FIITJEE

ALL INDIA TEST SERIES

PART TEST – III

JEE (Main)-2019

TEST DATE: 9-12-2018

Time Allotted: 3 Hours **Maximum Marks: 360**

General Instructions:

- The test consists of total 90 questions.
- Each subject (PCM) has 30 questions.
- This question paper contains **Three Parts.**
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each part has only one section: **Section-A**.

  Section-A (01 – 30, 31 – 60, 61 – 90) *contains 90 multiple choice questions which have* ***only one correct answer****. Each question carries* ***+4 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*

Physics

PART – I

SECTION – A
Straight Objective Type

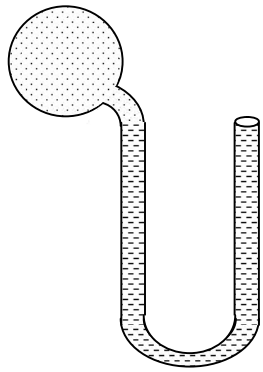
This section contains **30 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which only **ONE** option is correct

1. Match the quantities having same unit / dimension and choose the correct option

	Column – I		Column – II
(P)	Resistance 'R'	(1)	$\frac{\phi^2}{L}$, where ϕ is Magnetic flux and L is Self inductance
(Q)	Time 't'	(2)	$\sqrt{LC}$, where C is Capacitance and L is Self inductance
(R)	Energy 'E'	(3)	$\sqrt{\frac{L}{C}}$, where C is Capacitance and L is Self inductance
(S)	Force 'F'	(4)	q v B, where v is velocity, q is charge and B is Magnetic Field

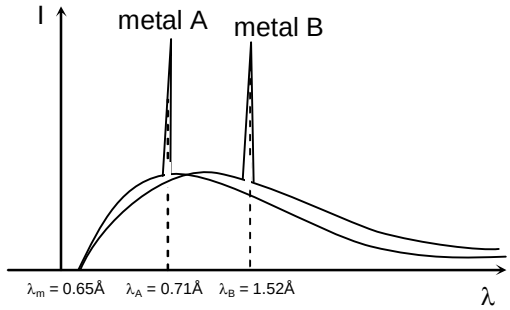
(A) P–1 Q–3 R–4 S–2
(B) P–3 Q–2 R–1 S–4
(C) P–1 Q–3 R–2 S–4
(D) P–3 Q–4 R–1 S–2

2. A vertical U tube of uniform cross sectional area A contains a liquid of density ρ. One end of tube is connected to a flask containing mono atomic gas (as shown in fig.) while other end opens to atmosphere ($P_{atm} = P_0$). Volume of flask and U tube are equal to V_0 each (neglect volume of horizontal portion). The flask is now slowly heated till half of liquid remain in U tube. Given $\frac{\rho g}{A} = \frac{P_0}{V_0}$, the ratio $\frac{\Delta U}{\Delta W}$ is



(ΔU = change in internal energy of the gas and ΔW = Work done by the gas)
(A) 1
(B) 2
(C) 3
(D) $\frac{12}{5}$

3. High energy electron beam is incident on target metals A and B in two different experiments. Graph between intensity I of rays generated and their wavelength is plotted on same scale and depicted as shown in figure. If metal A is identified as an element of mass no. Z = 41, choose the correct statement (given that σ = screening constant = 1, $\sqrt{2} = 0.7$).



(A) Metal B is copper with Z = 29
(B) Energy of electron beam is more for experiment with metal A.
(C) Metal B is iron with Z = 26
(D) None

4. A satellite of mass 'm' is orbiting a planet of mass M in a circular orbit of radius R. The satellite changes its orbit by expelling small amount of fuel [5% of its existing mass] with high speed U in a direction opposite to the direction of its orbital velocity. Find U_{max} (approximately) of the expelled mass for which, satellite cannot escape the gravitational field of planet.

(A) $\left[\frac{GM}{R}\right]^{1/2}$

(B) $5\left[\frac{GM}{R}\right]^{1/2}$

(C) $7\left[\frac{GM}{R}\right]^{1/2}$

(D) $3\left[\frac{GM}{R}\right]^{1/2}$

5. A nucleus is kept at rest. It breaks into two parts which fly off with velocity in the ratio 27 : 8. Then the ratio of radii of the parts is

(A) 27 : 8
(B) 8 : 27
(C) 2 : 3
(D) 3 : 2

6. A monochromatic light of wavelength 6500 Å is used in YDSE. Now both slits are covered by two thin slits of refractive index 3.2 and 2.7 respectively. By doing so central bright fringe shifts to original 7^{th} bright fringe. If both slits have same thickness then it is equal to

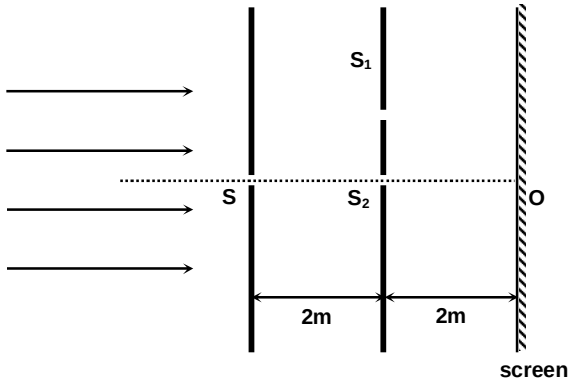
(A) 7.8 μm
(B) 9.1 μm
(C) 6.5 μm
(D) 9.8 μm

7. E, L, p and r are the energy, angular momentum, linear momentum and orbital radius of an electron in a atom corresponding to the quantum number n. Then EprL is

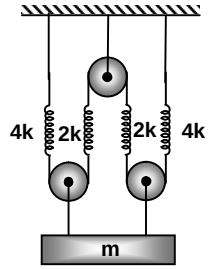
(A) proportional to n^2
(B) proportional to n.
(C) proportional to 1/n
(D) independent of n.

8. A parallel beam of light of wavelength 5000 Å is incident on slit S. Another two slits S_1 and S_2 are placed at a distance 2 meter as shown in the figure. The minimum distance between S_1 and S_2 such that maximum intensity will occur at O is

(A) $\sqrt{10}$ mm
(B) 1 mm
(C) $\frac{1}{2}$ mm
(D) $\sqrt{5}$ mm



9. A plank of mass M is connected with three massless pullies and four massless springs as shown in the figure in vertical plane. Plank is slightly displaced from its mean position. Assuming plank remain in horizontal position throughout the motion, the frequency of oscillation of plank is



(A) $\frac{1}{2\pi}\sqrt{\frac{32K}{3m}}$

(B) $\frac{1}{2\pi}\sqrt{\frac{8K}{3m}}$

(C) $\frac{1}{2\pi}\sqrt{\frac{4K}{3m}}$

(D) $\frac{1}{2\pi}\sqrt{\frac{16K}{3m}}$

10. If the gravitational constant 'G'. Plank's constant 'h' and velocity of light 'v' are assumed to be as fundamental units then dimension of length in new system is given by

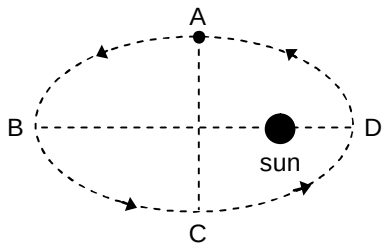
(A) $[G^2 h^2 v^{3/2}]$

(B) $[G^{1/2} h^{1/2} v^{3/2}]$

(C) $[G^{1/2} h^{1/2} v^{-3/2}]$

(D) $[G^2 h^2 v^{-3/2}]$

11. A satellite is moving around the sun in an elliptical orbit. 'M' is the mass of sun and 'a' is semi major axis of elliptical orbit. The velocity of satellite when it reaches at A is



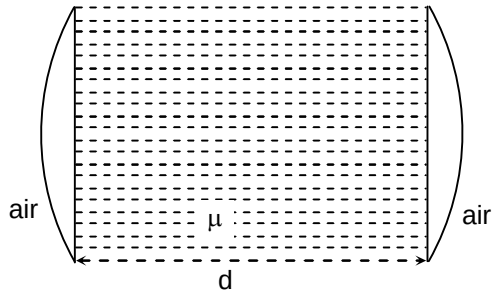
(A) $\sqrt{\frac{4GM}{a}}$

(B) $\sqrt{\frac{2GM}{a}}$

(C) $\sqrt{\frac{GM}{2a}}$

(D) $\sqrt{\frac{GM}{a}}$

12. Two thin plano-convex lenses, each of focal length $f = \frac{1}{3}m$ in air, are placed at some distance 'd' from each other as shown in the figure. The space between the lenses are filled with a substance with refractive index μ.



The distance 'd' between the lenses are so adjusted that a parallel beam of light passes through such an optical system remains parallel. Choose correct option(s).

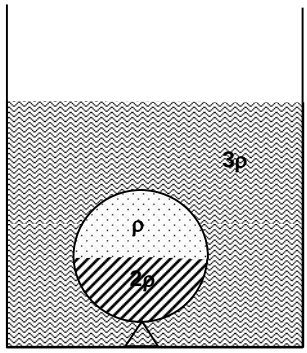
(A) If $\mu = \frac{3}{2}$, $d = 90\,cm$

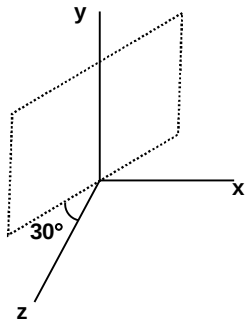
(B) If $\mu = \frac{3}{2}$, d = 100 cm

(C) If $\mu = \frac{4}{3}$, d = 100 cm

(D) If $\mu = \frac{4}{3}$, d = 80 cm

13. A solid sphere has density ρ in the top half and 2ρ in the bottom half. It is kept in a uniform fluid of density 3ρ with a hinge at the bottom (as shown) such that it can freely perform oscillations about any horizontal axis through the hinge (Radius of sphere is R). Find the period of small oscillations if all the points of the sphere are to oscillate in their respective planes parallel to the plane $x = -\sqrt{3}z$ (shown).





(A) $2\pi\sqrt{\frac{64R}{35g}}$

(B) $2\pi\sqrt{\frac{32R}{35g}}$

(C) $2\pi\sqrt{\frac{46R}{45g}}$

(D) $2\pi\sqrt{\frac{24R}{35g}}$

14. Two friends are located at the same point on the circumference of a circular track of radius R. One friend starts cycling around the track with angular speed ω and simultaneously blowing a whistle of frequency f_0. Assuming v_s to be the speed of sound in air, the minimum frequency heard by the stationary friend is

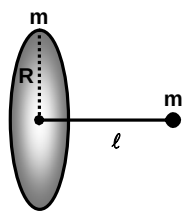
(A) $\frac{f_0}{1+\frac{\omega R}{v_s}}$

(B) $f_0\left(1-\frac{\omega R}{v_s}\right)$

(C) f_0

(D) Infinite

15. A thin homogeneous disc of radius R and mass m and a small sphere of same mass is placed at a distance ℓ from the disc on its axis of symmetry. Initially both are in rest and then released from rest. They collide because of gravitation attraction. Assume ℓ >> R, Find the magnitude of relative velocity of approach just before the collision.



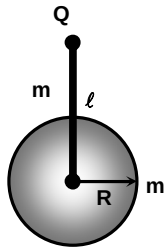
(A) $\sqrt{4Gm\left(\frac{2}{R}-\frac{1}{\ell}\right)}$

(B) $\sqrt{2Gm\left(\frac{2}{R}-\frac{1}{\ell}\right)}$

(C) $\sqrt{Gm\left(\frac{2}{R}-\frac{1}{\ell}\right)}$

(D) $\sqrt{\frac{Gm}{2}\left(\frac{2}{R}-\frac{1}{\ell}\right)}$

16. A meter stick connected with disc of same mass which is joint one end of stick and disc can freely rotates about its joint. System swings in a vertical plane about a fixed horizontal axis passing through its one end, undergoes small oscillation of frequency 'f_0'. If disc is removed from the stick, then its new frequency of small oscillation would become. (take R = ℓ/2)



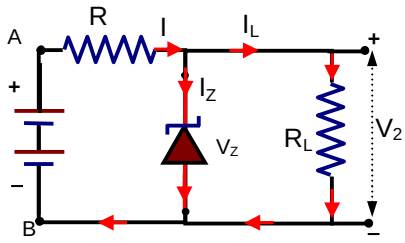
(A) $\sqrt{\frac{29}{6}}\, f_0$

(B) $\sqrt{\frac{4}{3}}\, f_0$

(C) $2f_0$

(D) $\sqrt{\frac{13}{3}}\, f_0$

17. In the given circuit, the supply voltage is V = 15 volt. The 12 volt, 0.36 watt Zener-diode operates at a minimum diode current of 2mA. Calculate the range over which load resistance R_L can be varied.



(A) $100\ \Omega < R_L < 500\ \Omega$

(B) $430\ \Omega \le R_L < 1000\ \Omega$

(C) $0 \le R_L < 5000\ \Omega$

(D) $430\ \Omega \le R_L$

18. The width of a slit in a diffraction experiment is doubled (2x). The intensity of light at the central maximum

(A) remains the same.

(B) increases by 2 times.

(C) increases by 4 times.

(D) decreases by a factor of 2.

19. How high should a transmitter be located, above the surface of the earth, so that it covers $\frac{1}{4}$ of the earth's surface through direct transmission? Assume that "R" is the radius of the earth.

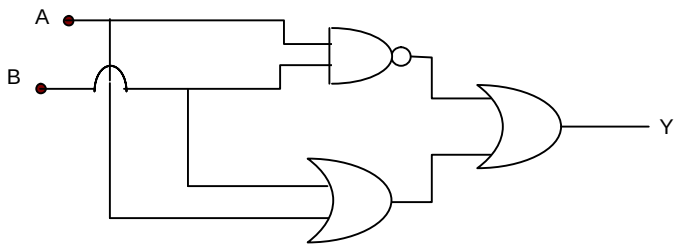
(A) $\sqrt{3}R$

(B) 2R

(C) R

(D) $\left(\sqrt{3}-1\right)R$

20. The truth table for the circuit shown in the figure is



(A)

A	B	Y
1	1	1
0	1	0
1	0	0
0	0	1

(B)

A	B	Y
1	1	0
0	0	1
1	0	0
0	1	1

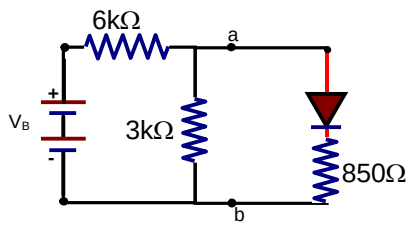
(C)

A	B	Y
1	1	0
0	1	0
1	0	0
0	0	0

(D)

A	B	Y
1	1	1
0	1	1
1	0	1
0	0	1

21. The p-n junction diode used as shown in the figure, has a cut in voltage of 0.6 V and a forward resistance of 150 ohm. If the diode can dissipate a maximum power of 200 mW, the maximum permissible value of the battery voltage V_B is nearly



(A) 330 V

(B) 110 V

(C) 220 V

(D) 440 V

22. A student performs an experiment to determine the Young's modulus of a wire, exactly 2m long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of $\pm$ 0.05 mm at a load of exactly 1.0 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of $\pm$ 0.01 mm. Take g = 9.8 m/s^2 (exact) and $\pi = \frac{49}{16}$ (exact). The Young's modulus obtained from the reading is

(A) $(2.0 \pm 0.3) \times 10^{11}$ N/m^2

(B) $(2.0 \pm 0.2) \times 10^{11}$ N/m^2

(C) $(2.0 \pm 0.1) \times 10^{11}$ N/m^2

(D) $(2.0 \pm 0.05) \times 10^{11}$ N/m^2

23. The equation of a traveling wave in a uniform string of mass per unit length μ is given as $y = A \sin(\omega t - kx)$. The total energy transferred through the origin in time interval from t = 0 to $t = \frac{\pi}{12\omega}$ is

(A) $\frac{(\pi+3)\mu A^2\omega^2}{24k}$

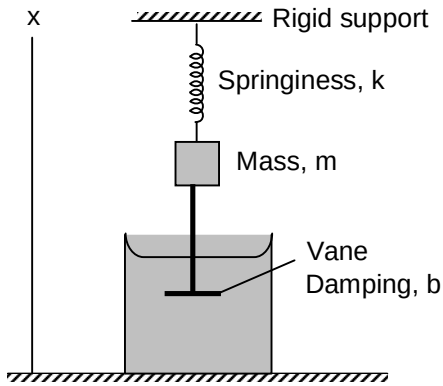
(B) $\frac{(\pi+3)\mu A^2\omega^2}{12k}$

(C) $\frac{\mu A^2\omega^2\pi}{24k}$

(D) $\frac{\mu A^2\omega^2\pi}{8k}$

24. The flow rate from a tap of diameter 1.25 cm is x litre/min. The coefficient of viscosity of water is 10^{-3} Pa s. For what value of x will the flow be turbulent?
(p) x = 6, (q) x = 3 (r) x = 0.5 (s) x = 0.1. Choose the correct option.
(A) p, q
(B) p, q, r
(C) p
(D) p, q, r, s

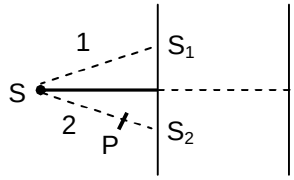
25. For the damped oscillator shown in figure, the mass m of the block is 200 g, k = 90 N m^{-1} and the damping constant b is 40 g s^{-1}. Calculate the time taken for its amplitude of vibrations to drop to half of its initial value.
(A) 1 s
(B) 3.5 s
(C) 7 s
(D) 14 s



A damped simple harmonic oscillator. A vane immersed in a liquid exerts a damping force on the block as it oscillates up and down

26. The human eye has an approximate angular resolution of $\phi = 6 \times 10^{-4}$ rad and a printer prints a minimum of 100 dpi (dots per inch, 1 inch = 2.54 cm). At what minimal distance z should a printed page be held so that one does not see the individual dots?
(A) 30 cm
(B) 45 cm
(C) 100 cm
(D) 200 cm

27. Figure shows a Young's double slit experiment with a source which emits un-polarised light. In addition, P is a polarizer with axis whose direction is not given, but it completely polarizes the light falling on S_2. Calculate the ratio of the intensities of the principal maximum to the first minimum i.e. I_{max}/I_{min}, when the polarizer is present.



(A) 2
(B) 4
(C) 5
(D) 8

28. A small metal sphere of radius r and density ρ falls from rest in a viscous liquid of density σ and coefficient of viscosity η. Due to friction heat is produced. The expression for the rate of production of heat when the sphere has acquired the terminal velocity is
(A) $\left[\frac{8\pi g}{27\eta}(\rho-\sigma)^2\right]r^5$
(B) $\left[\frac{8\pi g^2}{27\eta}(\rho-\sigma)^2\right]r^5$
(C) $\left[\frac{8\pi g^2}{27\eta}(\rho-\sigma)\right]r^5$
(D) $\left[\frac{8\pi g^2}{27\eta^2}(\rho-\sigma)\right]r^5$

29. A light bulb is immersed in water. Light travels out in all directions from the bulb, but only some of the light escapes the water's surface. What happens to the fraction f of light that escapes the water's surface as the bulb is moved deeper into the water? Assume that light is not absorbed by water and that 100% of light is transmitted at the air-water interface during refraction.
(A) f increases
(B) f decreases
(C) f remains the same
(D) the answer depends on the index of refraction of water.

30. Equation of a stationary and a traveling wave are as follows:
$y_1 = a \sin(kx) \cos(\omega t)$ and $y_2 = a \sin(\omega t - kx)$
The phase difference between two points $x_1 = \frac{\pi}{3k}$ and $x_2 = \frac{3\pi}{2k}$ are $\Delta\phi_1$ and $\Delta\phi_2$ respectively for the two waves. Then ratio $\frac{\Delta\phi_1}{\Delta\phi_2}$ is
(A) 1
(B) 5/6
(C) 3/4
(D) 6/7

Chemistry

PART – II

SECTION – A
Straight Objective Type

This section contains **30 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which only **ONE** option is correct

31. Which of the following property is *not correct* for colloidal solutions?
    (A) Finest gold sol is red in colour, as the size of particle increases, it appears purple, then blue finally golden.
    (B) The nature of charge on colloidal particle is same on all particles in a given colloidal solution.
    (C) The values of colligative properties of colloidal solution are of small order as compared to true solution.
    (D) The mixing of two oppositely charged sols prevents coagulation.

32. The *incorrect* statement for p-block elements is:
    (A) Nitrous oxide and nitric oxide are neutral oxides.
    (B) Zinc reacts with dilute nitric acid to give N_2O and with conc. nitric acid to give NO_2.
    (C) α-Black phosphorous is prepared by heating white phosphorous at 473 K under high pressure.
    (D) Fluorine and chlorine are gases, bromine is liquid and iodine is a solid at room temperature.

33. In an ionic compound A^+X^-, the radii of A^+ and X^- are 1 pm and 2 pm respectively. The volume of unit cell of crystal AX is …….. and structure is similar to …….
    (A) 27 pm^3, CsCl
    (B) 64 pm^3, ZnS
    (C) 125 pm^3, KCl
    (D) 216 pm^3, NaCl

34. Which of the following physical and chemical characteristics of interstitial compounds formed by d-block elements (TiC, Fe_3H etc.) is correct?
    (A) They have low melting point than those of pure metals.
    (B) They are very soft.
    (C) They retain metallic conductivity.
    (D) They are chemically very reactive.

35. The number of geometrical isomers and number of enantiomeric pairs of $[Co(gly)_3]$ respectively are:
    (A) 2, 1
    (B) 2, 2
    (C) 3, 2
    (D) 3, 1

36. Two experiments were performed. In the first experiment $[Ti(H_2O)_6]\ Cl_3$ is heated and in second experiment ethane-1,2-diamine (en) is added to $[Ni(H_2O)_6]^{2+}$ in the molar ratio en : Ni is 3 : 1. Which of the following colour changes occur in respective experiments?
    (A) No colour change in both the experiments.
    (B) In first experiment violet to colourless and in second experiment green to violet.
    (C) In first experiment colourless to violet and in second experiment no change in colour.
    (D) In first experiment colourless to violet and in second experiment violet to green is observed.

37. Pervoskite, a mineral of titanium is found to contain calcium atoms at corners, oxygen atoms at the face centres and titanium atoms at the centre of the cube. Oxidation number of titanium in the mineral is
(A) +2
(B) +3
(C) +4
(D) +1

38. Vapour phase refining of nickel is carried out using
(A) I_2
(B) HCl
(C) CO
(D) HBr

39. For the coagulation of 100 ml of arsenous sulphide sol, 4 ml of 1 M NaCl is required. What would be the flocculation value of NaCl?
(A) 40
(B) 20
(C) 60
(D) 80

40. Equal volume of 2 M each of $KMnO_4$ and $K_2Cr_2O_7$ are used to oxidise Fe(II) solution in acidic medium. The amount of Fe oxidized will be
(A) equal with both oxidizing agents.
(B) more with $KMnO_4$.
(C) more with $K_2Cr_2O_7$.
(D) cannot be determined.

41. One mole of CCl_4 vapour at 77^oC occupies a volume of 35 L. If van der Waals constants are a = 20.39 L^2 atm mol^{-2} and b = 0.138 L mol^{-1}. Calculate the compressibility factor (z) under high pressure region.
(A) 1.004
(B) 0.2
(C) 0.5
(D) 2

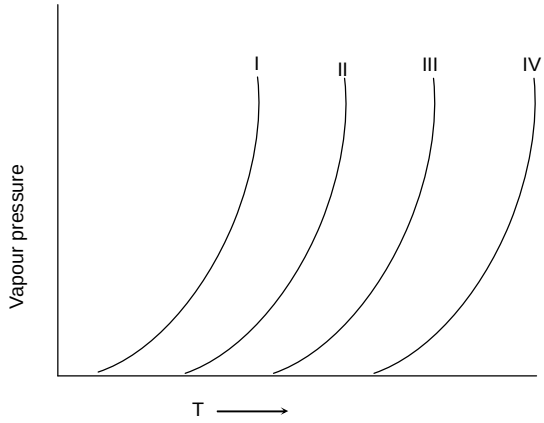
42. Which of the following is incorrect?
(A) Reducing property of dioxide increases from SO_2 to TeO_2.
(B) XeF_6 has a distorted octahedral structure.
(C) Basicity decreases in order $NH_3 > PH_3 > AsH_3 > SbH_3$.
(D) Acidic character increases from H_2O to H_2Te.

43. Addition of KI to Pb salt gives a precipitate. The colour of precipitate is
(A) Black
(B) Green
(C) Yellow
(D) White

44. Consider the redox reaction:
$Cu_2S + KMnO_4 + H_2SO_4 \longrightarrow CuSO_4 + MnSO_4 + K_2SO_4 + H_2O$
Moles of Cu_2S oxidised by two moles of $KMnO_4$ are:
(A) 0.5
(B) 1
(C) 2
(D) 3

45. A balloon filled with an ideal gas shrink when cooled. When shrinking completes, which of the following is same as it was originally?
(A) The RMS velocity of gas particles.
(B) The density of gas.
(C) The pressure in the balloon.
(D) The kinetic energy of gas particle.

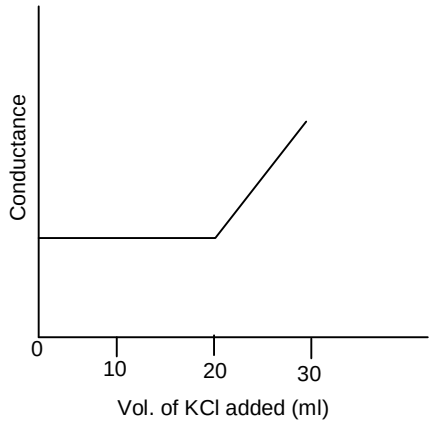
46. The following diagram shows the vapour pressure curves for CH_4, CH_3OH, CH_3COOH and H_2CO, which of the following match is correct?



(A)	CH_3OH – I	CH_4 – II	CH_3COOH – III	H_2CO – IV
(B)	CH_3OH – III	CH_4 – I	CH_3COOH – IV	H_2CO – II
(C)	CH_3OH – IV	CH_4 – III	CH_3COOH – I	H_2CO – II
(D)	CH_3OH – II	CH_4 – I	CH_3COOH – III	H_2CO – IV

47. The aqueous solutions of following substances were electrolysed. In which case the pH of solution doesn't change if inert electrodes are used
(A) $AgNO_3$
(B) $CuSO_4$
(C) NaCl
(D) K_2SO_4

48. 20 ml of $AgNO_3$ solution was titrated with 0.20 mol L^{-1} KCl solution in the conductivity cell. The data were plotted as follows.



The moles of $AgNO_3$ in the solution initially was
(A) 2×10^{-3}
(B) 4×10^{-3}
(C) 8×10^{-3}
(D) 2×10^{-2}

49. Which of the following chloride is most soluble in water?
(A) Hg_2Cl_2
(B) AgCl
(C) $PbCl_2$
(D) $CaCl_2$

50. Which of the class of drug is used for reducing or abolishing pain without causing impairment of consciousness?
(A) Antacids
(B) Antihistamines
(C) Analgesics
(D) Antimicrobials

51. The total number of protons present in 124 g of NO_3^- are:
(A) 124
(B) 62 N_A
(C) 31 N_A
(D) 62

52. Consider a binary mixture of volatile liquids. If at $X_A = 0.2$, the vapour pressure of solution is 580 torr, then the mixture could be $\left(P_A^o = 200 \text{ torr}, P_B^o = 600 \text{ torr}\right)$
(A) $CHCl_3 + CH_3COCH_3$
(B) C_2H_5OH + Hexane
(C) $H_2O + HNO_3$
(D) $nC_6H_{14} + nC_7H_{16}$

53. In the reaction
$A \longrightarrow B \qquad \Delta H = +90 \text{ kcal/mol}$
$B \longrightarrow C \qquad \Delta H = -70 \text{ kcal/mol}$
Rank the magnitudes of enthalpies of formation of A, B and C in increasing order.
(A) A, C, B
(B) A, B, C
(C) C, A, B
(D) C, B, A

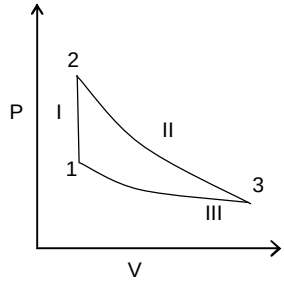
54. Density of NaCl is 1.8 g / cc. KCl has similar unit cell as NaCl and the following relationship among ionic radii exist $r\left(Na^+\right) = 0.5r\left(Cl^-\right), r\left(K^+\right) = 0.8\, r\left(Cl^-\right)$. The density of KCl is
(A) 2.44 g/cc
(B) 1.9 g/cc
(C) 1.33 g/cc
(D) 0.86 g/cc

55. A compound is known to be a salt of sodium (NaX). If 2 g of salt is dissolved in 100 g of water, the solution freezes at – 1.27°C. What will be the compound NaX? (K_f of water is 1.86 K kg/mol.)
(A) NaF
(B) NaCl
(C) NaBr
(D) NaI

56. A galvanic cell has a potential 3.5 V. In a particular experiment, if 2 moles of electrons were passed through this cell, what is magnitude of the maximum useful work (W_{max}) that would be obtained.
(A) 7×10^8 J
(B) 6.75×10^8 J
(C) 8×10^5 kJ
(D) 6.75×10^2 kJ

57. Which of the following is correct international standards for drinking water?
(A) The minimum limit of nitrate in drinking water is 50 ppm.
(B) The prescribe lower limit of lead in drinking water is 50 ppb.
(C) Soluble fluoride is often added to drinking water to bring its conc. up to 1 ppm.
(D) All of the above mentioned are correct.

58. One mole of ideal gas (C_V = 5/2 R) beginning at 1 atm and 300 K is put through the following cycle
Step – I: Heating to twice its initial pressure at constant volume.
Step – II: Adiabatic reversible expansion to its initial temperature.
Step – III: Isothermal compression back to 1 atm.
What is the volume at point 3?
(A) 40.4 L
(B) 65.0 L
(C) 139 L
(D) 279 L



59. In the extraction of copper from its sulphide ore, iron is removed as slag ($FeSiO_3$) by mixing
(A) sulphate salt
(B) silica
(C) oxygen
(D) carbon

60. Which of the following percentage strength is not possible for sample of oleum?
(A) 108%
(B) 110%
(C) 121%
(D) 135%

Mathematics

PART – III

SECTION – A
Straight Objective Type

This section contains **30 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which only **ONE** option is correct

61. a, b, c, d are zeroes of $P(x) = 5x^4 + px^3 + qx^2 + rx + s$ and a, c, d are zeroes of $Q(x) = x^3 - 9x^2 + ax - 24$ (a < b < c < d) if a, c, d be in arithmetic progression and a, b, c, d be in harmonic progression, then the value of $\left|\frac{P(1)}{Q(1)}\right|$ is equal to

(A) 5
(B) 7
(C) 3
(D) none of these

62. If 1, α, α^2, α^3 ..... α^{n-1} are the nth roots of unity, then ${}^nC_1 + {}^nC_2 \cdot \alpha + {}^nC_3 \cdot \alpha^2 + ... + {}^nC_n \cdot \alpha^{n-1}$ is equal to

(A) $\frac{2}{\alpha}$
(B) $\frac{1}{\alpha}$
(C) $\frac{1}{\alpha}\left[(1+\alpha)^n - 1\right]$
(D) $\frac{1}{\alpha}\left(2^n - 1\right)$

63. Standard deviation of the first 2n + 1 natural numbers is

(A) $\sqrt{\frac{n(n+1)}{2}}$
(B) $\sqrt{\frac{n(n+1)(2n+1)}{3}}$
(C) $\sqrt{\frac{n(n+1)}{3}}$
(D) $\sqrt{\frac{n^2(n+1)}{2}}$

64. If a and b are odd integers then number of real roots of $[x]^2 + a[x] + b = 0$ (where [.] denotes the greatest integer function)] is

(A) 3
(B) 1
(C) infinite
(D) 0

65. If $\frac{a^{n-\frac{1}{2}}+b^{n-\frac{1}{2}}}{a^{n+\frac{1}{2}}+b^{n+\frac{1}{2}}}$ is geometric mean of $\frac{1}{a}, \frac{1}{b}$ $(a \neq b)$, then the quadratic equation $bx^2+nx+b=0$ has

(A) rational and equal roots
(B) rational and distinct roots
(C) irrational roots
(D) imaginary roots

66. A natural number k is chosen from the set {1, 2, 3, ..., 100} at random and ω is a non-real cube root of unity. A is the event that ω^k is real and B is the event that i^k is real (where $i^2 = -1$), then $P(A \cup B)$ is equal to

(A) $\frac{16}{100}$
(B) $\frac{67}{100}$
(C) $\frac{8}{100}$
(D) $\frac{50}{100}$

67. Let $z = x + iy$ and $\text{amp}\left(e^{z^2}\right) = \text{amp}\left(e^{(z+i)}\right)$. If $y = f(x)$ is a function, then $f(3)$ is equal to

(A) $\frac{1}{4}$
(B) $\frac{1}{3}$
(C) $\frac{1}{2}$
(D) $\frac{1}{5}$

68. If the points z_1, z_2 lie on the curves $|z| = 2$ and $|z| = 3$ respectively and the angle between the vectors representing z_1, z_2 is 60^o, then $\left|\frac{z_1+z_2}{z_1-z_2}\right|$ is equal to

(A) $\sqrt{\frac{19}{7}}$
(B) $\sqrt{19}$
(C) $\sqrt{7}$
(D) $\sqrt{133}$

69. The number of distinct real roots of the equation $\left(\log_{\sqrt{3}}\tan x\right)\left(\sqrt{\log_{\sqrt{3}}3\sqrt{3}+\log_{\tan x}3}\right)=-1$ in interval $[0, 2\pi]$ is

(A) 0
(B) 2
(C) 4
(D) 6

70. Let 1, 4 , 7, 10 ..... and 9, 14, 19, 24 ..... be two arithmetic progressions. Then the total number of distinct integers in the collection of first 500 terms of each of the progressions is
(A) 833
(B) 835
(C) 837
(D) 901

71. A bag contains 20 white balls and 20 red balls. (Assume that balls of same colour are distinguishable). Pairs of balls are drawn at random without replacement until the bag is empty. The probability that each pair consists of one white and one real red ball is
(A) $\frac{2^{20}\times(20!)^2}{40!}$
(B) $\frac{2^{20}\times 20!}{40!}$
(C) $\frac{2^{20}\times 20!}{(40!)^2}$
(D) $\frac{2^{10}\times 20!}{40!}$

72. If D, E and F are the mid points of the sides BC, CA, AB respectively of a triangle ABC $\overrightarrow{AD}+\frac{2}{3}\overrightarrow{BE}+\frac{1}{3}\overrightarrow{CF}=K\overrightarrow{AC}$, then 2K is equal to
(A) 1
(B) 3
(C) 2
(D) 5

73. Let A be a square matrix such that then $A(\text{Adj } A)=\begin{bmatrix}4&0&0\\0&4&0\\0&0&4\end{bmatrix}$, then $\frac{|\text{Adj}(\text{Adj } A)|}{|\text{Adj } A|}$ is equal to
(A) 16
(B) 27
(C) 91
(D) none of these

74. The shortest distance between the y-axis and the line 2x + 3y + 5z + 1 = 0 = 3x + 4y + 6z + 2 is $\frac{2}{\sqrt{k}}$, then k is equal to
(A) 2
(B) 3
(C) 5
(D) 6

75. If $a_1, a_2, \ldots, a_n$ are real numbers with $a_n \neq 0$ and $\cos\alpha + i\sin\alpha$ is a root of $z^n + a_1z^{n-1} + a_2z^{n-2} + \ldots + a_{n-1}z + a_n = 0$, then the sum $a_1\cos\alpha + a_2\cos 2\alpha + a_3\cos 3\alpha + \ldots + a_n\cos n\alpha$ is
(A) 0
(B) 1
(C) –1
(D) $\frac{1}{2}$

76. If a singular matrix $A = \left[a_{ij}\right]_{2\times 2}$ always commute with $B = \begin{bmatrix} 1 & 1 \\ 2 & 1 \end{bmatrix}$ such that $\left(\frac{a_{11}}{a_{12}}\right)^2 = k$, then k is equal to

(A) 1
(B) 2
(C) 3
(D) 4

77. If z_1, z_2 are complex numbers such that $z_1^2 + z_2^2$ is real. If $z_1\left(z_1^2 - 3z_2^2\right) = 2$ and $z_2\left(3z_1^2 - z_2^2\right) = 11$, then the value of $z_1^2 + z_2^2$ is equal to

(A) 25
(B) 5
(C) $\sqrt{5}$
(D) 1

78. If z is a complex number such that |z – 1| = 1 then $\arg\left(\frac{1}{z} - \frac{1}{2}\right)$ may be

(A) $\frac{\pi}{6}$
(B) $-\frac{\pi}{2}$
(C) $\frac{\pi}{4}$
(D) $-\frac{\pi}{4}$

79. Let $\vec{r} = \left(\vec{a}\times\vec{b}\right)\sin x + \left(\vec{b}\times\vec{c}\right)\cos y + 2\left(\vec{c}\times\vec{a}\right)$ where $\vec{a}, \vec{b}, \vec{c}$ are three non-zero non-coplanar vectors. If $\vec{r}$ is perpendicular to $\vec{a} + \vec{b} + \vec{c}$, then minimum value of $x^2 + y^2$ is

(A) π^2
(B) $\frac{\pi^2}{4}$
(C) $\frac{5\pi^2}{4}$
(D) $\frac{7\pi^2}{4}$

80. If the line $\frac{x-2}{-1} = \frac{y+2}{1} = \frac{z+k}{4}$ is one of the angle bisector of the lines $\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$ and $\frac{x}{-2} = \frac{y}{3} = \frac{z}{1}$ then the value of k is

(A) 1
(B) 2
(C) 4
(D) 8

81. The coefficient of x^{20} in $(1 + x)(1 + 2x)(1 + 4x)(1 + 8x) \ldots\ldots (1 + 2^{20}x)$ is
(A) $2^{211} - 2^{190}$
(B) $2^{191} - 2^{171}$
(C) $2^{231} - 2^{209}$
(D) $2^{161} - 2^{142}$

82. If the intercept made by the plane $\vec{r} \cdot \vec{n} = q$ on x, y, z axis are respectively are a_1, a_2 and a_3 respectively, then
(A) $\vec{n} = \frac{q}{a_1}\hat{i} + \frac{q}{a_2}\hat{j} + \frac{q}{a_3}\hat{k}$
(B) $\vec{n} = (qa_1)\hat{i} + (qa_2)\hat{j} + (qa_3)\hat{k}$
(C) $\vec{n} = \left(\frac{1}{a_1 q}\right)\hat{i} + \left(\frac{1}{a_2 q}\right)\hat{j} + \left(\frac{1}{a_3 q}\right)\hat{k}$
(D) $\vec{n} = \frac{a_1}{q}\hat{i} + \frac{a_2}{q}\hat{j} + \frac{a_3}{q}\hat{k}$

83. Matrices of order 3 × 3 are formed by using the elements of the set $A = \{-3, -2, -1, 0, 1, 2, 3\}$, then probability that matrix is either symmetric or skew symmetric is
(A) $\frac{1}{7^6} + \frac{1}{7^3}$
(B) $\frac{1}{7^9} + \frac{1}{7^3} - \frac{1}{7^6}$
(C) $\frac{1}{7^3} + \frac{1}{7^9}$
(D) $\frac{1}{7^3} + \frac{1}{7^6} - \frac{1}{7^9}$

84. If the equation of the plane through the straight line $\frac{x-1}{2} = \frac{y+2}{-3} = \frac{z}{5}$ and perpendicular to the plane $x - y + z + 2 = 0$ is $ax - by + cz + 4 = 0$, then the value of $10^3a + 10^2b + 10c$ is equal to
(A) 342
(B) 684
(C) 1710
(D) 2018

85. The coefficient of $a^8b^4c^9d^9$ in $\{ab(c + d) + cd(a + b)\}^{10}$ is
(A) $\frac{10!}{8!\,4!\,9!\,9!}$
(B) 10!
(C) 2520
(D) none of these

86. If A, B and C are exhaustive events satisfying $P((A \cup B) \cap \bar{C}) = \frac{1}{5}$,
$P(B \cap C) - P(A \cap B \cap C) = \frac{1}{15}$ and $P(A \cap C) = \frac{1}{10}$, then $P\left(C \cap \left(\overline{A \cup B}\right)\right)$ is equal to
(A) $\frac{17}{30}$

(B) $\frac{18}{30}$

(C) $\frac{19}{30}$

(D) $\frac{20}{30}$

87. Number of ordered triplets of natural number (a, b, c) for which $abc \leq 11$ is
(A) 52
(B) 53
(C) 55
(D) 56

88. The equation $a_8x^8 + a_7x^7 + a_6x^6 + ... + a_0 = 0$ has all its roots positive and real $\left(\text{where } a_8 = 1, a_7 = -4, a_0 = \frac{1}{2^8}\right)$, then

(A) $a_1 = \frac{1}{2^8}$

(B) $a_1 = -\frac{1}{2^4}$

(C) $a_2 = \frac{7}{2^5}$

(D) $a_2 = \frac{7}{2^8}$

89. If Z is a non-real complex number, then the minimum value of $\frac{\text{Im}\,Z^5}{\text{Im}^5\,Z}$ is
(A) – 1
(B) – 2
(C) – 4
(D) – 5

90. The number of polynomials of the form $x^3 + ax^2 + bx + c$ which are divisible by $x^2 + 1$ where a, b, $c \in \{1, 2, 3, ..., 10\}$ is equal to
(A) 10
(B) 20
(C) 30
(D) 40