MOCK TEST 8

Time : 3 Hours **Stream-SA** **Maximum Marks : 100**

INSTRUCTIONS

1. There are 80 questions in this paper.
2. The question paper contains two parts; Part–I (1 Mark Questions) and Part–II (2 Marks Questions). There are four sections; Mathematics, Physics, Chemistry and Biology in each part.
3. There are four options given with each question, only one of them is correct.
4. For each incorrect answer 0.25 Mark in Part–I and 0.5 Mark in Part–II will be deducted.

PART-I (1 MARK QUESTIONS)

MATHEMATICS

1. In a $\Delta PQR, \angle R = \frac{\pi}{2}$. If $\tan\left(\frac{P}{2}\right)$ and $\tan\left(\frac{Q}{2}\right)$ are roots of the equation $ax^2 + bx + c = 0$ $(a \neq 0)$, then

(a) a + b = c (b) b + c = 0

(c) a + c = b (d) b = c

2. If N is a two digit number such that last two digit of N^3 is 44 then what is the summation of all the possible values of N?

(a) 78 (b) 80

(c) 72 (d) 86

3. How many values of natural number N exist such that both N and $N + 3293$ are perfect squares?

(a) 0 (b) 1

(c) 9 (d) None of these

4. If (k, k) is the set of solution of system of equations $ax + by + (t - s) = 0$ and $bx + ay + (s - r) = 0, a \neq b$. Then which of the following must be true.

(a) $2r = x + t$

(b) $2t = r + s$

(c) $2s = r + t$

(d) $r + s + t = 0$

5. Let a, b, c be distinct digits. Consider a two digit number 'ab' and three digits 'ccb' both defined under the usual decimal number system. If $(ab)^2 = ccb$ and $ccb > 300$, then the value of b is:

(a) 1 (b) 0

(c) 5 (d) 6

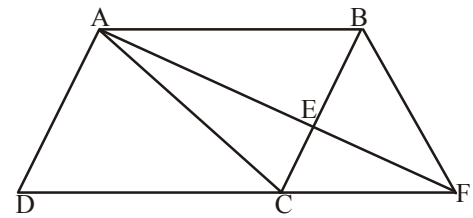
6. A point E is taken on the side BC of a parallelogram ABCD. AE and DC are produced to meet at F. Then

(a) Area (ΔABCD) = Area (ΔACF)

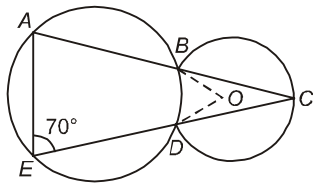
(b) Area (ΔADF) = Area (ABFC)

(c) Area (ΔABF) = Area (ΔACF)

(d) None of these

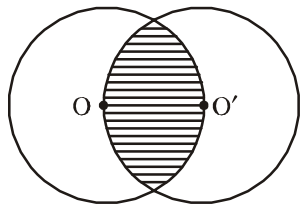


7. In the figure, O is the centre of the circle BCD. ABC and EDC are straight lines, $BC = DC$ and $\angle AED = 70°$, Find $\angle BOD$



(a) 40° (b) 70°
(c) 80° (d) 90°

8. In the figure shown, two identical circles of radii r are drawn. If the centre of the circles lie on each other circumference, what is the area of shaded region?



(a) $\frac{2}{3}\pi r^2 - \frac{\sqrt{3}}{2}r^2$ (b) $2\pi r^2 - \frac{\sqrt{3}}{2}r^2$

(c) $\frac{1}{3}\pi r^2$ (d) $\frac{\pi r^2}{2}$

9. If ABC is a triangle right angled at B and M, N are the mid-points of AB and BC, then $4(AN^2 + CM^2)$ is equal to :

(a) $4AC^2$ (b) $5AC^2$

(c) $\frac{5}{4}AC^2$ (d) $6AC^2$

10. AD is a diameter of a circle. Two more circles pass through A and intersect AD in B and C respectively, such that AB and AC are diameters of these circles and AD > AC > AB. If the circumference of the middle circle is average of the circumference of the other two, then given AB = 4 units and CD = 2 units, what is the area, in sq. units of the largest circle?

(a) 128π (b) 64À
(c) 48À (d) 16π

11. If cost price of 40 pens is more than cost of 15 copies but less than cost of 16 copies. What can be the minimum total cost of a pen and a copy if price of both pen and copy is an integer

(a) 16 (b) 18
(c) 20 (d) 21

12. A hollow cube is inscribed in a hollow sphere, such that all the corners of cube touches sphere. Then the ratio of air between sphere and cube to the air in cube is

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

(c) $\frac{\sqrt{3}\pi - 8}{8}$ (d) $\frac{8}{\sqrt{3}\pi - 8}$

13. Let $S = \{x \in R : x \geq 0$ and $2|\sqrt{x} - 3| + \sqrt{x}(\sqrt{x} - 6) + 6 = 0$. Then S :

(a) contains exactly one element.
(b) contains exactly two elements.
(c) contains exactly four elements.
(d) is an empty set.

14. How many two digit numbers exist such that the product of two digit number and two digit number formed by reversing its digits end with 5.

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

15. If two roots of the equation

$(p-1)(x^2+x+1)^2 - (p+1)(x^4+x^2+1) = 0$

are real and distinct and $f(x) = \frac{1-x}{1+x}$, then $f(f(x)) + f\left(f\left(\frac{1}{x}\right)\right)$ is equal to

(a) p (b) $-p$
(c) $2p$ (d) $-2p$

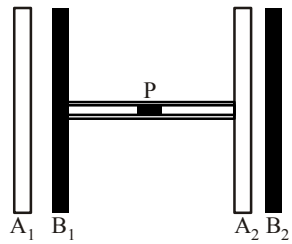
PHYSICS

16. One end of uniform wire of length L and of weight W is attached rigidly to a point in the roof and a weight W_1 is suspended from its lower end. If s is the area of cross section of the wire, the stress in the wire at a height $\left(\frac{3L}{4}\right)$ from its lower end is

(a) $\frac{W_1}{s}$ (b) $\left[W_1+\frac{W}{4}\right]s$

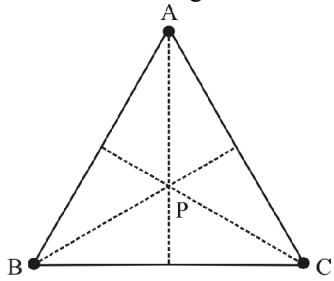
(c) $\left[W_1+\frac{3W}{4}\right]/s$ (d) $\frac{W_1+W}{s}$

17. Two plates identical in size, one of black and rough surface (B_1) and the other smooth and polished (A_2) are interconnected by a thin horizontal pipe with a mercury pellet at the centre. Two more plates A_1 (identical to A_2) and B_2 (identical to B_1) are heated to the same temperature and placed closed to the plates B_1, and A_2 as shown in the fig. The mercury pellet



(a) moves to the right
(b) moves to the left
(c) remains stationary
(d) starts oscillating left and right

18. Three equal masses (each m) are placed at the corners of an equilateral triangle of side '*a*'. Then the escape velocity of an object from the circumcentre *P* of triangle is :



(a) $\sqrt{\frac{2\sqrt{3}\,Gm}{a}}$ (b) $\sqrt{\frac{\sqrt{3}\,Gm}{a}}$

(c) $\sqrt{\frac{6\sqrt{3}\,Gm}{a}}$ (d) $\sqrt{\frac{3\sqrt{3}\,Gm}{a}}$

19. Consider a Vernier callipers in which each 1 cm on the main scale is divided into 8 equal divisions and a screw gauge with 100 divisions on its circular scale. In the Vernier callipers, 5 divisions of the Vernier scale coincide with 4 divisions on the main scale and in the screw gauge, one complete rotation of the circular scale moves it by two divisions on the linear scale.
Select the correct statement :

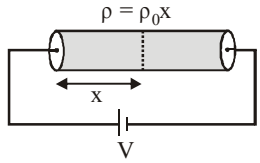
I. If the pitch of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is 0.01 mm
II. If the pitch of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is 0.005 mm
III. If the least count of the linear scale of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is 0.01 mm
IV. If the least count of the linear scale of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is 0.005 mm

(a) I only
(b) II and III
(c) III and IV
(d) I and IV

20. In an ideal transformer the number of turns of primary and secondary coil is given as 100 and 300 respectively. If the power input is 60 W, the power output is

(a) 100 W (b) 300 W
(c) 180 W (d) 60 W

21. A cylindrical solid of length L and radius a is having varying resistivity given by $\rho = \rho_0 x$, where ρ_0 is a positive constant and x is measured from left end of solid. The cell shown in the figure is having emf V and negligible internal resistance. The magnitude of electric field as a function of x is best described by



(a) $\frac{2V}{L^2}x$ (b) $\frac{2V}{\rho_0 L^2}x$

(c) $\frac{V}{L^2}x$ (d) None of these

22. Consider a moving charged particle in a region of magnetic field. Which of the following statements are correct ?

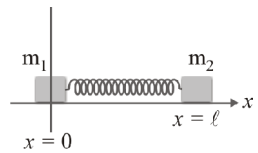
(a) If **v** is parallel to **B**, then path of particle is spiral.

(b) If **v** is perpendicular to **B**, then path of particle is a circle.

(c) If **v** has a component along **B**, then path of particle is zig-zag.

(d) If **v** is along **B**, then path of particle is a circle.

23. Two masses m_1 and m_2 are connected by a massless spring of spring constant k and unstretched length ℓ. The masses are placed on a frictionless straight channel, which are consider our x-axis. They are initially at $x = 0$ and $x = \ell$ respectively. At $t = 0$, a velocity v_0 is suddenly imparted to the first particle. At a later time t, the centre of mass of the two masses is at:



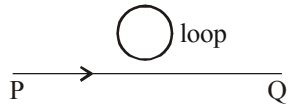
(a) $x = \frac{m_2\ell}{m_1 + m_2}$

(b) $x = \frac{m_1\ell}{m_1 + m_2} + \frac{m_2 v_0 t}{m_1 + m_2}$

(c) $x = \frac{m_2\ell}{m_1 + m_1} + \frac{m_2 v_0 t}{m_1 + m_2}$

(d) $x = \frac{m_2\ell}{m_1 + m_2} + \frac{m_1 v_0 t}{m_1 + m_2}$

24. An electron moves along the line PQ as shown which lies in the same plane as a circular loop of conducting wire as shown in figure. What will be the direction of the induced current initially in the loop when electron comes closer to loop?



(a) Anticlockwise

(b) Clockwise

(c) Direction can not be predicted

(d) No current will be induced

25. Choose the incorrect statement:

(a) Torque depends on transverse component of force.

(b) Angular momentum depends on transverse component of linear momentum.

(c) Radial component of linear momentum does not contribute to the angular momentum.

(d) None of these

26. A set of n identical cubical blocks lies at rest parallel to each other along a line on a smooth horizontal surface. The separation between the near surfaces of any two adjacent blocks is L. The block of one end is given a speed v towards the next one at time $t = 0$. All collisions are completely inelastic, then ;

(a) the last block starts moving at $t = \frac{(n-1)L}{v}$

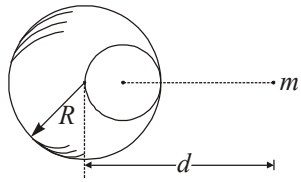
(b) the last block starts moving at $t = \frac{n(n+1)L}{2v}$

(c) the centre of mass of the system will have a final speed v

(d) the centre of mass of the system will have a final speed $\frac{v}{n}$

27. The figure shows a spherical hollow inside a lead sphere of radius R, the surface of the hollow passes through the centre of the sphere and "touches" the right side of the sphere. The mass of the sphere before hollowing was M. With what gravitational force does the hollowed out

lead sphere attract a small sphere of mass *m* that lies at a distance '*d*' from the centre of the lead sphere, on the straight line connecting the centres of the sphere and of the hollow :



(a) $\frac{GMm}{d^2}\left[1-\frac{1}{8\left(1-\frac{R}{2d}\right)^2}\right]$

(b) $\frac{GMm}{d^2}\left[1+\frac{1}{4\left(1-\frac{R}{2d}\right)^2}\right]$

(c) $\frac{GMm}{d^2}\left[1-\frac{1}{4\left(1-\frac{R}{2d}\right)^2}\right]$

(d) $\frac{GMm}{d^2}\left[1+\frac{1}{8\left(1-\frac{R}{2d}\right)^2}\right]$

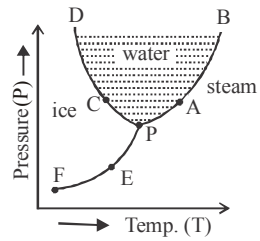
28. In the given pressure-temperature diagram, for water, which point indicates triple point?

(a) A

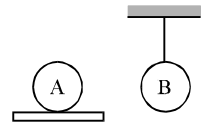
(b) C

(c) P

(d) E



29. Consider two identical iron spheres, one of which lies on a thermally insulating plate, while the other hangs from thermally insulating thread. The spheres are arranged so that their centres of mass are at the same height level (see figure).



If equal amount of heat is supplied to the two spheres, then

(a) temperature of A will be greater than B

(b) temperature of B will be greater than A

(c) their temperature will be equal

(d) can't be predicted

30. An aeroplane flying at a constant speed releases a bomb. As the bomb moves away from the aeroplane, it will

(a) always be vertically below the aeroplane only if the aeroplane was flying horizontally

(b) always be vertically below the aeroplane only if the aeroplane was flying at an angle of 45° to the horizontal

(c) always be vertically below the aeroplane

(d) gradually fall behind the aeroplane if the aeroplane was flying horizontally.

CHEMISTRY

31. The compound which contains both ionic and covalent bond is:

(a) KCl (b) KCN (c) CH_4 (d) H_2

32. Geometrical isomerism is possible in :

(a) $CH_3CH(CH_3)CH_2CH_2CH_3$

(b) $CH_3CH{=}CHCH_3$

(c) $CH_3CH{=}CH_2$

(d) ClH_2C-CH_2Cl

33. The number of hydrogen atoms present in 25.6 g of sucrose ($C_{12}H_{22}O_{11}$) which has a molar mass of 342.3 g is:

(a) 22×10^{23} (b) 9.91×10^{23}

(c) 11×10^{23} (d) 44×10^{23}

34. For the reaction

$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g), \Delta H=?$

(a) $\Delta E+2RT$ (b) $\Delta E-2RT$

(c) $\Delta E-RT$ (d) None of these

35. The number of moles of $KMnO_4$ needed to react completely with one mole of ferrous oxalate in acidic solution are :

(a) $\frac{3}{5}$ (b) $\frac{2}{5}$ (c) $\frac{4}{5}$ (d) 1

36. Which of the following has the maximum number of unpaired electrons?

(a) Mn (b) Ti (c) V (d) Al

37. Consider the following reaction :

$$H_2SO_4 + NH_3 \xrightarrow{\text{Water}} NH_4^+ + HSO_4^-$$

Which of the following is correct for above equation?

(a) HSO_4^- is a weak conjugate acid of H_2SO_4.

(b) NH_3 is a weak base.

(c) NH_4^+ is a weak conjugate acid of NH_3.

(d) H_2SO_4 is a weak acid.

38. In which of the following reactions, the underlined substance has been reduced?

(a) $\underline{CO} + CuO \longrightarrow CO_2 + Cu$

(b) $\underline{CuO} + 2HCl \longrightarrow CuCl_2 + H_2O$

(c) $\underline{4H_2O} + 3Fe \longrightarrow 4H_2 + Fe_3O_4$

(d) $\underline{C} + 4HNO_3 \longrightarrow CO_2 + 2H_2O + 4NO_2$

39. Which step is chain propagation step in the following mechanism?

(a) $Cl_2 \xrightarrow{h\nu} Cl^{\bullet} + Cl^{\bullet}$

(b) $Cl^{\bullet} + CH_4 \longrightarrow {}^{\bullet}CH_3 + HCl$

(c) $Cl^{\bullet} + Cl^{\bullet} \longrightarrow Cl_2$

(d) ${}^{\bullet}CH_3 + {}^{\bullet}Cl \longrightarrow CH_3Cl$

40. Aluminium is usually found in +3 oxidation state. In contrast, thallium exists in +1 and + 3 oxidation states. This is due to:

(a) Inert pair effect

(b) Diagonal relationship

(c) Lattice effect

(d) Lanthanoid contraction

41. Which of the following represents the correct order of increasing electron gain enthalpy with negative sign for the elements O, S, F and Cl ?

(a) $Cl < F < O < S$ (b) $O < S < F < Cl$

(c) $F < S < O < Cl$ (d) $S < O < Cl < F$

42. When a metal is added to dilute HCl solution, there is no evolution of gas. Metal is –

(a) K (b) Na (c) Ag (d) Zn

43. At 550K, the K_c for the following reaction is 10^4 mol^{-1} L

$X(g) + Y(g) \rightleftharpoons Z(g)$. At equilibrium, it was observed that $[X] = \frac{1}{2}[Y] = \frac{1}{2}[Z]$. What is value of [Z] (in mol L^{-1}) at equilibrium?

(a) 2×10^{-4} (b) 10^{-4}

(c) 2×10^4 (d) 10^4

44. Molecular weight of a gas that diffuses twice as rapidly as the gas with molecular weight 64 is:

(a) 16 (b) 8 (c) 64 (d) 6.4

45. Which of the following oxides is not expected to react with sodium hydroxide?

(a) CaO (b) SiO_2

(c) BeO (d) B_2O_3

BIOLOGY

46. Maltose consists of which one of the following?

(a) β- glucose and β-galactose

(b) α- glucose and α-fructose

(c) α-sucrose and β-glucose

(d) Glucose and glucose

47. Which one of the following shortens when a muscle fibre contracts?

(a) Thick filament (b) Sarcomere

(c) Troponin (d) Thin filament

48. Bacteria having single flagellum on both sides:

(a) Amphitrichous (b) Cephalotrichous

(c) Peritrichous (d) Lophotrichous

49. Meals which are rich in fat are not digested in the intestine in absence of:

(a) Pepsin (b) Enterokinase

(c) Insulin (d) Steapsin

50. Sinks are related to:

(a) Transport of minerals

(b) Stomata

(c) Enzymes

(d) Phytochrome

51. Pectin is:

(a) Monosaccharides

(b) Homopolysaccharides

(c) Mucopolysaccharides

(d) Heteropolysaccharides

52. The most common indicator organism of polluted water is:
(a) *E. coli* (b) *P. typhi*
(c) *Vibrio* (d) *Entamoeba*

53. Pentoses and hexoses are the most common:
(a) Disaccharides
(b) Monosaccharides
(c) Oilgosaccharides
(d) Polysaccharides

54. Which of the following elements are involved in muscle contraction?
(a) Ca^{2+} and Mg^{2+} (b) Ca^{2+} and Na^{+}
(c) Na^{+} and K^{+} (d) Mg^{2+} and K^{+}

55. In dicotyledonous stem, fascicular cambium is a meristematic tissue. It is an example of which of the following meristem?
(a) Lateral (b) Secondary
(c) Apical (d) Intercalary

56. Which of the following is not a steroid hormone?
(a) Androgen (b) Aldosterone
(c) Estrogen (d) Relaxin

57. Which of the following hormones can replace vernalisation?
(a) Ethylene (b) Gibberellins
(c) Cytokinins (d) Auxins

58. Which of the following conversions takes place in the blood clotting pathways?
(a) Conversion of vitamin K to prothrombin.
(b) Conversion of fibrin to fibrinogen.
(c) Conversion of thrombin to prothrombin.
(d) None of the above

59. Contraction of gall bladder is induced by:
(a) Gastrin (b) Cholecystokinin
(c) Secretin (d) Enterogastrone

60. Smallest cell of human body is:
(a) Erythrocyte (b) Monocyte
(c) Neuron (d) Blood platelets

PART-II (2 MARKS QUESTIONS)

MATHEMATICS

61. If a^8 and 8^a is completely divisible by 50! Then which one of the following is true about 'highest value of a'?
(a) $10 < a < 14$ (b) $14 < a < 16$
(c) $16 < a < 18$ (d) $18 < a < 20$

62. Let $-\frac{\pi}{6} < \theta < -\frac{\pi}{12}$. Suppose α_1 and β_1 are the roots of the equation $x_2 - 2x \sec \alpha + 1 = 0$ and α_2 and β_2 are the roots of the equation $x^2 + 2x \tan \theta - 1 = 0$. If $\alpha_1 > \beta_1$ and $\alpha_2 > \beta_2$, then $\alpha_1 + \beta_2$ equals
(a) $2(\sec \theta - \tan \theta)$ (b) $2 \sec \theta$
(c) $-2 \tan \theta$ (d) 0

63. The sum of the area of two circles, which touch each other externally is 153π. If the sum of their radii is 15, then ratio of the areas of smaller to the larger circle is
(a) 1 : 2 (b) 1 : 4
(c) 1 : 6 (d) 1 : 5

64. Through the vertex A of a parallelogram ABCD, line AEF is drawn to meet BC at E and DC produced at F. Then which of the following is true.
(a) The triangles BEF and DCE are equal in area
(b) Area $(\Delta BEF) = \frac{1}{2}$ Area (ΔABD)
(c) Area $(\Delta DCE) = \frac{1}{2}$ Area (ΔABF)
(d) Area $(\Delta BEF) = 2$ Area (ΔDCE)

65. For a positive integer n, let p_n denote the product of the digits of n, and s_n denote the sum of the digits of n. the number of integers between 10 and 1000 for which $p_n + s_n = n$ is
(a) 81 (b) 16
(c) 18 (d) 9

PHYSICS

66. A vertical cylinder contains a movable frictionless piston separating the former into two portions. The two portions are filled with ideal gases, and at equilibrium, the ratio of the volumes of upper to the lower portions is 5 : 3. When the temperature of the system is doubled, the ratio becomes 3 : 2. Then the ratio of number of molecules in the upper to the lower portions is

(a) 35 : 26 (b) 26 : 35

(c) 5 : 6 (d) 2 : 3

67. Steel ruptures when a shear of $3.5 \times 10^8\ \text{N m}^{-2}$ is applied. The force needed to punch a 1 cm diameter hole in a steel sheet 0.3 cm thick is nearly:

(a) 1.4×10^4 N (b) 2.7×10^4 N

(c) 3.3×10^4 N (d) 1.1×10^4 N

68. A uniformly tapering conical wire is made from a material of Young's modulus Y and has a normal, unextended length L. The radii, at the upper and lower ends of this conical wire, have values R and 3R, respectively. The upper end of the wire is fixed to a rigid support and a mass M is suspended from its lower end. The equilibrium extended length, of this wire, would equal :

(a) $L\left(1+\frac{2}{9}\frac{Mg}{\pi YR^2}\right)$ (b) $L\left(1+\frac{1}{9}\frac{Mg}{\pi YR^2}\right)$

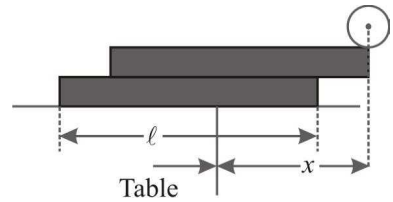
(c) $L\left(1+\frac{1}{3}\frac{Mg}{\pi YR^2}\right)$ (d) $L\left(1+\frac{2}{3}\frac{Mg}{\pi YR^2}\right)$

69. Two 20 kg cannon balls are chained together and fired horizontally with a velocity of 200 m/s from the top of a 30 m wall. The chain breaks during the flight of the cannon balls and one of them strikes the ground at $t = 1.5$s, at a distance of 250 m from the foot of the wall, and 5m to the right of the line of fire. Determine the position of the other cannon ball at that instant. Neglect the resistance of air.

(a) (20,550) (b) (550,20)

(c) (2,55) (d) (55,2)

70. Two identical uniform rectangular blocks (with longest side ℓ) and a solid sphere of radius R are to be balanced at the edge of a heavy table such that the centre of the sphere remains at the maximum possible horizontal distance from the vertical edge of the table without toppling as indicated in the figure. If the mass of each block is M and of the sphere is $\frac{M}{2}$, the maximum distance x that can be achieved is:

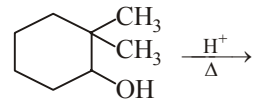


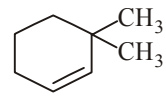
(a) $\frac{8\ell}{15}$ (b) $\frac{5\ell}{6}$

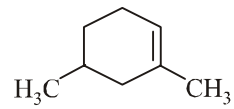
(c) $\frac{3\ell}{4}+R$ (d) $\frac{7\ell}{15}+R$

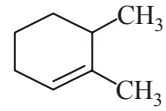
CHEMISTRY

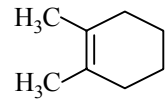
71. Find the product of the given reaction



(a) 

(b) 

(c) 

(d) 

72. 1 c.c. N_2O at NTP contains :

(a) $\frac{1.8}{224}\times10^{22}$ atoms

(b) $\frac{6.02}{22400}\times10^{23}$ molecules

(c) $\frac{1.32}{224}\times10^{23}$ electrons

(d) All of the above

73. 3-Methyl-pent-2-ene on reaction with HBr in presence of peroxide forms an addition product. The number of possible stereoisomers for the product is :

(a) Six (b) Zero

(c) Two (d) Four

74. Which of the following compounds of elements in group IV would you expect to be most ionic in character?

(a) CCl_4 (b) $SiCl_4$

(c) $PbCl_2$ (d) $PbCl_4$

75. The boiling point of *p*-nitrophenol is higher than that of *o*-nitrophenol because

(a) NO_2 group at *p*-position behaves in a different way from that at *o*-position.

(b) intramolecular hydrogen bonding exists in *p*-nitrophenol.

(c) there is intermolecular hydrogen bonding in *p*-nitrophenol.

(d) *p*-nitrophenol has a higher molecular weight than *o*-nitrophenol.

BIOLOGY

76. Which of the following are not used in the conversion by pyruvate to acetyl CoA?

(i) Oxidative dehydrogenation

(ii) Oxidative dehydration

(iii) Oxidative phosphorylation

(iv) Oxidative decarboxylation

(a) (i), (ii) and (iii) (b) (i) and (ii)

(c) (ii) and (iv) (d) (i) and (iii)

77. Sex determination in grasshoppers, humans, and *Drosophila* is similar because

(a) females are hemizygous.

(b) males have one X chromosome and females have two X chromosomes.

(c) all males always have one Y chromosome in all three species.

(d) the ratio of autosomes to sex chromosomes is the same in all three organisms.

78. Which of the following pair is not correctly matched?

(a) Rods – Twilight vision

(b) Ciliary body – Iris

(c) Retina – Optic chiasma

(d) Vitreous humour – Posterior compartment

79. Match the genetic phenomena given in column-I with their respective ratios given in column-II and select the correct option.

	Column-I (Genetic phenomena)		**Column-II (Ratios)**
A.	Inhibitory gene ratio	I.	9 : 3 : 4
B.	Complementary gene ratio	II.	1 : 1 : 1 : 1
C.	Recessive epistasis ratio	III.	12 : 3 : 1
D.	Dihybrid test cross ratio	IV.	13 : 3
E.	Dominant epistasis ratio	V.	9 : 7

(a) A – V; B – IV; C – III; D – II; E – I

(b) A – IV; B – V; C – I; D – II; E – III

(c) A – I; B – II; C – IV; D – III; E – V

(d) A – II; B – I; C – IV; D – V; E – III

80. The concentration of OH^- ions in a solution with the H^+ ions concentration of 1.3×10^{-4} M is:

(a) 7.7×10^{-4}M (b) 1.3×10^{-4}M

(c) 2.6×10^{-8}M (d) 7.7×10^{-11}M

ANSWER KEYS															
Part-I												Part-II			
1	(a)	**11**	(b)	**21**	(a)	**31**	(b)	**41**	(b)	**51**	(d)	**61**	(b)	**71**	(d)
2	(a)	**12**	(a)	**22**	(b)	**32**	(b)	**42**	(c)	**52**	(a)	**62**	(c)	**72**	(d)
3	(d)	**13**	(b)	**23**	(d)	**33**	(b)	**43**	(a)	**53**	(b)	**63**	(b)	**73**	(d)
4	(c)	**14**	(b)	**24**	(a)	**34**	(b)	**44**	(a)	**54**	(a)	**64**	(a)	**74**	(c)
5	(a)	**15**	(a)	**25**	(a)	**35**	(a)	**45**	(a)	**55**	(a)	**65**	(d)	**75**	(c)
6	(b)	**16**	(c)	**26**	(d)	**36**	(a)	**46**	(d)	**56**	(d)	**66**	(a)	**76**	(a)
7	(c)	**17**	(c)	**27**	(a)	**37**	(c)	**47**	(b)	**57**	(b)	**67**	(c)	**77**	(b)
8	(a)	**18**	(c)	**28**	(c)	**38**	(c)	**48**	(a)	**58**	(d)	**68**	(c)	**78**	(c)
9	(b)	**19**	(b)	**29**	(b)	**39**	(b)	**49**	(d)	**59**	(b)	**69**	(b)	**79**	(b)
10	(d)	**20**	(d)	**30**	(c)	**40**	(a)	**50**	(a)	**60**	(a)	**70**	(a)	**80**	(d)

MOCK TEST-8

PART-I

MATHEMATICS

1. (a) Since $\angle R = \frac{\pi}{2}$ so $\frac{P}{2}+\frac{Q}{2}=\frac{\pi}{4}$

$$\therefore \quad \tan\left(\frac{P}{2}+\frac{Q}{2}\right)=\tan\frac{\pi}{4}$$

$$\Rightarrow \quad \frac{\tan\frac{P}{2}+\tan\frac{Q}{2}}{1-\tan\frac{P}{2}\tan\frac{Q}{2}}=1$$

$$\Rightarrow \quad \frac{-b/a}{1-\left(\frac{c}{a}\right)}=1 \Rightarrow a+b=c$$

2. (a) If cube of a number ends in 4 means unit digit of the number should be 4

$(10a+4)^3 = 1000a^3 + 1200a^2 + 480a + 64$ has last two digit 44

Unit digit is 4 but 2nd last digit is 4 then–

$\Rightarrow$ Unit digit of $48a$ is 80 hence $a = 1$ or 6

So required values of N is 14 and 64 and their summation is $14 + 64 = 78$

3. (d) Given that both N and $N + 3293$ are perfect squares. We can assume that $N = a^2$ and $N + 3293 = b^2$ then $b^2 - a^2 = 3293$ or $(b + a)(b - a) = 3293 = 1 \times 3293 = 37 \times 89$

Case (i) when $3291 = 1 \times 3293$ then we will get $b + a = 3293$ and $b - a = 1$ on solving we will get $a = 1646$ and $N = 1646^2 = 2709316$

Case (ii) when $3291 = 37 \times 89$ then we will get $b + a = 89$ and $b - a = 37$ on solving we will get a = 26 and $N = 26^2 = 676$

Only two values of N exist.

4. (c) $\because$ (k, k) satisfies both equations

$\therefore \quad a(k) + b(k) + (t - s) = 0 \quad ...(1)$

also $b(k) + a(k) + (s - r) = 0 \quad ...(2)$

From (1) and (2)

$t - s = s - r \Rightarrow 2s = t + r$

i.e. t, s, r are in AP

5. (a) $(ab)^2 = ccb$ hence the 2 digit number $ab < 32$. From observation $ab = 30$ or 31 doesn't satisfy the condition hence $ab < 30$ or $a = 1$ or 2.

$(10a+b)^2 = 100a^2 + 20ab + b^2 = ccb$

$= 100c + 10c + b$

By observation, we have $(21)^2 = 441$ and hence only one value of b

6. (b) Since ABCD is a parallelogram and diagonal AC divides it into two triangles of equal area, we have

ar (ΔADC) = ar (ΔABC) ...(1)

As DC || AB, so CF || AB

Since triangles on the same base and between the same parallels are equal in area, so we have

ar (ΔACF) = ar (ΔBCF) ...(2)

Adding (1) and (2), we get

ar (ΔADC) + ar (ΔACF)

= ar (ΔABC) + ar (ΔBCF)

$\Rightarrow$ ar (ΔADF) = ar $(ABFC)$

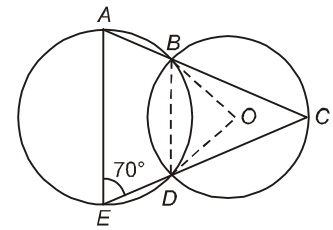
7. (c) Const: Join B to D

$\because$ ABC is a straight line and $ABDE$ is cyclic quad.

$\therefore \angle AED = \angle DBC = 70°$

also $BC = DC$ in ΔBDC

$\therefore \angle BDC = 70°$



In ΔBDC,

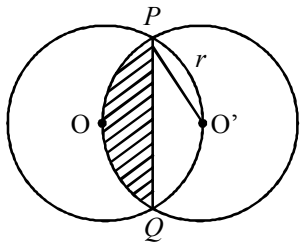
$\angle B = 70°$,

$\angle D = 70°$,

$\therefore$ $\angle C = 40°$ (by angle sum property)

$\therefore$ $\Delta BOD = 80°$ (as angle at centre is double of the angle at the remaining arc).

8. (a)



For area of segment POQ

$\Delta POO'$ is an equilateral Δ.

Also $\Delta QOO'$ is an equilateral Δ.

$\therefore \angle PO'Q = 120°$

$\therefore$ Area of segment POQ

$$= \frac{1}{2}r^2\left[\frac{120° \times \pi}{180°} - \sin 120°\right]$$

$$= \frac{1}{2}r^2\left[\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right]$$

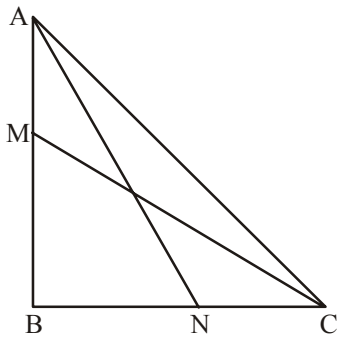
Area of total shaded region

$= 2 \times$ area of POQ

$$\text{Total area} = r^2\left[\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right]$$

$$= \frac{2}{3}\pi r^2 - \frac{\sqrt{3}}{2}r^2$$

9. (b)



Using Pythagoras theorem,

$AC^2 = AB^2 + BC^2$ ... (i)

Now, $AN^2 = AB^2 + BN^2$

$\Rightarrow 4AN^2 = 4AB^2 + 4BN^2$

$\Rightarrow 4AN^2 = 4AB^2 + (2BN)^2$

$\Rightarrow 4AN^2 = 4AB^2 + (2BN)^2$

$\Rightarrow 4AN^2 = 4AB^2 + BC^2$ ... (ii)

Also, $CM^2 = MB^2 + BC^2$

$\Rightarrow 4CM^2 = 4MB^2 + 4BC^2$

$\Rightarrow 4CM^2 (2MB)^2 + 4BC^2$

$\Rightarrow 4CM^2 = AB^2 + 4BC^2$ ... (iii)

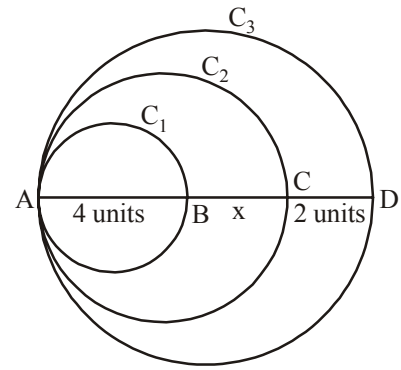
Adding (ii) and (iii), we have

$4AN^2 + 4CM^2 = 4AB^2 + BC^2 + AB^2 + 4BC^2$

$\Rightarrow 4(AN^2 + CM^2) = 5(AB^2 + BC^2)$

$\Rightarrow 4(AN^2 + CM^2) = 5AC^2$ ($\because$ From (i))

10. (d)



$C_1 = 2\pi \times 2 = 4\pi$ ($\therefore$ r = 2 units)

$AC = AB + BC \Rightarrow AC = 4 + x$

$$\text{Radius of } C_2 = \frac{4+x}{2}$$

$$C_2 = 2\pi\frac{(4+x)}{2} = \pi(4+x)$$

$$C_3 = 2\pi\frac{(6+x)}{2} = (6+x)\pi$$

[$\therefore AD = AB + BC + CD \Rightarrow AD = 4 + x + 2$

$\Rightarrow AD = 6 + x$; radius $= \frac{6+x}{2}$]

According to question

$$C_2 = \frac{C_1 + C_3}{2} \Rightarrow \pi(4+x) = \frac{4\pi + \pi(6+x)}{2}$$

$$\Rightarrow 2(4+x) = 4+6+x$$

$$\Rightarrow 8+2x = 10+x \Rightarrow x = 2$$

$$\text{Radius of } C_3 = \frac{6+x}{2} \Rightarrow \frac{6+2}{2} = 4$$

$$\text{Area of } C_3 = \pi r^2 = \pi(4)^2 \Rightarrow 16\pi$$

11. (b) Let cost of *a* pen is *x* and that of copy is *y*. According to the condition 40x> 15y and $16y > 40x$. Since 40x>15y hence

$8x > 3y$ or $8x > = 3y + 1$ …(i)

$16y > 40x$ or $2y > 5x$ or $5x < = 2y - 1$ …(ii)

Multiply eq (i) with 5 and eq(ii) with 8 and then compare the result we will get

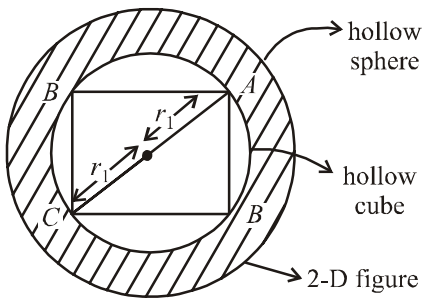
$16y - 8> = 40x> = 15y + 5$

or $16y - 8> = 15y + 5$

hence $y> = 13$ so minimum possible value of *y* is 13. Now 8x>3y or $x>3y/8$ or $x>39/8$ so minimum possible value of *y* is 5 so minimum possible value of

$x + y = 13 + 5 = 18$.

12. (a)



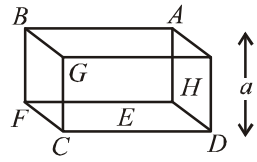
Let r_1 be radius of hollow cylinder

A and *C* are opposite corners of cube such that

So *AC* is longest diagonal

So, $\sqrt{3}a = 2r_1$

$$r_1 = \frac{\sqrt{3}a}{2}$$



V_1 = Vol. of air between cube and sphere

$$\Rightarrow \quad V_1 = \frac{4}{3}\pi r_1^3 - a^3 = \frac{4}{3}\pi\frac{3\sqrt{3}a^3}{8} - a^3$$

$$\Rightarrow \quad V_1 = \left(\frac{\sqrt{3}\pi}{2} - 1\right)a^3$$

$$\text{Ratio} = \frac{V_1}{\text{Vol. of air of cube}}$$

$$= \left(\frac{\sqrt{3}\pi - 2}{2}\right)\frac{a^3}{a^3} = \frac{\sqrt{3}\pi - 2}{2}$$

13. (b) **Case-I:** $x \in [0,9]$;

$$2(3 - \sqrt{x}) + x - 6\sqrt{x} + 6 = 0$$

$$\Rightarrow x - 8\sqrt{x} + 12 = 0 \Rightarrow \sqrt{x} = 4, 2$$

$$\Rightarrow x = 16, 4$$

Since $x \in [0,9] \therefore x = 4$

Case-II: $x \in [9,\infty]$;

$$2(\sqrt{x} - 3) + x - 6\sqrt{x} + 6 = 0$$

$$\Rightarrow x - 4\sqrt{x} = 0 \Rightarrow x = 16, 0$$

Since $x \in [9,\infty] \therefore x = 16$

Hence, $x = 4$ & 16

14. (b) Unit digit of product of two digit number is 5. Hence unit digit of these two digit must be either odd or 5.

Hence numbers are 15, 51, 35, 53, 75, 57, 95, 59 & 55. So total 9 such 2 digit number exist.

15. (a) Here,

$$\frac{p-1}{p+1}=\frac{x^4+x^2+1}{(x^2+x+1)^2}=\frac{x^4+2x^2+1-x^2}{(x^2+x+1)^2}$$

$$=\frac{(x^2+1)^2-x^2}{(x^2+x+1)^2}=\frac{(x^2+x+1)(x^2-x+1)}{(x^2+x+1)^2}$$

$$\therefore \frac{p-1}{p+1}=\frac{x^2-x+1}{x^2+x+1},$$ using componendo and dividendo.

$$\Rightarrow \frac{2p}{2}=\frac{2(x^2+1)}{2x} \quad \Rightarrow p=x+\frac{1}{x} \quad ...(1)$$

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

$$\Rightarrow f(f(x))+f\left(f\left(\frac{1}{x}\right)\right)=x+\frac{1}{x} \quad ...(2)$$

From Eqs. (1) and (2), we get

$$f(f(x))+f\left(f\left(\frac{1}{x}\right)\right)=p$$

PHYSICS

16. (c) Force = weight suspended + weight of $\frac{3L}{4}$ of wire

$$= W_1 + \frac{3W}{4}$$

$$\text{stress} = \frac{\text{force}}{\text{area}}$$

17. (c) Smooth and polished plates are poor radiators of heat. Hence, heat coming out from A_1 is small, even though B_1 being a black and rough plate is a good absorber. Effectively the heat coming to the left of pellet P is small.

Black and rough plates are good radiators of heat. Hence, plate B_2 radiates heat to a satisfactory level; however, plate A_2, being smooth and polisher, is a bad absorber. Effectively, the heat coming to the right of P is also small.

18. (c) $$\frac{-Gmm'}{r}\times 3+\frac{1}{2}m'v_e^2=0$$

$$\text{or } \frac{-3Gm}{(\frac{a}{2}/\cos 30°)}+\frac{1}{2}v_e^2=0$$

$$v_e=\sqrt{\frac{6\sqrt{3}\,Gm}{a}}.$$

19. (b) Vernier callipers

$$1\text{ MSD}=\frac{1\text{cm}}{8}=0.125\text{cm}$$

$$5\text{ VSD}=4\text{MSD}$$

$$\therefore 5\text{VSD}=4\times\frac{1}{8}\text{cm}=0.5\text{cm}$$

$$\therefore 1\text{ VSD}=0.1\text{cm}$$

$$\text{L.C} = 1\text{MSD}-1\text{VSD}$$
$$= 0.125\text{cm}-0.1\text{cm}$$
$$= 0.025\text{cm}$$

Screw gauge

One complete revolution = 2M.S.D

If the pitch of screw gauge is twice the L.C of vernier callipers then pitch

$= 2\times 0.025 = 0.05$cm.

L.C of screw Gauge

$$=\frac{\text{pitch}}{\text{Total no. of divisions of circular scale}}$$

$$=\frac{0.05}{100}\text{cm}=0.0005\text{cm}=0.005\text{ mm}.$$

(II) is a correct statement

Now if the least count of the linear scale of the screw gauge is twice the least count of venier callipers then.

L.C of linear scale of screw gauge

$= 2\times 0.025 = 0.05$cm.

Then pitch $= 2\times 0.05 = 0.1$cm.

Then L.C of screw gauge $= \frac{0.1}{100}$ cm

$= 0.001\text{cm} = 0.01\text{mm}.$

(III) is a correct statement.

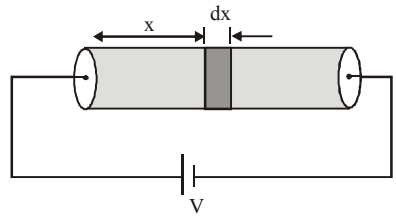
20. (d) Efficiency of a transformer,

$$\eta = \frac{\text{Power output}}{\text{Power input}}$$

for an ideal transformer, $\eta = 1$

$\therefore$ power output = power input = 60 W

21. (a) Consider an element part of solid at a distance x from left end of width dx.



Resistance of this elemental part is,

$$dR = \frac{\rho dx}{\pi a^2} = \frac{\rho_0 x dx}{\pi a^2}$$

$$R = \int dR = \int_0^L \frac{\rho_0 x dx}{\pi a^2} = \frac{\rho_0 L^2}{2\pi a^2}$$

Current through cylinder is,

$$I = \frac{V}{R} = \frac{V \times 2\pi a^2}{\rho_0 L^2}$$

Potential drop across element is,

$$dV = I\,dR = \frac{2V}{L^2} \times dx$$

$$E(x) = \frac{dV}{dx} = \frac{2V}{L^2} x$$

22. (b) If $v \perp B$, then path is circular and if v has a component along B, then path will be helical.

23. (d) Initial position of cm $= \frac{m_2 \ell}{m_1 + m_2}$

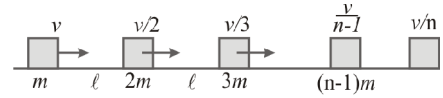
Also $\Delta_{cm} = \frac{m_1 \Delta x_1 + m_2 \Delta x_2}{m_1 + m_2} = \frac{m_1 v_0 t + 0}{m_1 + m_2}$

$\therefore$ final position $= \frac{m_2 \ell}{m_1 + m_2} + \frac{m_1 v_0 t}{m_1 + m_2}$

24. (a) The direction of current in the loop will be such as to oppose the increase in the magnetic field.

25. (a) Since torque $\vec{\tau}$ is rotational analogue of force $\vec{F}$ and $\vec{F}$ = mass × acceleration, therefore, torque $\vec{\tau}$ = (moment of inertia) × (angular acceleration) = (I α) as moment of inertia is rotational analogue of mass.

26. (d)



$$t_1 = \frac{\ell}{v}, t_2 = \frac{\ell}{v/2} = \frac{2\ell}{v}$$

$$t_3 = \frac{3\ell}{v}, \ldots\ldots, t_{n-1} = \frac{(n-1)\ell}{v}$$

So $T = \frac{\ell}{v} + \frac{2\ell}{v} + \frac{3\ell}{v} + \ldots\ldots + \frac{(n-1)\ell}{v}$

$$= \frac{\ell}{v}[1 + 2 + 3 + \ldots\ldots + (n-1)]$$

$$= \frac{n(n-1)\ell}{2v}$$

$$v_{cm} = \frac{mv + 0 + 0 + \ldots\ldots + 0}{nm} = \frac{v}{n}.$$

27. (a) Mass of the removed sphere

$$M' = \frac{M}{\frac{4}{3}\pi R^3} \times \frac{4}{3}\pi\left(\frac{R}{2}\right)^2 = \frac{M}{8}$$

Thus, $F = \frac{GMm}{d^2} - \frac{GM'm}{(d - R/2)^2}$

28. (c) The three curves AB, CD and EF meet at point P which is called the triple point of water. It is the point where all three states solid, liquid and gas of water co-exists.

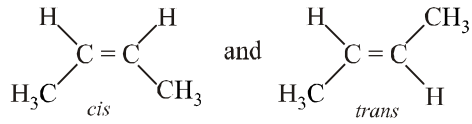
29. (b) Temperature of B will be higher as due to expansion centre of mass of B will come down same heat is supplied but in B, Potential energy is decreased therefore internal energy gain will be more and internal energy is directly proportional to temperature.

30. (c) Since horizontal component of the velocity of the bomb will be the same as the velocity of the aeroplane, therefore horizontal displacements remain the same at any instant of time.

CHEMISTRY

31. (b) In KCN, K^+ and CN^- have ionic bond and $C \equiv N$ has covalent bond.

32. (b) Geometrical isomerism is shown by compounds which have C=C and two groups attached to same C atoms are different. Choice (b) fulfills both conditions.



33. (b) Moles of $C_{12}H_{22}O_{11} = \frac{25.6}{342.3} = 0.0747$

Number of H-atoms

$= 0.0747 \times 22 \times 6.023 \times 10^{23} = 9.91 \times 10^{23}$

34. (b) $\Delta n_g = 2 - 4 = -2, \Delta H = \Delta E - 2RT.$

35. (a) $\overset{+2}{Fe}\overset{+2}{C_2}O_4 \rightarrow Fe^{3+} + 2\overset{+4}{C}O_2 + 3e^-$; In acidic medium MnO_4^- changes to Mn^{2+} and consumes $5e^-$

$\therefore$ $3e^-$ will be consumed by 3/5 moles of $KMnO_4$.

36. (a)

Mn(25)	$[Ar]3d^5 4s^2$	n = 5
Ti(22)	$[Ar]3d^2 4s^2$	n = 2
V(23)	$[Ar]3d^3 4s^2$	n = 3
Al(13)	$[Ne]3s^2 3p^1$	n = 1

37. (c) H_2SO_4 is a strong acid and HSO_4^- is its weak conjugate base.

NH_3 is a strong base and $\overset{+}{N}H_4$ is its weak conjugate acid of NH_3.

38. (c) $\overset{+1}{H_2}O \rightarrow \overset{0}{H_2}$

Oxidation number of H decreases from +1 to 0. Hence, H_2O is reduced to H_2.

39. (b) Chain propagating step is

$$Cl^{\bullet} + CH_4 \longrightarrow {}^{\bullet}CH_3 + HCl$$

40. (a) Due to the inert pair effect, thallium exists in more than one oxidation state. Also, for thallium + 1 oxidation state is more stable than +3 oxidation state.

41. (b) O < S < F < Cl

Electron gain enthalpy increases along the period and decreases along the group but in between III and II period elements, III period elements have greater electron gain enthalpy because of very high electron density of II period elements.

42. (c) Metal + dil. HCl $\rightarrow$ Metallic salt + Hydrogen

Ag is below hydrogen in reactivity series. So it fail to displace hydrogen from dil.HCl. Thus there is no product formed and no gas evolved.

43. (a) $K_c = \frac{[Z]}{[X][Y]}$

$\Rightarrow \frac{1}{2}[Y] = [X] = \frac{1}{2}[Z] = a(\text{say})$

$\therefore \quad [Z] = 2a, [Y] = 2a, [X] = a$

$10^4 = \frac{2a}{a.2a} \Rightarrow a = 10^{-4}$

$[Z] = 2a = 2 \times 10^{-4}$

44. (a) $M_1 = 64\ ;\ r_2 = 2r_1$

$$M_2 = M_1\left[\frac{r_1}{r_2}\right]^2 = 64 \times \frac{1}{4} = 16$$

45. (a) NaOH is a strong alkali. It combines with acidic and amphoteric oxides to form salts. Since CaO is a basic oxide, hence, it does not reacts with NaOH.

BIOLOGY

46. (d) Maltose, also known as maltobiose or malt sugar, is a disaccharide formed from two units of glucose joined with an α–1, 4–glycosidic bond.

47. (b) The sarcomere is the functional unit of muscle. As actin myofilaments slide over myosin, the sarcomere shortens, but not the individual components that make up the sarcomere.

48. (a) Amphitrichous bacteria have a single flagellum at each of the two ends or poles. e.g., *Spirillum volutans*.

49. (d) Pancreatic lipase (formely called steapsin) hydrolyses fats into glycerol and fatty acids.

50. (a) It is the long distance movement of organic substances from the source or supply end (region of manufacture or storage) to the region of utilisation or sink end.

51. (d) Pectin, a structural heteropolysaccharides, are abundant in fruits particularly in the citrus fruits like oranges and lemons. They are present in the cell wall and in the intracellular substance. They contain arabinose, galactose and galacturonic acid.

52. (a) *E. coli* resides in the large intestine of human. If they are present in water supply, it represents that water supply is contaminated.

53. (b) Monosaccharides are the class of sugars that cannot be hydrolysed to give a simpler sugar. Pentoses and hexoses are the examples of monosaccharides.

54. (a) Ca^{2+} and Mg^{2+} are involved in muscle contraction. Ca^{2+} ion promotes the formation of actomyosin which is a combination of myosin and actin. Ca^{2+} and Mg^{2+} ions are also helpful in relasing energy by the oxidation of food in the form of ATP which is broken down in ADP, phosphorous and energy. Released energy is used up in the contraction of muscle fibres.

55. (a) Lateral meristems are present along the lateral sides of stem and roots. Intrastelar cambium ring formed by intrafascicular and interfascicular cambia and extrastelar cork cambium are the examples of lateral meristem.

56. (d) Relaxin is a protein hormone, secreted by the placenta that causes the cervix to dilate and prepares the uterus for the action of oxytocin during labour.

57. (b) Gibberellin overcomes vernalisation requirement (low temperature) for flowering.

58. (d) Blood clotting involves none of the given options. In blood clotting pathways, prothrombin is converted into thrombin and fibrinogen is converted into fibrin.

59. (b) Contraction of gall bladder is induced by cholecystokinin. It is secreted by I-cells in the small intestine.

60. (a) Blood platelets are 2–3 μm in diameter. They are considered to be the cell fragments instead of being cell themselves.

PART-II

MATHEMATICS

61. (b) Since highest power of 2 in 50! Is 47 hence highest power of 8 in 50! Is [47/3] = 15

If we assume $a = 15$ then 15^8 or 3^8 and 5^8

So we have to check that whether 3^8 and 5^8 are divisible by 50! Or not, Since highest power of 3 in 50! Is 22 and that of 5 is 12, hence $a = 15$ will satisfy the condition.

62. (c) $x^2 - 2x \sec\theta + 1 = 0 \Rightarrow x = \sec\theta \pm \tan\theta$

and $x^2 + 2x \tan\theta - 1 = 0 \Rightarrow x = -\tan\theta \pm \sec\theta$

$\because \quad -\frac{\pi}{6} < \theta < -\frac{\pi}{12}$

$\Rightarrow \sec\frac{\pi}{6} > \sec\theta > \sec\frac{\pi}{12}$

and $-\tan\frac{\pi}{6} < \tan\theta < -\frac{\tan\pi}{12}$

also $\tan\frac{\pi}{12} < -\tan\theta < \tan\frac{\pi}{6}$

α_1, β_1 are roots of $x^2 - 2x \sec\theta + 1 = 0$

and $\alpha_1 > \beta_1$

$\therefore \alpha_1 = \sec\theta - \tan\theta$ and $\beta_1 = \sec\theta + \tan\theta$

α_2, β_2 are roots of $x^2 + 2x \tan\theta - 1 = 0$ and $\alpha_2 > \beta_2$

$\therefore \alpha_2 = -\tan\theta + \sec\theta, \beta_2 = -\tan\theta - \sec\theta$

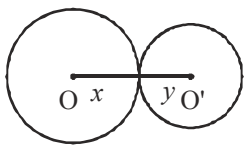
$\therefore \alpha_1 + \beta_2 = \sec\theta - \tan\theta - \tan\theta - \sec\theta$

$= -2\tan\theta$

63. (b) Let the radius of two circles with centres O and O′ be x and y respectively

sum of radii = 15

$\Rightarrow \quad x + y = 15$



Sum of areas of two circles = 153π

$\pi x^2 + \pi y^2 = 153\pi$

$\Rightarrow \quad x^2 + y^2 = 153 \quad$ .... (i)

$x + y = 15 \quad$ .... (ii) (Given)

$(x+y)^2 = x^2 + y^2 + 2xy$

$\Rightarrow 15^2 = 153 + 2xy$

$\Rightarrow \quad xy = \frac{225-153}{2} = \frac{72}{2} = 36$

$\Rightarrow \quad x(15-x) = 36 \quad \Rightarrow \quad 15x - x^2 - 36 = 0$

or $\quad x^2 - 15x + 36 = 0$

$\Rightarrow \quad (x-12)(x-3) = 0$

$\Rightarrow \quad x = 12$ or 3 and $y = 3$ or 12

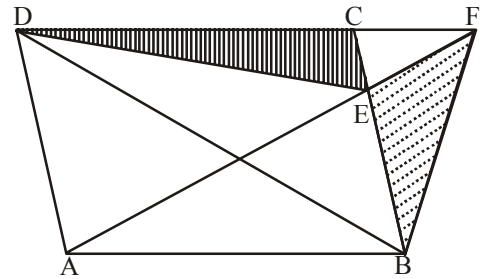
Since $x > y \Rightarrow x = 12$ and $y = 3$

Ratio of circumferences smaller to larger circle

$= \frac{2\pi(3)}{2\pi(12)} = 3 : 12 = 1 : 4$

64. (a) ΔABF and ||gm ABCD are on the same base AB and between the same parallels AB and DF.

$\therefore \quad \text{ar}(\Delta ABF) = \frac{1}{2}\,\text{ar}(\|\text{gm ABCD}) \quad$ .... (1)



$\because$ Diagonal BD of a ||gm ABCD, divides it into two congruent triangles.

$\therefore \text{ar}(\Delta BCD) = \text{ar}(\|\text{gm ABCD}) \quad$ .... (2)

$\text{ar}(\Delta ABF) = \text{ar}(\Delta BCD) \quad$ .... (3) [From (1) and (2)]

Also, ΔABE and ΔDBE are on the same base BE and between the same parallels BE and AD.

$\therefore$ ar (ΔABE) = ar (ΔDBE) ... (4)

Subtracting (4) from (3), we get

ar (ΔABF) – ar (ΔABE)

= ar (ΔBCD) – ar (ΔDBE)

Hence, ar (ΔBEF) = ar (ΔCDE).

65. (d) Since the number is between 10 to 1000, that means n may be a two digit or a three digit number, so we have two different cases-

Case (i) if the n is a two digit number,

ab = 10a +b, here none of the digit is zero.

From given information a + b + ab = 10a + b or ab = 9a or b = 9, and the two digit numbers that satisfy this condition is 19, 29, 39, 49, 59, 69, 79, 89 and 99 (Total 9 numbers)

Case (ii) if the number is a 3digit number then $P_n = abc$ and $S_n = a + b + c$

$a + b + c + abc = 100a + 10b + c$

or $abc = 9(11a + b)$

Here LHS is always less than the RHS, because $c \le 9$ and $ab < 11a$, no number satisfy this condition.

Thus there are only 9 values (all are two digit number) of n that satisfy the condition.

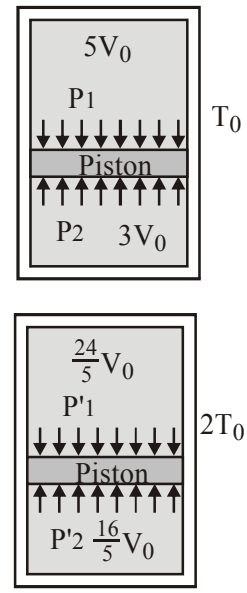
PHYSICS

66. (a) Let the weight of the piston W and cross-sectional area of the cylinder be A. Let the initial and the final pressures of the upper and the lower regions be P_1, P'_1 and P_2, P'_2 respectively. Further, if initial temperature be taken to be T_0, then final temperature will be $2T_0$.

From the F.B.D. of the piston, initially,

$$P_1A + W = P_2A$$

or $$\frac{n_1RT_0}{5V_0} + \frac{W}{A} = \frac{n_2RT_0}{3V_0} \quad \text{... (i)}$$



where n_1 and n_2 are the number of moles in the two portions.

Finally, from the F.B.D. of the piston,

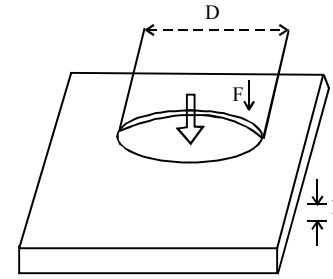
$P_1A + W = P_2A$

or $$\frac{n_1R(2T_0)}{3(8V_0/5)} + \frac{W}{A} = \frac{n_2R(2T_0)}{2(8V_0/5)} \quad \text{... (ii)}$$

Subtracting eq. (ii) from eq. (i), we have

$$n_1\left(\frac{1}{5} - \frac{5}{12}\right) = n_2\left(\frac{1}{3} - \frac{5}{8}\right) \quad \text{or} \quad n_1 : n_2 = 35 : 26$$

67. (c) Shearing strain is created along the side surface of the punched disk. Note that the forces exerted on the disk are exerted along the circumference of the disk, and the total force exerted on its center only.



Let us assume that the shearing stress along the side surface of the disk is uniform, then

$$F = \int_{\text{surface}} dF_{max}$$

$$= \int_{\text{surface}} \sigma_{max} dA = \sigma_{max} \int_{\text{surface}} dA$$

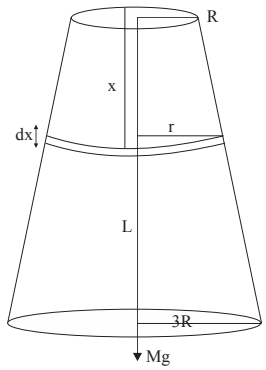
$$= \sigma_{max} .2\pi\left(\frac{D}{2}\right) h$$

$$= 3.5\times10^{8} \times \left(\frac{1}{2}\times10^{-2}\right) \times 0.3\times10^{-2} \times 2\pi$$

$$= 3.297\times10^{4} \Rightarrow h = 3.3\times10^{4}\,N$$

68. (c) Consider a small element dx of radius r,

$$r = \frac{2R}{L}x + R$$



At equilibrium change in length of the wire

$$\int_0^1 dL = \int \frac{Mg\,dx}{\pi\left[\frac{2R}{L}x + R\right]^2 y}$$

Taking limit from 0 to L

$$\Delta L = \frac{Mg}{\pi y}\left[-\frac{1}{\left[\frac{2Rx}{L} + R\right]_0^L} \times \frac{L}{2R}\right] = \frac{MgL}{3\pi R^2 y}$$

The equilibrium extended length of wire

$= L + \Delta L$

$$= L + \frac{MgL}{3\pi R^2 Y} = L\left(1 + \frac{1}{3}\frac{Mg}{\pi YR^2}\right)$$

69. (b) As no external force acts in z-direction, hence z-coordinate of the centre of mass of the ball should be zero. To make z-coordinate zero other ball should fall symmetrically with respect to z-axis.

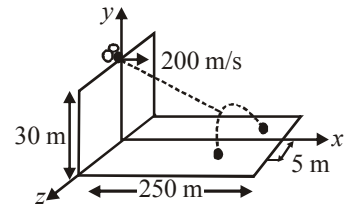
Hence z-coordinate of other ball = –5 *m*.

The balls do not have any external force in x-direction. Hence in x-direction the centre of mass should move with constant velocity.

x-coordinate of centre of mass at $t = 1.5$ s,

$= 200 \times 2 = 400\,m$

Hence, $x_{CM} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2}$



$$400 = \frac{20\times50 + 20x_2}{20 + 20}$$

$x_2 = 800 - 250 = 550\,m$

Position of centre of mass at $t = 2$ *s*,

$$h = \frac{1}{2}\times10\times2^2 = 20\,m$$

Hence y-coordinate of centre of mass $= 30 - 20 = 10\,m$

Hence $y_{CM} = \frac{m_1y_1 + m_2y_2}{m_1 + m_2}$

$$\Rightarrow 10 = \frac{20\times0 + 20\times y_2}{20 + 20} \qquad \therefore\ y_2 = 20\,m$$

70. (a) If x_1 is the overhang length on second blocks, then,

$$M\left(\frac{\ell}{2}-x_1\right)=\frac{M}{2}(x_1) \quad \therefore x_1=\frac{\ell}{3}$$

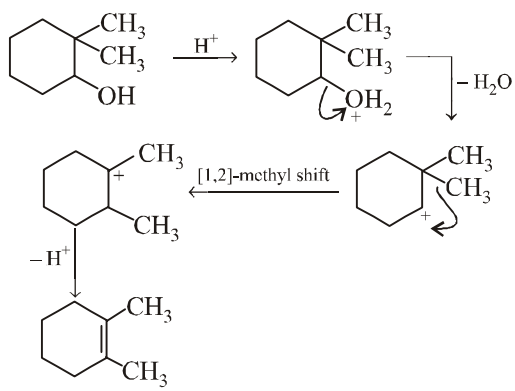
Now of x_2 is the overhang table then

$$M\left(\frac{\ell}{2}-x_2\right)=\frac{3M}{2}x_2 \quad \therefore x_2=\frac{\ell}{5}$$

Now $x=x_1+x_2=\frac{\ell}{3}+\frac{\ell}{5}=\frac{8\ell}{15}$.

CHEMISTRY

71. (d)



72. (d) At NTP 22400 c.c. of N_2O

$= 6.02\times10^{23}$ molecules

$$\therefore \text{ 1 cc } N_2O=\frac{6.02\times10^{23}}{22400} \text{ molecules}$$

$$=\frac{3\times6.02\times10^{23}}{22400} \text{ atoms}$$

$$=\frac{1.8}{224}\times10^{22} \text{ atoms}$$

No. of electrons in a molecule of

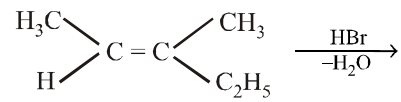
$N_2O=7+7+8=22$

Hence no. of electrons

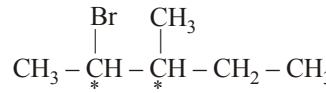
$$=\frac{6.02\times10^{23}}{22400}\times22$$

$$=\frac{1.32\times10^{23}}{224} \text{ electrons}$$

73. (d) If two chirality centres are created as a result of an addition reaction four stereoisomers can be obtained as products.



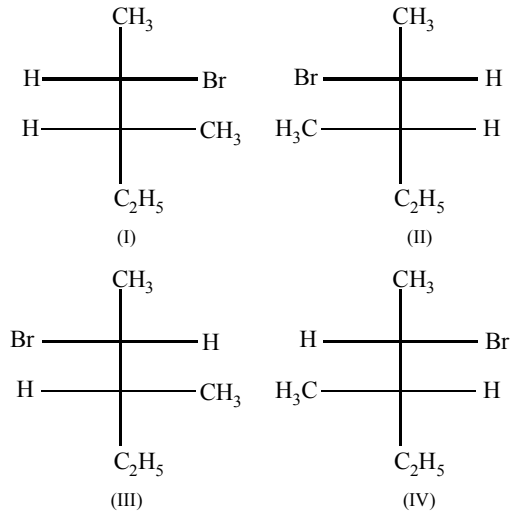
cis-3-methyl pent-2-ene



2-Bromo-3-methyl pentane
(2 chiral centre)

No. of stereoisomers = $2^n = 2^2 = 4$

where n = chiral centre



74. (c) $PbCl_2$ is most ionic because on going down the group the metallic character increases and also the inert pair effect predominates. Between $PbCl_2$ and $PbCl_4$; $PbCl_2$ is more ionic according to Fajan's rule.

75. (c) The b.p. of *p*-nitrophenol is higher than that of *o*-nitrophenol because in *p*-nitrophenol there is intermolecular H-bonding but in *o*-nitrophenol there is intramolecular H-bonding.

BIOLOGY

76. (a) In oxidative decarboxylation, the transition reaction converts the two molecules of the 3-carbon pyruvate into two molecules of 2-carbon molecule of acetyl CoA and two molecules of carbon dioxide.

77. (b) In grasshoppers, human and *Drosophila*, the sex determination is similar because all the male individuals consist of one X chromosome and the female individuals consist of two X chromosomes. In grasshopper and *Drosophila,* no Y chromosome is found. So, sex determination is done on the basis of presence or absence of X-chromosome.

78. (c) It is the part of brain where the optic nerves partially cross. The optic chiasma is located at the bottom of the brain immediately inferior to the hypothalamus.

79. (b) The inhibitory gene ratio is 13:3

Complementary gene ratio is 9:7

Recessive epistasis ratio is 9:3:4

Dihybrid test cross ratio is 1:1:1

Dominant epistasis ratio is 12:3:1

80. (d) $[H^+]\ [OH^-] = 10^{-14}$

$1.3 \times 10^{-4} \times [OH^-] = 10^{-14}$

$$[OH^-] = \frac{10^{-14}}{1.3 \times 10^{-4}} M$$

$= 0.769 \times 10^{-10} M$

$= 7.7 \times 10^{-11} M$