50. If $\vec{a}$ and $\vec{b}$ unequal unit vectors such that $(\vec{a}-\vec{b})\times[(\vec{b}+\vec{a})\times(2\vec{a}+\vec{b})]=\vec{a}+\vec{b}$, then smaller angle θ between $\vec{a}$ and $\vec{b}$ is

(A) $\frac{\pi}{2}$ (B) 0 (C) π (D) $\frac{\pi}{4}$

51. For the hyperbola $9x^2-16y^2-18x+32y-151=0$

(A) one of the directrix is $x=\frac{21}{5}$ (B) Length of latus rectum = $\frac{9}{2}$

(C) Focii are (6, 1) and (–4, 1) (D) eccentricity is $\frac{5}{4}$

52. System of equation $x+3y+2z=6$
$x+\lambda y+2z=7$
$x+3y+2z=\mu$ has

(A) unique solution if $\lambda=2, \mu\neq 6$ (B) infinitely many solution if $\lambda=4, \mu=6$
(C) no solution if $\lambda=5, \mu=7$ (D) no solution if $\lambda=3, \mu=5$

53. If the parabola $x^2=ay$ makes an intercept of length $\sqrt{40}$ on the line $y-2x=1$, then a =

(A) 1 (B) –2 (C) –1 (D) 2

54. A(1, 2) and B(7, 10) are two points. If P(x, y) is a point such that $\angle APB=60°$ and area of ΔAPB is maximum, then which of the following is (are) TRUE ?

(A) P lies on any line perpendicular to AB (B) P lies on the right bisector of AB
(C) P lies on the line $3x+4y=36$ (D) Radius of circumcircle of ΔPAB is 10 units

55. The value of the integral $\int_0^{2\pi} x\sin^6 x\cos^4 x\,dx$ is not equal to

(A) $\frac{3\pi}{256}$ (B) $\frac{3\pi^2}{256}$ (C) $\frac{3\pi^2}{128}$ (D) $\frac{3\pi^2}{64}$

56. If matrices A and B are symmetric and commute, then which of the following is/are symmetric ?

(A) $A^{-1}B$ (B) AB^{-1} (C) $A^{-1}B^{-1}$ (D) none of these

57. If $f(x)=[x]^2-[x^2]$, where [.] is greatest integer function, then f(x) is

(A) continuous at x = 1 (B) continuous at x = 1 and at x = – 1
(C) discontinuous at x = – 1 (D) discontinuous at x = 1 and at x = – 1

58. If $a=\underbrace{111.....1}_{55\text{ times}}$, $b=1+10+10^2+10^3+10^4$ and $c=1+10^5+10^{10}+.....+10^{50}$ then

(A) b, $\frac{a}{2}$, c are in A.P. (B) b, $\sqrt{a}$, c are in G.P.

(C) a is a prime number (D) a is a composite number

SECTION – III : (Maximum Marks : 16)

This section contains **TWO** questions. Each question contains two columns, **Column I** and **Column II**. **Column I** has **four** entries (A),(B), (C) and (D). **Column II** has **five** entries (P),(Q), (R), (S) and (T)

59. Match Column-I with Column-II and select the correct answer using the code given below the lists :

Column-I		**Column-II**	
(A)	If $(0, \alpha)$ lies inside the triangle formed by the lines $y - 3x + 2 = 0$, $3y - 2x - 5 = 0$ and $4y + x - 14 = 0$, then one possible value of $[2\alpha]$, where $[\cdot]$ denotes greatest integer function	(p)	–2
(B)	The point $(\alpha^2, \alpha + 1)$ lies in the angle between the lines $3x - y + 1 = 0$ & $x + 2y - 5 = 0$ containing the origin then one possible value of $[2\alpha]$, where $[\cdot]$ denotes greatest integer function	(q)	–1
(C)	The centre of circle touching the straight line $3x - y = 2$ at (1, 1) & passing through (1, –1) is (a, b) then a – 3b =	(r)	1
(D)	Locus of a point which is equidistant from (1, 2) & (–2, –1) is $ax + by + c = 0$, $(a > 0)$, then a – 2b =	(s)	3
		(t)	2

60. z_1, z_2, z_3 are vertices of a triangle. Match the condition on the left with type of triangle on the right.

Match Column-I with Column-II and select the correct answer using the code given below the lists :

Column-I	**Column-II**	
(A) $z_1^2 + z_2^2 + z_2^2 = z_2z_3 + z_1z_3 + z_2z_1$	(p)	right angled
(B) $\text{Re}\left(\frac{z_3 - z_1}{z_3 - z_2}\right) = 0$	(q)	obtuse angled
(C) $\text{Re}\left(\frac{z_3 - z_1}{z_3 - z_2}\right) < 0$	(r)	isosecles and right angled
(D) $\frac{z_3 - z_1}{z_3 - z_2} = i$	(s)	equilateral
	(t)	can't say

PRACTICE TEST - TWO

PAPER-2

Max. Marks : 240

Time : 3:00 Hrs.

GENERAL INSTRUCTIONS

1. The question paper consists of three parts (Physics, Chemistry and Mathematics). Each part consists of three sections and total number of questions are 60.

Marking Scheme & Question Paper Pattern

2. Section 1 contains 8 questions. The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).
Marking scheme: +4 for correct answer and 0 in all other cases.

3. Section 2 contains 8 multiple Choice question with one or more than one correct option.
Marking scheme: +4 for correct answer, 0 if not attempted and –2 in all other cases.

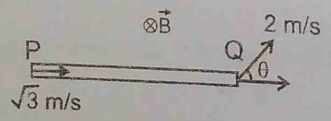
4. Section 3 contains 2 "paragraph" type questions. Each paragraph describes and experiment, a situation or a problem. Two multiple choice quesitons will be asked based on this paragraph. One or more than one option can be correct.
Marking scheme: +4 for correct answer, 0 if not attempted and –2 in all other cases.

PART-I (PHYSICS)

SECTION – 1 : (Maximum Marks : 32)

This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive

1. The diagram shows a conducting rod of length 1 m and speed of ends P and Q are $\sqrt{3}$ m/s and 2 m/s. If constant magnetic field B = 1T is present perpendicular to plane of paper in inwards direction. If induced emf in the rod is $\frac{X}{10}$ volt then, find the value 'X'.

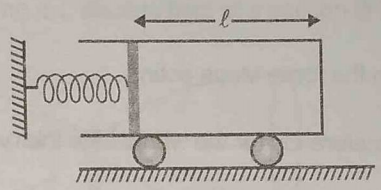


2. A gas consisting of rigid di–atomic molecules (degree of freedom = 5) at pressure $P_0 = 10^5$ N/m² and temperature 273 K was compressed adiabatically 5 times. The mean kinetic energy of rotating molecules in final state is $n \times 10^{-21}$ J. Find value of 'n'. ($K = 1.38 \times 10^{-23}$, $(5)^{2/5} = 1.90$).

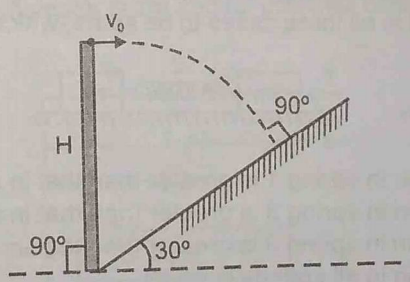
3. A uniform cube of mass M is floating on the surface of a liquid with three fourth of its volume immersed in the liquid (density of liquid is ρ).
Now a cubical cavity is made inside the cube and the cavity is filled by a material having twice the density of the original cube. The minimum dimension (sides) of this cavity such that this cube is now completely immersed in the liquid is $\left[\frac{4M}{n\rho}\right]^{\frac{1}{3}}$. Find the value of n.

4. Binary stars rotate under mutual gravitational force at separation $2\left(\frac{G}{\omega^2}\right)^{\frac{1}{3}}$, where ω is the angular velocity of each of the star about centre of mass of the system. If difference between the mass of stars is 6 units. Find the ratio of mass of bigger star to smaller star.

5. The figure shows a trolley with a light piston(area=10 cm^2)fitted on one end placed on a smooth horizontal surface .Two moles of a diatomic gas is filled in the trolley. The piston is placed in contact with an ideal spring which is undeformed.The walls of the trolley and the piston are adiabatic.There is no friction between the trolley and the piston.Initially the value of ℓ is 10 cm. Now the gas is given 20 cal of heat.After some time it was found that the temperature of the gas was increased by 1.8 K and the piston was at rest with respect to the trolley and which was then not in contact with the spring .Also the value of ℓ is now 14.2 cm. Neglect the heat capacity of the piston and the cylinder. If the kinectic energy of the trolley (with the piston and the gas) at this instant is 4.2 p joule, find the value of p. (Take R(gas constant)=2 cal/moleK and 1 cal= 4.2 J. and $P_{atm} = 10^5\ N/m^2$)

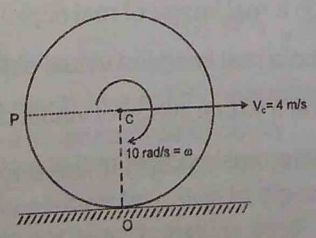


6. If the projectile hits the inclined plane perpendicularly when thrown horizontally with v_0 from a tower of height H as shown then the value of $\frac{2gH}{(v_0)^2}$ is



7. The Ra^{226} nucleus undergoes α–decay according to equation $Ra_{88}^{226} \rightarrow Rn_{86}^{222} + He_2^4$. If the Q value of reaction is Q = x MeV then find the value of [X]. Where [X] represents the greatest integer of x.
(Given : $m(Ra_{88}^{226}) = 226.025406u, m(Rn_{86}^{222}) = 222.017574u, m(He_2^4) = 4.002603u$]

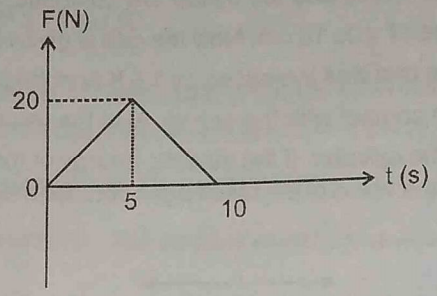
8. A uniform circular disc of radius 20 cm is rolling with slipping on the flat horizontal ground surface . At a certain instant the speed of the centre of mass of disc is 4 m/s and angular speed is 10 rad/s as shown in figure. The speed of lowest point 'C' is x m/s. Find the value of x.



SECTION – 2 : (Maximum Marks : 32)

This section contains **EIGHT** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

9. A particles of mass 25 kg, moving at 6 m/s, is acted upon by a force in the opposite direction to the velocity. The variation of force with time is shown in the graph. Then :



(A) Its speed will be 2 m/s when the force stops acting.

(B) its magnitude of average acceleration for the whole time interval in which force acts is $\frac{2}{5}$ m/s²

(C) its magnitude of average acceleration for the whole time interval in which force acts is $\frac{4}{5}$ m/s²

(D) Its direction of motion will be reversed atleast once during the time interval.

10. In each of three figures shown, two blocks are connected by a light spring and the system is placed on smooth horizontal surface. A constant horizontal force of magnitude F is applied to left block as shown. Assuming spring constant in all three cases to be same, which of the following statements is/are true.

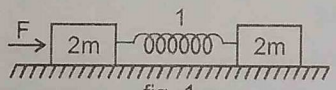


fig.-1

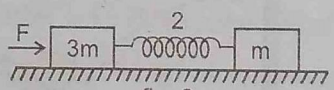


fig.-2

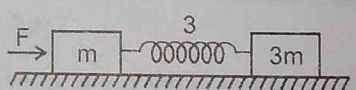
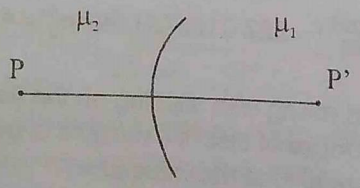


fig.-3

(A) maximum compression in spring 1 is greater than that in spring 2.
(B) maximum compression in spring 3 is greater than that in spring 1.
(C) maximum compression in spring 3 is greater than that in spring 2.
(D) maximum compression in all springs is equal.

11. Two refracting media are separated by a spherical interface as shown in figure. PP' is the principle axis. μ_1 and μ_2 are the refractive indices of medium of incidence and medium of refraction respectively. Then:



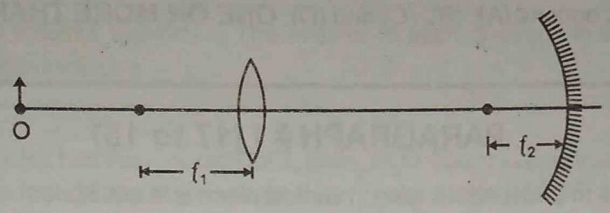
(A) If $\mu_2 > \mu_1$ then there cannot be a real image of real object.

(B) If $\mu_2 > \mu_1$, then there cannot be a real image of virtual object.

(C) If $\mu_1 > \mu_2$, then there cannot be a virtual image of virtual object

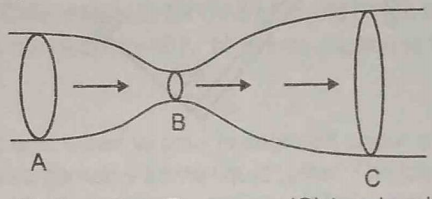
(D) If $\mu_1 > \mu_2$ then there cannot be a real image of real object

12. An object is placed in front of a converging lens at a distance equal to twice the focal length f_1 of the lens. On the other side of the lens is a concave mirror of focal length f_2 separated from the lens by a distance $2(f_1 + f_2)$. Light from the object passes rightward through the lens, reflects from the mirror, passes leftward through the lens, and forms a final image of the object.



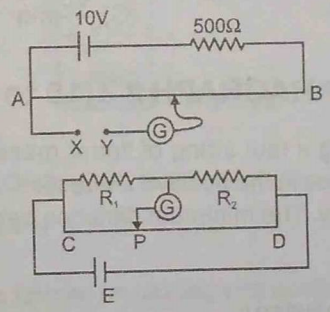
(A) The distance between the lens and the final image is equal to $2f_1$.
(B) The distance between the lens and the final image is equal to $2(f_1 + f_2)$.
(C) The final image is real, inverted and of same size as that of the object.
(D) The final image is real, erect and of same size as that of the object.

13. Figure shows a solid resistance wire of uniform material but non–uniform cross–section area. A,B and C are the three sections. Current flowing is i, electric field at a section is E, potential is V and flux of electric field cut by a cross–section is ϕ then :



(A) $i_B > i_A > i_C$ (B) $E_B > E_A > E_C$ (C) $\phi_A = \phi_B = \phi_C$ (D) $V_B > V_A > V_C$

14. In the circuit shown AB is potentiometer wire of length 10m and resistance 500Ω. CD is a 1m wire of meter bridge which is balanced at CP = 20 cm. Given that when the potential difference across R_1 is applied across XY the balancing length on potentiometer is 2m and for potential difference across R_2, the corresponding length is 8m. Then



(A) $\frac{R_1}{R_2} = \frac{1}{4}$ (B) Potential difference across R_1 is 1V

(C) Potential difference across R_2 is 4V (D) EMF of the battery E = 5V

15. A wire of lenght L, cross–sectional area A is made of a material of Young's modulus Y. The wire is stretched by an amount x, which lies well within the elastic limit. If k be the equivalent force constant of the wire and W be the work done then

(A) $k = \frac{YA}{2L}$ (B) $k = \frac{YA}{L}$ (C) $W = \frac{1}{2}\frac{YAx^2}{L}$ (D) $W = \frac{YAx^2}{L}$

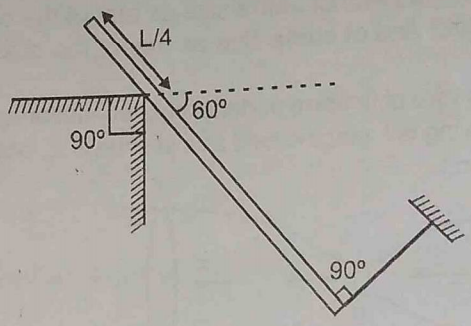
16. When a dipole is placed inside a cavity in a solid conducting body :
(A) No charges are induced on the inner surface of cavity
(B) No charges are induced on the outer surface of conducting body
(C) Every where out side the body electric field due to dipole is zero
(D) Every where out side the body net electric field is zero

SECTION – 3 : (Maximum Marks : 16)

This section contains **TWO** paragraphs. Based on each paragraph, there will be **TWO** questions. Each equation has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

PARAGRAPH # 1 (17 to 18)

A uniform rod of mass m and length L lying in vertical plane is in equilibrium as shown in diagram. The rod is making an angle of 60° with the horizontal and the string is perpendicular to the length of the rod at equilibrium.



17. The tension in the string is :

(A) $\frac{mg}{4}$ (B) $\frac{mg}{6}$ (C) $\frac{3mg}{4}$ (D) None of these

18. The friction force acting on the rod is :

(A) $\frac{mg}{2}$ (B) $\frac{mg}{4}$ (C) $\frac{\sqrt{3}}{2}mg$ (D) zero

PARAGRAPH # 2 (19 to 20)

A sinusoidal wave travels along a taut string of linear mass density 0.1 g/cm. The particles oscillate along y-direction and wave moves in the positive x-direction. The amplitude and frequency of oscillation are 2mm and 50 Hz respectively. The minimum distance between two particles oscillating in the same phase is 4m.

19. The tension in the string is (in newton)

(A) 4000 (B) 400 (C) 25 (D) 250

20. The amount of energy transferred (in Joules) through any point of the string in 5 seconds is

(A) $\frac{\pi^2}{10}$

(B) $\frac{\pi^2}{50}$

(C) $\frac{\pi^2}{5}$

(D) Cannot be calculated because area of cross-section of string is not given.

PART-II (CHEMISTRY)

SECTION – 1 : (Maximum Marks : 32)

This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive

21. A six co-ordinate complex has the formula $CoCl_3.5NH_3.H_2O$. Electrical conductance measurements indicate the presence of three ions in one formula unit. How many moles of AgCl will be percipitated with $AgNO_3$ solution with one mole of complex ?

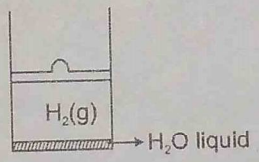
22. What is the spin only magnetic moment value (in Bhor magneton units) of $[V(CO)_6]^-$

23. In the disproportionation reaction of NaOH with one molecule of P_4, number of molecules of NaOH reacting are ..... .

24. A dilute solution of KCl was placed between two Pt electrodes 10 cm apart across which a potential difference of 6.0 volts was applied. Calcualte how far (in cm) would K^+ ion move in 2 hours 46 minutes and 40 seconds at 25°C. Given that ionic conductivity of K^+ at infinite dilution is 96.50 S cm^2 eq^{-1} at 25°C.
(Assume 1F = 96500 C).

25. Hydrogen gas saturated with water vapour is confined under a piston in a container of volume 10 litres as shown. The container also contains some liquid water. The total pressure over liquid water is 80 cm of Hg column. If now the piston is moved such that volume of the container is doubled, then find final total pressure in the container. (aq. tension of H_2O = 20 cm of Hg column) (Neglect volume of liquid H_2O).

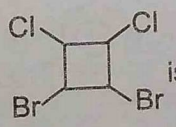
(Report your answer as y where $y = \frac{\text{Total pressure in cm of Hg}}{10}$)



26. Find the valency factor (n) for NH_2OH in given reaction :

$Fe^{3+} + NH_2OH \longrightarrow Fe^{2+} + N_2O + H^+ + H_2O$

27. How many structural products are formed on heating with acetaldehyde and acetone in basic medium?

28. Total number of steroisomer of  is :

SECTION – 2 : (Maximum Marks : 32)

This section contains **EIGHT** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

29. Which of the following statement (s) is/are true ?
(A) Ammonia burns in air with a pale yellow flame.
(B) Calcium carbide reacts with nitrogen gas at 1100°C to form a fertilizer, nitrolim.
(C) All the elements of nitrogen family are polyatomic.
(D) The melting point of antimony is less than arsenic.

30. Which of the following are correct statements
(A) Spontaneous adsorption of gases on solid surface is an exothermic process as entropy decreases during adsorption
(B) Formation of micelles takes place when temperature is below Kraft Temperature (T_k) and concentration is above critical micelle concentration (CMC)
(C) A colloid of $Fe(OH)_3$ is prepared by adding a little excess (required to completely precipitate Fe^{3+} ions as $Fe(OH)_3$)) of NaOH in $FeCl_3$ solution the particles of this sol will move towards cathode during electrophoresis.
(D) According to Hardy-Schulze rules the coagulation (flocculating) value of Fe^{3+} ion will be more than Ba^{2+} or Na^+.

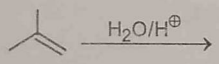
31. One mole of triatomic vapours of an unknown substance effused 4/3 times faster than 1 mole O_2 under same conditions. If the density of unknown vapours at pressure P and temperature T is 'd', which of the following holds true for the unknown substance.
(A) Vapour density (V.D.) = 9.
(B) Atomic weight = 6
(C) Z (compressibility factor) = $\frac{18P}{dRT}$
(D) Gas is heavier than O_2.

32. In which reactions 3° alcohol will be major product ?

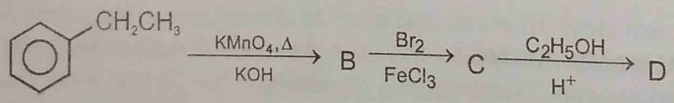
(A) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow[H^\oplus]{CH_3MgBr/ether/excess} \xrightarrow[H^\oplus]{CH_3MgBr/ईथर/आधिक्य}$

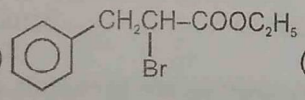
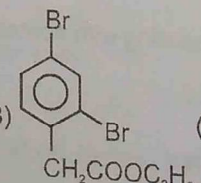
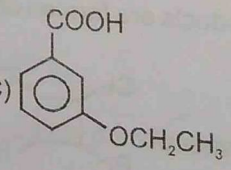
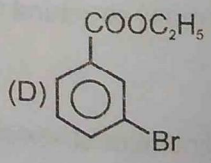
(B) $CH_3-\overset{\overset{O}{\|}}{C}-Cl \xrightarrow[H^\oplus]{CH_3MgBr/ether/excess} \xrightarrow[H^\oplus]{CH_3MgBr/ईथर/आधिक्य}$

(C) $Cl-\overset{\overset{O}{\|}}{C}-Cl \xrightarrow[H^\oplus]{CH_3MgBr/ether/excess} \xrightarrow[H^\oplus]{CH_3MgBr/ईथर/आधिक्य}$

(D)  $\xrightarrow{H_2O/H^\oplus}$

33. In the given reactions final product D is :



(A) 
(B) 
(C) 
(D) 

34. Which of the following compound will liberate CO_2 gas of reaction with Sodiumbicarbonate ?
(A) Picric acid (B) Aspirin (C) Squaric acid (D) Carbolic acid

35. Which of the following are ionic solids :
(A) N_2O_5 (B) PCl_5 (C) ICl_3 (D) XeF_6

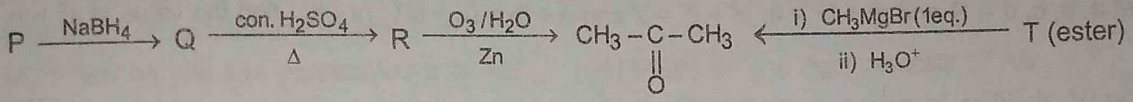
36. Which of the following is/are correct for potassium ferrocyanide ?
(A) It gives a white precipitate with Ag^+ ions.
(B) It gives a white precipitate of mixed salt with Ca^{2+} ions.
(C) It in excess gives a bluish white precipitate with Zn^{2+}.
(D) It develops a deep red colouration with Fe^{3+}.

SECTION – 3 : (Maximum Marks : 16)

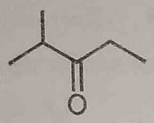
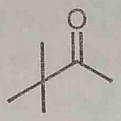
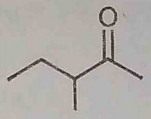
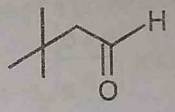
This section contains **TWO** paragraphs. Based on each paragraph, there will be **TWO** questions. Each equation has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

PARAGRAPH # 1 (37 to 38)

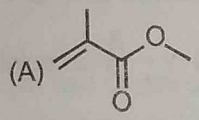
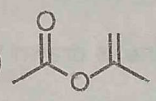
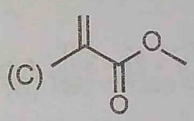
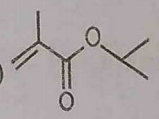
An acyclic hydrocarbon **P**, having molecular formula $C_6H_{10}O$, gave acetone as the only organic product through the following sequence of reactions, in which Q, R are intermediate organic compounds.



37. The compound 'P' is :

(A)  (B)  (C)  (D) 

38. The compound 'T' is

(A)  (B)  (C)  (D) 

PARAGRAPH # 2 (39 to 40)

Pure water is a weak electrolyte and neutral in nature, i.e. H^+ ion concentration is exactly equal to OH^- ion concentration $[H^+] = [OH^-]$. When this condition is disturbed by decreasing the concentration of either of the two ions, the neutral nature changes into acidic or basic. When $[H^+] > [OH^-]$, the water becomes acidic and when $[H^+] < [OH^-]$, the water acquires basic nature. This is exactly the change which occurs during the phenomenon known as salt hydrolysis. The pH of salt solution can be calculated using the following relations:

$pH = \frac{1}{2}[pK_w + pK_a + \log C]$ for salt of weak acid and strong base.

$pH = \frac{1}{2}[pK_w - pK_b - \log C]$ for salt of weak base and strong acid.

$pH = \frac{1}{2}[pK_w + pK_a - pK_b]$ for salt of weak acid and weak base.

where 'C' represents the concentration of salt.

When a weak acid or a weak base is not completely neutralized by strong base or strong acid respectively, then formation of buffer takes place. The pH of buffer solution can be calculated using the following relation :

$$pH = pK_a + \log \frac{[Salt]}{[Acid]} \; ; \; pOH = pK_b + \log \frac{[Salt]}{[Base]}$$

Answer the following questions using the following data :

$pK_a = 4.7447$, $pK_b = 4.7447$, $pK_w = 14$

39. When 50 mL of 0.1 M NH_4OH is added to 50 mL of 0.05 M HCl solution, the pH is :

(A) 1.6021 (B) 12.3979 (C) 4.7447 (D) 9.2553

40. 50 mL 0.1 M NaOH is added to 50 mL of 0.1 M CH_3COOH solution, the pH will be :

(A) 4.7447 (B) 9.2553 (C) 8.7218 (D) 1.6021

PART - III (MATHEMATICS)

SECTION – 1 : (Maximum Marks : 32)

This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive

41. If A and B are squares matrices such that $A^{2006} = 0$ and $AB = A + B$, then det(B).

42. Let $a, b, c, d \in R$ and $a^2 + b^2 = 4$, $c^2 + d^2 = 2$ and $a + ib = (c + id)\sqrt{x + iy}$, find the value of $x^2 + y^2$.

43. If singular solution of $p + \cos px \sin y = \sin px \cos y$ where $\left(p = \frac{dy}{dx}\right)$ is $y = a\sqrt{x^2 - b} - \sin^{-1}\frac{\sqrt{x^2 - c}}{x}$ then evaluate $\left|\frac{b + c}{a}\right|$.

44. Let $\vec{r}$ is position vector of a variable point in Cartesian plane OXY such that $\vec{r}.(10\hat{j} - 8\hat{i} - \vec{r}) = 40$ and $p_1 = \max\left\{\left|\vec{r} + 2\hat{i} - 3\hat{j}\right|\right\}, p_2 = \min\left\{\left|\vec{r} + 2\hat{i} - 3\hat{j}\right|\right\}$. A tangent line is drawn to the curve $y = \frac{8}{x^2}$ at point A with abscissa 2 if $p_1^2 + p_2^2 \in$ even; otherwise a normal line is drawn at the same point. The drawn line cuts x-axis at a point B. Find $\overline{AB}.\overline{OB}$. (where O is origin)

45. A circle touches a right angled triangle at mid-point of hypotenuse and passes through the middle point of shorter side. If 3, 4, 5 are the length of the sides and 'r' be the radius of the circle, then find the value of '3r'.

46. If $\int \frac{3x^2 + 2x}{x^6 + 2x^5 + x^4 + 2x^3 + 2x^2 + 5} dx = F(x)$, then find the value of $[F(1) - F(0)]$, where [.] represents greatest integer function.

47. Let z_1, z_2 and z_3 be complex numbers such that $|z_1| = |z_2| = |z_3| = |z_1 + z_2 + z_3| = 2$. If $|z_1 - z_2| = |z_1 - z_3|$ and $z_2 \neq z_3$. The value of $|z_1 + z_2| \cdot |z_1 - z_3|$ is _____.

48. Area enclosed by curve $4 \le x^2 + y^2 \le 2(|x| + |y|)$ is (in square units)

SECTION – 2 : (Maximum Marks : 32)

This section contains **EIGHT** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

49. If A, B, C are angles of ΔABC and $\tan A \tan C = 3$, $\tan B \tan C = 6$, then

(A) $A = \frac{\pi}{4}$

(B) $\tan A \tan B = 2$

(C) $\frac{\tan A}{\tan C} = \frac{3}{2}$

(D) $\tan^3 A + \tan^3 B = -\tan^3 C + 3 \tan A \tan B \tan C = 0$

50. If a, b, c are in H.P., then which of the following is true.

(A) $\frac{a}{1-2a}, \frac{b}{1-2b}, \frac{c}{1-2c}$ are in H.P. (B) $\ell n\left(a-\frac{b}{2}\right), \ell n\ \frac{b}{2}, \ell n\left(c-\frac{b}{2}\right)$ are in H.P.

(C) $c-\frac{b}{2}, \frac{b}{2}, a-\frac{b}{2}$ are in G.P. (D) $e^{1/a}, e^{1/b}, e^{1/c}$ are in G.P.

51. A(1, 2) and B(7, 10) are two points. If P(x, y) is a point such that $\angle APB = 60°$ and area of ΔAPB is maximum, then which of the following is (are) true ?

(A) P lies on any line perpendicular to AB (B) P lies on the right bisector of AB

(C) P lies on the line $3x + 4y = 36$ (D) Radius of circumcentre of ΔPAB is 10 units

52. If $f(x + y) = f(x) \cdot f(y)$ for all x, y and $f(1) = 2$, $a_r = f(r)$ for $r \in N$. Then the coordinates of a point on the parabola $y^2 = 8x$ whose focal distance is 4 may be

(A) (a_1, a_2) (B) $(a_1, -a_2)$ (C) (a_1, a_1) (D) $(-a_2, a_2)$

53. The polar equation $r = |\cos\theta|$ represents

(A) Two circles of radii $\frac{1}{2}$ each (B) Two circles centered at $\left(\frac{1}{2}, 0\right)$ & $\left(-\frac{1}{2}, 0\right)$

(C) Two circles touching each other at the origin (D) Pair of straight lines

54. If $\log_x a$, $a^{x/2}$, $\log_b x$ are in GP. then x is equal to

(A) $\log_a(\log_b a)$ (B) $\frac{\log(\log a) - \log(\log b)}{\log a}$

(C) $\log_b(\log_a b)$ (D) None of these

55. There exists a triangle ABC satisfying the conditions

(A) $b\sin A = a$, $A < \frac{\pi}{2}$ (B) $b\sin A > a$, $A > \frac{\pi}{2}$ (C) $b\sin A > a$, $A < \frac{\pi}{2}$ (D) $b\sin A < a$, $A < \frac{\pi}{2}$, $b > a$

56. If $x + 4|y| = 6y$, then y as a function of x is -

(A) defined for all real x (B) continuous at $x = 0$

(C) derivable at $x = 0$ (D) $\frac{dy}{dx} = \frac{1}{2}$ for $x > 0$

SECTION – 3 : (Maximum Marks : 16)

This section contains **TWO** paragraphs. Based on each paragraph, there will be **TWO** questions. Each equation has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

PARAGRAPH # 1 (57 to 58)

Three unit vectors $\hat{a}$, $\hat{b}$ and $\hat{c}$ are forming a right handed system, if $\hat{a}\times\hat{b}=\hat{c}$, $\hat{b}\times\hat{c}=\hat{a}$, $\hat{c}\times\hat{a}=\hat{b}$, then answer the following questions.

57. If vector $3\hat{a}-2\hat{b}+2\hat{c}$ and $-\hat{a}-2\hat{c}$ are adjacent sides of a parallelogram, then an angle between the diagonals is

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

58. $\hat{a}.(\hat{b}\times\hat{c}) + \hat{b}.(\hat{c}\times\hat{a}) + \hat{c}.(\hat{a}\times\hat{b})$ is equal to

(A) 1 (B) 3 (C) 0 (D) – 12

PARAGRAPH # 2 (59 to 60)

If [P] is greatest integer less than or equal to P
i.e. $P - 1 < [P] \le P$
& {P} is fractional part of P
$\therefore$ P = [P] + {P}
$0 \le \{P\} < 1$
then answer the following questions for $f\{x\} = \sin^{-1}[\tan x]$

59. If $\lim\limits_{x\to 0^+} f(x) = \ell$ then ℓ is equal to–

(A) 0 (B) $\frac{\pi}{2}$ (C) π (D) $\frac{3\pi}{2}$

60. If $\lim\limits_{x\to 0^-} f(x) = m$ then m is equal to–

(A) 0 (B) $-\frac{\pi}{2}$ (C) $\frac{\pi}{2}$ (D) $1+\frac{\pi}{2}$

PRACTICE TEST - THREE

PAPER-1

Time : 3:00 Hrs. **Max. Marks : 264**

GENERAL INSTRUCTIONS

1. The question paper consists of three parts (Physics, Chemistry and Mathematics). Each part consists of three sections and total number of questions are 60.

Marking Scheme & Question Paper Pattern

2. **Section 1** contains 8 question. The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).
Marking scheme: +4 for correct answer and 0 in all other cases.

3. **Section 2 contains** 10 multiple Choice question with one or more than one correct option.
Marking scheme: +4 for correct answer, 0 if not attempted and –2 in all other cases.

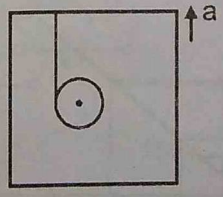
4. **Section 3 contains 2** "match the following" type question and you will have to match entries in Column I with the entries in Column II.
Marking scheme : for each entry in Column I, +2 for correct answer, 0 if not attempted and –1 in all other cases.

PART-I (PHYSICS)

SECTION - 1 : (Maximum Marks : 32)

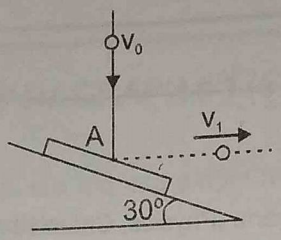
This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.

1. In the figure shown a thin light inextensible string is wrapped around a uniform disc. One end of the string is fixed to the ceiling of the lift and the other end is fixed to the circumference of the disc. Acceleration 'a' of the lift in such that the centre of disc does not move with respect to ground. Find the value of $\frac{a}{g}$. String does not slip on pulley.



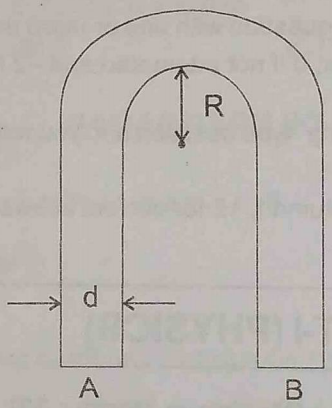
2. Light of intensity = $3W/m^2$ is incident on a perfectly absorbing metal surface of area 1 m^2 making an angle of 60^0 with the normal.If the force exerted by the photons on the surface is p $x10^{-9}$ (in Newton) find the value of p.

3. A steel ball falling vertically strikes a fixed rigid plate A with velocity v_0 and rebounds horizontally as shown. Assuming surface to be same and the effect of gravity on motion of ball to be neglected. If the coeficient of the restitution for the ball is 'e' then find the value of $\frac{1}{e}$.



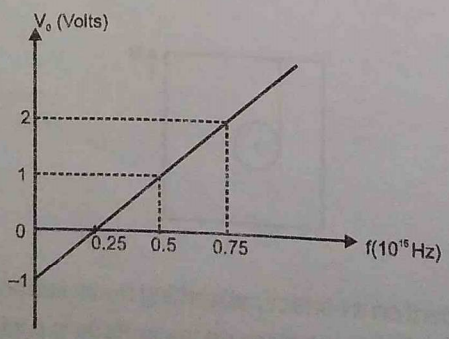
4. Force acting on a particle is $\vec{F} = (\alpha y \hat{i} + \beta xy \hat{j})$. Find the work done by this force , when particle is moved along the line 2x = 3y from origin to the point (3,2) {take all quantities in SI units and $\alpha = 1$, $\beta = 1$}

5. A glass rod of rectangular cross-section is bent into the shape shown in figure. A parallel beam of light falls perpendicularly on the flat surface A. What should be the minimum value of R/d for which all the light entering at surface A will emerge at surface B. Index of refraction of the glass is 1.5?

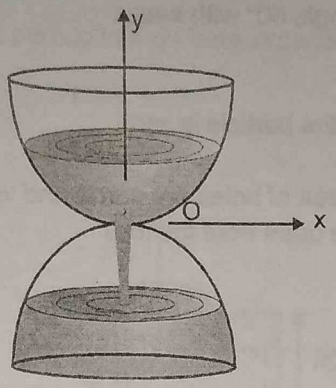


6. A man does work W on a ball to throw it vertically upto a height h on earth, if man does work $\frac{3W}{k}$ on same ball to throw it vertically upto height 2h on another planet having its radius $\frac{1}{4}$ of radius of earth and planet has same density as that of earth. Find 'k' ? (h is very small in comparison to radius of earth).

7. In a photoelectric effect experiment, for a certain cathode material, stopping potential V_0 as a function of frequency f of light used is shown. From the graph, find work function (in eV) of the material ?



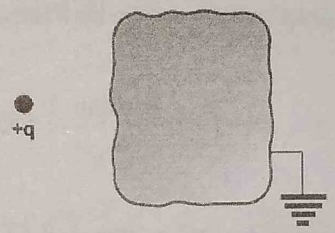
8. A water clock used in ancient Greece is designed as vessel with small orifice O. The time is determined according to the level of the water in vessel. For time scale to be linear, the surface of the vessel should be surface of revolution of curve $y = ax^n$, where 'a' is a constant. Find the value of n.



SECTION – 2 : (Maximum Marks : 40)

TThis section contains **TEN** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

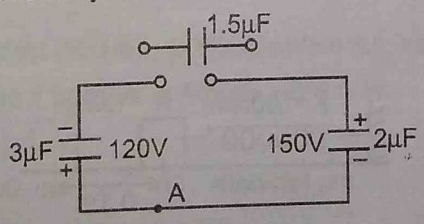
9. In front of an earthed conductor a point charge + q is placed as shown in figure :



(A) On the surface of conductor the net charge is always negative.
(B) On the surface of conductor at some points charges are negative and at some points charges may be positive distributed non uniformly
(C) Inside the conductor electric field due to point charge is non zero
(D) None of these

10. A wire of density 9×10^3 kg/m^3 is stretched between two clamps 1 m apart and is stretched to an extension of 4.9×10^{-4} metre. Young's modulus of material is 9×10^{10} N/m^2. Then
(A) The lowest frequency of standing wave is 35 Hz
(B) The frequency of 1st overtone is 70 Hz
(C) The frequency of 1st overtone is 105 Hz
(D) The stress in the wire is 4.41×10^7 N/m^2

11. Two capacitor of 2 μF and 3 μF are charged to 150 volt and 120 volt respectively. The plates of a capacitor are connected as shown in the figure. A discharged capacitor of capacity 1.5 μF falls to the free ends of the wire. Then after the system comes in steady state :



(A) Charge on the 1.5 μF capacitor will become 180 μC.
(B) Charge on the 2 μF capacitor will become 120 μC.
(C) +ve charge flows through A from left to right.
(D) +ve charge flows through A from right to left.

12. A charged particle is projected in magnetic field $\vec{B} = 10\hat{k}$ from origin in x-y plane. The particle moves in a circle and just touches a line y = 5 m at $x = 5\sqrt{3}$ m. Then (mass of particle = 5×10^{-5} kg , charge = 1μc)-

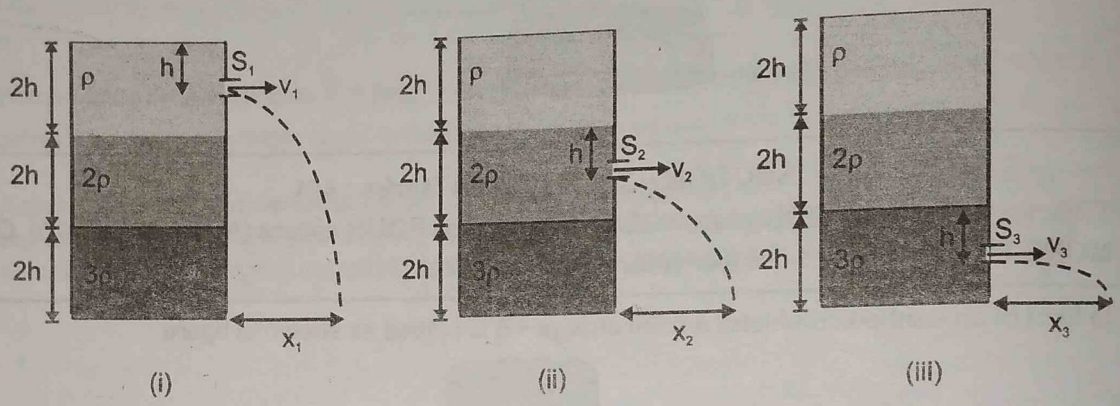
(A) The particle is projected at an angle 60° with x-axis

(B) The radius of circle is 10 m

(C) speed of particle is 2m/s

(D) workdone by magnetic force on the particle is zero.

13. In the figure shown cross–section area of holes are same and very small in comparison to area of cross-section of water tank : (tanks are the open from the top)



(A) $x_1 : x_2 : x_3 = \sqrt{5} : \sqrt{6} : \sqrt{3}$

(B) $x_1 : x_2 : x_3 = \sqrt{6} : \sqrt{5} : \sqrt{3}$

(C) If A_1, A_2, A_3 are the area of streams when it hits the ground then $12A_1^2 : 5A_2^2 : 4A_3^2 = 3 : 3 : 2$

(D) If A_1, A_2, A_3 are the area of streams when it hits the ground then $12A_1^2 : 5A_2^2 : 4A_3^2 = 2 : 2 : 3$

14. A satellite revolves around a planet in circular orbit of radius *R* (much larger than the radius of the planet) with a time period of revolution *T*. If the satellite is stopped and then released in its orbit (Assume that the satellite experiences gravitational force due to the planet only).

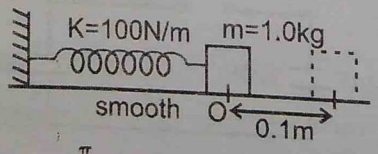
(A) It will fall into the planet

(B) The time of fall of the satellite is nearly $\frac{T}{\sqrt{8}}$

(C) The time of fall of the satellite into the planet is nearly $\frac{\sqrt{2}T}{8}$

(D) It cannot fall into the planet so time of fall of the satellite is meaningless

15. A block of mass m is placed on a smooth surface and is connected with a spring as shown. The block is pulled by a distance A = 0.10 m from its natural length and released at t = 0. Angular frequency $\omega = \sqrt{\frac{K}{m}}$.



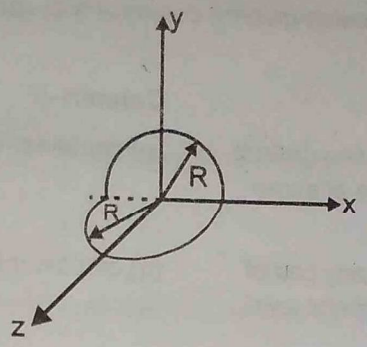
(A) The maximum speed is after $t = \frac{\pi}{20}$s.

(B) Time taken to cover first 0.10 m, $t = \frac{\pi}{20}$s.

(C) Time taken to cover first 0.05 m, $t = \frac{\pi}{40}$s.

(D) Time taken to cover first 0.05 m, $t = \frac{\pi}{30}$s.

16. A circular conducting loop of radius R and carrying current I_0 (direction not shown) is bent in two equal halves, one lying in x–y plane and other in x–z plane. Centre is at the origin. Loop is immersed in uniform external magnetic field $\vec{B} = \frac{\mu_0 I_0}{2\pi R}(\hat{i} + \hat{k})$. If portion in x–y plane experiences a net force in positive y–direction due to external field then :



(A) Magnetic dipole moment of the loop is $\frac{\pi R^2}{2} I_0(-\hat{k} - \hat{j})$

(B) Net magnetic force due to external field on the portion lying in x–z plane is $-\frac{\mu_0 I_0^{\,2}}{\pi}\hat{j}$

(C) Net torque experience by the loop is $\frac{\mu_0 I_0^{\,2} R}{4}(\hat{i} + \hat{j} - \hat{k})$

(D) Net magnetic field at the origin is $\frac{\mu_0 I_0}{4R}(\hat{j} + \hat{k})$

17. A train is moving with constant speed along a circular track. If length of the train is one fourth of length of circular track then which of the following is/are **correct** options (Assume that sound source is at engine) :

(A) Frequency observed by a passenger who is sitting in the middle of train (equidistant from front and rear end) will continuously increase.

(B) Frequency observed by a passenger who is sitting in the middle of train (equidistant from front and rear end) will remain constant but more than actual frequency.

(C) Frequency observed by a passenger who is sitting in the middle of train (equidistant from front and rear end) will remains constant and equal to actual frequency.

(D) Wavelength observed by the person who is on the rear end of train is more than the actual wavelength of sound wave.

18. A student working with sodium light (590 nm) in YDSE puts a thin transparent sheet (μ = 1.5) before one of the slits and it appears to him as if position of fringes were remain unchanged. Possible thickness of the sheet is/ are :

(A) 1.18 μm (B) 2.36 μm (C) 3.54 μm (D) 4.72 μm

SECTION – 3 : (Maximum Marks : 16)

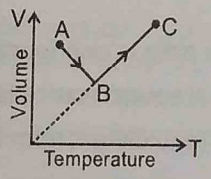
This section contains **TWO** questions. Each question contains two columns, **Column I** and **Column II**. **Column I** has **four** entries (A),(B), (C) and (D). **Column II** has **five** entries (P),(Q), (R), (S) and (T).

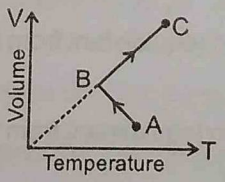
19. Consider incompressible and non–viscous liquid in a container. Density of liquid is r and acceleration due to gravity is g and h represents the vertical separation between two points. All points considered in column I are inside the liquid. Match the statements given in column-I with corresponding all possible conditions given in column-II.

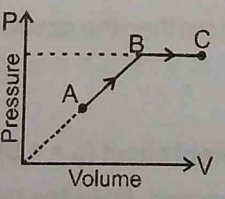
Column–I	**Column–II**
(A) Pressure difference between two distinct points is rgh where two points are at same vertical line at a separation h.	(p) container is stationary.
(B) Pressure difference between any pair of two distinct points on same horizontal level is zero.	(q) container is accelerating is horizontal direction
(C) Pressure difference between any pair of two distinct points on same horizontal level is non–zero.	(r) container is falling freely.
(D) Pressure difference between any two tinct with points on same vertical line is zero.	(s) container is accelerating up in vertical direction dis- an acceleration < g.
	(t) container is rotating about a vertical axis passing through its symemtry.

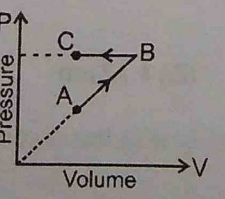
20. In each situation of column-I, a process A → B → C is given for an ideal gas. Match each situation of column-I with correct results in column-II.

Column-I

(A) 

(B) 

(C) 

(D) 

Column-II

(p) Temperature continuously increases.

(q) Pressure first increases and then remains constant

(r) Temperature first decreases and then increases

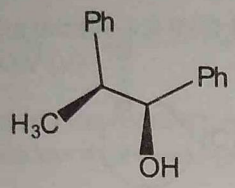
(s) Pressure first decreases and then remains constant

(t) Internal energy continuously increases.

PART-II (CHEMISTRY)

SECTION - 1 : (Maximum Marks : 32)

This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.

21. 

$\xrightarrow[\text{anhy. } ZnCl_2]{\text{Conc. HCl}}$ Number of possible isomeric products including stereoisomers will be.

22. In the following sequence of reactions all stereoisomers of (X) have been taken.

$$CH_3-\underset{\underset{D}{|}}{CH}-CH=CH-\underset{\underset{D}{|}}{CH}-CH_3 \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} (Y) \xrightarrow{NH_2OH} (Z)$$

(X)

Here, Q = Total number of stereoisomers of Y,
R = Total number of stereoisomers of Z
What is the sum of Q and R in the above reaction.

23. Amongst the following, the total number of species which does/do not exist is :
SF_6, BF_6^{3-}, XeF_2, OF_4, AlF_6^{3-}, PCl_5, NCl_5, HFO_4

24. A complex, *Prussian blue*, has formula $Fe_4[Fe(CN)_6]_3$. What is the sum of oxidation numbers of iron in ionisation sphere and coordination sphere?

25. How many of the following species have exactly four equally contributing resonance structures ?

ClO_4^-, PO_4^{3-}, XeO_6^{4-}, oxalate : $\begin{matrix}COO^-\\|\\COO^-\end{matrix}$, CH_3-COO^-, SF_4, N_3^-, HCO_3^-

26. If the binding energy of 2nd excited state of a hydrogen like sample is 24 eV approximately, then determine the atomic number Z of the H-like species :

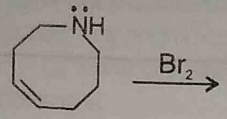
27. A electrode is prepared by dipping a silver strip into a solution saturated with silver thiocyanate and containing 0.1M SCN^-. The emf of the voltic cell constructed by connecting this electrode as the cathode to the standard hydrogen half cell, as the anode is 0.45V. The solubility of AgSCN is $x \times 10^{y}$. Report your answer as (x - y)?
[$E^\circ_{Ag^+/Ag}$ = 0.8 V]

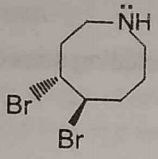
28. A non volatile, non electrolyte solute $C_nH_{2n}O_n$ of 2.4 g is dissolved in 100 g water so its boiling point get elevated upto 100.1°C (k_b of water = 0.5 K-kg/mole).What is the value of 'n'.

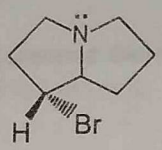
SECTION – 2 : (Maximum Marks : 40)

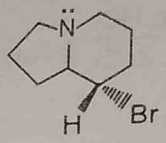
TThis section contains **TEN** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

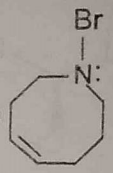
29. The major product of the following reaction would be



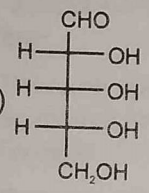
(A) 

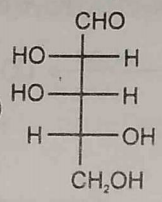
(B) 

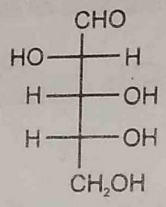
(C) 

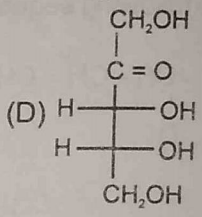
(D) 

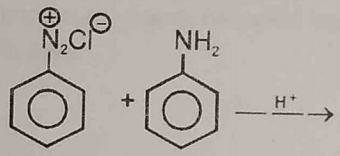
30. Which of the following will form same product (osazone) on reaction with $PhNHNH_2$ (excess).

(A) 

(B) 

(C) 

(D) 

31. 

Which of the following statements is/are correct about the above reaction ?

(A) Product shows geometrical isomerism

(B) Product shows colour due to extended conjugation

(C) Electophile attack at para position due to large size.

(D) Electron withdrawing group in aniline increases rate of reaction.

32. Correct statement about peptide linkage in a protein molecule is/are correct ?

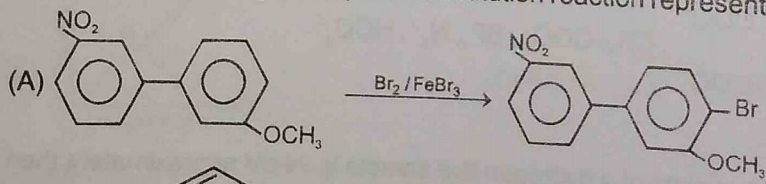
(A) It is amide linkage

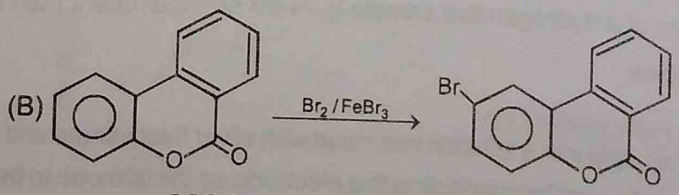
(B) It has partial double bond character.

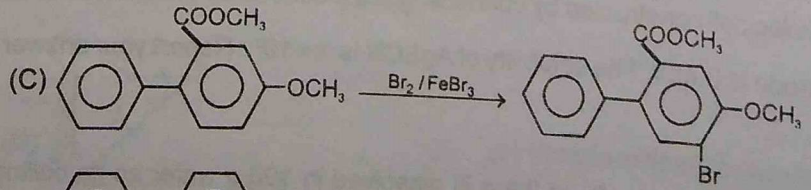
(C) It is hydrophilic in nature

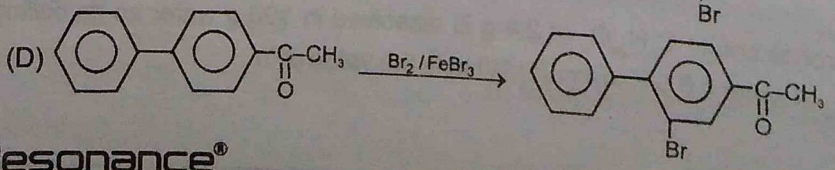
(D) It connects protein molecules through H-bonds.

33. Which of the following electophilic substitution reaction represent **correct** product.

(A) 

(B) 

(C) 

(D) 

34. What are true about the interstitial compounds formed by transition metals ?
(A) They have high melting points, higher than those of pure metals.
(B) They are very hard
(C) They have metallic condictivity
(D) They are chemically inert

35. Which of the following ore(s) is /are concentrated by magnetic separation method ?
(A) Haematite (B) Magnetite (C) Siderite (D) Iron pyrites

36. The tetrahedral $[MO_4]^{n-}$ ions are known for :
(A) V (V) (B) Cr(VI) (C) Mn (VI) (D) Fe(III)

37. Taking the reaction, A + 2B $\longrightarrow$ Products, to be of second order, which of the following is/are the correct rate law expression(s) ?

(A) $\frac{dx}{dt} = k[A]^2$ (B) $\frac{dx}{dt} = k[A][B]^2$ (C) $\frac{dx}{dt} = k[A][B]$ (D) $\frac{dx}{dt} = k_1[A] + k_2[B]^2$

38. Select the correct statements about three dimensional HCP system.
(A) Number of atoms in HCP unit cell is six.
(B) The volume of HCP unit cell is $24\sqrt{2}\ r^3$.
(C) The empty space in HCP unit cell is 26%.
(D) The base area of HCP unit cell is $6\sqrt{3}\ r^2$.

SECTION – 3 : (Maximum Marks : 16)

This section contains **TWO** questions. Each question contains two columns, **Column I** and **Column II**. **Column I** has **four** entries (A),(B), (C) and (D). **Column II** has **five** entries (P),(Q), (R), (S) and (T)

39. Match the ore with its consituting elements

Column I	**Column II**
(A) chalocpyrite	(p) Fe or Ca
(B) dolomite	(q) Mg or Cu
(C) chromite	(r) O atom
(D) carnalite	(s) K or Cr
	(t) S or Cl

40.

Columm - I	**Columm - II**
(A) Reversible adiabatic compression	(p) $\Delta S_{system} > 0$
(B) Reversible vaporisation of liquid	(q) $\Delta S_{system} < 0$
(C) $2N(g) \longrightarrow N_2(g)$	(r) $\Delta S_{surrounding} < 0$
(D) $MgCO_3(s) \xrightarrow{\Delta} MgO(s) + CO_2(g)$	(s) $\Delta S_{surrounding} = 0$
	(t) $\Delta S_{system} = 0$

PART - III (MATHEMATICS)

SECTION - 1 : (Maximum Marks : 32)

This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.

41. If $f(x) = [9^x - 3^x + 1]$, $x \in (-\infty, 1)$, then number of integers in the range of f(x) is (where [.] denotes greatest integer function)

42. Given $\vec{A} = 2\hat{i} + 3\hat{j} + 6\hat{k}$, $\vec{B} = \hat{i} + \hat{j} - 2\hat{k}$ and $\vec{C} = \hat{i} + 2\hat{j} + \hat{k}$. Compute the value of $\left|\vec{A}\times\left(\vec{A}\times(\vec{A}\times\vec{B})\right).\vec{C}\right|^{1/3}$.

43. The ratio of fifth term from the beginning to the fifth term from the end in the expansion of $\left(\sqrt[4]{2} + \frac{1}{\sqrt[4]{3}}\right)^n$ is $\sqrt{6}:1$. If $n = \frac{20}{\lambda}$, find the value of λ.

44. Let $f(x) = \begin{vmatrix} a^2+x & ab & ac \\ ab & b^2+x & bc \\ ac & bc & c^2+x \end{vmatrix}$, where $a,b,c \in R$ and not all simultaneously equal to zero.

If the interval in which f(x) is strictly decreasing is $\left[-\frac{2\lambda}{3}(a^2+b^2+c^2),\ 0\right]$, then λ =

45. There are 6 men $M_1, M_2, \ldots M_6$ and 5 women $W_1, W_2, \ldots W_5$. A committee of 2 women and 3 men is to be formed under the condition that M_1 will serve the committee if M_2 is present in committee and M_2 will serve the committee if W_1 is present in the committee. If total number of such committees are 16λ, then find the value of λ.

46. A function y = f(x) satisfying. $f''(x) = x^{-3/2}$, $f'(D) = 2$ and $f(0) = 0$ is $-\lambda\sqrt{x} + 3x$, then find the value of λ.

47. If $\ell = \lim\limits_{x\to\infty} \frac{\sqrt{x}}{\sqrt{x+\sqrt{x+\sqrt{x}}}}$ and $m = \lim\limits_{x\to\infty}\left(\sqrt{x+\sqrt{x+\sqrt{x}}} - \sqrt{x}\right)$, then $2(\ell - m) =$

48. A variable chord PQ of the parabola $y^2 = 4x$ is drawn parallel to the line y = x. The loucs of point of intersection of normals at P and Q is $\alpha x - y = \ell$, the value of $\frac{\alpha+\ell}{2}$ is

SECTION – 2 : (Maximum Marks : 40)

TThis section contains **TEN** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

49. Consider the function $f(x) = \sin^{-1}\left(\frac{1-x^2}{1+x^2}\right)$. Which of the following are **CORRECT** ?

(A) f(x) is continuous and differentiable for all x.

(B) f(x) is symmetric about y-axis

(C) Range of f(x) is $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

(D) Slope of the tangent at x = 1 is negative.

50. If $5\cos 2\theta + 2\cos^2\frac{\theta}{2} + 1 = 0$, $-\pi < \theta < \pi$ then $\theta =$

(A) $\frac{\pi}{3}$ (B) $\cos^{-1}\frac{3}{5}$ (C) $-\cos^{-1}\frac{3}{5}$ (D) $\pi - \cos^{-1}\frac{3}{5}$

51. Which of the following relations are false ?

(A) $\tan|\tan^{-1}x| = x$ (B) $\cot|\cot^{-1}x| = |x|$ (C) $\tan^{-1}|\tan x| = |x|$ (D) $\sin|\sin^{-1}x| = |x|$

52. If $z = x + iy$, $i = \sqrt{-1}$, $x, y \in R$, then which of the following are **CORRECT** ?

(A) If $|z - 2i| + |z - 7i| = 8$, locus of z is an ellipse.

(B) If $|z - 1| + |z - 6| = 5$, locus of z is a line segment.

(C) If $||z - 3| - |z - 4i|| = 7$, locus of z is a hyperbola.

(D) If $|z + 3i| = |z + 7i|$, locus of z is a perpendicular bisector of line segment joining 3i and 7i.

53. If the line $ax + by + c = 0$, where a,b,c are non-zero real numbers, is normal to the rectangular hyperbola $xy = 1$, then which of the following is/are true ?

(A) $a > 0, b > 0$ (B) $a > 0, b < 0$ (C) $a < 0, b > 0$ (D) $a < 0, b < 0$

54. Let the minimum value of real quadratic expression $ax^2 - bx + \frac{1}{2a}$, $a > 0$ be y_0. If y_0 occurs at $x = k$ and $k = 2y_0$, then possible values of b are

(A) 2 (B) -2 (C) 1 (D) -1

55. Consider two lines $\frac{x+3}{-4} = \frac{y-6}{3} = \frac{z}{2}$ and $\frac{x-2}{-4} = \frac{y+1}{1} = \frac{z-6}{1}$. Which of the following are **CORRECT**?

(A) Lines are coplanar.

(B) Lines are non-coplanar.

(C) Shortest distance between them is 9

(D) $(\hat{i} - 4\hat{j} + 8\hat{k})$ is a vector perpendicular to both given lines

56. If $3A = \begin{bmatrix} -1 & -2 & -2 \\ 2 & 1 & -2 \\ x & -2 & y \end{bmatrix}^T$ such that $AA^T = I$, then which of the following are **CORRECT** ?

(A) $x + 2y = 4$ (B) $x - y = 1$ (C) $x^2 + y^2 = -3$ (D) $x^2 + y^2 = 5$

57. Let S denote the set of all values of λ for which the system of linear equations

$\lambda x + (\sin\alpha)\, y + (\cos\alpha)\, z = 0$,

$x + (\cos\alpha)\, y + (\sin\alpha)\, z = 0$,

$-x + (\sin\alpha)\, y - (\cos\alpha)\, z = 0$,

has a non-trivial solution $\forall\, \alpha \in R$, then S contains

(A) $(-1, 1)$ (B) $[-\sqrt{2}, -1]$ (C) $[1, \sqrt{2}]$ (D) $(-2, 2)$

58. If $f(x) = \begin{cases} \frac{1-[x]}{1+x} & , x \neq 0 \\ 1 & , x = 0 \end{cases}$ (where [.] denotes the greatest integer function), then f(x) is

(A) continuous at $x = \frac{3}{2}$ (B) discontinuous at $x = 1$

(C) continuous at $x = \frac{1}{2}$ (D) continuous at $x = 0$

SECTION – 3 : (Maximum Marks : 16)

This section contains **TWO** questions. Each question contains two columns, **Column I** and **Column II**. **Column I** has **four** entries (A),(B), (C) and (D). **Column II** has **five** entries (P),(Q), (R), (S) and (T).

59.

Column-I	Column-II
(A) If three normals can be drawn to the curve $y^2 = x$ from the point (c, 0) then c can be equal to	(p) 0
(B) If a,b,c are complex numbers and roots of $z^3 + az^2 + bz + c = 0$, are $e^{i\alpha}$, $e^{i\beta}$, $e^{i\gamma}$, $\alpha, \beta, \gamma \in R$, then $\lvert c\rvert$ =	(q) 1
(C) If the point (a, a) lies between the lines $\lvert x + y\rvert = 6$ then $[\lvert a\rvert]$ can be (where [.] denotes greatest integer function)	(r) 4
(D) If point ([a + 1], [a]) lies inside the annular region bounded by circles $x^2 + y^2 - 2x - 15 = 0$ and $x^2 + y^2 - 2x - 7 = 0$ then number of values of a are (where [.] denotes greatest integer function)	(s) 3
	(t) 2

60.

Column-I	Column-II
(A) Fundamental period of $f(x) = \sin\left(2\pi x + \left\{\frac{x}{2}\right\}\right)$ is (where {.} represents fractional part function)	(p) 0
(B) Let $\vec{u} = \hat{i} + \hat{j}$, $\vec{v} = \hat{i} - \hat{j}$, $\vec{w} = \hat{i} + 2\hat{j} + 3\hat{k}$. If $\vec{n}$ is a unit vector such that $\vec{u} \cdot \vec{n} = 0$, $\vec{v} \cdot \vec{n} = 0$, then the value of $\lvert \vec{w} \cdot \vec{n} \rvert$ is	(q) 3
(C) If $f : [0, 2] \to [0, 2]$ is bijective function defined by $f(x) = ax^2 + bx + c$, where a, b, c are non-zero real numbers, then f(2) is equal to	(r) 1
(D) Ladder of length 5m leaning against a wall is being pulled along the ground at a rate 2cm/s. When the foot of the ladder is 4m away from the wall, the top of the ladder slides down on the wall at a rate $\frac{8}{\lambda}$ cm/s. The value of λ is	(s) 2
	(t) 4

PRACTICE TEST - THREE

PAPER-2

Time : 3:00 Hrs. **Max. Marks : 240**

GENERAL INSTRUCTIONS

1. The question paper consists of three parts (Physics, Chemistry and Mathematics). Each part consists of three sections and total number of questions are 60.

   Marking Scheme & Question Paper Pattern

2. Section 1 contains 8 questions. The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).
   Marking scheme: +4 for correct answer and 0 in all other cases.

3. Section 2 contains 8 multiple Choice question with one or more than one correct option.
   Marking scheme: +4 for correct answer, 0 if not attempted and –2 in all other cases.

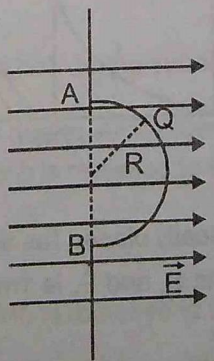
4. Section 3 contains 2 "paragraph" type questions. Each paragraph describes and experiment, a situation or a problem. Two multiple choice quesitons will be asked based on this paragraph. One or more than one option can be correct.
   Marking scheme: +4 for correct answer, 0 if not attempted and –2 in all other cases.

PART-I (PHYSICS)

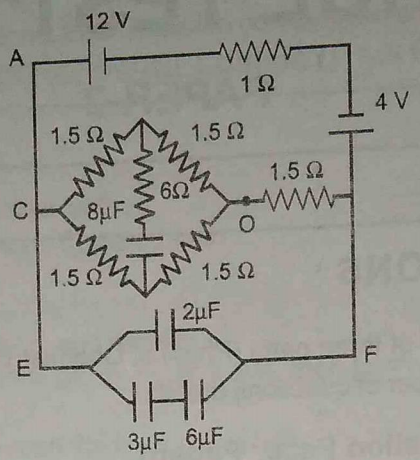
SECTION – 1 : (Maximum Marks : 32)

This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive

1. The charge Q = πC is distributed on a thin semicircular ring of radius R = 2m. There is a uniform electrostatic field $|\vec{E}|$ = 2N/C directed horizontally. Initially the ring is in static equilibrium as shown in figure. The semicircular ring can rotate freely about a fixed vertical axis AB. If we want to rotate it about the fixed axis by 90° then minimum work required on the ring is xJ. Find the value of x.



2. In the given circuit, the potential difference across the 6μF capacitor in steady state (in volts) is



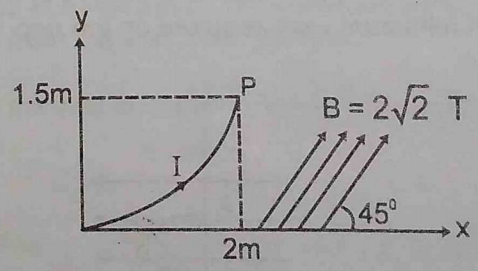
3. A man does work W on a ball to throw it vertically upto a height h on earth, if man does work $\frac{3W}{k}$ on same ball to throw it vertically upto height 2h on another planet having its radius $\frac{1}{4}$ of radius of earth and planet has same density as that of earth. Find 'k' ? (h is very small in comparison to radius of earth).

4. The dispersive power of the material of a lens is 0.04 and the focal length of the lens is 10 cm. Find the difference in the focal length (in mm) of the lens for violet and red colour.

5. If earth has uniform density, and radius 'R'. The value of acceleration due to gravity at distance d above the surface is same as acceleration due to gravity at distance d below the surface. If $d = \left(\frac{\sqrt{x}-1}{2}\right)R$, then find x.

6. A fiber of length 10 km is illuminated with light from an light emitting diode (LED) which is turned on and off repeatedely for equal amount of time. The speed of the pulses of light are 2.00×10^8 m/s and 2.1×10^8 m/s in fiber. Maximum frequency of LED so that pulse arrive without overlapping is 10X (KHz). Calculate X/7.

7. A parabolic wire as shown in the figure is located in x–y plane and carries a current I = 10 amp. A uniform magnetic field of intensity $2\sqrt{2}$ T, making an angle of 45° with x-axis exists throughout the plane. If the co–ordinates of end point 'P' of wire are (2m, 1.5 m), then the total force (in newton) acting on the wire is 5x. Find x :

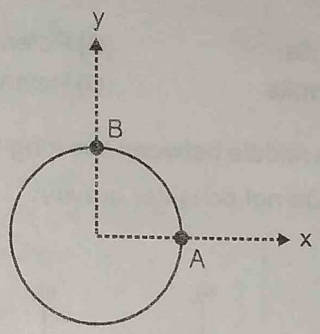


8. A point source 'S' which is symmetrically placed (as shown in figure) emits light rays of wavelength 4000 Å and 6000 Å. If distance between slits S_1 and S_2 is 1mm then least (non–zero) distance of point on screen from 'O' at which both the wavelengths produces maxima together is $\frac{X}{10}$ mm then calculate X/4.

SECTION – 2 : (Maximum Marks : 32)

This section contains **EIGHT** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

9. A non-uniform disc of mass m and radius R, hinged at some point and performing pure rotation with respect to hinge, in horizontal plane with an angular velocity ω. At certain instant center of the disc is at origin in the mentioned co-ordinate system and velocity of particle A is $\vec{V}_A = -\frac{\omega R}{4}\left(3\hat{i} - 4\hat{j}\right)$ **m/s. Choose the correct options :**



(A) Velocity of particle B at the given instant is $-\frac{7\omega R}{4}\hat{i}$

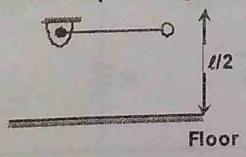
(B) Velocity of centre of disc at the given instant is $-\frac{3\omega R}{4}\hat{i}$

(C) Co-ordinates of hinge is $\left(-\frac{3R}{4}, 0\right)$ **(D) Co-ordinates of hinge is $\left(0, -\frac{3R}{4}\right)$**

10. **Which of the following dimensional formula is/are correct.**
(A) [permittivity of the free space × electric field] = $[M^0 L^{-2} T^1 A^1]$
(B) [electrical conductivity] = $[M^{-1} L^{-3} T^3 A^1]$

(C) [viscous force] = $[M^1 L^1 T^{-2}]$ **(D) $\left[\frac{\text{Electric field}}{\text{Magnetic field}}\right] = [M^0 L^1 T^{-1}]$**

11. **A bob of mass m connected to the end of an inextensible string of length ℓ, is released from position shown in figure. If impacts of bob with smooth floor is perfectly inelastic. Choose the correct option(s).**



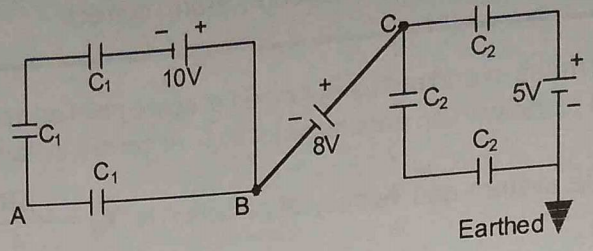
(A) The maximum height reached by the bob during subsequent motion is $\frac{\ell}{32}$.

(B) Maximum height reached by the bob during subsequent motion is zero.

(C) Energy loss from the time duration bob is released to the time it reaches at its maximum height during subsequent motion is $\frac{3mg\ell}{8}$.

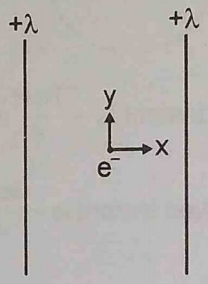
(D) Energy loss from the time duration bob is released to the time it reaches at its maximum height during subsequent motion is $\frac{15mg\ell}{32}$.

12. In the shown circuit diagram all capacitors are initially uncharged and cells are ideal. If $C_1 = 1\ \mu F$, $C_2 = 2\ \mu F$ and potential of earth is taken zero. Choose the correct options.



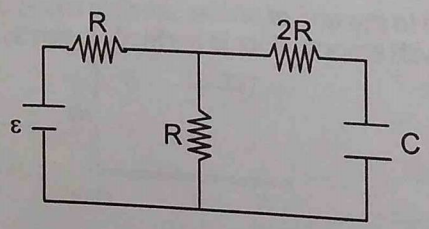
(A) Potential of point A is (4/3) volts
(B) Potential of point B is (–14/3) volts
(C) Potential of point C is (10/3) volts
(D) Potential of point A is (–4/3) volts

13. An electron is placed just in the middle between two long fixed line charges of charge density $+\lambda$ each. The wires are in the xy plane (Do not consider gravity)



(A) The equilibrium of the electron will be unstable along x-direction
(B) The equilibrium of the electron will be stable along y-direction
(C) The equilibrium of the electron will be neutral along y-direction
(D) The equilibrium of the electron will be stable along z-direction

14. Circuit shown in the figure is in steady state. Now the capacitor is suddenly filled with medium of dielectric constant K = 2.



(A) Current through '2R' just after this moment is $\frac{\varepsilon}{10R}$

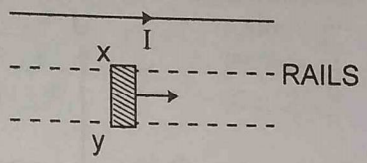
(B) Current through '2R' just after this moment is $\frac{\varepsilon}{15R}$

(C) Current through battery just after this moment is $\frac{11\varepsilon}{20R}$

(D) Potential difference across capacitor just after this moment is $\frac{\varepsilon}{4}$

15. In an x–ray tube the voltage applied is 20KV. The energy required to remove an electron from L shell is 19.9 KeV. In the x–rays emitted by the tube (Use hc = 12420 eVÅ)
(A) minimum wavelength will be 62.1 pm
(B) energy of the characterstic x-rays will be equal to or less than 19.9 KeV
(C) L_α x-ray may be emitted
(D) L_α x-ray will have energy 19.9 KeV

16. A metallic bar 'xy' is held on two parallel rails & moved parallel to a long straight current carrying conductor in the same plane as shown. Then :



(A) electron density will be more at end x compare to y.
(B) electron density will be more at end y compare to x.
(C) the direction of induced current is from y to x.
(D) no induced current flows through xy.

SECTION – 3 : (Maximum Marks : 16)

This section contains **TWO** paragraphs. Based on each paragraph, there will be **TWO** questions. Each equation has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

PARAGRAPH # 1 (17 to 18)

A wave represented by equation $y = 2(mm)\ \sin[4\pi(sec^{-1})t - 2\pi(m^{-1})x]$ is superimposed with another wave $y = 2(mm)\ \sin[4\pi(sec^{-1})t + 2\pi(m^{-1})x + \pi/3]$ on a tight string (Neglecting dissipative losses answer the following):

17. Phase difference between two particles which are located at $x_1 = \frac{1}{7}$ and $x_2 = \frac{5}{12}$ is :

(A) 0 (B) $\frac{5\pi}{6}$ rad (C) π rad (D) $\frac{5\pi}{3}$ rad

18. Which of the following is not a location of node :

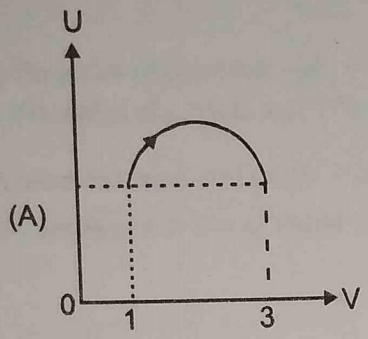
(A) $\frac{7}{6}$ m (B) $\frac{5}{3}$ m (C) $\frac{7}{6}$ m (D) $\frac{17}{12}$ m

PARAGRAPH # 2 (19 to 20)

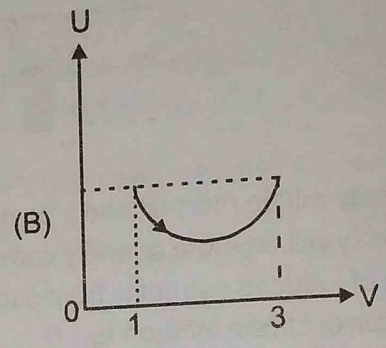
A diatomic ideal gas changes its state from A to B as shown in the figure. $T_A = 300$ K, $R = \frac{25}{3}$ J(mole)$^{-1}$K^{-1}, 1 atm = 10^5N/m^2 . U represents internal energy of gas.

19. Choose the correct U versus V graph :

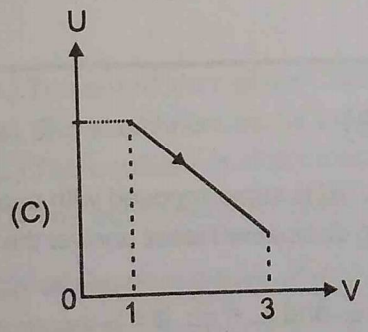
(A)



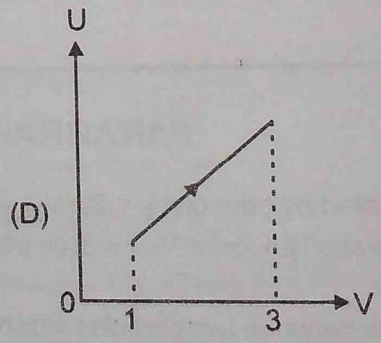
(B)



(C)



(D)



20. Maximum temperature of gas is :

(A) 300 K (B) 400 K (C) 500 K (D) 4 K

PART-II (CHEMISTRY)

SECTION – 1 : (Maximum Marks : 32)

This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive

21. The C.F.S.E value of $[Cr(H_2O)_6]Cl_2$ is $-\frac{x}{10}\Delta_0$ then what is the 'x' ?

22. How many complexes among the following are paramagnetic

$[Mn(CN)_6]^{3-}$,	$[Cr(H_2O)_6]^{3+}$,	$[Co(en)_3]^{3+}$,
$[V(CO)_6]$,	$[Ni(NH_3)_6]^{2+}$,	$[Ni(dmg)_2]$,
$[Pt(Cl)_2(NH_3)_2]$,	$[Cu(NH_3)_4]^{2+}$,	$[Cu(CN)_4]^{3-}$.

23. If Phosphorous acid, Tetrathionic acid and Pyrophosphoric acid have number of acidic hydrogen per molecule respectively as x, y and z, then find the value of x + y – z.

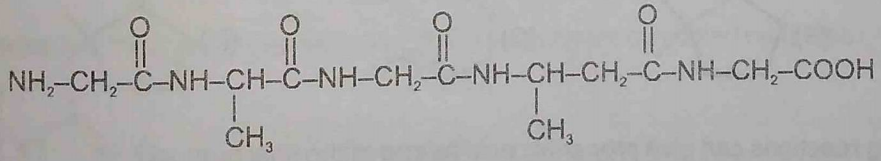
24. A fuel cell uses $CH_4(g)$ and forms CO_3^{2-} at the anode. It is used to power a car with 48.25 Amp. for 1 hr. How many litres of $CH_4(g)$ (STP) would be required ? (V_m = 22.4 L/mol) (F = 96500). Assume 100% efficiency. (Give your answer in nearest integer).

25. 0.75 mole of solid X_4 and 2 mole of O_2 are heated in a closed container to form only one gaseous compound. Find the ratio of final pressure at 327°C to the initial pressure at 27°C in the flask. Fill your answer as x, where ratio is x : 1.

26. How many moles of $KMnO_4$ are needed to oxidise 50 moles of $Fe_{0.9}O$ in acidic medium ?

27. How many total number of position isomers of trimethyl cyclohexane are :

28. How many peptide linkage are present in the following



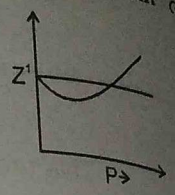
SECTION – 2 : (Maximum Marks : 32)

This section contains **EIGHT** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

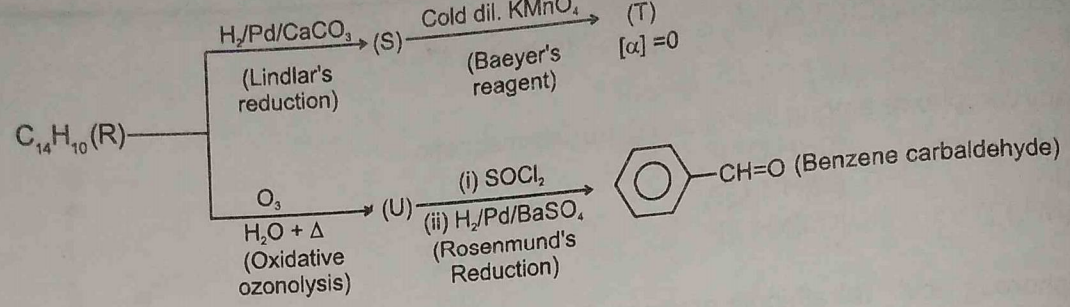
29. Identify the correct statement(s)
(A) P_4O_{10} is used as a drying agent
(B) P_4O_{10} contains $p\pi$–$p\pi$ back bonding
(C) In P_4O_{10} each P atom is bonded to three oxygen atoms
(D) P_4O_{10} hydrolyse in water forming phosphorus acid

30. The correct statement(s) pertiaining to the adsorption of a gas on a solid surface is (are)
(A) Adsorption is always exothermic
(B) Physisorption may transform into chemisorption at high temperature
(C) Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature
(D) Chemisorption is more exothermic than physisorption, however it is very slow due to higher energy of activation.

31. A gas shows following graph at 25°C. Which is/are correct for the gas ?

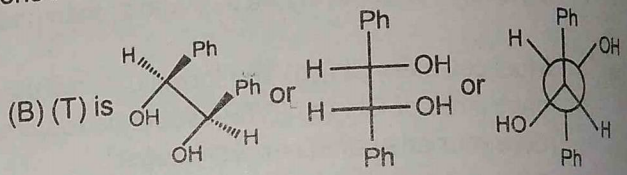


(A) Gas shows only negative deviation throughout the graph
(B) Boyle temperature of gas must be more than 25°C.
(C) Critical temperature of gas must be more than 25°C.
(D) In the high pressure region, the gas is less compressible than ideal gas at 25°C.

32. 

Select the correct statements for the above reactions :

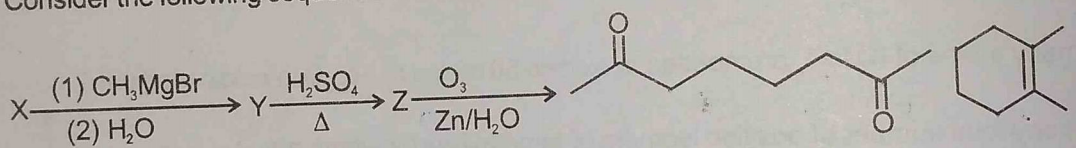
(A) (S) is cis-1, 2-Diphenylethene

(B) (T) is 

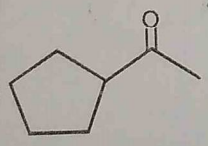
(C) (U) is Benzene carboxylic acid.

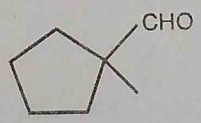
(D) (R) is an aromatic terminal alkyne.

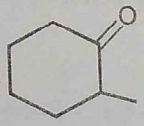
33. Consider the following sequence of reaction.

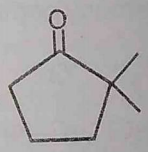


The compound X can be :

(A) 

(B) 

(C) 

(D) 

34. Which of the following reactions can give propanoic acid as one of the final product?

(A) $CH_3-CH_2-CH_2-MgBr \xrightarrow[(ii)\ H_2O]{(i)\ CO_2}$

(B) $CH_3-CH_2-Cl \xrightarrow[(ii)\ H_2O/H^+]{(i)\ KCN}$

(C) $CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_2-OH \xrightarrow{HIO_4}$

(D) $CH_3-CH_2-CH_2-MgBr \xrightarrow[(ii)\ K_2Cr_2O_7, H^+, \Delta]{(i)\ O_2, H_2O}$

35. pi bond results due to overlap of :
(A) d_{xy} and p_y along x—axis
(B) $d_{x^2-y^2}$ and p_y along x—axis
(C) d_{xy} and p_x along y—axis
(D) $d_{x^2-y^2}$ and p_y along y—axis

36. Which of the following statements is/are correct ?
(A) A pair of $Pb(NO_3)_2$ and $Cu(NO_3)_2$ salts can be distinguished by potassium iodide (aqueous solution) test.
(B) A pair of $BaCO_3$ and $BaSO_4$ salts can be distinguished by dilute hydrochloric acid test.
(C) A pair of Na_2SO_3 and Na_2S salts can be distinguished by lead acetate (aqueous solution) test.
(D) A pair of $AgNO_3$ and $Bi(NO_3)_3$ salts can be distinguished by adding a large volume of water to their aqueous solutions.

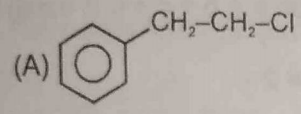
SECTION – 3 : (Maximum Marks : 16)

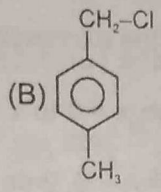
This section contains **TWO** paragraphs. Based on each paragraph, there will be **TWO** questions. Each equation has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

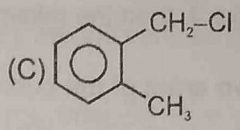
PARAGRAPH # 1 (37 to 38)

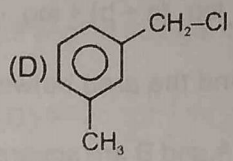
The compound A (C_8H_9Cl) on treatments with KCN followed by hydrolysis gives B ($C_9H_{10}O_2$) . Ammonium salt of B on dry distillation yields C . Which reacts with alkaline solution of bromine to gives D ($C_8H_{11}N$). Another compound E ($C_8H_{10}O$) is obtained by the action of nitrous acid on D, or by the reaction of aqueous potash with A. E on oxidation gives F (C_8H_6O) Which gives the inner anhydride G on heating.

37. The compound A is :

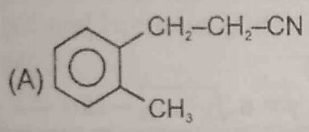
(A) 

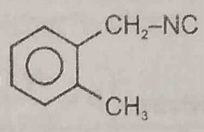
(B) 

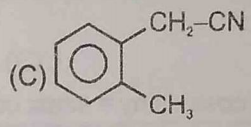
(C) 

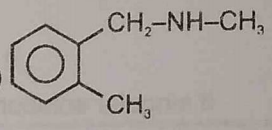
(D) 

38. The compound D is reacts with $CHCl_3$ + NaOH gives a compound H. The structrure of H.

(A) 

(B) 

(C) 

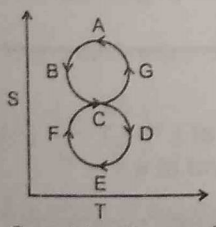
(D) 

PARAGRAPH # 2 (39 to 40)

$$dS = \frac{dq_{rev}}{T} \Rightarrow dq_{rev} = TdS$$

$$q_{rev} = \int TdS$$

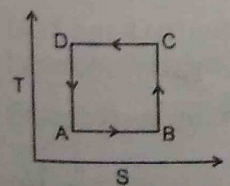
Hence q is the area under the curve in S vs T diagram projected on S axis.

39. 

Consider the cyclic process ABCDEFGA. The area of the two circles are equal. The net work done during ABCDEFGA is :

(A) positive (B) negative (C) Zero

(D) work cannot be determined in a cyclic process from S vs T diagram.

40. 

Which of the following is correct regarding the cycle ABCD ?

(A) $\Delta S_{surr} > 0$ along process BC and DA

(B) The process AB is isothermal expansion

(C) The process BC is adiabatic expansion

(D) $\Delta S_{surr} < 0$ in the complete cyclic process ABCDA.

PART-III (MATHEMATICS)

SECTION – 1 : (Maximum Marks : 32)

This section contains **EIGHT** questions. The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive

41. Let $f(x) = 8x^5 - 15x^4 + 10x^2$. Its point of local maxima is $x = a$ and point of inflexion is $x = b$, $b \in I$ then the value of $2(a + b)$ is

42. Number of values of z satisfying both the equations $1 + z + z^2 + \ldots + z^{17} = 0$ and $1 + z + z^2 + \ldots + z^{13} = 0$, where z is a complex number, is

43. If A is non-zero square matrix such that $A^2 = A$ and $(I - 3A)^{-1} = I - \alpha A$, where I is unit matrix of same order as that of A, then the value of 2α.

44. If $\log_2 (a + b) + \log_2 (c + d) \geq 4$, then the minimum value of the expression $a + b + c + d$ is equal to

45. Find the area between two arms of the curve $|y| = x^3$ from $x = 0$ to $x = 2$.

46. If A and B are squares matrices such that $A^{2006} = 0$ and $AB = A + B$, then det(B).

47. Let $a, b, c, d \in R$ and $a^2 + b^2 = 4$, $c^2 + d^2 = 2$ and $a + ib = (c + id)\sqrt{x + iy}$, find the value of $x^2 + y^2$.

48. If singular solution of $p + \cos px \sin y = \sin px \cos y$ where $\left(p = \frac{dy}{dx}\right)$ is $y = a\sqrt{x^2 - b} - \sin^{-1}\frac{\sqrt{x^2 - c}}{x}$ then evaluate $\left|\frac{b + c}{a}\right|$.

SECTION – 2 : (Maximum Marks : 32)

This section contains **EIGHT** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

49. If $f(x) = [x]^2 - [x^2]$, where [.] is greatest integer function, then f(x) is
(A) continuous at $x = 1$
(B) continuous at $x = 1$ and at $x = -1$
(C) discontinuous at $x = -1$
(D) discontinuous at $x = 1$ and at $x = -1$

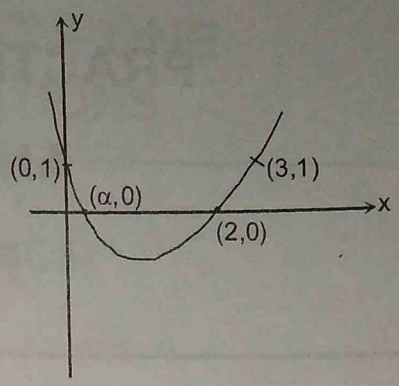
50. If matrices A and B are symmetric and commute, then which of the following is/are symmetric ?
(A) $A^{-1}B$ (B) AB^{-1} (C) $A^{-1}B^{-1}$ (D) none of these

51. The value of the integral $\int_0^{2\pi} x \sin^6 x \cos^4 x \, dx$ is not equal to

(A) $\frac{3\pi}{256}$ (B) $\frac{3\pi^2}{256}$ (C) $\frac{3\pi^2}{128}$ (D) $\frac{3\pi^2}{64}$

52. For the equation $|x - 1| + |x - 3| - |2x - 4| = \lambda x$ which of the following is/are true
(A) for $\lambda = 1$ above equation has two solutions
(B) for $\lambda \in (0,1)$ equation has three solutions
(C) for $\lambda \in (0,2)$ equation has three solutions
(D) for $\lambda = 0$ equation has infinite solutions

53. If graph of $f(x) = ax^2 + bx + c$ is given by



(A) $b = -3/2$

(B) vertex of parabola $\left(\frac{3}{2}, -\frac{1}{8}\right)$

(C) Value of α is 1

(D) $b = -3/4$

54. Number of solutions of the equation $\frac{8^x + 27^x}{12^x + 18^x} = \frac{7}{6}$ is/are

(A) Exactly one (B) Exactly two (C) Finitely many (D) Infinitely many

55. The points A(0,0), B$(\cos\alpha, \sin\alpha)$ and C$(\cos\beta, \sin\beta)$ are the vertices of a right angled triangle if -

(A) $\sin\left(\frac{\alpha-\beta}{2}\right) = \frac{1}{\sqrt{2}}$ (B) $\cos\left(\frac{\alpha-\beta}{2}\right) = -\frac{1}{\sqrt{2}}$ (C) $\cos\left(\frac{\alpha-\beta}{2}\right) = \frac{1}{\sqrt{2}}$ (D) $\sin\left(\frac{\alpha-\beta}{2}\right) = -\frac{1}{\sqrt{2}}$

56. ABCD is rectangle with A(–1, 2), B(3, 7) and AB : BC = 4 : 3. If d is the distance of origin from the intersection point of diagonals of rectangle, then possible values of [d] is/are
(where[.] denotes greatest integer function)

(A) 3 (B) 4 (C) 5 (D) 6

SECTION – 3 : (Maximum Marks : 16)

This section contains **TWO** paragraphs. Based on each paragraph, there will be **TWO** questions. Each equation has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

PARAGRAPH # 1 (57 to 58)

The normals to the parabola $y^2 = 4x$ at the points P, Q and R are concurrent at the point (15, 12).

57. The coordinates of the centroid of the triangle PQR are

(A) $\left(0, \frac{26}{3}\right)$ (B) $\left(\frac{26}{3}, 0\right)$ (C) $\left(\frac{13}{3}, \frac{1}{2}\right)$ (D) $\left(\frac{8}{3}, \frac{2}{3}\right)$

58. Equation of the circle circumscribing the triangle PQR is

(A) $x^2 + y^2 - 17x - 6y = 0$ (B) $x^2 + y^2 - 6x - 17y = 0$
(C) $x^2 + y^2 + 6x + 17y = 0$ (D) none of these

PARAGRAPH # 1 (59 to 60)

Die A has 4 red and 2 white faces where as die B has two red and 4 white faces. A fair coin is tossed. If head turns up, the game continues by throwing die A, if tail turns up then die B is to be used.

59. Probability of getting a red face at any throw is

(A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{1}{3}$ (D) none of these

60. If the first two throws resulted in red, what is the probability of getting red face at the third throw ?

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

PRACTICE TEST - ONE

ANSWER KEY

PAPER - 1

PART-I (PHYSICS)

1.	(6)	2.	(5)	3.	(2)	4.	(5)	5.	(6)	6.	(2)	7.	(1)
8.	(3)	9.	(A)	10.	(ABC)	11.	(AC)	12.	(BD)	13.	(ACD)	14.	(ABC
15.	(ABD)	16.	(AD)	17.	(ABD)	18.	(BC)						
19.	(A) q (B) s (C) r (D) t					20.	(A) p, t (B) r (C) q, r (D) q, r						

PART-II (CHEMISTRY)

21.	(6)	22.	(2)	23.	(8)	24.	(4)	25.	(4)	26.	(8)	27.	(4)
28.	(2)	29.	(ABCD)	30.	(CD)	31.	(B)	32.	(B)	33.	(ABCD)		
34.	(BD)	35.	(BC)	36.	(ABCD)	37.	(AD)		38	(BC)			
39.	(A) p,q,r ; (B) p, q ,r ; (C) q, s ; (D) r					40.	(A) p ; (B) p, q ; (C) q,r,s ; (D) r						

PART-III (MATHEMATICS)

41.	(1)	42.	(2)	43.	(6)	44.	(2)	45.	(4)	46.	(3)	47.	(1)
48.	(2)	49.	(ABC)	50.	(A)	51.	(AD)	52.	(ACD)	53.	(AC)	54.	(AD
55.	(CD)	56.	(BCD)	57.	(CD)	58.	(AC)						
59.	(A) t	(B) r	(C) s	(D) r		60.	(A) s	(B) r	(C) p	(D) q			

PRACTICE TEST - ONE
HINTS & SOLUTIONS

PAPER - 1
PART-I (PHYSICS)

1. Minimum velocity required at D $\frac{mv^2}{R-r} = mg \Rightarrow v = \sqrt{g(R-r)}$

Energy conservation between A and D

$$mg(h-2R+r) = \frac{1}{2}mv^2 + \frac{1}{2}\frac{mr^2}{2}\times\frac{v^2}{r^2}$$

$$g(h-2R+r) = \frac{3}{4}g(R-r) \Rightarrow R = \frac{4h+7r}{11} = \frac{52+14}{11} = 6 \text{ cm.}$$

2. By moseley's law,

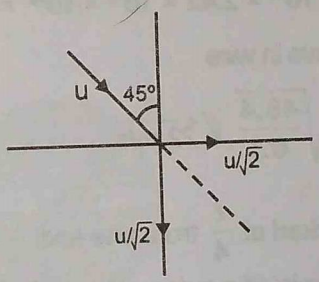
$$\sqrt{\upsilon} = a(z-b) \Rightarrow \sqrt{\frac{\lambda_2}{\lambda_1}} = \frac{z_1-1}{z_2-1} \Rightarrow 2 = \frac{z_1-1}{z_2-1} \Rightarrow 2 = \frac{36}{z_2-1}$$

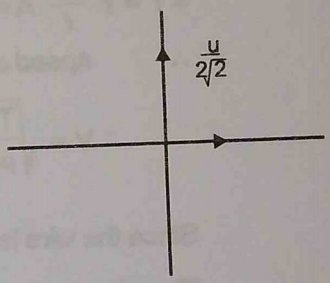
$$z_2 - 1 = 18 \Rightarrow z_2 = 19 = 95/n \Rightarrow n = 5$$

3. $Ndt = \frac{mu}{2\sqrt{2}} + \frac{mu}{\sqrt{2}}$ .....(i)

$mNdt = m.\frac{u}{\sqrt{2}}$ .....(ii)

(i) & (ii) $\mu = \frac{2}{3}$





4. $\varepsilon_i = \varepsilon_f$

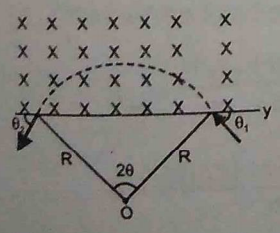
$$mg\frac{L}{2}\sin\theta + 0 = m_1 g\frac{(L-x)}{2}\sin\theta - mg\frac{x}{2} + \frac{1}{2}mv^2$$

$$mg\frac{L}{2}\sin\theta = \frac{g}{L}(L^2 + x^2 - 2Lx)\sin\theta - \frac{x^2}{L} + v^2$$

$$gL\sin\theta = \frac{g}{L}(L^2 + x^2 - 2Lx)\sin\theta - \frac{x^2}{L}g + v^2 \Rightarrow v = \sqrt{\frac{x}{8}g\ell}$$

5. $\frac{A_1}{A_0} = \left(\frac{1}{2}\right)^{t/\tau} \Rightarrow \frac{100/20}{141/20} = \frac{1}{\sqrt{2}} = \left(\frac{1}{2}\right)^{t/\tau} \Rightarrow \frac{t}{\tau} = \frac{1}{2} \Rightarrow \tau = 2t = 2 \times 3 \text{ days} = 6 \text{ days.}$

6.



Since the path is circular, from the geometry

$\theta_1 = \theta_2 = \theta$ $R = \frac{mv}{Bq}$; Displacement = 2, r sin θ $\frac{2mv\sin\theta}{Bq}$

7. **Method 1 :** If $\rho(r) = \rho_0$ (=constant) then we know that required ratio = $\frac{\frac{3}{2}\frac{KQ}{R}}{\frac{KQ}{R}} = \frac{3}{2}$

Hence n = 1

Method 2 : You may use integration method also to solve this problem.

8. $\tau_{y\text{-axis}} = I_{y\text{-axis}}\,\alpha$

$(l.\pi r^2)\,B = 1/2\ mr^2\alpha$

$\alpha = 12\ rad/sec^2$

$\therefore \quad X = 3$

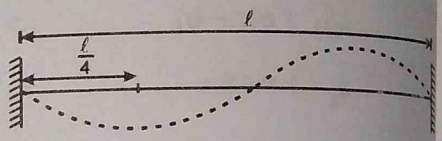
9. V at origin $\neq 0$

$$E(r = 2\ m) = \frac{K(-q)r}{(R_1^2 + r^2)^{3/2}} + \frac{K.Q.r}{(R_2^2 + r^2)^{3/2}} = K.rq\left[-\frac{1}{10^{3/2}} + \frac{2\sqrt{2}}{2^{3/2}.10^{3/2}}\right] = 0$$

From origin to r = 2, field is towards origin.

10. The mechanical strain

$$= \frac{\Delta\ell}{\ell} = \alpha\,\Delta T = 1.21 \times 10^{-5} \times 20 = 2.42 \times 10^{-5}$$



The tension in wire

$$= T = Y\frac{\Delta\ell}{\ell}A = 2 \times 10^{11} \times 2.42 \times 10^{-5} \times 10^{-6} = 48.4\ N$$

$\therefore$ speed of wave in wire

$$V = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{48.4}{0.1}} = 22\ m/s$$

Since the wire is plucked at $\frac{\ell}{4}$ from one end

The wire shall oscillate in 1st overtone (for minimum number of loops)

$\lambda = \ell = 1m$

Now $V = f\lambda$ or $f = \frac{V}{\lambda} = 22\ Hz.$

11. $Ex = 3x^2 + 0.4\ N/C$

$$V = \int E_x dx = \int_0^{0.2}(3x^2 + 0.4)dx = \left[x^3 + 0.4x\right]_0^{0.2}$$

$V = (0.2)^3 + 0.4 \times 0.2 = 0.088$ volt

$$C = \frac{Q}{V} = \frac{0.88}{0.088} = 10\ \mu F$$

12. For given condition :

Magnitude of $B_{solenoid}$ = Magnitude of B_{loop}

$$\mu_0 ni = \frac{\mu_0 I}{2R} \qquad \text{here } n = \frac{\text{Total no. of turn}}{\text{Total length}} = \frac{1300}{0.65}$$

$$i = \frac{I}{2R} \times \frac{1}{n} = \frac{8 \times 0.65}{2 \times 0.02 \times 1300} = 100\ mA.$$

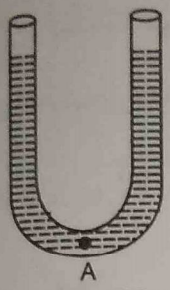
For given condition :

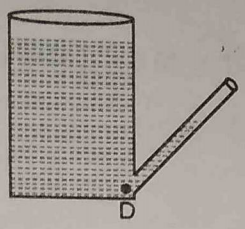
Total magnetic field at the centre of loop

$= |B_{loop}| + |B_{solenoid}|$ $\because$ $|B_{loop}| = ||B_{solenoid}|$

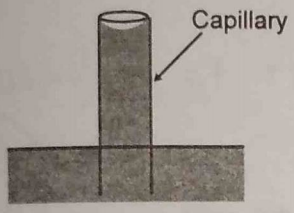
$= 2|B_{loop}| = 2 \times \frac{\mu_0 I}{2R} = \frac{2\times 4\pi\times 10^{-7}\times 8}{2\times 0.02} = 16\pi \times 10^{-5}$ T.

13. The pressure at any point can never have different values. Hence (A) & (D) are not possible. (Calculate the pressures at points A & D from both their left and right)



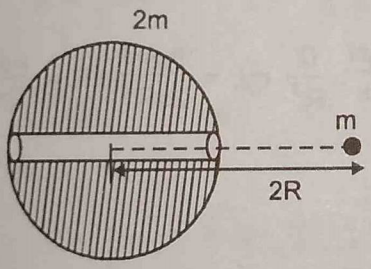


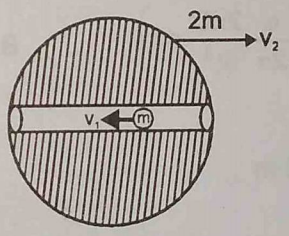
In case of insufficient length of capillary tube the shape of meniscus is as below :



(Stationary fluid)

14. (C)





Applying momentum conservation,

$0 = mv_1 - 2mv_2$

$\Rightarrow$ $v_2 = \frac{v_1}{2}$ .....(i)

From energy conservation,

$k_i + U_i = k_f + U_f$

$$0 + \left(-\frac{G(2m)}{2R}\right)m = \frac{1}{2}mv_1^2 + \frac{1}{2}(2m)v_2^2 + \left(-\frac{3}{2}\frac{G(2m)}{R}\right)(m) \quad .....(ii)$$

Solving eqn.(i) & (ii) get,

$$v_1 = \sqrt{\frac{8Gm}{3R}}$$

(A) COM will be fixed so,

$$S_{cm} = \frac{m_1 s_1 + m_2 s_2}{m_1 + m_2}$$

$$0 = \frac{(m)(x) + (2m)(-(2R - x))}{m + 2m} \quad \Rightarrow \quad x = \frac{4R}{3}$$

(B) $F_{net} = 0 \Rightarrow a = 0$

(D) $W_{gr} = U\downarrow \Rightarrow W_{gr} = \left(-\frac{G(2m)}{2R}\right)m - \left(-\frac{3}{2}\frac{G(2m)}{R}\right)m$.