Zn$
(c) $^{64}_{28}Ni$ (d) $^{65}_{30}Zn$

58. **How many moles of electrons will weigh one kilogram?**
(a) 6.023×10^{23}
(b) $\frac{1}{9.108}\times10^{31}$
(c) $\frac{6.023}{9.108}\times10^{54}$
(d) $\frac{1}{9.108\times6.023}\times10^{8}$

59. **Equal weights of ethane and hydrogen are mixed in an empty container at 25°C. The fraction of total pressure exerted by hydrogen is.**
(a) 1:2 (b) 1:1
(c) 1:16 (d) 15:16

60. **The heat of neutralisation of a strong base and a strong acid is 13.7 kcal . The heat released when 0.6 mole HCl solution is added to 0.25 mole of NaOH is.**
(a) 3.425 kcal
(b) 8.22 kcal
(c) 11.645 kcal
(d) 13.7 kcal

61. **A compound formed by elements *X* and *Y* crystallises in the cubic structure, where *X* atoms are at the corners of a cube and *Y* atoms are at the centre of the body. The formula of the compounds is.**
(a) XY (b) XY_2
(c) X_2Y_3 (d) XY_3

62. **What amount of electricity can deposit 1 mole of Al metal at cathode when passed through molten $AlCl_3$?**
(a) 0.3 F (b) 1 F
(c) 3 F (d) 1/3 F

63. **Given the standard half-cell potentials (E°) of the following as**
$Zn \longrightarrow Zn^{2+} + 2e^-;\quad E^\circ = +0.76\ V$
$Fe \longrightarrow Fe^{2+} + 2e^-;\quad E^\circ = 0.41\ V$
Then the standard e.m.f. of the cell with the reaction $Fe^{2+} + Zn \longrightarrow Zn^{2+} + Fe$ is.
(a) -0.35 V (b) +0.35 V
(c) +1.17 V (d) -1.17 V

64. **The following equilibrium constants are given**

$N_2 + 3H_2 \rightleftharpoons 2NH_3; K_1$
$N_2 + O_2 \rightleftharpoons 2NO; K_2$
$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O; K_3$

The equilibrium constant for the oxidation of 2 mole of NH_3 to give NO is.

(a) $K_1 \cdot \frac{K_2}{K_3}$ (b) $K_2 \cdot \frac{K_3^3}{K_1}$
(c) $K_2 \cdot \frac{K_3^2}{K_1}$ (d) $K_2^2 \frac{K_3}{K_1}$

65. Which one of the following is a condensation polymer?

(a) PVC (b) Teflon
(c) Dacron (d) Polystyrene

66. Which of the following is present in maximum amount in 'acid rain'?

(a) HNO_3 (b) H_2SO_4
(c) HCl ` (d) H_2CO_3

67. Which of the set of oxides are arranged in the proper order of basic, amphoteric, acidic?

(a) SO_2, P_2O_5, CO
(b) BaO, Al_2O_3, SO_2
(c) CaO, SiO_2, Al_2O_3
(d) CO_2, Al_2O_3, CO

68. Out of the following outer electronic configurations of atoms, the highest oxidation state is achieved by which one?

(a) $(n-1)d^8ns^2$
(b) $(n-1)d^5ns^2$
(c) $(n-1)d^3ns^2$
(d) $(n-1)d^5ns^1$

69. At room temperature, the reaction between water and fluorine produces.

(a) HF and H_2O_2
(b) HF, O_2 and F_2O_2
(c) F^-, O_2 and H^+
(d) HOF and HF

70. Which of the following is least thermally stable?

(a) $MgCO_3$ (b) $CaCO_3$
(c) $SrCO_3$ (d) $BeCO_3$

71. $[P] \xrightarrow{Br_2} C_2H_4Br_2 \xrightarrow[NH_3]{NaNH_2} [Q]$

$[Q] \xrightarrow[Hg^{2+},\Delta]{20\%H_2SO_4} [R] \xrightarrow{Zn-Hg/HCl} [S]$

The species P, Q, R and S respectively are

(a) ethene, ethyne, ethanal, ethane
(b) ethane, ethyne, ethanal, ethene
(c) ethene, ethyne, ethanal, ethanol
(d) ethyne, ethane, ethene, ethanal

72. The number of possible organobromine compounds which can be obtained in the allylic bromination of 1-butene with N -bromosuccinimide is.

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

73. A metal M (specific heat 0.16) forms a metal chloride with 65% chlorine present in it. The formula of the metal chloride will be.

(a) MCl (b) MCl_2
(c) MCl_3 (d) MCl_4

74. During a reversible adiabatic process, the pressure of a gas is found to be proportional to

the cube of its absolute temperature. The ratio $\frac{C_p}{C_v}$ for the gas is.

(a) $\frac{3}{2}$ (b) $\frac{7}{2}$

(c) $\frac{5}{3}$ (d) $\frac{9}{7}$

75. $[X] + \text{dil. } H_2SO_4 \rightarrow [\dot{Y}]$ **:**

Colourless, suffocating gas

$[Y] + K_2Cr_2O_7 + H_2SO_4 \rightarrow$

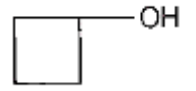
Green colouration of solution

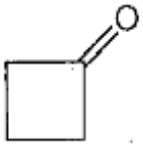
Then, $[X]$ **and** $[Y]$ **are.**

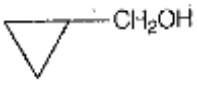
(a) SO_3^{2-}, SO_2 (b) Cl^-, HCl

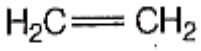
(c) S^{2-}, H_2S (d) CO_3^{2-}, CO_2

76. The possible product(s) to be obtained from the reaction of cyclobutyl amine with HNO_2 is/are.

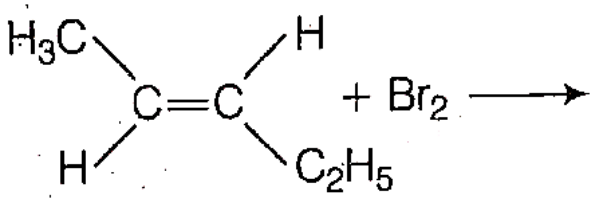
(a) 

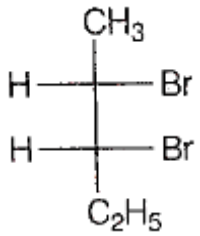
(b) 

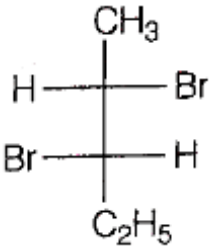
(c) 

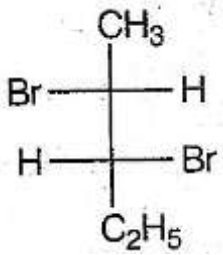
(d) 

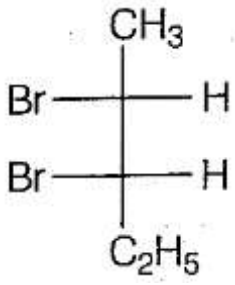
77. The major products obtained in the following reaction is/are.



(a) 

(b) 

(c) 

(d) 

78. Which statements are correct for the peroxide ion?

(a) It has five completely filled anti-bonding molecular orbitals

(b) It is diamagnetic

(c) It has bond order one

(d) It is isoelectronic with neon

79. Among the following, the extensive variables are.

(a) H (Enthalpy)

(b) p (Pressure)

(c) E (Internal energy)

(d) V (Volume)

80. White phosphorous P_4 has the following characteristics

(a) 6P-P single bonds
(b) 4P-P single bonds
(c) 4 lone pair of electrons
(d) $P-P-P$ angle of 60°

Mathematics

81. The approximate value of $\sin 31^\circ$ is.
(a) > 0.5 (b) > 0.6
(c) < 0.5 (d) < 0.4

82. Let $f_1(x) = e^x, f_2(x) = e^{f_1(x)}, \ldots \ldots, f_{n+1}(x) = e^{f_n(x)}$ for all $n \geq 1$. Then for any fixed $n, \frac{d}{dx} f_n(x)$ is.
(a) $f_n(x)$
(b) $f_n(x) f_{n-1}(x)$
(c) $f_n(x) f_{n-1}(x) \ldots f_1(x)$
(d) $f_n(x) \ldots f_1(x) e^x$

83. The domain of definition of $f(x) = \sqrt{\frac{1-|x|}{2-|x|}}$ is
(a) $(-\infty, -1) \cup (2, \infty)$
(b) $[-1,1] \cup (2, \infty) \cup (-\infty, -2)$
(c) $(-\infty, 1) \cup (2, \infty)$
(d) $[-1,1] \cup (2, \infty)$
Here $(a, b) \equiv \{x: a < x < b\}$ and
$[a, b] \equiv \{x: a \leq x \leq b\}$

84. Let $f: [a, b] \to R$ be differentiable on $[a, b]$ and $k \in R$. Let $f(a) = 0 = f(b)$. Also let $J(x) = f'(x) + kf(x)$. Then
(a) $J(x) > 0$ for all $x \in [a, b]$
(b) $J(x) < 0$ for all $x \in [a, b]$
(c) $J(x) = 0$ has at least one root in (a, b)
(d) $J(x) = 0$ through (a, b)

85. Let $f(x) = 3x^{10} - 7x^8 + 5x^6 - 21x^3 + 3x^2 - 7$. Then $\lim_{h \to 0} \frac{f(1-h)-f(1)}{h^3+3h}$
(a) does not exist (b) is $\frac{50}{3}$
(c) is $\frac{53}{3}$ (d) is $\frac{22}{3}$

86. Let $f: [a, b] \to R$ be such that f is differentiable in (a, b), f is continuous at $x = a$ and $x = b$ and moreover $f(a) = 0 = f(b)$. Then.
(a) there exists at least one point c in (a, b) such that $f'(c) = f(c)$
(b) $f'(x) = f(x)$ does not hold at any point in (a, b)
(c) at every point of (a, b), $f'(x) > f(x)$
(d) at every point of (a, b), $f'(x) < f(x)$

87. Let $f: R \to R$ be a twice continuously differentiable function such that $f(0) = f(1) = f'(0) = 0$. Then.
(a) $f''(0) = 0$
(b) $f''(c) = 0$ for some $c \in R$
(c) if $c \neq 0$, then $f''(c) \neq 0$
(d) $f'(x) > 0$ for all $x \neq 0$

88. If $\int e^{\sin x} \cdot \left[\frac{x\cos^3 x - \sin x}{\cos^2 x}\right] dx = e^{\sin x} f(x) + c$, where c is constant of integration, then $f(x)$ is equal to.
(a) $\sec x - x$
(b) $x - \sec x$
(c) $\tan x - x$
(d) $x - \tan x$

89. If $\int f(x) \sin x \cos x dx = \frac{1}{2(b^2-a^2)} \log f(x) + c$, where c is the constant of integration, then

$f(x)$ is equal to.

(a) $\frac{2}{(b^2-a^2)\sin 2x}$ (b) $\frac{2}{ab\sin 2x}$.

(c) $\frac{2}{(b^2-a^2)\cos 2x}$ (d) $\frac{2}{ab\cos 2x}$

90. If $M = \int_0^{\pi/2} \frac{\cos x}{x+2} dx$, $N = \int_0^{\pi/4} \frac{\sin x \cos x}{(x+1)^2} dx$, then the value of $M - N$ is.

(a) π (b) $\frac{\pi}{4}$

(c) $\frac{2}{\pi-4}$ (d) $\frac{2}{\pi+4}$

91. The value of the integral $I = \int_{1/2014}^{2014} \frac{\tan^{-1} x}{x} dx$ is.

(a) $\frac{\pi}{4}\log 2014$

(b) $\frac{\pi}{2}\log 2014$

(c) $\pi \log 2014$

(d) $\frac{1}{2}\log 2014$

92. Let $I = \int_{\pi/4}^{\pi/3} \frac{\sin x}{x} dx$. Then

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

(b) $4 \leq 1 \leq 2\sqrt{30}$

(c) $\frac{\sqrt{3}}{8} \leq 1 \leq \frac{\sqrt{2}}{6}$

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

93. The value of $I = \int_{\pi/2}^{5\pi/2} \frac{e^{\tan^{-1}(\sin x)}}{e^{\tan^{-1}(\sin x)} + e^{\tan^{-1}(\cos x)}} dx$, is.

(a) 1 (b) π

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

94. The value of $\lim_{n\to\infty} \frac{1}{n}\left\{\sec^2 \frac{\pi}{4n} + \sec^2 \frac{2\pi}{4n} + \cdots + \sec^2 \frac{n\pi}{4n}\right]$ is.

(a) $\log_e 2$ (b) $\frac{\pi}{2}$

(c) $\frac{4}{\pi}$ (d) e

95. The differential equation representing the family of curves $y^2 = 2d(x + \sqrt{d})$, where d is a parameter, is of.

(a) order 2

(b) degree 2

(c) degree 3

(d) degree 4

96. Let $y(x)$ be a solution of $(1 + x^2)\frac{dy}{dx} + 2xy - 4x^2 = 0$ and $y(0) = -1$. Then $y(1)$ is equal To.

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

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

97. The law of motion of a body moving along a straight line is $x = \frac{1}{2}vt$. x being its distance from a fixed point on the line at time t and v is its velocity there. Then.

(a) acceleration f varies directly with x

(b) acceleration f varies inversely with x

(c) acceleration f is constant

(d) acceleration f varies directly with t

98. Number of common tangents of $y = x^2$ and $y = -x^2 + 4x - 4$ is.

(a) 1 (b) 2

(c) 3 (d) 4

99. Given that n numbers of arithmetic means are inserted between two sets of numbers $a, 2b$ and $2a, b$ where $a, b \in R$. Suppose further that the m th means between these sets of numbers are same, then the ratio $a: b$ equals.

(a) $n-m+1:m$
(b) $n-m+1:n$
(c) $n:n-m+1$
(d) $m:n-m+1$

100. If $x+\log_{10}(1+2^x)=x\log_{10}5+\log_{10}6$, then the value of x is
(a) $\frac{1}{2}$ (b) $\frac{1}{3}$
(c) 1 (d) 2

101. If $Z_r=\sin\frac{2\pi r}{11}-i\cos\frac{2\pi r}{11}$, then $\sum_{r=0}^{10} Z_r$ is equal to.
(a) -1 (b) 0
(c) i (d) $-i$

102. If z_1 and z_2 be two non-zero complex numbers such that $\frac{z_1}{z_2}+\frac{z_2}{z_1}=1$, then the origin and the points represented by z_1 and z_2.
(a) lie on a straight line
(b) form a right angled triangle
(c) form an equilateral triangle
(d) form an isosceles triangle

103. If $b_1b_2=2(c_1+c_2)$ and b_1,b_2,c_1,c_2 are all real numbers, then at least one of the equations $x^2+b_1x+c_1=0$ and $x^2+b_2x+c_2=0$ has.
(a) real roots
(b) purely imaginary roots
(c) roots of the form $a+ib(a,b\in R,ab\neq 0)$
(d) rational roots

104. The number of selection of n objects from $2n$ objects of which n are identical and the rest are different, is.
(a) 2^n (b) 2^{n-1}
(c) 2^n-1 (d) $2^{n-1}+1$

105. If $(2\le r\le n)$, then ${}^nC_r+2\cdot{}^nC_{r+1}+{}^nC_{r+2}$ is equal to.
(a) $2\,{}^nC_{r+2}$ (b) ${}^{n+1}C_{r+1}$
(c) ${}^{n+2}C_{r+2}$ (d) ${}^{n+1}C_r$

106. The number $(101)^{100}-1$ is divisible by.
(a) 10^4 (b) 10^6
(c) 10^8 (d) 10^{12}

107. If n is even positive integer, then the condition that the greatest term in the expansion of $(1+x)^n$ may also have the greatest coefficient, is.
(a) $\frac{n}{n+2}<x<\frac{n+2}{n}$
(b) $\frac{n}{n+1}<x<\frac{n+1}{n}$
(c) $\frac{n+1}{n+2}<x<\frac{n+2}{n+1}$
(d) $\frac{n+2}{n+3}<x<\frac{n+3}{n+2}$

108. If $\begin{vmatrix}-1&7&0\\2&1&-3\\3&4&1\end{vmatrix}=A$, Then $\begin{vmatrix}13&-11&5\\-7&-1&25\\-21&-3&-15\end{vmatrix}$ is.
(a) A^2
(b) A^2-A+I_3
(c) A^2-3A+I_3
(d) $3A^2+5A-4I_3$
(I_3 denotes the det of the identity matrix of order 3)

109. If $a_r=(\cos 2r\pi+i\sin 2r\pi)^{1/9}$, then the value of $\begin{vmatrix}a_1&a_2&a_3\\a_4&a_5&a_6\\a_7&a_8&a_9\end{vmatrix}$ is equal to.
(a) 1 (b) -1
(c) 0 (d) 2

110. If $S_r = \begin{vmatrix} 2r & x & n(n+1) \\ 6r^2-1 & y & n^2(2n+3) \\ 4r^3-2nr & z & n^3(n+1) \end{vmatrix}$, then the value of $\sum_{r=1}^{n} S_r$ is independent of.

(a) only x (b) only y
(c) only n (d) x, y, z and n

111. If the following three linear equations have a non-trivial solution, then

$x + 4ay + az = 0$
$x + 3by + bz = 0$
$x + 2cy + cz = 0$

(a) a, b, c are in AP
(b) a, b, c are in GP
(c) a, b, c are in HP
(d) $a + b + c = 0$

112. On R, a relation ρ is defined by $x\rho y$ if and only if $x - y$ is zero or irrational. Then,

(a) ρ is equivalence relation
(b) ρ is reflexive but neither symmetric nor transitive
(c) ρ is reflexive and symmetric but not transitive
(d) ρ is symmetric and transitive but not reflexive

113. On the set R of real numbers, the relation ρ is defined by $x\rho y, (x, y) \in R$.

(a) |f$|x - y| < 2$, then ρ is reflexive but neither symmetric nor transitive.
(b) If $x - y < 2$, then ρ is reflexive and symmetric but not transitive.
(c) If $|x| \geq y$, then ρ is reflexive and transitive but not symmetric.
(d) If $x > |y|$, then ρ is transitive but neither reflexive nor symmetric.

114. If $f: R \to R$ be defined by $f(x) = e^x$ and $g: R \to R$ be defined by $g(x) = x^2$. The mapping $g \circ f: R \to R$ be defined by $(g \circ f)(x) = g[f(x)] \forall x \in R$. Then,

(a) $g \circ f$ is bijective but f is not injective
(b) gof is injective and g is injective
(c) gof is injective but g is not bijective
(d) gof is surjective and g is surjective

115. In order to get a head at least once with probability ≥ 0.9, the minimum number of times a unbiased coin needs to be tossed is.

(a) 3 (b) 4
(c) 5 (d) 6

116. A student appears for tests I, II and III. The student is successful if he passes in tests I, II or I, III. The probabilities of the student passing in tests I, II and III are respectively p, q and $1/2$. If the probability of the student to be successful is $1/2$. Then.

(a) $p(1+q) = 1$ (b) $q(1+p) = 1$
(c) $pq = 1$ (d) $\frac{1}{p} + \frac{1}{q} = 1$

117. If $\sin 6\theta + \sin 4\theta + \sin 2\theta = 0$, then general value of θ is.

(a) $\frac{n\pi}{4}, n\pi \pm \frac{\pi}{3}$ (b) $\frac{n\pi}{4}, n\pi \pm \frac{\pi}{6}$
(c) $\frac{n\pi}{4}, 2n\pi \pm \frac{\pi}{3}$ (d) $\frac{n\pi}{4}, 2n\pi \pm \frac{\pi}{6}$

(n is an integer)

118. If $0 \leq A \leq \frac{\pi}{4}$, then

$\tan^{-1}\left(\frac{1}{2}\tan 2A\right) + \tan^{-1}(\cot A) + \tan^{-1}\left(\cot^3 A\right)$ is equal to.

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

119. Without changing the direction of the axes, the origin is transferred to the point $(2, 3)$. Then the equation $x^2 + y^2 - 4x - 6y + 9 = 0$ changes to.

(a) $x^2 + y^2 + 4 = 0$
(b) $x^2 + y^2 = 4$

(c) $x^2 + y^2 - 8x - 12y + 48 = 0$
(d) $x^2 + y^2 = 9$

120. **The angle between a pair of tangents drawn from a point P to the circle $x^2 + y^2 + 4x - 6y + 9\sin^2\alpha + 13\cos^2\alpha = 0$ is 2α. The equation of the locus of the point P is**
(a) $x^2 + y^2 + 4x + 6y + 9 = 0$
(b) $x^2 + y^2 - 4x + 6y + 9 = 0$
(c) $x^2 + y^2 - 4x - 6y + 9 = 0$
(d) $x^2 + y^2 + 4x - 6y + 9 = 0$

121. **The point Q is the image of the point $P(1, 5)$ about the line $y = x$ and R is the image of the point Q about the line $y = -x$. The circumcentre of the $\triangle PQR$ is.**
(a) $(5,1)$ (b) $(-5,1)$
(c) $(1, -5)$ (d) $(0,0)$

122. **The angular points of a triangle are $A(-1, -7)$, $B(5, 1)$ and $C(1, 4)$. The equation of the bisector of the angle $\angle ABC$ is.**
(a) $x = 7y + 2$
(b) $7y = x + 2$
(c) $y = 7x + 2$
(d) $7x = y + 2$

123. **If one of the diameter of the circle, given by the equation $x^2 + y^2 + 4x + 6y - 12 = 0$, is a chord of a circle S, whose centre is $(2, -3)$, the radius of S is.**
(a) $\sqrt{41}$ unit (b) $3\sqrt{5}$ unit
(c) $5\sqrt{2}$ unit (d) $2\sqrt{5}$ unit

124. **A chord AB is drawn from the point $A(0, 3)$ on the circle $x^2 + 4x + (y - 3)^2 = 0$, and is extended to M such that $AM = 2AB$. The locus of M is.**
(a) $x^2 + y^2 - 8x - 6y + 9 = 0$
(b) $x^2 + y^2 + 8x + 6y + 9 = 0$
(c) $x^2 + y^2 + 8x - 6y + 9 = 0$
(d) $x^2 + y^2 - 8x + 6y + 9 = 0$

125. **Let the eccentricity of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ be reciprocal to that of the ellipse $x^2 + 9y^2 = 9$, then the ratio $a^2 : b^2$ equals.**
(a) 8: 1 (b) 1: 8
(c) 9: 1 (d) 1: 9

126. **Let A, B be two distinct points on the parabola $y^2 = 4x$. If the axis of the parabola touches a circle of radius r having AB as diameter, the slope of the line AB is.**
(a) $-\frac{1}{r}$ (b) $\frac{1}{r}$
(c) $\frac{2}{r}$ (d) $-\frac{2}{r}$

127. **Let $P(at^2, 2at), Q, R(ar^2, 2ar)$ be three points on a parabola $y^2 = 4ax$. If PQ is the focal chord and PK, QR are parallel where the co-ordinates of K is $(2a, 0)$, then the value of r is.**
(a) $\frac{t}{1-t^2}$ (b) $\frac{1-t^2}{t}$
(c) $\frac{t^2+1}{t}$ (d) $\frac{t^2-1}{t}$

128. **Let P be a point on the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ and the line through P parallel to the Y-axis meets the circle $x^2 + y^2 = 9$ at Q where P, Q are on the same side of the X-axis. If R is a point on PQ such that $\frac{PR}{RQ} = \frac{1}{2}$, then the locus of R is.**
(a) $\frac{x^2}{9} + \frac{9y^2}{49} = 1$ (b) $\frac{x^2}{49} + \frac{y^2}{9} = 1$
(c) $\frac{x^2}{9} + \frac{y^2}{49} = 1$ (d) $\frac{9x^2}{49} + \frac{y^2}{9} = 1$

129. **A point P lies on a line through $Q(1, -2, 3)$ and is parallel to the line $\frac{x}{1} = \frac{y}{4} = \frac{z}{5}$. If P lies on**

the plane $2x + 3y - 4z + 22 = 0$, then segment PQ equals.

(a) $\sqrt{42}$ units (b) $\sqrt{32}$ units
(c) 4 units (d) 5 units

130. The foot of the perpendicular drawn from the point $(1, 8, 4)$ on the line joining the point $(0, -11, 4)$ and $(2, -3, 1)$ is.

(a) (4,5,2)
(b) $(-4,5,2)$
(c) $(4, -5,2)$
(d) $(4,5, -2)$

131. A ladder 20 ft long leans against a vertical wall. The top end slides downwards at the rate of 2 ft per second. The rate at which the lower end moves on a horizontal floor when it is 12 ft from the wall is

(a) $\frac{-8}{3}$ (b) $\frac{6}{5}$
(c) $\frac{3}{2}$ (d) $\frac{17}{4}$

132. For $0 \leq p \leq 1$ and for any positive a, b; let $I(p) = (a+b)^p, J(p) = a^P + b^P$, then.

(a) $I(p) > J(p)$
(b) $/(p) \leq J(p)$
(c) $I(p) < J(p)$ in $\left[0, \frac{p}{2}\right]$ and $I(p) > J(p)$ in $\left[\frac{p}{2}, \infty\right)$
(d) $I(p) < J(p)$ in $\left[\frac{p}{2}, \infty\right)$ and $J(p) < I(p)$ in $\left[0, \frac{p}{2}\right]$

133. Let $\vec{\alpha} = \hat{\imath} + \hat{\jmath} + \hat{k}, \vec{\beta} = \hat{\imath} - \hat{\jmath} - \hat{k}$ and $\vec{\gamma} = -\hat{\imath} + \hat{\jmath} - \hat{k}$ be three vectors. A vector $\vec{\delta}$, in the plane of $\vec{\alpha}$ and $\vec{\beta}$, whose projection on $\vec{\gamma}$ is $\frac{1}{\sqrt{3}}$, is given by.

(a) $-\hat{\imath} - 3\hat{\jmath} - 3\hat{k}$
(b) $\hat{\imath} - 3\hat{\jmath} - 3\hat{k}$
(c) $-\hat{\imath} + 3\hat{\jmath} + 3\hat{k}$
(d) $\hat{\imath} + 3\hat{\jmath} - 3\hat{k}$

134. Let $\vec{\alpha}, \vec{\beta}, \vec{\gamma}$ be the three unit vectors such that $\vec{\alpha} \cdot \vec{\beta} = \vec{\alpha} \cdot \vec{\gamma} = 0$ and the angle between $\vec{\beta}$ and $\vec{\gamma}$ is $30°$. Then $\vec{\alpha}$ is.

(a) $2(\vec{\beta} \times \vec{\gamma})$
(b) $-2(\vec{\beta} \times \vec{\gamma})$
(c) $\pm 2(\vec{\beta} \times \vec{\gamma})$
(d) $(\vec{\beta} \times \vec{\gamma})$

135. Let z_1 and z_2 be complex numbers such that $z_1 \neq z_2$ and $|z_1| = |z_2|$. If $\mathrm{Re}(z_1) > 0$ and $\mathrm{Im}(z_2) < 0$, then $\frac{z_1+z_2}{z_1-z_2}$ is.

(a) one
(b) real and positive
(c) real and negative
(d) purely imaginary

136. From a collection of 20 consecutive natural numbers, four are selected such that they are not consecutive. The number of such selections is.

(a) 284×17
(b) 285×17
(c) 284×16
(d) 285×16

137. The least positive integer n such that $\begin{pmatrix} \cos\frac{\pi}{4} & \sin\frac{\pi}{4} \\ -\sin\frac{\pi}{4} & \cos\frac{\pi}{4} \end{pmatrix}^n$ is an identity matrix of order 2 is.

(a) 4 (b) 8
(c) 12 (d) 16

138. Let ρ be a relation defined on N, the set of natural numbers, as $\rho = \{(x, y) \in N \times N : 2x + y = 41\}$. Then.

(a) ρ is an equivalence re!ation

(b) ρ is only reflexive relation
(c) ρ is only symmetric relation
(d) ρ is not transitive

139. If the polynomial

$$f(x)=\begin{vmatrix}(1+x)^a & (2+x)^b & 1\\ 1 & (1+x)^a & (2+x)^b\\ (2+x)^b & 1 & (1+x)^a\end{vmatrix}$$

, then the constant term of $f(x)$ is

(a) $2-3\cdot 2^b+2^{3b}$
(b) $2+3\cdot 2^b+2^{3b}$
(c) $2+3\cdot 2^b-2^{3b}$
(d) $2-3.2^b-2^{3b}$
[a and b are positive integers]

140. A line cuts the X-axis at $A(5,0)$ and the Y-axis at $B(0,-3)$. A variable line PQ is drawn perpendicular to AB cutting the X-axis at P and the Y-axis at Q. If AQ and BP meet at R, then the locus of R is.

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

141. Let A be the centre of the circle $x^2+y^2-2x-4y-20=0$. Let $B(1,7)$ and $D(4,-2)$ be two points on the circle such that tangents at B and D meet at C. The area of the quadrilateral $ABCD$ is.

(a) 150 sq units
(b) 50 sq units
(c) 75 sq units
(d) 70 sq units

142. Let $f(x)=\begin{cases}-2\sin x, & \text{if } x\le -\frac{\pi}{2}\\ A\sin x+B, & \text{if } -\frac{\pi}{2}<x<\frac{\pi}{2}\\ \cos x, & \text{if } x\ge \frac{\pi}{2}\end{cases}$. Then,

(a) f is discontinuous for all A and B
(b) f is continuous for all $A=-1$ and $B=1$
(c) t is continuous for all $A=1$ and $B=-1$
(d) f is continuous for all real values of A, B

143. The normal to the curve $y=x^2-x+1$, drawn at the points with the abscissa $x_1=0, x_2=-1$ and $x_3=5/2$.

(a) are parallel to each other
(b) are pairwise perpendicular
(c) are concurrent
(d) are not concurrent

144. The equation $x\log x=3-x$

(a) has no root in (1,3)
(b) has exactly one root in (1,3)
(c) $x\log x-(3-x)>0$ in [1,3]
(d) $x\log x-(3-x)<0$ in [1,3]

145. Consider the parabola $y^2=4x$. Let P and Q be points on the parabola where $P(4,-4)$ and $Q(9,6)$. Let R be a point on the arc of the parabola between P and Q. Then, the area of $\triangle PQR$ is largest when.

(a) $\angle PQR=90^\circ$ (b) $R(4,4)$
(c) $R\left(\frac{1}{4},1\right)$ (d) $R\left(1,\frac{1}{4}\right)$

146. Let $I=\int_0^1 \frac{x^3\cos 3x}{2+x^2}dx$. Then

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

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

147. A particle is in motion along a curve $12y = x^3$. The rate of change of its ordinate exceeds that of abscissa in.
(a) $-2 < x < 2$
(b) $x = \pm 2$
(c) $x < -2$
(d) $x > 2$

148. The area of the region lying above X-axis, and included between the circle $x^2 + y^2 = 2ax$ and the parabola $y^2 = ax, a > 0$ is.
(a) $8\pi a^2$ (b) $a^2\left(\frac{\pi}{4} - \frac{2}{3}\right)$
(c) $\frac{16\pi a^2}{9}$ (d) $\pi\left(\frac{27}{8} + 3a^2\right)$

149. If the equation $x^2 - cx + d = 0$ has roots equal to the fourth powers of the roots of $x^2 + ax + b = 0$, where $a^2 > 4b$, then the roots of $x^2 - 4bx + 2b^2 - c = 0$ will be.
(a) both real
(b) both negative
(c) both positive
(d) one positive and one negative

150. On the occasion of Dipawali festival each student of a class sends greeting cards to others. If there are 20 students in the class, the number of cards sends by students is.
(a) ${}^{20}C_2$ (b) ${}^{20}P_2$
(c) $2 \times {}^{20}C_2$ (d) $2 \times {}^{20}P_2$

151. In a third order matrix A, a_{ij} denotes the element in the i th row and j th column.
$if\ a_{ij} = 0$ for $i = j$
$= 1$ for $i > j$
$= -1$ for $i < j$
Then the matrix is
(a) skew symmetric (b) symmetric
(c) not invertible (d) non-singular

152. The area of the triangle formed by the intersection of a line parallel to X-axis and passing through $P(h, k)$, with the lines $y = x$ and $x + y = 2$ is h^2. The locus of the point P is.
(a) $x = y - 1$ (b) $x = -(y - 1)$
(c) $x = 1 + y$ (d) $x = -(1 + y)$

153. A hyperbola, having the transverse axis of length $2\sin\theta$ is confocal with the ellipse $3x^2 + 4y^2 = 12$. Its equation is.
(a) $x^2\sin^2\theta - y^2\cos^2\theta = 1$
(b) $x^2\text{cosec}^2\theta - y^2\sec^2\theta = 1$
(c) $(x^2 + y^2)\sin^2\theta = 1 + y^2$
(d) $x^2\text{cosec}^2\theta = x^2 + y^2 + \sin^2\theta$

154. Let $f(x) = \cos\left(\frac{\pi}{x}\right), x \neq 0$, then assuming k as an integer,
(a) $f(x)$ increases in the interval $\left(\frac{1}{2k+1}; \frac{1}{2k}\right)$
(b) $f(x)$ decreases in the interval $\left(\frac{1}{2k+1}, \frac{1}{2k}\right)$
(c) $f(x)$ decreases in the interval $\left(\frac{1}{2k+2}, \frac{1}{2k+1}\right)$
(d) $f(x)$ increases in the interval $\left(\frac{1}{2k+2}, \frac{1}{2k+1}\right)$

155. Consider the function $y = \log_a\left(x + \sqrt{x^2 + 1}\right), a > 0, a \neq 1$. The inverse of the function
(a) does not exist
(b) is $x = \log_{1/a}\left(y + \sqrt{y^2 + 1}\right)$

(c) is $x = \sinh(y\log a)$

(d) is $x = \cosh\left(-y\log\frac{1}{a}\right)$