Mock Test- 2

General Instructions

- *This question booklet contains 150 Multiple Choice Questions (MCQs).*
  Section-A: *Physics & Chemistry - 50 Questions each and*
  Section-B: *Mathematics - 50 Questions.*
- *Choice and sequence for attempting questions will be as per the convenience of the candidate.*
- *Read each question carefully.*
- *Determine the one correct answer out of the four available options given for each question.*
- *Each question with correct response shall be awarded one (1) mark. There shall be no negative marking.*
- *No mark shall be granted for marking two or more answers of same question, scratching or overwriting.*
- *Duration of paper is 3 Hours.*

SECTION-A

PHYSICS

1. The maximum velocity (in ms⁻¹) with which a car driver must traverse a flat curve of radius 150 m and coefficient of friction 0.6 to avoid skidding is
   (a) 60 (b) 30 (c) 15 (d) 25

2. A ring of mass m and radius r is melted and then moulded into a sphere. The moment of inertia of the sphere will be
   (a) more than that of the ring
   (b) less than that of the ring
   (c) equal to that of the ring
   (d) None of these

3. The young's modulus of a wire of length l and radius r is y N/m^2. If the length and radius are reduced to $\ell/2$ and r/2, then its young's modulus will be
   (a) y/2 (b) y (c) 2y (d) 4y

4. When the light is incident at the polarizing angle on the transparent medium, then the completely polarized light is
   (a) refracted light
   (b) reflected light
   (c) refracted and reflected light
   (d) neither reflected nor refracted light

5. A simple pendulum is made of a body which is a hollow sphere containing mercury suspended by means of a wire. If a little mercury is drained off, the period of pendulum will

   (a) remain unchanged
   (b) increase
   (c) decrease
   (d) become erratic

6. Which of the following is not correct about relative magnetic permeability (μ_r)?
   (a) It is a dimensionless pure ratio.
   (b) For vacuum medium its value is one.
   (c) For ferromagnetic materials $\mu_r >> 1$
   (d) For paramagnetic materials $\mu_r < 1$.

7. A non-linear polyactomic gas molecule (like NH_3) have how much degree of freedom?
   (a) 5 (b) 6 (c) 4 (d) 3

8. A transverse wave is represented by $y = A \sin(\omega t - kx)$. For what value of the wavelength is the wave velocity equal to the maximum particle velocity?

   (a) $\dfrac{\pi A}{2}$ (b) πA (c) $2\pi A$ (d) A

9. In an induction coil the current increases from 0 to 6 amp in 0.3 sec by which induced emf of 30 volt is produced in it then the value of coefficient of self inductance of coil will be
   (a) 3 H (b) 2 H
   (c) 1 H (d) 1.5 H

10. The X-rays of wavelength 0.5 Å are scattered by a target. What will be the energy of incident X-rays, if these are scattered at an angle of 72° ?
    (a) 12.41 keV   (b) 6.2 keV
   (c) 18.6 keV   (d) 24.82 keV

11. The centre of mass of two particles lies on the line
    (a) joining the particles
    (b) perpendicular to the line joining the particles
    (c) at any angle to this line
    (d) None of these

12. A transistor has three impurity regions. All the three regions have different doping levels. In order of increasing doping level, the regions are
    (a) emitter, base and collector
    (b) collector, base and emitter
    (c) base, emitter and collector
    (d) base, collector and emitter

13. If a_r and a_t represent radial and tangential accelerations, the motion of particle will be uniformly circular, if
    (a) $a_r = 0$ and $a_t = 0$ (b) $a_r = 0$ but $a_t \neq 0$
    (c) $a_r \neq 0$ and $a_t = 0$ (d) $a_r \neq 0$ and $a_t \neq 0$

14. Which of the given graphs proves Newton's law of cooling?

    (a)

    (b)

    (c)   (d) None of these
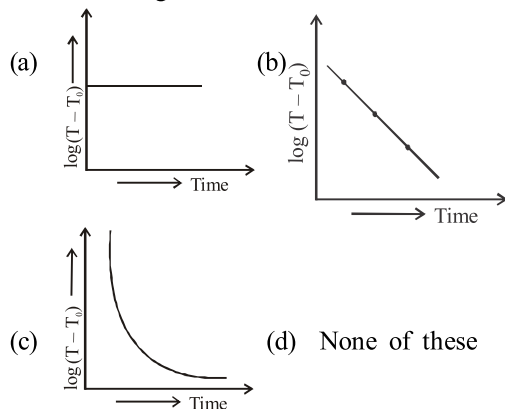
15. The mass number of He is 4 and that for sulphur is 32. The radius of sulphur nuclei is larger than that of helium by
    (a) $\sqrt{8}$ (b) 4 (c) 2   (d) 8

16. In a Young's double slit experiment, the separation of the two slits is doubled. To keep the same spacing of fringes, the distance D of the screen from the slits should be made
    (a) $\dfrac{D}{2}$ (b) $\dfrac{D}{\sqrt{2}}$ (c) $2D$ (d) $4D$

17. A pipe of length 85 cm is closed from one end. Find the number of possible natural oscillations of air column in the pipe whose frequencies lie below 1250 Hz. The velocity of sound in air is 340 m/s.
    (a) 12   (b) 8   (c) 6   (d) 4

18. Joule – second is a unit of
    (a) energy
    (b) torque
    (c) power
    (d) angular momentum

19. Magnetic lines of force due to a bar magnet do not intersect because
    (a) a point always has a single net magnetic field
    (b) the lines have similar charges and so repel each other
    (c) the lines always diverge from a single force
    (d) the lines need magnetic lenses to be made to interest

20. A Carnot engine whose sink is at 300 K has an efficiency of 40%. By how much should the temperature of source be increased so as to increase, its efficiency by 50% of original efficiency ?
    (a) 325 K (b) 250 K (c) 380 K (d) 275 K

21. A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block is
    (a) 20 N
    (b) 50 N
    (c) 100 N
    (d) 2 N
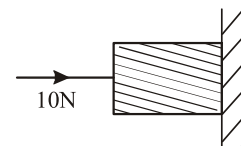
22. In an oscillating *LC* circuit with $L = 50$ mH and $C = 4.0$ μF, the current is initially a maximum. How long will it take before the capacitor is fully discharged for the first time :
    (a) 7×10^{-4} s   (b) 14×10^{-4} s
    (c) 28×10^{-4} s   (d) none

23. Pre-emphasis in FM system is done to
    (a) compress modulating signal
    (b) expand modulating signal
    (c) amplify lower frequency component of the modulating signal
    (d) amplify higher frequency component of the modulating signal

24. A body of mass m moving with velocity 3 km/h collides with a body of mass 2 m at rest. Now the coalesced mass starts to move with a velocity
(a) 1 km/h
(b) 2 km/h
(c) 3 km/h
(d) 4 km/h

25. The horizontal component of the earth's magnetic field is 3.6×10^{-5} tesla where the dip angle is $60°$. The magnitude of the earth's magnetic field is

(a) 2.8×10^{-4} tesla
(b) 2.1×10^{-4} tesla
(c) 7.2×10^{-5} tesla
(d) 3.6×10^{-5} tesla

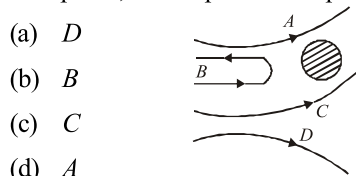26. If $\vec{A} = 4\hat{i} + 6\hat{j}$ and $\vec{B} = 2\hat{i} + 3\hat{j}$. Then

(a) $\vec{A} . \vec{B} = 29$

(b) $\vec{A} \times \vec{B} = \vec{0}$

(c) $\dfrac{|\vec{B}|}{|\vec{A}|} = \dfrac{2}{1}$

(d) angle between $\vec{A}$ and $\vec{B}$ is $30°$

27. In the Rutherford experiment, α-particles are scattered from a nucleus as shown. Out of the four paths, which path is not possible?
(a) D
(b) B
(c) C
(d) A

28. Two simple harmonic motions are represented by the equations $y_1 = 0.1 \sin \left(100\pi t + \dfrac{\pi}{3} \right)$ and $y_2 = 0.1 \cos \pi t$. The phase difference of the velocity of particle 1 with respect to the velocity of particle 2 is
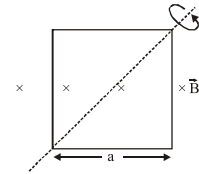
(a) $\dfrac{\pi}{3}$
(b) $\dfrac{-\pi}{6}$
(c) $\dfrac{\pi}{6}$
(d) $\dfrac{-\pi}{3}$

29. The wavefronts of a light wave travelling in vacuum are given by x + y + z = c. The angle made by the direction of propagation of light with the X-axis is
(a) $0°$
(b) $45°$
(c) $90°$
(d) $\cos^{-1}(1/\sqrt{3})$

30. A square loop of side a is rotating about its diagonal with angular velocity ω in a perpendicular magnetic field $\vec{B}$. It has 10 turns. The emf induced is
(a) $B a^2 \omega \sin \omega t$
(b) $B a^2 \omega \cos \omega t$
(c) $5 \sqrt{2} B a^2$
(d) $10 B a^2 \omega \sin \omega t$

31. A prism has a refracting angle of $60°$. When placed in the position of minimum deviation, it produces a deviation of $30°$. The angle of incidence is
(a) $30°$
(b) $45°$
(c) $15°$
(d) $60°$

32. An object of mass 10 kg moves at a constant speed of 10 ms^{-1}. A constant force, that acts for 4 sec on the object, gives it a speed of 2 ms^{-1} in opposite direction. The force acting on the object is
(a) -3 N
(b) -30 N
(c) 3 N
(d) 30 N

33. A charged particle q is placed at the centre O of cube of length L ($A\ B\ C\ D\ E\ F\ G\ H$). Another same charge q is placed at a distance L from O. Then the electric flux through $ABCD$ is

(a) $q / 4 \pi \epsilon_0 L$
(b) zero
(c) $q/2 \pi \epsilon_0 L$
(d) $q/3 \pi \epsilon_0 L$
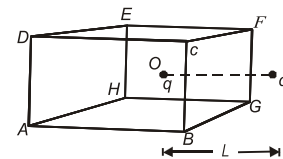
34. Spherical wavefronts, emanating from a point source, strike a plane reflecting surface. What will happen to these wave fronts, immediately after reflection?
(a) They will remain spherical with the same curvature, both in magnitude and sign.
(b) They will become plane wave fronts.
(c) They will remain spherical, with the same curvature, but sign of curvature reversed.
(d) They will remain spherical, but with different curvature, both in magnitude and sign.

35. Of the two eggs which have identical sizes, shapes and weights, one is raw, and other is half boiled. The ratio between the moment of inertia of the raw to the half boiled egg about central axis is
(a) one
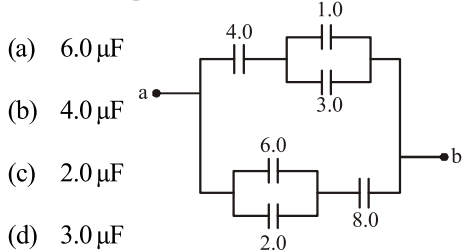(b) greater than one
(c) less than one
(d) not comparable

36. A current carrying conductor placed in a magnetic field experiences maximum force when angle between current and magnetic field is
(a) $3\pi/4$ (b) $\pi/2$ (c) $\pi/4$ (d) zero

37. In a photoelectric effect measurement, the stopping potential for a given metal is found to be V_0 volt when radiation of wavelength λ_0 is used. If radiation of wavelength $2\lambda_0$ is used with the same metal then the stopping potential (in volt) will be
(a) $\dfrac{V_0}{2}$
(b) $2V_0$
(c) $V_0 + \dfrac{hc}{2e\lambda_0}$
(d) $V_0 - \dfrac{hc}{2e\lambda_0}$

38. The equivalent capacitance between a and b for the combination of capacitors shown in figure where all capacitances are in microfarad is
(a) $6.0\,\mu F$
(b) $4.0\,\mu F$
(c) $2.0\,\mu F$
(d) $3.0\,\mu F$

39. A capillary tube is immersed vertically in water and the height of the water column is x. When this arrangement is taken into a mine of depth d, the height of the water column is y. If R is the radius of earth, the ratio $\dfrac{x}{y}$ is:
(a) $\left(1 - \dfrac{d}{R}\right)$
(b) $\left(1 - \dfrac{2d}{R}\right)$
(c) $\left(\dfrac{R - d}{R + d}\right)$
(d) $\left(\dfrac{R + d}{R - d}\right)$

40. The resistance of an ammeter is 13 Ω and its scale is graduated for a current upto 100 amps. After an additional shunt has been connected to this ammeter it becomes possible to measure currents upto 750 amperes by this meter. The value of shunt-resistance is
(a) $2\,\Omega$ (b) $0.2\,\Omega$ (c) $2\,k\Omega$ (d) $20\,\Omega$

41. A whistle S of frequency f revolves in a circle of radius R at a constant speed v. What is the ratio of largest and smallest frequency detected by a detector D at rest at a distance 2R from the centre of circle as shown in figure ?
(take c as speed of sound)
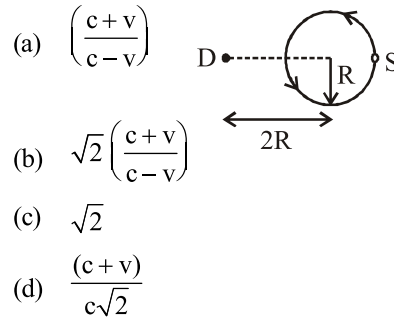
(a) $\left(\dfrac{c + v}{c - v}\right)$

(b) $\sqrt{2}\left(\dfrac{c + v}{c - v}\right)$

(c) $\sqrt{2}$

(d) $\dfrac{(c + v)}{c\sqrt{2}}$

42. A spherical ball of iron of radius 2 mm is falling through a column of glycerine. If densities of glycerine and iron are respectively 1.3×10^3 kg/m^3 and 8×10^3 kg/m^3. η for glycerine $= 0.83$ Nm^{-2} sec, then the terminal velocity is
(a) 0.7 m/s (b) 0.07 m/s
(c) 0.007 m/s (d) 0.0007 m/s

43. A potentiometer wire of length L and a resistance r are connected in series with a battery of e.m.f. E_0 and a resistance r_1. An unknown e.m.f. E is balanced at a length l of the potentiometer wire. The e.m.f. E will be given by :
(a) $\dfrac{E_0 r}{(r + r_1)} \cdot \dfrac{l}{L}$
(b) $\dfrac{E_0 l}{L}$
(c) $\dfrac{LE_0 r}{(r + r_1)l}$
(d) $\dfrac{LE_0 r}{l r_1}$

44. Two vibrating tuning forks producing waves given by
$y_1 = 27 \sin 600\pi t$ and $y_2 = 27 \sin 604\pi t$ are held near the ear of a person, how many beats will be heard in three seconds by him ?
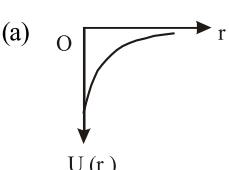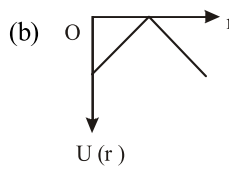(a) 4 (b) 2 (c) 6 (d) 12
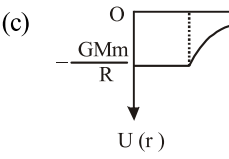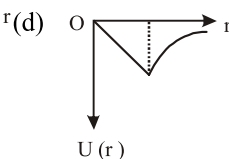
45. Two bodies of masses 4 kg and 9 kg are separated by a distance of 60 cm. A 1 kg mass is placed in between these two masses. If the net force on 1 kg is zero, then its distance from 4 kg mass is
(a) 26 cm (b) 30 cm (c) 28 cm (d) 24 cm

46. The diagram below shows a junction with currents labeled I_1 to I_6. Which of the following statements is correct?
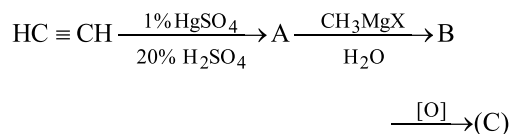(a) $I_1 + I_3 = I_6 + I_4$
(b) $I_1 + I_2 = I_6 + I_4$
(c) $I_4 + I_3 = I_6$
(d) $I_2 = I_6 + I_4$
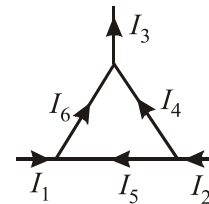
47. When a 8 kg mass is hung vertically on a light spring that obeys Hooke's law, the spring stretches by 4 cm. The work required to be done by an external agent in stretching this spring by 8 cm will be (g = 9.8 m/sec²)

(a) 4.2 joule   (b) 6.2 joule
(c) 5.2 joule   (d) 3.2 joule

48. A shell of mass M and radius R has a point mass m placed at a distance r from its centre. The graph of gravitational potential energy U(r) vs distance r will be

(a)

(b)

(c)

(d)

49. In an L-C-R series circuit connected to an AC source, $V = V_0 \sin\left(100\pi t + \dfrac{\pi}{6}\right)$. Given $V_R = 40V$, $V_L = 40V$ and $V_C = 10V$. Resistance $R = 4\Omega$. Peak value of current in the circuit is

(a) $10\sqrt{2}A$ (b) $15\sqrt{2}A$
(c) $20\sqrt{2}A$ (d) $25\sqrt{2}A$

50. A film of water is formed between two straight parallel wires of length 10 cm each separated by 0.5 cm. If their separation is increased by 1 mm while still maintaining their parallelism, how much work will have to be done? (Surface tension of water = 7.2×10^{-2} N/m)

(a) 7.22×10^{-6} J   (b) 1.44×10^{-5} J
(c) 2.88×10^{-5} J   (d) 5.76×10^{-5} J

CHEMISTRY

51. The end product (C) in the following sequence of reactions is

$$HC \equiv CH \xrightarrow[20\% \ H_2SO_4]{1\% \ HgSO_4} A \xrightarrow[H_2O]{CH_3MgX} B$$

$$\xrightarrow{[O]} (C)$$

(a) acetic acid   (b) isopropyl alcohol
(c) acetone   (d) ethanol

52. Octahedral complex of Cr(III) will be

(a) sp^3d^2 in case of weak field ligand
(b) d^2sp^3 in case of strong field ligand
(c) d^2sp^3 always
(d) sp^3d^2 always

53. Collision theory is applicable to

(a) first order reactions
(b) zero order reactions
(c) bimolecular reactions
(d) intra-molecular reactions

54. Which one of these is not compatible with arenes?

(a) Greater stability
(b) Delocalisation of π-electrons
(c) Electrophilic additions
(d) Resonance

55. Which set of following characteristics for ZnS crystal is correct?

(a) Coordination number (4 : 4); *ccp*; Zn^{2+} ion in the alternate tetrahedral voids
(b) Coordination number (6 : 6); *hcp*; Zn^{2+} ion in all tetrahedral voids.
(c) Coordination number (6 : 4); *hcp*; Zn^{2+} ion in all octahedral voids
(d) Coordination number (4 : 4); *ccp*; Zn^{2+} ion in all tetrahedral voids.

56. The correct order of decreasing polarisability of following ions is

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

57. For a first order reaction, A → products the concentration of A changes from 0.1 M to 0.025 M in 40 minutes.
The rate of reaction when the concentration of A is 0.01 M is :

(a) 1.73×10^{-5} M/min
(b) 3.47×10^{-4} M/min
(c) 3.47×10^{-5} M/min
(d) 1.73×10^{-4} M/min

58. One litre oxygen gas at S.T.P will weigh
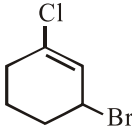
(a) 1.43 g   (b) 2.24 g
(c) 11.2 g   (d) 22.4 g

59. Which of the following is not the property of natural rubber?
(a) Low tensile strength
(b) High water absorption capacity
(c) Soft and sticky
(d) High elasticity

60. Which of the following will not give iodoform test?
(a) Isopropyl alcohol
(b) Ethanol
(c) Ethanal
(d) Benzyl alcohol

61. A deep brown gas is formed by mixing two colourless gases which are
(a) NO_2 and O_2
(b) N_2O and NO
(c) NO and O_2
(d) NH_3 and HCl

62. 18 g of glucose ($C_6H_{12}O_6$) is added to 178.2 g of water. The vapour pressure of water for this aqueous solution is
(a) 76.00 torr
(b) 752.40 torr
(c) 759.00 torr
(d) 7.60 torr

63. 16 g of oxygen and 3 g of hydrogen are mixed and kept at 760 mm of Hg pressure and 0° C. The total volume occupied by the mixture will be nearly

(a) 22.4 litres
(b) 33.6 litres
(c) 448 litres
(d) 44800 mL

64. An organic amino compound reacts with aqueous nitrous acid at low temperature to produce an oily nitrosoamine. The compound is
(a) CH_3NH_2
(b) $CH_3CH_2NH_2$
(c) $CH_3CH_2NHCH_2CH_3$
(d) $(CH_3CH_2)_3N$

65. Chemical formula for iron (III) hexacyanoferrate (II) is
(a) $Fe[Fe(CN)_6]$
(b) $Fe_3[Fe(CN)_6]$
(c) $Fe_3[Fe(CN)_6]_4$
(d) $Fe_4[Fe(CN)_6]_3$

66. In which of the following hydrogen is most acidic?
(a) Acetylene
(b) Methane
(c) Ethane
(d) Ethylene

67. A graph was plotted between molar conductivity of various electrolytes (NaCl, HCl and NH_4OH) and $\sqrt{c}$ (in $mol\,L^{-1}$). Correct set is :
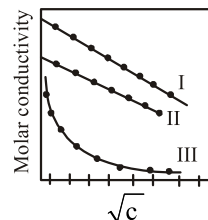
(a) I (NaCl), II (HCl), III, (NH_4OH)
(b) I (HCl), II (NaCl), III, (NH_4OH)
(c) I (NH_4OH), II (NaCl), III, (HCl)
(d) I (NH_4OH), II (HCl), III, (NaCl)

68. In the metallurgy of zinc, the reducing agent employed in reducing the zinc oxide to crude zinc metal in the last stage is
(a) Al
(b) Li
(c) Coke
(d) Water gas

69. Metals like Pt and Pd can adsorb large volume of hydrogen under specific conditions. Such adsorbed hydrogen by the metal is known as
(a) occluded hydrogen
(b) absorbed hydrogen
(c) reactive hydrogen
(d) atomic hydrogen

70. If concentration of reactants is increased by 'x', then k becomes

(a) $\ln \dfrac{k}{x}$ (b) $\dfrac{k}{x}$ (c) $k+x$ (d) k

71. At anode in the electrolysis of fused NaCl
(a) Na^+ is oxidized
(b) Cl^- is oxidized
(c) Cl is reduced
(d) Na is reduced

72. The correct decreasing order of priority of functional groups is
(a) $-SO_3H, -OH, -COCl, >C=C<$
(b) $-COOH, -SO_3H, -COOR, -OH$
(c) $-C \equiv C, -NH_2, -OH, >C=O$
(d) $-CN, -CONH_2, >C=O, -OH$

73. The main element of smog is
(a) O_3 and PAN
(b) O_3
(c) PAN
(d) PPN and PBN

74. Which of the following monosaccharide is a pentose ?
    (a) Galactose   (b) Glucose
    (c) Fructose   (d) Arabinose

75. 1-Chlorobutane on reaction with alcoholic potash gives
    (a) 1-butene   (b) 1-butanol
    (c) 2-butene   (d) 2-butanol

76. Which group contains coloured ions out of

    1. Cu^{2+} 2. Ti^{4+} 3. Co^{2+} 4. Fe^{2+}

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

77. In a solid lattice the cation has left a lattice site and is located at an interstitial position, the lattice defect is :
    (a) Interstitial defect   (b) Valency defect
    (c) Frenkel defect   (d) Schottky defect

78. The IUPAC name of the compound shown below is :

    (a) 3-bromo-1-chlorocyclohexene
    (b) 1-bromo-3-chlorocyclohexene
    (c) 2-bromo-6-chlorocyclohex-1-ene
    (d) 6-bromo-2-chlorocyclohexene

79. Phosphine is not obtained by which of the following 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

80. A drug that is antipyretic as well as analgesic is
    (a) chloropromazine hydrochloride
    (b) para- acetamidophenol
    (c) chloroquin
    (d) penicillin

81. Out of TiF_6^{2-}, CoF_6^{3-}, Cu_2Cl_2 and $NiCl_4^{2-}$ (Z of Ti = 22, Co = 27, Cu = 29, Ni = 28), the colourless species are:
    (a) Cu_2Cl_2 and $NiCl_4^{2-}$
    (b) TiF_6^{2-} and Cu_2Cl_2
    (c) CoF_6^{3-} and $NiCl_4^{2-}$
    (d) TiF_6^{2-} and CoF_6^{3-}

82. Equal moles of water and urea are taken in a flask. What is mass percentage of urea in the solution ?
    (a) 7.692%   (b) 769.2%
    (c) 76.92%   (d) 0.7692%

83. Surface tension of lyophilic sols is
    (a) lower than that of H_2O.
    (b) more than that of H_2O.
    (c) equal to that of H_2O.
    (d) either less or more than H_2O depending upon the nature of disperse phase.

84. The reaction of $KMnO_4$ and HCl results in
    (a) oxidation of Mn in $KMnO_4$ and production of Cl_2
    (b) reduction of Mn in $KMnO_4$ and production of H_2
    (c) oxidation of Mn in $KMnO_4$ and production of H_2
    (d) reduction of Mn in $KMnO_4$ and production of Cl_2

85. Chlorination of toluene in the presence of light and heat followed by treatment with aqueous NaOH gives
    (a) o-Cresol
    (b) p-Cresol
    (c) 2,4-Dihydroxytoluene
    (d) Benzoic acid

86. Consider the following complex $[Co(NH_3)_5CO_3]ClO_4$. The coordination number, oxidation number, number of d-electrons and number of unpaired d-electrons on the metal are respectively
    (a) 6, 3, 6, 0   (b) 7, 2, 7, 1
    (c) 7, 1, 6, 4   (d) 6, 2, 7, 3

87. In the diazotization of arylamines with sodium nitrite and hydrochloric acid, an excess of hydrochloric acid is used primarily to
    (a) supress the concentration of free aniline available for coupling.
    (b) supress hydrolysis of phenol.
    (c) ensure a stoichiometric amount of nitrous acid.
    (d) neutralise the base liberated.

88. Which ore contains both iron and copper?
    (a) Cuprite   (b) Chalcocite
    (c) Chalcopyrite   (d) Malachite

89. According to Le-Chatelier's principle, adding heat to a solid $\rightleftharpoons$ liquid equilibrium will cause the
    (a) temperature to increase
    (b) temperature to decrease
    (c) amount of liquid to decrease
    (d) amount of solid to decrease.

90. Consider the following statements for condensation polymerization -
    I.   Bifunctional or polyfunctional monomers
    II.   Loss of each kind of functional group in each step for bifunctional species
    III. Always accompanied by the release of a byproduct molecule
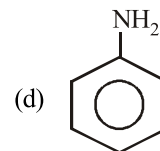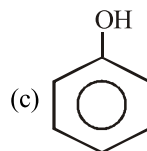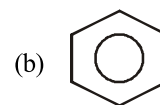   IV.   Monofunctional or polyfunctional monomers
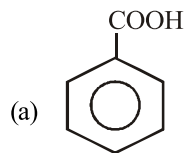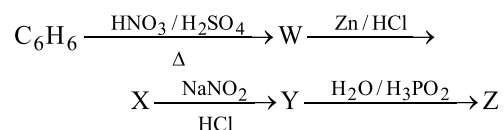   Which of the following are true?
    (a) I and II   (b) I, II and III
    (c) I and III   (d) III and IV

91. Aldehydes and ketones are distinguished by which of the following test ?
    (a) Lucas test
    (b) Tollen's test
    (c) $KMnO_4$ solution (Baeyer's test)
    (d) None of these

92. 'Z' in the following sequence of reactions is

    $$C_6H_6 \xrightarrow[\Delta]{HNO_3 / H_2SO_4} W \xrightarrow{Zn / HCl}$$
    $$X \xrightarrow[HCl]{NaNO_2} Y \xrightarrow{H_2O / H_3PO_2} Z$$

(a) COOH

(b)

(c) OH

(d) NH$_2$

93. Alum helps in purifying water by
    (a) forming Si complex with clay particles.
    (b) sulphate part which combines with the dirt and removes it.
    (c) aluminium which coagulates the mud particiles.
    (d) making mud water soluble.

94. In a solid 'AB' having the NaCl structure, 'A' atoms occupy the corners of the cubic unit cell. If all the face-centered atoms along one of the axes are removed, then the resultant stoichiometry of the solid is
    (a) AB_2 (b) A_2B (c) A_4B_3 (d) A_3B_4

95. Among the following actinide pairs, the maximum oxidation states is shown by
    (a) U and Np   (b) Np and Pu
    (c) Pu and Am   (d) U and Pa

96. Which one of the following reaction occurs at the cathode?
    (a) $2OH^- \longrightarrow H_2O + O + 2e^-$
    (b) $Ag \longrightarrow Ag^+ + e^-$
    (c) $Fe^{2+} \longrightarrow Fe^{3+} + e^-$
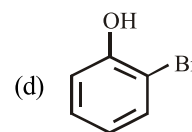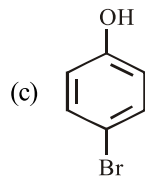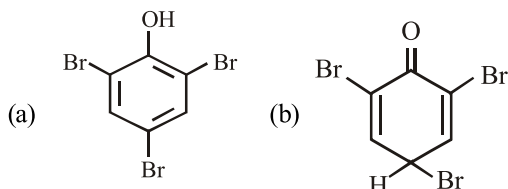   (d) $Cu^{2+} + 2e^- \longrightarrow Cu$

97. Lead pipes are not suitable for drinking water because
    (a) a layer of lead dioxide is deposited over pipes
    (b) lead reacts with air to form litharge
    (c) lead reacts with water containing air to form $Pb(OH)_2$
    (d) lead forms basic lead carbonate

98. Imino acid among these compounds is

(a) serine   (b) proline

(c) tyrosine   (d) lysine

99. What is the structure of the major product when phenol is treated with bromine water ?

(a) [structure: phenol with Br at positions 2,4,6 and OH]

(b) [structure: cyclohexadienone with Br substituents and H]

(c) [structure: 4-bromophenol]

(d) [structure: 2-bromophenol]

100. The presence or absence of hydroxyl group on which carbon atom of sugar differentiates RNA and DNA?

(a) 1st (b) 2nd (c) 3rd (d) 4th

SECTION-B

MATHEMATICS

1. In a class of 100 students, 55 students have passed in mathematics and 67 students have passed in physics. Then the number of students who have passed in physics only is

(a) 22   (b) 33   (c) 10   (d) 45

2. If $f(x) = x$ and $g(x) = |x|$, then $(f+g)(x)$ is equal to

(a) 0 for all $x \in R$ (b) $2x$ for all $x \in R$

(c) $\begin{cases} 2x, \text{ for } x \geq 0 \\ 0, \text{ for } x < 0 \end{cases}$ (d) $\begin{cases} 0, \text{ for } x \geq 0 \\ 2x, \text{ for } x < 0 \end{cases}$

3. Let A = {x, y, z} and B = {a, b, c, d}. Then, which one of the following is not a relation from A to B?

(a) {(x, a), (x, c)}   (b) {(y, c), (y, d)}

(c) {(z, a), (z, d)}   (d) {(z, b), (y, b), (a, d)}

4. A, B, C are the angles of a triangle, then

$\sin^2 A + \sin^2 B + \sin^2 C - 2\cos A \cos B \cos C =$

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

5. If the coefficients of rth, $(r+1)$th, and $(r+2)$th terms in the the binomial expansion of $(1+y)^m$ are in A.P., then m and r satisfy the equation

(a) $m^2 - m(4r-1) + 4r^2 - 2 = 0$

(b) $m^2 - m(4r+1) + 4r^2 + 2 = 0$

(c) $m^2 - m(4r+1) + 4r^2 - 2 = 0$

(d) $m^2 - m(4r-1) + 4r^2 + 2 = 0$

6. Two tangents PQ and PR drawn to the circle $x^2 + y^2 - 2x - 4y - 20 = 0$ from point P (16, 7). If the centre of the circle is C then the area of quadrilateral PQCR is

(a) 75 sq. unit   (b) 73 sq. unit

(c) 72 sq. unit   (d) 74 sq. unit

7. Two dice are thrown together. Then the probability, that the sum of numbers appearing on them is a prime number, is

(a) $\dfrac{5}{12}$ (b) $\dfrac{7}{18}$ (c) $\dfrac{13}{36}$ (d) $\dfrac{11}{36}$

8. If z and ω are two non-zero complex numbers such that $|z\omega| = 1$ and $Arg(z) - Arg(\omega) = \dfrac{\pi}{2}$, then $\bar{z}\omega$ is equal to

(a) $-i$ (b) 1   (c) -1 (d) i.

9. If $\dfrac{2}{9!} + \dfrac{2}{3!7!} + \dfrac{1}{5!5!} = \dfrac{2^a}{b!}$, where $a, b \in N$, then the ordered pair (a, b) is

(a) $(9, 10)$ (b) $(10, 9)$ (c) $(7, 10)$ (d) $(10, 7)$

10. If the third term in the expansion of $[x + x^{\log_{10} x}]^5$ is 10^6, then x may be

(a) 1   (b) $\sqrt{10}$ (c) 10   (d) $10^{-2/5}$

11. Find the equation of set points P such that $PA^2 + PB^2 = 2K^2$, where A and B are the points $(3, 4, 5)$ and $(-1, 3, -7)$, respectively :

(a) $K^2 - 109$

(b) $2K^2 - 109$

(c) $3K^2 - 109$

(d) $4K^2 - 10$

12. $\lim\limits_{x \to 0} (\text{cosec } x)^{1/\log x}$ is equal to :

(a) 0

(b) 1

(c) $\dfrac{1}{e}$

(d) None of these

13. If p and q are two statement then $(p \leftrightarrow \sim q)$ is true when –

(a) p and q both are true

(b) p and q both are false

(c) p is false and q is true

(d) None of these

14. Let $f : [4, \infty) \to [1, \infty)$ be a function defined by

$f(x) = 5^{x(x-4)}$, then $f^{-1}(x)$ is

(a) $2 - \sqrt{4 + \log_5 x}$ (b) $2 + \sqrt{4 + \log_5 x}$

(c) $\left(\dfrac{1}{5}\right)^{x(x-4)}$ (d) None of these

15. The sum of the infinite series

$\cot^{-1} 2 + \cot^{-1} 8 + \cot^{-1} 18 + \cot^{-1} 32 + \ldots$ is

(a) π

(b) $\dfrac{\pi}{2}$

(c) $\dfrac{\pi}{4}$

(d) None of these

16. If $A = \begin{bmatrix} 1 & 0 \\ 1/2 & 1 \end{bmatrix}$, A^{400} is equal to

(a) $\begin{pmatrix} 1 & 0 \\ 50 & 1 \end{pmatrix}$

(b) $\begin{pmatrix} 1 & 0 \\ (1/2)^{100} & 1 \end{pmatrix}$

(c) $\begin{pmatrix} 1 & 0 \\ 25 & 1 \end{pmatrix}$

(d) None of these

17. If the determinant

$\Delta = \begin{vmatrix} a & b & (ax+b)/x \\ b & c & bx+c \\ ax+b & bx+c & 0 \end{vmatrix} = 0,$

then a, b, c are in :

(a) A.P.

(b) G.P.

(c) H.P.

(d) None of the above

18. If $f(x) = \dfrac{1}{1-x}$, then the points of discontinuity of the function $f[f\{f(x)\}]$ are

(a) $\{0, -1\}$

(b) $\{0,1\}$

(c) $\{1, -1\}$

(d) None of these

19. The area enclosed between the curves $y = ax^2$ and $x = ay^2$ $(a > 0)$ is 1 sq. unit, then the value of a is

(a) $\dfrac{1}{\sqrt{3}}$ (b) $\dfrac{1}{2}$ (c) 1   (d) $\dfrac{1}{3}$

20. $\int \dfrac{dx}{\cos x - \sin x}$ is equal to

(a) $\dfrac{1}{\sqrt{2}} \log \left| \tan \left(\dfrac{x}{2} + \dfrac{3\pi}{8} \right) \right| + C$

(b) $\dfrac{1}{\sqrt{2}} \log \left| \cot \left(\dfrac{x}{2} \right) \right| + C$

(c) $\dfrac{1}{\sqrt{2}} \log \left| \tan \left(\dfrac{x}{2} - \dfrac{3\pi}{8} \right) \right| + C$

(d) $\dfrac{1}{\sqrt{2}} \log \left| \tan \left(\dfrac{x}{2} - \dfrac{\pi}{8} \right) \right| + C$

21. $\dfrac{d^n}{dx^n}(\log x) =$

(a) $\dfrac{(n-1)!}{x^n}$

(b) $\dfrac{n!}{x^n}$

(c) $\dfrac{(n-2)!}{x^n}$

(d) $(-1)^{n-1} \dfrac{(n-1)!}{x^n}$

22. Let $ABCD$ be a parallelogram. If $\overrightarrow{AB} = \hat{i} + 3\hat{j} + 7\hat{k}$, $\overrightarrow{AD} = 2\hat{i} + 3\hat{j} + -5\hat{k}$ and $\vec{p}$ is a unit vector parallel to $\overrightarrow{AC}$, then $\vec{p}$ is equal to

(a) $\frac{1}{3}(2\hat{i} + \hat{j} + 2\hat{k})$ (b) $\frac{1}{3}(2\hat{i} - 2\hat{j} + \hat{k})$

(c) $\frac{1}{7}(3\hat{i} + 6\hat{j} + 2\hat{k})$ (d) $\frac{1}{7}(6\hat{i} + 2\hat{j} + 3\hat{k})$

23. The two lines $x = ay + b$, $z = cy + d$ and $x = a'y + b'$, $z = c'y + d'$ will be perpendicular, if and only if

(a) $aa' + cc' + 1 = 0$

(b) $aa' + bb' + cc' + 1 = 0$

(c) $aa' + bb' + cc' = 0$

(d) $(a + a')(b + b') + (c + c') = 0$.

24. The equation of the tangent to the curve $y = e^{-|x|}$ at the point where the curve cuts the line $x = 1$ is

(a) $e(x + y) = 1$ (b) $y + ex = 1$

(c) $y + x = e$ (d) None of these

25. Maximize $Z = 4x + 6y$, subject to $3x + 2y \le 12$, $x + y \ge 4$, $x, y \ge 0$, is

(a) 16 at (4,0)   (b) 24 at (0, 4)

(c) 24 at (6, 0)   (d) 36 at (0, 6)

26. The gradient of the curve passing through (4, 0) is given by $\frac{dy}{dx} - \frac{y}{x} + \frac{5x}{(x+2)(x-3)} = 0$ if the point (5, a) lies on the curve, then the value of a is

(a) $\frac{67}{12}$ (b) $5\sin\frac{7}{12}$

(c) $5\log\frac{7}{12}$ (d) None of these

27. For a biased dice, the probability for the different faces to turn up are

Face	1	2	3	4	5	6
P	0.10	0.32	0.21	0.15	0.05	0.17

The dice is tossed and it is told that either the face 1 or face 2 has shown up, then the probability that it is face 1, is

(a) $\frac{16}{21}$ (b) $\frac{1}{10}$ (c) $\frac{5}{16}$ (d) $\frac{5}{21}$

28. $\int_0^2 [x^2]dx$ is

(a) $2 - \sqrt{2}$ (b) $2 + \sqrt{2}$

(c) $\sqrt{2} - 1$ (d) $-\sqrt{2} - \sqrt{3} + 5$

29. If $0 \le x \le \pi$ and $81^{\sin^2 x} + 81^{\cos^2 x} = 30$, then $x =$

(a) $\pi/6$ (b) $\pi/2$ (c) $\pi/4$ (d) $3\pi/4$

30. If $x = 1 + a + a^2 + ...$ to infinity and $y = 1 + b + b^2 + ...$ to infinity, where a, b are proper fractions, then $1 + ab + a^2b^2 + ...$ to infinity is equal :

(a) $\frac{xy}{x+y-1}$ (b) $\frac{xy}{x-y-1}$

(c) $\frac{xy}{x-y+1}$ (d) $\frac{xy}{x+y+1}$

31. The slopes of the lines which make an angle $45°$ with the line $3x - y = -5$ are

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

32. If $P \equiv (x, y)$, $F_1 \equiv (3, 0)$, $F_2 \equiv (-3, 0)$ and $16x^2 + 25y^2 = 400$, then $PF_1 + PF_2$ equals

(a) 8   (b) 6   (c) 10   (d) 12

33. Product of real roots of the equation $t^2x^2 + |x| + 9 = 0$

(a) is always positive (b) is always negative

(c) does not exist   (d) None of these

34. If $f(z) = \frac{7-z}{1-z^2}$, where $z = 1 + 2i$, then $|f(z)|$ is equal to :

(a) $\frac{|z|}{2}$ (b) $|z|$

(c) $2|z|$ (d) None of these

35. The solution set of the inequality $5^{x+2} > \left(\frac{1}{25}\right)^{1/x}$ is

(a) $(-2, 0)$ (b) $(-2, 2)$

(c) $(-5, 5)$ (d) $(0, \infty)$

36. The number of ways in which first, second and third prizes can be given to 5 competitors is
(a) 10   (b) 60   (c) 15   (d) 125

37. The number of dissimilar terms in the expansion of $(a+b)^n$ is $n+1$, therefore number of dissimilar terms in the expansion of $(a+b+c)^{12}$ is
(a) 13   (b) 39   (c) 78   (d) 91

38. If $y = \left(1+\dfrac{1}{x}\right)\left(1+\dfrac{2}{x}\right)\left(1+\dfrac{3}{x}\right)\ldots\left(1+\dfrac{n}{x}\right)$ and $x \neq 0$,

then $\dfrac{dy}{dx}$ when $x = -1$ is

(a) $n!$ (b) $(n-1)!$
(c) $(-1)^n(n-1)!$ (d) $(-1)^n \, n!$

39. Mean of 100 items is 49. It was discovered that three items which should have been 60, 70, 80 were wrongly read as 40, 20, 50 respectively. The correct mean is

(a) 48   (b) $82\dfrac{1}{2}$ (c) 50   (d) 80

40. If $f(x) = \sin x + \cos x$, $g(x) = x^2 - 1$, then $g(f(x))$ is invertible in the domain

(a) $\left[0, \dfrac{\pi}{2}\right]$ (b) $\left[-\dfrac{\pi}{4}, \dfrac{\pi}{4}\right]$

(c) $\left[-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right]$ (d) $[0, \pi]$

41. The matrix $A = \begin{bmatrix} -5 & -8 & 0 \\ 3 & 5 & 0 \\ 1 & 2 & -1 \end{bmatrix}$ is

(a) idempotent matrix   (b) involutory matrix
(c) nilpotent matrix   (d) None of these

42. Consider the system of equations :
$x + ay = 0$, $y + az = 0$ and $z + ax = 0$. Then the set of all real values of 'a' for which the system has a unique solution is:
(a) $R - \{1\}$ (b) $R - \{-1\}$
(c) $\{1, -1\}$ (d) $\{1, 0, -1\}$

43. If $y = \dfrac{(a-x)\sqrt{a-x} - (b-x)\sqrt{x-b}}{\sqrt{a-x} + \sqrt{x-b}}$, then $\dfrac{dy}{dx}$ wherever it is defined is

(a) $\dfrac{x+(a+b)}{\sqrt{(a-x)(x-b)}}$ (b) $\dfrac{2x-a-b}{2\sqrt{a-x}\sqrt{x-b}}$

(c) $-\dfrac{(a+b)}{2\sqrt{(a-x)(x-b)}}$ (d) $\dfrac{2x+(a+b)}{2\sqrt{(a-x)(x-b)}}$

44. $\displaystyle\int \dfrac{(1+x)e^x}{\cot(xe^x)}\,dx$ is equal to

(a) $\log\left|\cos(xe^x)\right| + C$ (b) $\log\left|\cot(xe^x)\right| + C$

(c) $\log\left|\sec(xe^{-x})\right| + C$ (d) $\log\left|\sec(xe^x)\right| + C$

45. If $(\vec{a} \times \vec{b})^2 + (\vec{a}.\vec{b})^2 = 676$ and $|\vec{b}| = 2$ then $|\vec{a}|$ is equal to
(a) 13   (b) 26
(c) 39   (d) None of these

46. The area enclosed between the curves $y^2 = x$ and $y = |x|$ is
(a) 1/6   (b) 1/3   (c) 2/3   (d) 1

47. A coin is tossed 7 times. The probability that at least 4 consecutive heads appear is

(a) $\dfrac{3}{16}$ (b) $\dfrac{5}{32}$ (c) $\dfrac{3}{32}$ (d) $\dfrac{1}{8}$

48. $f(x) = (\sin^2 x)e^{-2\sin^2 x}$; $\max. f(x) - \min. f(x) =$

(a) $\dfrac{1}{e^2}$ (b) $\dfrac{1}{2e} - \dfrac{1}{e^2}$

(c) 1   (d) None of these

49. The solution of $\dfrac{dy}{dx} = \dfrac{e^x(\sin^2 x + \sin 2x)}{y(2\log y + 1)}$ is
(a) $y^2(\log y) - e^x \sin^2 x + c = 0$
(b) $y^2(\log y) - e^x \cos^2 x + c = 0$
(c) $y^2(\log y) + e^x \cos^2 x + c = 0$
(d) None of these

50. $\displaystyle\int_0^\pi xf(\sin x)\,dx$ is equal to

(a) $\pi\displaystyle\int_0^\pi f(\cos x)\,dx$ (b) $\pi\displaystyle\int_0^\pi f(\sin x)\,dx$

(c) $\dfrac{\pi}{2}\displaystyle\int_0^{\pi/2} f(\sin x)\,dx$ (d) $\pi\displaystyle\int_0^{\pi/2} f(\cos x)\,dx$