

Solved Paper 2020*

Instructions

- There are 150 questions in all. The number of questions in each part is as given below.

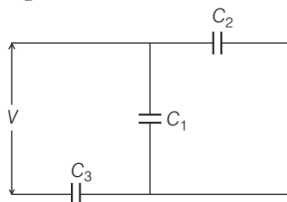
No. of Questions	
Part I Physics	1-40
Part II Chemistry	41-80
Part III a. English Proficiency	81-95
b. Logical Reasoning	96-105
Part IV Mathematics	106-150
- All questions are Multiple Choice Questions having four options out of which **only one** is correct.
- Each correct answer fetches 3 marks while incorrect answer has a penalty of 1 mark.
- Time allotted to complete this paper is 3 hrs.

PART I

Physics

- Three solenoid coils of same dimensions, same number of turns and same number of layers of windings are taken. Coil 1 has inductance L_1 wound by Mn wire of resistance $6\Omega\text{m}^{-1}$, coil 2 with inductance L_2 wound by similar wire but in reverse direction in each layer. Coil 3 with inductance L_3 wound by a superconducting wire. The relation between their self inductances will be

a. $L_1 = L_2, L_3 = 0$ b. $L_1 = L_2 = L_3$
 c. $L_1 = L_3, L_2 = 0$ d. $L_1 > L_2 > L_3$
- Three capacitors C_1, C_2 and C_3 are connected as shown in the figure below. If capacitor C_3 breaks down electrically, then the change in total charge on the combination of capacitors, is

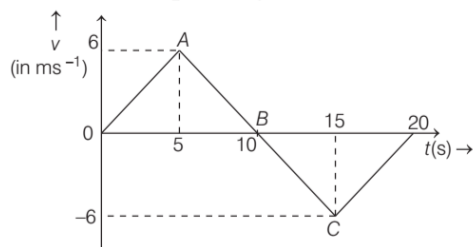


- a. $(C_1 + C_2)V \left[1 - \left(\frac{C_3}{C_1 + C_2 + C_3} \right) \right]$
 b. $(C_3 + C_2)V \left[1 - \left(\frac{C_1}{(C_1 + C_2 + C_3)} \right) \right]$
 c. $(C_1 + C_2)V \left[1 - \left(\frac{C_2 + C_1}{C_1 + C_3} \right) \right]$
 d. $(C_1 + C_2)V \left[1 - \left(\frac{C_2}{(C_1 + C_3)} \right) \right]$

- A black body radiates energy at the rate $E \text{ Wm}^{-2}$ at high temperature $T \text{ K}$. When the temperature is reduced to $(T/4) \text{ K}$, then the new radiant energy is

a. $E/256$ b. $4E$ c. $E/4$ d. $E/16$
- The length of the rectangle is $l = 15.2 \text{ cm}$ and breadth is $b = 2.9 \text{ cm}$ and the minimum possible measurement by scale = 0.1 cm . Then, the area of the rectangle is
 (Taking, significant figures into consideration)

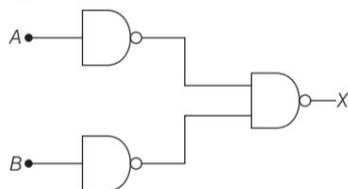
16. From the velocity-time graph of a body moving in a straight line, the distance travelled and the average velocity in the time interval $t = 0$ to $t = 20$ s are, respectively,



- a. 0, 0
c. 60 m, 0
- b. 120 m, 60 m
d. 0, 60 m
17. A thin equi-convex lens is made of glass of refractive index 1.5 and its focal length is 0.2 m. If it acts as a concave lens of focal length 0.5 m when dipped in a liquid, the refractive index of the liquid is
- a. $\frac{17}{8}$
c. $\frac{13}{8}$
- b. $\frac{15}{8}$
d. $\frac{9}{8}$
18. A moving coil galvanometer has a resistance of 60Ω and it indicates full deflection on passing a current of 4.5 mA. A voltmeter is made using this galvanometer and a $4.5 \text{ k}\Omega$ resistance. The maximum voltage, that can be measured using this voltmeter, will be close to

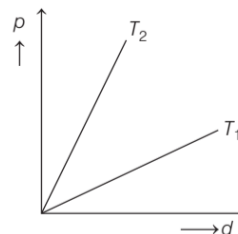
a. 21 V b. 20.5 V c. 20 V d. 19.5 V

19. The combination of the gates shown in following figure yields



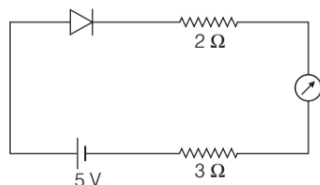
- a. NAND gate
c. NOT gate
- b. OR gate
d. XOR gate
20. A vessel contains one mole of O_2 gas (molar mass 32) at a temperature T . The pressure of the gas is p . An identical vessel containing one mole of He gas (molar mass 4) at a temperature $2T$ has a pressure of
- a. $\frac{p}{8}$
c. $2p$
- b. p
d. $8p$
21. The acceleration of a particle in m/s^2 is given by $a = (3t^2 - 2t + 1)$, where t is in second. If the particle starts with a velocity $v = 1 \text{ m/s}$ at $t = 1$ s, then velocity of the particle at the end of 4 s is
- a. 40 m/s b. 52 m/s c. 48 m/s d. 84 m/s

22. The figure shows graphs of pressure (p) versus density (d) for an ideal gas at two temperatures T_1 and T_2 , then



- a. $T_1 > T_2$
c. $T_1 = T_2$
- b. $T_1 < T_2$
d. None of these
23. Two spheres of the same material and same radii r are touching each other. The gravitational force between the spheres is proportional to
- a. $\frac{1}{r^2}$
c. $\frac{1}{r^4}$
- b. r^2
d. r^4
24. A spherical lens of power -4 D is placed at a distance of 15 cm from another spherical lens of power 5 D . A beam of parallel light falls on the first spherical lens. The final image formed is
- a. real and at a distance of 40 cm from the lens of power 5 D
b. real and at a distance of 10 cm from the lens of power -4 D
c. virtual and at a distance of 40 cm from the lens of power -5 D
d. None of the above
25. The wheel of a car, accelerated uniformly from rest, rotates through 5 rad during the first second. The angle (in rad) rotated during the next second is
- a. 15 b. 7.5 c. 12.5 d. 20
26. Lights of two different frequencies whose photons have energies 1.5 eV and 2.5 eV respectively illuminate a metallic surface whose work function is 0.5 eV successively. Ratio of maximum speeds of emitted electrons will be
- a. 3 : 2 b. 2 : 3
c. $\sqrt{3} : \sqrt{2}$ d. $\sqrt{2} : \sqrt{3}$
27. When a body is dropped from a height h , then it hits the ground with a momentum p . If the same body is dropped from a height which is three times more than previous height, the percentage change in momentum when it hits the ground is
- a. 25% b. 50%
c. 75% d. 100%

28. The reading of the ammeter for a germanium diode in the given circuit is



- a. 0.94 A b. 0 c. 2.8 A d. 5 A
29. The decay constants of two radioactive substances X and Y are 4λ and λ respectively. At $t = 0$, a sample has the same number of two nuclei. The time taken for the ratio of number of nuclei to become $\frac{1}{e^3}$ will be
- a. $\frac{1}{3\lambda}$ b. $\frac{1}{2\lambda}$ c. $\frac{2}{3\lambda}$ d. $\frac{3}{2\lambda}$
30. The magnitude of the force vector acting on a unit length of a thin wire carrying a current $I = 10$ A at a point O , if the wire is bent in the form of a semi-circle (shown below) with radius $R = 20\pi$ cm, is
- a. $30 \mu\text{N/m}$ b. $40 \mu\text{N/m}$
c. $50 \mu\text{N/m}$ d. $60 \mu\text{N/m}$

31. A long cylindrical iron core of cross-sectional area 5 cm^2 is inserted into a long solenoid having 4000 turns/metre and carrying a current 5 A. The magnetic field inside the core is π T. Find the pole strength developed.

- a. 1000 A-m b. 1240 A-m
c. 882 A-m d. 760 A-m

32. A plane requires for take off a speed of 72 kmh^{-1} , the run on the ground being 50 m. The mass of the plane is 10000 kg and the coefficient of friction between the plane and the ground is 0.2. Assume that the plane accelerates uniformly during take off. The minimum force required by the engine of the plane for take off is

- a. 4.43×10^4 N b. 5.96×10^4 N
c. 2.25×10^4 N d. 3.45×10^4 N

33. In a fluorescent lamp choke, 120 V of reverse voltage is produced when the choke current changes uniformly 0.50 A to 0.20 A in a duration of 0.030 ms. The self inductance of the choke (in mH) is estimated to be

- a. 12 H b. 12×10^{-3} mH
c. 12×10^{-3} H d. 0

34. A man grows into a giant such that his linear dimensions increase by a factor of 8. Assuming that his density remains same, the stress in his leg will change by a factor of

- a. 1/8 b. 8 c. 36 d. 64

35. When 2 moles of a monoatomic gas are mixed with 3 moles of a diatomic gas, the value of adiabatic exponent for the mixture is

- a. 15/16 b. 7/5 c. 31/21 d. 38/59

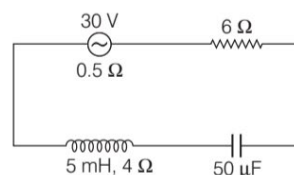
36. A simple pendulum is placed inside a lift, the lift is moving with a uniform acceleration. If the time periods of the pendulum, while the lift is moving upwards and downwards are in the ratio of 1 : 3, then the acceleration of the lift is [Take, acceleration due to gravity, $g = 10 \text{ m/s}^2$]

- a. 4 m/s^2 b. 6 m/s^2 c. 8 m/s^2 d. 10 m/s^2

37. A satellite is moving around the earth with speed v in a circular orbit of radius r . If the orbit radius is decreased by 2%, its speed will increase by

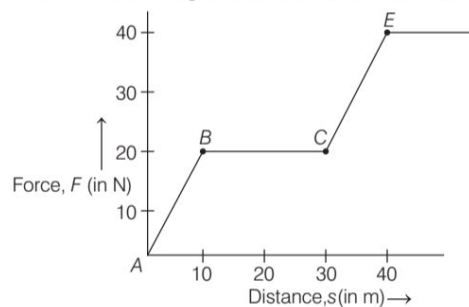
- a. 1% b. 2% c. 1.5% d. 1.414%

38. In the circuit shown in figure, the AC source has angular frequency $\omega = 2000 \text{ rad s}^{-1}$. The amplitude of the current will be nearest to



- a. 2.85 A b. 3 A c. 0.5 A d. 3.625 A

39. The work done by a force acting on a body is as shown in the following graph. The total work done in covering an initial distance of 40 m is



- a. 500 J b. 600 J c. 400 J d. 800 J

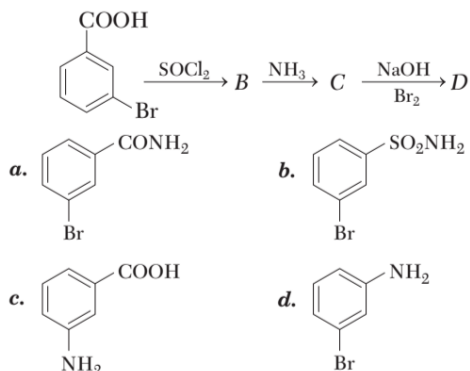
40. A potentiometer wire, 10 m long, has a resistance of 40Ω . It is connected in series with a resistance box and a 4 V storage cell. If the potential gradient along the wire is 0.4 mVcm^{-1} , the resistance unplugged in the box is

- a. 220Ω b. 360Ω c. 760Ω d. 848.3Ω

PART II

Chemistry

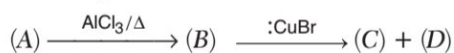
41. In a set of reactions, *m*-bromobenzoic acid gives a product *D*. Identify the product *D*.



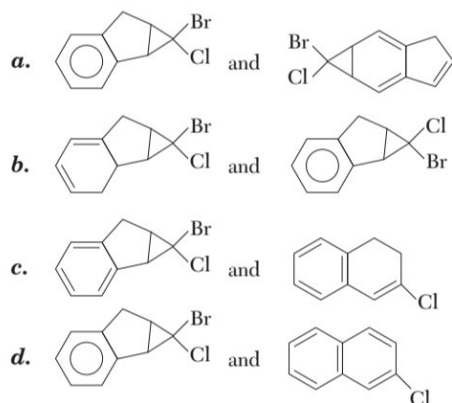
42. A volume of 50.00 mL of a weak acid of unknown concentration is titrated with 0.10 M solution of NaOH. The equivalence point is reached after 39.30 mL of NaOH solution has been added. At the half equivalence point (19.65 mL) the pH is 4.85. Thus, initial concentration of the acid and its pK_a values are

[HA]	pK_a
a. 0.1 M	4.85
b. 0.079 M	4.85
c. 0.1 M	3.70
d. 0.097 M	2.93

43. 1-phenyl-1, 3-dibromopropane on treatment with alc. KOH gives diastereomeric mixture in which compound (A) is major product. (A) gives the following reaction



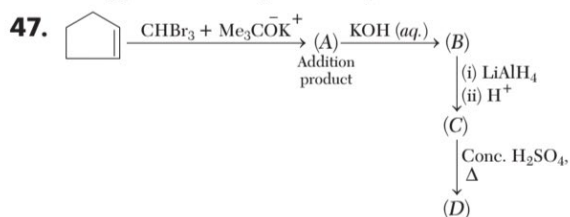
Compounds (C) and (D) are



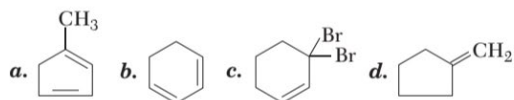
44. Which of the following statement is incorrect?
- α -D-fructose and β -D-fructose are enantiomers of each other.
 - D-glyceraldehyde and L-glyceraldehyde are enantiomers of each other.
 - The reserve carbohydrate of animals is glycogen.
 - Aldohexoses which react with phenyl hydrazine to give identical osazones are C-2 epimers.
45. Which of the following is not a mixed pair of oxides?
- Mn_3O_4 and Co_3O_4
 - Co_3O_4 and Pb_3O_4
 - Pb_3O_4 and Mn_3O_4
 - Fe_3O_4 and Fe_2O_3

46. A solution of copper sulphate is electrolysed between copper electrodes by a current of 10.0A passing for one hour. Which of the following statements is correct regarding the changes that occur at the electrodes and in the solution?
- 11.84 g of copper will deposit on the cathode
 - 11.84 g of copper will deposit on the anode

- 11.84 g of copper will deposit on the anode as well as on the cathode
- copper will not deposit on any of the electrode



Identify structure of compound (D).



48. Which of the following statement is correct?
- ΔS for $\frac{1}{2}\text{Cl}_2(g) \longrightarrow \text{Cl}(g)$ is positive.
 - $\Delta E < 0$ for combustion of $\text{CH}_4(g)$ in a sealed container with rigid adiabatic system.
 - ΔG is always zero for a reversible process in a closed system.
 - ΔG° for an ideal gas reaction is a function of pressure.

49. Which of the following statements on critical constants of gases are correct?

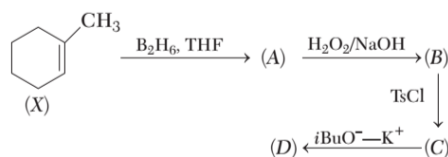
- Larger the T_c/p_c value of a gas, larger would be the included volume.
- Critical temperature (T_c) of a gas is greater than its Boyle temperature (T_B).
- At the critical point in the van der Waals' gas

$$\text{isotherm, } \left(\frac{\partial p}{\partial V_m} \right)_{T_c} = 0$$

Select the correct answer using the codes given below.

- a. Both I and II b. Both I and III
c. Both II and III d. I, II and III

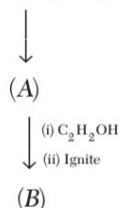
50. In the given reaction,



Product (D) is

- a positional isomer of X
- identical to X
- chain isomer of X
- an oxidation product of X

51. $\text{Na}_2\text{B}_4\text{O}_7 + \text{conc. H}_2\text{SO}_4 + \text{H}_2\text{O}$



(B) is identified by the characteristic colour of the flame. (A) and (B) are respectively

- H_3BO_3 and $\text{Na}_2\text{B}_4\text{O}_7$
 - $\text{B}(\text{OC}_2\text{H}_5)_3$ and H_3BO_3
 - NaBO_2 and H_3BO_3
 - H_3BO_3 and $\text{B}(\text{OC}_2\text{H}_5)_3$
52. How many mL of perhydrol is required to produce sufficient oxygen which can be used to completely convert 2 L of SO_2 gas?
- 10 mL
 - 5 mL
 - 20 mL
 - 30 mL
53. At the top of a mountain the thermometer reads 0°C and the barometer reads 710 mm Hg. At the bottom of the mountain the temperature is 30°C and the pressure is 760 mm Hg. The ratio

of the density of air at the top to that of the bottom is

- 1 : 1.04
- 0.4 : 1
- 1.04 : 1
- 1 : 0.4

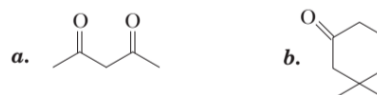
54. Match the following columns.

Column I (Compound)	Column II (Structure)
A. ClF_3	1. Square planar
B. PCl_5	2. Tetrahedral
C. IF_5	3. Trigonal bipyramidal
D. CCl_4	4. Square pyramidal
E. XeF_4	5. T-shaped

Codes

	A	B	C	D	E
a.	5	4	3	2	1
b.	5	3	4	2	1
c.	5	3	4	1	2
d.	4	3	5	2	1

55. Most acidic hydrogen is present in



c. $(\text{CH}_3\text{CO})_3\text{CH}$

d. $(\text{CH}_3)_3\text{COH}$

56. The process of 'eutrophication' is due to the

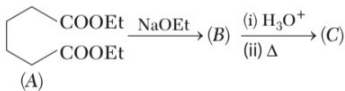
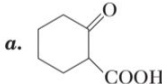
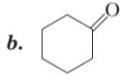
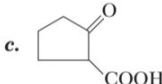
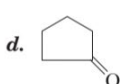
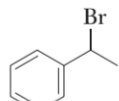
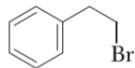
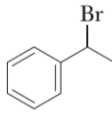
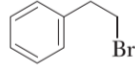
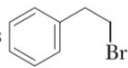
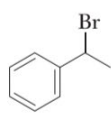
- increase in concentration of insecticide in H_2O
- increase in concentration of fluoride ion in H_2O
- reduction in concentration of the dissolved oxygen in water due to phosphate pollution in water.
- attack of younger leaves of a plant by peroxyacetyl nitrate

57. Ionisation energy of H-atom is 13.6 eV. The wavelengths of the spectral line emitted when an electron in Be^{3+} comes from 5th energy level to 2nd energy level is

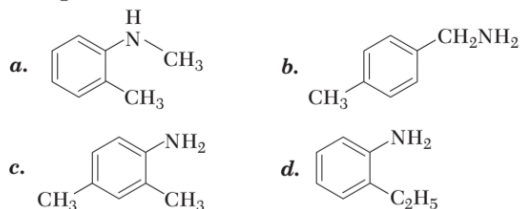
- 43.5 nm
- 4350 nm
- 4.35 nm
- 435 nm

58. The enthalpies of combustion of carbon and carbon monoxide in excess of oxygen at 298 K and constant pressure are -393.5 kJ/mol and -280.0 kJ/mol respectively. The heat of formation of carbon monoxide at constant volume is

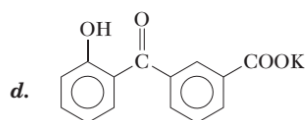
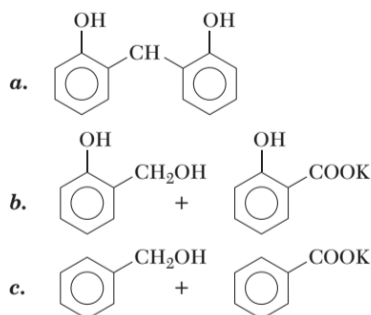
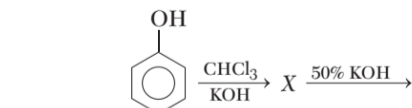
- $+111.7 \text{ kJ/mol}$
- -1111.7 kJ/mol
- -111.7 kJ/mol
- -11.7 kJ/mol

59. If the quantum number l could have the value n also then, Sc(21) would have electronic configuration as (other rules strictly followed)
- $1s^2 1p^6 2s^2 2p^6 2d^3 3s^2$
 - $1s^2 1p^6 2s^2 2p^6 3s^2 2d^3$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$
60. 1.1 mole of A mixed with 2.2 moles of B and the mixture is kept in a 1 L flask and the equilibrium, $A + 2B \rightleftharpoons 2C + D$ is reached. If at equilibrium 0.2 mole of C is formed then the value of K_C will be
- 0.1
 - 0.01
 - 0.001
 - 1
61. Choose the correct chemical reaction among the following:
- $\text{CaCN}_2 + \text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2 + \text{C}_2\text{H}_2 + \text{NH}_3$
 - $2\text{NH}_3 + \text{CaSO}_4 + \text{CO}_2 + \text{H}_2\text{O} \longrightarrow \text{CaCN}_2 + (\text{NH}_4)_2\text{SO}_4$
 - $\text{CaCl}_2 + \text{Na}_2\text{SO}_4 \longrightarrow \text{CaSO}_4 + 2\text{NaCl}$
 - $\text{CaC}_2 + \text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2 + 2\text{NaCl}$
62. Which of the following reactions represents disproportionation?
- $\text{CrO}_5 \longrightarrow \text{Cr}^{3+} + \text{O}_2$
 - $\text{IO}_3^- + \text{I}^- + \text{H}^+ \longrightarrow \text{I}_2$
 - $\text{CrO}_2\text{Cl}_2 + \text{NaOH} \longrightarrow \text{Na}_2\text{CrO}_4 + \text{NaCl} + \text{H}_2\text{O}$
 - $\text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{Na}_2\text{SO}_4 + \text{SO}_2 + \text{S}_8 + \text{H}_2\text{O}$
63. 
- Compound C is
- 
 - 
 - 
 - 
64. On the basis of Ellingham diagram, which of the following is not correct?
- Entropy change for all metal oxides is roughly same.
 - Below the boiling point, $T\Delta S$ factor is same irrespective of metal.
 - Above $\Delta G = 0$ line, oxide decomposes into metal and oxygen.
 - If randomness increases the slope increases.
65. Which of the following is not explained by adsorption?
- When acetic acid solution is shaken with charcoal the concentration of acid decreases.
 - The white ppt. of Mg(OH)_2 attains blue colour when precipitated in the presence of magneson reagent.
 - An aqueous solution of NaOH attains pink colour with a drop of phenolphthalein.
 - When animal charcoal is shaken with coloured methylene blue solution, the solution turns colourless.
66. Identify 'A' and 'B' in the following reaction
- $$B \xleftarrow[h\nu]{\text{HBr}} \text{C}_6\text{H}_5\text{CH=CH}_2 \xrightarrow{\text{HBr}} A$$
- Both A and B are 
 - Both A and B are 
 - A is  and B is 
 - A is  and B is 
67. An element occurs in two crystalline forms α and β . The α -form has an fcc with $a = 3.68 \text{ \AA}$ and β form has a bcc with $a = 2.92 \text{ \AA}$. Calculate the ratio of their densities.
- 1 : 1
 - 1 : 2
 - 2 : 1
 - 2 : 3
68. The molar heat of vaporisation of water at 100°C is 40.585 kJ/mol. The temperature at which a solution containing 5.60 g of $\text{Al}_2(\text{SO}_4)_3$ per 1000 g of water boil is (Assuming the degree of ionisation of salt to be 1).
- 100.042°C
 - 10.0042°C
 - 100.042°C
 - 105°C
69. An organic base $\text{C}_8\text{H}_{11}\text{N}(X)$ reacts with nitrous acid at 0°C to give a clear solution. Heating the solution with KCN and cuprous cyanide followed by continued heating with conc. HCl gives a crystalline solid. Heating this solid with alkaline potassium permanganate gives a compound which dehydrates on heating to an anhydride ($\text{C}_8\text{H}_4\text{O}_3$).

Compound X is



70. The final product of the following reaction is/are



71. The correct order of pseudohalide, polyhalide and interhalogen is

- a. BrI_2^- , OCN^- , IF_5 b. IF_5 , BrI_2^- , OCN^-
 c. OCN^- , IF_2 , BrI_2^- d. OCN^- , BrI_2^- , IF_5

72. An inorganic halide (A) reacts with water to form two acids (B) and (C). (A) also reacts with NaOH to form two salts (D) and (E) which remain in solution. The solution gives white precipitate with both AgNO_3 and BaCl_2 solutions respectively. (A) is a useful organic reagent. The compound (A) is

- a. SOCl_2 b. SO_2Cl_2 c. S_2Cl_2 d. SF_4

73. Following statements regarding the periodic trends of chemical reactivity to the alkali metals and the halogens are given. Which of these statements gives the correct picture?

- a. The reactivity decreases in the alkali metals but increases in the halogens with increase in atomic number down the group.
 b. In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group.

c. Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens.

d. In alkali metals the reactivity increases but in the halogens it decreases with increase in atomic number down the group.

74. According to IUPAC nomenclature sodium nitroprusside is named as

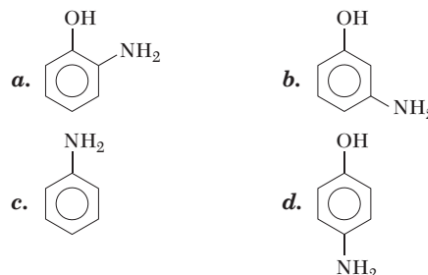
- a. sodiumpentacyanonitrosylferrate (II)
 b. sodiumpentacyanonitrosylferrate (III)
 c. sodiumnitroferrocyanide
 d. sodiumnitroferrocyanide

75. $A(g) \longrightarrow P(g) + Q(g) + R(g)$,

Follow first order kinetics with a half-life of 69.3 s at 500°C . Starting from the gas 'A' in a container at 500°C and at a pressure of 0.4 atm, the total pressure of the system after 230 s will be

- a. 1.15 atm b. 1.32 atm
 c. 1.22 atm d. 1.12 atm

76. Which of the following gives paracetamol on acetylation?



77. In qualitative analysis when H_2S is passed through an aqueous solution of salt acidified with dilute HCl, a black ppt. is obtained. On boiling the precipitate with dil. HNO_3 , it forms a solution of blue colour. Addition of excess of aqueous solution of NH_3 to this solution gives

- a. deep blue ppt. of $\text{Cu}(\text{OH})_2$
 b. deep blue solution of $[\text{Cu}(\text{NH}_3)_4]^{2+}$
 c. deep blue solution of $\text{Cu}(\text{NO}_3)_2$
 d. deep blue solution of $\text{Cu}(\text{OH})_2 \cdot \text{Cu}(\text{NO}_3)_2$

78. Titration of 0.1467 g of primary standard $\text{Na}_2\text{C}_2\text{O}_4$ required 28.85 mL of KMnO_4 solution. Calculate the molar concentration of KMnO_4 solution.

- a. 0.01518 M
 b. 0.001518 M
 c. 0.15180 M
 d. 1.5180 M

79. Which of the following facts about the complex $[\text{Cr}(\text{NH}_3)_6] \text{Cl}_3$ is wrong?
 a. The complex involves d^2sp^3 hybridisation and its octahedral in shape.
 b. The complex is paramagnetic.
 c. The complex is an outer orbital complex.
 d. The complex gives white precipitate with silver nitrate solution.
80. Sulphuric acid is a dibasic acid. It ionises in two stages and hence, has two dissociation constants K_{a_1} and K_{a_2} . Which of the following is the correct observation regarding K_{a_1} and K_{a_2} ?
 a. $K_{a_1} > K_{a_2}$ b. $K_{a_1} < K_{a_2}$
 c. $K_{a_1} = K_{a_2}$ d. $K_{a_1} = 1.2 \times 10^{-2}$, $K_{a_2} > 10$

PART III

a. English Proficiency

Directions (Q. Nos. 81-83) *In the following questions, find out which part of a sentence has an error. If there is no error, mark part (d) as your answer.*

81. The road a. / to famous monument b. / passes through a forest. c./ No error d
82. The master did not know a./ who of the servants b./ broke the glass c./ No error d
83. Had I come a./ to know about his difficulties b./ I would have certainly helped c./ No error d

Directions (Q. Nos. 84 and 85) *Fill in the blanks with suitable preposition from the alternatives given under each sentence.*

84. Her trekking was met obstacles.
 a. with b. from c. by d. of
85. She has not got the shock of losing her father.
 a. over b. at c. from d. with

Directions (Q. Nos. 86-88) *Select the word or phrase which is closest to the opposite in meaning of the italicised word or phrase.*

86. Yuvraj Singh is suffering from a *BENIGN* cancer.
 a. Unfriendly b. Friendly
 c. Fatal d. Malignant
87. He is a *NOTED* figure of film industry.
 a. Known b. Unknown
 c. Famous d. Infamous
88. *SAGACIOUS* decisions taken at right time in one's career has long effects.
 a. Foolish b. Intelligent
 c. Thoughtful d. Intuitive

Directions (Q. Nos. 89 and 90) *Choose the word nearest in meaning to the italicised word.*

89. The actor got *PEEVISH* on asking personal questions.
 a. Irritated b. Happy c. Shy d. Satisfied

90. The engineer *ROUGHED OUT* his ideas on a piece of paper while he talked.
 a. Shaped roughly b. Rejected
 c. Drew a quick plan d. Describe inaccurately

Directions (Q. Nos. 91-95) *Read the passage given below and answer the questions that follow.*

The Centre and the States must become partners in the planning process to determine national priorities together. The process of planning would undergo a change in view of the changes in domestic economic situation and momentous trends emerging in the world. The development of human resource and the building up of an institutional framework would have to receive priority attention. The role of the government would also have to be examined so as to fully involve the people in the process of nation-building. The main task would be to

ensure that the real initiative is transferred to the people. The private sector which would register expansion hereafter should keep this objective firmly in view. The need for an effective population policy is an urgent necessity in the country's planning strategy. The family welfare programme should not be treated as the Centre's responsibility alone. The States should evolve a suitable mechanism for closer involvement of the Government agencies, Zilla Parishads and Panchayats for making the family welfare programme a success.

91. Which one of the following statements is correct?
 a. Effective family welfare programme is Centre's responsibility alone.
 b. Population policy and planning process are interlinked.
 c. Family welfare programme should be left to the State Governments alone.
 d. The State Government should use punitive measures to control population.
92. What should be given priority attention?
 a. Role of the Government
 b. Decentralisation of power
 c. Involvement of people in labour welfare
 d. Human resource and institutional framework

93. Which one of the following statements is not correct?
 a. Role of the government in nation-building should be examined.
 b. Real initiatives should be transferred to the people.
 c. There should be no role for the government as far as planning is concerned.
 d. The Centre and the States must become equal partners in the planning process.
94. What would force the planning process to undergo a change?

- a. Free market forces
 b. Domestic economic situation and world trends
 c. Domestic compulsions
 d. International pressures

95. Which one of the following is implied by the expression 'momentous trends'?
 a. GDP growth of the country
 b. Memorable historical events
 c. Important changes in the international scene
 d. Improvement of foreign exchange reserves

b. Logical Reasoning

96. Find out the wrong number.

2, 6, 12, 72, 865, 62208

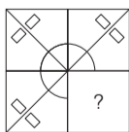
- a. 72 b. 12 c. 62208 d. 865

97. Each of P, Q, T, A and B has different heights. T is taller than P and B but shorter than A and Q. P is not the shortest, who is the tallest?

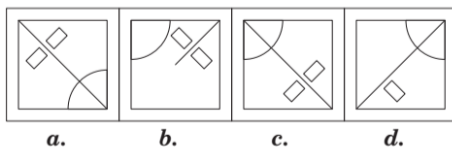
- a. A b. Q c. A or Q d. P or B

98. Identify the missing part of the question figure and select it from given answer figures.

Question Figure



Answer Figures

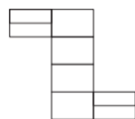


99. Select the related word from the given alternatives.

Mechanic : Spanner :: Carpenter : ?

- a. tree b. wood c. furniture d. saw

100. How many rectangles are there in the following figure?



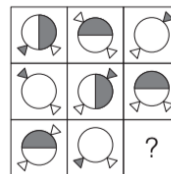
- a. 8 b. 18 c. 17 d. 20

101. In the following question find the odd letters/group from the given alternatives.

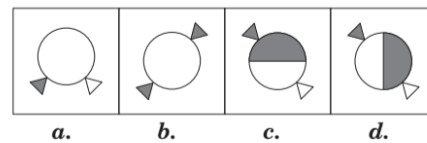
- a. BADC b. JILK
 c. NMPO d. VUWX

102. Find out which of the answer figures (a), (b), (c) and (d) completes the figure matrix?

Question Figure

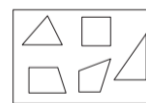


Answer Figures

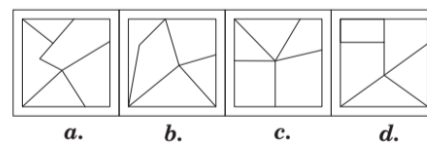


103. Among the four answer figures, which one can be formed from the cut out pieces given below in the question figures?

Question Figure

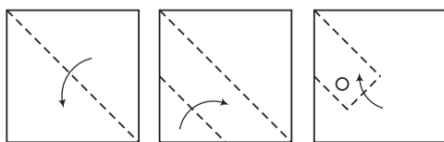


Answer Figures

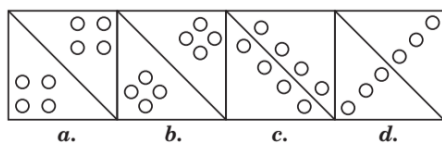


- 104.** A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicates how it will appear when opened.

Question Figures



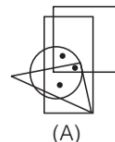
Answer Figures



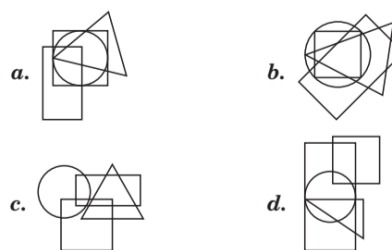
- 105.** In the following question three dots are placed in the figure marked as (A). The figure is followed by four alternatives marked as (a), (b), (c) and (d). One out of these four options

contains region(s) common to the circle, square, triangle, similar to that marked by the dot in figure (A).

Question Figure



Answer Figure



PART IV

Mathematics

- 106.** If $A = \{x : x^2 = 1\}$ and $B = \{x : x^4 = 1\}$, then $A \Delta B$ is equal to
a. $\{-i, i\}$ **b.** $\{-1, i\}$
c. $\{-1, 1, -i, i\}$ **d.** None of these
- 107.** If $2f(xy) = (f(x))^y + (f(y))^x$ for all $x, y \in R$ and $f(1) = a (a \neq 1)$. Then $\sum_{k=1}^n f(k)$ is equal to
a. $(a^n - 1)/(a - 1)$
b. $a(a^{n-1} - 1)/(a - 1)$
c. $a(a^n - 1)/(a - 1)$
d. $(a^n - 1)/a + 1$
- 108.** Let $f(x) = x - 3$ and $g(x) = 4 - x$. Then the set of values of x for which $|f(x) + g(x)| < |f(x)| + |g(x)|$ is true, is given by :
a. R **b.** $R - (3, 4)$
c. $R - [3, 4]$ **d.** None of these
- 109.** If $a_1, a_2, a_3, \dots, a_{20}$ are AM's between 13 and 67 then the maximum value of $a_1 \cdot a_2 \cdot a_3 \dots a_{20}$ is equal to
a. $(20)^{20}$ **b.** $(40)^{20}$
c. $(60)^{20}$ **d.** $(80)^{20}$
- 110.** If p, q, r are in AP and are positive, the roots of the quadratic equation $px^2 + qx + r = 0$ are all real for
a. $\left| \frac{r}{p} - 7 \right| \geq 4\sqrt{3}$ **b.** $\left| \frac{p}{r} - 7 \right| < 4\sqrt{3}$
c. All p and r **d.** No p and r
- 111.** The value of ${}^{47}C_4 + \sum_{r=1}^5 {}^{52-r}C_3$ is equal to
a. ${}^{47}C_6$ **b.** ${}^{52}C_5$ **c.** ${}^{52}C_4$ **d.** None of these
- 112.** The number of numbers divisible by 3 that can be formed by four different even digits is
a. 36 **b.** 18 **c.** 0 **d.** None of these
- 113.** If $n(A) = 1000, n(B) = 500, n(A \cap B) \geq 1$ and $n(A \cup B) = P$, then
a. $500 \leq P \leq 1000$ **b.** $1001 \leq P \leq 1498$
c. $1000 \leq P \leq 1498$ **d.** $1000 \leq P \leq 1499$
- 114.** $\left\{ x \in R : \frac{2x-1}{x^3+4x^2+3x} \in R \right\}$ is equal to
a. $R - \{0\}$ **b.** $R - \{0, 1, 3\}$
c. $R - \{0, -1, -3\}$ **d.** $R - \left\{ 0, -1, -3, \frac{1}{2} \right\}$

- 115.** Let $f(x)$ be a polynomial function of second degree. If $f(1) = f(-1)$ and a, b, c are in AP, then $f'(a), f'(b)$ and $f'(c)$ are in
a. AP
b. GP
c. Arithmetic-Geometric progression
d. None of the above
- 116.** The value of $\lim_{x \rightarrow \infty} \frac{1}{n} \left\{ \frac{1}{n+1} + \frac{2}{n+2} + \dots + \frac{3n}{4n} \right\}$ is
a. $5 - 2\log 2$
b. $4 - 2\log 2$
c. $3 - 2\log 2$
d. $2 - 2\log 2$
- 117.** The coefficient of x^8 in the polynomial $(x-1)(x-2)\dots(x-10)$
a. 2640
b. 1320
c. 1370
d. 2740
- 118.** If $z = \frac{7+i}{3+4i}$, then z^{14} is
a. 2^7
b. $2^7 i$
c. $(-2)^7$
d. $(-2)^7 i$
- 119.** The solution of the equation $\frac{dy}{dx} + \frac{1}{x} \tan y = \frac{1}{x^2} \tan y \sin y$ is
a. $2y = \sin y(1 - 2cx^2)$
b. $2x = \cot y(1 + 2cx^2)$
c. $2x = \sin y(1 - 2cx^2)$
d. $2x \sin y = 1 - 2cx^2$
- 120.** The value of the definite integral $\int_0^{\pi/2} \frac{dx}{\tan x + \cot x + \operatorname{cosec} x + \sec x}$
a. $1 - \frac{\pi}{4}$
b. $1 + \frac{\pi}{4}$
c. $\pi + \frac{1}{4}$
d. None of these
- 121.** If \mathbf{a} and \mathbf{b} are two vectors such that $|\mathbf{a}| = 1, |\mathbf{b}| = 4$ and $\mathbf{a} \cdot \mathbf{b} = 2$, If $\mathbf{c} = (2\mathbf{a} \times \mathbf{b}) - 3\mathbf{b}$, then angle between \mathbf{b} and \mathbf{c}
a. $\frac{\pi}{6}$
b. $\frac{\pi}{3}$
c. $\frac{2\pi}{3}$
d. $\frac{5\pi}{6}$
- 122.** Let x_1 and x_2 be the real roots of the equation $x^2 - (k-2)x + (k^2 + 3k + 5) = 0$, then maximum value of $x_1^2 + x_2^2$ is
a. 19
b. 22
c. 18
d. 17
- 123.** Circle centered at origin and having radius π units is divided by the curve $y = \sin x$ in two parts. Then area of upper parts equals to
a. $\frac{\pi^2}{2}$
b. $\frac{\pi^3}{4}$
c. $\frac{\pi^3}{2}$
d. $\frac{\pi^3}{8}$
- 124.** The root of the equation $2(1+i)x^2 - 4(2-i)x - 5 - 3i = 0$, where $i = \sqrt{-1}$, which has greater modulus, is
a. $\frac{3-5i}{2}$
b. $\frac{5-3i}{2}$
c. $\frac{3+i}{2}$
d. $\frac{3i+1}{2}$
- 125.** The equation $(\cos \beta - 1)x^2 + (\cos \beta)x + \sin \beta = 0$ in the variable x has real roots, then β lies in the interval
a. $(0, 2\pi)$
b. $(-\pi, 0)$
c. $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$
d. $(0, \pi)$
- 126.** An ordered pair (α, β) for which the system of linear $(1+\alpha)x + \beta y + z = 2$, $\alpha x + (1+\beta)y + z = 3$ and $\alpha x + \beta y + 2z = 2$ has a unique solution.
a. $(1, -3)$
b. $(-3, 1)$
c. $(2, 4)$
d. $(-4, 2)$
- 127.** A bird is sitting on the top of a vertical pole 20 m high and its elevation from a point O on the ground is 45° . If flies off horizontally straight way from the point O . After one second, the elevation of the bird from O is reduced to 30° , then the speed (in m/s) of the bird is
a. $40(\sqrt{2} - 1)$
b. $40(\sqrt{3} - \sqrt{2})$
c. $20\sqrt{2}$
d. $20(\sqrt{3} - 1)$
- 128.** If one GM, g and two AM's p and q are inserted between two numbers a and b , then $(2p - q)(p - 2q)$ is equal to
a. g^2
b. $-g^2$
c. $2g$
d. $3g^2$
- 129.** When x^{100} is divided by $x^2 - 3x + 2$, the remainder is $(2^{k+1} - 1)x - 2(2^k - 1)$, then k is
a. 97
b. 99
c. 100
d. 101
- 130.** The mean of five observation is 5 and their variance is 9.20. If three of the given five observation are 1, 3 and 8, then a ratio of other two observations is
a. 4 : 9
b. 6 : 7
c. 5 : 8
d. 10 : 3
- 131.** How many three digit number satisfy the property that the middle digit is arithmetic mean of the first and the last digit.
a. 41
b. 45
c. 43
d. 44
- 132.** If $z = re^{i\theta}$, then $\arg(e^{iz})$ is
a. $-r \sin \theta$
b. $r \cos \theta$
c. $e^{-r \sin \theta}$
d. $-r \cos \theta$
- 133.** If 4 dice are rolled, then the number of ways of getting the sum 10 is
a. 56
b. 64
c. 72
d. 80

- 134.** Distance of point $A(1, 2)$ measured parallel to the line $3x - y = 10$ from the line $x + y + 5 = 0$, is
a. $2\sqrt{5}$ **b.** $2\sqrt{10}$ **c.** $4\sqrt{5}$ **d.** $4\sqrt{10}$
- 135.** Let $f(x) = a_0 + a_1x^2 + a_2x^4 + a_3x^6 + \dots + a_nx^{2n}$ be a polynomial in a real variable x with $0 < a_1 < a_2 < a_3 < \dots < a_n$, the function $f(x)$ has
a. neither a maxima nor a minima
b. only one maxima
c. both maxima and minima
d. only one minima
- 136.** If $f(x) = 2x^3 + x^4 + \log x$ and g is the inverse of f , then $g'(3)$ is equal to
a. $1/9$ **b.** $1/7$ **c.** $1/11$ **d.** $1/8$
- 137.** A line passing through $P(3, 7, 1)$ and $R(2, 5, 7)$ meet the plane $3x + 2y + 11z - 9 = 0$ at Q . Then PQ is equal to
a. $\frac{5\sqrt{41}}{59}$ **b.** $\frac{\sqrt{41}}{59}$ **c.** $\frac{50\sqrt{41}}{59}$ **d.** $\frac{25\sqrt{41}}{59}$
- 138.** $\int \frac{8x^{43} + 13x^{38}}{(x^{13} + x^5 + 1)^4} dx$ equals to
a. $\frac{x^{39}}{3(x^{13} + x^5 + 1)^3} + C$ **b.** $\frac{x^{39}}{(x^{13} + x^5 + 1)^3} + C$
c. $\frac{x^{39}}{5(x^{13} + x^5 + 1)^5} + C$ **d.** None of these
- 139.** If $\mathbf{a} = -\hat{i} + \hat{j} + \hat{k}$ and $\mathbf{b} = 2\hat{i} + \hat{k}$, then find z component of a vector \mathbf{r} , which is coplanar with \mathbf{a} and \mathbf{b} , $\mathbf{r} \cdot \mathbf{b} = 0$ and $\mathbf{r} \cdot \mathbf{a} = 7$.
a. 0 **b.** 3 **c.** 6 **d.** $5/2$
- 140.** If x, y, z are three consecutive positive integers, $x - z + 2 = 0$, then
 $\frac{1}{2} \log_e x + \frac{1}{2} \log_e z + \frac{1}{2xz + 1} + \frac{1}{3} \left(\frac{1}{2xz + 1} \right)^3 + \dots$
is equal to
a. $\log_e x$ **b.** $\log_e y$
c. $\log_e z$ **d.** None of these
- 141.** The solution of differential equation $(xy^5 + 2y) dx - xdy = 0$, is
a. $9x^8 + 4x^9y^4 = 9y^4C$ **b.** $9x^8 - 4x^9y^4 - 9y^4C = 0$
c. $x^8(9 + 4y^4) = 10y^4C$ **d.** None of these
- 142.** The solution set of $\frac{|x-2|-1}{|x-2|-2} \leq 0$ is
a. $[0, 1] \cup (3, 4)$ **b.** $[0, 1] \cup [3, 4]$
c. $[-1, 1] \cup (3, 4)$ **d.** None of these
- 143.** Let $f(x) = \frac{x}{\sqrt{1+x^2}}$, the $\underbrace{\text{fofofo} \dots \text{of}(x)}_{n \text{ times}}$ is
a. $\frac{x}{\sqrt{1 + \left(\sum_{r=1}^n r\right) x^2}}$ **b.** $\frac{x}{\sqrt{1 + \left(\sum_{r=1}^n 1\right) x^2}}$
c. $\left(\frac{x}{\sqrt{1+x^2}}\right)^x$ **d.** $\frac{nx}{\sqrt{1+nx^2}}$
- 144.** If $\log_5 \frac{(a+b)}{3} = \frac{\log_5 a + \log_5 b}{2}$, then $\frac{a^4 + b^4}{a^2 b^2}$ is equal to
a. 50 **b.** 47 **c.** 44 **d.** 53
- 145.** The number of distinct solutions of the equation $\frac{5}{4} \cos^2 2x + \cos^4 x + \sin^4 x + \cos^6 x + \sin^6 x = 2$ in the interval $[0, 2\pi]$ is
a. 8 **b.** 10 **c.** 6 **d.** 15
- 146.** If the tangent at a point $\left(4 \cos \phi, \frac{16}{\sqrt{11}} \sin \phi\right)$ to the ellipse $16x^2 + 11y^2 = 256$ is also a tangent to $x^2 + y^2 - 2x = 15$, then ϕ equals
a. $\frac{\pi}{3}$ **b.** $\frac{\pi}{6}$ **c.** $-\frac{\pi}{6}$ **d.** $\frac{\pi}{4}$
- 147.** The distance of point of intersection of the tangents to the parabola $x = 4y - y^2$ drawn at the points where it is meet by Y -axis, from its focus is
a. $11/4$ **b.** $17/4$ **c.** $13/4$ **d.** 3
- 148.** The value of the sum $\sum_{k=1}^{\infty} \sum_{n=1}^{\infty} \frac{k}{2^{n+k}}$ is
a. 5 **b.** 4 **c.** 3 **d.** 2
- 149.** A curve passes through $(2, 0)$ and the slope of the tangent at $P(x, y)$ is equal to $\frac{(x+1)^2 + y - 3}{x+1}$ then the equation of the curve is
a. $y = x^2 - 2x$ **b.** $y = x^3 - 8$
c. $y^2 = x^2 + 2x$ **d.** $y^2 = 5x^2 - 6$
- 150.** Consider matrix $A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$, if $A^{-1} = \alpha I + \beta A$, where $\alpha, \beta \in R$, then $(\alpha + \beta)$ is equal to (where A^{-1} denotes the inverse of matrix A)
a. 1 **b.** $\frac{4}{3}$ **c.** $\frac{5}{3}$ **d.** $\frac{1}{3}$