



**PHYSICS  
WALLAH**

**JEE MAIN 2026**

**SESSION-01**

**Date: 22-01-2026**

**Shift-02**

## SECTION-I (PHYSICS)

### Single Correct Type Questions

1. Given below are two statements:

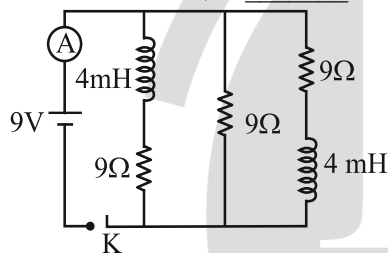
**Statement I:** For a mechanical system of many particles total kinetic energy is the sum of kinetic energies of all the particles

**Statement II:** The total kinetic energy can be the sum of kinetic energy of the center of mass w.r.t. to the origin and the kinetic energy of all the particles w.r.t. the center of mass as the reference.

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

- (1) Statement I is false but Statement II is true
- (2) Statement I is true but Statement II is false
- (3) Both Statement I and Statement II are false
- (4) Both Statement I and Statement II are true

2. Figure shows the circuit that contains three resistances ( $9\Omega$  each) and two inductors ( $4\text{ mH}$  each). The reading of ammeter at the moment switch  $K$  is turned ON, is \_\_\_\_\_ A.



- (1) 3
- (2) zero
- (3) 2
- (4) 1

3. An electric power line having total resistance of  $2\Omega$ , delivers  $1\text{ kW}$  of power at  $250\text{V}$ . The percentage efficiency of transmission line is \_\_\_\_\_

- (1) 92.5
- (2) 86.5
- (3) 100
- (4) 96.9

4. If  $\epsilon$ ,  $E$  and  $t$  represent the free space permittivity, electric field and time respectively, then the unit of  $\frac{\epsilon E}{t}$  will be:

- (1)  $\text{Am}^2$
- (2)  $\text{A/m}$
- (3)  $\text{A/m}^2$
- (4)  $\text{Am}$

5. Which of the following are true for a single slit diffraction?

- A. Width of central maxima increases with increase in wavelength keeping slit width constant
- B. Width of central maxima increases with decrease in wavelength keeping slit width constant
- C. Width of central maxima increases with decrease in slit width at constant wavelength.

D. Width of central maxima increases with increase in slit width at constant wavelength.

E. Brightness of central maxima increases for decrease in wavelength at constant slit width.

- (1) A, C, E only
- (2) B, C only
- (3) B, D only
- (4) A, D only

6. Three small identical bubbles of water having same charge on each coalesce to form a bigger bubble. Then the ratio of the potentials on one initial bubble and that on the resultant bigger bubble is:

- (1)  $1 : 2^{2/3}$
- (2)  $3^{2/3} : 1$
- (3)  $1 : 3^{2/3}$
- (4)  $1 : 3^{1/3}$

7. Consider two boxes containing ideal gases  $A$  and  $B$  such that their temperatures, pressures and number densities are same. The molecular size of  $A$  is half of that of  $B$  and mass of molecule  $A$  is four times that of  $B$ . If the collision frequency in gas  $B$  is  $32 \times 10^{18}/\text{s}$  then collision frequency in gas  $A$  is \_\_\_\_\_/s.

- (1)  $4 \times 10^8$
- (2)  $32 \times 10^8$
- (3)  $2 \times 10^8$
- (4)  $8 \times 10^8$

8. In an open organ pipe  $v_3$  and  $v_6$  are 3<sup>rd</sup> and 6<sup>th</sup> harmonic frequencies, respectively. If  $v_3 - v_6 = 2200\text{ Hz}$  then length of the pipe is \_\_\_\_\_ mm. (Take velocity of sound in air is  $330\text{ m/s}$ .)

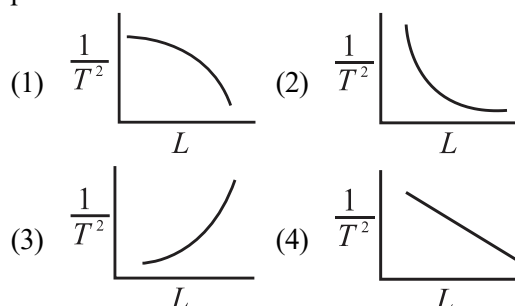
- (1) 225
- (2) 275
- (3) 200
- (4) 250

9. A laser beam has intensity of  $4.0 \times 10^{14}\text{ W/m}^2$ . The amplitude of magnetic field associated with beam is \_\_\_\_\_ T.

(Take  $\epsilon_0 = 8.85 \times 10^{-12}\text{ C}^2/\text{Nm}^2$  and  $c = 3 \times 10^8\text{ m/s}$ )

- (1) 18.3
- (2) 5.5
- (3) 1.83
- (4) 2.0

10. Using a simple pendulum experiment  $g$  is determined by measuring its time period  $T$ . Which of the following plots represent the correct relation between the pendulum length  $L$  and time period  $T$ ?



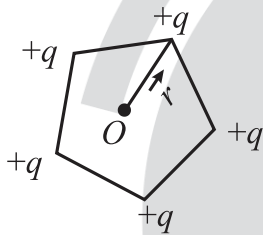
11. The smallest wavelength of Lyman series is 91 nm. The difference between the largest wavelengths of Paschen and Balmer series is nearly \_\_\_\_\_ nm.

- (1) 1550                      (2) 1784  
 (3) 1217                      (4) 1875

12. Light is incident on a metallic plate having work function  $110 \times 10^{-20}$  J. If the produced photoelectrons have zero kinetic energy then the angular frequency of the incident light is \_\_\_\_\_ rad/s. ( $h = 6.63 \times 10^{-34}$  J.s).

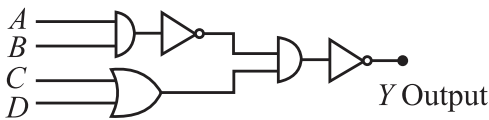
- (1)  $1.04 \times 10^{13}$               (2)  $1.66 \times 10^{16}$   
 (3)  $1.66 \times 10^{15}$               (4)  $1.04 \times 10^{16}$

13. Five positive charges each having charge  $q$  are placed at the vertices of a pentagon as shown in the figure. The electric potential ( $V$ ) and the electric field ( $\vec{E}$ ) at the center  $O$  of the pentagon due to these five positive charges are:



- (1)  $V = \frac{5q}{4\pi\epsilon_0 r}$  and  $\vec{E} = \frac{5\sqrt{3}q}{8\pi\epsilon_0 r^2} \hat{r}$   
 (2)  $V = 0$  and  $\vec{E} = 0$   
 (3)  $V = \frac{5q}{4\pi\epsilon_0 r}$  and  $\vec{E} = -\frac{5q}{4\pi\epsilon_0 r^2} \hat{r}$   
 (4)  $V = \frac{5q}{4\pi\epsilon_0 r}$  and  $\vec{E} = 0$

14. The correct truth table for the given input data of the following logic gate is:



(1)

Inputs				Outputs
A	B	C	D	Y
1	1	0	1	1
0	0	1	1	0
1	0	1	0	1
1	1	1	1	0

(2)

Inputs				Outputs
A	B	C	D	Y
1	1	0	1	0
0	0	1	1	0
1	0	1	0	1
1	1	1	1	1

(3)

Inputs				Outputs
A	B	C	D	Y
1	1	0	1	0
0	0	1	1	1
1	0	1	0	1
1	1	1	1	1

(4)

Inputs				Outputs
A	B	C	D	Y
1	1	0	1	1
0	0	1	1	0
1	0	1	0	0
1	1	1	1	1

15. In parallax method for the determination of focal length of a concave mirror, the object should always be placed:

- (1) between the focus ( $F$ ) and the centre of curvature ( $C$ ) of the mirror only  
 (2) beyond the centre of the curvature ( $C$ ) of the mirror only  
 (3) between the pole ( $P$ ) and the focus ( $F$ ) of the concave mirror only  
 (4) at any point beyond the focus ( $F$ ) of the mirror

16. When a part of a straight capillary tube is placed vertically in a liquid, the liquid raises upto certain height  $h$ . If the inner radius of the capillary tube, density of the liquid and surface tension of the liquid decrease by 1% each, then the height of the liquid in the tube will change by \_\_\_\_\_ %.

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

17. Given below are two statements:

**Statement I:** A satellite is moving around earth in the orbit very close to the earth surface. The time period of revolution of satellite depends upon the density of earth.

**Statement II:** The time period of revolution of the satellite is  $T = 2\pi\sqrt{\frac{R_e}{g}}$  (for satellite very close to

the earth surface), where  $R_e$  radius of earth and  $g$  acceleration due to gravity.

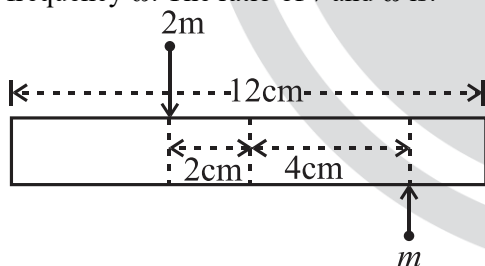
In the light of the above statements, choose the correct answer from the options given below:

- (1) Statement I is true but Statement II is false  
 (2) Both statement I and Statement II are false  
 (3) Statement I is false but Statement II is true  
 (4) Both statement I and Statement II are true

18. Given below are two statements:  
**Statement I:** An object moves from position  $r_1$  to position  $r_2$  under a conservative force field  $\vec{F}$ . The work done by the force is  $W = -\int_{r_1}^{r_2} \vec{F} \cdot d\vec{r}$   
**Statement II:** Any object moving from one location to another location can follow infinite number of paths. Therefore, the amount of work done by the object changes with the path it follows for a conservative force.  
 In the light of the above statements, choose the correct answer from the options given below:  
 (1) Statement I is true but Statement II is false  
 (2) Both statement I and Statement II are false  
 (3) Statement I is false but Statement II is true  
 (4) Both statement I and Statement II are true

19. The wavelength of light, while it is passing through water is 540 nm. The refractive index of water is  $\frac{4}{3}$ . The wavelength of the same light when it is passing through a transparent medium having refractive index of  $\frac{3}{2}$  is \_\_\_\_\_ nm.  
 (1) 540 (2) 380  
 (3) 480 (4) 840

20. A uniform bar of length 12 cm and mass  $20m$  lies on a smooth horizontal table. Two points masses  $m$  and  $2m$  are moving in opposite directions with same speed of  $v$  and in the same plane as the bar, as shown in figure. These masses strike the bar simultaneously and get stuck to it. After collision the entire system is rotating with angular frequency  $\omega$ . The ratio of  $v$  and  $\omega$  is:



- (1)  $2\sqrt{88}$  (2) 66  
 (3) 32 (4) 33

### Integer Type Questions

21. A capacitor  $P$  with capacitance  $10 \times 10^{-6}$  F is fully charged with a potential difference of 6.0 V and disconnected from the battery. The charged capacitor  $P$  is connected across another capacitor  $Q$  with capacitance  $20 \times 100^{-6}$  F. The charge on capacitor  $Q$  when equilibrium is established will be  $\alpha \times 10^{-5}$  C (assume capacitor  $Q$  does not have any charge initially), the value of  $\alpha$  is \_\_\_\_\_.
22. An insulated cylinder of volume 60 cm<sup>3</sup> is filled with a gas at 27°C and 2 atmospheric pressure. Then the gas is compressed making the final volume as 20 cm<sup>3</sup> while allowing the temperature to rise to 77°C. The final pressure is \_\_\_\_\_ atmospheric pressure.
23. A cylindrical conductor of length 2 m and area of cross-section 0.2 mm<sup>2</sup> carries an electric current of 1.6 A when its ends are connected to a 2V battery. Mobility of electrons in the conductor is  $\alpha \times 10^{-3}$  m<sup>2</sup>/V.s. The value of  $\alpha$  is: (electron concentration =  $5 \times 10^{28}$ /m<sup>3</sup> and electron charge =  $1.6 \times 10^{-19}$  C)
24. Two masses  $m$  and  $2m$  are connected by a light string going over a pulley (disc) of mass  $30m$  with radius  $r = 0.1$  m. The pulley is mounted in a vertical plane and it is free to rotate about its axis. The  $2m$  mass is released from rest and its speed when it has descended through a height of 3.6 m is \_\_\_\_\_ m/s. (Assume string does not slip and  $g = 10$  m/s<sup>2</sup>)
25. A conducting circular loop is rotated about its diameter at a constant angular speed of 100 rad/s in a magnetic field of 0.5 T perpendicular to the axis of rotation. When the loop is rotated by 30° from the horizontal position, the induced EMF is 15.4 mV. The radius of the loop is \_\_\_\_\_ mm. (Take  $\pi = \frac{22}{7}$ )

## SECTION-II (CHEMISTRY)

### Single Correct Type Questions

26. Among H<sub>2</sub>S, H<sub>2</sub>O, NF<sub>3</sub>, NH<sub>3</sub> and CHCl<sub>3</sub>, identify the molecule (X) with lowest dipole moment value. The number of lone pairs of electrons present on the central atom of the molecule (X) is:  
 (1) 0  
 (2) 1  
 (3) 3  
 (4) 2
27. Which of the following mixture gives a buffer solution with pH = 9.25?  
 Given :  $pK_b(\text{NH}_4\text{OH}) = 4.75$   
 (1) 0.5 M NH<sub>4</sub>OH (0.2 L) + 0.2 M HCl (0.5 L)  
 (2) 0.2 M NH<sub>4</sub>OH (0.4 L) + 0.1 M HCl (1 L)  
 (3) 0.4 M NH<sub>4</sub>OH (1 L) + 0.1 M HCl (1 L)  
 (4) 0.2 M NH<sub>4</sub>OH (0.5 L) + 0.1 M HCl (0.5 L)

28. Given below are two statements:

**Statement I:**  $C < O < N < F$  is the correct order in terms of first ionization enthalpy values.

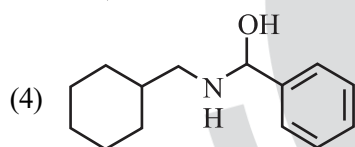
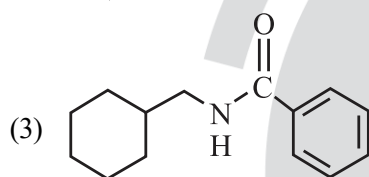
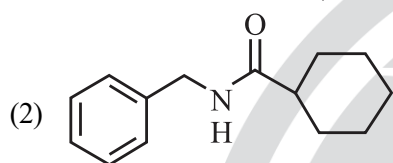
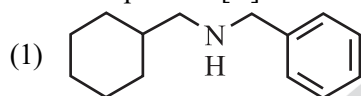
**Statement II:**  $S > Se > Te > Po > O$  is the correct order in terms of the magnitude of electron gain enthalpy values.

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

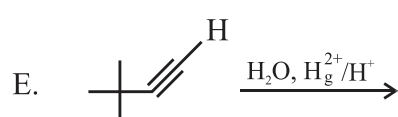
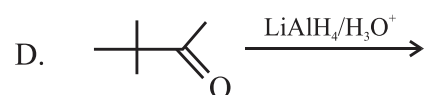
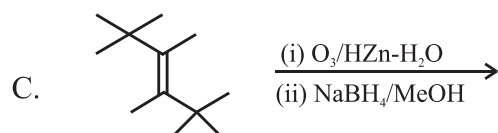
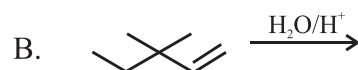
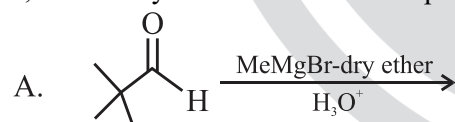
- (1) Both statement I and statement II are true
- (2) Both statement I and statement II are false
- (3) Statement I is true but Statement II is false
- (4) Statement I is false but Statement II is true



The final product [B] is:



30. 3, 3-Dimethyl-2-butanol cannot be prepared by:



Choose the correct answer from the options given below:

- (1) B, C and E only
- (2) B only
- (3) B and E only
- (4) B and C only

31. The energy of first (lowest) Balmer line of H atom is  $x$  J. The energy (in J) of second Balmer line of H atom is:

- (1)  $x^2$
- (2)  $2x$
- (3)  $\frac{x}{1.35}$
- (4)  $1.35x$

32. Correct statement regarding Arrhenius equation among the following are:

- A. Factor  $e^{-E_a/RT}$  corresponds to fraction of molecules having kinetic energy less than  $E_a$ .
- B. At given temperature, lower the  $E_a$ , faster is the reaction.
- C. Increase in temperature by about  $10^\circ\text{C}$  doubles the rate of reaction.
- D. Plot of  $\log k$  vs  $\frac{1}{T}$  gives a straight line with

$$\text{slope} = -\frac{E_a}{R}$$

Choose the correct answer from the options given below:

- (1) A and C only
- (2) A and B only
- (3) B and C only
- (4) B and D only

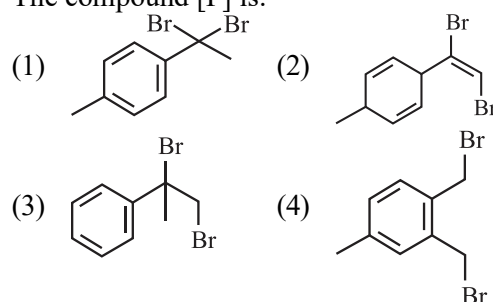
33.  $[\text{Ni}(\text{PPh}_3)_2\text{Cl}_2]$  is a paramagnetic complex. Identify the incorrect statements about this complex.

- A. The complex exhibits geometrical isomerism
- B. The complex is white in colour.
- C. The calculated spin-only magnetic moment of the complex is 2.84 BM.
- D. The calculated CFSE (Crystal Field Stabilization Energy) of Ni in this complex is  $-0.8 \Delta_0$ .
- E. The geometrical arrangement of ligands in this complex is similar to that in  $\text{Ni}(\text{CO})_4$ .

Choose the correct answer from the options given below:

- (1) A, B and D only
- (2) C and D only
- (3) A and B only
- (4) C, D and E only

34. The dibromo compound [P] (molecular formula:  $\text{C}_9\text{H}_{10}\text{Br}_2$ ) when heated with excess sodamide followed by treatment with dilute HCl gives [Q]. On warming [Q] with mercuric sulphate and dilute sulphuric acid yield [R] which gives positive Iodoform test but negative Tollen's test. The compound [P] is:



35. Given below are two statements:

**Statement I:** Elements 'X' and 'Y' are the most and least electronegative elements, respectively among N, As, Sb and P. The nature of the oxides  $X_2O_3$  and  $Y_2O_3$  is acidic and amphoteric, respectively.

**Statement II:**  $BCl_3$  is covalent in nature and get hydrolysed in water. It produces  $[B(OH)_4]^-$  and  $[B(H_2O)_6]^{3+}$  in aqueous medium.

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

- (1) Both statement I and statement II are true
- (2) Statement I is false but statement II is true
- (3) Statement I is true but Statement II is false
- (4) Both statement I and statement II are false

36. Identify the correct statements:

- A. Hydrated salts can be used as primary standard.
- B. Primary standard should not unergo any reaction with air.
- C. Reactions of primary standard with another substance should be instantaneous and stoichiometric.
- D. Primary standard should not be soluble in water
- E. Primary standard should have low relative molar mass.

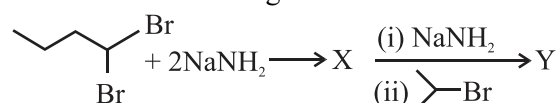
Choose the correct answer from the options given below:

- (1) D and E only
- (2) A, B, C and E only
- (3) A, B and C only
- (4) A, B and E only

37. The compound A,  $C_8H_8O_2$  reacts with acetophenone to form a single product via cross-Aldol condensation. The compound A on reaction with conc. NaOH forms a substituted benzyl alcohol as one of the two products. The compound A is:

- (1) 4-methoxy benzaldehyde
- (2) 2-hydroxy acetophenone
- (3) 4-methyl benzoic acid
- (4) 4-hydroxy benzylaldehyde

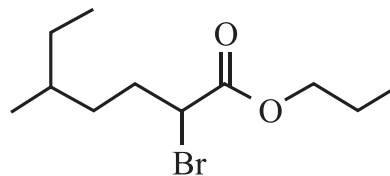
38. Consider the following reaction:



The product Y formed is:

- (1) 2-methylhex-3-yne
- (2) Isopropylbut-1-yne
- (3) 5-methylhex-2-yne
- (4) 2-methylhex-2-yne

39. The IUPAC name of the following compound is



- (1) n-propyl-2-bromo-5-methylheptanoate
- (2) 2-bromo-5-methylhexylpropanoate
- (3) 2-bromo-5-methylpropanoate
- (4) n-propyl-1-bromo-4-methylhexanoate

40.  $A + 2B \longrightarrow AB_2$

360.0 g of 'A' (Molar mass :  $60 \text{ g mol}^{-1}$ ) and 56.0 g of 'B' (Molar mass :  $80 \text{ g mol}^{-1}$ ) are allowed to react. Which of the following statements are correct?

- A. 'A' is the limiting reagent
- B. 77.0 g of  $AB_2$  is formed
- C. Molar mass of  $AB_2$  is  $140 \text{ g mol}^{-1}$ .
- D. 15.0 g of A is left unreacted after the completion of reaction.

Choose the correct answer from the options given below:

- (1) B and D only
- (2) C and D only
- (3) A and C only
- (4) A and B only

41. When 1 g of compound (X) is subjected to Kjeldahl's method for estimation of nitrogen, 15 mL 1 M  $H_2SO_4$  was neutralized by ammonia evolved. The percentage of nitrogen in compound (X) is:

- (1) 42
- (2) 0.21
- (3) 21
- (4) 0.42

42. Match Column-I with Column-II

Column-I Reaction of Glucose with		Column-II Product formed	
A.	Hydroxylamine	I.	Gluconic acid
B.	$Br_2$ water	II.	Glucose pentacetate
C.	Excess acetic anhydride	III.	Saccharic acid
D.	Concentrated $HNO_3$	IV.	Glucosime

Choose the correct answer from the options given below:

- |     | A   | B   | C  | D   |
|-----|-----|-----|----|-----|
| (1) | IV  | I   | II | III |
| (2) | IV  | III | II | I   |
| (3) | I   | III | IV | II  |
| (4) | III | I   | IV | II  |

43. Given below are two statements:  
**Statement I :** The first ionization enthalpy of Cr is lower than that of Mn.  
**Statement II:** The second and third ionization enthalpies of Cr are higher than those of Mn.  
 In the light of the above statements, choose the correct answer from the options given below:  
 (1) Both statement I and statement II are false  
 (2) Both statement I and statement II are true  
 (3) Statement I is false but statement II is true  
 (4) Statement I is true but statement II is false

44. At T(K), 100 g of 98% H<sub>2</sub>SO<sub>4</sub> (w/w) aqueous solution is mixed with 100 g of 49% H<sub>2</sub>SO<sub>4</sub> (w/w) aqueous solution. What is the mole fraction of H<sub>2</sub>SO<sub>4</sub> in the resultant solution?  
 (Given: Atomic mass H = 1 u; S = 32u; O = 16 u)  
 (Assume that temperature after mixing remains constant)  
 (1) 0.1 (2) 0.9  
 (3) 0.663 (4) 0.337

45. Consider the following reduction process:  
 $\text{Al}^{3+} + 3\text{e}^- \longrightarrow \text{Al(s)}, E^\circ = -1.66\text{V}$   
 $\text{Fe}^{3+} + \text{e}^- \longrightarrow \text{Fe}^{2+}, E^\circ = +0.77\text{V}$   
 $\text{Co}^{3+} + \text{e}^- \longrightarrow \text{Co}^{2+}, E^\circ = +1.81\text{V}$   
 $\text{Cr}^{3+} + 3\text{e}^- \longrightarrow \text{Cr(s)}, E^\circ = -0.74\text{V}$   
 The tendency to act as reducing agent decreases in the order:  
 (1) Al > Cr > Fe<sup>2+</sup> > Co<sup>2+</sup>  
 (2) Al > Cr > Co<sup>2+</sup> > Fe<sup>2+</sup>  
 (3) Al > Fe<sup>2+</sup> > Cr > Co<sup>2+</sup>  
 (4) Cr > Fe<sup>2+</sup> > Al > Co<sup>2+</sup>

### Integer Type Questions

46. Consider the following electrochemical cell:  
 $\text{Pt}|\text{O}_2(\text{g})(1 \text{ bar})|\text{HCl}(\text{aq})||\text{M}^{2+}(\text{aq}, 1.0 \text{ M})|\text{M}(\text{s})$   
 The pH above which, oxygen gas would start to evolve at anode is \_\_\_\_\_ (nearest integer)  
 Given:  
 $E^\circ_{\text{M}^{2+}/\text{M}} = 0.994\text{V}$   
 $E^\circ_{\text{O}_2/\text{H}_2\text{O}} = 1.23\text{V}$  } standard reduction potential  
 And  $\frac{RT}{F}(2.303) = 0.059\text{V}$  at the given condition
47. If the enthalpy of sublimation of Li is 155 kJ mol<sup>-1</sup>, enthalpy of dissociation of F<sub>2</sub> is 150 kJ mol<sup>-1</sup>, ionization enthalpy of Li is 520 kJ mol<sup>-1</sup>, electron gain enthalpy of F is -313 kJ mol<sup>-1</sup>, standard enthalpy of formation of LiF is -594 kJ mol<sup>-1</sup>. The magnitude of lattice enthalpy of LiF is kJ mol<sup>-1</sup>. (Nearest Integer)
48. Among the following oxides of 3d elements, the number of mixed oxides are \_\_\_\_\_.  
 Ti<sub>2</sub>O<sub>3</sub>, V<sub>2</sub>O<sub>4</sub>, Cr<sub>2</sub>O<sub>3</sub>, Mn<sub>3</sub>O<sub>4</sub>, Fe<sub>3</sub>O<sub>4</sub>, Fe<sub>2</sub>O<sub>3</sub>, Co<sub>3</sub>O<sub>4</sub>
49. Consider  $\text{A} \xrightarrow{k_1} \text{B}$  and  $\text{C} \xrightarrow{k_2} \text{D}$  are two reactions. If the rate constant ( $k_1$ ) of the  $\text{A} \longrightarrow \text{B}$  reaction can be expressed by the following equation  $\log_{10} k = 14.34 - \frac{1.5 \times 10^4}{T/K}$  and activation energy of  $\text{C} \longrightarrow \text{D}$  reaction ( $E_{a2}$ ) is  $\frac{1}{5}$ th of the  $\text{A} \longrightarrow \text{B}$  reaction ( $E_{a1}$ ), then the value of ( $E_{a2}$  is \_\_\_\_\_ kJ mol<sup>-1</sup>).  
 (Nearest Integer)
50. The mass of benzanilide obtained from the benzoylation reaction of 5.8 g of aniline, if yield of product is 82% is \_\_\_\_\_ g (nearest integer).  
 (Given molar mass in g mol<sup>-1</sup> H : 1, C : 12, N : 14, O : 16)

## SECTION-III (MATHEMATICS)

### Single Correct Type Questions

51. Let the locus of the mid-point of the chord through the origin  $O$  of the parabola  $y^2 = 4x$  be the curve  $S$ . Let  $P$  be any point on  $S$ . Then the locus of the point, which internally divides  $OP$  in the ratio 3 : 1, is:  
 (1)  $3y^2 = 2x$  (2)  $3x^2 = 2y$   
 (3)  $2y^2 = 3x$  (4)  $2x^2 = 3y$
52. Among the statements  
**(S<sub>1</sub>) :** If  $A(5, -1)$  and  $B(-2, 3)$  are two vertices of a triangle, whose orthocentre is  $(0, 0)$ , then its third vertex is  $(-4, -7)$  and  
**(S<sub>2</sub>) :** If positive numbers  $2a, b, c$  are three consecutive terms of an A.P., then the lines  $ax + by + c = 0$  are concurrent at  $(2, -2)$ ,

- (1) both are correct  
 (2) only (S<sub>1</sub>) is correct  
 (3) both are incorrect  
 (4) only (S<sub>2</sub>) is correct

53. Let  $[.]$  denote the greatest integer function, and let  $f(x) = \min\{\sqrt{2}x, x^2\}$ . Let  $S = \{x \in (-2, 2) :$  the function  $g(x) = |x|[x^2]$  is discontinuous at  $x\}$ . Then  $\sum_{x \in S} f(x)$  equals  
 (1)  $\sqrt{6} - 2\sqrt{2}$  (2)  $2\sqrt{6} - 3\sqrt{2}$   
 (3)  $2 - \sqrt{2}$  (4)  $1 - \sqrt{2}$

54. Let  $f(x) = [x]^2 - [x+3] - 3$ ,  $x \in R$ , where  $[.]$  is the greatest integer function. Then
- (1)  $f(x) = 0$  for finitely many values of  $x$
  - (2)  $f(x) < 0$  only for  $x \in [-1, 3)$
  - (3)  $f(x) = 0$  only for  $x \in [4, \infty)$
  - (4)  $\int_0^2 f(x) dx = -6$
55. If  $\lim_{x \rightarrow 0} \frac{e^{(a-1)x} + 2 \cos bx + (c-2)e^{-x}}{x \cos x - \log_e(1+x)} = 2$ , then  $a^2 + b^2 + c^2$  is equal to:
- (1) 7
  - (2) 9
  - (3) 5
  - (4) 3
56. Let  $C_r$  denote the coefficient of  $x^r$  in the binomial expansion of  $(1+x)^n$ ,  $n \in N$ ,  $0 \leq r \leq n$ .
- If  $P_n = C_0 - C_1 + \frac{2^2}{3}C_2 - \frac{2^3}{4}C_3 + \dots + \frac{(-2)^n}{n+1}C_n$ ,
- then the value of  $\sum_{n=1}^{25} \frac{1}{P_{2n}}$  equals
- (1) 675
  - (2) 650
  - (3) 580
  - (4) 525
57. If the mean deviation about the median of the numbers  $k, 2k, 3k, \dots, 1000k$  is 500, then  $k^2$  is equal to:
- (1) 9
  - (2) 4
  - (3) 16
  - (4) 1
58. The area of the region  $A = \{(x, y) : 4x^2 + y^2 \leq 8 \text{ and } y^2 \leq 4x\}$  is
- (1)  $\pi + 4$
  - (2)  $\frac{\pi}{2} + \frac{1}{3}$
  - (3)  $\frac{\pi}{2} + 2$
  - (4)  $\pi + \frac{2}{3}$
59. The number of elements in the relation  $R = \{(x, y) : 4x^2 + y^2 < 52, x, y \in Z\}$  is
- (1) 86
  - (2) 67
  - (3) 77
  - (4) 89
60. Let  $L$ , be the line  $\frac{x+1}{2} = \frac{y+1}{3} = \frac{z+3}{6}$  and let  $S$  be the set of all points  $(a, b, c)$  on  $L$ , whose distance from the line  $\frac{x+1}{2} = \frac{y+1}{3} = \frac{z-9}{0}$  along the line  $L$  is 7. Then  $\sum_{(a,b,c) \in S} (a+b+c)$  is equal to:
- (1) 40
  - (2) 34
  - (3) 28
  - (4) 6

61. If  $y = y(x)$  satisfies the differential equation  $16(\sqrt{x+9\sqrt{x}})(4+\sqrt{9+\sqrt{x}}) \cos y \, dy = (1+2 \sin y) \, dx$ ,  $x > 0$  and  $y(256) = \frac{\pi}{2}$ ,  $y(49) = \alpha$ , then  $2 \sin \alpha$  is equal to
- (1)  $\sqrt{2} - 1$
  - (2)  $2(\sqrt{2} - 1)$
  - (3)  $2\sqrt{2} - 1$
  - (4)  $3(\sqrt{2} - 1)$
62. Let  $P(10, 2\sqrt{15})$  be a point on the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ , whose foci are  $S$  and  $S'$ . If the length of its latus rectum is 8, then the square of the area of  $\Delta PSS'$  is equal to
- (1) 2700
  - (2) 900
  - (3) 4200
  - (4) 1462
63. If  $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$  is a solution of the system of equation  $AX = B$ , where  $\text{adj } A = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$  and  $B = \begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix}$ , then  $|x+y+z|$  is equal to:
- (1) 1
  - (2)  $\frac{3}{2}$
  - (3) 3
  - (4) 2
64. Let  $n$  be the number obtained on rolling a fair die. If the probability that the system  $x - ny + z = 6$   
 $x + (n-2)y + (n+1)z = 8$   
 $(n-1)y + z = 1$  Has a unique solution is  $\frac{k}{6}$ , then the sum of  $k$  and all possible values of  $n$  is:
- (1) 24
  - (2) 21
  - (3) 20
  - (4) 22
65. Let  $\alpha, \beta$  be the roots of the quadratic equation  $12x^2 - 20x + 3\lambda = 0$ ,  $\lambda \in Z$ . If  $\frac{1}{2} \leq |\beta - \alpha| \leq \frac{3}{2}$ , then the sum of all possible values of  $\lambda$  is:
- (1) 3
  - (2) 4
  - (3) 6
  - (4) 1

66. Let the domain of the function  $f(x) = \log_3 \log_5$   
 $(7 - \log_2(x^2 - 10x + 85)) + \sin^{-1}\left(\frac{3x-7}{17-x}\right)$  be  
 $(\alpha, \beta]$ . Then  $\alpha + \beta$  is equal to:  
 (1) 12 (2) 9  
 (3) 10 (4) 8
67. Let  $f$  and  $g$  be functions satisfying  $f(x+y) =$   
 $f(x)f(y)$ ,  $f(1) = 7$  and  $g(x+y) = g(xy)$ ,  
 $g(1) = 1$ , for all  $x, y \in N$ . If  $\sum_{x=1}^n \left(\frac{f(x)}{g(x)}\right) = 19607$ ,  
 then  $n$  is equal to:  
 (1) 4 (2) 6  
 (3) 5 (4) 7
68. Let  $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$  and  $\vec{b} = \lambda\hat{j} + 2\hat{k}$ ,  $\lambda \in Z$  be the  
 two vectors. Let  $\vec{c} = \vec{a} \times \vec{b}$  and  $\vec{d}$  be the vector  
 of magnitude 2 in  $yz$ -plane. If  $|\vec{c}| = \sqrt{53}$ , then the  
 maximum possible value of  $(\vec{c} \cdot \vec{d})^2$  is equal to:  
 (1) 208 (2) 26  
 (3) 104 (4) 52
69. Let  $S = \{z \in \mathbb{C} : 4z^2 + \bar{z} = 0\}$ . Then  $\sum_{z \in S} |z|^2$  is  
 equal to  
 (1)  $\frac{5}{64}$  (2)  $\frac{7}{64}$   
 (3)  $\frac{3}{16}$  (4)  $\frac{1}{16}$
70. Let  $S$  and  $S'$  be the foci of the ellipse  
 $\frac{x^2}{25} + \frac{y^2}{9} = 1$  and  $P(\alpha, \beta)$  be a point on the  
 ellipse in the first quadrant. If  
 $(SP)^2 + (S'P)^2 - SP \cdot S'P = 37$ , then  $\alpha^2 + \beta^2$  is  
 equal to

- (1) 17 (2) 13  
 (3) 15 (4) 11

### Integer Type Questions

71. Let  $S$  be the set of the 11 natural numbers. Then  
 the number of elements in  $A = \{B \subseteq S : n(B) \geq 2$   
 and the product of all elements of  $B$  is even\} is
72. Let  $\cos(\alpha + \beta) = -\frac{1}{10}$  and  $\sin(\alpha - \beta) = -\frac{3}{8}$ ,  
 where  $0 < \alpha < \frac{\pi}{3}$  and  $0 < \beta < \frac{\pi}{4}$ .  
 If  $\tan 2\alpha = \frac{3(1-r\sqrt{5})}{\sqrt{11}(s+\sqrt{5})}$ ,  $r, s \in N$ , then  $r + s$  is  
 equal to
73. Let a vector  $\vec{a} = \sqrt{2}\hat{i} - \hat{j} + \lambda\hat{k}$ ,  $\lambda > 0$ , make an  
 obtuse angle with the vector  
 $\vec{b} = -\lambda^2\hat{i} + 4\sqrt{2}\hat{j} + 4\sqrt{2}\hat{k}$  and an angle  
 $\theta$ ,  $\frac{\pi}{6} < \theta < \frac{\pi}{2}$ , with the positive  $z$ -axis. If the set  
 of all possible values of  $\lambda$  is  $(\alpha, \beta) - \{\gamma\}$ , then  
 $\alpha + \beta + \gamma$  is equal to
74. Suppose  $a, b, c$  are in A.P. and  $a^2, 2b^2, c^2$  are in  
 G.P. If  $a < b < c$  and  $a + b + c = 1$ , then  
 $9(a^2 + b^2 + c^2)$  is equal to
75. Let  $[.]$  be the greatest integer function. If  
 $\alpha = \int_0^{64} (x^{1/3} - [x^{1/3}]) dx$ , then  $\frac{1}{\pi} \int_0^{\alpha\pi} \left(\frac{\sin^2 \theta}{\sin^6 \theta + \cos^6 \theta}\right) d\theta$   
 is equal to

