

## PART-I PHYSICS

### SECTION-A

1. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

**Assertion A:** The binding energy per nucleon is practically independent of the atomic number for nuclei of mass number in the range 30 to 170.

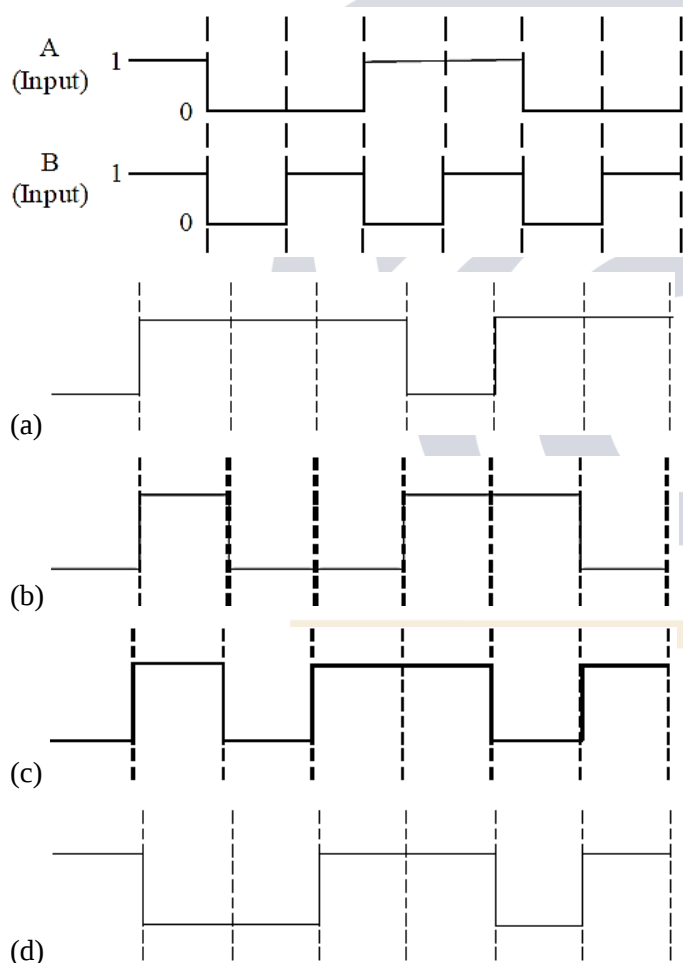
**Reason R:** Nuclear force is short ranged.

In the light of the above statements, choose the correct answer from the options given below

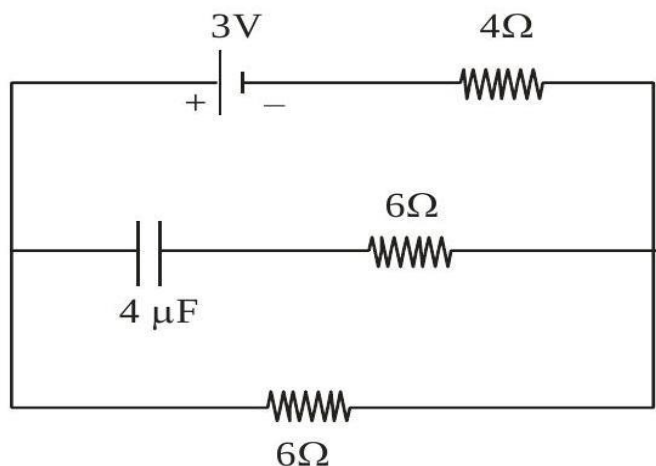
**Option:**

- (a) Both A and R are true but R is NOT the correct explanation of A
- (b) A is true but R is false
- (c) A is false but R is true
- (d) Both A and R are true and R is the correct explanation of A

2. The output from a NAND gate having inputs A and B given below will be.



3. In the network shown below, the charge accumulated in the capacitor in steady state will be :



Option:

- (a)  $7.2\mu\text{C}$  (b)  $4.8\mu\text{C}$   
(c)  $10.3\mu\text{C}$  (d)  $12\mu\text{C}$

4. Given below are two statements:

**Statement I:** For a planet, if the ratio of mass of the planet to its radius increases, the escape velocity from the planet also increases.

**Statement II:** Escape velocity is independent of the radius of the planet.

In the light of above statements, choose the most appropriate answer from the options given below

Option:

- (a) Both Statement I and Statement II are incorrect  
(b) Statement I is correct but statement II is incorrect  
(c) Statement I is incorrect but statement II is correct  
(d) Both Statement I and Statement II are correct

5. A particle executes SHM of amplitude  $A$ . The distance from the mean position when its kinetic energy becomes equal to its potential energy is:

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

6. A passenger sitting in a train A moving at 90 km/h observes another train B moving in the opposite direction for 8 s. If the velocity of the train B is 54 km/h, then length of train B is:

- (a) 80 m (b) 200 m  
(c) 120 m (d) 320 m

7. The initial pressure and volume of an ideal gas are  $P_0$  and  $V_0$ . The final pressure of the gas when the gas is suddenly compressed to volume  $\frac{V_0}{4}$  will be: (Given  $\gamma$  = ratio of specific heats at constant pressure and at constant volume)

- (a)  $P_0(4)^{\frac{1}{\gamma}}$  (b)  $P_0(4)^{\gamma}$   
(c)  $P_0$  (d)  $4P_0$

8. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

**Assertion A:** A spherical body of radius  $(5 \pm 0.1)$  mm having a particular density is falling through a liquid of constant density. The percentage error in the calculation of its terminal velocity is 4%.

**Reason R:** The terminal velocity of the spherical body falling through the liquid is inversely proportional to its radius.

In the light of the above statements, choose the correct answer from the options given below

- (a) Both A and R are true but R is NOT the correct explanation of A
- (b) Both A and R are true and R is the correct explanation of A
- (c) A is false but R is true
- (d) A is true but R is false

9. In an electromagnetic wave, at an instant and at a particular position, the electric field is along the negative z-axis and magnetic field is along the positive x-axis. Then the direction of propagation of electromagnetic wave is:

- (a) at  $45^\circ$  angle from positive y-axis
- (b) negative y-axis
- (c) positive z-axis
- (d) positive y-axis

10. The distance travelled by an object in time  $t$  is given by  $s = (2 \cdot 5)t^2$ . The instantaneous speed of the object at  $t = 5$  s will be:

- (a)  $12.5 \text{ ms}^{-1}$
- (b)  $62.5 \text{ ms}^{-1}$
- (c)  $5 \text{ ms}^{-1}$
- (d)  $25 \text{ ms}^{-1}$

11. An electron is moving along the positive x-axis. If the uniform magnetic field is applied parallel to the negative z-axis, then

- (A) The electron will experience magnetic force along positive y-axis
- (B) The electron will experience magnetic force along negative y-axis
- (C) The electron will not experience any force in magnetic field
- (D) The electron will continue to move along the positive x-axis
- (E) The electron will move along circular path in magnetic field

Choose the correct answer from the options given below:

- (a) B and E only
- (b) A and E only
- (c) C and D only
- (d) B and D only

12. Two planets A and B of radii  $R$  and  $1.5R$  have densities  $\rho$  and  $\rho/2$  respectively. The ratio of acceleration due to gravity at the surface of B to A is:

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

13. Given below are two statements:

**Statement I:** An AC circuit undergoes electrical resonance if it contains either a capacitor or an inductor.

**Statement II: An AC circuit containing a pure capacitor or a pure inductor consumes high power due to its non-zero power factor.**

**In the light of above statements, choose the correct answer from the options given below:**

- (a) Both Statement I and Statement II are false
- (b) Statement I is true but Statement II is false
- (c) Both Statement I and Statement II are true
- (d) Statement I is false but Statement II is true

**14. A vehicle of mass 200 kg is moving along a levelled curved road of radius 70 m with angular velocity of 0.2rad/s. The centripetal force acting on the vehicle is:**

- (a) 560 N
- (b) 2800 N
- (c) 14 N
- (d) 2240 N

**15. To radiate EM signal of wavelength  $\lambda$  with high efficiency, the antennas should have a minimum size equal to:**

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

**16. Given below are two statements:**

**Statement I: Out of microwaves, infrared rays and ultraviolet rays, ultraviolet rays are the most effective for the emission of electrons from a metallic surface.**

**Statement II: Above the threshold frequency, the maximum kinetic energy of photoelectrons is inversely proportional to the frequency of the incident light.**

**In the light of above statements, choose the correct answer from the options given below**

- (a) Statement I is true but Statement II is false
- (b) Both Statement I and Statement II are true
- (c) Statement I is false but Statement II is true
- (d) Both Statement I and Statement II are false

**17. A  $10\mu\text{C}$  charge is divided into two parts and placed at 1 cm distance so that the repulsive force between them is maximum. The charges of the two parts are:**

- (a)  $9\mu\text{C}$ ,  $1\mu\text{C}$
- (b)  $5\mu\text{C}$ ,  $5\mu\text{C}$
- (c)  $7\mu\text{C}$ ,  $3\mu\text{C}$
- (d)  $8\mu\text{C}$ ,  $2\mu\text{C}$

**18. In the equation  $\left[X + \frac{a}{y^2}\right][Y - b] = RT$ , X is pressure, Y is volume, R is universal gas constant and T is temperature. The physical quantity equivalent to the ratio  $\frac{a}{b}$  is:**

- (a) Energy
- (b) Impulse
- (c) Pressure gradient
- (d) Coefficient of viscosity

**19. In a Young's double slits experiment, the ratio of amplitude of light coming from slits is 2:1. The ratio of the maximum to minimum intensity in the interference pattern is:**

- (a) 9: 4                      (b) 9: 1  
(c) 2: 1                      (d) 25: 9

20. The mean free path of molecules of a certain gas at STP is  $1500d$ , where  $d$  is the diameter of the gas molecules. While maintaining the standard pressure, the mean free path of the molecules at 373 K is approximately:

- (a)  $1098d$                       (b)  $2049d$   
(c)  $750d$                       (d)  $1500d$

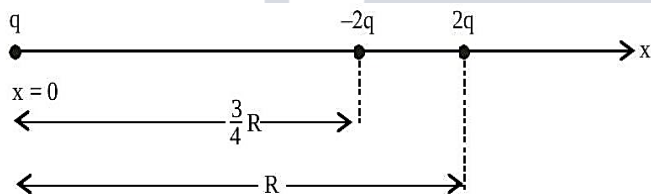
## SECTION-B

21. A bi convex lens of focal length 10 cm is cut in two identical parts along a plane perpendicular to the principal axis. The power of each lens after cut is D.

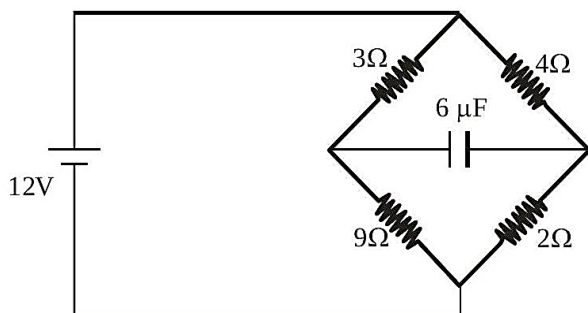
22. An atom absorbs a photon of wavelength 500 nm and emits another photon of wavelength 600 nm. The net energy absorbed by the atom in this process is  $n \times 10^{-4} \text{ eV}$ . The value of  $n$  is \_\_\_\_ [Assume the atom to be stationary during the absorption and emission process]

(Take  $h = 6.6 \times 10^{-34} \text{ Js}$  and  $c = 3 \times 10^8 \text{ m/s}$  ).

23. Three-point charges  $q$ ,  $-2q$  and  $2q$  are placed on x-axis at a distance  $x = 0$ ,  $x = \frac{3}{4}R$  and  $x = R$  respectively from origin as shown. If  $q = 2 \times 10^{-6} \text{ C}$  and  $R = 2 \text{ cm}$ , the magnitude of net force experienced by the charge  $-2q$  is \_\_\_\_ N.

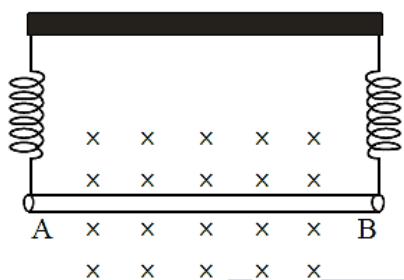


24. In the circuit shown, the energy stored in the capacitor is  $n\mu\text{J}$ . The value of  $n$  is \_\_\_\_



25. An insulated copper wire of 100 turns is wrapped around a wooden cylindrical core of the cross-sectional area  $24 \text{ cm}^2$ . The two ends of the wire are connected to a resistor. The total resistance in the circuit is  $12\Omega$ . If an externally applied uniform magnetic field in the core along its axis changes from 1.5 T in one direction to 1.5 T in the opposite direction, the charge flowing through a point in the circuit during the change of magnetic field will be \_\_\_\_ mC.

26. In an experiment with sonometer when a mass of 180 g is attached to the string, it vibrates with fundamental frequency of 30 Hz. When a mass  $m$  is attached, the string vibrates with fundamental frequency of 50 Hz. The value of  $m$  is g.
27. A light rope is wound around a hollow cylinder of mass 5 kg and radius 70 cm. The rope is pulled with a force of 52.5 N. The angular acceleration of the cylinder will be \_\_\_  $\text{rad s}^{-2}$ .
28. A car accelerates from rest to  $u$  m/s. The energy spent in this process is  $EJ$ . The energy required to accelerate the car from  $u$  m/s to  $2u$  m/s is  $nEJ$ . The value of  $n$  is \_\_\_
29. Two plates A and B have thermal conductivities  $84\text{Wm}^{-1}\text{K}^{-1}$  and  $126\text{Wm}^{-1}\text{K}^{-1}$  respectively. They have same surface area and same thickness. They are placed in contact along their surfaces. If the temperatures of the outer surfaces of A and B are kept at  $100^\circ\text{C}$  and  $0^\circ\text{C}$  respectively, then the temperature of the surface of contact in steady state is \_\_\_  $^\circ\text{C}$ .
30. A straight wire AB of mass 40 g and length 50 cm is suspended by a pair of flexible leads in uniform magnetic field of magnitude 0.40 T as shown in the figure. The magnitude of the current required in the wire to remove the tension in the supporting leads is \_\_\_ A. (Take  $g = 10\text{ ms}^{-2}$ ).



## PART-II CHEMISTRY

### SECTION-A

31. In the wet tests for detection of various cations by precipitation,  $\text{Ba}^{2+}$  cations are detected by obtaining precipitate of
- (a)  $\text{Ba}(\text{ox})$ : Barium oxalate      (b)  $\text{BaCO}_3$
- (c)  $\text{Ba}(\text{OAc})_2$       (d)  $\text{BaSO}_4$
32. The naturally occurring amino acid that contains only one basic functional group in its chemical structure is
- (a) arginine      (b) lysine
- (c) asparagine      (d) histidine

33. Given below are two statements related to Ellingham diagram:

Statement-I: Ellingham diagrams can be constructed for formation of oxides, sulfides and halides of metals.

Statement-II: It consists of plots of  $\Delta_f H^\circ$  vs  $T$  for formation of oxides of elements.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (a) Both Statement I and Statement II are incorrect
- (b) Statement I is incorrect but Statement II is correct
- (c) Both Statement I and Statement II are correct
- (d) Statement I is correct but Statement II is incorrect

34. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.

**Assertion A:** The diameter of colloidal particles in solution should not be much smaller than wavelength of light to show Tyndall effect.

**Reason R :** The light scatters in all directions when the size of particles is large enough.

In the light of the above statements, choose the correct answer from the options given below:

- (a) A is true but R is false
- (b) A is false but R is true
- (c) Both A and R are correct and R is the correct explanation of A
- (d) Both A and R are correct but R is NOT the correct explanation of A

35. The total number of stereoisomers for the complex

$[\text{Cr}(\text{ox})_2\text{ClBr}]^{3-}$  ( where ox = oxalate ) is:

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

36. Better method for preparation of  $\text{BeF}_2$ , among the following is

- (a)  $(\text{NH}_4)_2\text{BeF}_4 \xrightarrow{\Delta} \text{BeF}_2$
- (b)  $\text{BeH}_2 + \text{F}_2 \xrightarrow{\Delta} \text{BeF}_2$
- (c)  $\text{Be} + \text{F}_2 \xrightarrow{\Delta} \text{BeF}_2$
- (d)  $\text{BeO} + \text{C} + \text{F}_2 \xrightarrow{\Delta} \text{BeF}_2$

37. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.

**Assertion A:** Isotopes of hydrogen have almost same chemical properties, but difference in their rates of reaction.

**Reason R:** Isotopes of hydrogen have different enthalpy of bond dissociation.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (a) Both A and R are correct but R is NOT the correct explanation of A
- (b) Both A and R are correct and R is the correct explanation of A
- (c) A is not correct but R is correct
- (d) A is correct but R is not correct

38. Given below are two statements:

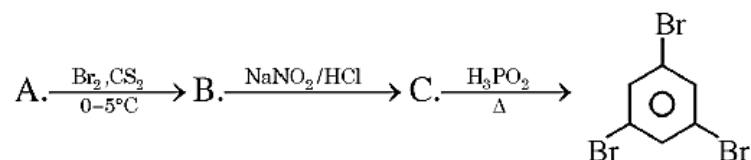
**Statement I:** Tropolone is an aromatic compound and has  $8\pi$  electrons.

**Statement II:**  $\pi$  electrons of  $> \text{C} = \text{O}$  group in tropolone is involved in aromaticity.

In the light of the above statements, choose the correct answer from the options given below:

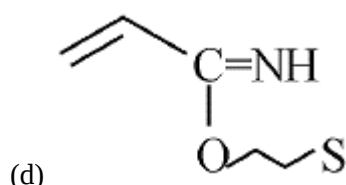
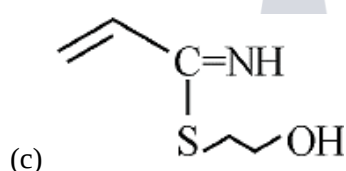
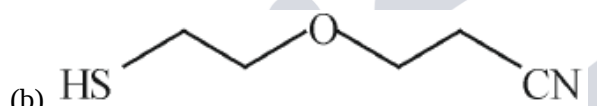
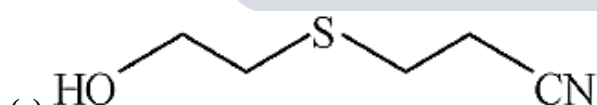
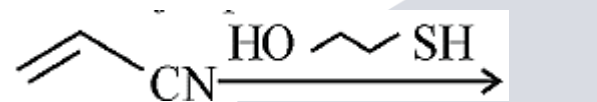
- (a) Both Statement I and Statement II are true
- (b) Statement I is true but Statement II is false
- (c) Statement I is false but Statement II is true
- (d) Both Statement I and Statement II are false

39. Compound A from the following reaction sequence is:



- (a) Benzoic Acid
- (b) Phenol
- (c) Salicylic Acid
- (d) Aniline

40. The major product for the following reaction is:



41. Which of the following are the Greenhouse gases?

- (A) Water vapour (B) Ozone
- (C)  $\text{I}_2$  (D) Molecular hydrogen

Choose the most appropriate answer from the options given

- (a) B and C only
- (b) C and D only
- (c) A and D only
- (d) A and B only

42. Match List I with List II

|  | LIST I |  | LIST II |
|--|--------|--|---------|
|  |        |  |         |

|     |                                          |       |                                    |
|-----|------------------------------------------|-------|------------------------------------|
| (A) | Weak intermolecular forces of attraction | (I)   | Hexamethylenediamine + adipic acid |
| (B) | Hydrogen bonding                         | (II)  | $\text{AlEt}_3 + \text{TiCl}_4$    |
| (C) | Heavily branched polymer                 | (III) | 2-chloro-1,3-butadiene             |
| (D) | High density polymer                     | (IV)  | Phenol formaldehyde                |

Choose the correct answer from the options given below:

- (a) A-II, B-IV, C-I, D-III      (b) A-III, B-I, C-IV, D-II  
(c) A-IV, B-I, C-III, D-II      (d) A-IV, B-II, C-III, D-I

43. Given below are two statements:

Statement I:  $\text{SO}_2$  and  $\text{H}_2\text{O}$  both possess V-shaped structure.

Statement II: The bond angle of  $\text{SO}_2$  is less than that of  $\text{H}_2\text{O}$ .

In the light of the above statements, choose the most appropriate answer from the options given below:

- (a) Both Statement I and Statement II are correct  
(b) Statement I is correct but Statement II is incorrect  
(c) Both Statement I and Statement II are incorrect  
(d) Statement I is incorrect but Statement II is correct

44. The correct group of halide ions which can be oxidised by oxygen in acidic medium is

- (a)  $\text{Br}^-$  only      (b)  $\text{Cl}^-$ ,  $\text{Br}^-$  and  $\text{I}^-$  only  
(c)  $\text{Br}^-$  and  $\text{I}^-$  only      (d)  $\text{I}^-$  only

45. What happens when methane undergoes combustion in systems A and B respectively?

Adiabatic  
system

System A

Diathermic  
container

System B

| System A          | System B                 |
|-------------------|--------------------------|
| Temperature rises | Temperature remains same |

(a)

| System A          | System B          |
|-------------------|-------------------|
| Temperature falls | Temperature rises |

(b)

| System A          | System B                 |
|-------------------|--------------------------|
| Temperature falls | Temperature remains same |

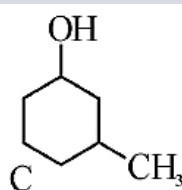
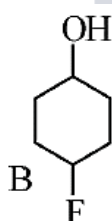
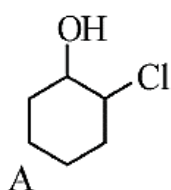
(c)

| System A                 | System B          |
|--------------------------|-------------------|
| Temperature remains same | Temperature rises |

(d)

46. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Order of acidic nature of the following compounds is  $A > B > C$ .



Reason R : Fluoro is a stronger electron withdrawing group than Chloro group.

In the light of the above statements, choose the correct answer from the options given below:

- (a) A is false but R is true  
 (b) Both A and R are correct and R is the correct explanation of A  
 (c) Both A and R are correct but R is NOT the correct explanation of A  
 (d) A is true but R is false

47. Identify the correct order of standard enthalpy of formation of sodium halides.

- (a)  $\text{NaI} < \text{NaBr} < \text{NaCl} < \text{NaF}$   
 (b)  $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$   
 (c)  $\text{NaCl} < \text{NaF} < \text{NaBr} < \text{NaI}$   
 (d)  $\text{NaI} < \text{NaBr} < \text{NaF} < \text{NaCl}$

48. Match List I with List II

1 - Bromopropane is reacted with reagents in List I to give product in List II

|  | LIST I -<br>Reagent |  | LIST II -<br>Product |
|--|---------------------|--|----------------------|
|--|---------------------|--|----------------------|

|     |                       |       |             |
|-----|-----------------------|-------|-------------|
| (A) | KOH (alc)             | (I)   | Nitrile     |
| (B) | KCN (alc)             | (II)  | Ester       |
| (C) | AgNO <sub>2</sub>     | (III) | Alkene      |
| (D) | H <sub>3</sub> CCOOAg | (IV)  | Nitroalkane |

- (a) A-IV, B-III, C-II, D-I      (b) A-III, B-I, C-IV, D-II  
(c) A-I, B-II, C-III, D-IV      (d) A-I, B-III, C-IV, D-II

49. The covalency and oxidation state respectively of boron in  $[\text{BF}_4]^-$ , are

- (a) 4 and 3      (b) 4 and 4  
(c) 3 and 4      (d) 3 and 5

50. Which of the following complexes will exhibit maximum attraction to an applied magnetic field?

- (a)  $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$       (b)  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$   
(c)  $[\text{Co}(\text{en})_3]^{3+}$       (d)  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$

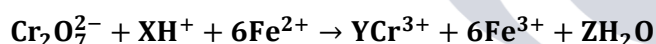
## SECTION-B

51. 0.400 g of an organic compound (X) gave 0.376 g of AgBr in Carius method for estimation of bromine. % of bromine in the compound (X) is \_\_\_\_

(Given: Molar mass AgBr = 188 g mol<sup>-1</sup> Br = 80 g mol<sup>-1</sup>)

52. 1 g of a carbonate ( $\text{M}_2\text{CO}_3$ ) on treatment with excess HCl produces 0.01 mol of CO<sub>2</sub>. The molar mass of  $\text{M}_2\text{CO}_3$  is \_\_\_\_ g mol<sup>-1</sup>. (Nearest integer)

53. See the following chemical reaction:



The sum of X, Y and Z is \_\_\_\_

54. If the formula of Borax is  $\text{Na}_2\text{B}_4\text{O}_x(\text{OH})_y \cdot z\text{H}_2\text{O}$ , then  $x + y + z =$  \_\_\_\_

55. At 298 K, the standard reduction potential for  $\text{Cu}^{2+}/\text{Cu}$  electrode is 0.34 V.

Given:  $K_{\text{sp}}\text{Cu}(\text{OH})_2 = 1 \times 10^{-20}$

Take  $\frac{2.303RT}{F} = 0.059 \text{ V}$

The reduction potential at pH = 14 for the above couple is  $(-)\text{x} \times 10^{-2} \text{ V}$ . The value of x is \_\_\_\_

56. 20 mL of 0.1M NaOH is added to 50 mL of 0.1M acetic acid solution. The pH of the resulting solution is \_\_\_\_  $\times 10^{-2}$  (Nearest integer)

Given:  $pK_a(\text{CH}_3\text{COOH}) = 4.76$

$\log 2 = 0.30$

$\log 3 = 0.48$

57.  $\text{A(g)} \rightarrow 2 \text{B(g)} + \text{C(g)}$  is a first order reaction. The initial pressure of the system was found to be 800 mmHg which increased to 1600 mmHg after 10 min. The total pressure of the system after 30 min will be \_\_\_ mmHg. (Nearest integer)

58. The orbital angular momentum of an electron in 3 s orbital is  $\frac{xh}{2\pi}$ . The value of .x is

59. Sodium metal crystallizes in a body centred cubic lattice with unit cell edge length of 4 Å. The radius of sodium atom is \_\_\_  $\times 10^{-1} \text{ Å}$  (Nearest integer)

60. Sea water contains 29.25% NaCl and 19%  $\text{MgCl}_2$  by weight of solution. The normal boiling point of the sea water is \_\_\_ °C (Nearest integer) Assume 100% ionization for both NaCl and  $\text{MgCl}_2$  Given :  $K_b(\text{H}_2\text{O}) = 0.52 \text{ K kg mol}^{-1}$

Molar mass of NaCl and  $\text{MgCl}_2$  is 58.5 and 95  $\text{g mol}^{-1}$  respectively.

## PART-III MATHEMATICS

### SECTION-A

61. If the system of equations

$$2x + y - z = 5$$

$$2x - 5y + \lambda z = \mu$$

$$x + 2y - 5z = 7$$

has infinitely many solutions, then  $(\lambda + \mu)^2 + (\lambda - \mu)^2$  is equal to

- (a) 916 (b) 912  
(c) 920 (d) 904

62. The coefficient of  $x^5$  in the expansion of  $\left(2x^3 - \frac{1}{3x^2}\right)^5$  is

- (a) 8 (b) 9  
(c)  $\frac{80}{9}$  (d)  $\frac{26}{3}$

63. The plane, passing through the points  $(0, -1, 2)$  and  $(-1, 2, 1)$  and parallel to the line passing through  $(5, 1, -7)$  and  $(1, -1, -1)$ , also passes through the point.

- (a)  $(1, -2, 1)$  (b)  $(0, 5, -2)$   
(c)  $(-2, 5, 0)$  (d)  $(2, 0, 1)$

64. Let  $\alpha, \beta$  be the roots of the equation  $x^2 - \sqrt{2}x + 2 = 0$ . Then  $\alpha^{14} + \beta^{14}$  is equal to

- (a)  $-64\sqrt{2}$  (b)  $-128\sqrt{2}$   
(c) -64 (d) -128

65. Let  $a_1, a_2, a_3, \dots$  be a G.P. of increasing positive numbers. Let the sum of its 6<sup>th</sup> and 8<sup>th</sup> terms be 2 and the product of its 3<sup>rd</sup> and 5<sup>th</sup> terms be  $\frac{1}{9}$ . Then  $6(a_2 + a_4)(a_4 + a_6)$  is equal to
- (a)  $2\sqrt{2}$  (b) 2  
(c)  $3\sqrt{3}$  (d) 3
66. Let  $(\alpha, \beta)$  be the centroid of the triangle formed by the lines  $15x - y = 82$ ,  $6x - 5y = -4$  and  $9x + 4y = 17$ . Then  $\alpha + 2\beta$  and  $2\alpha - \beta$  are the roots of the equation
- (a)  $x^2 - 7x + 12 = 0$  (b)  $x^2 - 13x + 42 = 0$   
(c)  $x^2 - 14x + 48 = 0$  (d)  $x^2 - 10x + 25 = 0$
67. Let  $|\vec{a}| = 2$ ,  $|\vec{b}| = 3$  and the angle between the vectors  $\vec{a}$  and  $\vec{b}$  be  $\frac{\pi}{4}$ . Then  $|(\vec{a} + 2\vec{b}) \times (2\vec{a} - 3\vec{b})|^2$  is equal to
- (a) 482 (b) 441  
(c) 841 (d) 882
68. Let N be the foot of perpendicular from the point P (1, -2, 3) on the line passing through the points (4, 5, 8) and (1, -7, 5). Then the distance of N from the plane  $2x - 2y + z + 5 = 0$  is
- (a) 6 (b) 9  
(c) 7 (d) 8
69. If  $\lim_{x \rightarrow 0} \frac{e^{ax} - \cos(bx) - \frac{cxe^{-cx}}{2}}{1 - \cos(2x)} = 17$ , then  $5a^2 + b^2$  is equal to
- (a) 72 (b) 76  
(c) 68 (d) 64
70. Let the centre of a circle C be  $(\alpha, \beta)$  and its radius  $r < 8$ . Let  $3x + 4y = 24$  and  $3x - 4y = 32$  be two tangents and  $4x + 3y = 1$  be a normal to C. Then  $(\alpha - \beta + r)$  is equal to
- (a) 7 (b) 9  
(c) 5 (d) 6
71. All words, with or without meaning, are made using all the letters of the word MONDAY. These words are written as in a dictionary with serial numbers. The serial number of the word MONDAY is
- (a) 327 (b) 326  
(c) 328 (d) 324
72. The range of  $f(x) = 4\sin^{-1}\left(\frac{x^2}{x^2+1}\right)$  is
- (a)  $[0, \pi]$  (b)  $[0, 2\pi]$   
(c)  $[0, \pi)$  (d)  $[0, 2\pi]$
73. The statement
- $(p \wedge (\sim q)) \vee ((\sim p) \wedge q) \vee ((\sim p) \wedge (\sim q))$  is equivalent to

(a)  $(\sim p) \vee (\sim q)$  (b)  $p \vee (\sim q)$

(c)  $(\sim p) \vee q$  (d)  $p \vee q$

74. The random variable  $X$  follows binomial distribution  $B(n, p)$  for which the difference of the mean and the variance is 1. If  $2P(X = 2) = 3P(X = 1)$ , then  $n^2P(X > 1)$  is equal to

(a) 12 (b) 15

(c) 11 (d) 16

75. Let for  $A = \begin{bmatrix} 1 & 2 & 3 \\ a & 3 & 1 \\ 1 & 1 & 2 \end{bmatrix}$ ,  $|A| = 2$ . If  $|2\text{adj}(2\text{adj}(2A))| = 32^n$ , then  $3n + \alpha$  is equal to

(a) 10 (b) 9

(c) 12 (d) 11

76. Let  $S = \{Z \in \mathbb{C} : \bar{z} = i(z^2 + \text{Re}(\bar{z}))\}$ . Then  $\sum_{z \in S} |z|^2$  is equal to

(a)  $\frac{7}{2}$  (b) 4

(c)  $\frac{5}{2}$  (d) 3

77. The area of the region

$\{(x, y) : x^2 \leq y \leq |x^2 - 4|, y \geq 1\}$  is

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

(c)  $\frac{4}{3}(4\sqrt{2} + 1)$  (d)  $\frac{3}{4}(4\sqrt{2} + 1)$

78. Let for a triangle ABC,

$\overrightarrow{AB} = -2\hat{i} + \hat{j} + 3\hat{k}$

$\overrightarrow{CB} = \alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$

$\overrightarrow{CA} = 4\hat{i} + 3\hat{j} + \delta\hat{k}$

If  $\delta > 0$  and the area of the triangle ABC is  $5\sqrt{6}$ , then  $\overrightarrow{CB} \cdot \overrightarrow{CA}$  is equal to

(a) 60 (b) 120

(c) 108 (d) 54

79. The line, that is coplanar to the line  $\frac{x+3}{-3} = \frac{y-1}{1} = \frac{z-5}{5}$ , is

(a)  $\frac{x+1}{1} = \frac{y-2}{2} = \frac{z-5}{5}$  (b)  $\frac{x+1}{-1} = \frac{y-2}{2} = \frac{z-5}{5}$

(c)  $\frac{x+1}{-1} = \frac{y-2}{2} = \frac{z-5}{4}$  (d)  $\frac{x-1}{-1} = \frac{y-2}{2} = \frac{z-5}{5}$

80. The value of  $\frac{e^{-\frac{\pi}{4}} + \int_0^{\frac{\pi}{4}} e^{-x} \tan^{50} x dx}{\int_0^{\frac{\pi}{4}} e^{-x} (\tan^{49} x + \tan^{51} x) dx}$  is

- (a) 50 (b) 49  
(c) 51 (d) 25

## SECTION-B

81. The mean and standard deviation of the marks of 10 students were found to be 50 and 12 respectively. Later, it was observed that two marks 20 and 25 were wrongly read as 45 and 50 respectively. Then the correct variance is
82. Let  $A = \{-4, -3, -2, 0, 1, 3, 4\}$  and  $R = \{(a, b) \in A \times A : b = |a| \text{ or } b^2 = a + 1\}$  be a relation on A. Then the minimum number of elements, that must be added to the relation R so that it becomes reflexive and symmetric, is
83. Let  $f(x) = \sum_{k=1}^{10} kx^k, x \in \mathbb{R}$ . If  $2f(b) + f'(b) = 119(2)^n + 1$  then n is equal to
84. Total numbers of 3-digit numbers that are divisible by 6 and can be formed by using the digits 1, 2, 3, 4, 5 with repetition, is
85. Let  $[\alpha]$  denote the greatest integer  $\leq \alpha$ . Then  $[\sqrt{1}] + [\sqrt{2}] + [\sqrt{3}] + \dots + [\sqrt{120}]$  is equal to.
86. For  $x \in (-1, 1]$ , the number of solutions of the equation  $\sin^{-1} x = 2\tan^{-1} x$  is equal to
87. If  $y = y(x)$  is the solution of the differential equation  $\frac{dy}{dx} + \frac{4x}{(x^2-1)}y = \frac{x+2}{(x^2-1)^{\frac{5}{2}}}, x > 1$  such that  $y(b) = \frac{2}{9}\log_e(2 + \sqrt{3})$  and  $y(\sqrt{2}) = \alpha\log_e(\sqrt{\alpha} + \beta) + \beta - \sqrt{\gamma}, \alpha, \beta, \gamma \in \mathbb{N}$ , then  $\alpha\beta\gamma$  is equal to
88. The foci of a hyperbola are  $(\pm 2, 0)$  and its eccentricity is  $\frac{3}{2}$ . A tangent, perpendicular to the line  $2x + 3y = 6$ , is drawn at a point in the first quadrant on the hyperbola. If the intercepts made by the tangent on the x - and y-axes are a and b respectively, then  $|6a| + |5b|$  is equal to
89. Let  $f_n = \int_0^{\frac{\pi}{2}} \left( \sum_{k=1}^n \sin^{k-1} x \right) \left( \sum_{k=1}^n (2k-1) \sin^{k-1} x \right) \cos x \, dx, n \in \mathbb{N}$ . Then  $f_{21} - f_{20}$  is equal to
90. The remainder, when  $7^{103}$  is divided by 17 is