BITSAT 2011 Question Paper

INSTRUCTIONS

- *This question paper contains total 150 questions divided into four parts:*

  Part I : Physics Q. No. 1 to 40

  Part II : Chemistry Q. No. 41 to 80

  Part III : Mathematics Q. No. 81 to 125

  Part IV : (A) English Proficiency Q. No. 126 to 140

  (B) Logical Reasoning Q. No. 141 to 150
- *All questions are multiple choice questions with four options, only one of them is correct.*
- *Each correct answer awarded 3 marks and –1 for each incorrect answer.*
- *Duration of paper 3 Hours*

PART - I : PHYSICS

1. A passenger in a open car travelling at 30 m/s throws a ball out over the bonnet. Relative to the car the initial velocity of the ball is 20 m/s at 60° to the horizontal. The angle of projection of the ball with respect to the horizontal road will be

(a) $\tan^{-1}\left(\frac{2}{3}\right)$ (b) $\tan^{-1}\left(\frac{\sqrt{3}}{4}\right)$

(c) $\tan^{-1}\left(\frac{4}{\sqrt{3}}\right)$ (d) $\tan^{-1}\left(\frac{3}{4}\right)$

2. A particle is moving in a straight line with initial velocity and uniform acceleration a. If the sum of the distance travelled in t^{th} and $(t+1)^{th}$ seconds is 100 cm, then its velocity after t seconds, in cm/s, is

(a) 80 (b) 50 (c) 20 (d) 30

3. The two vectors $\vec{A}$ and $\vec{B}$ are drawn from a common point and $\vec{C} = \vec{A} + \vec{B}$, then angle between $\vec{A}$ and $\vec{B}$ is –

(1) 90° if $C^2 = A^2 + B^2$

(2) greater than 90° if $C^2 < A^2 + B^2$

(3) greater than 90° if $C^2 > A^2 + B^2$

(4) less than 90° if $C^2 > A^2 + B^2$

Correct options are –

(a) 1, 2 (b) 1, 2, 3, 4

(c) 2, 3, 4 (d) 1, 2, 4

4. If $T = 2\pi\sqrt{\frac{ML^3}{3\ Yq}}$ then find the dimensions of q.

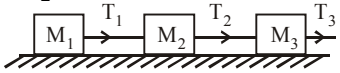
Where T is the time period of bar of mass M, length L and Young modulus Y.

(a) [L] (b) $[L^2]$ (c) $[L^4]$ (d) $[L^3]$

5. An object experiences a net force and accelerates from rest to its final position in 16s. How long would the object take to reach the same final position from rest if the object's mass was four times larger ?

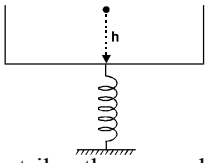
(a) 64 s (b) 32 s (c) 16 s (d) 8s

6. Three blocks of masses m_1, m_2 and m_3 are connected by massless strings, as shown, on a frictionless table. They are pulled with a force T_3 = 40 N. If m_1 = 10 kg, m_2 = 6 kg and m_3 = 4kg, the tension T_2 will be



(a) 20 N (b) 40 N (c) 10 N (d) 32 N

7. A massless platform is kept on a light elastic spring as shown in fig. When a sand particle of mass 0.1 kg is dropped on the pan from a height of 0.24 m, the particle strikes the pan and spring is compressed by 0.01 m.



From what height should the particle be dropped to cause a compression of 0.04 m.

(a) 3.96 m (b) 0.396 m (c) 4m (d) 0.4 m

8. A constant torque of 31.4 N-m is exerted on a pivoted wheel. If angular acceleration of wheel is 4π rad/s^2, then the moment of inertia of the wheel is

(a) 2.5 kg m^2 (b) 3.5 kg m^2
(c) 4.5 kg m^2 (d) 5.5 kg m^2

9. A man of mass m starts falling towards a planet of mass M and radius R. As he reaches near to the surface, he realizes that he will pass through a small hole in the planet. As he enters the hole, he sees that the planet is really made of two pieces a spherical shell of negligible thickness of mass 2M/3 and a point mass M/3 at the centre. Change in the force of gravity experienced by the man is

(a) $\frac{2}{3}\frac{GMm}{R^2}$ (b) 0

(c) $\frac{1}{3}\frac{GMm}{R^2}$ (d) $\frac{4}{3}\frac{GMm}{R^2}$

10. Geo-stationary satellite is one which

(a) remains stationary at a fixed height from the earth's surface
(b) revolves like other satellites but in the opposite direction of earth's rotation
(c) revolves round the earth at a suitable height with same angular velocity and in the same direction as earth does about its own axis
(d) None of these

11. Two wires are made of the same material and have the same volume. However wire 1 has cross-sectional area A and wire 2 has cross-sectional area $3A$. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount?

(a) $4F$ (b) $6F$ (c) $9F$ (d) F

12. An iron rod of length 2m and cross-sectional area of 50 mm^2 stretched by 0.5 mm, when a mass of 250 kg is hung from its lower end. Young's modulus of iron rod is

(a) 19.6×10^{20} N/m^2 (b) 19.6×10^{18} N/m^2
(c) 19.6×10^{10} N/m^2 (d) 19.6×10^{15} N/m^2

13. Viscosity is the property of a liquid due to which it :

(a) occupies minimum surface area
(b) opposes relative motion between its adjacent layers
(c) becomes spherical in shape
(d) tends to regain its deformed position

14. The radiation emitted by a perfectly black body is proportional to

(a) temperature on ideal gas scale
(b) fourth root of temperature on ideal gas scale
(c) fourth power of temperature on ideal gas scale
(d) square of temperature on ideal gas scale

15. A copper sphere cools from 62°C to 50°C in 10 minutes and to 42°C in the next 10 minutes. Calculate the temperature of the surroundings.

(a) 18.01°C (b) 26°C
(c) 10.6°C (d) 20°C

16. An air bubble of volume v_0 is released by a fish at a depth h in a lake. The bubble rises to the surface. Assume constant temperature and standard atmospheric pressure above the lake. The volume of the bubble just before touching the surface will be (density) of water is ρ

(a) v_0 (b) $v_0(\rho gh/p)$

(c) $\frac{v_0}{\left(1+\frac{\rho gh}{p}\right)}$ (d) $v_0\left(1+\frac{\rho gh}{p}\right)$

17. The molecules of a given mass of gas have a root mean square velocity of 200m s^{-1} at 27°C and 1.0×10^5 N m^{-2} pressure. When the temperature is 127°C and the pressure 0.5×10^5 Nm^{-2}, the root mean square velocity in ms^{-1}, is

(a) $\frac{400}{\sqrt{3}}$ (b) $100\sqrt{2}$

(c) $\frac{100\sqrt{2}}{3}$ (d) $\frac{100}{3}$

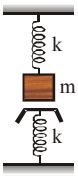
18. Which of the following expressions corresponds to simple harmonic motion along a straight line, where x is the displacement and a, b, c are positive constants?

(a) $a + bx - cx^2$ (b) bx^2
(c) $a - bx + cx^2$ (d) $-bx$

19. A mass m is suspended from a spring of force constant k and just touches another identical spring fixed to the floor as shown in the figure. The time period of small oscillations is

(a) $2\pi\sqrt{\frac{m}{k}}$ (b) $\pi\sqrt{\frac{m}{k}}+\pi\sqrt{\frac{m}{k/2}}$

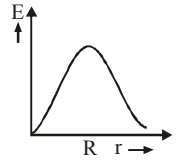
(c) $\pi\sqrt{\frac{m}{3k/2}}$ (d) $\pi\sqrt{\frac{m}{k}}+\pi\sqrt{\frac{m}{2k}}$.

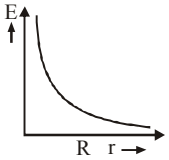


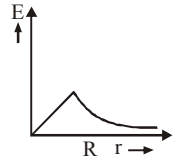
20. The fundamental frequency of an open organ pipe is 300 Hz. The first overtone of this pipe has same frequency as first overtone of a closed organ pipe. If speed of sound is 330 m/s, then the length of closed organ pipe is

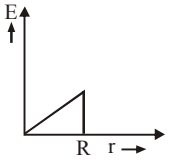
(a) 41 cm (b) 37 cm (c) 31 cm (d) 80 cm

21. In an uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as function of distance from the centre. The graph which would correspond to the above will be

(a) 

(b) 

(c) 

(d) 

22. A charge Q_1 exerts some force on a second charge Q_2. If a 3rd charge Q_3 is brought near, then the force of Q_1 exerted on Q_2 –

(a) will increase
(b) will decrease
(c) will remain unchanged
(d) will increase if Q_3 is of the same sign as Q_1 and will decrease if Q_3 is of opposite sign.

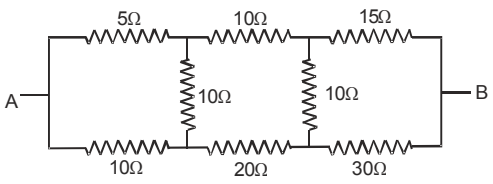
23. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. The potential at a distance of 2 cm from the centre of the sphere is

(a) zero (b) 10 V (c) 4 V (d) 10/3 V

24. If the potential of a capacitor having capacity 6 μF is increased from 10 V to 20 V, then increase in its energy will be

(a) 4×10^{-4} J (b) 4×10^{-6} J
(c) 9×10^{-4} J (d) 12×10^{-6} J

25. Calculate the effective resistance between A and B in following network.



(a) 5 Ω (b) 10 Ω (c) 20 Ω (d) 30 Ω

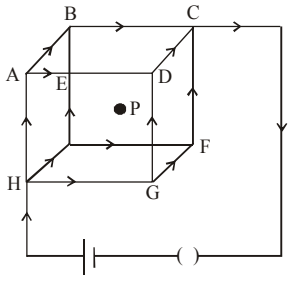
26. A steady current is set up in a cubic network composed of wires of equal resistance and length d as shown in figure. What is the magnetic field at the centre P due to the cubic network

(a) $\frac{\mu_0}{4\pi}\frac{2I}{d}$

(b) $\frac{\mu_0}{4\pi}\frac{2I}{\sqrt{2}d}$

(c) 0

(d) $\frac{\mu_0}{4\pi}\frac{\theta\pi I}{d}$



27. If M is magnetic moment and B is the magnetic field, then the torque is given by

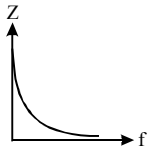
(a) $\vec{M}.\vec{B}$ (b) $\frac{|\vec{M}|}{|\vec{B}|}$

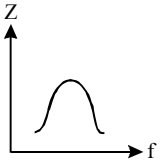
(c) $\vec{M} \times \vec{B}$ (d) $|\vec{M}||\vec{B}|$

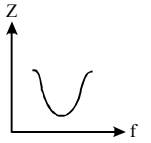
28. A metal rod of length 1 m is rotated about one of its ends in a plane right angles to a field of inductance 2.5×10^{-3} Wb/m². If it makes 1800 revolutions/min. Calculate induced e.m.f. between its ends.

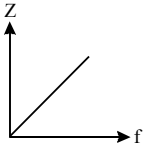
(a) 2.471 V (b) 3.171 V
(c) 0.471 V (d) 1.771 V

29. Which one of the following curves represents the variation of impedance (Z) with frequency f in series LCR circuit?

(a) 

(b) 

(c) 

(d) 

30. An electromagnetic wave passes through space and its equation is given by $E = E_0 \sin(\omega t - kx)$ where E is electric field. Energy density of electromagnetic wave in space is

(a) $\frac{1}{2}\varepsilon_0 E_0^2$ (b) $\frac{1}{4}\varepsilon_0 E_0^2$

(c) $\varepsilon_0 E_0^2$ (d) $2\varepsilon_0 E_0^2$

31. A thin convergent glass lens ($\mu_g = 1.5$) has a power of + 5.0 D. When this lens is immersed in a liquid of refractive index μ, it acts as a divergent lens of focal length 100 cm. The value of μ must be

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

32. A vessel of depth 2d cm. is half filled with a liquid of refractive index μ_1 and the upper half with a liquid of refractive index μ_2. The apparent depth of the vessel seen perpendicularly is –

(a) $d\left(\frac{\mu_1\mu_2}{\mu_1+\mu_2}\right)$ (b) $d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$

(c) $2d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$ (d) $2d\left(\frac{1}{\mu_1\mu_2}\right)$

33. If the distance between the first maxima and fifth minima of a double slit pattern is 7mm and the slits are separated by 0.15 mm with the screen 50 cm. from the slits, then the wavelength of the light used is :

(a) 200 nm (b) 100 nm
(c) 800 nm (d) 600 nm

34. If the energy of a photon is 10 eV, then its momentum is

(a) 5.33×10^{-23} kg m/s
(b) 5.33×10^{-25} kg m/s
(c) 5.33×10^{-29} kg m/s
(d) 5.33×10^{-27} kg m/s

35. The energies of energy levels A, B and C for a given atom are in the sequence $E_A < E_B < E_C$. If the radiations of wavelengths λ_1, λ_2 and λ_3 are emitted due to the atomic transitions C to B, B to A and C to A respectively then which of the following relations is correct ?

(a) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (b) $\lambda_3 = \lambda_1^2 + \lambda_2$

(c) $\lambda_3 = \lambda_1 + \lambda_2$ (d) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$

36. Which one is correct about fission?

(a) Approx. 0.1% mass converts into energy.
(b) Most of energy of fission is in the form of heat.
(c) In a fission of U^{235} about 200 eV energy is released.
(d) On an average, one neutron is released per fission of U^{235}.

37. The output of an OR gate is connected to both the inputs of a NAND gate. The combination will serve as a:

(a) NOT gate (b) NOR gate
(c) AND gate (d) OR gate

38. In a semiconductor diode, the barrier potential offers opposition to

(a) holes in P-region only
(b) free electrons in N-region only
(c) majority carriers in both regions
(d) majority as well as minority carriers in both regions

39. An electron, in a hydrogen-like atom, is in an excited state. It has a total energy of –3.4 eV. The kinetic energy and the de-Broglie wavelength of the electron are respectively

(a) +3.4 eV, 0.66×10^{-9} m
(b) –3.4 eV, 1.99×10^{-9} m
(c) 2.8 eV, 2.38×10^{-10} m
(d) 1.1 eV, 1.28×10^{-9} m

40. Light of wavelength 180 nm ejects photoelectron from a plate of a metal whose work function is 2 eV. If a uniform magnetic field of 5×10^{-5} T is applied parallel to plate, what would be the radius of the path followed by electrons ejected normally from the plate with maximum energy ?

(a) 1.239 m (b) 0.149 m
(c) 3.182 m (d) 2.33 m

PART - II : CHEMISTRY

41. The product of atomic weight and specific heat of any element is a constant, approximately 6.4. This is known as :

(a) Dalton's law (b) Avogadro's law
(c) Newton's law (d) Dulong Pettit law

42. 1.520 g of hydroxide of a metal on ignition gave 0.995g of oxide. The equivalent weight of metal is :

(a) 1.52 (b) 0.995 (c) 190 (d) 9

43. The correct order of radii is

(a) N < Be < B (b) $F^- < O^{2-} < N^{3-}$
(c) Na < Li < K (d) $Fe^{3+} < Fe^{2+} < Fe^{4+}$

44. Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in

(a) forming covalent halides
(b) forming polymeric hydrides
(c) exhibiting maximum covalency in compounds
(d) exhibiting amphoteric nature in their oxides

45. Among Al_2O_3, SiO_2, P_2O_3 and SO_2 the correct order of acid strength is:

(a) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$

(b) $SiO_2 < SO_2 < Al_2O_3 < P_2O_3$

(c) $SO_2 < P_2O_3 < SiO_2 < Al_2O_3$

(d) $Al_2O_3 < SiO_2 < P_2O_3 < SO_2$

46. A σ bonded molecule MX_3 is T-shaped. The number of non bonded pair of electrons is

(a) 0 (b) 2

(c) 1

(d) can be predicted only if atomic number is known

47. The correct bond order in the following species is:

(a) $O_2^{2+} < O_2^- < O_2^+$ (b) $O_2^+ < O_2^- < O_2^{2+}$

(c) $O_2^- < O_2^+ < O_2^{2+}$ (d) $O_2^{2+} < O_2^+ < O_2^-$

48. What is the free energy change, ΔG, when 1.0 mole of water at 100° C and 1 atm pressure is converted into steam at 100°C and 1 atm. pressure?

(a) 540 cal (b) –9800 cal

(c) 9800 cal (d) 0 cal

49. H_2S gas when passed through a solution of cations containing HCl precipitates the cations of second group of qualitative analysis but not those belonging to the fourth group. It is because

(a) presence of HCl decreases the sulphide ion concentration.

(b) solubility product of group II sulphides is more than that of group IV sulphides.

(c) presence of HCl increases the sulphide ion concentration.

(d) sulphides of group IV cations are unstable in HCl.

50. The pH of a solution is increased from 3 to 6; its H^+ ion concentration will be

(a) reduced to half

(b) doubled

(c) reduced by 1000 times

(d) increased by 1000 times

51. A gas X at 1 atm is bubbled through a solution containing a mixture of 1 M Y^- and 1 M Z^- at 25°C. If the reduction potential is Z > Y > X, then

(a) Y will oxidise X and not Z

(b) Y will oxidise Z and not X

(c) Y will oxidise both X and Z

(d) Y will reduce both X and Z

52. When a crystal of caustic soda is exposed to air, a liquid layer is deposited because :

(a) Crystal loses water

(b) Crystal absorbs moisture and CO_2

(c) Crystal melts

(d) Crystal sublimes

53. Which of the following compound is not chiral?

(a) $DCH_2CH_2CH_2Cl$ (b) CH_3CHDCH_2Cl

(c) $CH_3CHClCH_2D$ (d) CH_3CH_2CHDCl

54. $C_6H_5C \equiv N$ and $C_6H_5N \overrightarrow{=} C$ exhibit which type of isomerism?

(a) Position (b) Functional

(c) Demotropism (d) Position isomerism

55. The correct nucleophilicity order is

(a) $CH_3^- < NH_2^- < HO^- < F^-$

(b) $CH_3^- \simeq NH_2^- > HO^- \simeq F^-$

(c) $CH_3^- > NH_2^- > HO^- > F^-$

(d) $NH_2^- > F^- > HO^- > CH_3^-$

56. In the anion $HCOO^-$ the two carbon-oxygen bonds are found to be of equal length. What is the reason for it ?

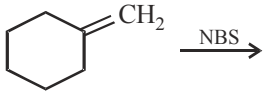
(a) The C = O bond is weaker than the C — O bond.

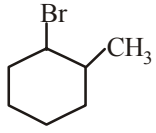
(b) The anion $HCOO^-$ has two resonating structures.

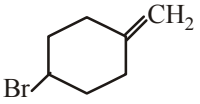
(c) The anion is obtained by removal of a proton from the acid molecule.

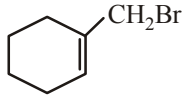
(d) Electronic orbitals of carbon atom are hybridised.

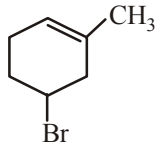
57. What will be the product in the following reaction?



(a) 

(b) 

(c) 

(d) 

58. The fraction of total volume occupied by the atoms present in a simple cube is

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

59. 1.00 g of a non-electrolyte solute (molar mass 250 g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant, K_f of benzene is 5.12 K kg mol^{-1}, the freezing point of benzene will be lowered by

(a) 0.3 K (b) 0.5 K (c) 0.4 K (d) 0.2

60. The number of coulombs required for the deposition of 108 g of silver is

(a) 96500 (b) 48250
(c) 193000 (d) 10000

61. During the kinetic study of the reaction, $2A + B \rightarrow C + D$, following results were obtained:

Run	[A]/mol L^{-1}	[B]/mol L^{-1}	Initial rate of formation of D/mol L^{-1} min^{-1}
I	0.1	0.1	6.0×10^{-1}
II	0.3	0.2	7.2×10^{-1}
III	0.3	0.4	28.8×10^{-1}
IV	0.4	0.1	24.0×10^{-1}

Based on the above data which one of the following is correct?

(a) rate = $k[A]^2[B]$ (b) rate = $k[A][B]$
(c) rate = $k[A]^2[B]^2$ (d) rate = $k[A][B]^2$

62. Position of non-polar and polar part in micelle is

(a) polar at outer surface and non-polar at inner surface.
(b) polar at inner surface and non-polar at outer surface.
(c) distributed all over the surface.
(d) present in the surface only.

63. For adsorption of a gas on a solid, the plot of log *x/m* vs log *P* is linear with slope equal to (*n* being whole number)

(a) *k* (b) log *k* (c) *n* (d) $\frac{1}{n}$

64. Calcination is used in metallurgy for removal of?

(a) Water and sulphide
(b) Water and CO_2
(c) CO_2 and H_2S
(d) H_2O and H_2S

65. Phosphine is not obtained by the reaction

(a) White P is heated with NaOH
(b) Red P is heated with NaOH
(c) Ca_3P_2 reacts with water
(d) Phosphorus trioxide is boiled with water

66. Which of the following halides is not oxidized by MnO_2

(a) F^- (b) Cl^- (c) Br^- (d) I^-

67. Which of the following exhibit only + 3 oxidation state?

(a) U (b) Th (c) Ac (d) Pa

68. Which of the following pairs has the same size?

(a) Fe^{2+}, Ni^{2+} (b) Zr^{4+}, Ti^{4+}
(c) Zr^{4+}, Hf^{4+} (d) Zn^{2+}, Hf^{4+}

69. Which of the following is not considered as an organometallic compound?

(a) cis-platin (b) Ferrocene
(c) Zeise's salt (d) Grignard reagent

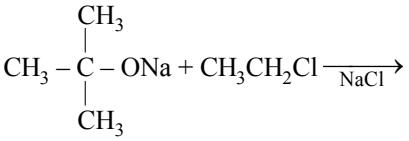
70. The most stable ion is

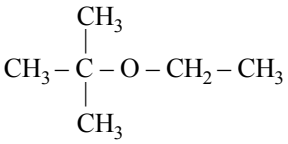
(a) $[Fe(OH)_3]^{3-}$ (b) $[FeCl_6]^{3-}$
(c) $[Fe(CN)_6]^{3-}$ (d) $[Fe(H_2O)_6]^{3+}$

71. A is an optically inactive alkyl chloride which on reaction with aqueous KOH gives B. B on heating with Cu at 300°C gives an alkene C, what are A and C

(a) CH_3CH_2Cl, $CH_2 = CH_2$
(b) Me_3CCl, $MeCH = CH.Me$
(c) Me_3CCl, $Me_2C = CH_2$
(d) $Me_2CH.CH_2Cl$, $Me_2C = CH_2$

72. The reaction





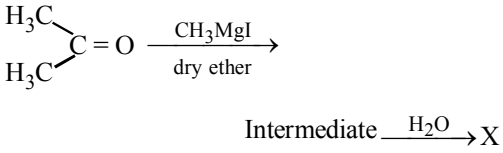
is called :

(a) Williamson continuous etherification process
(b) Etard reaction
(c) Gatterman - Koch reaction
(d) Williamson Synthesis

73. Which of the following esters cannot undergo Claisen self condensation ?
(a) $CH_3CH_2CH_2CH_2COOC_2H_5$
(b) C_6H_5–$COOC_2H_5$
(c) $C_6H_{11}CH_2COOC_2H_5$
(d) $C_6H_5CH_2COOC_2H_5$

74. Schotten-Baumann reaction is a reaction of phenols with
(a) benzoyl chloride and sodium hydroxide.
(b) acetyl chloride and sodium hydroxide.
(c) salicylic acid and conc. H_2SO_4.
(d) acetyl chloride and conc H_2SO_4.

75. Identify X,



$$\text{Intermediate} \xrightarrow{H_2O} X$$

(a) CH_3OH (b) Ethyl alcohol
(c) Methyl cyanide (d) *tert*-Butyl alcohol

76. The reagent (s) which can be used to distinguish acetophenone from benzophenone is (are)
(a) 2,4- dinitrophenylhydrazine
(b) aqueous solution of $NaHSO_3$
(c) benedict reagent
(d) $I_2$and NaOH.

77. Aniline reacts with nitrous acid to produce
(a) phenol
(b) nitrobenzene
(c) chlorobenzene
(d) benzene diazonium chloride

78. The structural feature which distinguishes proline from natural α-amino acids?
(a) Proline is optically inactive.
(b) Proline contains aromatic group.
(c) Proline is a dicarboxylic acid.
(d) Proline is a secondary amine.

79. Which of the following cannot give iodometric titration?
(a) Fe^{3+} (b) Cu^{2+} (c) Pb^{2+} (d) Ag^{2+}

80. Acetaldehyde and acetone can be distinguished by :
(a) Iodoform test
(b) Nitroprusside test
(c) Fehlings solution test
(d) C & P test

PART - III : MATHEMATICS

81. If f(x) is a function that is odd and even simultaneously, then f(3) – f(2) is equal to
(a) 1 (b) –1
(c) 0 (d) None of these

82. If, $\tan A = \frac{1}{2}$ and $\tan B = \frac{1}{3}$, then find the value of A + B
(a) π (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{4}$ (d) $\frac{-\pi}{4}$

83. If $\sin\theta = -\frac{1}{2}$ and $\tan\theta = 1/\sqrt{3}$, then θ =
(a) $2n\pi + \pi/6$ (b) $2n\pi + 11\pi/6$
(c) $2n\pi + 7\pi/6$ (d) $2n\pi + \pi/4$

84. $\frac{\cos\theta}{1-\tan\theta} + \frac{\sin\theta}{1-\cot\theta}$ is equal to
(a) $\sin\theta - \cos\theta$ (b) $\sin\theta + \cos\theta$
(c) $\tan\theta + \cot\theta$ (d) $\tan\theta - \cot\theta$

85. For $n \in N$, $x^{n+1} + (x+1)^{2n-1}$ is divisible by
(a) x (b) $x+1$
(c) $x^2 + x + 1$ (d) $x^2 - x + 1$

86. If α, β are the roots of the equation $ax^2 + bx + c = 0$, then the roots of the equation $ax^2 + bx(x+1) + c(x+1)^2 = 0$ are
(a) $\alpha - 1, \beta - 1$ (b) $\alpha + 1, \beta + 1$
(c) $\frac{\alpha}{\alpha-1}, \frac{\beta}{\beta-1}$ (d) $\frac{\alpha}{1-\alpha}, \frac{\beta}{1-\beta}$

87. If $a > 0$, $a \in R$, $z = a + 2i$ and $z|z| - az + 1 = 0$ then
(a) z is always a positive real number
(b) z is always a negative real number
(c) z is purely imaginary number
(d) such a complex z does not exist

88. Which of the following is not a vertex of the positive region bounded by the inqualities $2x + 3y \le 6$, $5x + 3y \le 15$ and $x, y \ge 0$
(a) (0, 2) (b) (0, 0)
(c) (3, 0) (d) None of these

89. If $^{20}C_r = {}^{20}C_{r-10}$ then $^{18}C_r$ is equal to
(a) 4896 (b) 816
(c) 1632 (d) None of these

90. The term independent of x in the expansion of $\left(9x - \frac{1}{3\sqrt{x}}\right)^{18}$, $x > 0$, is a times the corresponding binomial coefficient. Then a is
(a) 3 (b) 1/3
(c) –1/3 (d) None of these

91. In the binomial $(2^{1/3}+3^{-1/3})^n$, if the ratio of the seventh term from the beginning of the expansion to the seventh term from its end is 1/6, then n equal to

(a) 6 (b) 9 (c) 12 (d) 15

92. If p^{th}, q^{th} and r^{th} terms of H.P. are u,v,w respectively, then find the value of the expression $(q-r)\,vw + (r-p)\,wu + (p-q)\,uv$.

(a) 2 (b) 0 (c) 4 (d) 8

93. If the sum of the first 2n terms of 2, 5, 8, ... is equal to the sum of the first n terms of 57, 59, 61....., then n is equal to

(a) 10 (b) 12 (c) 11 (d) 13

94. The distance of the point (–1, 1) from the line $12(x+6) = 5(y-2)$ is

(a) 2 (b) 3 (c) 4 (d) 5

95. The family of straight lines $(2a+3b)\,x + (a-b)\,y + 2a - 4b = 0$ is concurrent at the point

(a) $\left(\frac{2}{5}, \frac{-14}{5}\right)$ (b) $\left(\frac{-2}{5}, \frac{-14}{5}\right)$

(c) $\left(\frac{-2}{5}, \frac{14}{5}\right)$ (d) $\left(\frac{2}{5}, \frac{14}{5}\right)$

96. The length of the latus-rectum of the parabola whose focus is $\left(\frac{u^2}{2g}\sin 2\alpha, -\frac{u^2}{2g}\cos 2\alpha\right)$ and directrix is $y = \frac{u^2}{2g}$, is

(a) $\frac{u^2}{g}\cos^2\alpha$ (b) $\frac{u^2}{g}\cos 2\alpha$

(c) $\frac{2u^2}{g}\cos^2 2\alpha$ (d) $\frac{2u^2}{g}\cos^2\alpha$

97. The equation of the ellipse with focus at (±5, 0) and $x = \frac{36}{5}$ as one directrix is

(a) $\frac{x^2}{36} + \frac{y^2}{25} = 1$ (b) $\frac{x^2}{36} + \frac{y^2}{11} = 1$

(c) $\frac{x^2}{25} + \frac{y^2}{11} = 1$ (d) None of these

98. For what value of k the circles $x^2+y^2+5x+3y+7=0$ and $x^2 + y^2 - 8x + 6y + k = 0$ cuts orthogonally

(a) 16 (b) –18 (c) –13 (d) –10

99. If the lines $3x - 4y + 4 = 0$ and $6x - 8y - 7 = 0$ are tangents to a circle, then the radius of the circle is

(a) 3/2 (b) 3/4 (c) 1/10 (d) 1/20

100. Evaluate $\lim_{x\to\infty} \frac{\sqrt{1+\sin 3x} - 1}{\ln(1+\tan 2x)}$;

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

101. Negation of "Paris in France and London is in England" is

(a) Paris is in England and London is in France
(b) Paris is not in France or London is not in England
(c) Paris is in England or London is in France
(d) None of these

102. Find the A.M. of the first ten odd numbers.

(a) 10 (b) 20 (c) 15 (d) 25

103. If A and B are mutually exclusive events and if $P(B) = \frac{1}{3}$, $P(A \cup B) = \frac{13}{21}$, then P(A) is equal to

(a) 1/7 (b) 4/7 (c) 2/7 (d) 5/7

104. A die is loaded such that the probability of throwing the number i is proportional to its reciprocal. The probability that 3 appears in a single throw is-

(a) 3/22 (b) 3/11
(c) 9/22 (d) None of these

105. If $f(x) = \begin{cases} x; \text{ when x is rational} \\ 1-x; \text{ when x is irrational} \end{cases}$, then $fof(x)$ is given as

(a) 1 (b) x
(c) $1+x$ (d) None of these

106. If $f(x) = \frac{1-x}{1+x}$ the domain of $f^{-1}(x)$ is

(a) R (b) $R - \{-1\}$
(c) $(-\infty, -1)$ (d) $(-1, \infty)$

107. The value of $\sin\left(4\tan^{-1}\frac{1}{3}\right) - \cos\left(2\tan^{-1}\frac{1}{7}\right)$ is

(a) 3/7 (b) 7/8
(c) 8/21 (d) None of these

108. The matrix $A^2 + 4A - 5I$, where I is identity matrix and $A = \begin{bmatrix} 1 & 2 \\ 4 & -3 \end{bmatrix}$, equals :

(a) $4\begin{bmatrix} 2 & 1 \\ 2 & 0 \end{bmatrix}$ (b) $4\begin{bmatrix} 0 & -1 \\ 2 & 2 \end{bmatrix}$

(c) $32\begin{bmatrix} 2 & 1 \\ 2 & 0 \end{bmatrix}$ (d) $32\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$

109. If $A=\begin{bmatrix}2&0&0\\2&2&0\\2&2&2\end{bmatrix}$, then adj (adj A) is equal to -

(a) $8\begin{bmatrix}1&0&0\\1&1&0\\1&1&1\end{bmatrix}$ (b) $16\begin{bmatrix}1&0&0\\1&1&0\\1&1&1\end{bmatrix}$

(c) $64\begin{bmatrix}1&0&0\\1&1&0\\1&1&1\end{bmatrix}$ (d) None of these

110. If $y=x^{x^2}$, then $\frac{dy}{dx}$ is equal to

(a) $(2\ln x)$ (b) $(2\ln x+1)$

(c) $(\ln\ln x+1)x^{x^2}$ (d) None of these

111. The function $f(x)=(x-1)\sqrt{|\ell n\, x|}$ is at $x=1$

(a) discontinuous
(b) continuous but not differentiable
(c) differentiable with $f'(1)=0$
(d) differentiable with $f'(1)\neq 0$

112. The function $f(x)=\sin x-kx-c$, where k and c are constants, decreases always when

(a) $k>1$ (b) $k\geq 1$ (c) $k<1$ (d) $k\leq 1$

113. The minimum value of $f(x)=\sin^4 x+\cos^4 x$ in the interval $\left(0,\frac{\pi}{2}\right)$ is

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

114. The curve $y-e^{xy}+x=0$ has a vertical tangent at

(a) (1, 1) (b) (0, 1)
(c) (1, 0) (d) no point

115. The function $f(x)=2x^3-3x^2-12x+4$, has

(a) two points of local maximum
(b) two points of local minimum
(c) one maxima and one minima
(d) no maxima or minima

116. Evaluate $\int\frac{x^2}{x^2-1}\,dx$

(a) $x-\frac{1}{2}\log\left(\frac{x-1}{x+1}\right)+c$ (b) $x+\frac{1}{2}\log\left(\frac{x+1}{x-1}\right)+c$

(c) $x+\frac{1}{2}\log\left(\frac{x-1}{x+1}\right)+c$ (d) None of these

117. Find the value of $\int_0^{4\pi}|\sin x|\,dx$

(a) 8 (b) 6 (c) 4 (d) 2

118. Let $I_1=\int_1^2\frac{1}{\sqrt{1+x^2}}dx$ and $I_2=\int_1^2\frac{1}{x}dx$, then

(a) $I_1>I_2$ (b) $I_2>I_1$
(c) $I_1=I_2$ (d) None of these

119. What is the area bounded by $y=\tan x$, $y=0$ and $x=\frac{\pi}{4}$?

(a) $\ell n\ 2$ sq. units (b) $\frac{\ell n 2}{2}$ sq. units
(c) $2\ (\ell n\ 2)$ sq. units (d) None of these

120. The degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^{2/3}+4-3\frac{d^2y}{dx^2}+5\frac{dy}{dx}=0$ is

(a) 1 (b) 2 (c) 3 (d) None of these

121. Two vectors $\vec{A}$ and $\vec{B}$ are such that $|\vec{A}+\vec{B}|=|\vec{A}-\vec{B}|$. The angle between the two vectors will be–

(a) 60° (b) 90° (c) 180° (d) 0°

122. Gives the line L : $\frac{x-1}{3}=\frac{y+1}{2}=\frac{z-3}{-1}$ and the plane $\pi: x-2y-z=0$. Of the following assertions, the only one that is always true is

(a) L is $\perp$ to π (b) L lies in π
(c) L is not parallel to π (d) None of these

123. A ladder rests against a wall so that its top touches the roof of the house. If the ladder makes an angle of 60° with the horizontal and height of the house be $6\sqrt{3}$ meters, then the length of the ladder in meters is

(a) $12\sqrt{3}$ (b) 12
(c) $12/\sqrt{3}$ (d) None of these

124. In an equilateral triangle, the in radius, circumradius and one of the ex-radii are in the ratio

(a) 2 : 3 : 5 (b) 1 : 2 : 3 (c) 3 : 7 : 9 (d) 3 : 7 : 9

125. For the constraints of a L.P. Problem given by $x_1+2x_2\leq 2000$, $x_1+x_2\leq 1500$ and $x_2\leq 600$ and $x_1, x_2\geq 0$, which one of the following points does not lie in the positive bounded region

(a) (1000, 0) (b) (0, 500)
(c) (2, 0) (d) (2000, 0)

PART - IV : ENGLISH

DIRECTIONS (126 & 127): In the following questions, two sentences are given. There may be an error in the sentence(s). Mark as your correct answer.

126. I. Although he was innocent, baseless accusations were leveled at him.
II. Despite of repeated representations from the people, the authorities have failed to take any action.
(a) if there is an error only in the first sentence;
(b) if there is an error only in the second sentence;
(c) if there are errors in both sentences; and
(d) if there is no error in either of the sentences.

127. I. I deem it as a privilege to address the gathering.
II. Perfection can be achieved with practice.
(a) if there is an error only in the first sentence;
(b) if there is an error only in the second sentence;
(c) if there are errors in both sentences; and
(d) if there is no error in either of the sentences.

DIRECTIONS (Qs. 128 - 130): For each of the following questions, select the option which is CLOSEST in meaning to the capitalized word.

128. TURBULENCE
(a) Treachery (b) Triumph
(c) Commotion (d) Overflow

129. DEFER
(a) Discourage (b) Minimize
(c) Postpone (d) Estimate

130. ADAGE
(a) Proverb (b) Youth
(c) Supplement (d) Hardness

DIRECTIONS (Qs. 131 - 133): Choose the word, which is most OPPOSITE in meaning as the word given in **bold.**

131. FRAGRANCE
(a) Aroma (b) Perfume
(c) Smell (d) Stink

132. PECULIAR
(a) Characteristic (b) Special
(c) Specific (d) Universal

133. ETERNAL
(a) Momentary (b) Continual
(c) Everlasting (d) Endless

DIRECTIONS (Qs. 134 & 135): Pick out the most effective word from the given words to fill in the blanks to make the sentence meaningfully complete in the contest of the sentence.

134. _____to popular belief that red meat makes human aggressive, scientist have found that it actually has a calming effect.
(a) Sticking (b) Similarly
(c) Opposite (d) Contrary

135. From its_____opening sequence, it is clear that we are in the grip of a delicious new voice, a voice of breathtaking.
(a) Imagination (b) Evocative
(c) Mesmerizing (d) Resonance

DIRECTIONS (Qs. 136-140): In the following passages, the first and the last parts of the sentence are numbered 1 and 6. The rest of the sentence is split into four parts and named, P, Q, R and S. These four parts are not given in their proper order. Read the parts and find out which of the four combinations is correct. Then find the correct answer.

136. 1. making ourselves
P. our language
Q. part of growing into
R. Masters of
S. is an important
6. full manhood or womanhood
(a) PSRQ (b) SQPR (c) RPSQ (d) PRSQ

137. 1. The very first battle they fought
P. and they had to fall back
Q. cross the border
R. was lost
S. letting the enemy
6. an enter the country
(a) RQSP (b) RPSQ (c) QRPS (d) QPRS

138. 1. A nation
P. the material assets it possesses
Q. is not made by
R. and collective determination
S. but by the will
6. of the people
(a) PQRS (b) QPSR (c) RSPQ (d) SRPQ

139. 1. When the Governor
P. the bell had rung
Q. justice should be immediately
R. he ordered that
S. found out why
6. done to the horse
(a) RSPQ (b) PQSR (c) SPRQ (d) SQRP

140. 1. When you ponder over
P. that the only hope
Q. you will realize
R. of world peace lies
S. the question deeply
6. in the United Nations
(a) QRSP (b) SPQR (c) SQPR (d) RSPQ

DIRECTION (Q. 141 & 142): In the following question, a series is given with one term missing. Choose the correct alternative from the given ones that will complete the series:

141. One of the, numbers does not fit into the series. Find the wrong number.
15, 20, 45, 145, 565, 2830
(a) 20 (b) 45 (c) 145 (d) 565

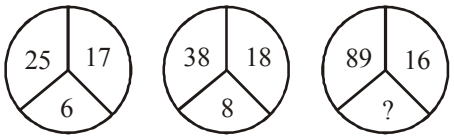
142. VWX, BCD, HIJ, ?
(a) NOQ (b) NOP (c) MNO (d) OPQ

143. In a code language, if TARGET is coded as 201187520, then the word WILLIUM will be coded as
(a) 239121292113 (b) 239121291213
(c) 239122191213 (d) 239121292213

144. Sanjay is taller than Suresh but shorter than Rakesh. Rakesh is taller than Harish but shorter than Binit. Who among is the tallest?
(a) Suresh (b) Sanjay
(c) Binit (d) Rakesh

145. In a row of 62 persons. Rahul is 36th from left side of the row and Nitesh is 29th form the right side of the row. Find out the number of persons sitting between them?
(a) 1 (b) 2 (c) 3 (d) 4

146. The missing number in the given figure is



(a) 13 (b) 15 (c) 17 (d) 19

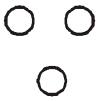
147. Select the combination of number so that the letters arranged will from a meaningful word.

H	N	R	C	A	B
1	2	3	4	5	6

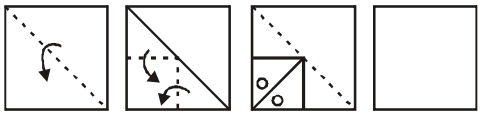
(a) 2, 5, 3, 4, 1, 6 (b) 3, 5, 6, 4, 1, 2
(c) 4, 1, 5, 6, 2, 3 (d) 6, 3, 5, 2, 4, 1

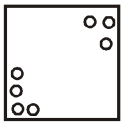
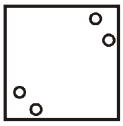
148. Which of the given Venn diagrams out of (a), (b), (c) or (d) correctly represents the relationship among the following classes?
Rose, Flower, Lotus

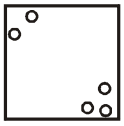
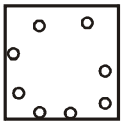
(a)  (b) 

(c)  (d) 

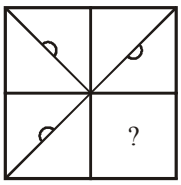
149. A piece of paper is folded and a cut is made as shown below. From the given responses indicate how it will appear when opened?

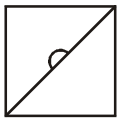
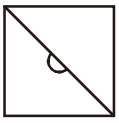


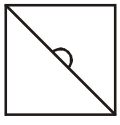
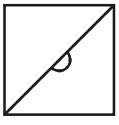
(a)  (b) 

(c)  (d) 

150. Which answer figure will complete the question figure?
Question figure



(a)  (b) 

(c)  (d) 

SOLUTIONS

PART - I : PHYSICS

1. (b) $(\vec{v}_{bc})_x = (\vec{v}_b)_x - (\vec{v}_c)_x$

$20\cos 60° = (\vec{v}_b)_x - 30$

$(\vec{v}_b)_x = 40$; $(\vec{v}_{bc})_y = (\vec{v}_b)_y - (\vec{v}_c)_y$

$20\sin 60° = (\vec{v}_b)_y - 0$

$(\vec{v}_b)_y = 10\sqrt{3}$; $\tan\theta = \dfrac{(\vec{v}_b)_y}{(\vec{v}_b)_x} = \dfrac{10\sqrt{3}}{40} = \dfrac{\sqrt{3}}{4}$

2. (b) **3. (d)**

4. (c) $T = 2\pi\sqrt{\dfrac{ML^3}{3\,Yq}}$, writing dimensions of both the sides, we get $[T] = \left[\dfrac{ML^3}{ML^{-1}T^{-2}q}\right]^{1/2}$

or $q = [L^4]$

5. (b) When the mass increases by a factor of 4 the acceleration must decrease by a factor of four if the same force is applied. The question asks about position so we need to relate acceleration and time to position. We can do this by the equation : $x_f - x_i = v_{xi}\,t + ½\,a_x\,t^2$ We want the change in position to stay the same. The initial velocity is zero so in order for the change in position to remain constant the term $(1/2)\,at^2$ must remain the same. If the acceleration is reduced by a factor of 4 you can see that the time must be increased by a factor of 2 in order for the term to remain the same.

6. (d) For equilibrium of all 3 masses,

$a = \dfrac{T_3}{m_1 + m_2 + m_3}$

For equilibrium of m_1 & m_2

$T_2 = (m_1 + m_2)\cdot a$ or, $T_2 = \dfrac{(m_1 + m_2)T_3}{m_1 + m_2 + m_3}$

Given $m_1 = 10$ kg, $m_2 = 6$ kg, $m_3 = 4$ kg, $T_3 = 40$ N

$\therefore\ T_2 = \dfrac{(10+6).40}{10+6+4} = 32\text{N}$

7. (b)

8. (a) $I = \dfrac{\tau}{\alpha} = \dfrac{31.4}{4\pi} = \dfrac{31.4}{4\times 3.14} = 2.5\ \text{kg m}^2.$

9. (a) Change in force of gravity

$= \dfrac{GMm}{R^2} - \dfrac{G\frac{M}{3}m}{R^2}$

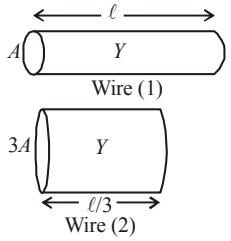
(only due to mass M/3 due to shell gravitational field is zero (inside the shell))

$= \dfrac{2GMm}{3R^2}$

10. (c) Geo-stationary satellites are also called synchronous satellite. They always remain about the same path on equater, i.e., it has a period of exactly one day (86400 sec)

So orbit radius $\left(T = 2\pi\sqrt{\dfrac{r^3}{GM}}\right)$ comes out to be 42400 km, which is nearly equal to the circumference of earth. So height of Geostationary satellite from the earth surface is 42,400 – 6400 = 36,000 km.

11. (c)



As shown in the figure, the wires will have the same Young's modulus (same material) and the length of the wire of area of cross-section $3A$ will be $\ell/3$ (same volume as wire 1).

For wire 1, $Y = \dfrac{F/A}{\Delta x/\ell}$ ...(i)

For wire 2, $Y = \dfrac{F'/3A}{\Delta x/(\ell/3)}$ ...(ii)

From (i) and (ii), $\dfrac{F}{A}\times\dfrac{\ell}{\Delta x} = \dfrac{F'}{3A}\times\dfrac{\ell}{3\Delta x}$

$\Rightarrow F' = 9F$

12. (c) $Y = \dfrac{F/A}{\Delta\ell/\ell} = \dfrac{\frac{250\times 9.8}{50\times 10^{-6}}}{\frac{0.5\times 10^{-3}}{2}}$

$= \dfrac{250\times 9.8}{50\times 10^{-6}}\times\dfrac{2}{0.5\times 10^{-3}} \Rightarrow 19.6\times 10^{10}\ \text{N/m}^2$

13. (b) **14. (c)**

15. (b) By Newton's law of cooling,

$$\frac{\theta_1-\theta_2}{t}=-k\left[\frac{\theta_1+\theta_2}{2}-\theta_0\right] \quad ....(1)$$

A sphere cools from 62°C to 50°C in 10 min.

$$\frac{62-50}{10}=-k\left[\frac{62+50}{2}-\theta_0\right] \quad ....(2)$$

Now, sphere cools from 50°C to 42°C in next 10 min.

$$\frac{50-42}{10}=-k\left[\frac{50+42}{2}-\theta_0\right] \quad ....(3)$$

Dividing eq^n. (2) by (3) we get,

$$\frac{56-\theta_0}{46-\theta_0}=\frac{1.2}{0.8} \text{ or } 0.4\theta_0=10.4$$

Hence $\theta_0=26°C$

16. (d) As the bubble rises the pressure gets reduced for constant temperature, if P is the standard atmospheric pressure, then $(P+\rho gh)V_0=PV$

or $V=V_0\left(1+\frac{\rho gh}{P}\right)$

17. (a) $\frac{c_2}{c_1}=\sqrt{\frac{400}{300}}=\frac{2}{\sqrt{3}}$

$$\Rightarrow c_2=\frac{2}{\sqrt{3}}\times 200=\frac{400}{\sqrt{3}}\ ms^{-1}$$

18. (d) In linear S.H.M., the restoring force acting on particle should always be proportional to the displacement of the particle and directed towards the equilibrium position.

i.e., $F\propto x$

or $F=-bx$ where b is a positive constant.

19. (d) When the spring undergoes displacement in the downward direction it completes one half oscillation while it completes another half oscillation in the upward direction. The total time period is:

$$T=\pi\sqrt{\frac{m}{k}}+\pi\sqrt{\frac{m}{2k}}$$

20. (a) For open pipe, $n=\frac{v}{2\ell}$, where n_0 is the fundamental frequency of open pipe.

$$\therefore \quad \ell=\frac{v}{2n}=\frac{330}{2\times 300}=\frac{11}{20}$$

As freq. of 1st overtone of open pipe = freq. of 1st overtone of closed pipe

$$\therefore \quad 2\frac{v}{2\ell}=3\frac{v}{4\ell'}\Rightarrow \ell'=\frac{3\ell}{4}=\frac{3}{4}\times\frac{11}{20}$$

$$=41.25\text{ cm}$$

21. (c) Electric field inside the uniformly charged sphere varies linearly, $E=\frac{kQ}{R^3}.r$, $(r\le R)$, while outside the sphere, it varies as inverse square of distance, $E=\frac{kQ}{r^2};(r\ge R)$ which is correctly represented in option (c).

22. (c)

23. (b) Potential at any point inside the sphere = potential at the surface of the sphere = 10V.

24. (c) Capacitance of capacitor (C) = 6 μF $=6\times10^{-6}$ F; Initial potential $(V_1)=10$ V and final potential $(V_2)=20$ V.

The increase in energy (ΔU)

$$=\frac{1}{2}C(V_2^2-V_1^2)$$

$$=\frac{1}{2}\times(6\times10^{-6})\times[(20)^2-(10)^2]$$

$$=(3\times10^{-6})\times300=9\times10^{-4}\text{ J}.$$

25. (c) Equivalent resistance

$=(5+10+15)||(10+20+30)$

So, $R_{eq}=\frac{30\times60}{30+60}=20\Omega$

26. (c) By symmetry, the magnetic field at the centre P is zero.

27. (c) Torque, $\tau=\vec{M}\times\vec{B}$

28. (c) Given : $\ell=1$m, $B=5\times10^{-3}$ Wb/m²

$$f=\frac{1800}{60}=30\text{ rotations/sec}$$

In one rotation, the moving rod of the metal traces a circle of radius $r=\ell$

$\therefore$ Area swept in one rotation $=\pi r^2$

$$\frac{d\phi}{dt}=\frac{d}{dt}(BA)=B.\frac{dA}{dt}=\frac{B\pi r^2}{T}$$

$$=Bf\pi r^2=(5\times10^{-3})\times3.14\times30\times1=0.471\text{ V}$$

29. (c) $Z=\sqrt{R^2+\left(2\pi fL-\frac{1}{2\pi fC}\right)^2}$

30. (a) Energy density

$$=\varepsilon_0E_{rms}^2=\varepsilon_0\left(\frac{E_0}{\sqrt{2}}\right)^2=\frac{1}{2}\varepsilon_0E_0^2$$

31. (b) $\dfrac{P_a}{P_l}=\dfrac{\left(\dfrac{\mu_g}{\mu_a}-1\right)}{\left(\dfrac{\mu_g}{\mu_1}-1\right)}=\dfrac{+5}{-100/100}=-5$

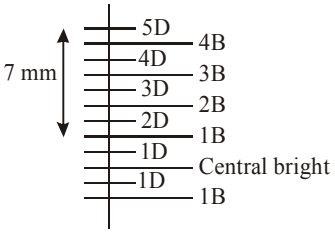
$$-5\left(\frac{\mu_g}{\mu_1}-1\right)=\frac{\mu_g}{\mu_a}-1$$

$$\frac{1.5}{\mu_1}-1=\frac{-1}{5}(1.5-1)=-0.1\,;$$

$$\mu_1=\frac{1.5}{0.9}=\frac{5}{3}$$

32. (b) $h'=\dfrac{d_1}{\mu_1}+\dfrac{d_2}{\mu_2}=d\left(\dfrac{1}{\mu_1}+\dfrac{1}{\mu_2}\right)$

33. (d) There are three and a half fringes from first maxima to fifth minima as shown.



$$\Rightarrow\quad \beta=\frac{7\text{ mm}}{3.5}=2\text{ mm}\Rightarrow\lambda=\frac{\beta D}{d}=600\text{ nm}$$

34. (d) Momentum of a photon $\propto \dfrac{E}{c}$

$= 5.33\times10^{-27}\text{ kg ms}^{-1}$

35. (d) **36. (a)**

37. (b) $\left(\overline{A+B}\right)=$ NOR gate

When both inputs of NAND gate are connected, it behaves as NOT gate

OR + NOT = NOR.

38. (c)

39. (a) $E_n=-3.4\text{ eV}$

The kinetic energy is equal to the magnitude of total energy in this case.

$\therefore$ K.E. $=+3.4\text{ eV}$

The de Broglie wavelength of electron

$$\lambda=\frac{h}{\sqrt{2mK}}=\frac{6.64\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times3.4\times1.6\times10^{-19}}}\text{ eV}$$

$$=0.66\times10^{-9}\text{ m}$$

40. (b) If v_{max} is the speed of the fastest electron emitted from the metal surface, then

$$\frac{hc}{\lambda}=W_0+\frac{1}{2}mv_{max}^2\quad\frac{(6.63\times10^{-34})\times(3\times10^8)}{(180\times10^{-9})}$$

$$=2\times(1.6\times10^{-19})+\frac{1}{2}(9.1\times10^{-31})v_{max}^2$$

$\therefore\quad v=1.31\times10^6\text{ m/s}$

The radius of the electron is given by

$$r=\frac{mv}{qB}=\frac{(9.1\times10^{-31})\times(1.31\times10^6)}{(1.6\times10^{-19})\times(5\times10^{-9})}=0.149\text{ m}$$

PART - II : CHEMISTRY

41. (d) According to Dulong and Pettit's law

Atomic weight × Specific heat = 6.4 (approx)

This law is applicable only to solid elements but it fails to explain very high specific heat of diamond.

42. (d) Let E be the equivalent weight of the metal

So, $\dfrac{E+17}{E+8}=\dfrac{1.52}{0.995}$

[17 is equivalent weight of OH and 8 is equivalent weight of oxygen]

$\Rightarrow 0.995E+17\times0.995=E\times1.52+8\times1.52$

$\Rightarrow 0.525E=16.915-12.16=4.755$

$\therefore\quad E=\dfrac{4.755}{0.525}=9$

43. (b) Effective nuclear charge (i,e. Z/e ratio) decreases from F^- to N^{3-} hence the radii follows the order: $F^- < O^{2-} < N^{3-}$. Z/e for $F^-=9/10=0.9$, for $O^{2-}=8/10=.8$, for $N^{3-}=0.7$

44. (c) The valency of beryllium is +2 while that of aluminium is +3.

45. (d) $\underset{\text{Acidic}}{SO_2} > P_2O_3 > \underset{\text{Weak acidic}}{SiO_2} > \underset{\text{Amphoteric}}{Al_2O_3}$

46. (b) For T-shape geometry the molecule must have 3 bonded pair and 2 lone pair of electrons.

47. (c) O_2^+ ion - Total number of electrons $(16-1)=15$.

E.C. :

$$\sigma1s^2\sigma^*1s^2\sigma2s^2\sigma^*2s^2\sigma2p_z^2$$

$$\pi2p_x^2=\pi2p_y^2\pi^*2p_x^1=\pi^*2p_y$$

Bond order $=\dfrac{N_b-N_a}{2}=\dfrac{10-5}{2}=\dfrac{5}{2}=2\dfrac{1}{2}$

O_2^- (Super oxide ion): Total number of electrons $(16+1)=17$.

E.C.:

$\sigma 1s^2\sigma^*1s^2\sigma 2s^2\sigma^*2s^2\sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2\ \pi^*2p_x^2 = \pi^*2p_y^1$

Bond order $= \frac{(N_b - N_a)}{2} = \frac{10-7}{2} = \frac{3}{2} = 1\frac{1}{2}$

O_2^{2+} ion: Total number of electrons $= (16-2) = 14$

E.C.:

$\sigma 1s^2\sigma^*1s^2\sigma 2s^2\sigma^*2s^2\pi 2p_x^2 = \pi 2p_y^2\sigma 2p_z^2$

Bond order $= \frac{(N_b - N_a)}{2} = \frac{10-4}{2} = \frac{6}{2} = 3$

So bond order: $O_2^- < O_2^+ < O_2^{2+}$

48. (d) Condition of equilibrium, hence $\Delta G = 0$.

49. (a) IVth group needs higher S^{2-} ion concentration. In presence of HCl, the dissociation of H_2S decreases hence produces less amount of sulphide ions due to common ion effect, thus HCl decreases the solubility of H_2S which is sufficient to precipitate IInd group radicals.

50. (c) pH = 3. $\therefore [H^+] = 10^{-3}$; pH = 6, $\therefore [H^+] = 10^{-6}$. Hence $[H^+]$ is reduced by 10^{-3} times.

51. (a) The more the reduction potential, the more the oxidising power.

52. (b) It is hygroscopic and deliquescent and hence absorbs moisture and CO_2 to form Na_2CO_3

$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$

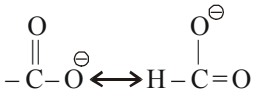
53. (a) None of the carbon atoms in $DCH_2CH_2CH_2Cl$ is chiral i.e., each carbon atom is achiral (symmetric).

54. (b)

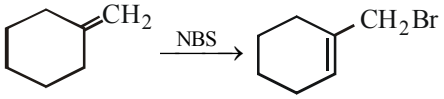
55. (c) Nucleophilicity increases with the decrease in electronegativity of the central atom. Since electronegativity follows the order: F > O > N > C; nucleophilicity of the concerned group will follow the reverse order i.e.,

$CH_3^- > NH_2^- > OH^- > F^-$

56. (b)



57. (c)



58. (d) Number of atoms per unit cell = 1

Atoms touch each other along edges.

Hence $r = \frac{a}{2}$

(r = radius of atom and a = edge length)

Therefore % fraction $= \frac{\frac{4}{3}\pi r^3}{(2r)^3} = \frac{\pi}{6}$

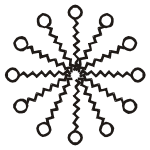
59. (c) $\Delta T_f = K_f m = 5.12 \times \frac{1}{250} \times \frac{1000}{51.2} = 0.4K$

60. (a) Amt. deposited $= \frac{\text{E. wt} \times Q}{96500}$;

$107.870 = \frac{107.870}{96500} \times Q; \quad \therefore Q = 96500C$

61. (d) In case of (II) and (III) Keeping concentration of [A] constant, when the concentration of [B] is doubled, the rate quadruples. Hence it is second order with respect to B. In case of I & IV Keeping the concentration of [B] constant, when the concentration of [A] is increased four times, rate also increases four times. Hence, the order with respect to A is one. Hence Rate $= k[A][B]^2$

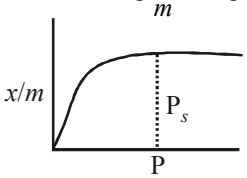
62. (a)



o- Polarhead
n- Non-polar tail
(micelle)

63. (d) According to Freundlich adsorption isotherm, at intermediate pressure, extent of adsorption

$\frac{x}{m} = kP^{1/n}$ or $\log\frac{x}{m} = \log k + \frac{1}{n}\log P;$



plot of $\log\frac{x}{m}$ vs log P is linear with slope $= \frac{1}{n}$

64. **(b)** Calcination is used for removal of volatile impurities and decompose carbonates.

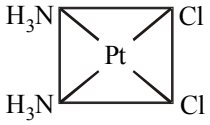
65. **(b)** Red P does not react with NaOH to give PH_3.

66. **(a)** F_2 is strongest oxidising agent. F^- is not oxidised by MnO_2

67. **(c)** Ac (89) = [Rn] [$6d^1$] [$7s^2$]

68. **(c)** Due to lanthanide contraction, the size of Zr and Hf (atom and ions) become nearly similar.

69. **(a)** The structural formula of cis-platin is



Since no carbon is involved it is not a organometallic compound.

70. **(b)** A more basic ligand forms stable bond with metal ion, Cl^- is most basic amongst all.

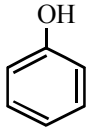
71. **(c)** $\underset{(A)}{Me_3CCl} \xrightarrow{KOH} \underset{\text{tert. alcohol}}{Me_3COH} \xrightarrow{Cu/300^\circ} CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}=CH_2 + H_2O$

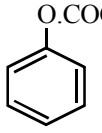
or

$\underset{(C)}{Me_2C=CH_2}$

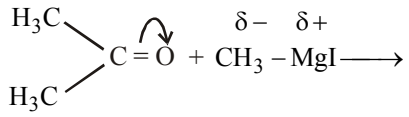
72. **(d)** Williamson synthesis is one of the best methods for the preparation of symmetrical and unsymmetrical ethers. In this method, an alkyl halide is allowed to react with sodium alkoxide.

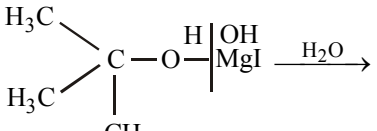
73. **(b)** Claisen condensation is given by esters having two α-hydrogen atoms.

74. **(a)**  $+ C_6H_5COCl \xrightarrow{\text{aq. NaOH}}$

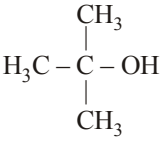


phenyl benzoate

75. **(d)** 



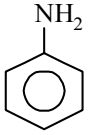
+ Mg(OH)I



Tert butyl alcohol

76. **(d)** I_2 and NaOH react with acetophenone ($C_6H_5COCH_3$) to give yellow ppt. of CHI_3 but benzophenone ($C_6H_5COC_6H_5$) does not give haloform test.

77. **(d)** When aniline is treated with nitrous acid in the presence of HCl, then benzene diazonium chloride is obtained.



$+ NaNO_2 + 2HCl \longrightarrow$

$C_6H_5N=NCl + NaCl + 2H_2O$

(Benzene diazonium chloride)

78. **(d)** Proline contains imino (secondary amino), $>NH$ group.

79. **(a)** There is no reaction between I^- and Fe^{3+}.

80. **(c)** Acetaldehyde is easily oxidised to acetic acid by a mild oxidising agent like Fehling solution. Acetone is not easily oxidised.
Both acetone and acetaldehyde give iodoform test. Other two conditions are not relevant to aldehydes and ketones.

PART - III : MATHEMATICS

81. **(c)** $f(x)=0 \ \forall \ x \in R \Rightarrow f(3)-f(2)=0$

82. **(c)** $\tan(A+B)=\dfrac{\tan A+\tan B}{1-\tan A\tan B}=\dfrac{\frac{1}{2}+\frac{1}{3}}{1-\frac{1}{2}.\frac{1}{3}}=1$

$\therefore A+B=45^\circ=\dfrac{\pi}{4}$

83. (c) We shall first consider values of θ between 0 and 2π $\sin\theta = -\frac{1}{2} = -\sin\frac{\pi}{6} = \sin\left(\pi + \frac{\pi}{6}\right)$

or $\sin(2\pi - \pi/6)$

$\therefore\ \theta = 7\pi/6\ ;\ 11\pi/6$

$\tan\theta = 1/\sqrt{3} = \tan(\pi/6)$ or $\tan(\pi + \pi/6)$

$\therefore\ \theta = \pi/6\ ,\ 7\pi/6$

The value of θ which satisfies both the equations is $7\pi/6$

Hence the general value of θ is $2n\pi + 7\pi/6$ where $n \in I$

84. (b) $$\frac{\cos\theta}{1-\tan\theta} + \frac{\sin\theta}{1-\cot\theta} = \frac{\cos\theta}{1-\frac{\sin\theta}{\cos\theta}} + \frac{\sin\theta}{1-\frac{\cos\theta}{\sin\theta}}$$

$$= \frac{\cos^2\theta}{\cos\theta - \sin\theta} - \frac{\sin^2\theta}{\cos\theta - \sin\theta} = \cos\theta + \sin\theta$$

85. (c) For $n = 1$, we have;

$x^{n+1} + (x+1)^{2n-1} = x^2 + (x+1) = x^2 + x + 1$,

which is divisible by $x^2 + x + 1$

For $n = 2$, we have; $x^{n+1} + (x+1)^{2n-1}$

$= x^3 + (x+1)^3 = (2x+1)(x^2 + x + 1)$,

which is divisible by $x^2 + x + 1$.

86. (d) The second equation can be rewritten as

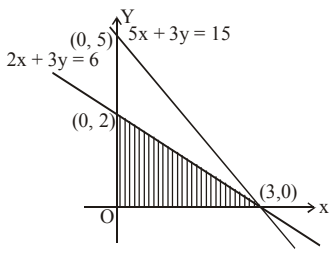
$$a\left(\frac{x}{x+1}\right)^2 + b\left(\frac{x}{x+1}\right) + c = 0$$

and hence its roots correspond to $\frac{x}{x+1} = \alpha$ and $\frac{x}{x+1} = \beta$.

Hence $x = \frac{\alpha}{1-\alpha}$ and $\frac{\beta}{1-\beta}$.

87. (d) Putting $z = a + 2i$ in the given equation and comparing imaginary parts, we get $a^2 + 4 = a^2$, which is not possible.

88. (d) Here (0, 2), (0, 0) and (3, 0) all are vertices of feasible region.



89. (b) $^{20}C_r = {}^{20}C_{r-10} \Rightarrow r + (r-10) = 20 \Rightarrow r = 15$

$\therefore\ {}^{18}C_r = {}^{18}C_{15} = {}^{18}C_3 = \frac{18.17.16}{1.2.3} = 816$

90. (d) $$T_{r+1} = {}^{18}C_r (9x)^{18-r}\left(-\frac{1}{3\sqrt{x}}\right)^r$$

$$= (-r)^r\, {}^{18}C_r\, 9^{18-\frac{3r}{2}}\, x^{18-\frac{3r}{2}}$$

is independent of x provided r = 12 and then a = 1.

91. (b) $T_{r+1} = {}^nC_r\, a^{n-r}\, .\, b^r$ where $a = 2^{1/3}$ and $b = 3^{-1/3}$

T_7 from beginning $= {}^nC_6\, a^{n-6}\, b^6$ and

T_7 from end $= {}^nC_6\ b^{n-6}\ a^6$

$$\Rightarrow\ \frac{a^{n-12}}{b^{n-12}} = \frac{1}{6}\ \Rightarrow\ 2^{\frac{n-12}{3}}\, .\, 3^{\frac{n-12}{3}} = 6^{-1}$$

$\Rightarrow\ n - 12 = -3\ \Rightarrow\ n = 9$

92. (b) Let H.P. be $\frac{1}{a} + \frac{1}{a+d} + \frac{1}{a+2d} + ...$

$$\therefore u = \frac{1}{a+(p-1)d},\quad v = \frac{1}{a+(q-1)d},$$

$$w = \frac{1}{a+(r-1)d} \quad \Rightarrow a + (p-1)\,d = \frac{1}{u}$$

$$a + (q-1)\,d = \frac{1}{v},\ a + (r-1)d = \frac{1}{w}$$

$$\Rightarrow (q-r)\{a + (p-1)d\} + (r-p)\{a + (q-1)d\} + ...$$

$$= \frac{1}{u}(q-r) + \frac{1}{v}(r-p) + ... \Rightarrow (q-r)\,vw + ... = 0$$

93. (c) Given,

$$\frac{2n}{2}\{2.2 + (2n-1)3\} = \frac{n}{2}\{2.57 + (n-1)2\}$$

or $2(6n+1) = 112 + 2n$ or $10n = 110,\ \therefore\ n = 11$

94. (d) The given line is $12(x+6) = 5(y-2)$

$\Rightarrow\ 12x + 72 = 5y - 10$

or $12x - 5y + 72 + 10 = 0 \quad \Rightarrow 12x - 5y + 82 = 0$

The perpendicular distance from (x_1, y_1) to the line $ax + by + c = 0$ is $\frac{(ax_1 + by_1 + c)}{\sqrt{a^2 + b^2}}$.

The point (x_1, y_1) is (–1, 1), therefore, perpendicular distance from (–1, 1) to the line $12x - 5y + 82 = 0$ is

$$= \frac{|-12-5+82|}{\sqrt{12^2+(-5)^2}} = \frac{65}{\sqrt{144+25}} = \frac{65}{\sqrt{169}} = 5$$

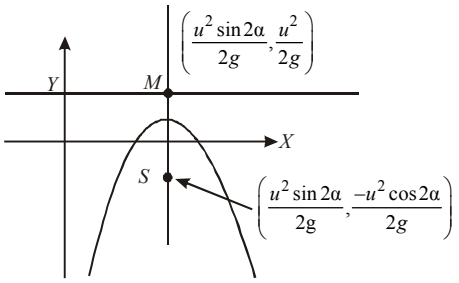
95. (a) Rewriting the equation

$(2x + y + 2)a + (3x - y - 4)b = 0$ and for all a, b the straight lines pass through the intersection of $2x + y + 2 = 0$ and $3x - y - 4 = 0$

i.e., the point $\left(\frac{2}{5}, -\frac{14}{5}\right)$.

96. (d) According to the figure, the length of latus rectum is

$$2(SM) = 2 \times \frac{u^2}{2g}(1 + \cos 2\alpha) = \frac{2u^2 \cos^2 \alpha}{g}.$$



97. (b) We have $ae = 5$ [Since focus is $(\pm ae, 0)$]

and $\frac{a}{e} = \frac{36}{5}$ $\left[\text{since directrix is } x = \pm\frac{a}{e}\right]$

On solving we get $a = 6$

and $e = \frac{5}{6} \Rightarrow b^2 = a^2(1 - e^2) = 36\left(1 - \frac{25}{36}\right) = 11$

Thus, the required equation of the ellipse is

$$\frac{x^2}{36} + \frac{y^2}{11} = 1$$

98. (b) Let the two circles be $x^2 + y^2 + 2g_1 x + 2f_1 y + c_1 = 0$ and $x^2 + y^2 + 2g_2 x + 2f_2 y + c_2 = 0$ where $g_1 = 5/2$, $f_1 = 3/2$, $c_1 = 7$, $g_2 = -4$, $f_2 = 3$ and $c_2 = k$

If the two circles intersects orthogonally, then

$$2(g_1 g_2 + f_1 f_2) = c_1 + c_2 \Rightarrow 2\left(-10 + \frac{9}{2}\right) = 7 + k$$

$$\Rightarrow 11 = 7 + k \Rightarrow k = -18$$

99. (b) The diameter of the circle is perpendicular distance between the parallel lines (tangents)

$3x - 4y + 4 = 0$ and $3x - 4y - \frac{7}{2} = 0$ and so it is equal to

$$\frac{4}{\sqrt{9+16}} + \frac{7/2}{\sqrt{9+16}} = \frac{3}{2}.$$ Hence radius is $\frac{3}{4}$

100. (c) $\lim_{x \to 0} \frac{\sqrt{1 + \sin 3x} - 1}{\ln(1 + \tan 2x)}$

$$= \lim_{x \to 0} \frac{(1 + \sin 3x) - 1}{\left\{\sqrt{1 + \sin 3x} + 1\right\}\ln(1 + \tan 2x)}$$

$$= \lim_{x \to 0} \frac{1}{\left(\sqrt{1 + \sin 3x} + 1\right)} \cdot \frac{\sin 3x}{\ln(1 + \tan 2x)^{\frac{1}{\tan 2x}}} \times \frac{1}{\tan 2x}$$

$$= \lim_{x \to 0} \frac{1}{\left(\sqrt{1 + \sin 3x} + 1\right)} \cdot \left(\frac{\sin 3x}{3x}\right)\left(\frac{2x}{\tan 2x}\right) \times \frac{3}{2} \cdot \frac{1}{\ln(1 + \tan 2x)^{\frac{1}{\tan 2x}}}$$

$$= \left(\frac{1}{1+1}\right)(1)(1)\left(\frac{3}{2}\right)\frac{1}{\ln e} = \frac{3}{4}.$$

101. (b) Let p : Paris is in France, q : London is in England

$\therefore$ we have $p \wedge q$

Its negation is $\sim(p \wedge q) = \sim p \vee \sim q$

i.e., Paris is not in France or London is not in England.

102. (a) First ten odd numbers are 1, 3, 5, 7, 11, 13, 15, 17, 19 respectively. So A.M.

$$(\bar{x}) = \frac{1+3+5+7+9+11+13+15+17+19}{10} = \frac{100}{10} = 10$$

103. (c) For mutually exclusive events

$$P(A \cup B) = P(A) + P(B) \Rightarrow P(A) = \frac{2}{7}$$

104. (d) $P(i) = \frac{k}{i} \Rightarrow 1 = \sum_{i=1}^{6} P(i) = k\sum_{i=1}^{6} \frac{1}{i} = k\frac{49}{20}$

$$\Rightarrow k = \frac{20}{49}. P(3) = \frac{20}{147}$$

105. (b) $f \circ f(x) = \begin{cases} f(x) \text{ ; when } f(x) \text{ is rational} \\ 1 - f(x); \text{ when } f(x) \text{ is irrational} \end{cases}$

$$= \begin{cases} x \text{ ; when } x \text{ is rational} \\ 1 - (1 - x); \text{ when } x \text{ is irrational} \end{cases} = x$$

106. (b) Let $f(x) = y$. Then $\frac{1-x}{1+x} = y$

$$\Rightarrow x = \frac{1-y}{1+y} \Rightarrow f^{-1}(y) = \frac{1-y}{1+y}$$

Thus, $f^{-1}(x) = \frac{1-x}{1+x}$

Clearly, $f^{-1}(x)$ is defined for $1 + x \neq 0$.

Hence, domain of $f^{-1}(x)$ is $R - \{-1\}$

107. (d) $\sin\left(4\tan^{-1}\frac{1}{3}\right)$

$$= 2\sin\left(2\tan^{-1}\frac{1}{3}\right)\cos\left(2\tan^{-1}\frac{1}{3}\right)$$

$$= 2\sin\left(\tan^{-1}\frac{3}{4}\right) = \cos\left(\tan^{-1}\frac{3}{4}\right) = 2.\frac{3}{5}.\frac{4}{5} = \frac{24}{25}$$

$$\cos\left(2\tan^{-1}\frac{1}{7}\right) = \cos\left(\tan^{-1}\frac{7}{24}\right) = \frac{24}{25}.$$

The given expression = 0

108. (a) $A^2 + 4A - 5I = A \times A + 4A - 5I$

$$= \begin{bmatrix}1 & 2\\ 4 & -3\end{bmatrix}\times\begin{bmatrix}1 & 2\\ 4 & -3\end{bmatrix} + 4\begin{bmatrix}1 & 2\\ 4 & -3\end{bmatrix} - 5\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$$

$$= \begin{bmatrix}9 & -4\\ -8 & 17\end{bmatrix} + \begin{bmatrix}4 & 8\\ 16 & -12\end{bmatrix} - \begin{bmatrix}5 & 0\\ 0 & 5\end{bmatrix}$$

$$= \begin{bmatrix}9+4-5 & -4+8-0\\ -8+16-0 & 17-12-5\end{bmatrix} = \begin{bmatrix}8 & 4\\ 8 & 0\end{bmatrix}$$

$$= 4\begin{bmatrix}2 & 1\\ 2 & 0\end{bmatrix}$$

109. (b) $|A| = \begin{bmatrix}2 & 0 & 0\\ 2 & 2 & 0\\ 2 & 2 & 2\end{bmatrix} = (2)(2)(2) = 8$

Now adj (adj A) $= |A|^{3-2}A$

$$= 8\begin{bmatrix}2 & 0 & 0\\ 2 & 2 & 0\\ 2 & 2 & 2\end{bmatrix} = 16\begin{bmatrix}1 & 0 & 0\\ 1 & 1 & 0\\ 1 & 1 & 1\end{bmatrix}$$

110. (d) Consider $y = x^{x^2} \Rightarrow \ln y = x^2 \ln x$

$$\frac{1}{y}\frac{dy}{dx} = 2x\ln x + x^2.\frac{1}{x} = x(1 + 2\ln x)$$

$$\frac{dy}{dx} = x^{x^2}.x(1 + 2\ln x) = x^{x^2+1}(1 + 2\ln x)$$

111. (c) Continuous as well as differentiable, so $f'(1) = 0$

112. (b) Let $f(x) = \sin x - kx - c$ where k and c are constants. $f'(x) = \cos x - k$

$\therefore$ f decreases if $\cos x \leq k$

Thus, $f(x) = \sin x - kx - c$ decrease always when $k \geq 1$.

113. (a) Let $y = \sin^4 x + \cos^4 x$

$$\frac{dy}{dx} = 4\sin^3 x\cos x + 4\cos^3 x(-\sin x)$$

$$= 4\sin x\cos x(\sin^2 x - \cos^2 x)$$

$$= (2\sin 2x)(-\cos 2x) = -\sin 4x$$

$$\therefore \frac{dy}{dx} = 0 \Rightarrow \sin 4x = 0 \Rightarrow 4x = 0,\ \pi, 2\pi, 3\pi$$

or $x = 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \ldots\ldots\ldots, \Rightarrow x = \frac{\pi}{4}$

114. (c) $y - e^{xy} + x = 0$

$$\therefore \frac{dy}{dx} - e^{xy}\left(y + x\frac{dy}{dx}\right) + 1 = 0$$

i.e., $\frac{dy}{dx} - y(x+y) - x(x+y)\frac{dy}{dx} + 1 = 0$

i.e., $[1 - x(x+y)]\frac{dy}{dx} = y(x+y) - 1$

for the vertical tangents

$1 - x(x+y) = 0$ i.e., $y = \frac{1-x^2}{x}$

$\therefore x = 1$ and $y = 0$

115. (c) $f(x) = 2x^3 - 3x^2 - 12x + 4$

$$\Rightarrow f'(x) = 6x^2 - 6x - 12 = 6(x^2 - x - 2)$$

$$= 6(x-2)(x+1)$$

For maxima and minima $f'(x) = 0$

$\therefore$ $6(x-2)(x+1) = 0 \Rightarrow x = 2, -1$

Now, $f''(x) = 12x - 6$

At $x = 2$; $f''(x) = 24 - 6 = 18 > 0$

$\therefore$ $x = 2$, local min. point

At $x = -1$; $f''(x) = 12(-1) - 6 = -18 < 0$

$\therefore x = -1$ local max. point

116. (c) Given integral $I = \int\left(1 + \frac{1}{x^2-1}\right)dx$

$$= \int dx + \int\frac{dx}{(x-1)(x+1)}$$

$$= x + \frac{1}{2}\int\left(\frac{1}{x-1} - \frac{1}{x+1}\right)dx = x + \frac{1}{2}\log\left(\frac{x-1}{x+1}\right) + c$$

117. (a) We know that $|\sin x|$ is a periodic function of π

Hence $\int_0^{4\pi}|\sin x|dx = 4\int_0^{\pi}|\sin x|dx = 4\int_0^{\pi}\sin x dx$

$$= 4\left[-\cos x\right]_0^{\pi} = 8$$

118. (b) If $I_1 = \int_1^2 \frac{dx}{\sqrt{1+x^2}}$, $I_2 = \int_1^2 \frac{dx}{x}$

$I_1 = \ell n\left(\frac{2+\sqrt{5}}{1+\sqrt{2}}\right)$, $I_2 = \ell n 2 \Rightarrow I_1 < I_2$

119. (b) Required area $= \int_0^{\frac{\pi}{4}} \tan x\, dx$

$= \ln|\sec 1|_0^{\frac{\pi}{4}} = \ln\sqrt{2} = \frac{\ln 2}{2}$

120. (b) $\left(\frac{d^3y}{dx^3}\right)^{2/3} + 4 - 3\frac{d^2y}{dx^2} + 5\frac{dy}{dx} = 0$

$\Rightarrow \left(\frac{d^3y}{dx^3}\right)^2 = \left[3\frac{d^2y}{dx^2} - 5\frac{dy}{dx} - 4\right]^3$

It is a differential equation of degree 2.

121. (b) $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$

$\Rightarrow \sqrt{A^2 + B^2 + 2AB\cos\theta} = \sqrt{A^2 + B^2 - 2AB\cos\theta}$

Squaring both the sides, we get

$\vec{A}^2 + \vec{B}^2 + 2\vec{A}\vec{B}\cos\theta = \vec{A}^2 + \vec{B}^2 - 2\vec{A}\vec{B}\cos\theta$

or $4\vec{A}\vec{B}\cos\theta = 0$ or $\cos\theta = 0$ (since the scalar or dot product is zero) . Therefore angle between $\vec{A}$ to $\vec{B}$ is 90°

122. (b) Since $3(1) + 2(-2) + (-1)(-1) = 3 - 4 + 1 = 0$

$\therefore$ Given line is $\perp$ to the normal to the planei.e., given line is parallel to the given plane.

Also, (1, –1, 3) lies on the plane $x - 2y - z = 0$ if $1 - 2(-1) - 3 = 0$ i.e., $1 + 2 - 3 = 0$

which is true $\therefore$ L lies in plane π.

123. (b) Length of ladder $= \frac{6\sqrt{3}}{\sin 60°} = 12$ m

124. (b) We have $\Delta = \frac{\sqrt{3}}{4}a^2$, $s = \frac{3a}{2}$

$\therefore \quad r = \frac{\Delta}{s} = \frac{a}{2\sqrt{3}}$, $R = \frac{abc}{4\Delta} = \frac{a^3}{\sqrt{3}a^2} = \frac{a}{\sqrt{3}}$

and $r_1 = \frac{\Delta}{s-a} = \frac{\sqrt{3}/4a^2}{a/2} = \frac{\sqrt{3}}{2}a$

Hence, $r : R : r_1 = \frac{a}{2\sqrt{3}} : \frac{a}{\sqrt{3}} : \frac{\sqrt{3}}{2}a = 1 : 2 : 3$

125. (d) Clearly point (2000, 0) is outside.

PART - IV : ENGLISH

126. (c) Sentence I, accusations were leveled against him not at him. Sentence II, despite is not followed by of.

127. (c) Sentence I: I deem it a privilege not as a privilege.
Sentence II: …… achieved through practice not with practice.

128. (c) Commotion means an disorderly outburst or tumult. Its most close to tubulence which means unstable flow of a liquid or gas. Turbulence also refers to a state of disturbance.

129. (c) Other synonyms are prorogue, put off, set back, shelve.

130. (a) An adage is a proverb or byword.

131. (d) **132. (d)** **133. (a)**

134. (d) Sticking-extending out above a surface or boundary contrary-very opposite in nature or character or purpose.

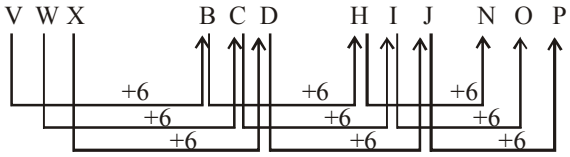
135. (c) Evocative-recreate strong feelings, memory etc.
Mesmerizing-attract strongly.

136. (c) **137. (b)** **138. (b)** **139. (c)**

140. (c)

141. (c) The number should be 140.
$\times 1 + 5, \times 2 + 5, \times 3 + 5$……

142. (b) The pattern is:



143. (a)

T	A	R	G	E	T
↓	↓	↓	↓	↓	↓
20	1	18	7	5	20

Similarly,

W	I	L	L	I	U	M
↓	↓	↓	↓	↓	↓	↓
23	9	12	12	9	21	13

144. (c) From the question we get,
Rakesh > Sanjay > Suresh
Binit > Rakesh > Harish
So, Binit is the tallest among them.

145. (a) No. of Persons between Rahul and Nitesh
= (36 + 29) - 62-2 = 65 - 62-2=1

146. (a) **147. (d)** BRANCN **148. (b)**

149. (b) **150. (c)**