No.: 120560995

This booklet contains **24** printed pages.

PAPER - 1 : MATHEMATICS, PHYSICS & CHEMISTRY

Test Booklet Code

C

Do not open this Test Booklet until you are asked to do so.

Read carefully the Instructions on the Back Cover of this Test Booklet.

Important Instructions :

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.*
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are ***three*** parts in the question paper A, B, C consisting of **Mathematics, Physics** and **Chemistry** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for each correct response.
6. *Candidates will be awarded marks as stated above in instruction No. 5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use ***Blue/Black Ball Point Pen only*** for writing particulars/marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.
10. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page and in 3 pages (Pages **21 – 23**) at the end of the booklet.
11. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***
12. The CODE for this Booklet is **C**. Make sure that the CODE printed on **Side-2** of the Answer Sheet is the same as that on this booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
13. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital letters) : SAKSHI MATHUR

Roll Number : in figures | 2 | 4 | 9 | 0 | 2 | 8 | 4 | 9 |

: in words Two crore forty nine lakh two thousand eight hundred forty nine

Examination Centre Number : | 2 | 4 | 9 | 0 | 0 | 6 |

Name of Examination Centre (in Capital letters) : A ONE SECONDARY SCHOOL UNIVERSITY ROAD AYA UDAIPU

Candidate's Signature : Rishi Invigilator's Signature : Ramesh

PART A – MATHEMATICS

1. The equation $e^{\sin x} - e^{-\sin x} - 4 = 0$ has :

   (1) infinite number of real roots.

   (2) no real roots.

   (3) exactly one real root.

   (4) exactly four real roots.

2. Let $\hat{a}$ and $\hat{b}$ be two unit vectors. If the vectors $\vec{c} = \hat{a} + 2\hat{b}$ and $\vec{d} = 5\hat{a} - 4\hat{b}$ are perpendicular to each other, then the angle between $\hat{a}$ and $\hat{b}$ is :

   (1) $\frac{\pi}{6}$

   (2) $\frac{\pi}{2}$

   (3) $\frac{\pi}{3}$

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

3. A spherical balloon is filled with 4500 π cubic meters of helium gas. If a leak in the balloon causes the gas to escape at the rate of 72 π cubic meters per minute, then the rate (in meters per minute) at which the radius of the balloon decreases 49 minutes after the leakage began is :

   (1) 9/7

   (2) 7/9

   (3) 2/9

   (4) 9/2

4. **Statement 1 :** The sum of the series $1 + (1+2+4) + (4+6+9) + (9+12+16) + \ldots + (361+380+400)$ is 8000.

   Statement 2 : $\sum_{k=1}^{n} \left(k^3 - (k-1)^3\right) = n^3$, for any natural number n.

   (1) Statement 1 is false, Statement 2 is true.

   (2) Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation for Statement 1.

   (3) Statement 1 is true, Statement 2 is true; Statement 2 is **not** a correct explanation for Statement 1.

   (4) Statement 1 is true, Statement 2 is false.

5. The negation of the statement

   "If I become a teacher, then I will open a school", is :

   (1) I will become a teacher and I will not open a school.

   (2) Either I will not become a teacher or I will not open a school.

   (3) Neither I will become a teacher nor I will open a school.

   (4) I will not become a teacher or I will open a school.

SPACE FOR ROUGH WORK

SEAL

6. If the integral

$$\int \frac{5\tan x}{\tan x - 2}\,dx = x + a\ln|\sin x - 2\cos x| + k$$

then a is equal to :

(1) -1

(2) -2

(3) 1

(4) 2

7. **Statement 1 :** An equation of a common tangent to the parabola $y^2 = 16\sqrt{3}\,x$ and the ellipse $2x^2 + y^2 = 4$ is $y = 2x + 2\sqrt{3}$.

Statement 2 : If the line $y = mx + \frac{4\sqrt{3}}{m}$, $(m \neq 0)$ is a common tangent to the parabola $y^2 = 16\sqrt{3}\,x$ and the ellipse $2x^2 + y^2 = 4$, then m satisfies $m^4 + 2m^2 = 24$.

(1) Statement 1 is false, Statement 2 is true.

(2) Statement 1 is true, Statement 2 is true, Statement 2 is a correct explanation for Statement 1.

(3) Statement 1 is true, Statement 2 is true, Statement 2 is **not** a correct explanation for Statement 1.

(4) Statement 1 is true, Statement 2 is false.

8. Let $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix}$. If u_1 and u_2 are column matrices such that $Au_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ and $Au_2 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$, then $u_1 + u_2$ is equal to :

(1) $\begin{pmatrix} -1 \\ 1 \\ 0 \end{pmatrix}$

(2) $\begin{pmatrix} -1 \\ 1 \\ -1 \end{pmatrix}$

(3) $\begin{pmatrix} -1 \\ -1 \\ 0 \end{pmatrix}$

(4) $\begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix}$

9. If n is a positive integer, then $\left(\sqrt{3}+1\right)^{2n} - \left(\sqrt{3}-1\right)^{2n}$ is :

(1) an irrational number

(2) an odd positive integer

(3) an even positive integer

(4) a rational number other than positive integers

SPACE FOR ROUGH WORK

10. If 100 times the 100^{th} term of an AP with non zero common difference equals the 50 times its 50^{th} term, then the 150^{th} term of this AP is :

(1) -150

(2) 150 times its 50^{th} term

(3) 150

(4) zero

11. In a ΔPQR, if $3 \sin P + 4 \cos Q = 6$ and $4 \sin Q + 3 \cos P = 1$, then the angle R is equal to :

(1) $\frac{5\pi}{6}$

(2) $\frac{\pi}{6}$

(3) $\frac{\pi}{4}$

(4) $\frac{3\pi}{4}$

12. An equation of a plane parallel to the plane $x - 2y + 2z - 5 = 0$ and at a unit distance from the origin is :

(1) $x - 2y + 2z - 3 = 0$

(2) $x - 2y + 2z + 1 = 0$

(3) $x - 2y + 2z - 1 = 0$

(4) $x - 2y + 2z + 5 = 0$

13. If the line $2x + y = k$ passes through th point which divides the line segmer joining the points (1, 1) and (2, 4) in th ratio 3 : 2, then k equals :

(1) 29/5

(2) 5

(3) 6

(4) 11/5

14. Let $x_1, x_2, \ldots, x_n$ be n observations, and l $\bar{x}$ be their arithmetic mean and σ^2 be the variance.

Statement 1 : Variance of $2x_1, 2x_2, \ldots, 2$ is $4\sigma^2$.

Statement 2 : Arithmetic mean $2x_1, 2x_2, \ldots, 2x_n$ is $4\bar{x}$.

(1) Statement 1 is false, Statement 2 true.

(2) Statement 1 is true, Statement 2 true, Statement 2 is a corre explanation for Statement 1.

(3) Statement 1 is true, Statement 2 true, Statement 2 is **not** a corr explanation for Statement 1.

(4) Statement 1 is true, Statement 2 false.

SPACE FOR ROUGH WORK

SEAL

15. The population p(t) at time t of a certain mouse species satisfies the differential equation $\frac{dp(t)}{dt} = 0.5\,p(t) - 450$. If $p(0) = 850$, then the time at which the population becomes zero is :

(1) $2 \ln 18$

(2) $\ln 9$

(3) $\frac{1}{2} \ln 18$

(4) $\ln 18$

16. Let $a, b \in R$ be such that the function f given by $f(x) = \ln|x| + bx^2 + ax$, $x \neq 0$ has extreme values at $x = -1$ and $x = 2$.

Statement 1 : f has local maximum at $x = -1$ and at $x = 2$.

Statement 2 : $a = \frac{1}{2}$ and $b = \frac{-1}{4}$.

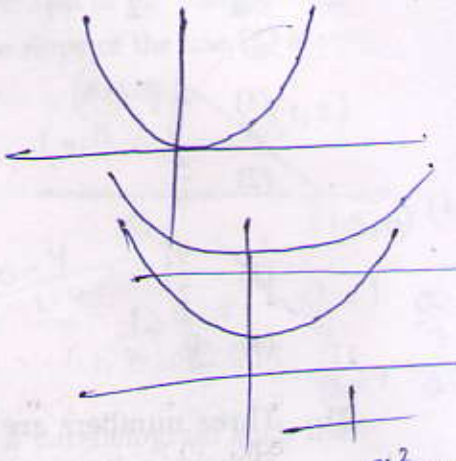
(1) Statement 1 is false, Statement 2 is true.

(2) Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation for Statement 1.

(3) Statement 1 is true, Statement 2 is true; Statement 2 is **not** a correct explanation for Statement 1.

(4) Statement 1 is true, Statement 2 is false.

17. The area bounded between the parabolas $x^2 = \frac{y}{4}$ and $x^2 = 9y$, and the straight line $y = 2$ is :



(1) $20\sqrt{2}$

(2) $\frac{10\sqrt{2}}{3}$

(3) $\frac{20\sqrt{2}}{3}$

(4) $10\sqrt{2}$

18. Assuming the balls to be identical except for difference in colours, the number of ways in which one or more balls can be selected from 10 white, 9 green and 7 black balls is :

(1) 880

(2) 629

(3) 630

(4) 879

19. If $f : R \to R$ is a function defined by $f(x) = [x] \cos\left(\frac{2x-1}{2}\right)\pi$, where $[x]$ denotes the greatest integer function, then f is :

(1) continuous for every real x.

(2) discontinuous only at $x = 0$.

(3) discontinuous only at non-zero integral values of x.

(4) continuous only at $x = 0$.

SPACE FOR ROUGH WORK

20. If the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-k}{2} = \frac{z}{1}$ intersect, then k is equal to :

(1) -1

(2) $\frac{2}{9}$

(3) $\frac{9}{2}$

(4) 0

21. Three numbers are chosen at random without replacement from {1, 2, 3, ..., 8}. The probability that their minimum is 3, given that their maximum is 6, is :

(1) $\frac{3}{8}$

(2) $\frac{1}{5}$

(3) $\frac{1}{4}$

(4) $\frac{2}{5}$

22. If $z \neq 1$ and $\frac{z^2}{z-1}$ is real, then the point represented by the complex number z lies :

(1) either on the real axis or on a circle passing through the origin.

(2) on a circle with centre at the origin.

(3) either on the real axis or on a circle not passing through the origin.

(4) on the imaginary axis.

23. Let P and Q be 3×3 matrices with $P \neq$ If $P^3 = Q^3$ and $P^2Q = Q^2P$, th determinant of $(P^2 + Q^2)$ is equal to :

(1) -2

(2) 1

(3) 0

(4) -1

24. If $g(x) = \int_0^x \cos 4t \, dt$, then $g(x$ equals :

(1) $\frac{g(x)}{g(\pi)}$

(2) $g(x) + g(\pi)$

(3) $g(x) - g(\pi)$

(4) $g(x).g(\pi)$

25. The length of the diameter of the ci which touches the x-axis at the p (1, 0) and passes through the point (is :

(1) 10/3

(2) 3/5

(3) 6/5

(4) 5/3

26. Let $X = \{1, 2, 3, 4, 5\}$. The numbe different ordered pairs (Y, Z) that ca formed such that $Y \subseteq X$, $Z \subseteq X$ and Y is empty, is :

(1) 5^2

(2) 3^5

(3) 2^5

(4) 5^3

SPACE FOR ROUGH WORK

27. An ellipse is drawn by taking a diameter of the circle $(x-1)^2+y^2=1$ as its semi-minor axis and a diameter of the circle $x^2+(y-2)^2=4$ as its semi-major axis. If the centre of the ellipse is at the origin and its axes are the coordinate axes, then the equation of the ellipse is :

(1) $4x^2+y^2=4$

(2) $x^2+4y^2=8$

(3) $4x^2+y^2=8$

(4) $x^2+4y^2=16$

28. Consider the function,
$f(x)=|x-2|+|x-5|,\ x \in R$.

Statement 1 : $f'(4)=0$

Statement 2 : f is continuous in [2, 5], differentiable in (2, 5) and $f(2)=f(5)$.

(1) Statement 1 is false, Statement 2 is true.

(2) Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation for Statement 1.

(3) Statement 1 is true, Statement 2 is true; Statement 2 is **not** a correct explanation for Statement 1.

(4) Statement 1 is true, Statement 2 is false.

29. A line is drawn through the point (1, 2) to meet the coordinate axes at P and Q such that it forms a triangle OPQ, where O is the origin. If the area of the triangle OPQ is least, then the slope of the line PQ is :

(1) $-1/4$

(2) -4

(3) -2

(4) $-1/2$

30. Let ABCD be a parallelogram such that $\vec{AB}=\vec{q}$, $\vec{AD}=\vec{p}$ and $\angle BAD$ be an acute angle. If $\vec{r}$ is the vector that coincides with the altitude directed from the vertex B to the side AD, then $\vec{r}$ is given by :

(1) $\vec{r}=3\vec{q}-\dfrac{3\left(\vec{p}\cdot\vec{q}\right)}{\left(\vec{p}\cdot\vec{p}\right)}\vec{p}$

(2) $\vec{r}=-\vec{q}+\left(\dfrac{\vec{p}\cdot\vec{q}}{\vec{p}\cdot\vec{p}}\right)\vec{p}$

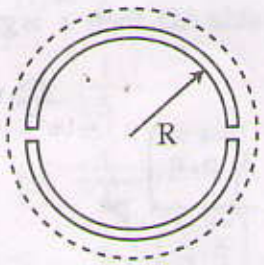
(3) $\vec{r}=\vec{q}-\left(\dfrac{\vec{p}\cdot\vec{q}}{\vec{p}\cdot\vec{p}}\right)\vec{p}$

(4) $\vec{r}=-3\vec{q}+\dfrac{3\left(\vec{p}\cdot\vec{q}\right)}{\left(\vec{p}\cdot\vec{p}\right)}\vec{p}$

SPACE FOR ROUGH WORK

PART B – PHYSICS

31. A wooden wheel of radius R is made of two semicircular parts (see figure). The two parts are held together by a ring made of a metal strip of cross sectional area S and length L. L is slightly less than $2\pi R$. To fit the ring on the wheel, it is heated so that its temperature rises by ΔT and it just steps over the wheel. As it cools down to surrounding temperature, it presses the semicircular parts together. If the coefficient of linear expansion of the metal is α, and its Youngs' modulus is Y, the force that one part of the wheel applies on the other part is :

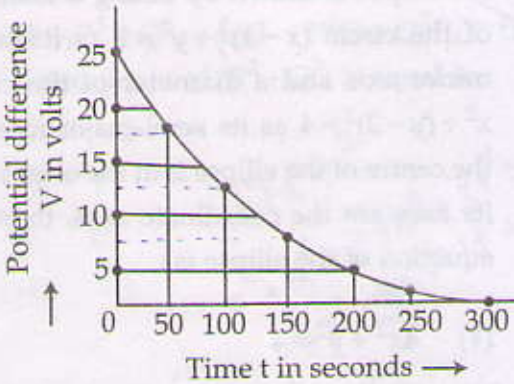


(1) $2\pi SY\alpha\Delta T$

(2) $SY\alpha\Delta T$

(3) $\pi SY\alpha\Delta T$

(4) $2SY\alpha\Delta T$

32. 

The figure shows an experimental plot discharging of a capacitor in an circuit. The time constant τ of this cir lies between :

(1) 150 sec and 200 sec

(2) 0 and 50 sec

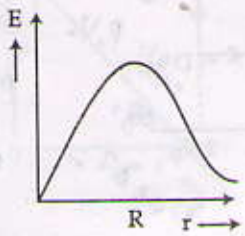
(3) 50 sec and 100 sec

(4) 100 sec and 150 sec

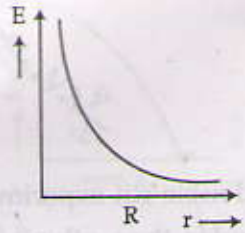
SPACE FOR ROUGH WORK

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

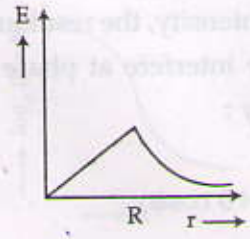
(1)



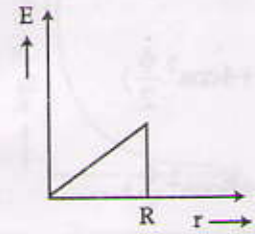
(2)



(3)



(4)



34. An electromagnetic wave in vacuum has the electric and magnetic fields $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then :

(1) $\vec{X} \| \vec{B}$ and $\vec{k} \| \vec{B} \times \vec{E}$

(2) $\vec{X} \| \vec{E}$ and $\vec{k} \| \vec{E} \times \vec{B}$

(3) $\vec{X} \| \vec{B}$ and $\vec{k} \| \vec{E} \times \vec{B}$

(4) $\vec{X} \| \vec{E}$ and $\vec{k} \| \vec{B} \times \vec{E}$

35. If a simple pendulum has significant amplitude (up to a factor of 1/e of original) only in the period between t = 0s to t = τs, then τ may be called the average life of the pendulum. When the spherical bob of the pendulum suffers a retardation (due to viscous drag) proportional to its velocity, with 'b' as the constant of proportionality, the average life time of the pendulum is (assuming damping is small) in seconds :

(1) $\frac{0.693}{b}$

(2) b

(3) $\frac{1}{b}$

(4) $\frac{2}{b}$

SPACE FOR ROUGH WORK

36. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be :

(1) 2
(2) 3
(3) 5
(4) 6

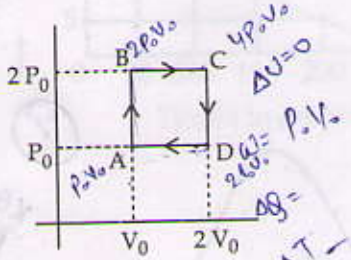
37. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating; it is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to :

(1) development of air current when the plate is placed.
(2) induction of electrical charge on the plate
(3) shielding of magnetic lines of force as aluminium is a paramagnetic material.
(4) electromagnetic induction in the aluminium plate giving rise to electromagnetic damping.

38. The mass of a spaceship is 1000 kg. It is to be launched from the earth's surface out into free space. The value of 'g' and 'R' (radius of earth) are 10 m/s^2 and 6400 km respectively. The required energy for this work will be :

(1) 6.4×10^{11} Joules
(2) 6.4×10^{8} Joules
(3) 6.4×10^{9} Joules
(4) 6.4×10^{10} Joules

39. Helium gas goes through a cycle ABC (consisting of two isochoric and t isobaric lines) as shown in figu Efficiency of this cycle is nearly : (Assume the gas to be close to ideal ga



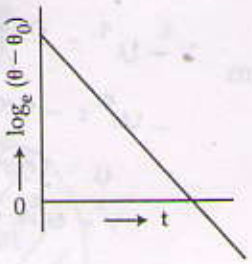
(1) 15.4%
(2) 9.1%
(3) 10.5%
(4) 12.5%

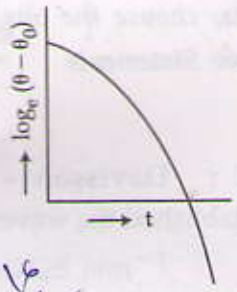
40. In Young's double slit experiment, on the slit is wider than other, so tha amplitude of the light from one s double of that from other slit. If I_m b maximum intensity, the resultant inte I when they interfere at phase differ ϕ is given by :

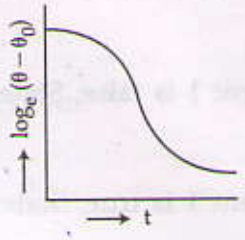
(1) $\frac{I_m}{9}(4+5\cos\phi)$
(2) $\frac{I_m}{3}(1+2\cos^2\frac{\phi}{2})$
(3) $\frac{I_m}{5}(1+4\cos^2\frac{\phi}{2})$
(4) $\frac{I_m}{9}(1+8\cos^2\frac{\phi}{2})$

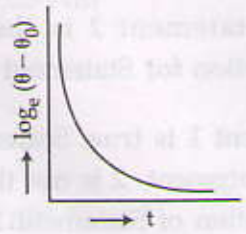
SPACE FOR ROUGH WORK

41. A liquid in a beaker has temperature $\theta(t)$ at time t and θ_0 is temperature of surroundings, then according to Newton's law of cooling the correct graph between $\log_e(\theta - \theta_0)$ and t is :

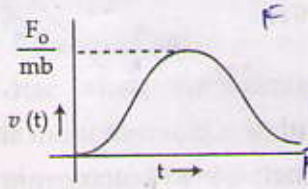
(1) 

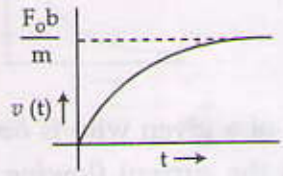
(2) 

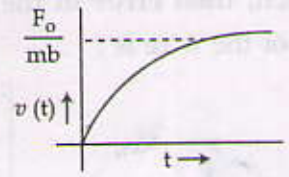
(3) 

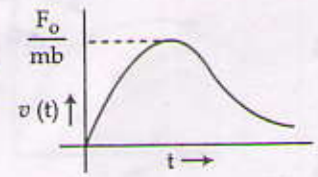
(4) 

42. A particle of mass m is at rest at the origin at time t=0. It is subjected to a force $F(t) = F_0 e^{-bt}$ in the x direction. Its speed $v(t)$ is depicted by which of the following curves ?

(1) 

(2) 

(3) 

(4) 

SPACE FOR ROUGH WORK

43. Two electric bulbs marked 25W-220V and 100W-220V are connected in series to a 440V supply. Which of the bulbs will fuse ?

(1) both

(2) 100W

(3) 25W

(4) neither

44. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measurement of the current and the voltage difference are 3% each, then error in the value of resistance of the wire is :

(1) 6%

(2) zero

(3) 1%

(4) 3%

45. A boy can throw a stone up to a maxim height of 10 m. The maximum horizor distance that the boy can throw the sa stone up to will be :

(1) $20\sqrt{2}$ m

(2) 10 m

(3) $10\sqrt{2}$ m

(4) 20 m

46. *This question has Statement 1 Statement 2. Of the four choices given the Statements, choose the one that describes the two Statements.*

Statement 1 : Davisson - Ger experiment established the wave natu electrons.

Statement 2 : If electrons have w nature, they can interfere and s diffraction.

(1) Statement 1 is false, Statement true.

(2) Statement 1 is true, Statement false

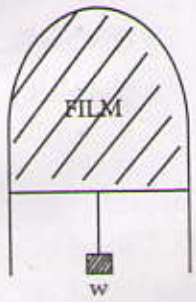
(3) Statement 1 is true, Statement true, Statement 2 is the co explanation for Statement 1

(4) Statement 1 is true, Statemen true, Statement 2 is **not** the co explanation of Statement 1

SEAL

SPACE FOR ROUGH WORK

47. A thin liquid film formed between a U-shaped wire and a light slider supports a weight of 1.5×10^{-2}N (see figure). The length of the slider is 30 cm and its weight negligible. The surface tension of the liquid film is :



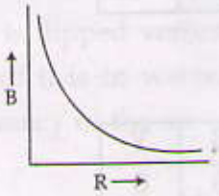
(1) 0.0125 Nm^{-1}

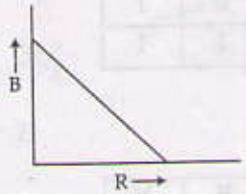
(2) 0.1 Nm^{-1}

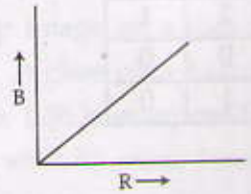
(3) 0.05 Nm^{-1}

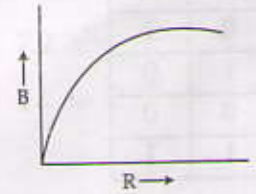
(4) 0.025 Nm^{-1}

48. A charge Q is uniformly distributed over the surface of non- conducting disc of radius R. The disc rotates about an axis perpendicular to its plane and passing through its centre with an angular velocity ω. As a result of this rotation a magnetic field of induction B is obtained at the centre of the disc. If we keep both the amount of charge placed on the disc and its angular velocity to be constant and vary the radius of the disc then the variation of the magnetic induction at the centre of the disc will be represented by the figure :

(1) 

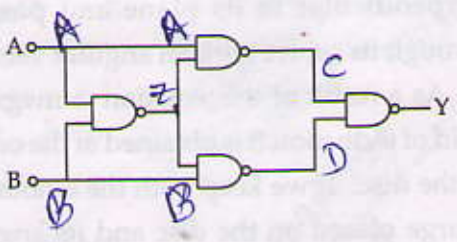
(2) 

(3) 

(4) 

SPACE FOR ROUGH WORK

49. Truth table for system of four NAND gates as shown in figure is :



(1)

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

(2)

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

(3)

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

(4)

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

50. A radar has a power of 1 kW and is operating at a frequency of 10 GHz. It is located on a mountain top of height 500 m. The maximum distance upto which it can detect object located on the surface of the earth (Radius of earth = 6.4×10^6 m) is :

(1) 80 km

(2) 16 km

(3) 40 km

(4) 64 km

51. Assume that a neutron breaks into a proton and an electron. The energy released during this process is :

(Mass of neutron = 1.6725×10^{-27} kg

Mass of proton = 1.6725×10^{-27} kg

Mass of electron = 9×10^{-31} kg)

(1) 0.73 MeV

(2) 7.10 MeV

(3) 6.30 MeV

(4) 5.4 MeV

SPACE FOR ROUGH WORK

52. A Carnot engine, whose efficiency is 40%, takes in heat from a source maintained at a temperature of 500 K. It is desired to have an engine of efficiency 60%. Then, the intake temperature for the same exhaust (sink) temperature must be :

(1) efficiency of Carnot engine cannot be made larger than 50%

(2) 1200 K

(3) 750 K

(4) 600 K

53. *This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.*

If two springs S_1 and S_2 of force constants k_1 and k_2, respectively, are streched by the same force, it is found that more work is done on spring S_1 than on spring S_2.

Statement 1 : If stretched by the same amount, work done on S_1, will be more than that on S_2

Statement 2 : $k_1 < k_2$

(1) Statement 1 is false, Statement 2 is true.

(2) Statement 1 is true, Statement 2 is false.

(3) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

(4) Statement 1 is true, Statement 2 is true, Statement 2 is **not** the correct explanation of Statement 1.

54. Two cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2, respectively. Their speeds are such that they make complete circles in the same time t. The ratio of their centripetal acceleration is :

(1) $m_1 r_1 : m_2 r_2$

(2) $m_1 : m_2$

(3) $r_1 : r_2$

(4) 1 : 1

55. A cylindrical tube, open at both ends, has a fundamental frequency, f, in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of the air-column is now :

(1) f

(2) $f/2$

(3) $3f/4$

(4) 2f

56. An object 2.4 m in front of a lens forms a sharp image on a film 12 cm behind the lens. A glass plate 1 cm thick, of refractive index 1.50 is interposed between lens and film with its plane faces parallel to film. At what distance (from lens) should object be shifted to be in sharp focus on film ?

(1) 7.2 m

(2) 2.4 m

(3) 3.2 m

(4) 5.6 m

SPACE FOR ROUGH WORK

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(3) $r_1 : r_2$

(4) 1 : 1

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(1) 7.2 m

(2) 2.4 m

(3) 3.2 m

(4) 5.6 m

SPACE FOR ROUGH WORK

57. A diatomic molecule is made of two masses m_1 and m_2 which are separated by a distance r. If we calculate its rotational energy by applying Bohr's rule of angular momentum quantization, its energy will be given by :

(n is an integer)

(1) $\frac{(m_1+m_2)^2 n^2 h^2}{2m_1^2 m_2^2 r^2}$

(2) $\frac{n^2h^2}{2(m_1+m_2)r^2}$

(3) $\frac{2n^2h^2}{(m_1+m_2)r^2}$

(4) $\frac{(m_1+m_2)n^2h^2}{2m_1m_2r^2}$

58. A spectrometer gives the following reading when used to measure the angle of a prism.

Main scale reading : 58.5 degree

Vernier scale reading : 09 divisions

Given that 1 division on main scale corresponds to 0.5 degree. Total divisions on the vernier scale is 30 and match with 29 divisions of the main scale. The angle of the prism from the above data :

(1) 58.59 degree

(2) 58. 77 degree

(3) 58.65 degree

(4) 59 degree

59. *This question has Statement 1 an Statement 2. Of the four choices given aft the Statements, choose the one that be describes the two Statements.*

An insulating solid sphere of radius R h a uniformly positive charge density ρ. A a result of this uniform charge distributio there is a finite value of electric potenti at the centre of the sphere, at the surfa of the sphere and also at a point out si the sphere. The electric potential at infini is zero.

Statement 1 : When a charge 'q' is tak from the centre to the surface of the sphe its potential energy changes by $\frac{q\rho}{3\epsilon_0}$

Statement 2 : The electric field at a distan r (r<R) from the centre of the sphere is $\frac{\rho}{3}$

(1) Statement 1 is true, Statement 2 true; Statement 2 is **not** the corr explanation of Statement 1.

(2) Statement 1 is true Statement 2 false.

(3) Statement 1 is false Statement 2 true.

(4) Statement 1 is true, Statement 2 true, Statement 2 is the corr explanation of Statement 1.

60. Proton, Deuteron and alpha particle of same kinetic energy are moving in circu trajectories in a constant magnetic fi The radii of proton, deuteron and al particle are respectively r_p, r_d and Which one of the following relation **correct** ?

(1) $r_\alpha = r_p = r_d$

(2) $r_\alpha = r_p < r_d$

(3) $r_\alpha > r_d > r_p$

(4) $r_\alpha = r_d > r_p$

SPACE FOR ROUGH WORK

PART C – CHEMISTRY

61. Which among the following will be named as dibromidobis(ethylene diamine) chromium (III) bromide ?

(1) $[Cr(en)_3]Br_3$

(2) $[Cr(en)_2Br_2]Br$

(3) $[Cr(en)Br_4]^-$

(4) $[Cr(en)Br_2]Br$

62. Which method of purification is represented by the following equation :

$$Ti(s)+2I_2(g) \xrightarrow{523\ K} TiI_4(g) \xrightarrow{1700\ K} Ti(s)+2I_2(g)$$

(1) Zone refining

(2) Cupellation

(3) Poling

(4) Van Arkel

63. Lithium forms body centred cubic structure. The length of the side of its unit cell is 351 pm. Atomic radius of the lithium will be :

(1) 75 pm

(2) 300 pm

(3) 240 pm

(4) 152 pm

64. The molecule having smallest bond angle is :

(1) NCl_3

(2) $AsCl_3$

(3) $SbCl_3$

(4) PCl_3

65. Which of the following compounds can be detected by Molisch's test ?

(1) Nitro compounds

(2) Sugars

(3) Amines

(4) Primary alcohols

66. The **incorrect** expression among the following is :

(1) $\frac{\Delta G_{system}}{\Delta S_{total}} = -T$

(2) In isothermal process,

$$w_{reversible} = -nRT \ln \frac{V_f}{V_i}$$

(3) $\ln K = \frac{\Delta H^\circ - T\Delta S^\circ}{RT}$

(4) $K = e^{-\Delta G^\circ/RT}$

67. The density of a solution prepared by dissolving 120 g of urea (mol. mass = 60 u) in 1000 g of water is 1.15 g/mL. The molarity of this solution is :

(1) 0.50 M

(2) 1.78 M

(3) 1.02 M

(4) 2.05 M

68. The species which can best serve as an initiator for the cationic polymerization is :

(1) $LiAlH_4$

(2) HNO_3

(3) $AlCl_3$

(4) BuLi

SPACE FOR ROUGH WORK

69. Which of the following on thermal-decomposition yields a basic as well as an acidic oxide ?

(1) $NaNO_3$

(2) $KClO_3$

(3) $CaCO_3$

(4) NH_4NO_3

70. The standard reduction potentials for Zn^{2+}/Zn, Ni^{2+}/Ni, and Fe^{2+}/Fe are -0.76, -0.23 and -0.44 V respectively. The reaction $X + Y^{2+} \rightarrow X^{2+} + Y$ will be spontaneous when :

(1) X = Ni, Y = Fe

(2) X = Ni, Y = Zn

(3) X = Fe, Y = Zn

(4) X = Zn, Y = Ni

71. According to Freundlich adsorption isotherm, which of the following is **correct** ?

(1) $\frac{x}{m} \propto p^0$

(2) $\frac{x}{m} \propto p^1$

(3) $\frac{x}{m} \propto p^{1/n}$

(4) All the above are correct for different ranges of pressure.

72. The equilibrium constant (K_c) for the reaction $N_2(g) + O_2(g) \rightarrow 2NO(g)$ at temperature T is 4×10^{-4}. The value of K_c for the reaction, $NO(g) \rightarrow \frac{1}{2} N_2(g) + \frac{1}{2} O_2(g)$ at the same temperature is :

(1) 0.02

(2) 2.5×10^2

(3) 4×10^{-4}

(4) 50.0

73. The compressibility factor for a real gas at high pressure is :

(1) $1 + RT/pb$

(2) 1

(3) $1 + pb/RT$

(4) $1 - pb/RT$

74. Which one of the following statements is **correct** ?

(1) All amino acids except lysine are optically active.

(2) All amino acids are optically active.

(3) All amino acids except glycine are optically active.

(4) All amino acids except glutamic acid are optically active.

75. Aspirin is known as :

(1) Acetyl salicylic acid

(2) Phenyl salicylate

(3) Acetyl salicylate

(4) Methyl salicylic acid

76. Ortho – Nitrophenol is less soluble in water than p – and m – Nitrophenols because

(1) o – Nitrophenol is more volatile in steam than those of m – and p – isomers.

(2) o – Nitrophenol shows Intramolecular H - bonding

(3) o – Nitrophenol shows Intermolecular H - bonding

(4) Melting point of o – Nitrophenol is lower than those of m – and p – isomers.

SPACE FOR ROUGH WORK

77. How many chiral compounds are possible on monochlorination of 2 - methyl butane ?

(1) 8

(2) 2

(3) 4

(4) 6

78. Very pure hydrogen (99.9%) can be made by which of the following processes ?

(1) Reaction of methane with steam

(2) Mixing natural hydrocarbons of high molecular weight

(3) Electrolysis of water

(4) Reaction of salt like hydrides with water

79. The electrons identified by quantum numbers n and l :

(a) n = 4, l = 1

(b) n = 4, l = 0

(c) n = 3, l = 2

(d) n = 3, l = 1

can be placed in order of increasing energy as :

(1) (c) < (d) < (b) < (a)

(2) (d) < (b) < (c) < (a)

(3) (b) < (d) < (a) < (c)

(4) (a) < (c) < (b) < (d)

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

(1) 1.73×10^{-5} M/min

(2) 3.47×10^{-4} M/min

(3) 3.47×10^{-5} M/min

(4) 1.73×10^{-4} M/min

81. Iron exhibits +2 and +3 oxidation states. Which of the following statements about iron is **incorrect** ?

(1) Ferrous oxide is more basic in nature than the ferric oxide.

(2) Ferrous compounds are relatively more ionic than the corresponding ferric compounds.

(3) Ferrous compounds are less volatile than the corresponding ferric compounds.

(4) Ferrous compounds are more easily hydrolysed than the corresponding ferric compounds.

82. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionization constant, Ka of this acid is :

(1) 3×10^{-1}

(2) 1×10^{-3}

(3) 1×10^{-5}

(4) 1×10^{-7}

SPACE FOR ROUGH WORK

83. Which branched chain isomer of the hydrocarbon with molecular mass 72u gives only one isomer of mono substituted alkyl halide ?

(1) Tertiary butyl chloride

(2) Neopentane

(3) Isohexane

(4) Neohexane

84. K_f for water is 1.86 K kg mol^{-1}. If your automobile radiator holds 1.0 kg of water, how many grams of ethylene glycol ($C_2H_6O_2$) must you add to get the freezing point of the solution lowered to $-2.8°C$?

(1) 72 g

(2) 93 g

(3) 39 g

(4) 27 g

85. What is DDT among the following :

(1) Greenhouse gas

(2) A fertilizer

(3) Biodegradable pollutant

(4) Non - biodegradable pollutant

86. The increasing order of the ionic radii of the given isoelectronic species is :

(1) $Cl^-, Ca^{2+}, K^+, S^{2-}$

(2) $S^{2-}, Cl^-, Ca^{2+}, K^+$

(3) $Ca^{2+}, K^+, Cl^-, S^{2-}$

(4) $K^+, S^{2-}, Ca^{2+}, Cl^-$

87. 2 - Hexyne gives trans - 2 - Hexene on treatment with :

(1) Pt/H_2

(2) Li/NH_3

(3) $Pd/BaSO_4$

(4) $Li\,AlH_4$

88. Iodoform can be prepared from all except :

(1) Ethyl methyl ketone

(2) Isopropyl alcohol

(3) 3 - Methyl - 2 - butanone

(4) Isobutyl alcohol

89. In which of the following pairs the two species are **not** isostructural ?

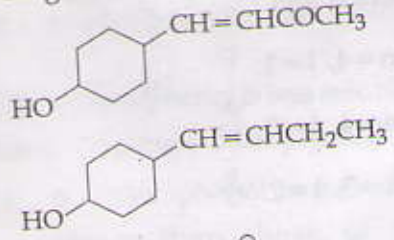
(1) CO_3^{2-} and NO_3^-

(2) PCl_4^+ and $SiCl_4$

(3) PF_5 and BrF_5

(4) AlF_6^{3-} and SF_6

90. In the given transformation, which of the following is the most appropriate reagent ?



Reagent

(1) $NH_2NH_2, \overset{\ominus}{O}H$

(2) Zn - Hg/HCl

(3) Na, Liq. NH_3

(4) $NaBH_4$

- o 0 o -

SPACE FOR ROUGH WORK